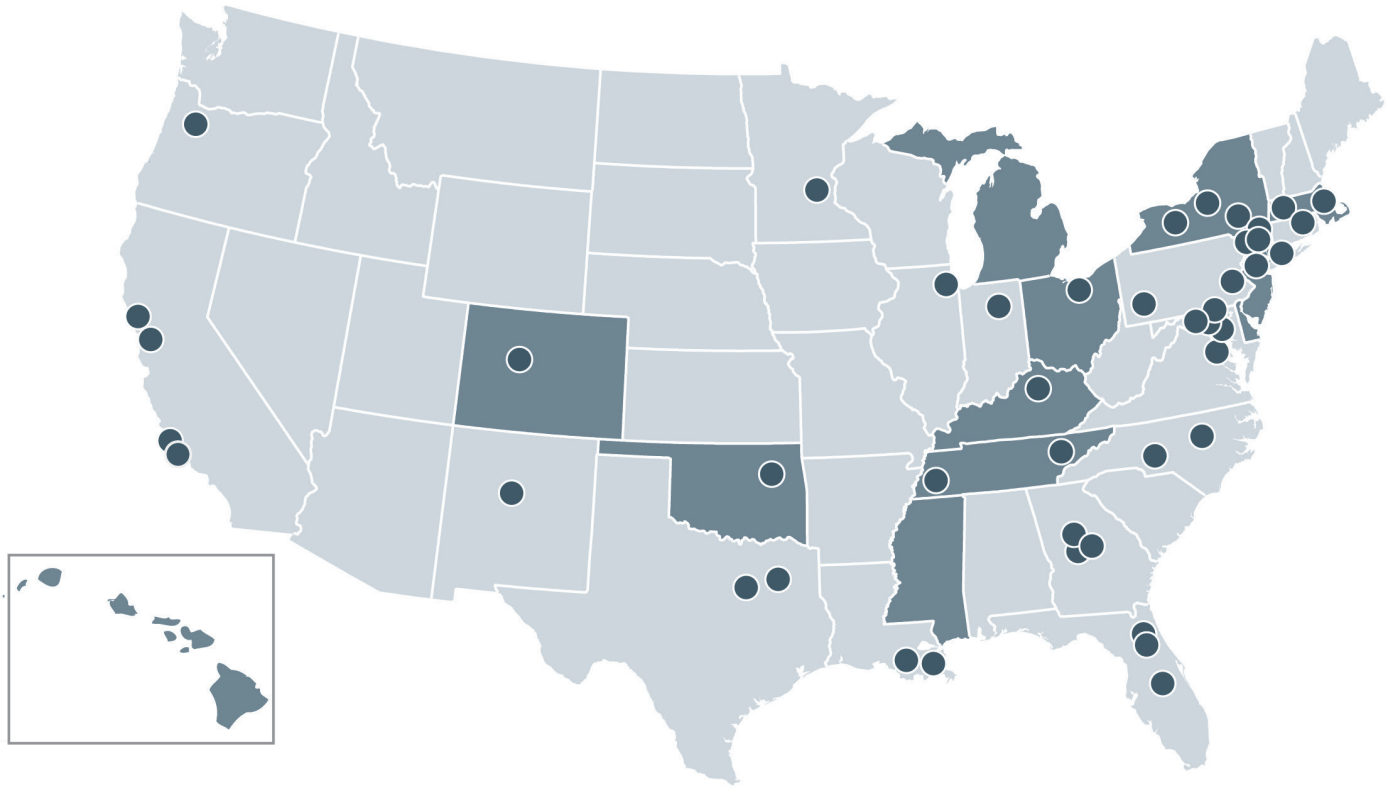
STRATEGIC DATA PROJECT

SDP COURSE GRADES DIAGNOSTIC

Denver Public Schools

April 2014



THE STRATEGIC DATA PROJECT (SDP)

Since 2008, SDP has partnered with 56 school districts, charter school networks, state agencies, and nonprofit organizations to bring high-quality research methods and data analysis to bear on strategic management and policy decisions. Our mission is to transform the use of data in education to improve student achievement.

Part of the Center for Education Policy Research at Harvard University, SDP was formed on two fundamental premises:

1. Policy and management decisions can directly influence schools' and teachers' ability to improve student achievement.
2. Valid and reliable data analysis significantly improves the quality of decision making.

SDP's theory of action is that if we are able to bring together the right people, assemble the right data, and perform the right analysis, we can help leaders make better decisions—ultimately improving student achievement significantly.

To make this happen, SDP pursues three strategies:

1. building a network of top-notch data strategists who serve as fellows for two years with our partners (e.g., school district, charter management organization, nonprofit, or state education agency);
2. conducting rigorous diagnostic analyses of teacher effectiveness and college-going success using agency data; and
3. disseminating our tools, methods, and lessons learned to the education sector broadly.

The project is supported by the Bill & Melinda Gates Foundation.

