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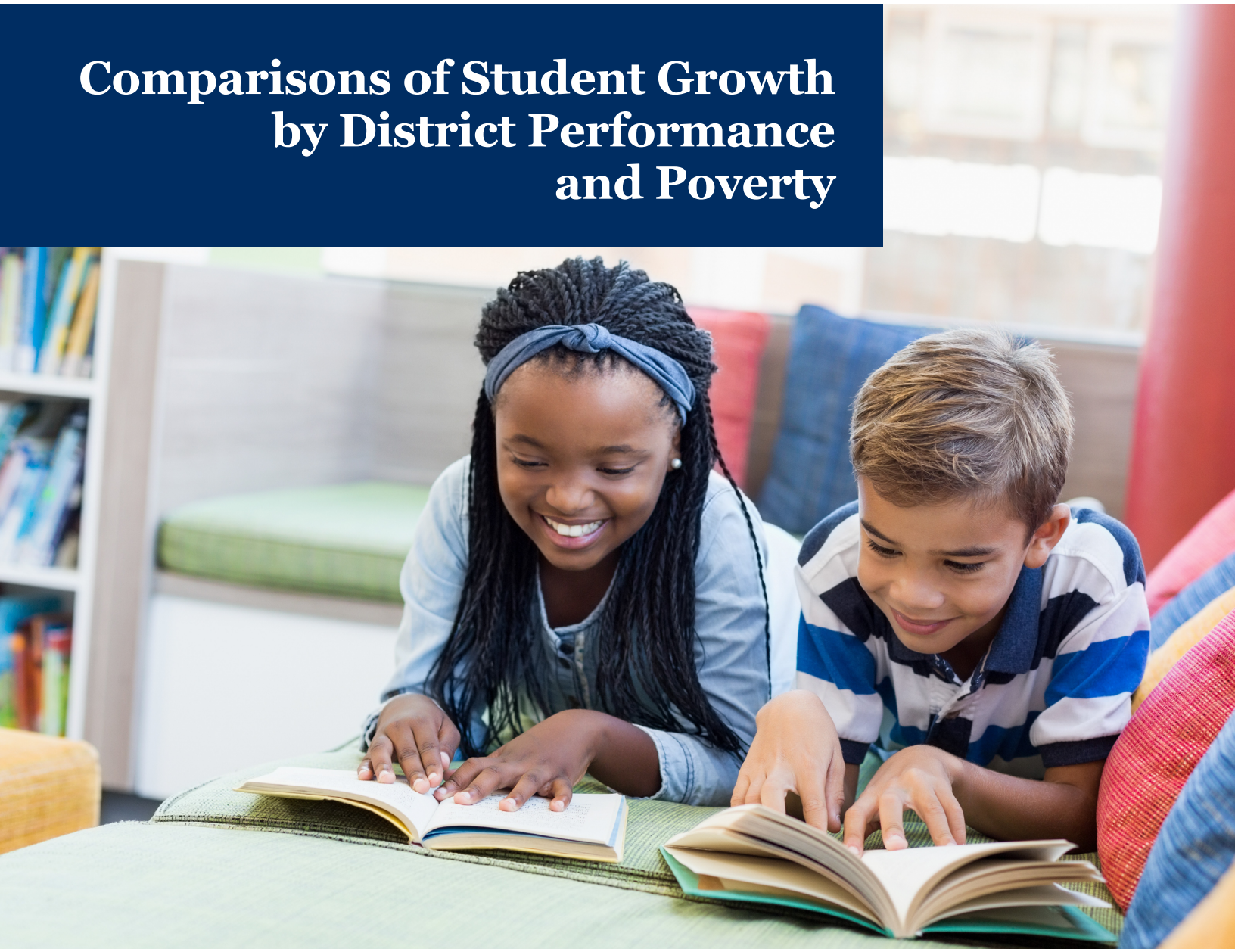
Comparisons of Student Growth by District Performance and Poverty



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Abstract

This report looks at student growth in Arkansas school districts disaggregated by district poverty and by the district's value-added performance relative to other districts. We estimated district value-added performance statistics by subject and grade level (8 and 11–12) for longitudinal student cohorts, using statistical models that adjusted for district demographics, the percentage of students in the analysis, and prior student scores. We found that differences in these value-added statistics across districts at each poverty level were large enough to be of practical importance to educators and policymakers.

In addition to value-added statistics, we also calculated unadjusted descriptive statistics related to changes in student achievement over time—such the percentage of students at a given achievement level in an earlier year who reached the On-Track level in the current year—for districts classified as above or below average based on the value-added statistics. At all poverty levels, we found substantial differences in these statistics between districts identified as above and below average in the models. However, even in above-average districts, the great majority of Off-Track students were not reaching On-Track benchmarks for college and career readiness in English, mathematics, reading, and science. No group of high-poverty districts was able to catch up at least a third of their Off-Track students or more than 11% of their Far-Off-Track students in any subject. This is reason to pay increased attention to promising but sometimes underemphasized long-term strategies for improving student outcomes.

Comparisons of Student Growth by District Performance and Poverty[1]

Introduction

A substantial body of literature has focused on the role of school districts in supporting improvement in student learning (Hightower, Knapp, Marsh, & McLaughlin, 2002; Marsh et al., 2005; Supovitz, 2006; MacIver & Farley-Ripple, 2008; ACT, 2012a; Daly & Finnigan, 2016). As such, school districts have been a significant focus of education reform efforts (Whitehurst, Chingos, & Gallaher, 2013; Chingos, Whitehurst, & Gallaher, 2013) and public recognition (Broad Foundation, 2014).

School districts are potentially important because they are often the administrative unit closest to students that can oversee improvement strategies spanning preschool through grade 12 (ACT, 2012a). For example, working closely with teachers and school leaders, district leaders can work to ensure students receive a content-rich curriculum in each subject aligned across elementary, middle, and high school levels; establish assessment and data systems to monitor student progress and follow students as they change schools; promote educators' use of those systems (Dougherty, 2015a, 2015b); ensure that time is set aside in every school for teachers to collaborate; develop a coaching system for teachers; and lead efforts to involve parents and community leaders. District leaders can benefit from systematic, ongoing feedback on how well these practices are implemented in their district (Dougherty, 2016).

In theory, we would expect differences in educator practices across districts to account for a substantial share of cross-district differences in student outcome indicators, such as test scores, high school graduation rates, and college enrollment rates. In practice, the relationship between differences in practices and student outcomes across districts has been difficult to investigate. Information is usually missing on what practices are being implemented, and how well, in which districts. Second, practices are not generally introduced separately in randomized trials, so that it is difficult to demonstrate a causal relationship between changes in specific practices and changes in student performance. Third, practices may be implemented inconsistently within districts, so that a given practice may be found only in some schools and classrooms. This dilutes the overall impact of the practice on district-wide outcomes.[2]

In connection with this issue, it is worth investigating whether differences in outcomes across districts serving similar student populations are large enough to inspire us to study differences in their practices. Does there appear to be a large enough "district effect" to make it worthwhile to investigate the cause? This question was explored by Whitehurst, Chingos, and Gallaher (2013), who studied differences in student performance in fourth- and fifth-grade mathematics across districts in Florida and North Carolina after adjusting for differences in student demographics. They found that a one-standard-deviation difference in district performance statistics amounted to a difference in test scores similar to the gains associated with seven to 12 weeks of instruction. This is of practical importance, given that performance in the 5th- and 95th-percentile districts might be expected to differ by about 3.3 standard deviations, or

[1] This study uses data maintained by the Arkansas Department of Education and is published with its permission.

[2] Variation in practices across schools and classrooms within districts can be related to variation in student outcomes at the school and classroom levels, with the usual need to disentangle alternative causal explanations for these student outcome differences.

between 23 and 39 weeks of instruction. The latter estimate amounts to more than a standard school year of 36 weeks.

We explored cross-district performance differences in two previous reports. In the first report (Dougherty & Shaw, 2016a), we found that differences in model-generated performance statistics between above- and below-average districts were large enough to be of practical importance. However, the districts identified as above- and below-average varied by grade and subject, so that a district with better-than-average performance in elementary school mathematics might not be above average in high school mathematics or in elementary school reading.[3] The second report (Dougherty & Shaw, 2016b) classified districts into three poverty categories—high-poverty, medium-poverty, and lower-poverty districts—and looked at the gap in model-generated district performance statistics between above- and below-average districts in each poverty category. Our disaggregation of districts by poverty category was motivated by the idea that efforts to improve teaching and learning are likely to be particularly important for economically disadvantaged students, who are more likely to start out far behind academically and have more trouble catching up when they are behind (Stanovich, 1986; ACT, 2012b; Dougherty, 2014).

In addition to comparing districts on performance statistics that adjust for student demographics, the second report looked at gaps between districts on unadjusted descriptive student achievement statistics, such as average student scores and the percentages of students who were On Track or Far Off Track.[4] These gaps were also of practical importance based on the larger number of additional students who would be On Track and the smaller number who would be Far Off Track if student achievement in below-average districts could replicate that in above-average districts. Despite these promising results, the report also found that among medium- and high-poverty districts, no group of districts got the majority of their students to meet On-Track benchmarks in reading, mathematics, or science.

The current report follows up on the first two by comparing districts using statistics related to student growth—change in achievement over time. As in the second report, we classified districts into three poverty levels—high-poverty, medium-poverty, and lower-poverty—and compared the model-generated performance statistics of above- and below-average districts at each poverty level. In the current report, district performance statistics were calculated using value-added models that took prior student scores into account. In addition, we compared districts on unadjusted descriptive student growth statistics—percentages of students at different achievement levels in a prior year reaching the On-Track level in the current year, and change in average scores.

Specifically, this report addresses the following questions:

1. What were the differences in district value-added performance statistics between above- and below-average districts at each poverty level, and were they large enough to be of practical importance?
2. Did value-added performance vary more in one poverty category than in another? For example, did we see a larger variation in value-added performance statistics among high-poverty districts?

[3] District performance also varied based on the statistical model used to calculate the performance statistics. Each of the models controlled for student demographics, but the models differed on whether they also controlled for district average student demographics, prior student test scores, and district average prior student scores.

[4] See the Data section of this report for definitions of “On Track,” “Off Track,” and “Far Off Track.”

3. How much did the change in average student scores relative to On-Track targets differ between above- and below-average districts at each poverty level? Were these differences large enough to be of practical importance?
4. How much did the percent of previously On-Track students who stayed On Track differ between above- and below-average districts at each poverty level? Were these differences large enough to be of practical importance?
5. How much did the percent of previously Off-Track and Far-Off-Track students who got On Track differ between above- and below-average districts at each poverty level? Were these differences large enough to be of practical importance?
6. In what grades and subjects did specified percentages of previously On-Track students remain On Track in districts at different poverty and performance levels?
7. In what grades and subjects did specified percentages of previously Off-Track and Far-Off-Track students get On Track in districts at different poverty and performance levels?

In this report, we use the phrase "district value-added performance statistics" to refer to model-generated estimates of differences in student scores between districts that control for student and district demographics and prior student achievement levels. These statistics were used to answer Questions 1 and 2. We use "student growth statistics" to refer to unadjusted descriptive statistics on changes in student achievement over time. These statistics were used to answer Questions 3 through 7. In general, unadjusted student growth statistics such as changes in average scores and movement of students across achievement levels are better at addressing the question, "How well did the students do?" District value-added performance statistics are better at addressing the question, "How well did the district do?" In all cases, we classified districts as above-average, average, or below-average based on their value-added performance statistics, not their unadjusted student growth statistics.[5]

Data

This report used longitudinal cohorts created from student-level enrollment and test data supplied by the Arkansas Department of Education for the 2006–07 through the 2013–14 school years. The test data we used included student scores on the Arkansas Benchmark Exams (ABE) in grade 4, the ACT Explore® tests in grade 8, and the ACT® in grades 11 and 12. All enrollment and test datasets contained state-encrypted student IDs so that records for the same students could be linked anonymously across enrollment and test datasets.

Our statistical analysis used data both on students' individual demographic characteristics and prior test scores and the demographics and average prior test scores of their districts. This required three steps to create the necessary datasets: (1) create longitudinal cohorts of students to be included in the analysis, coding individual students into demographic and academic achievement level categories; (2) calculate district-level statistics and apply rules for including districts in the analysis; and (3) merge student- and district-level datasets together based on the district in which each student was enrolled.

[5] Cross-district comparisons may look different depending on whether value-added performance statistics or unadjusted student achievement statistics are used. For example, a district with above-average value-added performance but more disadvantaged students may have a lower level of student growth than a district with average value-added statistics but more advantaged students.

1. Creation of Student Cohorts and Calculation of Student-Level Statistics

This section describes how longitudinal cohorts of students were created for the analysis, how their demographic characteristics were derived from the Arkansas state enrollment and test data, and how students were classified into achievement levels (On Track, Off Track, and Far Off Track) based on their test results.

Creation of student cohorts. For the analysis using eighth-grade test scores, we began with students enrolled in fourth grade in the initial cohort year (for example, the 2006–07 school year) and followed them forward for four subsequent school years, keeping students who were enrolled in the district the entire time and who took both fourth-grade ABE tests in the initial cohort year and all four ACT Explore tests in eighth grade in the final cohort year. For the analysis using eleventh- and twelfth-grade scores, we followed initial-year eighth-grade students forward for four subsequent years, keeping students who were twelfth graders four years later who had been enrolled in the district the entire time, and who took all four ACT Explore tests in the initial cohort year and all four ACT tests in twelfth grade in the final cohort year or in eleventh grade in the next to final year. We used the most recent score for students who took the ACT more than once in grades 11 and 12.

This process created four longitudinal cohorts at each level, referred to as the 2007–11, 2008–12, 2009–13, and 2010–14 cohorts based on the initial cohort year and the final cohort year four years later.[6] Thus, there were eight total student cohorts (four each for grades 4–8 and 8–12). At each grade level (4–8 and 8–12), we concatenated the four student-level cohorts into a single dataset in order to avoid double-counting students who were retained in the initial cohort grade and to create an indicator variable for those retained students. In all, the 73,633 students in our four 4–8 cohorts and the 36,377 students in our four 8–12 longitudinal cohorts comprised respectively 51% and 25% of the students enrolled in the initial cohort years (Appendix A, Tables A1–A3).[7]

We separated out students who had been enrolled in the same district for multiple years—as opposed to using snapshot data on all students enrolled in the final year—in order to focus on those students whose test results would be more likely to reflect the instructional program in the district where they were tested. We followed students forward from an initial cohort year—rather than starting with tested students in the final year and looking backward—in order to account for student attrition between grades 8 and 12, when many students in some districts may drop out.[8] We required that students in the 4–8 and 8–12 cohorts have test scores from the initial year because the value-added statistical models we used controlled for those prior test scores.

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[6] In this nomenclature, school years are named after their spring semesters, so that students in a 2007–11 cohort were present in the district from the collection of enrollment data in the fall of the 2006–07 school year to the collection of test data in the spring of the 2010–11 school year.

[7] As clarified in Table A3, most of the difference in percentages of students in the analysis between grades 8–12 and 4–8 is due to differences in the percentage of students who were enrolled in the final grade four years later (accounting for 26 vs. 16 percentage points attrition from the sample in 8–12 vs. 4–8, likely due to high school dropout) and differences in the percentage of students taking the test in the initial grade (accounting for 28 vs. 4 percentage points attrition in 8–12 vs. 4–8, because many students in the grades 8–12 cohorts did not take ACT Explore in eighth grade, but nearly all students in the 4–8 cohorts took the ABE in fourth grade). The state began paying for students to take ACT Explore in the 2010–11 school year, which benefitted all of the grades 4–8 cohorts in their final cohort years but none of the grades 8–12 cohorts in their initial cohort years.

[8] A backward- or forward-looking cohort selection process can create the same student cohort, with the only difference being the denominator to which the size of the cohort is compared.

