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What Makes for a "Gifted" Education? Exploring How Participation in Gifted Programs Affects Students' Learning Environments

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Abstract

What does it mean for students to be in a gifted program? While about 7% of students nationally participate in gifted programs, relatively little is known about the experiences of students in these programs or how they vary across districts. Combining administrative and survey data, we describe the structure of gifted programs across nearly 300 school districts in Washington State. Using covariate adjustments and student fixed effects, we find that participation in gifted programs increases access to advanced courses, high-achieving peers, smaller classrooms, and more qualified teachers. These effects are largely concentrated in larger urban and suburban school districts that frequently run large, self-contained gifted programs. Effects of participation are much smaller for small school districts, rural or town school districts, and districts with small gifted programs. While gifted participation changes the educational environment for the average student in the state, the median school district program effect is near zero across the measures of educational environments we consider. This divergence is driven by a pattern of large school districts, high-income school districts, and urban and suburban school districts having programs with significantly larger effects on learning environments. Finally, we find that gifted program effects are larger for some student subgroups, but this is entirely due to district treatment effect heterogeneity, not differential effects on subgroups within districts.

1. Introduction

The landmark federal law on gifted education, the Javits Act of 1988, supports research on special programs targeted at gifted children but does not mandate implementation of gifted programs. In the absence of a federal mandate, there is wide variation across states and districts in the extent of services provided to gifted children. Surveys of school districts suggest that offerings range from part-time courses that supplement the standard curriculum to stand-alone curricula offered in dedicated, self-contained classes (Hamilton et al., 2019). These programmatic decisions have the potential to affect various aspects of students' educational experiences: the schools they attend, the curricula they study, the peer groups they study with, and the teachers to whom they are assigned. Yet there is very little descriptive evidence on the educational experiences of students in gifted programs and how this varies across school districts and locales.

In this paper, we describe the structure of gifted and talented programs across nearly 300 school districts in Washington State and how these structures affect gifted students' learning environments. Combining administrative data collected by the state, state-mandated reporting on the implementation of gifted programs, and an original survey of district program coordinators, we link qualitative descriptions of program features to quantitative information on the classroom assignments of individual students. The administrative data allow us to identify students participating in different types of programs even within the same school district. We use these data to describe variation in gifted program design across grade levels and school districts and consider how different kinds of programs shape students' access to a variety of educational resources.

We use regression adjustment and student fixed effects to compare access to a broad array of educational resources for gifted students relative to high-achieving, non-gifted students. We find that participation in a gifted program changes various aspects of students' educational environment: their classroom peers score about 0.21–0.25 standard deviations higher on standardized tests and are 25 to 28 percentage points more likely to be gifted students themselves; they are more likely to take honors, dual credit, and other advanced courses; and their teachers tend to have better qualifications, such as experience and licensure scores. On the other hand, the relationship between gifted status and other characteristics of the classroom, such as class size or teacher value added, is weaker, and varies across grade levels.

These mean effects of gifted programs on learning environments for the typical student mask considerable heterogeneity across districts and gifted program structures. Individual districts vary considerably in the extent to which gifted participants have different learning environments than high-achieving non-participants. While gifted participation changes the educational environment for the average *student* in the state, the median *school district* program effect is near zero across the measures of educational environments we consider. This divergence is driven by a pattern of large school districts, high-income school districts, and urban and suburban school districts having programs with significantly larger effects on learning environments. In smaller, rural school districts, gifted students tend to have educational environments similar to those of high-achieving, non-gifted students.

We then examine differences in student learning environments across gifted program types. In particular, we use administrative data to classify gifted students into one of four program categories based on where services are delivered: the regular classroom, full-time self-contained programs, supplemental programs outside the classroom, and acceleration-based programs. Using an original survey, mandatory reporting, and administrative data, we verify that these programs use different approaches for the instruction of gifted students (e.g., intentional placement of gifted students in the same classroom, referred to as cluster grouping; differentiated instruction; accelerated pacing of material; and independent projects). We find that self-contained gifted programs are most likely to employ "curricular compacting," a practice where teachers replace material students already know with new content or enrichment options, and that self-contained programs tend to be the most differentiated in terms of exposure to high-achieving peers and advanced courses.

Our results highlight the extent to which the learning environments for gifted programs vary considerably depending on the structure of the program and other district characteristics. These patterns may help explain the notable variation in findings of the effects of participation in gifted programs on student outcomes among studies with credible research designs. Although some studies document large effects from participation in gifted programs (e.g., Card & Giuliano, 2016a; Watts et al., 2015), others find little evidence that they improve student outcomes (Bui et al., 2014). Our results showing district-level heterogeneity of gifted learning environments strongly suggest that researchers should expect to find considerable heterogeneity in the effects of gifted programs on student learning outcomes.

2. Background and Literature Review

This descriptive study of gifted programs is motivated by an apparent contradiction in the empirical literature. Several experimental and quasi-experimental studies have found that individual components of gifted programs—such as accelerated instruction, ability grouping, or enrichment—improve student achievement outcomes (Gentry & Owen, 1999; Matthews et al., 2013; Steenbergen-Hu & Moon, 2011; Tieso, 2005). Yet the evidence on the overall effects of participation in gifted programs is much more mixed. Several studies using assignment lotteries or regression discontinuity designs have found that gifted programs do not improve student achievement on average (Bui et al., 2014; Card & Giuliano, 2014; Cohodes, 2020), although the evidence is more positive from some national studies and for students from traditionally underserved socioeconomic groups (Card & Giuliano, 2016a, 2016b; Cohodes, 2020; Redding & Grissom, 2021). Both findings are consistent with a similar literature on the effects of selective high schools (Abdulkadiroğlu et al., 2014; Shi, 2020), but raise important questions about the generalizability of research on gifted programs.

Some researchers have questioned whether the programs studied in the recent empirical literature are representative of best practices in gifted education or of gifted programs more broadly (Kettler, 2016). But there is relatively little empirical evidence on the structure of gifted programs in the United States or on the types of services students typically receive. One of the few large-scale studies is a survey of school and district officials about gifted programs in three states conducted by the National Center for Research on Gifted Education (NCRGE). Although they found significant variation in district objectives, the NCGRE surveys suggested that more districts favored extensions to state or district curricula over acceleration programs. They also found that students spent considerable time in the mainstream classroom, with about 70% of respondents reporting that fifth-grade gifted students attend general education math and ELA classrooms for at least 5 hours per day (Hamilton et al., 2019).

The NCRGE findings suggest that students in many gifted programs may have classroom environments similar to those of other high-achieving students. Similarly, Baker (2001a, 2001b) examines school finances and finds significant cross-district variation in per-pupil expenditures on gifted programs. The relative lack of empirical evidence on the educational services received by gifted students is an important omission given the strong theoretical and empirical evidence that high-achieving learners benefit from more advanced coursework and more targeted instruction.

There is extensive literature on the effects of peers and coursework on student achievement. In the gifted context, there are two main arguments for tracking students. First, gifted students might benefit directly from studying with other high-achieving peers (Gentry & Owen, 1999; Matthews et al., 2013; Tieso, 2005). Second, ability grouping may also facilitate instructional strategies that benefit high-achieving students. For instance, homogeneous classrooms may allow instructional approaches that are more precisely targeted at individual students (Betts & Shkolnik, 2000; Figlio & Page, 2002). In the gifted context, Kulik and Kulik (1992) report meta-analytic findings that gifted students benefit from more homogeneous grouping patterns. And Card and Giuliano (2016a) find that the creation of high-achieving tracks as part of a district's gifted program especially benefited minority students. Gifted and talented programming also often encompasses a range of educational activities that accelerate the standard curriculum. A significant body of research suggests the benefits of rigorous coursework for high-achieving students, although the magnitude of such effects varies by study (Altonji, 1995; Attewell & Domina, 2008; Long et al., 2012). Steenbergen-Hu and Moon (2011) review the literature on acceleration for gifted students and reach a similar conclusion.

In this study, we use administrative data, annual district reporting on gifted programs, and an original survey to document how participation in gifted programs changes the classroom resources available to gifted learners. We focus on multiple dimensions of the intensity of gifted programming, including access to advanced or accelerated courses, ability grouping, and other features of the classroom environment, such as teacher quality and class size. However, it is important to note that some gifted programs may serve students' nonacademic talents (and therefore not affect measured classroom resources), or may focus on enrichment activities without other modifications to the classroom environment or instruction (Erickson et al., 2019; Greene et al., 2017; Reis et al., 2011). Nonetheless, serving the academic needs of advanced students is one of the more common public justifications of these programs, and is commonly cited by program coordinators as a central program objective (McCoach et al., 2021).

3. Data and Setting

Washington funds gifted programming through its basic program of education, and state law requires districts to operate programs for gifted students. These programs are collectively called "highly capable programs" (HCPs). The basic education allocation includes an additional amount for HCPs funded at 5% of the district's student enrollment. Districts are supposed to use these funds to support a continuum of services for students deemed to be highly capable. Importantly, districts may use multiple definitions of highly capable and may include programming for students showing merit in arts in addition to academic accomplishment (RCW 28A.185.020).

We study the variety of gifted programs in Washington using three main sources of data. These data include longitudinal student records maintained by the Office of the Superintendent of Public Instruction (OSPI), an annual district report to OSPI on the content of their gifted programs, and an original survey of districts' gifted program coordinators conducted in early 2019.

3.1. State Administrative Data

The state administrative data track student enrollment, participation in special programs, and course schedules at the individual student level. In addition, that data include detailed transcript information for high school students. We use data on students in grades K–12 from the 2016–2019 school years, when the state tracked detailed information on student participation in gifted programs.

For our analysis of what it means to be in a gifted program, we must define which students are participating in such a program. Districts assign gifted students to one of four program types based on where services are delivered: programs offered in the general education classroom, through unique gifted programs, through accelerated courses, or through non-traditional arrangements outside the school day.[2] These state classification codes do not perfectly match common distinctions in the gifted literature. In particular, the state code for "unique highly capable program" encompasses both programs offered through full-time programs, where students receive their instruction in a self-contained gifted classroom, and part-time or pull-out programs, where students receive most of their instruction in the regular classroom. In order to distinguish between full- and part-time gifted programs, we therefore reclassify students who

[2] See Appendix Table A.1 for more detail on the definitions used in the state administrative data system.

receive instruction primarily with other gifted students as participating in full-time programs. We then identify all other gifted students participating in general classroom programs, accelerated programs, and supplemental programs based on the reported code. We make each of these assignments at the district by grade level, so that each student reported in a school district using one of the four program type codes in a given year is assigned to the same type in our analyses. We provide more detailed descriptions of these program types and the assignment algorithm in Appendix A.

We then link student enrollment and program participation data to other information on educational background and learning environments. We measure students' prior achievement on the Smarter Balanced Assessment (SBAC). In grades 4 through 8, we match students to their prior-year score; for students in grades 9 through 12, we match them to their 8th grade SBAC scores. We also use the administrative data to identify student gender, race/ethnicity, participation in free- or reduced-price lunch (FRL) programs, primary language, and learning disability status.

In order to understand how gifted participation relates to course-taking, a potential avenue through which gifted programs—especially acceleration-based gifted programs in secondary schools—may influence the classroom environments of gifted students—we use students' course schedule data to construct indicators of whether students take several types of special courses. The course schedule data include a common system for numbering and categorizing course types used by all districts in the state.[3] These variables include proxies for the academic level and enrichment of a student's course load. We identify whether a student takes an art or foreign language course (for grades K–12); a student takes an honors course (for grades 6–12); a student takes an advanced (above grade-level) math course (for grades 6–8);[4] a student takes a dual enrollment course (for grades 9–12); and a student takes an AP course in English, math, social studies, or science (for grades 9–12).[5]

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[3] Not all school districts reliably report courses using this system and many districts fail to report course codes for some courses in 2017 (Chen et al., 2018). We therefore impute course types using district-specific course titles and a classification algorithm that uses natural language processing tools on the complete cases data. We describe these methods in more detail in Appendix A.

[4] We define an advanced course as either a math course that is above the student's reported grade level or an algebra or other high-school-level math course.

[5] Two years of foreign languages are a graduation requirement for some districts and an admission requirement for in-state public 4-year institutions. However, even among the high-achieving sample, there is variation in how many

To understand how gifted programming might change peer composition, we supplement the above with data about a student's peers. We average students' prior math and ELA standardized test scores and take the average and within-class standard deviation of the combined measure for each classroom. We also construct averages of students' gifted status and grade level. For each student, we average these values over all courses in their schedule. To consolidate the several course-taking variables available at the high school level, we create a general course rigor index for high school students that combines the indicators described above using factor analysis (e.g., dual credit course, honors course).[6] We standardize the resulting index within grade and year.

Using the unique course codes included in these files, we additionally link course enrollments to the assigned teacher to ascertain whether gifted participation is related to measures of teacher quality. We obtain data on teacher experience and educational attainment from state employment files. We also use linked student–teacher data for math and ELA classrooms in grades 4–8 to construct two value-added based measures of teacher quality. The first is a leave-out estimate of teacher value added to student test scores.[7] Because these estimates are only available for students in tested grades, we also create a second, *predicted* value-added measure using observable teacher characteristics (Jackson, 2012). We estimate the predicted value-added measure by regressing teacher value added in math and reading on indicators for teacher experience, standardized licensure test scores, and educational attainment. We then use the regression coefficients to construct an estimate of teacher quality based on observable characteristics. We standardize the predicted teacher quality metric using the full sample of teachers; one standard deviation in teacher quality using this measure equates to about 0.03 standard deviations in predicted student achievement. For comparison, one standard

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years of foreign languages are taken and in which grade students begin. For example, for the 2016 cohort of high-achieving ninth graders, about one quarter of the sample took fewer than 2 years of foreign languages and about 30% took more than 2 years.

[6] The weights for the course index can be found in Appendix A, Table A.3.