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INTRODUCTION AND BACKGROUND

In the fall of 2005, spurred by concerns about low graduation rates and low performance on state measures of reading, writing, and math, administrators in the Denver Public Schools (DPS) launched the Denver Plan, a series of reforms aimed at improving students' achievement, raising high school graduation rates, reducing dropout rates, and prompting college matriculation. The reform efforts were focused around three strategies: (1) empowering a highly skilled set of teachers with access to timely assessment data, (2) strengthening instructional leadership via highly trained principals and assistant principals, and (3) promoting close collaboration between the Denver community and all DPS stakeholders.[1] Administrators in DPS note that the Denver Plan has evolved over time and, in addition to its original goals, now emphasizes (1) recruiting great people to become part of the school system, (2) promoting family and community engagement, and (3) strategically managing financial resources.

In the years following DPS's implementation of these reforms, there have been considerable improvements in key metrics. DPS's four-year graduation rate has increased by more than 20 percentage points over the past five years, from 38.7% in 2006–07 to 58.8% in 2011–12. The five-year completion rate was 70% in 2011–12. The drop-out rate declined from 10.4% in 2006–07 to 5.7% in 2011–12. In addition to the Denver Public Schools graduating more of their students, the percentage of graduates who enroll in college is also increasing. The seamless college enrollment rate for high school graduates has increased by three percentage points, from 44% in 2006–07 to 47% in 2011–12. These statistics reveal a compelling story: More Denver students are staying in school, graduating, and ultimately going to college than five years ago.

While these results are encouraging, Denver district officials have also noted other trends that give them pause. Specifically, the remediation rates of DPS students who enroll in postsecondary institutions have increased from 57.1% in 2006–07 to 59.7% in 2010–11.[2] These relatively high and increasing remediation rates were one source of evidence that prompted DPS administrators to ask a series of important questions: If the Denver Plan reforms were the source of increasing high school graduation and college enrollment rates, were these same policies responsible for the emerging trends in college remediation rates? How should the district put the gains in graduation and college enrollment rates in context if DPS schools were sending students off to college who were not prepared to succeed there? Were some high schools promoting greater proportions of underprepared students, and, if so, were inconsistent grading policies across high schools masking important information about students' potential to succeed in postsecondary settings? Lastly, was there any evidence to suggest that students from particular middle schools were more or less likely to success in high school and college?

In the fall of the 2012–13 school year, the Denver Public Schools and the Strategic Data Project engaged in a research collaboration aimed at providing the district with preliminary evidence that could inform some of these questions, potentially help refine existing reform efforts, and motivate support for future initiatives, such as establishing consistent grading policies rooted in new Common Core standards.

To this end, the Strategic Data Project (SDP) conducted a Course Grades Diagnostic analysis as a means to:

1. better inform district leaders about the distribution of students' grade point averages (GPAs) in core subjects;
2. investigate the relationship between students' GPAs and college enrollment and remediation rates; and
3. identify potential areas for action to increase students' college enrollment and decrease remediation rates.

This report presents findings from our research diagnostic, illuminating the extent to which average GPAs, standardized assessment scores, and college remediation rates vary across the district and within DPS high schools; how GPAs differ for students from different racial/ethnic backgrounds; and whether knowing a student's middle school helps predicts her subsequent success.

CONTENTS

This Course Grades Diagnostic represents a partnership between SDP and Denver Public Schools to bring data to bear on policy and management decisions. As such, it is neither an exhaustive set of analyses, nor does it contain specific recommendations for the district to enact immediately. The diagnostic is, however, a set of analyses that can help the district better understand its current performance, set future goals, and plan responses strategically. Additionally, it is meant to demonstrate how other districts can capitalize on existing data to inform decision making.

For the diagnostic, researchers used DPS administrative student data (including demographic characteristics and test scores) to track students' progress through high school to graduation. These data were also connected with (1) college enrollment data, allowing student outcomes to be tracked into college, and (2) information about students' enrollment and GPAs in particular high school courses.

These analyses were completed by members of the research team at the Center for Education Policy Research at Harvard University with the support of DPS staff.

Contents

We divide the key guiding questions into the following four sections, which we use as a guide in the presentation of our findings in this brief:

1. Distribution of GPAs

- What is the distribution of students' GPAs in core subject areas at the district and high school levels?

2. Differences in GPA by Students' FRL Eligibility, Race, and Prior Performance on Standardized Assessments

- To what extent do students' average GPAs in core subject areas differ across student subgroups (specifically, FRL-eligible and non-FRL-eligible students, students from different racial/ethnic backgrounds, and students with different levels of prior performance on standardized assessments)?

3. Differences in GPA by High School and Courses

- To what extent do students' average GPAs in core subject areas differ across DPS high schools?
- How do students' average GPAs in core subject areas differ across DPS high schools, after controlling for students' prior achievement?
- Do these results differ when we examine students' average GPAs in particular courses (e.g., algebra I, algebra II, geometry, AP calculus, etc.) across DPS high schools?

4. Differences in College Remediation Rates by High School and GPA

- What is the relationship between students' academic performance (as measured by their GPAs and performance on standardized assessments) and their remedial course-taking in postsecondary settings?

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KEY FINDINGS

1. Distribution of GPAs

- Mathematics, language arts, and science GPA distributions are similar, and there is a wide range of GPAs in these core courses across the district.
- The median mathematics GPA is between 2.0 and 3.0 in most high schools, yet each school has a wide range of GPAs in mathematics (and also language arts and science).