Identification of students' demographic and program participation status. Students' characteristics may vary naturally over time: For example, a student's family may qualify for the free- and reduced-price lunch program when the student is in fourth grade but not when the same student is in eighth grade. Likewise, a student's special education and English language learner (ELL) status or a student's self-identified ethnicity may change over time. Because an indicator of low-income, English language learner, or special education status may signal a level of disadvantage even if the status is not consistent every year, we identified students as low-income, English language learners, or special education if they had that status in either the initial or final cohort grade level, e.g., either fourth or eighth grade for the students in the grades 4–8 analysis. Because no such logic applies to inconsistent reporting of student ethnic status, we used the student's reported ethnicity in the earliest cohort year as the determining factor for the student's overall ethnic status.[9] Students whose ethnicity, low-income status, special education status, or English language learner status could not be ascertained using these criteria were dropped from the analysis. Less than 1% of records were dropped based on incomplete demographic data (table notes in Appendix A, Tables A1 and A2).[10]

Classification of students by academic achievement level. In grades 8 and 11–12, we classified students as On Track in a given subject if they met or exceeded the ACT College Readiness Benchmark on ACT Explore (in grade 8) or the ACT (in grades 11–12) in the subject in question.[11] To identify prior student achievement levels in fourth grade, we used the ABE On-Track targets calculated for a previous study (Dougherty, Hiserote, & Shaw, 2014), which identified the fourth grade ABE score in literacy and mathematics associated with a 50% or better probability of meeting or exceeding the eighth-grade Benchmark on ACT Explore in the corresponding subject.[12] In turn, Off-Track students were defined as those missing the On-Track Level by one standard deviation or less in the grade and subject in question, while Far-Off-Track students scored more than a full standard deviation below the On-Track Level. These criteria resulted in the definitions for On-Track, Off-Track, and Far-Off-Track achievement levels shown in Table 1.

[9] The only exception was for a student with missing ethnic data for the earliest cohort grade (e.g., fourth grade in the grades 4–8 analysis) but ethnic data present for the final cohort grade level (e.g., eighth grade), in which case we used the data from the final grade level.

[10] The percentage of records dropped due to incomplete data was around 0.1% in grades 4–8 and 8–12.

[11] The ACT College Readiness Benchmarks, updated in 2013, identify the ACT scores associated with a 50% probability of earning a B or approximately a 75% chance of earning a C in entry-level college courses corresponding to the ACT subject tested (Allen & Sconing, 2005; Allen, 2013). In turn, the ACT Explore Benchmarks identify the scores on that test associated with a 50% probability of reaching the Benchmark in the corresponding subject on the ACT (Allen, 2013).

[12] The analysis linked student-level fourth grade ABE scores in 2007 and 2008 with the same student's ACT Explore scores in the 2010–11 and 2011–12 school years. The eighth-grade ACT Explore reading test was treated as the closest same-subject match to the fourth-grade ABE literacy test, which covers both reading and writing.

Table 1. Scale Score Ranges for On Track, Off Track, and Far Off Track[13]

	On Track	Off Track	Far Off Track
Grade 4 Arkansas Benchmark Exam			
Literacy	772 and above	586–771	585 or below
Mathematics	675 and above	575–674	574 or below
Grade 8 ACT Explore			
English	13–25	9–12	8 or below
Mathematics	17–25	14–16	13 or below
Reading	16–25	12–15	11 or below
Science	18–25	15–17	14 or below
Grade 11/12 ACT			
English	18–36	12–17	11 or below
Mathematics	22–36	17–21	16 or below
Reading	22–36	16–21	15 or below
Science	23–36	18–22	17 or below

Calculation of changes in students' scores relative to the On-Track level. We calculated each student's score relative to the On-Track level in the initial and final grades, measured in standard deviation units, and defined the difference between these two relative scores as the change in the student's score relative to the On-Track level. For example, consider a hypothetical student with an ACT Explore reading score of 13 and an ACT reading score of 20. Measured in score points, this student scored three points below the On-Track level of 16 on the ACT Explore reading test and two points below the On-Track level of 22 in ACT reading. Measured in standard deviation units, the student scored 3/3.9 = 0.77 standard deviations below the On-Track level on ACT Explore and 2/6.3 = 0.32 standard deviations below the On-Track level on the ACT, for a gain of (-0.32) – (-0.77) = 0.45 standard deviation units.[14] We used these changes in standardized scores relative to the On-Track level as our measure of student growth or progress, as it did not depend on having a common scale across the two tests. No common scale existed in grades 4–8 between the ABE and ACT Explore tests.

2. District-Level Statistics and Inclusion of Districts in the Analysis

Our calculation of district-level statistics began with 238 K–12 school districts that were in existence continuously from the 2006–07 through the 2013–14 school years.[15] Since our focus was on traditional K–12 school districts, charter schools that were not part of such a district were omitted from the analysis.[16] For these 238 districts, we calculated statistics on district-

[13] Standard deviations on the ACT Explore tests were 4.2 points in English, 3.5 in mathematics, 3.9 in reading, and 3.3 in science (ACT, 2013, Table 4.11). Standard deviations on the ACT were 6.5 in English, 5.3 in mathematics, 6.3 in reading, and 5.3 in science (ACT, 2014, Table 5.4). Standard deviations on the grade 4 ABE, calculated for all students tested in the 2006–07 and 2007–08 school years, were 186.37 scale score points in literacy and 100.93 in mathematics.

[14] A student who was the same number of score points below the On-Track level on the ACT Explore and the ACT would be shown as making progress, as standard deviations on the ACT are larger than those on ACT Explore.

[15] If District A consolidated into District B at any time between the 2006–07 and 2013–14 school years, then A's students were combined with B's for the years prior to the consolidation and everyone was treated as part of District B. Thus, basing the analysis on the 238 districts that existed after consolidation did not, in itself, reduce the number of students in the analysis.

[16] Omitting students in charter schools that were not part of a K–12 district reduced the number of students in the analysis—after the other rules for inclusion were applied—by 199 students in grades 4–8 and 86 students in grades 8–12.

wide demographics and the district's number and percentage of students included in the analysis. Next, we classified districts as rural or non-rural, identified districts that were eligible for the analysis, and divided the eligible districts into the three poverty categories used in this report.

District-wide demographics. We used each district's fall student-level enrollment data for kindergarten through twelfth grade for each year from 2006–07 through 2009–10 to derive annual statistics on the overall district-wide percentage of low-income, African American, Hispanic, Asian, White, Native American, English language learner, and special education students. These statistics were used as district-level predictors in our statistical models.[17]

District percentage of students in the analysis. For each cohort, we calculated the number of students in the analysis in each district as a percentage of the total number of students enrolled in the district in the initial cohort grade and year. If a district's percentage of students in the analysis is low compared with other districts—reflecting a higher rate of student mobility or a lower percentage of students taking the test—this might either raise or lower the relative performance of the district. For example, if students whose families face the most challenges leave the sample in disproportionate numbers, that could bias the results in favor of districts with high attrition.[18] High attrition could also result from the presence of a nearby military base or from the district's being less effective at retaining and educating students. In the last of these cases, controlling for attrition rates in the statistical model picks up some of the district performance we are trying to measure. Further research may explore the variables that are associated with student attrition to identify when attrition should be treated as a district performance indicator (e.g., as in the case of high school dropout rates) and when it is simply an aspect of the environment in which the district operates.

Rural district status. Using school-level information from the 2012–13 Common Core of Data (U.S. Department of Education, 2014), we defined as "rural" any district in which all schools have a two-digit NCES locale code beginning with 3 (small town) or 4 (rural).

Selection of districts for inclusion in the analysis. We applied two additional criteria to identify which of the 238 continuously existing regular K–12 districts should be included in the analysis:

Accuracy of low-income statistics. The use of students' low-income status as an important control in the statistical models made the accuracy of this classification an important consideration. To assess the accuracy of each district's low-income statistics in a given year, we regressed the district's overall percentage of low-income students in that year on U.S. Census estimates of poverty rates of individuals age 5–17 in the district to get a statewide relationship between the two variables, which in turn yielded a Census-predicted district low-income percentage for each year.[19] To have its students included in the analysis, a district's

[17] The district-wide demographic statistics calculated this way differ from ones that would be calculated by aggregating our cohort data, which do not cover all grades. As was the case in our student cohorts, we dropped students with missing demographic data when calculating the district-wide statistics.

[18] The poverty measure based on students' free- and reduced-price lunch status is an imperfect measure of those challenges, so using this measure as a predictor in the statistical models does not completely adjust for this possible bias.

[19] Census-defined poverty uses a lower income threshold than the state definition of low income, which is based on federal eligibility requirements for the free- and reduced-price school lunch program. Thus we needed to derive a predicted low-income percentage from the Census data rather than just using the Census percentage. We hypothesized that a district with accurate low-income data would have a relationship between the two poverty measures that is not too different from the state average relationship between the two measures.

percentage of low-income students in kindergarten through grade 12 had to fall within 20 percentage points of its Census-predicted value in each school year from 2006–07 through 2009–10, the starting years for the cohorts in this report. Of 238 Arkansas K–12 districts, 202 met this requirement.

Number of students in the analysis. To be included in the analysis for a given grade level (4–8 or 8–12),[20] districts were required to have at least 20 students in the four combined longitudinal cohorts for that grade level. In grades 4–8, all 202 districts that met the income data requirement also met this criterion, despite the fact that Arkansas has many small districts (Appendix B, Figure B1 and Table B1). Because of low ACT Explore and ACT participation rates, 33 of the 202 districts meeting the low-income data criterion had fewer than 20 students eligible for the grades 8–12 analysis, leaving 169 eligible districts at that grade level.[21]

Disaggregation of districts into poverty categories. We calculated district-wide percentages of low-income students across the initial cohort years, 2006–07 through 2009–10, and used these cross-year percentages to classify school districts in the study into three poverty categories:

- Lower poverty: >20–50% low-income students
- Medium poverty: >50%–70% low-income students
- High poverty: >70% low-income students

We selected these categories because the bottom and top categories each accounted for just under one-quarter of the 202 Arkansas districts included in the grades 4–8 analysis, while just over half of the eligible districts were contained in the middle category (Appendix B, Figure B2). Arkansas had no districts with 20% or fewer low-income students.

3. Combining Student- and District-Level Data

At each grade level (4–8 and 8–12), we merged the concatenated file containing student-level data on the four cohorts with the district-level data created in the previous step, based on the district in which each student was enrolled. This process created a single dataset at each level with matched student- and district-level data.

Methods

Once the datasets for the study were built, our analysis had four steps: (1) Use statistical models to estimate district value-added performance statistics for each subject and grade level; (2) use these value-added statistics to classify districts into above-average, average, or below-average performance categories by subject and grade level; (3) calculate descriptive district-level student growth statistics; (4) aggregate the model-based district value-added performance statistics and the descriptive student growth statistics to address the research questions in the study. We describe these steps here.

[20] We refer to the analysis of eighth-grade test scores that takes fourth-grade test scores into account as a grades 4–8 analysis, and the analysis of test scores in grades 11 and 12 that took eighth-grade test scores into account as a grades 8–12 analysis.

[21] The differences between the third and fourth data columns in Appendix A, Tables A1–A2, show the effect that removing ineligible districts (and charter schools) had on the number of students in the analysis. The percentages in the last column are based on the number of students in eligible districts.

1. Statistical Models Used to Create District Value-Added Performance Statistics

We used similar sets of student- and district-level predictors to predict student-level scores on each of the four eighth-grade ACT Explore tests and four ACT tests for students in grades 11–12 (Tables 2 and 3).[22] The models (one per subject and grade level) contained student-level predictors measuring students' low-income, ethnic, English language learner, special education status, and prior test scores; and district-level averages of these predictors. The district-level averages might be related to a school district's academic culture, funding, and priorities; these influences might in turn affect students' test scores. The models also contained predictors on the district's number and percentage of students included in the analysis, in order to explore effects of district size and cohort attrition, respectively. We also included a dummy variable for whether the district was located in a rural area, on the theory that that might affect teacher recruitment and thus, indirectly, student performance. In addition, dummy variables for three of the four student cohorts were included to allow for shifts in average test scores across years.

We refer to the models in Tables 2 and 3 as value-added models because they included students' prior achievement in the set of variables used to predict students' current achievement. The statistics generated by the models may be thought of as answering the question: How did students in this district perform relative to what would have been predicted for students with the same demographics and prior scores in districts with the same demographics and average prior scores? These statistics differed from most of those produced by state accountability reports on student status in three major ways. First, our statistical models used student scores, not proficiency status, as the dependent variable. Second, accountability reports often do not adjust for students' and districts' demographic characteristics, as policymakers do not want to convey the message that educators are free to aim for lower test results for disadvantaged students. Third, many state accountability reports do not adjust for students' prior scores (student growth reports being the exception), emphasizing student achievement levels in the current year without regard to the same students' performance in prior years. As such, model-based statistics might be hypothesized to do a better job of reflecting relative district effectiveness, and model-based statistics that take prior scores into account might do a better job of reflecting relative district effectiveness over a particular grade span. The regression coefficients associated with student characteristics allow for differences in the degree of difficulty in educating students, just as degree of difficulty is taken into account in scoring Olympic gymnastics or diving events.

[22] These value-added models are similar to Model 4 in Dougherty & Shaw (2016a), except that Model 4 did not include a variable for districts' rural status.

Table 2. Predictors in the Models for Grades 4–8

Type of Data	Predictor
Student-Level	Intercept
	Low-income status
	African American status
	Hispanic status
	Asian status
	Native American status
	English Language Learner status
	Special education status
	Flag for retained student*
	4th-grade literacy score
	4th-grade mathematics score
	Number of years between tests
	Flag for cohort ending in 2012
	Flag for cohort ending in 2013
	Flag for cohort ending in 2014
District-Level	% low-income students
	% African American students
	% Hispanic students
	% Asian students
	% Native American students
	% English Language Learner students
	% special education students
	District average 4th-grade literacy score
	District average 4th-grade mathematics score
	Number of students in model
	% of students in model
	Flag for rural district

* Retained students included in the analysis had enrollment records in consecutive initial cohort years and met the other inclusion criteria.

Table 3. Predictors in the Models for Grades 8–12

Type of Data	Predictor
Student-Level	Intercept
	Low-income status
	African American status
	Hispanic status
	Asian status
	Native American status
	English Language Learner status
	Special education status
	Flag for retained student*
	8th-grade English score
	8th-grade mathematics score
	8th-grade reading score
	8th-grade science score
	Number of years between tests
	Flag for cohort ending in 2012
	Flag for cohort ending in 2013
	Flag for cohort ending in 2014
District-Level	% low-income students
	% African American students
	% Hispanic students
	% Asian students
	% Native American students
	% English Language Learner students
	% special education students
	District average 8th-grade English score
	District average 8th-grade mathematics score
	District average 8th-grade reading score
	District average 8th-grade science score
	Number of students in model
	% of students in model
	Flag for rural district

* Retained students included in the analysis had enrollment records in consecutive initial cohort years and met the other inclusion criteria.

Because the models used in the study contained both student- and district-level predictors, we estimated them as hierarchical linear models.[23] We used the district-level random effect estimated by the model as the district performance statistic for the grade and subject in question. This process generated four sets of district performance statistics at each grade level, one for each ACT Explore or ACT subject.

2. Classification of Districts into Relative Performance Categories

For each subject and grade level, we defined as “above-average” those districts whose value-added performance statistics fell in the top quintile for the grade and subject in question and

[23] SAS Proc Mixed was used for all of the statistical models in this report. Information on the SAS code used for the models is available on request. Fixed effect coefficients estimated by the models are shown in Appendix G.

also were statistically different from average at the .05 confidence level. Similarly, "below-average" districts were those in the bottom quintile whose performance statistics were different from average at the .05 confidence level. Districts not meeting these requirements—i.e., in the middle three quintiles, or in the top or bottom quintile but not statistically different from average at the .05 level—were classified as average.[24]

Although each district is in the same poverty category throughout, the same district might fall into different performance categories in different subjects and grade levels. For example, a district could be above average in grades 4–8 mathematics and below average in grades 8–12 reading.[25] Thus, a performance category such as "above-average districts" comprised different districts depending on the grade and subject.