[7] We estimate a standard "one-step" value-added model (Koedel et al., 2015) using cubic polynomials in prior achievement, student demographic characteristics, and classroom and school aggregates. To avoid mechanical correlations between HCP status and value added, we estimate leave-out teacher effects using data from other school years (Chetty et al., 2014; Stepner, 2014). The value-added data are estimated using a sample of linked student and teacher schedules. The administrative data include fields designed to link students to their individual teachers, based on reported schedules. However, limitations of reporting standards and practices across the state may result in ambiguities or inaccuracies around these links.

deviation in teacher value added corresponds to a 0.13 standard deviation increase in student test scores in ELA and 0.16 in math, which is similar to prior studies (e.g., Chetty et al., 2014).[8]

3.2. Annual Gifted Reports and Gifted Coordinator Survey

Washington law requires districts to offer a continuum of highly capable services as part of their basic education programming. Each year, districts report to OSPI about the types of program services they offer. For each program type (self-contained, general classroom, acceleration, and non-traditional programs), districts report whether teachers use specific instructional approaches or ability grouping strategies. The annual district reports are linkable to the program codes used to identify individual students in the administrative data. For districts that operate multiple gifted programs, we can therefore identify instructional practices for the specific program a student participates in.

We focus on five instructional strategies and two ability grouping patterns that have been considered in prior research on gifted education. The five instructional strategies involve modifying the traditional curriculum to cover more advanced material or allow time for more enrichment activities. *Acceleration* involves studying more advanced material, typically above a student's grade level. Common forms of acceleration include grade skipping, Advanced Placement courses, or taking advanced courses in one or more subjects. *Compacting* is an instructional practice in which teachers remove easier or repetitive material from the curriculum and spend the additional time on more advanced material, more in-depth coverage of particular topics, or other enrichment activities (Reis et al., 1993). *Pacing* involves adapting the speed of instruction to individual students, and may include acceleration or compacting (Daniel & Cox, 1988). *Supplemental instruction* involves gifted programs offered outside the general classroom setting, such as academic competitions, before- or after-school programs, and mentorship programs. Finally, *independent study* involves self-directed research projects that are planned and monitored by the teacher (Johnsen & Goree, 2009).

The two ability grouping practices we consider determine how gifted students are distributed within and among mainstream classrooms. *Cluster* grouping is the practice of assigning gifted students to a single mainstream classroom, generally to facilitate the kinds of accelerated instructional practices described above (Gentry & Owen, 1999). In *flexible* grouping,

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[8] We estimate the variance of teacher quality using the linked student–teacher data as the covariance between teacher value-added estimates in consecutive years.

gifted students may not be intentionally assigned to a subset of mainstream classrooms, but teachers are encouraged to group gifted students together to receive small-group instruction within the general education classroom (Matthews et al., 2013; Tieso, 2005).

We link the district annual reports for 2016–2019 to student-level gifted participation codes. Although districts separately report instructional practices used for each of their individual gifted program codes, they are not asked to report instructional practices separately by grade level. If practices vary across grade levels within gifted program type, there is likely some error in the student-level instructional strategies variables we construct. However, the measurement error should be somewhat ameliorated by the fact that districts frequently use different program types for their gifted programs at different grade levels.

In order to gather additional context on the structure of gifted programming in each district and how students are screened for gifted programs, we surveyed all gifted program district coordinators in Washington State about district policies on program design and student identification procedures in winter 2019. The survey asked district coordinators about whether highly capable students were identified globally in all subjects (rather than subject by subject), whether the district had a districtwide curriculum for gifted students in math or ELA in each grade, whether the district had a universal screening policy, and whether the district made any modifications to its screening policy for low-income students or students from underrepresented minority groups. The overall response rate to the survey was 60%; however, responding districts enrolled 78% of all students in our sample and 80% of all highly capable students.[9]

4. Empirical Strategy

Gifted programs in Washington generally serve the highest scoring percentiles of the academic achievement distribution. In most of our analyses, we therefore construct a sample of high-achieving students as a comparison. To construct this sample, we first estimate a propensity score for gifted participation. Because our analyses focus on within-district comparisons, and because the percentage of students participating in gifted programs differs substantially across districts, we estimate propensity scores with district-grade-year effects following the approach

[9] A comparison of responding and non-responding districts may be found in Appendix Table C-2. Because we specifically targeted large districts in our survey response follow-up strategy in order to provide coverage of as many students as possible, districts that responded are disproportionately likely to be large and urban.

suggested by Arkhangelsky and Imbens (2018). Specifically, we estimate the following model by logistic regression:

$$Gifted_{it} = \beta_0 + X_{ijgt}\beta_1 + \bar{X}_{jgt}\beta_2 + \overline{Gifted}_{jgt}\beta_3 + \epsilon_{ijgt}$$

where *i* indexes student, g indexes grade, j indexes district, and *t* indexes year. The vector of student observables includes third-order polynomials in prior math and ELA achievement, and $\overline{Gifted}_{jgt}$ indicates mean gifted participation in the school district. We then trim the sample using the rule-of-thumb method described in Crump et al. (2009), which retains observations with estimated propensity scores between 0.10 and 0.90. The resulting sample includes 18% of all students and 75% of all gifted students in our sample. Our primary analyses use data on students in grades 4–12 for whom we have prior testing data.[10]

Our main results for the relationship between gifted participation and access to educational resources involve comparing the learning environments of gifted students to other high-achieving students in the same school district. Our basic empirical model is

$$R_{ijgt} = Gifted_{it}\delta + X_{it}\beta + \alpha_{jgt} + \epsilon_{ijgt} \quad (1)$$

where R_{ijgt} is some measure of the learning environment for student *i* in district j and grade *g* in year *t*, restricted to a sample of students deemed to have high propensity to be identified for gifted programs using the procedure described above. We control for a district-grade-year effect (α_{jgt}) so that comparisons are made to non-gifted students in the same district, grade, and school year.[11] In equation (1), the coefficient δ provides the difference in resource *R* between gifted participants and nonparticipants with similar observable student covariates in the same district, grade, and year.

The estimated coefficients δ from regressions like equation (1) do not necessarily have a causal interpretation of the effect of gifted participation on students' learning environments. Indeed, in our base model without student covariates, δ is simply a comparison of the experiences of gifted students and non-gifted students in the same school district. A causal interpretation of the gifted coefficient requires that other factors that might influence access to schooling inputs (e.g., academic aptitude or parental involvement) are not correlated with gifted

[10] Because the resource information is more limited and we cannot estimate the same specifications due to lack of student testing data in early grades, we provide a separate analysis of gifted programs in grades K–3 in Appendix C.
[11] In some school districts, school assignments are driven by participation in GT programs, so we do not control for school fixed effects in any of our specifications.

status—an assumption that seems unlikely. We therefore estimate two additional models that may mitigate some of the potential problems in equation (1) by comparing outcomes for students who switch into or out of gifted programs; in each school year, about 1.5% of students switch into gifted programs and about 5.3% of gifted students exit their programs.[12] In the results that follow, we take these to be our preferred specifications, as they alleviate some of the concerns about equation (1) described below.

The first additional specification is motivated by the concern that our proxy for students' academic aptitude, prior achievement, may itself depend on prior participation in gifted programs (Card & Giuliano, 2016; Watts et al., 2015) and is therefore not a clean control variable. In some specifications, we therefore restrict the sample to students in the trimmed, high-achieving sample who were not participating in gifted programs during the prior school year, and identify the effects of gifted programs based on students newly enrolled in such programs.

In the second additional specification, we estimate models where we replace the student covariates with student fixed effects:

$$R_{ijgt} = Gifted_{it}\delta + \theta_i + \alpha_{jgt} + \epsilon_{ijgt} \qquad (2)$$

The student fixed effects approach also identifies the effects of gifted participation on student learning environments by comparing students' learning environment in years they participated in a gifted program to their learning environment in years they did not. The key identifying assumption is that students who switched into gifted programs would have experienced similar changes in their classrooms as non-switchers. This assumption may be too strong if changes in district educational programs across grades are correlated with baseline student academic aptitude or if switches are brought about due to changes in student or parent motivation. Since this is likely to be the case, we restrict estimation to the trimmed sample so that counterfactual trends are estimated only from a sample of high-achieving students. Although the fixed effects estimate would still be biased if changes in other factors, such as parent or student motivation, that might affect a student's learning environment were correlated with changes in gifted status, this is a weaker assumption than is embedded in the model in equation (1).

[12] Students are most likely to switch into gifted programs in grades 2 and 3, consistent with other research finding that these are the grades in which students are most likely to be first identified for gifted programs (McCoach et al., 2021).

5. Descriptive Overview of Gifted Programs

Before discussing the estimated effects of gifted programs on educational resources, we first describe access to these programs and their classroom environments. We begin by displaying a map of the state of Washington parceled into school districts, with each district colored according to the rate at which students participate in gifted programs, displayed in Figure 1. Districts with relatively high gifted participation rates are clustered in the Puget Sound area (near Seattle), the southwest portion of the state neighboring Portland, Oregon; and districts near the Spokane area, in the eastern region of the state. Districts with very low gifted participation rates tend to be the districts in the rural eastern portion of the state.

5.1. Student-Level Summary Statistics

Summary statistics by grade level are presented in Table 1. The breakdown of background variables yields patterns that one would expect based on prior research on gifted selection (e.g., Grissom et al., 2019). In elementary school, for example, Asian students are dramatically overrepresented in the high-achieving sample, only making up 8% of the full sample but 18% of the gifted sample and 12% of the high-achieving non-gifted sample. The reverse is true for Black and Hispanic students, with Black students making up 4% of the full sample but 2% of both the gifted and non-gifted high-achieving samples, and Hispanic students making up 15% of the full sample and 8% (non-gifted) and 6% (gifted) of the high-achieving samples. Similar patterns hold for FRL status and the disability flag (underrepresented in gifted sample). Patterns of participation across demographic groups are similar to the analyses of Gentry et al. (2019). In addition, the trimming results in a dramatic shift of student achievement relative to the full sample, with prior test scores being about the mean for the full sample, by construction, but about 1 standard deviation higher for the trimmed samples. In other words, the trimming approach helps ensure comparisons are between gifted students and high-achieving non-gifted students. Summarizing Table 1, about 80% of student-year observations in Washington are discarded in most of the analyses that follow in order to compare gifted students to high-achieving non-gifted students. The excluded students are more likely to be Black or Hispanic, are less likely to be Asian, and have substantially lower prior math and ELA scores.

5.2. Inequities in Access to Gifted Programs

Before exploring how gifted programs are structured, we begin by investigating demographic factors related to gifted participation. The underrepresentation of low-income and minority students in gifted programs has attracted particular attention because identification procedures often include nomination or referral processes requiring subjective evaluation of student ability. Nationally, low-income and non-White students are significantly less likely to participate in gifted programs (Grissom & Redding, 2016). Nonetheless, the empirical evidence on student underrepresentation and the effects of different identification procedures is mixed. Using data from Utah public schools, Warne et al. (2013) found that non-White students were more likely than White students to participate in gifted programs, conditional on student achievement. Using national data, Grissom and Redding (2016) find that prior achievement explains the gap between Hispanic and White identification rates, but not the gap between Black and White rates. One limitation of these studies is that they may mask within-district inequities if students are nonrandomly sorted across school districts with differently sized gifted programs. Indeed, many studies have documented associations or causal relationships between district policies—such as teacher referrals (Ford, 2003; Grissom & Redding, 2016; McBee, 2006), universal screening (Card & Giuliano, 2016b), and modifications for underrepresented students (Card & Giuliano, 2016a)—and identification patterns.

We investigate participation in gifted programs by student race/ethnicity and socioeconomic status using the sample of students in grades 4–12. We regress student participation in gifted programs on indicators for student race/ethnicity, FRL eligibility, and student and district covariates. Results are shown in Table 2. We begin with models that control for neither prior test achievement nor district fixed effects (column 1). Relative to White students, we observe Asian students being more likely to be found in gifted programs, while Black, Hispanic, and FRL students are less likely to receive gifted services. This basic pattern is consistent with the means presented above in Table 1. When prior test scores are added as additional covariates (column 2), the Black-White and Hispanic-White gifted gaps disappear.[13]

[13] Note that in order to include controls for prior test scores, this specification cannot capture students who switch into gifted programs in early grades, which is an important limitation because grades 2 and 3 are the grades in which students are most commonly first identified as gifted (McCoach et al., 2021). When examining the relationship between demographic factors and switching into a gifted program in grade 2 or grade 3, we observe the same basic patterns as in column 1 of Table 2; i.e., a positive coefficient on Asian and negative on Black, Hispanic, and FRL. However, without any proxies for student ability included, it is unclear how to interpret these coefficients.

For example, the coefficient for Black students falls from -0.03 to 0.01 when trimming the sample and adding prior test scores, and for Hispanic students, from -0.03 to 0.00.

In column 3, we include a subset of district policies related to screening. We include an indicator related to screening modifications. In the survey of program coordinators, we asked whether the district used a screening modification for underrepresented minorities or low-income students. We code students as having a screening modification if their district reported the policy and they match the demographic group (American Indian/Alaskan Native, Black, or Hispanic for underrepresented minority students; FRL eligible for low-income students). We also include indicators for whether the district has a universal screening policy or uses the mandatory state assessment for screening. We find little association between these policy variables and gifted participation; indeed the association between screening modifications and participation is negative and statistically significant. Consequently, including these covariates does little to change the estimated coefficients on student race or FRL eligibility. However, we caution readers that these estimates do not have a casual interpretation. If districts with weaker procedures for identifying students from diverse backgrounds or those with few minority or low-income students are more likely to adopt these procedures, we may not find positive associations between district policies and student participation.