2. Differences in GPA by Students' FRL Eligibility, Race, and Prior Performance on Standardized Assessments

- FRL-eligible students have lower GPAs, on average, than non-FRL-eligible students. Black and Hispanic students have lower GPAs, on average, than White and Asian students.
- More Asian and White students with high Colorado ACT (COACT) scores enroll in academically challenging courses than Black and Hispanic students with similar COACT scores.
- Among students who enrolled in academically challenging courses, the top-performing White students had GPAs about half a letter grade higher than their Hispanic and Black counterparts. (Asian students could not be included in this analysis because of their small sample size.)

3. Differences in GPA by High School and Courses

- Mean GPAs differ across DPS high schools, with most schools having mean GPAs that range between 2.0 and 3.0; however, the differences in schools' mean GPAs do not appear to be strongly related to the average COACT, Colorado Student Assessment Program (CSAP), or Advanced Placement (AP) test performance of students in DPS high schools.
- Specifically with regard to AP, the vast majority of students who enroll in AP calculus receive high GPAs (over 3.0)—despite students receiving scores on the AP calculus exam that range from 1.0 to 4.0.

4. Differences in College Remediation Rates by High School and GPA

- Many students who earn a C or better in mathematics courses are nevertheless taking or required to take remedial courses in college.
- Remediation rates are related to school-level average test scores, and there is substantial variation in remediation rates across schools.

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Analyses: Distribution of GPAs

1. Distribution of GPAs

In this section we first explore the district-wide distribution of students' GPAs[3] in mathematics, language arts, and science. Then, we examine how the distribution of students' GPAs in mathematics courses differs within DPS high schools.

Figure 1.1 presents the distributions of DPS high students' GPAs in their fourth-year mathematics, language arts, and science classes. As the figure reveals, distributions are similar across all three subjects; students have GPAs that range from just above a 0.0 up to a 5.2. The average GPA for all three subjects is between 2.6 for math and 2.9 for language arts. Given the similarities of the distributions, for ease of exposition, we focus our subsequent investigations on students' GPAs and performance in mathematics classes.

Figure 1.2 presents a plot that reveals the distribution of students' GPA in their Year-4 mathematics courses within each DPS high school. The schools are ordered by students' average 11th-grade COACT scores in each school. The schools on the left have the lowest average COACT scores while the schools on the right have the highest.

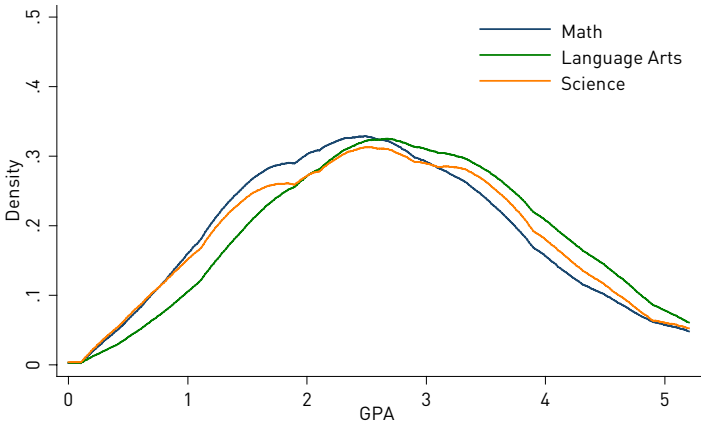
The horizontal line within each shaded box represents the median GPA within a given high school. As the figure reveals, almost all schools have a median GPA between a 2.0 and 3.0. The 25th percentile (the lower edge of the blue shaded box) tends to be about half a letter grade to a full letter grade below the median, and the 75th percentile tends to be about half a letter grade to a full letter grade above the median. This means that there is a substantial range of GPAs within DPS high schools, even just between the 25th and 75th percentiles.[4]

GPAs tend to be higher for language arts than mathematics, but the variation in students' GPAs across and within schools is similar across the three core subject areas that we examined: language arts, mathematics, and science.

Conclusions

- The distributions of students' GPAs in mathematics, language arts, and science are similar, and there is a wide range of GPAs in these core courses across the district.
- In most DPS high schools, the median mathematics GPA is between 2.0 and 3.0, yet there is a wide range of GPAs in mathematics with each school (and results are similar for language arts and science).