3. District-Level Student Growth Statistics

In the next step, we created datasets containing the following district-level student growth statistics for each subject area across grades 4–8 and 8–12:

- the district average change in student scores relative to the On-Track level;
- the district's percentage of On-Track students in the earlier grade who stayed On Track in the later grade;
- the district's percentage of Off-Track students in the earlier grade who reached the On-Track benchmark in the later grade;
- the district's percentage of Far-Off-Track students in the earlier grade who reached the On-Track benchmark in the later grade;
- the district average change in student scores relative to the On-Track level for students who were On Track, Off Track, or Far Off Track in the earlier grade (one statistic per district per prior achievement level).

District-level growth statistics were calculated from student-level datasets that contained data on students from all four cohorts; the statistics were aggregated across the four cohorts, rather than being calculated for each cohort separately. For eighth-grade reading, we used fourth-grade ABE literacy as the prior test for identifying which students were On Track, Off Track, or Far Off Track leaving fourth grade.

4. Aggregation of Achievement Statistics by District Performance and Poverty

For each grade and subject, we calculated weighted averages of the district value-added performance statistics and student growth statistics across districts in each poverty and performance category, using the number of students in the analysis in each district as the weights. We used the average district performance statistics to address the first question in the study, and the student growth statistics to address the third through the seventh question. To address the second research question—whether district effect variances differ by poverty category—we calculated the unweighted average variance of the district performance statistics within each poverty category. We did pairwise statistical tests (F-tests) of whether these

[24] Top- or bottom-quintile districts were more likely to be classified as average if they had smaller numbers of students in the analysis.

[25] We explored the frequency with which this sort of inconsistency occurs in Dougherty & Shaw (2016a).

variances differed at a .05 significance level between pairs of poverty categories in a given subject—for example, whether the variances were different in high- and medium-poverty districts in eighth-grade mathematics.

Limitations

Though this report looked at district performance statistics, we were not able to differentiate "district effects" from "school effects." Thus, we did not make a distinction between "value-added performance of the district in grades X to Y" and "value-added performance of the district's school(s) in grades X to Y." The majority of Arkansas school districts are small and rural, and many districts have only one school at a given level. For example, in 2014, 156 (92%) of the 169 districts in the grades 8–12 cohort analysis had only one high school serving grades 11 and 12. Likewise, 180 (89%) of the 202 districts in the grades 4–8 cohort analysis had only one school serving eighth grade. Thus, for the great majority of Arkansas districts, the performance statistic in grades 8–12 could also be thought of as an indicator of the performance of the district's single high school. The comparable statistic for eighth grade could be used as an indicator of the performance between grades 4 and 8 of the district's single middle or junior high school and its feeder elementary school(s).[26] The value of treating the district as the unit of analysis is to focus attention on the district's potential to improve its schools systematically across the elementary, middle, and high school levels.

Second, we did not attempt to compare the wide range of statistical models that could be used to generate district value-added performance statistics. Our goal was to examine results from relatively straightforward value-added models that control for generally available student- and district-level demographic statistics. We did not refine the models to eliminate variables that did not add much explanatory power to the models.

Third, we studied measured district performance differences with the understanding that these differences may reflect the effects both of educator practices and of unmeasured student, parent, and community influences that were not picked up as controls in the statistical analysis (Bryk, Sebring, Allensworth, Luppescu, & Easton, 2010). For example, some districts may operate in more favorable community environments than other districts with similar student demographics. Thus, the measured performance differences such as those discussed in this report should be treated as the starting point for further inquiry into why these differences exist and what can be done to improve student outcomes in all school systems.

Fourth, our focus on specific goals in Questions 6 and 7 was for illustrative purposes. Educators and policymakers may choose to set different goals.

Fifth, because the data in this report are for Arkansas students and districts, further research in other states is needed to determine how the results generalize across states. One goal of this study is to encourage this research.

Finally, because of concerns about the statistical reliability of results from small student groups, we did not report results for groups of fewer than 20 students.

[26] In a state with a number of larger districts, one could partition the variance in performance across schools in those districts into the variance across districts and the variance across schools within districts.

Results

Question 1: Were differences in district value-added performance statistics between above- and below-average districts at each poverty level large enough to be of practical importance?

Tables 4 and 5 compare the district value-added statistics of above- and below-average districts by district poverty level, as estimated using the value-added models described in Tables 2 and 3. For example, in eighth-grade English, students in the seven above-average lower-poverty districts performed on average 0.11 standard deviations above predicted based on the variables in the model (Table 3).[27] Likewise, students in the eight below-average lower-poverty districts scored an average of 0.12 standard deviations below predicted. Thus, the performance gap between the two groups of districts was 0.23 standard deviations.[28]

In general, the performance differences between above- and below-average districts estimated using a value-added model, as shown in Tables 4 and 5, were smaller than those estimated using a status model (Dougherty & Shaw, 2016b, Tables 4 and 5).[29] Nonetheless, these differences were still large enough to be of practical significance. For example, the differences in eighth-grade scores shown in Table 4 may be compared with average growth per year between grades 4 and 8 on the ABE exam ranging from 0.24 to 0.30 standard deviations in literacy and from 0.27 to 0.35 standard deviations in mathematics (depending on student cohort), calculated for the three study cohorts in Dougherty and Shaw (2016a). Differences in eleventh or twelfth grade scores in Table 5 may be compared with average growth per year between the ACT Explore and ACT exams of 0.26 standard deviations in English, 0.28 in mathematics, 0.31 in reading, and 0.24 in science (ACT, 2012c), using the average of the ACT Explore and ACT standard deviations to convert typical growth in score points to standard deviations. Thus, the difference in statistically adjusted student performance between above- and below-average districts in the same poverty category frequently came close to a year's typical student growth.

[27] The size of a single standard deviation in score points is shown by subject and test in footnote 13.

[28] Appendix F provides information on district-wide demographics by poverty and performance group. For example, the demographics of the districts compared in eighth-grade English are shown in Appendix F, Table F1.

[29] If districts with stronger student growth between fourth and eighth grades also have higher fourth-grade scores, the district random effect in an eighth-grade status model would reflect the impact of those higher fourth-grade scores. By contrast, an eighth-grade value-added model would adjust out the effect of the higher fourth-grade scores.

Table 4. Value-Added Performance of Above- and Below-Average Districts in Grades 4–8, by District Poverty

		Lower Poverty		Medium Poverty		High Poverty	
Subject	District Performance Level	# of Districts	Average of District Performance Statistics	# of Districts	Average of District Performance Statistics	# of Districts	Average of District Performance Statistics
English	Above average	7	0.11	14	0.12	4	0.10
	Below average	8	-0.12	17	-0.10	5	-0.11
	Difference		0.23		0.22		0.21
Mathematics	Above average	15	0.16	16	0.16	3	0.16
	Below average	9	-0.16	21	-0.15	3	-0.14
	Difference		0.32		0.31		0.30
Reading	Above average	6	0.15	13	0.13	3	0.11
	Below average	6	-0.12	10	-0.13	6	-0.14
	Difference		0.26		0.26		0.26
Science	Above average	11	0.13	12	0.14	5	0.17
	Below average	7	-0.19	18	-0.14	6	-0.17
	Difference		0.32		0.28		0.35

Apparent discrepancies in the differences shown in the tables in this report are due to rounding; the differences shown are between the unrounded numbers.

Table 5. Value-Added Performance of Above- and Below-Average Districts in Grades 8–12, by District Poverty

		Lower Poverty		Medium Poverty		High Poverty	
Subject	District Performance Level	# of Districts	Average of District Performance Statistics	# of Districts	Average of District Performance Statistics	# of Districts	Average of District Performance Statistics
English	Above average	8	0.09	7	0.12	3	0.11
	Below average	3	-0.13	8	-0.10	4	-0.10
	Difference		0.22		0.22		0.22
Mathematics	Above average	9	0.17	12	0.12	5	0.14
	Below average	7	-0.11	12	-0.14	4	-0.14
	Difference		0.27		0.25		0.28
Reading	Above average	6	0.11	5	0.08	2	0.10
	Below average	4	-0.12	4	-0.08	1	-0.11
	Difference		0.23		0.17		0.21
Science	Above average	5	0.10	3	0.07	1	0.11
	Below average	3	-0.12	2	-0.10	1	-0.11
	Difference		0.22		0.17		0.23

Question 2: Did value-added performance vary more in one poverty category than in another?

Theory does not provide us with a clear expectation of whether value-added performance differences should be larger among high- or lower-poverty districts. We might hypothesize that in lower-poverty districts, a larger share of student learning takes place outside of school—which is why average student achievement is generally higher in those districts. In that case, in-school factors might account for a smaller share of learning differences across districts. On the other hand, we do not know how much out-of-school learning varies across districts or whether that variation is greater in lower-poverty districts. Nor do we know whether educator practices vary more across high-poverty than across lower-poverty districts or how these differences in practices are likely to affect variations in district performance.

Tables 4 and 5 do not appear to show a consistent pattern in the size of value-added performance differences across districts in the three poverty-level categories. For example, looking from left to right in Table 4, lower-poverty districts had the largest performance gaps in grades 4–8 English (0.23 of a standard deviation, versus 0.22 and 0.21 for medium- and high-poverty districts) and mathematics (0.32 of a standard deviation, versus 0.31 and 0.30 for medium- and high-poverty districts). In science, the gaps were largest for high-poverty districts in science (0.35 of a standard deviation, versus 0.32 and 0.28 for lower- and medium-poverty districts). As these cases illustrate, many of these differences were small. Some comparisons were based on small numbers of districts: For example, the difference between above- and below-average high-poverty districts in science in grades 8–12 was based on a single district in each performance category (Table 5).

To explore this issue in a way that examines variation across all districts, including those not statistically different from average, we calculated the unweighted standard deviation and variance (the square of the standard deviation) of the value-added performance statistics for districts in each poverty category by grade and subject, and conducted a set of statistical significance tests comparing these variances between district poverty categories. Table 6 shows the standard deviations of the district value-added statistics and the results of the statistical tests.

Table 6. Comparison of Within-Category Performance Variation between Poverty Categories

		Performance Variation within Poverty Category			Statistical Significance of Comparison between Categories		
Grade Span	Subject	Lower-Poverty Districts	Medium-Poverty Districts	High-Poverty Districts	Lower vs. High	Lower vs. Medium	Medium vs. High
4–8	English	0.083	0.072	0.067			
	Mathematics	0.125	0.101	0.088	**	*	
	Reading	0.086	0.080	0.085			
	Science	0.109	0.094	0.108			
8–12	English	0.070	0.062	0.063			
	Mathematics	0.103	0.082	0.088		*	
	Reading	0.066	0.049	0.056		**	
	Science	0.060	0.043	0.047		**	

***Significant at the .01 level. **Significant at the .05 level. *Significant at the .10 level.

From Table 6, we can see that the variation in performance was at least slightly larger for lower-poverty districts in all cases, but in only a few cases was the difference between poverty categories large enough to be statistically significant. For example, there were no statistically significant differences in the variation in performance between medium- and high-poverty districts (last column of Table 6). In twelfth-grade reading and science, the difference between lower- and medium-poverty districts was significant at the .05 level, but the (smaller) difference between lower- and high-poverty districts was not. Thus, we are unable to conclude from this evidence that the variation of performance across districts varies systematically by district poverty level.

Question 3: How much did the change in student scores relative to On-Track targets differ between above- and below-average districts at each poverty level? Were these differences large enough to be of practical importance?

In grades 4–8, students in above-average districts made substantially more academic progress than did their counterparts in below-average districts, as measured by the change in student scores relative to the On-Track target (Table 7, shown in more detail in Appendix C, Table C1). For example, in high-poverty districts, eighth-grade students in above-average districts were 0.10 of a standard deviation closer to the On-Track target in eighth-grade mathematics than they were as fourth graders relative to the fourth-grade target. In below-average districts, however, eighth graders were 0.10 of a standard deviation farther below the eighth-grade target than they were as fourth graders relative to the fourth-grade target. This amounts to a difference in student progress between above- and below-average districts of 0.20 of a standard deviation (Table 7). Overall, these differences between above- and below-average districts ranged from 0.20 of a standard deviation for high-poverty districts in mathematics to 0.37 of a standard deviation among medium-poverty districts in reading. As with the differences in random effects in Table 4, the differences in Table 7 may be compared with average growth per year in ABE in grades 4–8 ranging from 0.24 to 0.30 standard deviations in literacy and 0.27 to 0.35 standard deviations in mathematics. By this measure, even the smallest difference between above- and below-average districts amounted to more than half of a year's student progress.[30]

In grades 8–12, differences in student progress between above- and below-average districts ranged from 0.15 of a standard deviation for medium-poverty districts in science to 0.93 of a standard deviation among high-poverty districts in science (Table 8). The largest difference with more than one district on both sides of the comparison was 0.37 of a standard deviation for high-poverty districts in mathematics, which may be compared with average mathematics growth per year between the ACT Explore and the ACT of 0.28 of a standard deviation (ACT, 2012c).[31] Thus, these differences ranged from more than half a year to well over a year of typical student growth.

[30] The progress measure in grades 4–8 reading is based on the ABE literacy test in fourth grade and the ACT Explore reading test in eighth grade, although the literacy test also assesses writing. No progress measures were available for English and science. However, value-added measures were available for all four ACT Explore subjects, based on the statistical models in Table 2 that use fourth-grade literacy and mathematics scores as predictors of ACT Explore scores in each subject.

[31] Appendix C, Table C1 expands on the information in Table 7, and Tables C2 and C3 expand on the information in Table 8, including information on average districts, numbers of students, and average scores in the prior and current grades.

Table 7. Average Changes in Scores Relative to On-Track Targets in Grades 4–8

		Lower Poverty		Medium Poverty		High Poverty	
Subject	District Performance Level	Number of Districts	Change in Scores	Number of Districts	Change in Scores	Number of Districts	Change in Scores
Mathematics	Above average	15	0.09	16	0.10	3	0.10
	Below average	9	-0.16	21	-0.21	3	-0.10
	Difference		0.25		0.31		0.20
Reading	Above average	6	0.34	13	0.34	3	0.28
	Below average	6	0.09	10	-0.03	6	0.05
	Difference		0.25		0.37		0.22

Table 8. Average Changes in Scores Relative to On-Track Targets in Grades 8–12

		Lower Poverty		Medium Poverty		High Poverty	
Subject	District Performance Level	Number of Districts	Change in Scores	Number of Districts	Change in Scores	Number of Districts	Change in Scores
English	Above average	8	-0.04	7	-0.05	3	-0.03
	Below average	3	-0.25	8	-0.26	4	-0.30
	Difference		0.21		0.21		0.27
Mathematics	Above average	9	0.06	12	-0.01	5	0.12
	Below average	7	-0.16	12	-0.21	4	-0.25
	Difference		0.22		0.20		0.37
Reading	Above average	6	0.21	5	0.20	2	0.30
	Below average	4	-0.04	4	-0.05	1	-0.16
	Difference		0.25		0.25		0.46
Science	Above average	5	-0.01	3	-0.01	1	0.56
	Below average	3	-0.24	2	-0.16	1	-0.37
	Difference		0.23		0.15		0.93

Question 4: How much did the percent of previously On-Track students who stayed On Track differ between above- and below-average districts at each poverty level? Were these differences large enough to be of practical importance?

Differences between above- and below-average districts in the percentage of fourth-grade On-Track students staying On Track in eighth grade ranged from 11 percentage points for high-poverty districts in mathematics to 28 percentage points for high-poverty districts in reading (Table 9).[32] In grades 8–12, these differences ranged from five percentage points for medium-

[32] Apparent discrepancies between the percentages in Tables 9–14 and their differences are due to rounding; the differences are calculated using the unrounded percentages. Also, the numbers of students in Tables 9–14 cannot be added up across subjects without double-counting students who would change their status in more than one subject.