In the remaining columns, we include district fixed effects to adjust for unobserved district policies that might influence participation. The coefficients on race/ethnicity and FRL status are quite similar, although the estimated Asian-White gap is statistically significant in these specifications. In the remaining columns, we restrict the sample to students not participating (column 5) or participating (column 6) in gifted programs during the prior year. One potential concern with the analyses including the full sample is that prior test scores may be determined in part by prior participation in gifted programs. The results are somewhat more ambiguous when we make these restrictions. Black students not participating in gifted programs are slightly more likely to be identified the following year, but Black gifted students are also 2 percentage points more likely to transition back into mainstream instruction than White students with similar test scores. The same is true for Hispanic and low-income students.

In sum, the results from Table 2 suggest consistent evidence of disparities in access to GT programs conditional on student achievement for low-income students. We find less consistent evidence of disparities by student race/ethnicity, although we do find that Black and Hispanic students exit gifted programs at higher rates than similarly high-achieving gifted White students. However, two general cautions are warranted. First, we do not have data on student academic aptitude prior to school enrollment, so we cannot assess the initial classification decision. Second, the academic achievement measure is itself potentially related to prior participation in GT programs.

5.3. Educational Resources Available to Gifted Students

Table 3 displays summary statistics for gifted classification and access to the educational resources used in the analyses below, broken down by school level. For each grade level (elementary school, middle school, and high school), there are three columns: one for all students in the state; one for the trimmed sample of high-achieving, non-gifted students; and one for gifted students. For parsimony, we refer to the non-discarded sample as the high-achieving sample even though some additional predictors beyond student-level test scores are included in the estimation of the propensity score (district-level prior test scores, district-level gifted participation rates, and year fixed effects).

Beginning with the first three rows summarizing the characteristics of other students sharing a student's classroom, gifted students are much more likely to sit in classrooms with other gifted students, even after trimming the sample to high achievers. In addition, gifted students' classmates have substantially higher achievement indices (average prior math and ELA scores), and more homogenous classrooms as measured by the standard deviation in peer achievement, with these patterns being most pronounced in elementary school. Finally, gifted students are taught by more qualified teachers in elementary and middle school, as measured by experience, licensure test scores, and educational attainment. We investigate these patterns in more detail in Section 6 below.

5.4. Instructional Strategies by Gifted Delivery Model

Table 4 displays summary statistics for *instructional strategies* and *screening/identification policies* obtained from district surveys. The annual district reports provided to the state include information on the instructional strategies used in each of their gifted programs for each delivery model. We link the instructional strategies to student-level data on gifted participation by program type and report the strategies used in different delivery models weighted by student population.

Overall, districts report using a variety of instructional approaches with gifted students. Explicit instructional modifications appear to be more common in self-contained programs and those with an acceleration focus. Self-contained programs report using a broad array of instructional strategies, with at least 85% of students in programs that use acceleration, compacting, and pacing. Ninety-five percent of accelerated programs use an accelerated curriculum; fewer of these programs use other instructional modifications. General classroom and supplemental programs are less likely to report using instructional modifications, and are more likely to report using independent study (79% and 73%, respectively).

Although all program types report using some ability grouping, general classroom programs are most likely to report using cluster and flexible grouping patterns. Ninety-three percent of students participate in general classroom gifted programs that report using flexible grouping in heterogeneous classrooms, and 75% of students are in general classroom programs that report using cluster grouping. Both acceleration and self-contained programs report less use of ability grouping than in mainstream classrooms. And well under half of districts have established gifted curricula for math or ELA, with about 20% of gifted students being in a district that reports having a districtwide math curriculum and 25% being in a districtwide ELA curriculum, consistent with McCoach et al.'s (2021) survey of districts in three states.

We use data from our survey of district coordinators to assess district gifted screening and identification policies. These do not ask about district policy for particular delivery models, so responses are not necessarily specific to the program in which a student participates.[14] Overall, about half of gifted students participate in programs that globally identify students as gifted (rather than as gifted in a particular subject). In addition, about 90% of students are in districts that report having some sort of universal screening policy, and about 45% of students are in districts that report using a different assessment or weighting process for low-income and underrepresented minority students.[15] Comparing these findings to a similar survey administered

[14] Variation across columns in Panel 2 thus reflects differences in delivery model offerings across districts; for example, if large districts were disproportionately likely to globally identify students and to have more gifted students be in self-contained programs, we would expect to observe that students in self-contained programs were more likely to be in districts that globally identify students.

[15] Note that a universal screening policy does not necessarily imply the use of one test with a fixed cut score that operates as a sole screener. When asked to describe screening policies, while many districts did report that students scoring at the highest level on the state test were automatically referred to their HCP (Level 4 on SBAC), other districts that answered yes to the universal screening question described systems where multiple pieces of data are used in the screening process, including SBAC, the Cognitive Abilities Test, and the iReady assessment.

across three states (McCoach et al., 2021), our findings fall within the range of the highest and lowest state results, although this is an extremely wide range.[16] For example, in the three states surveyed by McCoach et al. (2021), universal identification ranged from 22% to 94%, and modified identification strategies for underrepresented groups ranged from 23% to 65%.

6. Gifted Programs and Educational Resources

6.1. Gifted Participation and Student Learning Environment

We now turn to the main results, estimating relationships between gifted participation and access to educational resources. Table 5 shows outcomes for the full sample that can be linked to prior-year test scores, with results broken down by school level in subsequent tables. With the exception of column 1, which includes all students as a point of comparison, the sample in Table 5 is restricted to high-achieving students, as measured by their propensity for gifted participation.[17] Each row displays a different resource, and the coefficient represents the association between gifted participation and that resource, conditional on observable characteristics and district-grade-year fixed effects. We vary the research design/controls across the columns.

The first several rows of Table 5 include several measures of the student classroom environment. Beginning with the sample of all students and a regression that only controls for district by grade by year fixed effects (column 1), we see a 0.61 standard deviation positive association between gifted status and an index of prior-year math and ELA scores of a student's peers. Restricting the sample to students in the high achievement sample, the coefficient on gifted participation falls to 0.35 (column 2). Adding student covariates (column 3), restricting the sample to students who were non-gifted students in the prior year (column 4), or including student fixed effects (column 5) reduces the coefficient to 0.21–0.28 standard deviations. In addition, using our preferred specifications in columns 4 and 5, gifted students' classrooms also tend to be more homogeneous: the within-classroom standard deviation in average achievement

[16] We thank Del Siegel and NCRGE for generously sharing their survey instruments with us, which we used to develop our own survey.

[17] That is, with the exception of column 1, the sample is trimmed according to the procedure outlined in Section 4 above; thus the comparisons are of gifted students to high-achieving non-gifted students.

is about 0.05–0.06 standard deviations lower among gifted students. Furthermore, we see that the proportion of gifted peers increases by about 0.25–0.28 when students enroll in gifted programs.

The bottom set of rows concerns the relationship between gifted participation and class size and teacher quality. We find some evidence that gifted students have slightly smaller classes. Across all grades, the average class size is about 0.40–0.45 students smaller, although the effect is only significant at the 10% level in models with student fixed effects. We also find that gifted teachers are more highly qualified, as measured by a composite index of experience, educational attainment, and licensure test scores described in Section 3.1 above. Teachers of gifted students are about 0.04–0.05 standard deviations higher on our teacher quality index. However, the implications of this difference are arguably not of much practical significance: as discussed above, one standard deviation of the teacher quality index corresponds to only about 0.03 standard deviations in student learning, so these effects suggest gifted teacher quality is higher by about 0.001–0.002 standard deviations on student test scores.

Finally, we also see some evidence of additional enrichment courses: gifted students are about 3 percentage points more likely to take a foreign language and about 1 percentage point more likely to take an art class (although the latter is insignificant in our preferred specifications).

In Tables 6–8, we separately assess gifted effects on learning environments for students in grades 4 and 5 (Table 6), 6–8 (Table 7), and 9–12 (Table 8). The patterns are generally similar, but we do see two notable trends across grade levels. First, gifted programs in the earlier grades appear to be more segregated than those in higher grades. The relationship between gifted participation and peer gifted status declines from about 0.30 in grades 4–5 to 0.25 in grades 6–8 and to 0.14 in high school.[18] Similarly, the association between gifted participation and the mean and standard deviation of peer achievement declines from 0.32 and -0.08, respectively, in grades 4 and 5, to 0.08 and -0.01 in high school. The effects of class size decline as well. We estimate that gifted participation reduces average class size by about 1.2 students in elementary school but has no effect on class size in middle or high school.[19]

[18] This pattern is due in part to students in earlier grades being more likely to be in self-contained gifted programs.
[19] Although we cannot estimate the same specifications as in Tables 4–7, the results in the earlier elementary grades are also consistent with this pattern (Appendix Table C.1). Estimates of the effects of gifted participation in grades K–3 on peer gifted status and class size using student fixed effects are quite similar to those in grades 4–5.

Differences in teacher qualifications between gifted and non-gifted students appear to be most pronounced in middle school, with the qualification index ("predicted value added" in the tables) being 0.05–0.06 standard deviations higher for gifted students in middle school, compared to 0.03–0.05 in elementary school and 0.02–0.04 in high school. Examining the components that make up the qualification index, teachers of gifted middle school students tend to have higher licensure test scores. In elementary school and high school, the relationship between gifted status and teacher qualifications in column 1 appears to be partially driven by the sorting of highly qualified teachers to high-achieving students, as the coefficient on predicted teacher value added falls in elementary school, for example, from 0.09 with no trimming or student-level controls to 0.02 once student fixed effects are added. Since the student fixed effects models are identified by within-student variation in schooling resources, the difference between the estimates with and without student fixed effects suggests that many gifted students who were exposed to highly qualified teachers were also in classrooms with highly qualified teachers in the years that they did not receive gifted services. Turning to actual value added, which can be estimated for elementary and middle school teachers, we find that gifted students are exposed to more effective teachers as measured by value added in elementary school but not middle school.

On the other hand, the effects of gifted participation on course-taking patterns appear to increase with grade level. We find no evidence that gifted participation increases access to special courses (peer grade level, art classes, foreign languages) at the elementary level. At the middle school level, we find mixed evidence on arts and foreign languages. Although we estimate that gifted students are about 3 percentage points more likely to take both class types in some specifications, the models with student fixed effects are smaller and statistically insignificant.

We do find consistent evidence that gifted students take above-grade math courses. In particular, we estimate that gifted participation increases the probability that a student takes an advanced math course by about 5 percentage points. Similarly, high school gifted students are more likely to take foreign language, honors, and dual-credit courses: they are about 7 percentage points more likely to take a foreign language in a given year, about 29 percentage points more likely to take an honors class, and about 20 percentage points more likely to take a dual-credit class.

6.2. Heterogeneity by Student Subgroup and by Gifted Delivery Model

In this section, we explore how the relationship between gifted participation and access to educational resources varies across student subgroups and by gifted structure. For brevity, we focus on four key outcomes: peer achievement, peer gifted status, predicted teacher value added, and class size.

Figure 2 displays gifted effects on educational resources by race and socioeconomic status. As a general pattern, to the extent that there are estimated race-specific effects in the most basic models that only control for student-level information, these effects are largely explained by district and delivery model; in other words, when district by delivery model fixed effects are incorporated (referred to as "Gifted FE" in the figure), the race-specific coefficients attenuate towards zero. In the full models with fixed effects for student and gifted program, there are few notable differences across subgroups, with the exception of Hispanic students tending to have a weaker relationship between gifted participation and exposure to high-achieving peers and other gifted peers.

Figure 3 divides the general gifted indicator into subcomponents describing the structure of the gifted offering: self-contained gifted classrooms, gifted programs in a general education classroom, supplemental offerings, or acceleration. Using our preferred specification with student fixed effects, we find that the relationship between gifted participation and educational resources is most pronounced in self-contained gifted programs. In elementary school, students in self-contained programs are exposed to peers with prior test scores of about 0.8 standard deviations higher than similar non-gifted students. In addition, gifted students in self-contained programs see the proportion of gifted peers rise by about 0.8, a teacher qualifications index increase of about 0.1, and a class of about 4 students smaller. These effects are largest in elementary school. However, we do not find clear evidence that program structures other than self-contained have any effect on class size or predicted value added.

6.3. Heterogeneity by District

The Washington basic education law provides school districts with flexibility in the design and implementation of their gifted programs, suggesting we might see significant cross-district variation. To assess this possibility, we first obtain a gifted-by-program-level estimate of the effect of gifted participation on each of the measures of gifted experience for each district in

Washington. Because gifted students are only a small proportion of the total student population, we construct empirical Bayes estimates of the district effects. Specifically, we use our trimmed sample of high-achieving students in grades 4–12 and estimate:

$$R_{ijgpt} = X_{it}\beta + \alpha_{jgt} + \theta_{jp} + \epsilon_{ijgpt} \quad (3)$$

where θ_{jp} is a district-by-program effect; in other words, we replace the gifted indicator in our base regression model in equation (1) with an indicator for each district program. To construct empirical Bayes predictions, we borrow methods from the teacher effectiveness literature (e.g., Koedel et al., 2015):

$$\hat{\theta}_{jp}^{EB} = \lambda_j \hat{\theta}_{jp}^{FE} + (1 - \lambda_j)\bar{\theta} \quad (4)$$

where $\lambda_j = \sigma_\theta^2/(\sigma_\theta^2 + var(\hat{\theta}_{jp}^{FE}))$ is a weight that varies inversely with the precision of the district estimate. We describe the empirical Bayes approach in more detail in Appendix B.

We plot the density of the estimated program effects on the selected key outcomes in Figure 4. In all cases, the average effects shown in Table 5 are significantly larger than the median district effect. Although participation in gifted programs tends to increase access to advanced courses and high-achieving peers, there is substantial variation across school districts.

In Figure 5, we plot estimates of the means of the estimated district effects of gifted participation. We find that gifted effects are largely concentrated in urban and suburban districts. The estimated gifted effects are typically much smaller in the western and eastern school districts in rural portions of the state.