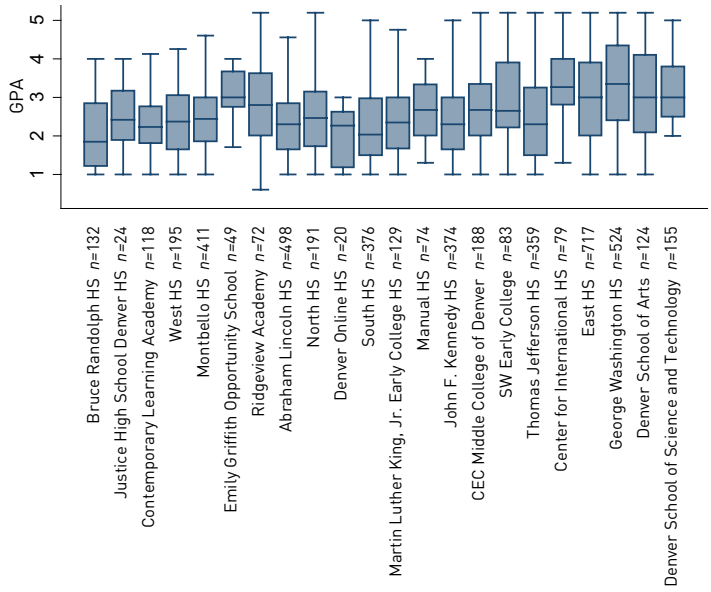
Figure 1.1 Distribution of Year-4 GPA



Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: Math: *n*=5,904; Language arts: *n*=6,585; Science: *n*=4,721

SUBJECT	AVERAGE YEAR-4 GPA
MATHEMATICS	2.6
LANGUAGE ARTS	2.9
SCIENCE	2.7

Figure 1.2 Year-4 Mathematics GPA Distribution by High School



Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: 4,892
Observations without COACT math scores were dropped.
Groups with fewer than 20 observations were dropped.

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Analyses: Differences in GPA (FRL, Race, and Prior Performance)

2. Differences in GPA by Students' FRL Eligibility, Race, and Prior Performance on Standardized Assessments

In this section, we first examine how students' GPAs differ according to their eligibility for free or reduced–price lunch (FRL eligibility). Then, we examine how this distribution of GPAs differs by students' race/ethnicity and by prior performance on standardized assessments. Analyses of this nature can help schools and districts identify performance gaps across subgroups of students that may require further investigation or intervention.

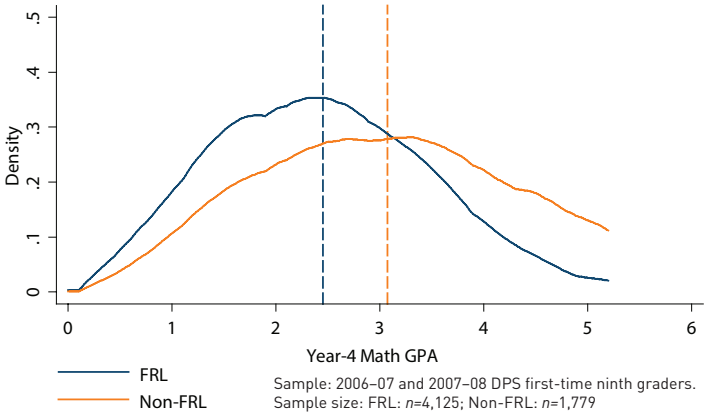
Figure 2.1 presents the distributions of GPA for students who receive free and reduced-priced lunch (FRL students) versus students who do not receive free and reduced-priced lunch (non-FRL students). On average, FRL students have lower GPAs than non-FRL students. The average GPA for FRL students (represented by the blue vertical dashed line) is just below the district-wide mathematics GPA. Non-FRL students, however, have an average GPA above a 3.0. Although FRL students, on average, have lower GPAs, it is worth noting that there is significant overlap in the two distributions. It is also worth noting that over 70% of the students in the district are eligible to receive free or reduced-price lunch.[5]

For language arts courses (not shown), the overall GPAs for both groups are higher than mathematics, but the difference between the GPAs of FRL and non-FRL students is similar. The distributions for science courses (also not shown) are very similar to mathematics.

To gather preliminary evidence about the extent to which students' mathematics GPAs differ across racial/ethnic subgroups, we examine students' average math GPA in their fourth year of high school.[6] Because students enroll in different math courses (e.g., calculus, geometry, algebra II, etc.) in their fourth year of high school, these analyses may depict differences in GPA that result from students from specific racial/ethnic backgrounds disproportionately enrolling in advanced courses that receive weighted GPAs. We explore this issue further in subsequent analyses. To begin, however, we examine broad differences in students' Year-4 math GPA across racial subgroups.

Figure 2.2 presents students' average Year-4 mathematics GPA for students from different racial/ethnic subgroups. Although the district-wide average Year-4 mathematics GPA is 2.6, White and Asian students have average GPAs above this district-wide average (3.1) while Black and Hispanic students have GPAs below this average (2.4). In other words, White and Asian students, on average, have mathematics GPAs that are about half a letter grade higher than Black and Hispanic students. The results are similar for language arts and science courses (not shown).