Table 9. Percentages of On-Track Fourth-Grade Students Staying On Track in Grade 8, by District Poverty and Performance

Subject	District Poverty Category	Number of Above-Average Districts	% Staying On Track	Number of Below-Average Districts	% Staying On Track	Difference in On-Track Rates	Number of On-Track Grade 4 Students in Below-Average Districts	Simulated Additional On-Track Grade 8 Students in Below-Average Districts
Mathematics	Lower	15	79%	9	60%	19%	1,484	289
	Medium	16	76%	21	56%	20%	1,672	329
	High	3	70%	3	59%	11%	87	10
Reading	Lower	6	77%	6	64%	13%	1,208	160
	Medium	13	74%	10	59%	15%	826	125
	High	3	72%	6	43%	28%	265	75

poverty districts in English to 35 percentage points for high-poverty districts in mathematics, where less than a third of On-Track eighth graders were still On Track in grade 12 in the four below-average districts (Table 10).

To provide context for how important these differences are, we can simulate how many additional previously On-Track students in the below-average districts would have stayed On Track had those districts matched the percentage in the above-average districts. Results of these simulations are shown in the rightmost column of Tables 9 and 10. For example, looking at lower-poverty districts in mathematics (Table 9), increasing the percentage of students staying On Track in eighth grade in the nine below-average lower-poverty districts from 60% to 79% to match the percentage in the 15 above-average lower-poverty districts would have resulted in 289 additional students remaining On Track. By comparison, increasing the percentage of students staying On Track in mathematics in the three below-average high-poverty districts by 11 percentage points to match the corresponding percentage in the three above-average districts would add only 10 On-Track eighth-grade students, because the number of On-Track fourth-grade students in the below-average districts—87 students—was relatively low to begin with.[33]

[33] In all, there were 87 On-Track, 151 Off-Track, and 146 Far-Off-Track fourth graders in the three below-average high-poverty districts in grades 4–8 mathematics, as shown in Tables 9, 11, and 13, respectively.

Table 10. Percentages of On-Track Eighth-Grade Students Staying On Track by Grade 12, by District Poverty and Performance

Subject	District Poverty Category	Number of Above-Average Districts	% Staying On Track	Number of Below-Average Districts	% Staying On Track	Difference in On-Track Rates	Number of On-Track Grade 8 Students in Below-Average Districts	Simulated Additional On-Track Grade 12 Students in Below-Average Districts
English	Lower	8	91%	3	79%	12%	486	56
	Medium	7	85%	8	80%	5%	1,668	77
	High	3	74%	4	62%	12%	264	31
Mathematics	Lower	9	79%	7	62%	17%	761	132
	Medium	12	71%	12	50%	21%	495	103
	High	5	67%	4	32%	35%	143	50
Reading	Lower	6	83%	4	63%	20%	310	63
	Medium	5	78%	4	68%	10%	313	31
	High	2	65%	1	NR	NR	16	NR
Science	Lower	5	73%	3	52%	20%	221	44
	Medium	3	69%	2	51%	18%	51	9
	High	1	NR	1	NR	NR	14	NR

NR = Not Reported because the calculation is based on a group of fewer than 20 students.

Question 5: How much did the percent of previously Off-Track and Far-Off-Track students who got On Track differ between above- and below-average districts at each poverty level? Were these differences large enough to be of practical importance?

Off-Track Students. Differences between above- and below-average districts in the percentage of fourth-grade Off-Track students getting On Track in eighth grade ranged from six percentage points for high-poverty districts in mathematics to 17 percentage points for lower- and medium-poverty districts in the same subject (Table 11). In grades 8–12, these differences ranged from 10 percentage points for medium-poverty districts in English and mathematics and high-poverty districts in science to 21 percentage points for medium-poverty districts in reading (Table 12).

For context, we can simulate how many additional Off-Track students in the earlier grade in the below-average districts would have been On Track in the later grade had those districts matched the percentage getting On Track in the above-average districts (Tables 11 and 12). For example, increasing the percentage of students getting On Track in eighth-grade mathematics in the nine below-average lower-poverty districts from 21% to 38% would result in 284 additional Off-Track students getting On Track (Table 11). On the other hand, increasing the percentage of students getting On Track by six percentage points in the three below-average high-poverty districts would add only nine students getting On Track on those districts (Table 11).

Table 11. Percentages of Off-Track Fourth-Grade Students Getting On Track in Grade 8, by District Poverty and Performance

Subject	District Poverty Category	Number of Above-Average Districts	% Getting On Track	Number of Below-Average Districts	% Getting On Track	Difference in On-Track Rates	Number of On-Track Grade 4 Students in Below-Average Districts	Simulated Additional On-Track Grade 8 Students in Below-Average Districts
Mathematics	Lower	15	38%	9	21%	17%	1,675	284
	Medium	16	35%	21	18%	17%	1,906	332
	High	3	20%	3	14%	6%	151	9
Reading	Lower	6	38%	6	28%	9%	1,384	131
	Medium	13	35%	10	20%	15%	1,108	166
	High	3	25%	6	13%	11%	716	82

Table 12. Percentages of Off-Track Eighth-Grade Students Getting On Track by Grade 12, by District Poverty and Performance

Subject	District Poverty Category	Number of Above-Average Districts	% Getting On Track	Number of Below-Average Districts	% Getting On Track	Difference in On-Track Rates	Number of Off-Track Grade 8 Students in Below-Average Districts	Simulated Additional On-Track Grade 12 Students in Below-Average Districts
English	Lower	8	41%	3	23%	18%	193	34
	Medium	7	35%	8	25%	10%	597	59
	High	3	27%	4	9%	18%	261	47
Mathematics	Lower	9	31%	7	19%	12%	628	76
	Medium	12	22%	12	11%	10%	561	59
	High	5	16%	4	4%	12%	225	28
Reading	Lower	6	43%	4	24%	19%	303	57
	Medium	5	39%	4	18%	21%	329	68
	High	2	29%	1	15%	14%	40	5
Science	Lower	5	26%	3	14%	13%	320	41
	Medium	3	25%	2	14%	11%	101	11
	High	1	10%	1	0%	10%	58	6

Far-Off-Track Students. Differences between above- and below-average districts in the percentage of fourth-grade Far-Off-Track students getting On Track in eighth grade ranged from just under one percentage point favoring the three below-average high-poverty districts in mathematics to five percentage points for medium- and high-poverty districts in reading (Table 13).[34] In grades 8–12, differences ranged from one percentage point favoring the below-average medium-poverty districts in science to 12 percentage points for lower-poverty districts

[34] Looking further into the comparison between above- and below-average high-poverty districts in mathematics, Far-Off-Track students in the above-average districts gained an average of 0.41 standard deviations relative to the On-Track target between fourth and eighth grades, compared with a gain of 0.32 standard deviations for students in the below-average districts (Appendix D, Table D1). Thus the apparent anomaly of more Far-Off-Track students getting On Track in the below-average districts is not matched in the average growth statistics, and could result from differences in the distribution of gains across students.

in reading (Table 14). In general, percentage differences were low because relatively few Far-Off-Track students were able to get On Track in both above- and below-average districts.[35]

For context, Tables 13 and 14 simulate how many additional Far-Off-Track students in the below-average districts would have gotten On Track had those districts matched the percentage in the above-average districts. For example, in the six below-average high-poverty districts in reading in grades 4–8, increasing the percentage of Far-Off-Track students getting On Track from 1% to 6% would have resulted in 64 additional Far-Off-Track students getting On Track (Table 13).

Table 13. Percentages of Far-Off-Track Fourth-Grade Students Getting On Track in Grade 8, by District Poverty and Performance

Subject	District Poverty Category	Number of Above-Average Districts	% Getting On Track	Number of Below-Average Districts	% Getting On Track	Difference in On-Track Rates	Number of Far-Off-Track Grade 4 Students in Below-Average Districts	Simulated Additional On-Track Grade 8 Students in Below-Average Districts
Mathematics	Lower	15	6%	9	3%	3%	812	23
	Medium	16	5%	21	2%	3%	1,309	41
	High	3	3%	3	4%	-1%	146	-1
Reading	Lower	6	10%	6	7%	2%	782	18
	Medium	13	9%	10	4%	5%	663	35
	High	3	6%	6	1%	5%	1,227	64

[35] Appendices D and E expand on the information shown in Tables 9–14. Appendix D provides information on prior and current average scores and the change in scores, while Appendix E provides information on the percentage of students getting On Track. Both tables provide information on the number of students in the analysis. For example, the denominator for 30% of Far-Off-Track students getting On Track in English in grades 8–12 in above-average lower-poverty districts is 23 students (first row of Tables D2 and E2).

Table 14. Percentages of Far-Off-Track Eighth-Grade Students Getting On Track by Grade 12, by District Poverty and Performance

Subject	District Poverty Category	Number of Above-Average Districts	% Getting On Track	Number of Below-Average Districts	% Getting On Track	Difference in On-Track Rates	Number of Far-Off-Track Grade 8 Students in Below-Average Districts	Simulated Additional On-Track Grade 12 Students in Below-Average Districts
English	Lower	8	30%	3	NR	NR	7	NR
	Medium	7	NR	8	NR	NR	19	NR
	High	3	4%	4	0%	4%	21	1
Mathematics	Lower	9	7%	7	3%	5%	240	12
	Medium	12	6%	12	1%	5%	253	12
	High	5	2%	4	0%	2%	133	2
Reading	Lower	6	18%	4	5%	12%	240	29
	Medium	5	13%	4	7%	7%	260	18
	High	2	11%	1	0%	11%	50	5
Science	Lower	5	12%	3	4%	8%	128	11
	Medium	3	9%	2	9%	-1%	55	0
	High	1	6%	1	0%	6%	53	3

NR = Not Reported because the calculation is based on a group of fewer than 20 students.

Question 6: In what grades and subjects did specified percentages of previously On-Track students remain On Track in districts at different poverty and performance levels?

In this section, we show the percentages of previously On-Track students who remained On Track in districts at different poverty and performance levels (Table 15), color-coding the table to show cases in which these percentages met or exceeded specified targets. Somewhat arbitrarily, we chose three target percentages: that at least 90%, 75%, or 60% of students who were On Track in the initial cohort grade remain On Track in the final cohort grade. By varying these target percentages and observing the resulting pattern of who has met the targets, educators and policymakers can get an idea of what kinds of targets might be realistic for the near future. For example, the goal that at least 90% of previously On-Track students remain On Track was not met in any group of districts in any subject except for English, and thus might be considered an aspirational goal in those other subjects.

Table 15. Percentages of Previously On-Track Students Staying On Track in Districts with Different Poverty and Performance Levels[36]

		Lower-Poverty			Medium-Poverty			High-Poverty		
Grade	**Subject**	**Above**	**Average**	**Below**	**Above**	**Average**	**Below**	**Above**	**Average**	**Below**
4–8	Mathematics	79	74	60	76	67	56	70	62	59
	Reading	77	74	64	74	69	59	72	60	43
8–12	English	91	89	79	85	82	80	74	75	62
	Mathematics	79	72	62	71	67	50	67	53	32
	Reading	83	80	63	78	75	68	65	63	NR
	Science	73	69	52	69	62	51	NR	49	NR

NR = Not Reported because the calculation is based on a group of fewer than 20 students. Apparent discrepancies in the table are due to rounding: For example, below-average lower-poverty districts had slightly fewer than 60% of fourth-grade On-Track students in mathematics staying On Track in eighth grade.

Criterion ≥ 90% ≥ 75% ≥ 60%

Table 15 can also be used to illustrate groups of districts where student performance is of concern because their students have not met relatively modest goals. For example, less than 60% of fourth-grade On-Track students remained On Track in eighth grade in reading and mathematics in below-average medium- and high-poverty districts, and less than a third of eighth-grade On-Track students stayed On Track in high school mathematics in below-average high-poverty districts.

Question 7: In what grades and subjects did specified percentages of previously Off-Track and Far-Off-Track students get On Track in districts at different poverty and performance levels?

Off-Track Students. In this section, we show the percentages of previously Off-Track students who got On Track in districts at different poverty and performance levels (Table 16), illustrating cases in which these percentages met or exceeded arbitrarily selected targets that at least 40%, 30%, or 20% of initial-grade Off-Track students get On Track in the final grade.

Table 16. Percentages of Previously Off-Track Students Getting On Track in Districts with Different Poverty and Performance Levels[37]

		Lower-Poverty			Medium-Poverty			High-Poverty		
Grade	**Subject**	**Above**	**Average**	**Below**	**Above**	**Average**	**Below**	**Above**	**Average**	**Below**
4–8	Mathematics	38	30	21	35	25	18	20	19	14
	Reading	38	34	28	35	28	20	25	22	13
8–12	English	41	35	23	35	25	25	27	18	9
	Mathematics	31	24	19	22	17	11	16	10	4
	Reading	43	37	24	39	30	18	29	23	15
	Science	26	24	14	25	17	14	10	12	0

Criterion ≥ 40% ≥ 30% ≥ 20%

[36] These percentages are also shown for above- and below-average districts in Table 9 and 10, and for all groups of districts in Appendix E, Tables E7–E9.

[37] These percentages are shown for above- and below-average districts in Table 11 and 12, and for all groups of districts in Appendix E, Tables E4–E6.

Even though the students in Table 16 were not the farthest-Off-Track group—these students were no more than one standard deviation below the On-Track level in the initial grade—still, in most cases, less than 30%, and in many cases less than 20% of those students reached the On-Track level in the final grade.

Far-Off-Track Students. In this section, we compare the percentages of previously Far-Off-Track students who got On Track in districts at different poverty and performance levels (Table 17), showing cases in which these percentages met or exceeded targets that at least 15%, 10%, or 5% of students who were Off Track in the initial cohort grade get On Track in the final cohort grade.

Table 17. Percentages of Previously Far-Off-Track Students Getting On Track in Districts with Different Poverty and Performance Levels[38]

		Lower-Poverty			Medium-Poverty			High-Poverty		
Grade	**Subject**	**Above**	**Average**	**Below**	**Above**	**Average**	**Below**	**Above**	**Average**	**Below**
4–8	Mathematics	6	5	3	5	3	2	3	3	4
	Reading	10	7	7	9	4	4	6	3	1
8–12	English	30	11	NR	NR	9	NR	4	6	0
	Mathematics	7	4	3	6	3	1	2	1	0
	Reading	18	13	5	13	8	7	11	4	0
	Science	12	9	4	9	6	9	6	3	0

NR = Not Reported because the calculation is based on a group of fewer than 20 students.

Criterion ≥ 15% ≥ 10% ≥ 5%

Table 17 illustrates the low percentages of previously Far-Off-Track students who were able to get On Track. In only two subjects (high school English and reading) and one district category (above-average lower-poverty districts) did as many as 15% of these students get On Track. In many cases, less than 5% of Far-Off-Track students got On Track.

Conclusion

When performance was adjusted for differences in student demographics and prior student achievement, value-added performance differences between above- and below-average Arkansas districts were large enough to be of practical importance, often close to a year's typical student growth. These differences occurred within each district poverty category, so that for students in high-poverty school districts, it mattered what high-poverty district they were in, and the same for students in lower-poverty districts.

Likewise, differences in unadjusted student growth statistics were large enough in most cases to be of practical significance for students, parents, educators, and policymakers, judging by the number of additional On-Track students who would have stayed On Track, and the additional Off-Track students who would have gotten On Track, had student growth in below-average districts matched those in above-average districts in the same poverty category. Differences in percentages of Far-Off-Track students getting On Track were much smaller, owing to the low percentages of those students who catch up.

[38] These percentages are shown for above- and below-average districts in Table 13 and 14, and for all groups of districts in Appendix E, Tables E1–E3.

However, even in above-average, lower-poverty districts, the majority of Off-Track and Far-Off-Track students were unable to get On Track. In many subjects and groups of districts, less than 30% of Off-Track students and less than 10% of Far-Off-Track students were able to get On Track.

The existence of sizeable differences in student progress across districts with similar poverty levels—and the need for all districts to improve—indicates the value of researching why students in some districts do better than students in other demographically similar districts (ACT, 2012a). This research might examine the improvement strategies on which district leaders focus and how teachers and school leaders implement those strategies. Research might also look at differences in strategies and implementation in high- and lower-poverty and rural and non-rural districts.