The individual district estimates suggest that the positive effects of participation in gifted programs are driven by large districts or large programs. We explore these possibilities more formally by interacting the gifted effect in equation (3) with district characteristics. We use the log of average district enrollment between 2016 and 2019 and district urbanicity from the National Center for Education Statistics Common Core of Data (CCD), estimates of district poverty rates for children aged 5–17 from the Small Area Income and Poverty Estimates (SAIPE), and average district gifted enrollment.[20]

We plot bivariate relationships between the gifted resource effects and log enrollment, school poverty, and district gifted participation in Figures 6–8 using the district empirical Bayes

[20] The CCD and SAIPE data come from the Urban Institute Education Data Portal (Urban Institute, 2021).

gifted effects described above.[21] These relationships have the expected effects. For the peer and course outcomes, we find that programs in districts with fewer than about 1,000 students typically have almost zero effect on student resources.

7. Discussion and Conclusions

Using administrative data in Washington State, we document significant variation in the structure of gifted programs across school districts. Larger, higher income districts in cities and suburbs operate larger gifted programs that provide more significant changes in students' learning environments. Students in these programs are more likely to share classrooms with other gifted students and with high-achieving students, and—in the case of large districts—sit in smaller classrooms with more qualified teachers. But while there is a positive relationship between participation and access to many types of educational resources for the average *student* across the state, the median *district* effect is close to zero for many resources due to the large number of small districts where the educational environments of gifted and high-achieving, non-gifted students are quite similar.

Another source of heterogeneity among students participating in gifted programs is the structure of the program. In any given year, about one third of gifted students in our study participate in programs offered through services in regular classrooms, where independent study, supplemental instruction, and flexible ability grouping appear to be important strategies. But many districts also offer programs with more intensive tracking of students. The relationship between gifted participation and access to resources is largely driven by these self-contained gifted programs that disproportionately employ instructional strategies such as curricular compacting and pacing. Overall, these findings validate a two-decades-old body of literature that documents variation in district expenditures (e.g., Baker, 2001a, 2001b) as well as survey evidence on the scope and design of gifted programming (Hamilton et al., 2019).

There is a growing body of empirical literature that provides causal estimates of the effect of gifted participation on student achievement (Bui et al., 2014; Card & Giuliano, 2014; Cohodes, 2020). These studies use administrative data from a single school district. However, the results from this study of gifted programs across an entire state suggest that district-specific

[21] The graphical results are consistent with estimates using the student-level data. See Appendix C for additional detail.

gifted programming effects are likely to vary substantially. This implies both that we should be cautious about generalizing based on district-level studies and that the variation in findings across studies may be indicative of true variation in program effectiveness.

Although not definitive, one possible explanation for the similar learning environments of gifted students and high-achieving, non-gifted students in many districts—especially for students in districts without self-contained programs and in small school districts—is that the creation of gifted programs has spillover effects on non-participants. For instance, cluster grouping programs implicitly require tracking students by academic achievement and if districts create tracks to support gifted programs, these policies could raise the achievement of non-gifted students as well. This is the case in the district program studied by Card and Giuliano (2016a), where the formal identification of a gifted student triggered the creation of an advanced track in elementary schools. Such policies are consistent with financing systems in some states, which provide funding for gifted programming but do not restrict its use to identified students alone (Baker & Friedman-Nimz, 2004). One potential area for future research is on the effects of state financing or mandates on student outcomes. If state funding for gifted programs leads to the creation of accelerated tracks that serve many non-identified high-achieving students, for example, the effects of *participation* in gifted programs may understate the effects of *financing* them.

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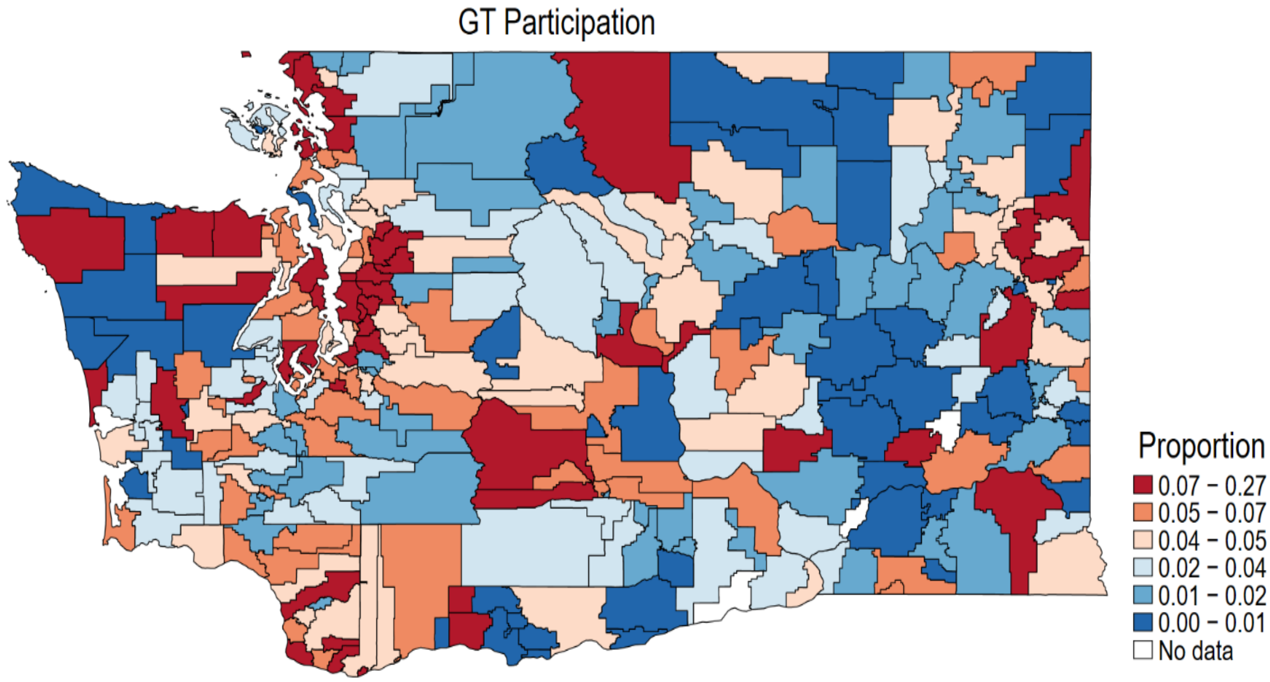
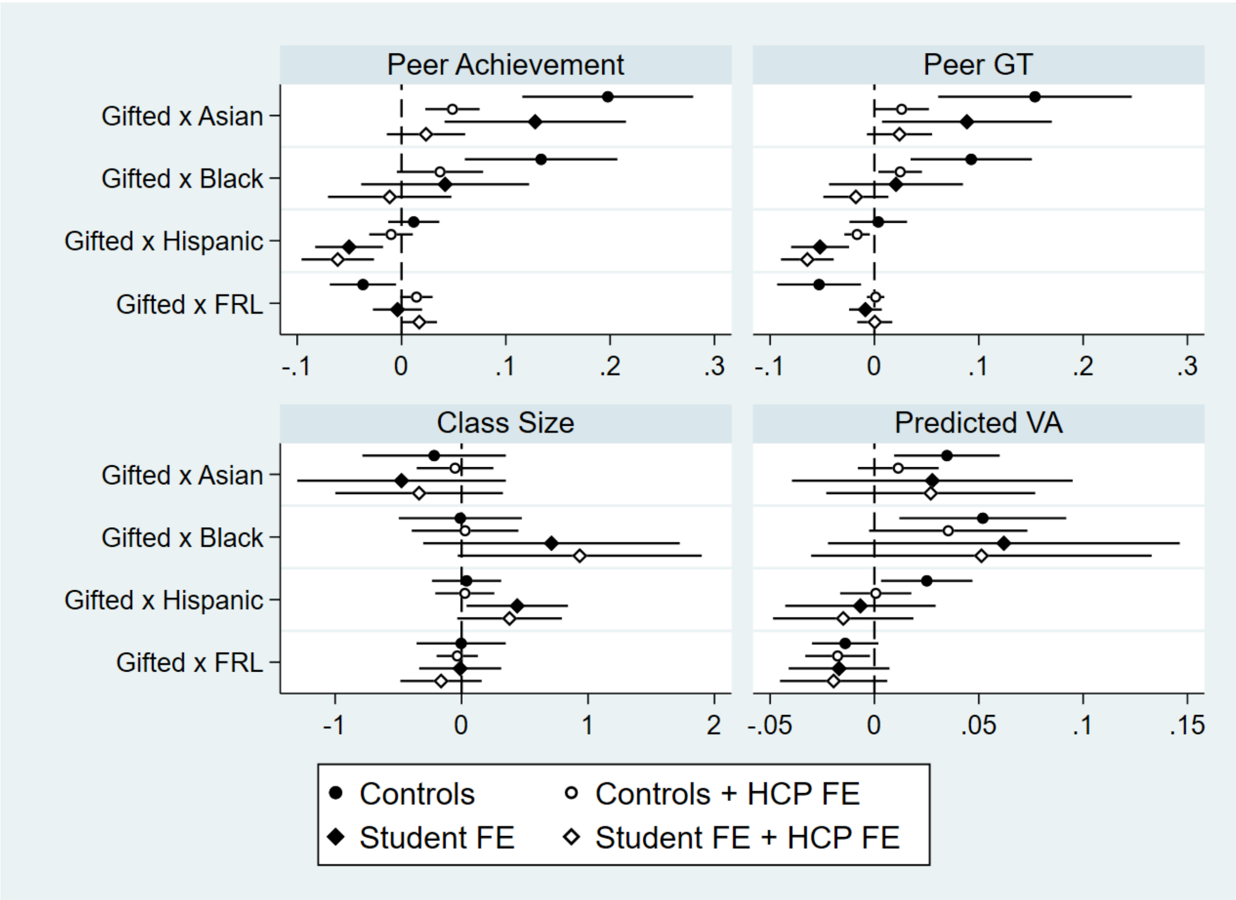
Figure 1. Gifted Participation Rates by District



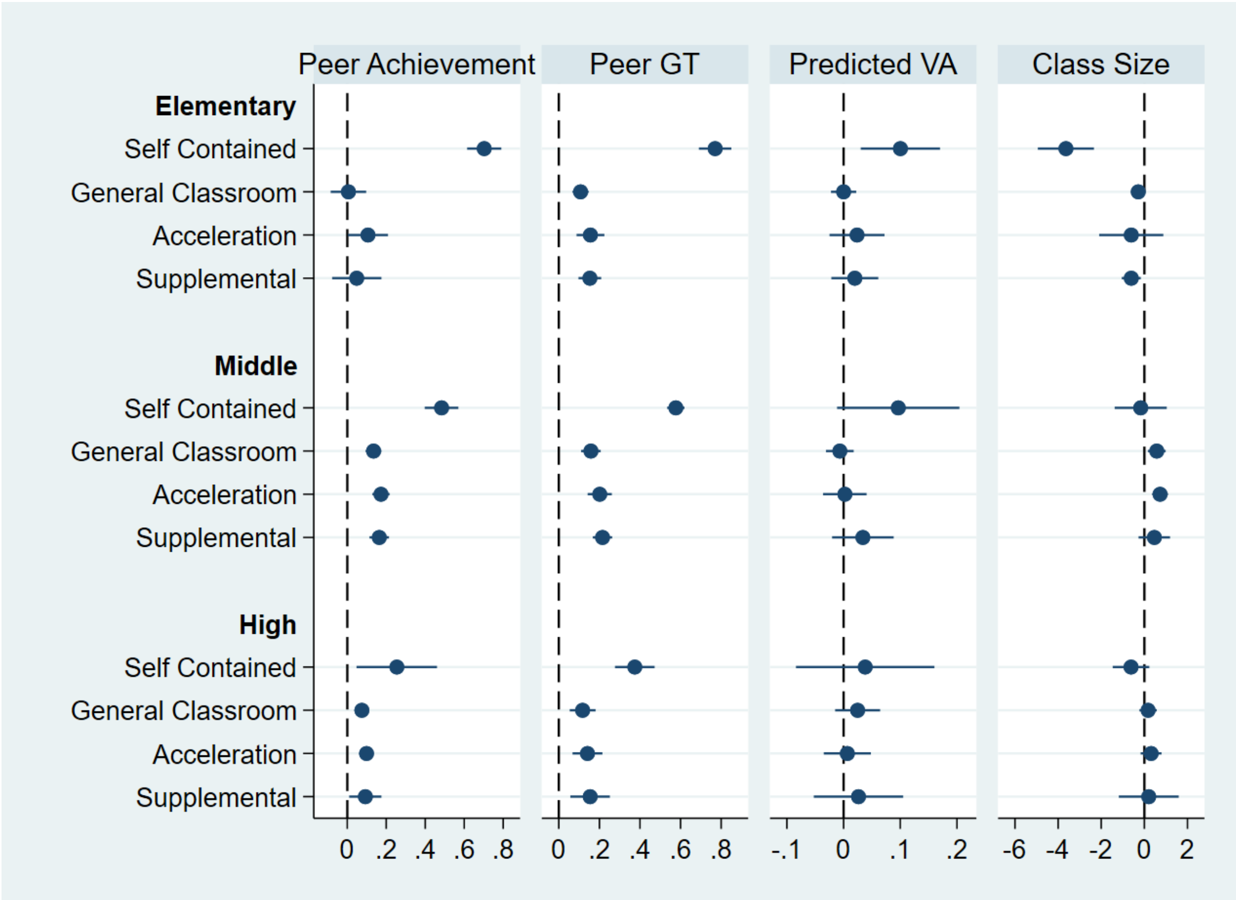
Notes: Gifted participation rate by school district (2016 – 2019). Sample includes all students in grades K – 12.