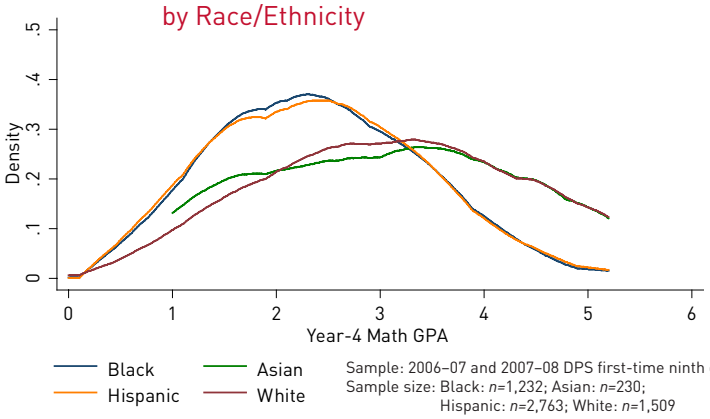
Figure 2.1 Distribution of Year-4 Mathematics GPA by FRL Status



Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: FRL: *n*=4,125; Non-FRL: *n*=1,779

FRL STATUS	AVERAGE YEAR- 4 GPA
FRL-ELIGIBLE	2.5
NON-FRL	3.1
DISTRICT-WIDE	2.6

Figure 2.2 Distribution of Year-4 Mathematics GPA by Race/Ethnicity



Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: Black: *n*=1,232; Asian: *n*=230;
Hispanic: *n*=2,763; White: *n*=1,509

RACE	AVERAGE YEAR-4 MATHEMATICS GPA
BLACK	2.4
HISPANIC	2.4
WHITE	3.1
ASIAN	3.1
DISTRICT-WIDE	2.6

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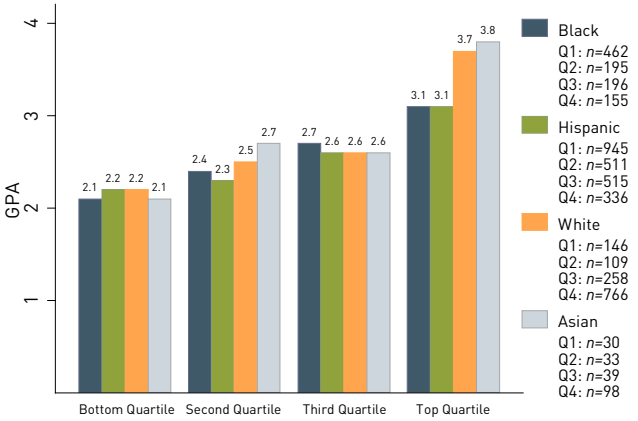
Analyses: Differences in GPA (FRL, Race, and Prior Performance)

Figure 2.3 presents students' average Year-4 mathematics GPAs by their race/ethnicity and their scores on the 11th-grade COACT mathematics assessment—specifically, whether students received 11th-grade COACT mathematics scores in the bottom, second, third, or top quartile. Not surprisingly, we observe a positive relationship between students' Year-4 mathematics GPAs and their performance level on the 11th-grade mathematics COACT. In other words, students who receive COACT scores in the higher quartiles tend to have higher GPAs, on average, than students in the lower quartiles; however, it seems important to note that students' average Year-4 mathematics GPAs do not appear to differ dramatically for students who score in the lower three quartiles on the 11th-grade mathematics COACT. For instance, students who score in the third quartile on the 11th-grade mathematics COACT have Year-4 mathematics GPAs that are roughly half a letter grade higher than those of students in the bottom performance quartile.

Figure 2.3 Average Year-4 Mathematics GPA by Race/Ethnicity and COACT Mathematics Score

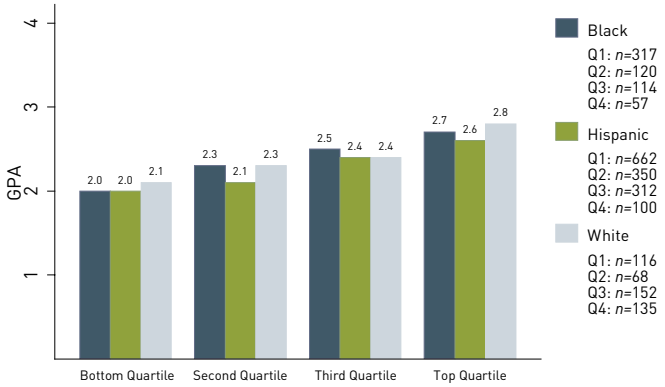


Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: 4,794

Perhaps most interesting are the discrepancies across the COACT quartile categories in the extent to which students' Year-4 mathematics GPAs differ for students from different racial/ethnic backgrounds. White and Asian students in the top COACT quartile have GPAs that are over half a letter grade higher than Black and Hispanic students with similar performances. However, students in the bottom and third COACT performance quartiles have relatively similar GPAs regardless of their race/ethnicity. When examining similar analyses for science and language arts GPAs, we see more persistent differences across race/ethnicity within each of the COACT performance quartile categories (i.e., regardless of which COACT quartile category they fall into, White and Asian students tend to have higher GPAs than their Black and Hispanic counterparts; see appendix).