In thinking about how to improve student outcomes, educators and policymakers should consider four basic approaches:

1. Start early. College and career readiness does not begin in high school, or even in middle school (ACT, 2008). Gaps in student learning begin in early childhood and are well established by kindergarten (Hart & Risley, 1995; West, Denton, & Germino-Hausken, 2000). But "starting early" is not confined to improving early childhood and preschool programs. Improvements must be made in the elementary grades as well. These improvements can include strengthening the early reading and mathematics program, promoting better student behaviors and non-academic skills, and emphasizing a content-rich curriculum in the early grades that includes science, history/social studies, and the fine arts (Dougherty, 2013).

2. Monitor and improve implementation of practices in key areas. These areas should be chosen based on their ability to improve a district's capacity to address a wide range of problems related to student learning. Based on research by ACT and others, these practice areas might include (Dougherty, 2016):

- Developing or adopting, refining, and using a written district curriculum that describes what students should learn in each grade/course and subject.
- Teaching a content-rich curriculum in the early grades.
- Using data from multiple sources to guide improvements in teaching and learning.
- Encouraging teachers to collaborate routinely around curriculum, instruction, and assessment.
- Developing a coaching system for teachers.
- Communicating with parents about their children's academic progress and what their children are expected to learn.

When district leaders target improvement in a given practice area, they should systematically gather information on what practices are actually being implemented and how that implementation correlates with gains in student learning (Dougherty, 2016). They should treat teachers and school leaders as partners in figuring out how to improve practices (Knight, 2007).

3. Form networks among practitioners and researchers to share learning about improvement. These networks can connect educators in different districts working on the same problem, in addition to connecting educators in different schools in the same district.

The creation of cross-district knowledge-sharing networks can be particularly important in a state such as Arkansas that has many small geographically dispersed districts. The creation of such a network can be facilitated by researchers and practitioners in a state education agency, university, regional education laboratory, or nonprofit organization (Bryk, Gomez, Grunow, & LeMahieu, 2015).

4. Work with policymakers and community leaders to strengthen out-of-school supports for students and their families. This approach can be particularly valuable in high-poverty communities, where students face out-of-school challenges that distract them from learning (Willingham, 2012). Strengthening support for students and their families can require better coordination among social service agencies and between social service agencies and schools (Broader, Bolder Approach to Education, 2016).

By using these four approaches and keeping track of associations between well-implemented practices and improvements in student outcomes, educators and policymakers can increase their effectiveness in improving student learning.

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Appendix A: Descriptive Statistics on Students in the Analysis

Tables A1 and A2 show the number and percentage of students from each cohort who were included in the statistical analysis. Table A3 summarizes this information across cohorts to facilitate comparisons across grade levels. Enrollment attrition—defined as students not enrolled in the expected grade four years later—was higher in grades 8–12 than in grades 4–8. Higher enrollment attrition in high school is likely a result of students dropping out. In addition, fewer students took the ACT Explore in the grades 8–12 cohorts than took the ABE in the grades 4–8 cohorts, resulting in attrition of 28% from the grades 8–12 cohorts versus only 4% for the grades 4–8 cohorts (Table A3). The percentage of students taking ACT Explore rose substantially in 2010–11 when the state of Arkansas began paying the districts' costs of giving students the ACT Explore test in eighth grade. This policy increased the number and percentage of students included in the 4–8 cohorts (Table A1), but not in the 8–12 cohorts (Table A2), as students in the 8–12 cohorts were eighth graders prior to the 2010–11 school year.

Table A4 illustrates how student attrition affected the percentages of students in various at-risk groups in the statistical analysis. As would be expected, the students in the analysis—who were continuously enrolled in the same district, progressed by four grades in four years, and took all tests—were less at-risk than the general enrolled population in the initial cohort years. The percentages of low-income, African American, and special education students in the study cohorts were lower in both grades 4–8 and 8–12 than in the population from which the cohorts were drawn. Likewise, the percentages of Hispanic students and English language learners were lower in the high school study cohorts than in the population from which these cohorts were drawn. Sample attrition was greater in high school than in grades 4–8 for low-income, Hispanic, English language learner, and special education students (Table A4).

Table A1. Percentage of Arkansas Fourth-Grade Students in the Grades 4–8 Analysis

Student Cohort	Total 4th-Grade Enrollment	Students Tested in 4th and 8th Grade	Students Eligible for Statistical Analysis	Eligible Students in Eligible Districts	Percent of Students in Statistical Analysis
2007–11	34,570	25,512	20,282	17,600	51%
2008–12	35,418	26,499	21,133	18,340	52%
2009–13	37,954	28,018	21,883	18,870	50%
2010–14	37,732	26,465	21,332	18,823	50%
Total	145,674	106,494	84,630	73,633	51%

Notes:

The attrition of 39,180 students between the first two data columns of this chart includes 115 students with incomplete demographic data; 23,706 students who were not enrolled in eighth grade four years later; 4,590 students who were enrolled four years later but had not taken both fourth-grade state tests; and 10,769 students enrolled and tested in grade 4 and enrolled in grade 8, but who did not take the ACT Explore test in eighth grade.

The attrition of 21,864 students between the second and third columns of this chart consists of students enrolled and tested in both grades 4 and 8 but who were not enrolled throughout grades 4–8 and tested in grades 4 and 8 in the same district.

Table A2. Percentage of Arkansas Eighth-Grade Students in Grades 8–12 Analysis

Student Cohort	Total 8th-Grade Enrollment	Students Tested in 8th and 11th or 12th Grade	Students Eligible for Statistical Analysis	Eligible Students in Eligible Districts	Percent of Students in Statistical Analysis
2007–11	34,810	10,020	8,469	7,082	20%
2008–12	35,421	10,768	9,180	8,172	23%
2009–13	36,769	14,078	11,461	9,843	27%
2010–14	36,882	15,328	13,248	11,280	31%
Total	143,882	50,194	42,358	36,377	25%

Notes:

The attrition of 93,688 students between the first two data columns of this chart includes 155 students with incomplete demographic data; 37,833 students who were enrolled in eighth grade but not in twelfth grade four years later; 39,162 students enrolled in grade 12 four years later but who had not taken ACT Explore in eighth grade; and 16,538 students enrolled and taking ACT Explore in grade 8 and following a normal grade progression between grades 8 and 12 but not taking the ACT.

The attrition of 7,836 students between the second and third data columns of this chart consists of students who met the requirements for inclusion in the second column but who were not enrolled throughout grades 8–12 and tested in grades 8 and 11 or 12 in the same district.

Table A3. Comparing Attrition in Grades 4–8 and 8–12 Cohorts

	Grades 4–8		Grades 8–12	
Student Population	Number of Students	% of Students in Initial Grade	Number of Students	% of Students in Initial Grade
All enrolled students in the initial grade	145,674	100%	143,882	100%
…with complete demographic information	145,559	99.9%	143,727	99.9%
…and enrolled in final grade four years later	121,853	84%	105,894	74%
…and taking all tests in initial grade	117,263	80%	66,732	46%
…and taking all tests in final grade	106,494	73%	50,194	35%
…and continuously enrolled in the district	84,630	58%	42,358	29%
…and in an eligible district	73,633	51%	36,377	25%

Table A4. Demographics of Students in Arkansas Growth Analysis

	Grades 4–8		Grades 8–12	
Demographic Category	All Students in Grade 4	Students in the Analysis	All Students in Grade 8	Students in the Analysis
% low-income	67%	60%	61%	46%
% African American	22%	18%	22%	19%
% Hispanic	9%	10%	8%	6%
% Asian	2%	2%	1%	1%
% Native American	1%	1%	1%	1%
% English Language Learner	7%	7%	5%	2%
% special education	14%	11%	12%	5%

Note: The denominators for the percentages of "All students in grade 4 (or 8)" are students with complete demographic data.

Appendix B: Descriptive Statistics on Districts in the Analysis

Arkansas is a largely rural state whose largest district, the Little Rock School District, had approximately 25,000 K–12 students, averaged across the four initial cohort years.[39] Overall, the majority of Arkansas school districts were small; only 13 (6%) of the 202 eligible districts in the analysis had more than 5,000 students (Figure B1). About half of the districts were in the medium-poverty category with 50–70% low-income students, while about one-quarter of the districts were in each of the lower- and high-poverty categories (Figure B2). Higher-poverty districts were more likely than their lower-poverty counterparts to be small and located in rural areas or small towns—for example, only one of the 41 high-poverty districts had more than 5,000 students, and 38 of the 41 high-poverty districts were located in rural areas (Table B1). High-poverty districts also had greater concentrations of African American and Hispanic students.

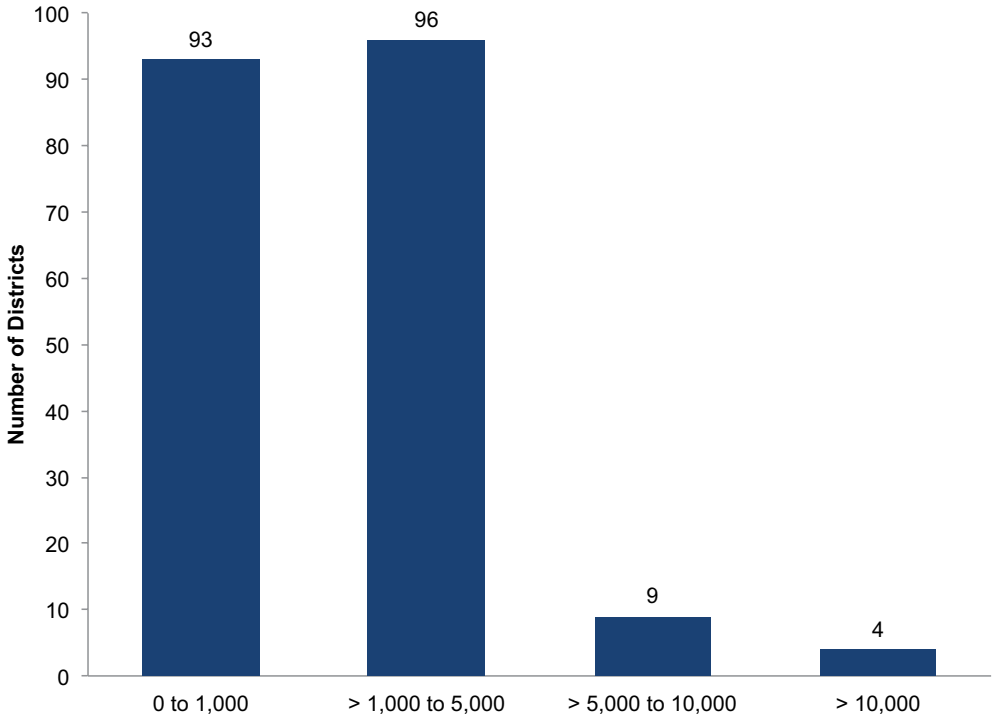

Figure B1. Distribution of eligible districts by total K–12 enrollment (N = 202 districts)

[39] District size and demographic percentages reported in this appendix are based on K–12 statistics averaged across the 2006–07 through the 2009–10 school years.

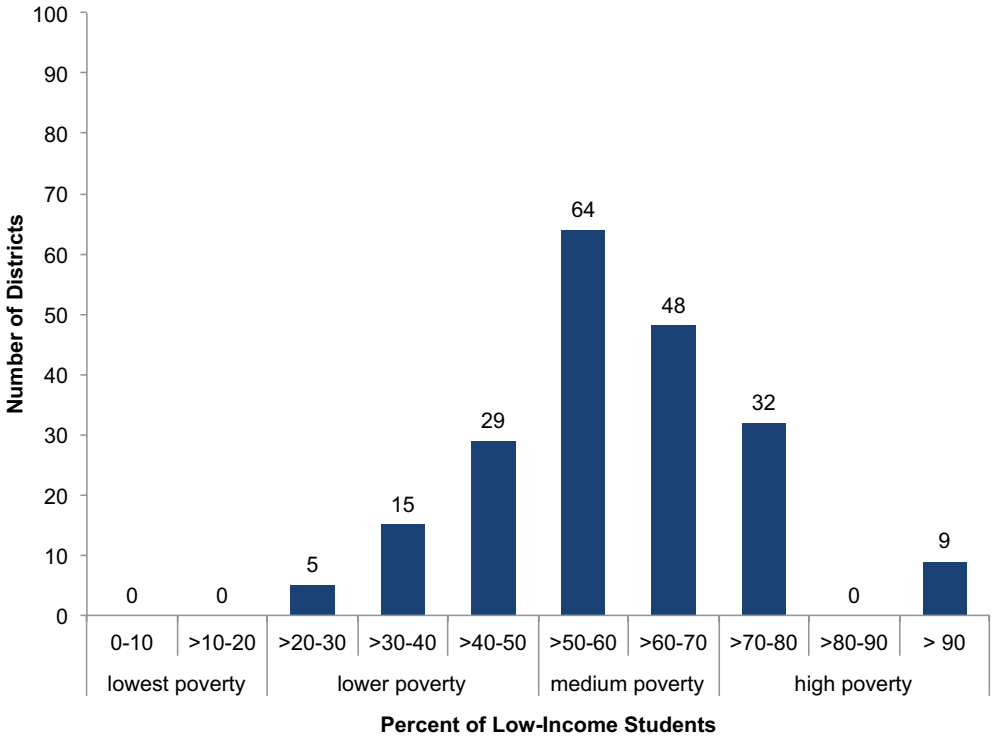

Figure B2. Distribution of eligible districts by their percentage of low-income students (N = 202 districts)

Table B1. District Characteristics by District Poverty Category

	District Poverty Category (Percentage of Low-Income Students)		
District characteristics	**Lower (> 20–50%)**	**Medium (> 50%–70%)**	**High (> 70–100%)**
Number of districts	49	112	41
Average size (Number of K–12 students)	2,521	1,996	1,263
% of districts > 5,000 students	10%	6%	2%
% of districts ≤ 1,000 students	37%	45%	61%
% of districts rural	69%	90%	93%
% African American students	5%	11%	40%
% Hispanic students	3%	5%	6%
% special education students	11%	12%	13%

Note: Statistics are for the 202 districts eligible for the grades 4 and 8 analysis.

Tables B2 and B3 provide district-wide demographic data aggregated across the four initial cohort years (the 2006–07 through the 2009–10 school years). Although three-quarters of districts had 50% or more low-income students, districts with substantial percentages of African American, Hispanic, or English language learner students were in the minority. In addition, Arkansas had relatively few Asian and Native American students.

In addition, Tables B2 and B3 provide information on the number and percentages of students in the analysis, aggregating across the four student cohorts at each grade level. The median percentages of students in the analysis shown in these tables are likely to be higher than the percentages of all students in the analysis shown in Tables A1 and A2, because the denominators for the percentages in Tables A1 and A2 include districts not in the analysis.

Table B2. Descriptive Statistics for Arkansas School Districts in the Grades 4–8 Analysis (N = 202)

	District Percentile						
District Statistic	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
% low-income	35%	42%	50%	58%	65%	74%	79%
% African-American	0%	0%	1%	2%	24%	51%	67%
% Hispanic	1%	1%	1%	2%	5%	11%	17%
% Asian	0%	0%	0%	0%	1%	2%	3%
% Native American	0%	0%	0%	0%	1%	1%	3%
% English Language Learner	0%	0%	0%	1%	3%	7%	11%
% special education	9%	9%	10%	12%	14%	15%	17%
# students in analysis – grade 4	67	76	102	179	365	688	978
# students in analysis – grade 8	73	84	114	196	379	754	984
% students in analysis – grade 4	43%	47%	53%	58%	62%	64%	66%
% students in analysis – grade 8	43%	50%	56%	61%	66%	68%	70%

Note: The statistics shown are based on district-wide demographic data from the 2006–07 through the 2009–10 school years (the initial cohort years) and the number and percentages of students in the analysis for the four cohorts. In general, reading down the columns, the percentiles refer to different districts: For example, the district with the median percentage of low-income students is not necessarily the district that with the median percentage of African American students.