Figure 2. Effects of Gifted Participation on Educational Resources by Student Race/Ethnicity and FRL Status



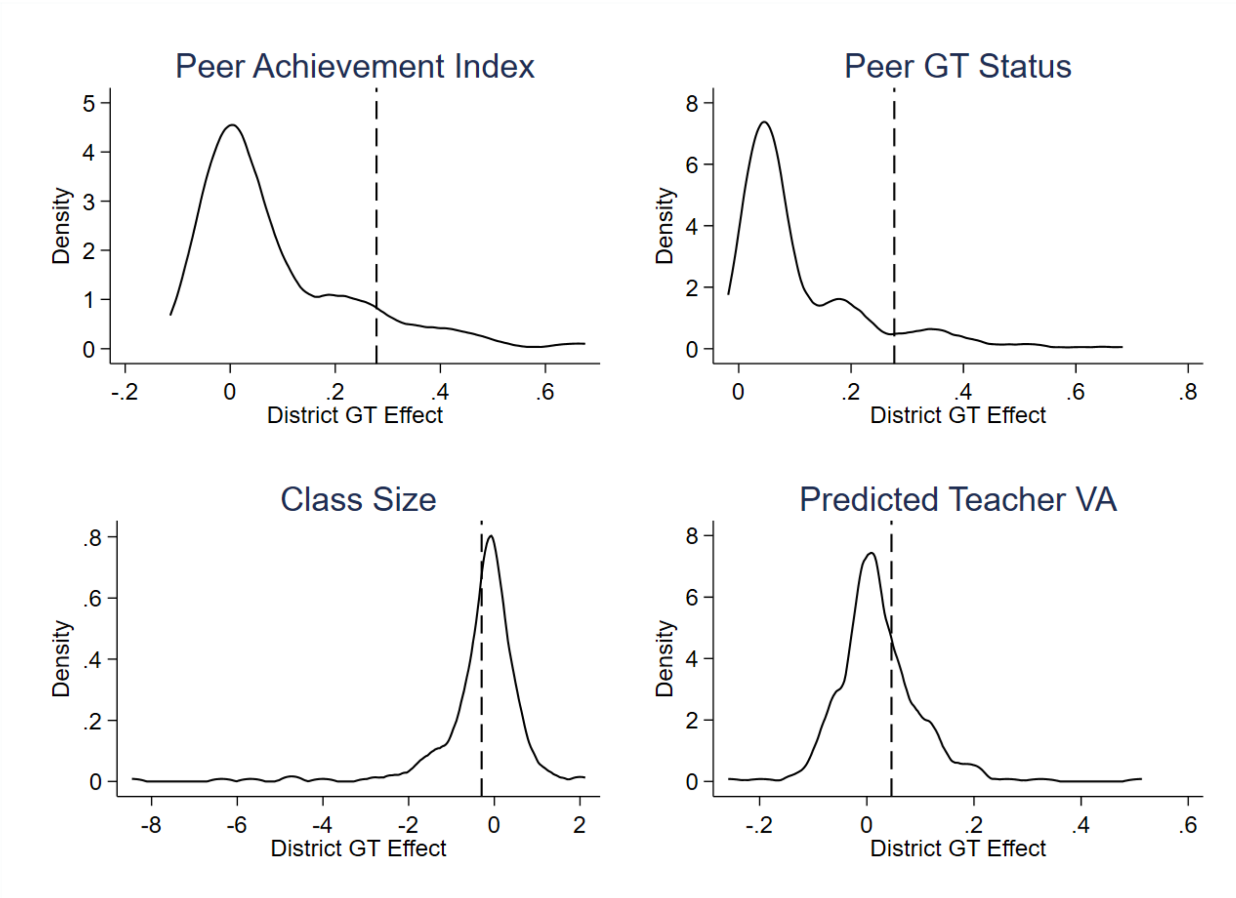
Notes: Estimated coefficients from models of student outcomes on interactions between Gifted and indicators for student race/ethnicity or FRL eligibility. In the case of student race/ethnicity, White students are the omitted group. Estimates are derived from the models indicated in the legend and estimated on the trimmed sample of 4th-12th grade students in 2016-2019. The spikes indicate 95% confidence intervals based on standard errors clustered by district.

Figure 3. Effects of Gifted Participation on Educational Resources by Program Type



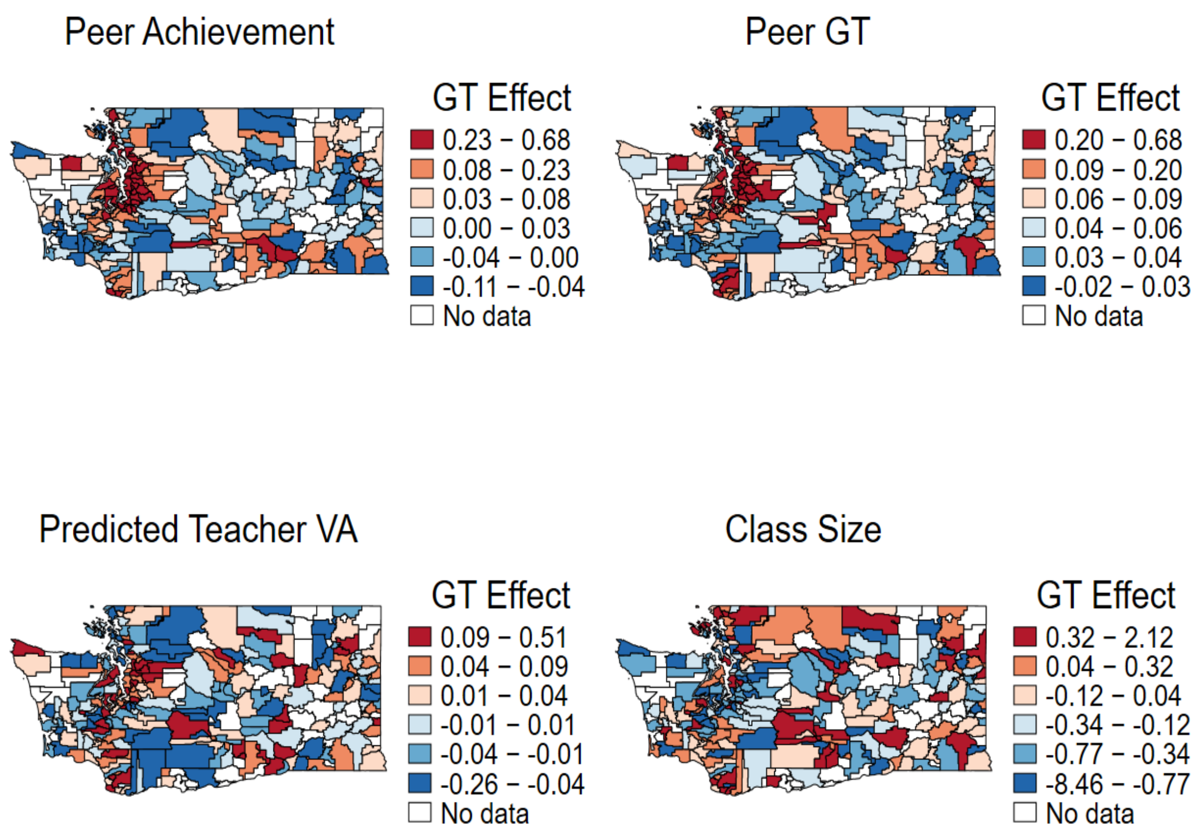
Notes: Estimated coefficients from models of student outcomes on indicators for type of gifted program. Estimates are derived from the student fixed effects model described in text estimated on the trimmed sample of 4th-12th grade students in 2016-2019. Self-contained programs are those with evidence of intentional grouping of gifted students. General classroom programs are those offered through the general classroom without gifted sorting. Acceleration programs are those reported by districts to include an acceleration component and where there is not evidence of gifted sorting across classrooms. Supplemental programs are those offered in pull-out programs or outside the traditional school day. The spikes indicate 95% confidence intervals based on standard errors clustered by district.

Figure 4. Distribution of District Gifted Effects On Selected Educational Resources



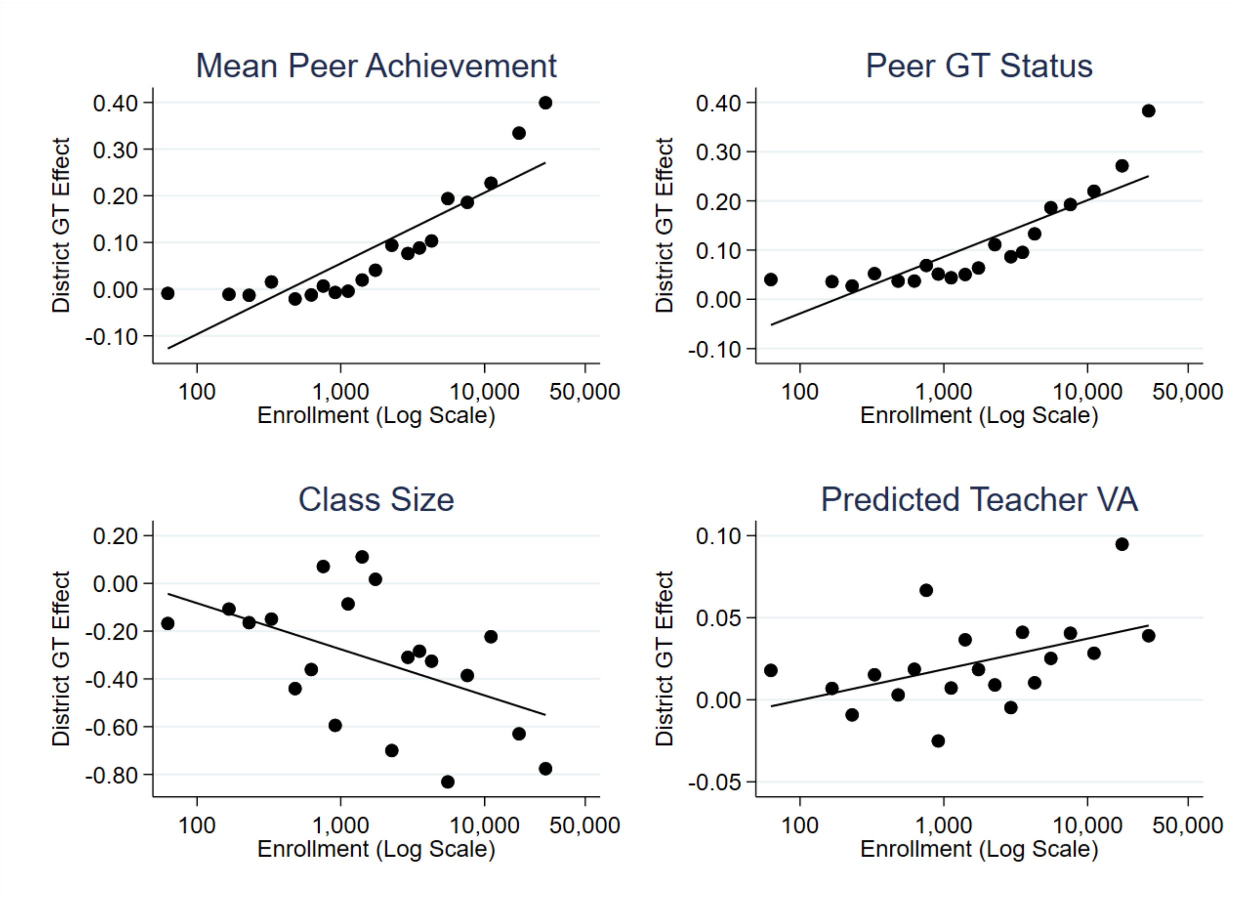
Notes: Kernel density plots of estimated district-by-program effects on student outcomes. District-specific estimates are derived from covariate adjustment model using trimmed sample of 4^{th}-12^{th} grade students in 2016-2019 described in the text and in Appendix B. Student controls include lagged achievement (interacted with grade), student race/ethnicity, gender, FRL status, whether English is the student's home language, and learning disability status. Trimmed sample indicates the sample trimmed using a propensity score based on student prior achievement and district HCP participation rates, as described in the text. Dashed line indicates estimate of gifted effect from the OLS specification included in Table 4, column 3.