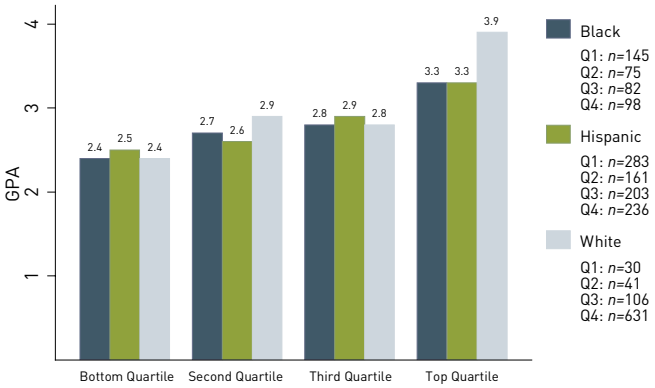
To further explore the difference in mathematics GPAs of the highest-performing DPS students, we examine the GPAs of students who do not take academically challenging (labeled "difficult" in the figures below) mathematics courses (Figure 2.4) versus those who take challenging courses (Figure 2.5) in their fourth year of high school.[7,8]

Figure 2.4 Average Year-4 Mathematics GPA by Race/Ethnicity and 11th-Grade COACT Math Score Among Students Not Enrolled in Difficult Math Courses



Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: 2,503

Figure 2.5 Average Year-4 Mathematics GPA by Race/Ethnicity and 11th-Grade COACT Math Score Among Students Enrolled in Difficult Math Courses



Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: 2,091

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Analyses: Differences in GPA (FRL, Race, and Prior Performance)

In comparing the GPAs across the two figures, one can observe, unsurprisingly, that the average GPA of students who do not take difficult courses is lower, on average, than the GPAs of students who take difficult courses in their fourth year of high school.[9] As in previous analyses, we see in both figures that students with higher COACT scores tend to have higher GPAs. However, within each COACT quartile, we notice different patterns across the racial/ethnic subgroups depending on whether students enrolled in a difficult Year-4 mathematics course. For instance, among students who took difficult Year-4 mathematics courses and scored in the top quartile on their 11th-grade mathematics COACT, White students received GPAs that were roughly half a letter grade higher than their Black and Hispanic counterparts (Figure 2.5). By contrast, we see no such difference in GPA across race/ethnicity among top-performing students who did not take difficult courses (Figure 2.4). Indeed, it appears that the most notable differences in students' Year-4 mathematics GPAs across racial/ethnic subgroups are among the top-scoring students who enroll in difficult mathematics courses. From these analyses, it does not appear that students from different racial/ethnic backgrounds who perform similarly on the 11th-grade mathematics COACT have notably different Year-4 mathematics GPAs (with the exception of top-performing students enrolling in challenging courses). In other words, students who score in the bottom, second, and third quartiles on the 11th-grade mathematics COACT tend to have Year-4 mathematics GPAs that are comparable to students in the same COACT quartile, regardless of their race/ethnicity.

In our final subgroup analysis, we investigated whether top-performing White and Asian students were more likely to enroll in difficult courses than their Black and Hispanic counterparts. As Table 2.1 reveals, 82% and 93% of top-performing White and Asian students, respectively, enrolled in difficult courses, as compared to only 63% and 70% of top-performing Black and Hispanic students, respectively.

In summary, these analyses reveal a few findings of note for Denver practitioners and administrators. First, there are broad differences in students' Year-4 math GPAs and 11th-grade math COACT scores across racial/ethnic groups. The magnitudes of these differences suggest discrepancies in performance that practitioners undoubtedly want to address and are working hard to surmount. However, our analyses also reveal that some of the most notable differences across race are among Denver's top-performing students and are a result of both differential enrollment in challenging courses as well as differential performance in these classes. After controlling for students' prior performance on the 11th-grade math COACT, the most notable discrepancies in students' Year-4 math GPAs across racial/ethnic subgroups are among Denver's highest-performing students who are enrolled in the most academically challenging courses. This finding suggests that Denver practitioners and administrators may be well advised to focus on learning why their top-performing Black and Hispanic students are not (a) enrolling in academically challenging courses in the same proportions as their White and Asian counterparts, and (b) are not performing as well in the academically challenging courses in which they do enroll.

Conclusions

- More Asian and White students with high COACT scores enroll in academically challenging courses than Black and Hispanic students with similar COACT scores.
- Among students who enrolled in academically challenging courses, the top-performing White students had GPAs about half a letter grade higher than their Hispanic and Black counterparts. (Asian students could not be included in this analysis because of their small sample size.)

Table 2.1 Percentage of Top-Quartile Students Taking Difficult Mathematics Courses Differs Across Races

RACE	AVERAGE COACT SCORE	NOT TAKING DIFFICULT MATHEMATICS COURSES (*n*)	TAKING DIFFICULT MATHEMATICS COURSES (*n*)	TAKING DIFFICULT MATHEMATICS COURSES (%)
BLACK	23.4	57	98	63%
HISPANIC	23.1	100	236	70%
WHITE	25.8	135	631	82%
ASIAN	25.1	7	91	93%

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Analyses: Differences in GPA by High School and Courses