Table B3. Descriptive Statistics for Arkansas School Districts in the Grades 8–12 Analysis (N = 169)

	District Percentile						
District Statistic	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**
% low-income	34%	38%	50%	59%	68%	75%	92%
% African-American	0%	0%	1%	2%	27%	56%	75%
% Hispanic	1%	1%	1%	2%	5%	11%	17%
% Asian	0%	0%	0%	0%	1%	2%	3%
% Native American	0%	0%	0%	0%	1%	2%	3%
% English Language Learner	0%	0%	0%	1%	2%	6%	10%
% special education	9%	10%	10%	12%	14%	15%	17%
# students in analysis – grade 12	33	40	65	118	215	487	630
% students in analysis – grade 12	12%	20%	29%	37%	45%	51%	54%

Note: The statistics shown are based on district-wide demographic data from the 2006–07 through the 2009–10 school years (the initial cohort years) and the number and percentages of students in the analysis for the four cohorts. In general, reading down the columns, the percentiles refer to different districts: For example, the district with the median percentage of low-income students is not necessarily the district that with the median percentage of African American students.

Correlation of District-Level Statistics

Tables B4 and B5 show correlations of district-level statistics used as predictors in the analysis. To calculate these correlations, we aggregated each statistic over the four initial cohort years, rather than using the yearly values of each statistic.

Only a minority of variable pairs had at least moderately high correlations (.3 or greater in absolute value). Not surprisingly, districts' percentages of English Language Learners were strongly related to their percentages of Hispanic students (with a correlation of .94 for the 202 districts in the grades 4–8 analyses and the subset of 169 districts in the grades 8–12 analysis).[40] In addition, districts' percentages of students in poverty were correlated with their percentages of African American students (correlation of .60 in the 202 districts and .62 in the subset of 169 districts), and districts with more low-income students tended to have lower percentages of cohort students in the analysis, as shown by the negative correlations between those two variables in the bottom row of Tables B4 and B5.

Table B4. Pairwise Correlations between District-Level Statistics for Arkansas School Districts: Grades 4–8 Analysis (N = 202)

	% Low-Income	% African American	% Hispanic	% Asian	% Native American	% ELL	% Special Education	# in Analysis
% African American	**.60**							
	.000							
% Hispanic	.04	-.09						
	.528	*.223*						
% Asian	-.16	-.20	**.37**					
	.023	*.005*	*.000*					
% Native American	-.07	-.24	.16	**.33**				
	.298	*.000*	*.024*	*.000*				
% English Language Learner	.04	-.07	**.94**	**.49**	.17			
	.559	*.298*	*.000*	*.000*	*.018*			
% special education	.29	-.10	-.17	-.13	-.03	-.16		
	.000	*.160*	*.013*	*.056*	*.699*	*.025*		
# students in analysis	-.24	.06	**.42**	**.39**	.02	**.50**	-.22	
	.001	*.361*	*.000*	*.000*	*.793*	*.000*	*.002*	
% students in analysis	**-.52**	**-.49**	.17	.12	.02	.14	-.16	.13
	.000	*.000*	*.018*	*.095*	*.822*	*.046*	*.023*	*.072*

Notes: p-values are in italics. Correlations with p-values of .05 or less and with absolute values of .3 or higher are in bold.

[40] This might indicate the possibility of paring down the model by dropping one of those two variables.

Table B5. Pairwise Correlations between District-Level Statistics for Arkansas School Districts: Grades 8–12 Analysis (Grades 8–12 Student Cohorts) (N = 169)

	% Low-Income	% African American	% Hispanic	% Asian	% Native American	% ELL	% Special Education	# in Analysis
% African American	**.62**							
	.000							
% Hispanic	.05	-.08						
	.516	*.315*						
% Asian	-.20	-.19	.21					
	.008	*.012*	*.006*					
% Native American	-.06	-.25	.18	**.39**				
	.412	*.001*	*.019*	*.000*				
%English Language Learner	.05	-.05	**.94**	**.32**	.21			
	.501	*.482*	*.000*	*.000*	*.005*			
% special education	.27	-.10	-.19	-.16	-.02	-.18		
	.000	*.207*	*.012*	*.039*	*.757*	*.016*		
# students in analysis	-.27	.08	.27	.29	.03	**.33**	-.21	
	.000	*.272*	*.000*	*.000*	*.700*	*.000*	*.007*	
% students in analysis	**-.30**	-.15	.13	.12	.00	.07	-.21	.26
	.000	*.046*	*.100*	*.135*	*.975*	*.335*	*.006*	*.001*

Notes: p-values are in italics. Correlations with p-values of .05 or less and with absolute values of .3 or higher are in bold.

Appendix C: Average Scores and Changes in Scores

The tables in this section provide information on average scores relative to On-Track targets and the change in average scores between grades 4 and 8 and grades 8 and 12. This supplements the information shown in Tables 7 and 8, providing information on starting and ending scores, average scores and score changes in average-performing districts, and the number of students involved in each comparison.

In general, students in above-average districts made more progress relative to On-Track targets than did students in average districts, who in turn made more progress than did students in below-average districts. This was not automatically true based on how the districts were chosen, as it was possible for above-average districts to be demographically more disadvantaged than average- or below-average districts in the same poverty category, leading students in the above-average districts to perform worse despite the fact that they performed better once demographics were controlled for.[41]

In some cases, even students in above-average districts did not gain ground relative to the On-Track target. This occurred in grades 8–12 English at all three district poverty levels (Table C2).

Changes in scores were more similar than were starting or ending scores for districts at different poverty levels in the same performance category. For example, in grades 4–8 mathematics, the changes in scores relative to the On-Track target for above-average districts were 0.09, 0.10, and 0.10 in lower-, medium-, and high-poverty districts, respectively (Table C1). On the other hand, average fourth-grade mathematics scores for above-average districts in three poverty categories were -0.15, -0.34, and -0.67, indicating that students in above-average high-poverty districts started out over half a standard deviation below their lower-poverty above-average counterparts and did not significantly narrow this gap between grades 4 and 8.

[41] See Appendix C in Dougherty & Shaw (2016b) for an example. Appendix F in this report shows demographic data on the groups of districts identified in this study.

Table C1. Average Scores and Changes in Scores Relative to On-Track Targets in Grades 4–8

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students	Average Scores Relative to On-Track Target		
					Grade 4	Grade 8	Grades 4–8 Change
Mathematics	Lower	Above average	15	12,202	-0.15	-0.06	0.09
		Average	25	8,621	-0.21	-0.23	-0.01
		Below average	9	3,971	-0.30	-0.46	-0.16
	Medium	Above average	16	4,743	-0.34	-0.24	0.10
		Average	75	31,035	-0.48	-0.50	-0.02
		Below average	21	4,887	-0.42	-0.63	-0.21
	High	Above average	3	710	-0.67	-0.57	0.10
		Average	35	7,080	-0.75	-0.74	0.01
		Below average	3	384	-0.71	-0.81	-0.10
Reading	Lower	Above average	6	3,917	-0.43	-0.08	0.34
		Average	37	17,503	-0.41	-0.18	0.23
		Below average	6	3,374	-0.39	-0.30	0.09
	Medium	Above average	13	4,993	-0.59	-0.26	0.34
		Average	89	33,075	-0.69	-0.46	0.23
		Below average	10	2,597	-0.47	-0.50	-0.03
	High	Above average	3	770	-0.75	-0.47	0.28
		Average	32	5,196	-0.89	-0.70	0.19
		Below average	6	2,208	-1.12	-1.06	0.05

Table C2. Average Scores and Changes in Scores Relative to On-Track Targets in Grades 8–12 English and Mathematics

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students	Average Scores Relative to On-Track Target		
					Grade 8	Grade 12	Grades 8–12 Change
English	Lower	Above average	8	4,932	0.81	0.77	-0.04
		Average	32	8,268	0.65	0.57	-0.09
		Below average	3	686	0.49	0.24	-0.25
	Medium	Above average	7	1,134	0.54	0.48	-0.05
		Average	74	14,483	0.45	0.29	-0.15
		Below average	8	2,284	0.58	0.32	-0.26
	High	Above average	3	485	-0.12	-0.16	-0.03
		Average	30	3,559	0.19	0.00	-0.19
		Below average	4	546	0.02	-0.28	-0.30
Mathematics	Lower	Above average	9	4,806	0.02	0.08	0.06
		Average	27	7,451	-0.06	-0.12	-0.06
		Below average	7	1,629	-0.21	-0.37	-0.16
	Medium	Above average	12	2,683	-0.24	-0.24	-0.01
		Average	65	13,909	-0.35	-0.41	-0.06
		Below average	12	1,309	-0.42	-0.63	-0.21
	High	Above average	5	413	-0.64	-0.52	0.12
		Average	28	3,676	-0.62	-0.71	-0.10
		Below average	4	501	-0.69	-0.94	-0.25

Note: Includes eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

Table C3. Average Scores and Changes in Scores Relative to On-Track Targets in Grades 8–12 Reading and Science

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students	Average Scores Relative to On-Track Target		
					Grade 8	Grade 12	Grades 8–12 Change
Reading	Lower	Above average	6	3,299	-0.04	0.17	0.21
		Average	33	9,734	-0.08	0.06	0.14
		Below average	4	853	-0.32	-0.36	-0.04
	Medium	Above average	5	801	-0.30	-0.10	0.20
		Average	80	16,198	-0.33	-0.23	0.10
		Below average	4	902	-0.33	-0.38	-0.05
	High	Above average	2	349	-0.93	-0.63	0.30
		Average	34	4,135	-0.62	-0.58	0.04
		Below average	1	106	-0.82	-0.98	-0.16
Science	Lower	Above average	5	3,466	-0.10	-0.10	-0.01
		Average	35	9,751	-0.18	-0.25	-0.07
		Below average	3	669	-0.41	-0.64	-0.24
	Medium	Above average	3	1,199	-0.40	-0.41	-0.01
		Average	84	16,495	-0.44	-0.54	-0.11
		Below average	2	207	-0.58	-0.75	-0.16
	High	Above average	1	184	-1.53	-0.97	0.56
		Average	35	4,281	-0.71	-0.88	-0.17
		Below average	1	125	-1.02	-1.39	-0.37

Note: Includes eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

Appendix D: Average Scores and Changes in Scores by Prior Achievement Level

This appendix disaggregates the average scores and changes in scores in Appendix C by students' prior achievement levels, so that the progress of students relative to On-Track targets can be compared for students who started out On Track, Off Track, or Far Off Track in the earlier grade.[42]

In nearly all cases, average score changes for students in above-average districts were greater than for those in average districts, which in turn were greater than those in below-average districts.[43] This is not automatically true based on how the districts were chosen, as it is possible for above-average districts to be demographically more disadvantaged within their poverty category than average- or below-average districts.[44] In addition, it is possible for districts that are above average with their students overall to fail to perform as well with a particular student prior achievement subgroup.

In addition, Far-Off-Track students tended to make more progress on average than their Off-Track counterparts in the same districts, who in turn made more progress than initially On-Track students. For example, in the 15 above-average lower-poverty districts in mathematics in grades 4–8, the Far-Off-Track and Off-Track students gained 0.48 and 0.16 standard deviations, respectively, relative to the On-Track target between grades 4 and 8 (Tables D1 and D4), while previously On-Track students slipped back an average of 0.12 standard deviations relative to the target (Table D7). This pattern is consistent with the statistical phenomenon of regression to the mean.[45]

As was the case in the data shown in Appendix C, changes in scores were more similar across poverty categories than were starting or ending scores for students in the same prior achievement subgroup and district performance level.

[42] Thus, the average fourth- and eighth-grade scores and fourth- to eighth-grade score change of the 12,202 students in the 15 above-average lower-poverty school districts in mathematics (Appendix C, Table C1) are weighted averages of the corresponding scores and score changes of the 1,999 of those students who were Far Off Track, 4,862 who were Off Track, and 5,341 who were On Track in fourth grade, as shown in Tables D1, D4, and D7.

[43] The two exceptions to this pattern were Far-Off-Track students in high-poverty districts in grades 8–12 English (Table D2) and On-Track students in high-poverty districts in grades 8–12 reading (Table D9).

[44] Appendix F in this report shows demographic data on the groups of districts identified in this study.

[45] Because the scores of any predefined group of students contains a random component that is positive on average for students chosen from near the top of the score distribution and negative on average for students chosen from near the bottom, all averages of groups of students *chosen based on their prior performance* tend to move back toward the average of all students. Using a sports analogy, a group of baseball players chosen for the highest batting averages in the first six weeks of the season will probably bat at a lower average for the rest of the season, even if they continue to bat well above the average for all players; the reverse holds for players with the lowest batting averages in the first six weeks (Campbell & Kenny, 1999). This regression effect tends to reduce the average growth of students in the On-Track group and increase the growth of students in the Far-Off-Track group. Regression effects are enhanced when scores are reported in standard deviation units rather than score points. Scores measured in points can spread out due to Matthew effects (Stanovich, 1986) and natural increases over time in the variation in scores. Measuring scores in standard deviations adjusts for these widening gaps in scores, while making no adjustment to offset regression effects.

Table D1. Average Scores and Change in Scores Relative to On-Track Targets in Grades 4–8: Students Who Were Far Off Track in Grade 4

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students Far Off Track in 4th Grade	Average Scores Relative to On-Track Target		
					Grade 4	Grade 8	Grades 4–8 Change
Mathematics	Lower	Above average	15	1,999	-1.53	-1.05	0.48
		Average	25	1,660	-1.55	-1.10	0.45
		Below average	9	812	-1.54	-1.20	0.34
	Medium	Above average	16	1,101	-1.57	-1.04	0.53
		Average	75	8,908	-1.66	-1.28	0.38
		Below average	21	1,309	-1.63	-1.38	0.25
	High	Above average	3	267	-1.65	-1.23	0.41
		Average	35	2,790	-1.71	-1.33	0.38
		Below average	3	146	-1.62	-1.30	0.32
Reading	Lower	Above average	6	943	-1.68	-0.93	0.75
		Average	37	4,224	-1.58	-0.99	0.58
		Below average	6	782	-1.59	-1.04	0.55
	Medium	Above average	13	1,573	-1.63	-0.95	0.68
		Average	89	11,913	-1.72	-1.14	0.58
		Below average	10	663	-1.62	-1.20	0.43
	High	Above average	3	304	-1.77	-1.13	0.63
		Average	32	2,266	-1.73	-1.21	0.52
		Below average	6	1,227	-1.78	-1.40	0.38

Table D2. Average Scores and Change in Scores Relative to On-Track Targets in Grades 8–12 English and Mathematics: Students Who Were Far Off Track in Grade 8

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students Far Off Track in 8th Grade	Average Scores Relative to On-Track Target		
					Grade 8	Grade 12	Grades 8–12 Change
English	Lower	Above average	8	23	-1.58	-0.51	1.08
		Average	32	71	-1.45	-0.75	0.70
		Below average	3	7	NR	NR	NR
	Medium	Above average	7	10	NR	NR	NR
		Average	74	252	-1.56	-0.91	0.66
		Below average	8	19	NR	NR	NR
	High	Above average	3	26	-1.36	-1.01	0.35
		Average	30	99	-1.55	-1.02	0.53
		Below average	4	21	-1.54	-1.27	0.27
Mathematics	Lower	Above average	9	435	-1.69	-0.97	0.71
		Average	27	737	-1.68	-1.08	0.60
		Below average	7	240	-1.67	-1.14	0.52
	Medium	Above average	12	399	-1.71	-1.04	0.67
		Average	65	2,685	-1.74	-1.17	0.57
		Below average	12	253	-1.79	-1.24	0.56
	High	Above average	5	114	-1.96	-1.15	0.82
		Average	28	1,036	-1.80	-1.22	0.58
		Below average	4	133	-1.91	-1.34	0.56

Note: Based on eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

NR = Not Reported because the calculation is based on a group of fewer than 20 students.