Figure 5. Gifted Effects on Selected Educational Resources by District Location



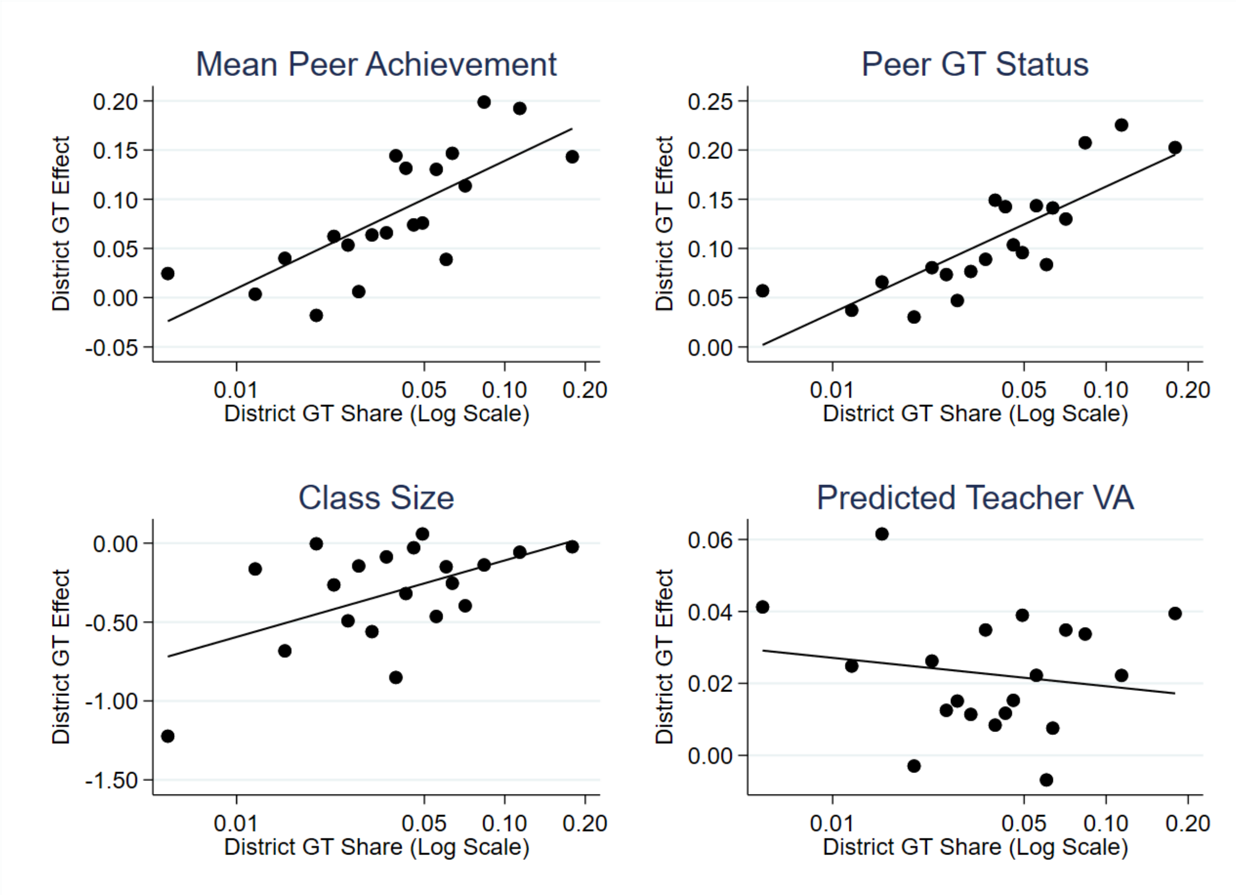
Notes: Estimated gifted effects on student outcomes by school district. District-specific estimates are derived from covariate adjustment model using trimmed sample of 4th-12th grade students in 2016-2019 described in the text and in Appendix B. Student controls include lagged achievement (interacted with grade), student race/ethnicity, gender, FRL status, whether English is the student's home language, and learning disability status. Trimmed sample indicates the sample trimmed using a propensity score based on student prior achievement and district gifted participation rates, as described in the text.

Figure 6. Gifted Effects on Selected Educational Resources by District Enrollment



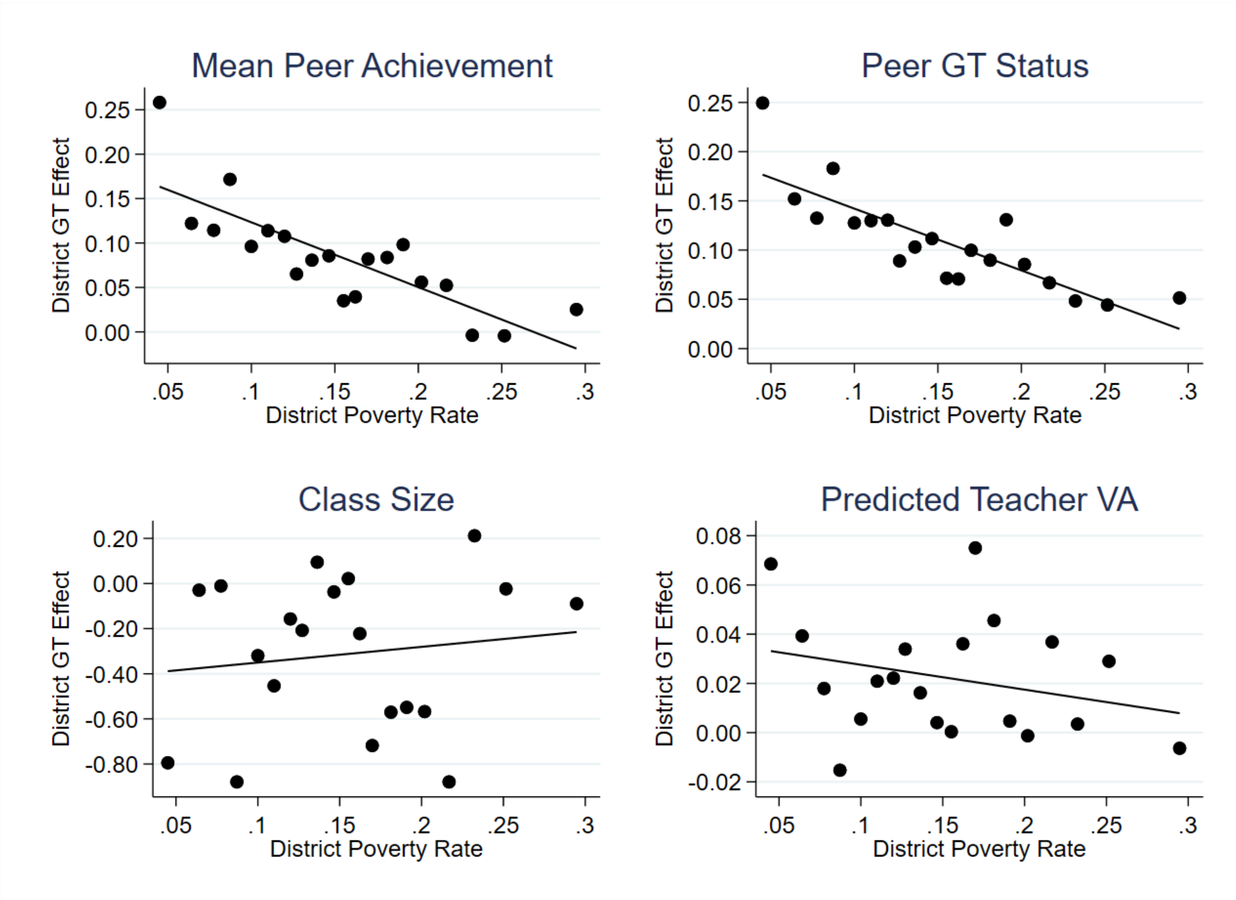
Notes: Estimated gifted effects on student outcomes by school district enrollment. District-specific estimates are derived from covariate adjustment model using trimmed sample of 4th-12th grade students in 2016-2019 described in the text and in Appendix B. Student controls include lagged achievement (interacted with grade), student race/ethnicity, gender, FRL status, whether English is the student's home language, and learning disability status. Trimmed sample indicates the sample trimmed using a propensity score based on student prior achievement and district gifted participation rates, as described in the text.

Figure 7. Gifted Effects on Selected Educational Resources by District Enrollment Share in Gifted Programs



Notes: Estimated gifted effects on student outcomes by school district HCP enrollment share. District-specific estimates are derived from covariate adjustment model using trimmed sample of 4th-12th grade students in 2016-2019 described in the text and in Appendix B. Student controls include lagged achievement (interacted with grade), student race/ethnicity, gender, FRL status, whether English is the student's home language, and learning disability status. Trimmed sample indicates the sample trimmed using a propensity score based on student prior achievement and district gifted participation rates, as described in the text.

Figure 8. Gifted Effects on Selected Educational Resources by District Poverty Rate



Notes: Estimated gifted effects on student outcomes by school district poverty rate (among children aged 5 – 17). District-specific estimates are derived from covariate adjustment model using trimmed sample of 4th-12th grade students in 2016-2019 described in the text and in Appendix B. Student controls include lagged achievement (interacted with grade), student race/ethnicity, gender, FRL status, whether English is the student's home language, and learning disability status. Trimmed sample indicates the sample trimmed using a propensity score based on student prior achievement and district gifted participation rates, as described in the text.

Table 1. Summary Statistics

	Grades 4-5			Grades 6-8			Grades 9-12		
	All	Trim	GT	All	Trim	GT	All	Trim	GT
Male student	0.51	0.49	0.54	0.51	0.47	0.52	0.52	0.46	0.50
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
Asian	0.08	0.12	0.18	0.08	0.13	0.15	0.08	0.14	0.13
	(0.27)	(0.33)	(0.38)	(0.27)	(0.34)	(0.36)	(0.27)	(0.35)	(0.34)
Black	0.04	0.02	0.02	0.04	0.02	0.02	0.05	0.02	0.02
	(0.21)	(0.14)	(0.13)	(0.21)	(0.14)	(0.13)	(0.21)	(0.13)	(0.13)
Hispanic	0.15	0.08	0.06	0.14	0.08	0.06	0.13	0.08	0.07
	(0.36)	(0.27)	(0.23)	(0.35)	(0.27)	(0.24)	(0.34)	(0.27)	(0.25)
White	0.62	0.68	0.65	0.63	0.68	0.68	0.65	0.68	0.70
	(0.49)	(0.47)	(0.48)	(0.48)	(0.47)	(0.47)	(0.48)	(0.47)	(0.46)
Student FRL status	0.50	0.28	0.19	0.48	0.28	0.19	0.43	0.26	0.21
	(0.50)	(0.45)	(0.39)	(0.50)	(0.45)	(0.39)	(0.50)	(0.44)	(0.41)
English is spoken at home	0.79	0.86	0.88	0.80	0.86	0.89	0.82	0.86	0.89
	(0.41)	(0.35)	(0.33)	(0.40)	(0.35)	(0.31)	(0.39)	(0.35)	(0.32)
Student disability flag	0.14	0.04	0.04	0.13	0.02	0.02	0.12	0.01	0.01
	(0.35)	(0.20)	(0.20)	(0.34)	(0.14)	(0.14)	(0.33)	(0.12)	(0.10)
Lagged math score	0.02	1.18	1.33	0.01	1.07	1.21	0.03	1.14	1.11
	(1.00)	(0.49)	(0.70)	(1.00)	(0.51)	(0.66)	(0.99)	(0.69)	(0.81)
Lagged ELA score	0.01	1.12	1.22	0.01	1.01	1.12	0.03	1.00	0.98
	(1.00)	(0.51)	(0.64)	(1.00)	(0.54)	(0.63)	(0.99)	(0.69)	(0.75)
Lagged cumulative GPA							2.77	3.38	3.45
							(0.97)	(0.84)	(0.72)
Student-year obs	660,569	79,974	46,985	954,973	126,441	79,755	1,182,829	132,007	84,269

Notes: Student demographics for elementary, middle, and high school students. The sample includes students in grades 4-12 between 2016 and 2019. Columns referred to as "Trimmed" contain a trimmed sample of high-achieving students using propensity for giftedness described in the text.

Table 2. Estimates of Gifted Participation by Race/Ethnicity and FRL Eligibility

	(1)	(2)	(3)	(4)	(5)	(6)
Asian	0.05***	0.02	0.02	0.03**	0.01***	-0.00
	(0.01)	(0.01)	(0.02)	(0.01)	(0.00)	(0.00)
Black	-0.03***	0.01	0.01**	0.01***	0.00***	-0.02**
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)
Hispanic	-0.03***	0.00	0.01	-0.00	-0.00	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FRL Eligible	-0.07***	-0.01**	-0.01	-0.02***	-0.00***	-0.02***
	(0.01)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Screening Modification			-0.02**	-0.01	0.00	0.00
			(0.01)	(0.01)	(0.00)	(0.01)
Universal Screening			0.01			
			(0.01)			
State Test			-0.00			
			(0.01)			
N	2,798,371	2,413,383	1,449,700	2,413,258	1,622,190	136,071
Student Controls		X	X	X	X	X
District FE				X	X	X
Non-Gifted prior year					X	
Gifted prior year						X

Notes: Regressions of indicator for gifted participation in current school year on student characteristics and grade by year (columns (1) – (3)) or district by grade by year (columns (4) – (6)) fixed effects. Sample includes students in grades 4 – 12. Results in columns (2) – (6) include controls for prior achievement in math and ELA, student gender, indicators for whether the home language is English, and learning disability status. "Screening modification" indicates that the district has a modification to the screening process that applies to the student (either FRL or URM (Black, Hispanic, and American Indian/Alaskan Native)). "Universal screening" indicates the district has a universal screening policy. "State test" indicates that the district uses the state standardized test in the screening process. Results in column (5) are estimated using the sample of students not participating in gifted programs during the prior school year and in column (6) are estimated using the sample of students participating in gifted programs during the prior school year. Standard errors clustered by district in parentheses. Both columns (5) and (6) exclude data from 2016, the first year in the sample.

* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Table 3. Student Educational Resources by Gifted Status

	Grades 4-5			Grades 6-8			Grades 9-12		
	All	Trim	GT	All	Trim	GT	All	Trim	GT
Peer GT status	0.04	0.05	0.52	0.05	0.10	0.41	0.05	0.11	0.32
	(0.06)	(0.09)	(0.41)	(0.06)	(0.10)	(0.26)	(0.07)	(0.10)	(0.22)
Peer achievement index	-0.05	0.20	0.71	-0.07	0.30	0.59	-0.06	0.37	0.45
	(0.45)	(0.41)	(0.70)	(0.48)	(0.38)	(0.49)	(0.52)	(0.42)	(0.43)
Std. dev. peer achievement index	0.81	0.82	0.68	0.74	0.74	0.69	0.72	0.73	0.71
	(0.14)	(0.15)	(0.21)	(0.10)	(0.11)	(0.13)	(0.10)	(0.09)	(0.10)
Takes honors class				0.05	0.11	0.14	0.21	0.42	0.52
				(0.22)	(0.32)	(0.34)	(0.41)	(0.49)	(0.50)
Takes dual credit class							0.30	0.51	0.62
							(0.46)	(0.50)	(0.48)
Takes advanced math				0.11	0.27	0.39			
				(0.31)	(0.44)	(0.49)			
Takes art class	0.32	0.34	0.36	0.60	0.67	0.70	0.48	0.52	0.54
	(0.47)	(0.48)	(0.48)	(0.49)	(0.47)	(0.46)	(0.50)	(0.50)	(0.50)
Takes foreign language	0.00	0.01	0.01	0.11	0.18	0.21	0.45	0.61	0.64
	(0.06)	(0.08)	(0.08)	(0.31)	(0.38)	(0.41)	(0.50)	(0.49)	(0.48)
Predicted teacher VA	0.00	0.02	0.09	0.06	0.07	0.12	0.14	0.16	0.18
	(0.69)	(0.68)	(0.68)	(0.51)	(0.50)	(0.50)	(0.51)	(0.51)	(0.51)
Teacher experience	13.66	14.03	14.74	14.03	14.39	14.44	14.33	14.66	14.74
	(6.94)	(6.84)	(6.99)	(5.32)	(5.24)	(5.18)	(5.54)	(5.48)	(5.44)
Teacher advanced degree	0.64	0.66	0.68	0.70	0.71	0.72	0.71	0.74	0.76
	(0.33)	(0.33)	(0.32)	(0.24)	(0.23)	(0.22)	(0.24)	(0.23)	(0.22)
Teacher licensure test scores	0.13	0.15	0.18	0.15	0.17	0.19	0.18	0.21	0.21
	(0.34)	(0.33)	(0.32)	(0.24)	(0.23)	(0.23)	(0.24)	(0.23)	(0.22)
Class size	26.48	27.15	25.35	27.09	28.40	28.45	25.99	27.41	27.34
	(6.51)	(7.11)	(8.36)	(6.30)	(5.13)	(4.63)	(7.07)	(6.43)	(6.29)
Peer grade	4.49	4.52	4.53	6.99	6.99	7.02	10.41	10.39	10.44
	(0.51)	(0.50)	(0.50)	(0.78)	(0.78)	(0.78)	(0.81)	(0.83)	(0.81)
Student-year obs	613584	79974	46985	875218	126441	79755	1098560	132007	84269

Notes: Student educational resources for elementary, middle, and high school students. The sample includes students in grades 4-12 between 2016 and 2019. Columns referred to as "Trimmed" contain a trimmed sample of high-achieving students using propensity for giftedness described in the text.

Table 4. Gifted Program Design Characteristics

	Self-Contained	General Classroom	Supplemental	Acceleration
Panel 1. Instructional Strategies				
Content acceleration	0.92	0.77	0.70	0.95
	(0.27)	(0.42)	(0.46)	(0.23)
Curricular compacting	0.85	0.68	0.63	0.66
	(0.35)	(0.47)	(0.48)	(0.47)
Pacing	0.95	0.67	0.60	0.67
	(0.21)	(0.47)	(0.49)	(0.47)
Supplemental instruction	0.52	0.61	0.66	0.44
	(0.50)	(0.49)	(0.47)	(0.50)
Independent study	0.80	0.79	0.78	0.72
	(0.40)	(0.41)	(0.42)	(0.45)
Cluster grouping	0.57	0.76	0.50	0.48
	(0.50)	(0.43)	(0.50)	(0.50)
Flexible clustering	0.75	0.93	0.72	0.67
	(0.43)	(0.25)	(0.45)	(0.47)
Global identification	0.61	0.36	0.56	0.44
	(0.49)	(0.48)	(0.50)	(0.50)
Gifted math curriculum	0.24	0.15	0.19	0.24
	(0.43)	(0.36)	(0.39)	(0.43)
Gifted ELA curriculum	0.36	0.19	0.18	0.31
	(0.48)	(0.39)	(0.38)	(0.46)
Panel 2. Screening Policies				
Universal screening policy	0.95	0.87	0.89	0.86
	(0.22)	(0.33)	(0.32)	(0.35)
State test used for screening	0.33	0.26	0.40	0.40
	(0.47)	(0.44)	(0.49)	(0.49)
Modification for low income students	0.50	0.37	0.31	0.42
	(0.50)	(0.48)	(0.46)	(0.49)
Modification for URM	0.43	0.42	0.42	0.54
	(0.50)	(0.49)	(0.49)	(0.50)
Student-year obs	65,835	79,509	29,212	78,894
Districts	64	235	164	160

Notes: The sample includes gifted students between 2016 and 2019 whose district submitted an annual gifted program report and responded to the original survey of gifted program coordinators. Instructional strategies and ability grouping based on district self-report in annual gifted program report. District policies based on survey of gifted program coordinators about policies used in their gifted programs.

Table 5. Gifted Program Resource Effects (Grades 4 – 12)

	(1)	(2)	(3)	(4)	(5)
Peer GT	0.31***	0.29***	0.28***	0.28***	0.25***
	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)
Mean Peer Achievement	0.61***	0.35***	0.28***	0.25***	0.21***
	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)
SD Peer Achievement	-0.06***	-0.06***	-0.07***	-0.06***	-0.05***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Peer Grade	0.05***	0.03***	0.02***	0.01	-0.01**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Takes Art Class	0.06***	0.03***	0.02***	0.01*	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Takes Foreign Language	0.10***	0.03***	0.03***	0.03***	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Mean Class Size	0.71***	-0.24	-0.30	-0.45**	-0.40*
	(0.25)	(0.22)	(0.22)	(0.19)	(0.22)
Teacher Experience	0.83***	0.38**	0.22	0.36***	0.38**
	(0.16)	(0.17)	(0.16)	(0.11)	(0.16)
Teacher Adv. Deg.	0.03***	0.02***	0.01***	0.02***	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Teacher Licensure Test	0.03***	0.02***	0.02***	0.01***	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Predicted Teacher VA	0.07***	0.05***	0.05***	0.05***	0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
N	2,798,298	496,206	496,206	262,930	409,468
Student Controls			X	X	
Trimmed Sample		X	X	X	X
Student FE					X

Notes: Estimated effects of gifted participation on educational resources for students in grades 4-12. Column 1 includes district by grade by year fixed effects only. Student controls include lagged achievement (interacted with grade), student race/ethnicity, gender, FRL status, whether English is the student's home language, and learning disability status. Trimmed sample indicates the sample trimmed using a propensity score based on student prior achievement and district gifted participation rates, as described in the text. Standard errors clustered by school district in parentheses.

* p < 0.10 ** p < 0.05 *** p < 0.01

Table 6. Elementary Gifted Program Resource Effects (Grades 4-5)

	(1)	(2)	(3)	(4)	(5)
Peer GT	0.47***	0.48***	0.46***	0.33***	0.29***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Mean Peer Achievement	0.70***	0.56***	0.49***	0.34***	0.32***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.06)
SD Peer Achievement	-0.13***	-0.14***	-0.15***	-0.10***	-0.08***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Peer Grade	0.01*	0.00	0.00	0.01	0.00
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Takes Art Class	0.01*	0.01	0.01	0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Takes Foreign Language	-0.00	-0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mean Class Size	-1.55***	-1.72***	-1.76***	-1.44***	-1.22**
	(0.45)	(0.43)	(0.41)	(0.31)	(0.49)
ELA Teacher VA	0.04***	0.04***	0.03***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Math Teacher VA	0.05***	0.05***	0.04***	0.03***	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Teacher Experience	1.12***	0.79***	0.60**	0.67***	0.54
	(0.31)	(0.28)	(0.26)	(0.18)	(0.33)
Teacher Adv. Deg.	0.04***	0.03***	0.03***	0.02***	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Teacher Licensure Test	0.03***	0.03***	0.03***	0.02**	-0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Predicted Teacher VA	0.09***	0.08***	0.07***	0.05***	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)
N	660,559	117,051	117,051	65,992	59,229
Student Controls			X	X	
Trimmed Sample		X	X	X	X
Student FE					X

Notes: Estimated effects of gifted participation on educational resources for students in grades 4-5. Column 1 includes district by grade by year fixed effects only. Student controls include lagged achievement (interacted with grade), student race/ethnicity, gender, FRL status, whether English is the student's home language, and learning disability status. Trimmed sample indicates the sample trimmed using a propensity score based on student prior achievement and district gifted participation rates, as described in the text. Standard errors clustered by school district in parentheses.

* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

Table 7. Middle School Gifted Program Resource Effects (Grades 6-8)

	(1)	(2)	(3)	(4)	(5)
Peer GT	0.33***	0.31***	0.29***	0.27***	0.25***
	(0.03)	(0.04)	(0.04)	(0.04)	(0.06)
Mean Peer Achievement	0.63***	0.35***	0.28***	0.22***	0.17***
	(0.03)	(0.03)	(0.03)	(0.02)	(0.03)
SD Peer Achievement	-0.06***	-0.06***	-0.06***	-0.05***	-0.04***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Peer Grade	0.02***	0.01***	0.01*	0.01	0.00
	(0.00)	(0.00)	(0.00)	(0.01)	(0.02)
Takes Honors Class	0.06***	0.02	0.02	0.02	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Takes Advanced Math	0.29***	0.15***	0.11***	0.08***	0.05***
	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
Takes Art Class	0.09***	0.03***	0.03***	0.03***	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Takes Foreign Language	0.07***	0.03**	0.03**	0.03*	0.01
	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
Mean Class Size	1.34***	0.24	0.16	0.12	-0.12
	(0.34)	(0.29)	(0.29)	(0.21)	(0.25)
ELA Teacher VA	0.01***	0.01***	0.01***	0.01***	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Math Teacher VA	0.02***	0.01***	0.01***	-0.00	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Teacher Experience	0.59***	0.15	-0.02	0.27	0.40
	(0.18)	(0.21)	(0.21)	(0.18)	(0.28)
Teacher Adv. Deg.	0.02***	0.01**	0.01**	0.02***	0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Teacher Licensure Test	0.03***	0.02***	0.02***	0.02***	0.02**
	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)
Predicted Teacher VA	0.07***	0.05***	0.04***	0.05***	0.06**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
N	954,941	189,859	189,859	98,741	122,614
Student Controls			X	X	
Trimmed Sample		X	X	X	X
Student FE					X

Notes: Estimated effects of gifted participation on educational resources for students in grades 6-8. Column 1 includes district by grade by year fixed effects only. Student controls include lagged achievement (interacted with grade), student race/ethnicity, gender, FRL status, whether English is the student's home language, and learning disability status. Trimmed sample indicates the sample trimmed using a propensity score based on student prior achievement and district gifted participation rates, as described in the text. Standard errors clustered by school district in parentheses.

* p < 0.10 ** p < 0.05 *** p < 0.01

Table 8. High School Gifted Program Resource Effects (Grades 9-12)

	(1)	(2)	(3)	(4)	(5)
Peer GT	0.20***	0.16***	0.14***	0.20***	0.14***
	(0.02)	(0.02)	(0.02)	(0.04)	(0.02)
Mean Peer Achievement	0.53***	0.21***	0.14***	0.14***	0.08***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
SD Peer Achievement	-0.01***	-0.01***	-0.02***	-0.02***	-0.01***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Peer Grade	0.10***	0.05***	0.04***	-0.00	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Course Index	1.04***	0.58***	0.46***	0.53***	0.45***
	(0.05)	(0.04)	(0.05)	(0.13)	(0.11)
Takes Honors Class	0.30***	0.13***	0.11***	0.39**	0.29***
	(0.03)	(0.03)	(0.03)	(0.15)	(0.10)
Takes Dual Credit Class	0.35***	0.17***	0.14***	0.26***	0.20***
	(0.01)	(0.02)	(0.02)	(0.06)	(0.06)
Takes Art Class	0.05***	0.03***	0.02**	-0.01	-0.03*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Takes Foreign Language	0.18***	0.06***	0.04***	0.07***	0.07***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Mean Class Size	1.44***	0.21	0.14	0.12	-0.41
	(0.18)	(0.15)	(0.15)	(0.39)	(0.40)
Teacher Experience	0.91***	0.38***	0.23**	-0.02	0.21
	(0.11)	(0.11)	(0.10)	(0.16)	(0.18)
Teacher Adv. Deg.	0.04***	0.02***	0.01***	-0.00	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Teacher Licensure Test	0.03***	0.01***	0.01*	0.00	-0.01
	(0.00)	(0.00)	(0.00)	(0.01)	(0.01)
Predicted Teacher VA	0.07***	0.04***	0.03***	0.04	0.02
	(0.01)	(0.01)	(0.01)	(0.03)	(0.02)
N	1,182,798	189,296	189,296	98,197	150,424
Student Controls			X	X	
Trimmed Sample		X	X	X	X
Student FE					X

Notes: Estimated effects of gifted participation on educational resources for students in grades 9-12. Column 1 includes district by grade by year fixed effects only. Student controls include lagged achievement (interacted with grade), student race/ethnicity, gender, FRL status, whether English is the student's home language, and learning disability status. Trimmed sample indicates the sample trimmed using a propensity score based on student prior achievement and district gifted participation rates, as described in the text. Standard errors clustered by school district in parentheses.

* p < 0.10 ** p < 0.05 *** p < 0.01

Appendix A. Data Appendix

A.1. Defining Gifted Program Types

We use information reported in the administrative data systems and annual gifted program district reports to classify students into various gifted program types. The first source of information on gifted enrollment is a program participation code reported in the student-level administrative data. The state provides four codes to report gifted enrollment: general education classroom, unique gifted program, acceleration program, and non-traditional programs. OSPI provides guidance on how to report student participation in gifted programs, which we include in Table A.1. Note that the state refers to gifted students as "highly capable".

Table A.1. State Gifted Program Reporting Codes

Code	Description
32	Services or programs provided in the regular classroom *Student receives services in the regular classroom through options such as cluster grouping, enrichment, differentiated instruction, etc.*
33	Services or programs provided in a unique highly capable program *Student receives services in a learning environment unique to the highly capable program such as self-contained classroom, multi-age classroom, pull-out services, or part-time grouping outside the regular classroom, etc.*
34	Services or programs provided through acceleration *Student receives services through access to accelerated curriculum or instruction such as advanced subject placement, grade level advancement, early entrance or access to college level coursework, etc.*
35	Services or programs provided outside the traditional school setting *Student receives services provided outside the regular classroom such as mentorships, collaborative partnerships with industry, cooperative arrangements with ESD/higher education/other districts, competitions, summer enrichment, etc.*

Source: Office of the Superintendent of Public Instruction (2018).