3. Differences in GPA by High School and Courses

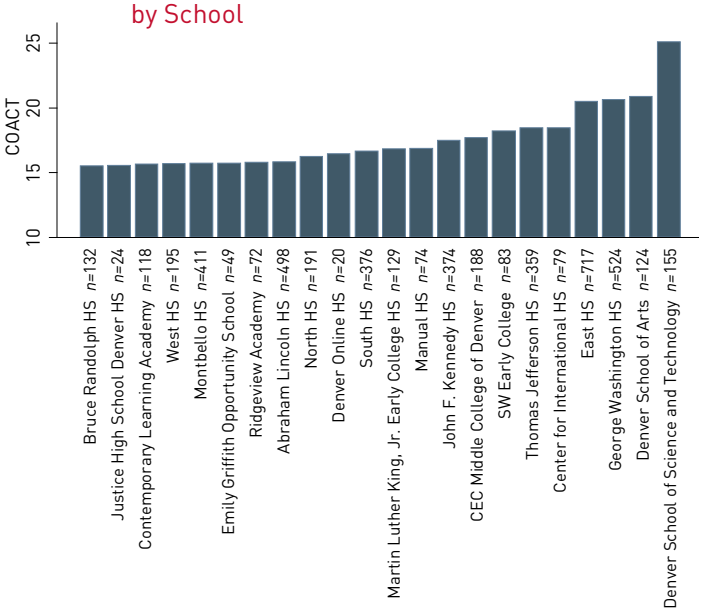
This section examines whether average mathematics GPAs differ across high schools in the DPS system and whether these differences are prevalent across a range of mathematics courses, from beginning algebra to AP calculus. In section 1, we present analyses that show the distribution of GPAs is more similar across schools than within schools. However, we do see some differences across schools. In this section, we examine whether these differences in average GPAs across schools are related to school-level average test scores.

At the outset of this collaboration, administrators in the Denver Public Schools hypothesized that grading policies and/or practices were inconsistent across the districts' high schools. If this were so, administrators were concerned that students' GPAs would not be a good indicator of students' content mastery or their suitability for promotion from one grade to the next. These analyses investigate this hypothesis using available data.

We begin by examining how students' mathematics performance differs across Denver high schools by depicting schools' mean 11th-grade COACT mathematics scores. Figure 3.1 presents these results, ordering DPS high schools from left to right according to the average 11th-grade mathematics COACT score for students in each high school. As the figure reveals, the average 11th-grade COACT score differs across DPS high schools. Specifically, roughly 1/3 of the high schools in our sample have average 11th-grade COACT scores that are close to 15. Slightly more than 1/3 of the schools have mean COACT scores that are slightly higher but relatively similar to one another—in other words, scores between 16 and 18. Lastly, a smaller group of schools has notably higher average mathematics COACT scores (close to 20), and one school—Denver School of Science and Technology—has a mean COACT mathematics score close to 25.

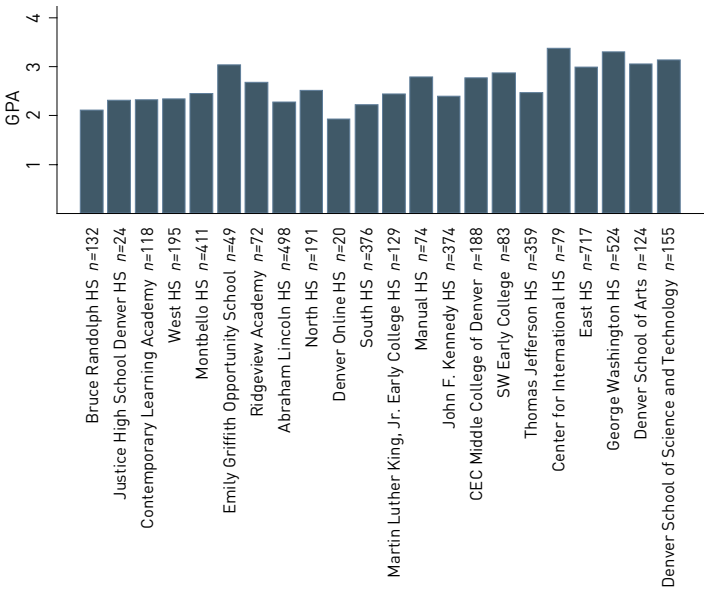
Next, we investigated how the average Year-4 mathematics GPA differs across DPS high schools. Figure 3.2 depicts the results from this analysis. Note: Figure 3.2 retains the same order of schools as Figure 3.1, meaning that schools are ordered from left to right according to the schools' average 11th-grade COACT mathematics scores. Comparing Figures 3.1 and 3.2 provides interesting food for thought related to DPS administrators' hypothesis regarding inconsistent grading policies or practices. For instance, in examining Figure 3.1, one might observe that roughly

Figure 3.1 Mean 11th-Grade COACT Mathematics Score by School



Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: 4,892
Observations without COACT math scores were dropped.
Groups with fewer than 20 observations were dropped.

Figure 3.2 Mean Year-4 Mathematics GPA by School



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Sample size: 4,892
Observations without COACT math scores were dropped.
Groups with fewer than 20 observations were dropped.