Table D3. Average Scores and Change in Scores Relative to On-Track Targets in Grades 8–12 Reading and Science: Students Who Were Far Off Track in Grade 8

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students Off Track in 8th Grade	Average Scores Relative to On-Track Target		
					Grade 8	Grade 12	Grades 8–12 Change
Reading	Lower	Above average	6	625	-1.31	-0.71	0.61
		Average	33	1,955	-1.31	-0.77	0.54
		Below average	4	240	-1.36	-1.06	0.30
	Medium	Above average	5	218	-1.31	-0.78	0.53
		Average	80	4,821	-1.34	-0.95	0.39
		Below average	4	260	-1.29	-0.98	0.31
	High	Above average	2	213	-1.45	-0.91	0.54
		Average	34	1,779	-1.36	-1.08	0.27
		Below average	1	50	-1.37	-1.38	-0.01
Science	Lower	Above average	5	396	-1.54	-0.93	0.61
		Average	35	1,342	-1.53	-1.01	0.51
		Below average	3	128	-1.53	-1.28	0.25
	Medium	Above average	3	280	-1.61	-1.08	0.53
		Average	84	3,588	-1.59	-1.22	0.36
		Below average	2	55	-1.54	-1.24	0.30
	High	Above average	1	114	-2.15	-1.13	1.02
		Average	35	1,388	-1.60	-1.39	0.21
		Below average	1	53	-1.69	-1.64	0.05

Note: Based on eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

Table D4. Average Scores and Change in Scores Relative to On-Track Targets in Grades 4–8: Students Who Were Off Track in Grade 4

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students Off Track in 4th Grade	Average Scores Relative to On-Track Target		
					Grade 4	Grade 8	Grades 4–8 Change
Mathematics	Lower	Above average	15	4,862	-0.45	-0.29	0.16
		Average	25	3,359	-0.45	-0.41	0.03
		Below average	9	1,675	-0.47	-0.60	-0.12
	Medium	Above average	16	1,937	-0.46	-0.32	0.15
		Average	75	12,204	-0.48	-0.51	-0.03
		Below average	21	1,906	-0.48	-0.67	-0.19
	High	Above average	3	269	-0.51	-0.51	0.01
		Average	35	2,697	-0.50	-0.62	-0.12
		Below average	3	151	-0.52	-0.75	-0.22
Reading	Lower	Above average	6	1,631	-0.47	-0.21	0.26
		Average	37	7,342	-0.49	-0.30	0.19
		Below average	6	1,384	-0.47	-0.43	0.03
	Medium	Above average	13	2,062	-0.50	-0.26	0.24
		Average	89	12,855	-0.50	-0.41	0.09
		Below average	10	1,108	-0.49	-0.59	-0.10
	High	Above average	3	266	-0.51	-0.45	0.06
		Average	32	2,027	-0.54	-0.56	-0.02
		Below average	6	716	-0.54	-0.83	-0.29

Table D5. Average Scores and Change in Scores Relative to On-Track Targets in Grades 8–12 English and Mathematics: Students Who Were Off Track in Grade 8

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students Off Track in 8th Grade	Average Scores Relative to On-Track Target		
					Grade 8	Grade 12	Grades 8–12 Change
English	Lower	Above average	8	882	-0.49	-0.20	0.29
		Average	32	1,919	-0.50	-0.30	0.20
		Below average	3	193	-0.51	-0.52	-0.02
	Medium	Above average	7	307	-0.53	-0.34	0.19
		Average	74	4,451	-0.53	-0.48	0.05
		Below average	8	597	-0.51	-0.48	0.03
	High	Above average	3	256	-0.61	-0.50	0.11
		Average	30	1,475	-0.56	-0.59	-0.03
		Below average	4	261	-0.57	-0.73	-0.16
Mathematics	Lower	Above average	9	1,576	-0.52	-0.44	0.09
		Average	27	2,650	-0.53	-0.55	-0.02
		Below average	7	628	-0.54	-0.67	-0.13
	Medium	Above average	12	1,022	-0.55	-0.60	-0.05
		Average	65	5,499	-0.56	-0.70	-0.14
		Below average	12	561	-0.55	-0.82	-0.27
	High	Above average	5	170	-0.56	-0.65	-0.09
		Average	28	1,532	-0.58	-0.85	-0.27
		Below average	4	225	-0.60	-1.05	-0.45

Note: Based on eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

Table D6. Average Scores and Change in Scores Relative to On-Track Targets in Grades 8–12 Reading and Science: Students Who Were Off Track in Grade 8

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students Off Track in 8th Grade	Average Scores Relative to On-Track Target		
					Grade 8	Grade 12	Grades 8–12 Change
Reading	Lower	Above average	6	1,101	-0.48	-0.16	0.32
		Average	33	3,284	-0.49	-0.24	0.25
		Below average	4	303	-0.49	-0.46	0.03
	Medium	Above average	5	291	-0.50	-0.25	0.25
		Average	80	5,624	-0.50	-0.37	0.13
		Below average	4	329	-0.52	-0.55	-0.03
	High	Above average	2	84	-0.54	-0.43	0.11
		Average	34	1,390	-0.53	-0.54	-0.01
		Below average	1	40	-0.60	-0.79	-0.18
Science	Lower	Above average	5	1,360	-0.54	-0.49	0.05
		Average	35	3,991	-0.54	-0.56	-0.01
		Below average	3	320	-0.57	-0.81	-0.24
	Medium	Above average	3	496	-0.58	-0.64	-0.07
		Average	84	7,410	-0.58	-0.73	-0.15
		Below average	2	101	-0.57	-0.81	-0.24
	High	Above average	1	59	-0.67	-0.84	-0.17
		Average	35	1,966	-0.61	-0.87	-0.26
		Below average	1	58	-0.66	-1.25	-0.58

Note: Based on eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

Table D7. Average Scores and Change in Scores Relative to On-Track Targets in Grades 4–8: Students Who Were On Track in Grade 4

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students On Track in 4th Grade	Average Scores Relative to On-Track Target		
					Grade 4	Grade 8	Grades 4–8 Change
Mathematics	Lower	Above average	15	5,341	0.63	0.51	-0.12
		Average	25	3,602	0.62	0.35	-0.27
		Below average	9	1,484	0.58	0.11	-0.48
	Medium	Above average	16	1,705	0.60	0.38	-0.22
		Average	75	9,923	0.59	0.23	-0.36
		Below average	21	1,672	0.58	0.01	-0.58
	High	Above average	3	174	0.60	0.35	-0.25
		Average	35	1,593	0.52	0.09	-0.43
		Below average	3	87	0.46	-0.12	-0.59
Reading	Lower	Above average	6	1,343	0.50	0.67	0.17
		Average	37	5,937	0.50	0.54	0.04
		Below average	6	1,208	0.48	0.34	-0.14
	Medium	Above average	13	1,358	0.48	0.56	0.08
		Average	89	8,307	0.48	0.42	-0.06
		Below average	10	826	0.49	0.18	-0.31
	High	Above average	3	200	0.48	0.52	0.03
		Average	32	903	0.46	0.28	-0.19
		Below average	6	265	0.41	-0.14	-0.54

Table D8. Average Scores and Change in Scores Relative to On-Track Targets in Grades 8–12 English and Mathematics: Students Who Were On Track in Grade 8

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students On Track in 8th Grade	Average Scores Relative to On-Track Target		
					Grade 8	Grade 12	Grades 8–12 Change
English	Lower	Above average	8	4,027	1.11	0.99	-0.12
		Average	32	6,278	1.03	0.85	-0.18
		Below average	3	486	0.92	0.56	-0.35
	Medium	Above average	7	817	0.96	0.81	-0.15
		Average	74	9,780	0.94	0.67	-0.27
		Below average	8	1,668	1.00	0.62	-0.38
	High	Above average	3	203	0.65	0.39	-0.26
		Average	30	1,985	0.83	0.48	-0.35
		Below average	4	264	0.72	0.25	-0.48
Mathematics	Lower	Above average	9	2,795	0.60	0.54	-0.05
		Average	27	4,064	0.54	0.33	-0.21
		Below average	7	761	0.52	0.13	-0.39
	Medium	Above average	12	1,262	0.48	0.29	-0.19
		Average	65	5,725	0.50	0.23	-0.27
		Below average	12	495	0.43	-0.11	-0.54
	High	Above average	5	129	0.43	0.21	-0.23
		Average	28	1,108	0.43	-0.06	-0.49
		Below average	4	143	0.31	-0.39	-0.70

Note: Based on eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

Table D9. Average Scores and Change in Scores Relative to On-Track Targets in Grades 8–12 Reading and Science: Students Who Were On Track in Grade 8

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students On Track in 8th Grade	Average Scores Relative to On-Track Target		
					Grade 8	Grade 12	Grades 8–12 Change
Reading	Lower	Above average	6	1,573	0.77	0.75	-0.02
		Average	33	4,495	0.74	0.64	-0.10
		Below average	4	310	0.65	0.28	-0.36
	Medium	Above average	5	292	0.67	0.57	-0.10
		Average	80	5,753	0.70	0.52	-0.18
		Below average	4	313	0.68	0.31	-0.37
	High	Above average	2	52	0.56	0.21	-0.35
		Average	34	966	0.62	0.30	-0.32
		Below average	1	16	NR	NR	NR
Science	Lower	Above average	5	1,710	0.59	0.40	-0.19
		Average	35	4,418	0.55	0.25	-0.30
		Below average	3	221	0.48	-0.03	-0.51
	Medium	Above average	3	423	0.61	0.30	-0.30
		Average	84	5,497	0.50	0.14	-0.36
		Below average	2	51	0.42	-0.09	-0.51
	High	Above average	1	11	NR	NR	NR
		Average	35	927	0.40	-0.12	-0.52
		Below average	1	14	NR	NR	NR

Note: Based on eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

NR = Not Reported because the calculation is based on a group of fewer than 20 students.

Appendix E: On-Track Percentages by Prior Achievement Level

The tables in this section supplement the information in Tables 9–14 by providing information on percentages of students getting On Track in average school districts, and on numbers of students in each prior achievement group.

As expected, in most cases above-average districts had more students reaching On-Track status than in average and below-average districts. In cases where this pattern is reversed, in all but two cases the reversal is not reflected in the average growth statistics in Appendix D. In addition, some differences are sensitive to score changes by a small number of students. For example, 4% of Far-Off-Track students got On Track in grade 8 mathematics in high-poverty below-average districts, compared with 3% in average and above-average districts (Table E1). However, the order of these percentages would have changed had two fewer students in the below-average districts reached the On-Track level.

Table E1. Percentages of Far-Off-Track Fourth-Grade Students Getting On Track in Grade 8, by District Poverty and Performance

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students Far Off Track in 4th Grade	Number Getting On Track in 8th Grade	Percent Getting On Track in 8th Grade
Mathematics	Lower	Above average	15	1,999	125	6%
		Average	25	1,660	87	5%
		Below average	9	812	28	3%
	Medium	Above average	16	1,101	56	5%
		Average	75	8,908	252	3%
		Below average	21	1,309	26	2%
	High	Above average	3	267	9	3%
		Average	35	2,790	80	3%
		Below average	3	146	6	4%
Reading	Lower	Above average	6	943	92	10%
		Average	37	4,224	291	7%
		Below average	6	782	58	7%
	Medium	Above average	13	1,573	143	9%
		Average	89	11,913	493	4%
		Below average	10	663	25	4%
	High	Above average	3	304	19	6%
		Average	32	2,266	58	3%
		Below average	6	1,227	13	1%

Table E2. Percentages of Far-Off-Track Eighth-Grade Students Getting On Track in Grades 11–12 English and Mathematics, by District Poverty and Performance

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students Far Off Track in 8th Grade	Number Getting On Track by 12th Grade	Percent Getting On Track by 12th Grade
English	Lower	Above average	8	23	7	30%
		Average	32	71	8	11%
		Below average	3	7	NR	NR
	Medium	Above average	7	10	NR	NR
		Average	74	252	23	9%
		Below average	8	19	NR	NR
	High	Above average	3	26	1	4%
		Average	30	99	6	6%
		Below average	4	21	0	0%
Mathematics	Lower	Above average	9	435	32	7%
		Average	27	737	28	4%
		Below average	7	240	6	3%
	Medium	Above average	12	399	23	6%
		Average	65	2,685	72	3%
		Below average	12	253	3	1%
	High	Above average	5	114	2	2%
		Average	28	1,036	14	1%
		Below average	4	133	0	0%

Notes: Based on eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

NR = Not Reported because the calculation is based on a group of fewer than 20 students.

Table E3. Percentages of Far-Off-Track Eighth-Grade Students Getting On Track in Grades 11–12 Reading and Science, by District Poverty and Performance

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students Far Off Track in 8th Grade	Number Getting On Track by 12th Grade	Percent Getting On Track by 12th Grade
Reading	Lower	Above average	6	625	110	18%
		Average	33	1,955	259	13%
		Below average	4	240	13	5%
	Medium	Above average	5	218	29	13%
		Average	80	4,821	404	8%
		Below average	4	260	17	7%
	High	Above average	2	213	23	11%
		Average	34	1,779	78	4%
		Below average	1	50	0	0%
Science	Lower	Above average	5	396	49	12%
		Average	35	1,342	120	9%
		Below average	3	128	5	4%
	Medium	Above average	3	280	24	9%
		Average	84	3,588	205	6%
		Below average	2	55	5	9%
	High	Above average	1	114	7	6%
		Average	35	1,388	45	3%
		Below average	1	53	0	0%

Note: Based on eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

Table E4. Percentages of Off-Track Fourth-Grade Students Getting On Track in Grade 8, by District Poverty and Performance

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students Off Track in 4th Grade	Number Getting On Track in 8th Grade	Percent Getting On Track in 8th Grade
Mathematics	Lower	Above average	15	4,862	1,868	38%
		Average	25	3,359	1,014	30%
		Below average	9	1,675	360	21%
	Medium	Above average	16	1,937	685	35%
		Average	75	12,204	3,052	25%
		Below average	21	1,906	342	18%
	High	Above average	3	269	54	20%
		Average	35	2,697	519	19%
		Below average	3	151	21	14%
Reading	Lower	Above average	6	1,631	619	38%
		Average	37	7,342	2,489	34%
		Below average	6	1,384	394	28%
	Medium	Above average	13	2,062	728	35%
		Average	89	12,855	3,657	28%
		Below average	10	1,108	225	20%
	High	Above average	3	266	66	25%
		Average	32	2,027	446	22%
		Below average	6	716	96	13%

Table E5. Percentages of Off-Track Eighth-Grade Students Getting On Track in Grades 11–12 English and Mathematics, by District Poverty and Performance

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students Off Track in 8th Grade	Number Getting On Track by 12th Grade	Percent Getting On Track by 12th Grade
English	Lower	Above average	8	882	360	41%
		Average	32	1,919	678	35%
		Below average	3	193	45	23%
	Medium	Above average	7	307	106	35%
		Average	74	4,451	1,112	25%
		Below average	8	597	147	25%
	High	Above average	3	256	69	27%
		Average	30	1,475	268	18%
		Below average	4	261	23	9%
Mathematics	Lower	Above average	9	1,576	492	31%
		Average	27	2,650	643	24%
		Below average	7	628	120	19%
	Medium	Above average	12	1,022	220	22%
		Average	65	5,499	941	17%
		Below average	12	561	62	11%
	High	Above average	5	170	28	16%
		Average	28	1,532	158	10%
		Below average	4	225	9	4%

Note: Based on eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

Table E6. Percentages of Off-Track Eighth-Grade Students Getting On Track in Grades 11–12 Reading and Science, by District Poverty and Performance

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students Off Track in 8th Grade	Number Getting On Track by 12th Grade	Percent Getting On Track by 12th Grade
Reading	Lower	Above average	6	1,101	470	43%
		Average	33	3,284	1,207	37%
		Below average	4	303	72	24%
	Medium	Above average	5	291	113	39%
		Average	80	5,624	1,689	30%
		Below average	4	329	60	18%
	High	Above average	2	84	24	29%
		Average	34	1,390	316	23%
		Below average	1	40	6	15%
Science	Lower	Above average	5	1,360	360	26%
		Average	35	3,991	943	24%
		Below average	3	320	44	14%
	Medium	Above average	3	496	122	25%
		Average	84	7,410	1,276	17%
		Below average	2	101	14	14%
	High	Above average	1	59	6	10%
		Average	35	1,966	238	12%
		Below average	1	58	0	0%