The annual report requests that districts report the types of programs they offer under each gifted program enrollment code. Districts report several program subtypes under each program type code as well as the kinds of curricular modifications used by each program.[22] We list the program subtypes in Table A.2.

[22] The curricular modification options are as follows: differential instruction, flexible grouping, independent study, pacing, supplemental instruction in area of interest, cluster grouping, curriculum compacting, enrichment, independent projects, content acceleration, and supplemental materials in area of interest.

Table A.2. Gifted Program Types in Annual District Report

Code	Program Subtypes
General Education Classroom (32)	General Education Classroom
Unique HCP (33)	Self-Contained Classroom Supplemental Pull-Out Program Specialty Online Courses
Acceleration Program (34)	Advanced Placement Cambridge AICE Dual Enrollment Credit by Examination Early Entrance Middle School, High School, or College Grade Level Advancement Honors/Advanced International Baccalaureate Online Course for Subject Acceleration Running Start* Subject-Based Acceleration
Non-Traditional Program (35)	Mentorship Collaborative partnership with industry Cooperative agreement with Educational Service District Cooperative agreement with other districts Supplemental academic competitions Supplemental summer enrichment or acceleration Supplemental before or after school programs

Source: Office of the Superintendent of Public Instruction (2013-2018).
*Running Start is the state's dual enrollment program for high school juniors and seniors operated through the state community college system.

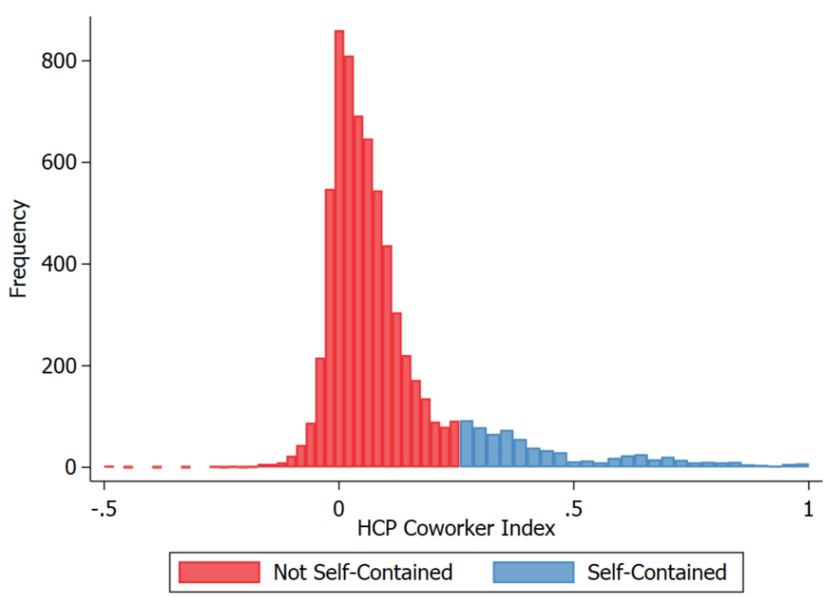
We define four types of gifted delivery models in this study. These include programs delivered in the regular classroom; in self-contained (tracked) programs; in general classroom settings; and in accelerated programs. Under our definition, self-contained programs deliver content instruction in core academic subjects in classrooms with disproportionate numbers of students in gifted programs. We define general classroom programs as where students are assigned classes with non-gifted students and the district does not report the student as participating in a specific supplementary program. These include some ability grouping models, such as where gifted students are only moderately sorted to the same classrooms, and flexible models where gifted students are assigned to heterogeneous classrooms. We also identify supplemental gifted programs that offer services in supplemental classes or outside the general education classroom. Finally, we identify accelerated programs where districts report using instructional acceleration models but where highly capable students are not disproportionately assigned to particular classrooms. The methods for categorizing students are displayed in Table A.3 and are summarized below.

Self-Contained Programs

We first identify programs that deliver instruction in special classes for gifted students. To identify full-time programs, we first use student course schedules to measure the proportion of gifted students in each class. We then construct the coworker index for each gifted code by district, grade, and year (Hellerstein & Neumark, 2008). The coworker index is a measure of the strength of sorting of gifted students into classrooms and accounts for the fact that some districts have larger gifted programs (which would imply larger shares of gifted students in each classroom). Formally, for each student and class enrollment, we construct the percentage of *other* students in the classroom participating in gifted programs. We then average these percentages for each program, district, grade, and year. We then deduct the average percentages for students not participating in gifted programs. Larger coworker indices indicate more sorting into classrooms; if gifted students are perfectly sorted into self-contained classrooms, the coworker index would be 1. We then assign programs (at the district, grade, and year level) to either self-contained or non-self-contained using a k-means clustering algorithm.

In Figure A.1, we plot the distribution of the coworker index by gifted type. The mode of the distribution is near zero, which indicates the gifted students are randomly distributed among classrooms. But the distribution has a long right tail, with some programs having nearly perfect sorting of gifted students into self-contained classrooms.

Figure A.1. Gifted Coworker Index by Program Type



Notes: Coworker index for each Gifted code at the district-grade-year level.

Acceleration

We assign students to acceleration programs if they are reported with a gifted code of 35 (acceleration) and their school district does not appear to sort gifted students intentionally into particular classrooms.

Regular Classroom

We classify programs as occurring in the regular classroom if students receive core instruction in classrooms that do not satisfy the criterion for self-contained programs. This includes districts that report gifted programs in the general education classroom without cluster grouping and accelerated or cluster grouping programs that do not appear to be full-time gifted programs based on student enrollment patterns.

Supplemental Programs

We combine two types of gifted codes into a supplemental category. In the administrative data, districts report (1) students in a full-time, self-contained gifted classroom and (2) students in a part-time, supplemental program as participating in a unique gifted program. We assign students in a unique gifted program to the self-contained category if their district enrollment patterns show evidence of sorting gifted students (as described above). We assign all other students to supplemental programs. The state administrative data also includes a separate code for gifted programs offered outside the classroom setting. These include mentorship programs and extracurricular activities. We classify students in these programs as participating in supplemental programs.

A.2. High School Course Index

We consolidate the outcomes used for high school students by estimating a factor model using the dual credit, Advanced Placement (English, math, science, and social studies), honors course, foreign language, and art flags. The factor analysis yields a single factor with an eigenvalue greater than 1 and we use the Bartlett scores (standardized by grade and year) as our general measure of course rigor. The weights for the variables are shown in Table A.3.

Table A.3. Course Weights

	Weight
Takes Art Class	0.02
Takes Foreign Language	0.07
Takes Dual Credit Class	0.47
Takes AP English	0.25
Takes AP Math	0.27
Takes AP Science	0.28
Takes AP Social Studies	0.27
Takes Honors Class	0.07

A.3. Imputing Missing Course Data

The course schedule data is linked by district course codes to a database on all courses offered in a school district. The course database includes several characteristics of courses that we use to construct the class identifiers in our data. These include a state course code, which links the individual course to a common set of state courses aligned with the School Courses for the Exchange of Data (SCED) codes, a district-assigned course classification code that identifies honors and dual credit courses, and a code linking Advanced Placement (AP) courses to the specific AP exam.

The course schedule data includes some missing information on course characteristics. Some districts fail to reliably report the course classification data for dual enrollment courses and there are an unusual number of classes missing state course codes in 2017. However, the course database does include a descriptive, locally defined course title. We use these course titles and the complete cases data to fill in missing course characteristics. We first convert the state course titles to a numeric dictionary (i.e., an indicator for each 2-word combination in the full set of course titles) (Selianov et al., 2020). We then construct several outcomes using courses with complete information: whether the course is a Running Start course (the state dual enrollment program offered at public community colleges); whether the course is an Advanced Placement course; whether the course is an honors course; and a subject code that takes on six values (English/Language arts, Math, Science, Social studies, Arts, Foreign languages).

Finally, for each outcome, we estimate a classification model by logit (or multinomial logit) using the LASSO penalty to regularize the regression (Friedman et al., 2010). We fit the model on an 80% sample of the complete cases data and use 10-fold cross-validation to estimate the tuning parameter. We assess the accuracy of the classification using the hold-out sample, and then assign course codes to those courses missing course information. The estimated classification accuracy for these classifications (using the hold-out sample) is shown in Table A.4, along with the percentage of courses that are reclassified by imputation. The misclassification rate is quite low for both the Running Start and Advanced Placement outcomes. We estimate a misclassification rate of about 11% for the subject classifier, but only 5% of observations are missing data on the subject.

Table A.4. Course Imputation and Misclassification Rates

Outcome	Complete Course Information	Recoded	Recoded (%)	Misclassification (%)
Running Start	351,537	67,659	16.1	0.2
Advanced Placement	853,352	10,900	1.3	0.1
Honors	912,387	37,049	3.9	1.6
Subject	39,026,796	2,130,690	5.2	10.9

Notes: Data on imputed course information and model misclassification. Recoded courses are those missing information on course type or subject. Data in column 3 indicate the percentage of the given course type that is recoded. Misclassification rate refers to the course classification model described in the text and applies to the recoded data.

Appendix B. Estimation of District Gifted Program Effects

We use methods from the teacher effectiveness literature (Koedel et al., 2015) to construct the empirical Bayes predictions from the regression residuals

$$\tilde{R}_{ijgpt} = R_{ijgt} - X_{ijgt}\hat{\beta} - \hat{\alpha}_{jgt}.$$

We use the residuals to construct the empirical Bayes estimates using the following structure on the variance components:

$$\tilde{R}_{ijgpt} = \theta_{jp} + \xi_{jgpt} + \eta_{ijgpt}.$$

We first estimate the total variance of the combined residuals ($\tilde{R}_{ijgpt}$). We next estimate the variance of η_{ijgpt} as the variance within district, grade, program, and year for students in gifted programs:

$$\hat{\sigma}_{\xi}^2 = var(\tilde{R}_{ijgpt} - \bar{\tilde{R}}_{ijgpt}).$$

We then estimate the variance in district program effects, θ_{jp}. We take the mean residuals for each district, grade, program, and year and estimate their covariance with randomly matched grade-year mean from the same program:

$$\hat{\sigma}_{\theta}^2 = cov(\lambda_{jgpt}, \lambda_{jg'pt'}).$$

Finally, we construct the empirical Bayes weights

$$\lambda_j = \frac{\hat{\sigma}_{\theta}^2}{\hat{\sigma}_{\theta}^2 + 1/\sum\left(\sigma_{\xi}^2 + \sigma_{\eta}^2/n_{jgpt}\right)^{-1}}$$

and predictions

$$\hat{\theta}_{jp}^{EB} = \lambda_j \hat{\theta}_{jp}^{FE} + \left(1 - \lambda_j\right)\bar{\theta}.$$

Appendix C. Additional Results

C.1. Elementary School Gifted Programs (Grades K – 3)

Table C.1. Elementary Gifted Program Resource Effects (K-3)

	(1)	(2)	(3)	(4)
Peer Gifted	0.35***	0.35***	0.34***	0.31***
	(0.04)	(0.04)	(0.04)	(0.04)
Peer Grade	0.00**	0.00**	0.01***	0.01***
	(0.00)	(0.00)	(0.00)	(0.00)
Takes Art Class	0.00	0.01	0.00	0.00
	(0.00)	(0.01)	(0.00)	(0.00)
Takes Foreign Language	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Mean Class Size	-1.31***	-1.32***	-1.51***	-1.22***
	(0.32)	(0.33)	(0.33)	(0.35)
Predicted Teacher VA	0.04**	0.04**	0.03**	0.02
	(0.02)	(0.02)	(0.02)	(0.02)
N	1301908	1301907	1301883	1083697
Student Controls			X	
Student FE				X
District FE		Y	Y	Y

Notes: Estimated effects of gifted participation on educational resources for students in grades K-3. Column 1 includes grade by year fixed effects. District FE denotes district by grade by year effects. Student controls include student race/ethnicity, gender, FRL status, whether English is the student's home language, and learning disability status. Standard errors clustered by school district in parentheses.

* $p < 0.10$ ** $p < 0.05$ *** $p < 0.01$

C.2. Comparison of District Survey Respondents and Non-Respondents

Table C.2. Comparison of District Survey Respondents and Non-Respondents

	Non-Respondents	Respondents	Difference
City	0.04	0.12	-0.09**
	(0.19)	(0.33)	(-2.88)
Rural	0.83	0.66	0.17***
	(0.37)	(0.47)	(3.48)
District enrollment	2133.40	4701.16	-2567.77***
	(3760.38)	(7698.08)	(-3.82)
Prior math score	-0.17	-0.12	-0.05
	(0.35)	(0.31)	(-1.16)
Prior ELA score	-0.14	-0.10	-0.04
	(0.37)	(0.30)	(-0.98)
Gifted	0.03	0.05	-0.01**
	(0.04)	(0.04)	(-2.73)
Male student	0.51	0.52	-0.00
	(0.05)	(0.02)	(-0.26)
Grade	5.57	5.70	-0.13
	(1.14)	(0.87)	(-1.00)
Asian	0.02	0.03	-0.01*
	(0.03)	(0.06)	(-2.20)
Black	0.01	0.02	-0.01**
	(0.02)	(0.04)	(-3.19)
Hispanic	0.12	0.13	-0.01
	(0.14)	(0.13)	(-0.72)
Student FRL status	0.55	0.53	0.01
	(0.23)	(0.21)	(0.51)
English is spoken at home	0.86	0.84	0.02
	(0.21)	(0.19)	(0.79)
Districts	109	186	295

Notes: Characteristics of school districts for districts that did and did not respond to our survey of district gifted program coordinators. Each cell represents the average across districts in a given column not weighted by student population.