Note: Based on eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

Table E7. Percentages of On-Track Fourth-Grade Students Staying On Track in Grade 8, by District Poverty and Performance

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students On Track in 4th Grade	Number Staying On Track in 8th Grade	Percent Staying On Track in 8th Grade
Mathematics	Lower	Above average	15	5,341	4,242	79%
		Average	25	3,602	2,652	74%
		Below average	9	1,484	890	60%
	Medium	Above average	16	1,705	1,288	76%
		Average	75	9,923	6,691	67%
		Below average	21	1,672	934	56%
	High	Above average	3	174	121	70%
		Average	35	1,593	985	62%
		Below average	3	87	51	59%
Reading	Lower	Above average	6	1,343	1,040	77%
		Average	37	5,937	4,367	74%
		Below average	6	1,208	775	64%
	Medium	Above average	13	1,358	1,007	74%
		Average	89	8,307	5,703	69%
		Below average	10	826	488	59%
	High	Above average	3	200	143	72%
		Average	32	903	546	60%
		Below average	6	265	114	43%

Table E8. Percentages of On-Track Eighth-Grade Students Staying On Track in Grades 11–12 English and Mathematics, by District Poverty and Performance

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students On Track in 8th Grade	Number Staying On Track in 12th Grade	Percent Staying On Track in 12th Grade
English	Lower	Above average	8	4,027	3,646	91%
		Average	32	6,278	5,557	89%
		Below average	3	486	384	79%
	Medium	Above average	7	817	694	85%
		Average	74	9,780	8,014	82%
		Below average	8	1,668	1,340	80%
	High	Above average	3	203	150	74%
		Average	30	1,985	1,492	75%
		Below average	4	264	164	62%
Mathematics	Lower	Above average	9	2,795	2,212	79%
		Average	27	4,064	2,937	72%
		Below average	7	761	470	62%
	Medium	Above average	12	1,262	897	71%
		Average	65	5,725	3,821	67%
		Below average	12	495	249	50%
	High	Above average	5	129	87	67%
		Average	28	1,108	582	53%
		Below average	4	143	46	32%

Note: Based on eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

Table E9. Percentages of On-Track Eighth-Grade Students Staying On Track in Grades 11–12 Reading and Science, by District Poverty and Performance

Subject	District Poverty Category	District Performance Level	Number of Districts	Number of Students On Track in 8th Grade	Number Staying On Track in 12th Grade	Percent Staying On Track in 12th Grade
Reading	Lower	Above average	6	1,573	1,307	83%
		Average	33	4,495	3,615	80%
		Below average	4	310	195	63%
	Medium	Above average	5	292	227	78%
		Average	80	5,753	4,290	75%
		Below average	4	313	212	68%
	High	Above average	2	52	34	65%
		Average	34	966	613	63%
		Below average	1	16	NR	NR
Science	Lower	Above average	5	1,710	1,241	73%
		Average	35	4,418	3,031	69%
		Below average	3	221	116	52%
	Medium	Above average	3	423	293	69%
		Average	84	5,497	3,403	62%
		Below average	2	51	26	51%
	High	Above average	1	11	NR	NR
		Average	35	927	453	49%
		Below average	1	14	NR	NR

Notes: Based on eleventh-grade scores for twelfth graders who took the ACT for the last time in grade 11.

NR = Not Reported because the calculation is based on a group of fewer than 20 students.

Appendix F: District-Wide Demographic Statistics by District Poverty and Performance

This appendix provides district-wide demographic data across kindergarten through twelfth grade on the groups of districts whose value-added performance statistics and student growth statistics are compared in this report. These demographic statistics are averaged across the four initial cohort years (2006–07 through 2009–10).

The tables show that even within poverty categories, there may be substantial differences in average demographics between the above-average, average, and below-average districts as identified by the statistical models. That is why it can be helpful to use statistical models to control for these demographic differences.

Table F1. District-Wide Demographic Statistics by District Poverty and Performance in Grade 8 English and Mathematics

Subject	District Poverty Level	District Performance Level	Low-Income	African American	Hispanic	Asian	English Language Learner	Special Education
English	Lower	Above average	37%	7%	6%	2%	4%	11%
		Average	37%	6%	5%	1%	2%	11%
		Below average	39%	2%	2%	1%	1%	12%
	Medium	Above average	57%	16%	7%	1%	4%	12%
		Average	59%	23%	12%	2%	10%	11%
		Below average	59%	16%	5%	1%	2%	12%
	High	Above average	75%	38%	3%	1%	2%	13%
		Average	80%	53%	7%	1%	4%	12%
		Below average	84%	54%	11%	0%	5%	11%
Mathematics	Lower	Above average	37%	8%	6%	2%	4%	11%
		Average	39%	4%	3%	1%	1%	11%
		Below average	38%	3%	3%	1%	1%	12%
	Medium	Above average	58%	15%	7%	1%	5%	11%
		Average	59%	23%	12%	2%	10%	11%
		Below average	60%	20%	3%	0%	1%	12%
	High	Above average	85%	54%	4%	0%	3%	11%
		Average	80%	52%	7%	1%	4%	12%
		Below average	73%	31%	10%	1%	4%	15%

Table F2. District-Wide Demographic Statistics by District Poverty and Performance in Grade 8 Reading and Science

Subject	District Poverty Level	District Performance Level	Low-Income	African American	Hispanic	Asian	English Language Learner	Special Education
Reading	Lower	Above average	41%	7%	6%	2%	4%	11%
		Average	37%	6%	5%	1%	2%	11%
		Below average	38%	2%	3%	1%	1%	11%
	Medium	Above average	56%	18%	7%	1%	4%	13%
		Average	59%	23%	12%	2%	9%	11%
		Below average	58%	9%	3%	1%	1%	12%
	High	Above average	72%	40%	1%	1%	0%	11%
		Average	81%	46%	9%	1%	5%	12%
		Below average	82%	69%	5%	0%	3%	12%
Science	Lower	Above average	34%	5%	6%	2%	4%	11%
		Average	40%	7%	3%	1%	1%	11%
		Below average	44%	2%	2%	1%	0%	11%
	Medium	Above average	57%	19%	8%	1%	5%	11%
		Average	59%	24%	12%	2%	9%	11%
		Below average	59%	7%	3%	1%	1%	12%
	High	Above average	81%	43%	3%	1%	2%	12%
		Average	78%	41%	10%	1%	5%	12%
		Below average	87%	79%	2%	0%	1%	12%

Table F3. District-Wide Demographic Statistics by District Poverty and Performance in Grades 11–12 English and Mathematics

Subject	District Poverty Level	District Performance Level	Low-Income	African American	Hispanic	Asian	English Language Learner	Special Education
English	Lower	Above average	36%	11%	6%	2%	3%	11%
		Average	38%	3%	4%	2%	2%	11%
		Below average	38%	7%	2%	2%	0%	9%
	Medium	Above average	59%	11%	3%	0%	1%	12%
		Average	60%	28%	6%	1%	4%	11%
		Below average	59%	6%	26%	2%	20%	12%
	High	Above average	88%	68%	1%	0%	1%	12%
		Average	80%	51%	8%	1%	4%	12%
		Below average	81%	64%	10%	0%	5%	10%
Mathematics	Lower	Above average	37%	5%	5%	2%	3%	11%
		Average	37%	7%	5%	2%	2%	11%
		Below average	35%	6%	3%	1%	2%	11%
	Medium	Above average	57%	12%	7%	1%	4%	11%
		Average	60%	26%	10%	1%	7%	12%
		Below average	59%	10%	5%	2%	3%	12%
	High	Above average	78%	40%	5%	1%	1%	13%
		Average	81%	54%	8%	1%	5%	12%
		Below average	81%	62%	2%	0%	0%	10%

Table F4. District-Wide Demographic Statistics by District Poverty and Performance in Grades 11–12 Reading and Science

Subject	District Poverty Level	District Performance Level	Low-Income	African American	Hispanic	Asian	English Language Learner	Special Education
Reading	Lower	Above average	37%	6%	5%	2%	4%	12%
		Average	37%	6%	5%	2%	2%	11%
		Below average	39%	7%	2%	1%	0%	9%
	Medium	Above average	58%	14%	3%	1%	1%	11%
		Average	60%	24%	9%	1%	6%	12%
		Below average	62%	26%	5%	1%	3%	12%
	High	Above average	76%	87%	1%	0%	0%	12%
		Average	82%	49%	9%	1%	4%	12%
		Below average	79%	62%	1%	0%	0%	11%
Science	Lower	Above average	38%	13%	6%	2%	4%	12%
		Average	37%	3%	4%	1%	2%	11%
		Below average	38%	10%	2%	2%	0%	8%
	Medium	Above average	63%	31%	6%	1%	3%	12%
		Average	60%	23%	9%	1%	6%	12%
		Below average	60%	0%	5%	0%	1%	15%
	High	Above average	77%	97%	1%	0%	0%	12%
		Average	81%	47%	9%	1%	4%	12%
		Below average	92%	93%	1%	0%	0%	11%

Appendix G: Fixed-Effect Coefficients from Statistical Models

Tables G1 and G2 show the fixed-effect coefficients from the hierarchical models, measured in units of scale score points on the test used as the dependent variable. These are partial effects: For example, in Table G1, the fixed-effect coefficient for "low-income status" of -0.447 in eighth-grade English indicates that the predicted score of a low-income student is just under half a point (about one-ninth of a standard deviation) lower on the grade 8 ACT Explore English test than the predicted score of a non-low-income student who has the same values of the other variables in the model. No interaction effects were modeled, i.e., we did not model how a student's ethnicity or prior score might affect the differences in predicted scores between low- and non-low-income students.

The tables also show the standard deviation of the district random effects in each model, labeled as "SD of random effects (pts)." This statistic estimates the variation across districts in the true random effect. For example, in Table F1, the "SD of random effects (pts)" is 0.36 in eighth-grade English. Given the assumed normal distribution of the random effect in the model, for approximately two-thirds of the districts, the absolute value of the random effect is 0.36 score points or less; for approximately 95% of the districts, the absolute value of the random effect is 0.72 score points or less.

We also converted these standard deviations, measured in score points, into standardized form by dividing them by the standard deviation of student scores on the test in question. This facilitates comparisons with the sizes of the district effects of above- and below-average districts shown in Tables 4 and 5. For example, for eighth-grade English, the standard deviation of 0.36 score points translates into a standardized standard deviation of 0.09. Thus, the absolute value of the random effect is 0.09 of a test score standard deviation or less in approximately two-thirds of the districts and 0.18 standard deviations or less in approximately 95% of the districts.

Table G1. Fixed-Effect Coefficients in Regressions Predicting Grade 8 Scores

Variable	English		Mathematics		Reading		Science	
Intercept	3.444	***	5.496	***	6.896	***	9.266	***
Low-Income Status	-0.447	***	-0.428	***	-0.371	***	-0.351	***
African American Status	-0.433	***	-0.271	***	-0.415	***	-0.264	***
Hispanic Status	-0.140	**	-0.001		-0.019		0.067	
Asian Status	0.439	***	0.622	***	0.572	***	0.563	***
Native American Status	-0.185		0.186	*	-0.035		0.014	
ELL Status	-0.194	***	-0.011		-0.090		-0.075	
Special Education Status	0.231	***	-0.389	***	0.491	***	0.117	***
Fourth-Grade Literacy Score	0.012	***	0.004	***	0.011	***	0.006	***
Fourth-Grade Mathematics Score	0.011	***	0.017	***	0.008	***	0.011	***
Number Years between Tests	0.875	***	0.963	***	0.361		0.449	*
District % Low-Income	-0.007	***	-0.012	***	-0.008	***	-0.009	***
District % African American	-0.006	***	-0.003	*	-0.009	***	-0.003	
District % Hispanic	0.003		0.030	***	0.011		0.008	
District % Asian	0.013		-0.009		-0.017		0.012	
District % Native American	-0.022		-0.022		-0.004		0.013	
District % ELL	-0.008		-0.030	**	-0.014		-0.005	
District % Special Education	-0.024	***	-0.004		-0.033	***	-0.017	*
District Avg. Grade 4 Literacy Score	-0.002	***	0.001		-0.003	***	0.000	
District Avg. Grade 4 Mathematics Score	-0.006	***	-0.009	***	-0.005	***	-0.007	***
District Number Students in Model	0.000		0.000		0.000		0.000	
District % Students in Model	0.001		-0.002		0.000		-0.001	
Rural District	-0.351	***	-0.106		-0.154		-0.095	
Earlier Record Deleted	-0.911	***	-0.887	***	-0.790	***	-0.672	***
Took Eighth-Grade Test in 2012	-0.376	***	-0.196	***	-0.165	***	-0.418	***
Took Eighth-Grade Test in 2013	-0.318	***	-0.397	***	-0.109	**	-0.217	***
Took Eighth-Grade Test in 2014	-0.738	***	-0.768	***	-0.541	***	-0.499	***
SD of random effect (pts)	0.36		0.41		0.37		0.37	
SD of random effect (std)	0.09		0.12		0.10		0.11	

***Significant at the .01 level. **Significant at the .05 level. *Significant at the .10 level.

Table G2. Fixed-Effect Coefficients in Regressions Predicting Grades 11–12 Scores

Variable	English		Mathematics		Reading		Science	
Intercept	0.265		7.817	***	1.983	**	5.714	***
Low-Income Status	-0.944	***	-0.610	***	-0.382	***	-0.456	***
African American Status	-1.367	***	-0.761	***	-1.298	***	-1.137	***
Hispanic Status	-0.678	***	-0.255	***	-0.810	***	-0.631	***
Asian Status	0.803	***	1.455	***	0.398	**	0.686	***
Native American Status	-0.406	*	-0.165		-0.063		-0.312	
ELL Status	-0.877	***	-0.012		-0.706	***	-0.221	
Special Education Status	-1.165	***	0.122		-0.394	***	-0.126	
Eighth-Grade English Score	0.640	***	0.193	***	0.396	***	0.194	***
Eighth-Grade Mathematics Score	0.261	***	0.522	***	0.166	***	0.361	***
Eighth-Grade Reading Score	0.287	***	0.062	***	0.536	***	0.190	***
Eighth-Grade Science Score	0.218	***	0.298	***	0.239	***	0.345	***
Number Years between Tests	1.135	***	0.164	***	0.660	***	0.469	***
District % Low-Income	-0.010	**	-0.021	***	-0.010	**	-0.014	***
District % African American	0.004		0.007	**	0.002		0.005	**
District % Hispanic	-0.034	**	-0.003		-0.047	***	-0.025	*
District % Asian	0.023		0.097	**	0.033		0.073	**
District % Native American	-0.007		-0.001		0.043		0.002	
District % ELL	0.053	**	0.026		0.081	***	0.040	**
District % Special Education	-0.024		-0.007		0.005		-0.002	
District Avg. Grade 8 English Score	-0.199	***	-0.153	***	-0.109		0.031	
District Avg. Grade 8 Mathematics Score	0.019		-0.080		0.089		-0.024	
District Avg. Grade 8 Reading Score	0.008		0.050		-0.014		-0.073	
District Avg. Grade 8 Science Score	-0.095		-0.074		-0.156	*	-0.118	*
District Number Students in Model	0.000		0.000		0.000		0.001	*
District % Students in Model	-0.006	*	-0.004		-0.007	**	-0.009	***
Rural District	-0.665	***	-0.229		-0.484	***	-0.290	**
Earlier Record Deleted	0.479		1.015	**	0.734		-0.113	
Twelfth Grader in 2012	-0.191	***	-0.097	*	-0.048		-0.244	***
Twelfth Grader in 2013	-0.042		0.100	*	0.091		-0.062	
Twelfth Grader in 2014	-0.278	***	-0.168	**	0.006		-0.158	**
SD of random effect (pts)	0.51		0.55		0.45		0.35	
SD of random effect (std)	0.08		0.10		0.07		0.07	

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