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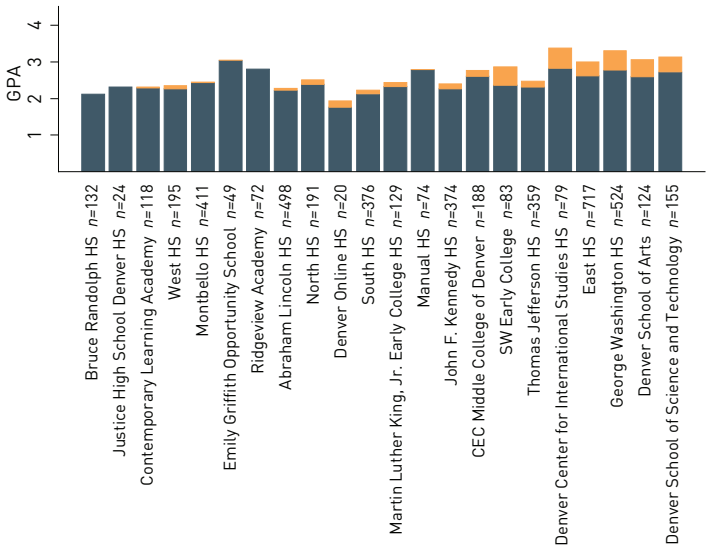
Analyses: Differences in GPA by High School and Courses

half of the schools in the sample (from Bruce Randolph to Manual High School) have similar average 11th-grade mathematics COACT scores. Inspecting this same group of schools in Figure 3.2, one notices that schools' mean Year-4 mathematics GPAs differ, in some cases by about a full letter grade (for instance, Emily Griffith compared to Bruce Randolph High School). Further, one might also notice that some schools have fairly similar mean Year-4 mathematics GPAs (for instance, there are a number of schools where the mean Year-4 mathematics GPA is about a 3.0, such as Emily Griffith and East High School), despite these schools having mean 11th-grade COACT scores that differ by more than five points. We observe similar patterns when we examine differences between mean language arts and science test sores across Denver high schools and mean GPAs in the same subjects (not shown).

We cannot draw definitive conclusions from these analyses, as standardized assessments and GPAs admittedly measure different things. Specifically, students' GPAs take into account their performance across a range of assignments—from papers to exams to presentations, etc.—and likely also reflect students' levels of effort, contributions to their classmates' learning, and improvement in any of these areas over the duration of courses. On the other hand, one might argue that some substantial amount of a student's GPA should reflect their content mastery of the subject at hand. Building on this rationale, one might further posit that mastery of subject area content should be based on some rigorous, external standards, so that GPAs are comparable across schools and so that schools promote similarly high expectations regarding performance and promotion for all students. With this framing in mind, one might take pause when comparing the results from Figures 3.1 and 3.2. Should we expect to see the mean Year-4 mathematics GPAs that we do given the differences across schools in mean 11th-grade COACT mathematics scores?

To explore these findings in greater depth, we examined whether differences in schools' mean Year-4 mathematics GPA were influenced by whether students enrolled in difficult courses that add additional weight to their GPA. As Figure 3.3 reveals, schools with higher average COACT scores (such as George Washington High School and the Denver Center for International Studies High School) tend to have higher GPAs because of their students' enrollment in courses that receive additional weightings. Thus, if you were to compare schools' mean unweighted Year-4 mathematics GPAs—the GPAs that students would receive without the additional weighting—the mean GPAs across Denver high schools differ very little and still appear unrelated to differences in students' performance on the 11th-grade mathematics COACT. Our analyses of language arts and science GPAs yielded similar results.

Figure 3.3 Mean Weighted and Unweighted Year-4 Mathematics GPA by School



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Groups with fewer than 20 observations were dropped.

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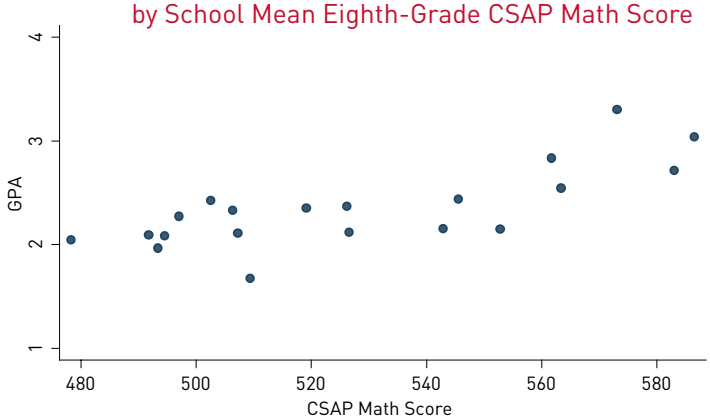
Analyses: Differences in GPA by High School and Courses

One potential limitation to these analyses is that they examine differences in GPAs across the combination of courses that students take in their fourth year of high school. Hypothetically, one might argue that it is sensible that GPAs would be similar across high schools because the students in the higher-achieving high schools (as measured by test scores) take courses that are more academically challenging and, thus, courses in which it is harder to receive high GPAs. To drill more deeply into this idea, we conducted a series of similar analyses but for GPAs in different mathematics courses, from algebra 1 through AP calculus. Rather than depict these findings across a series of two charts, as we did previously, Figures 3.4–3.7 depict both schools' average test score (on the x-axis) and schools' average GPA (on the y-axis). In other words, each dot in this series of figures represents a specific Denver high school's average GPA and standardized mathematics assessment score.

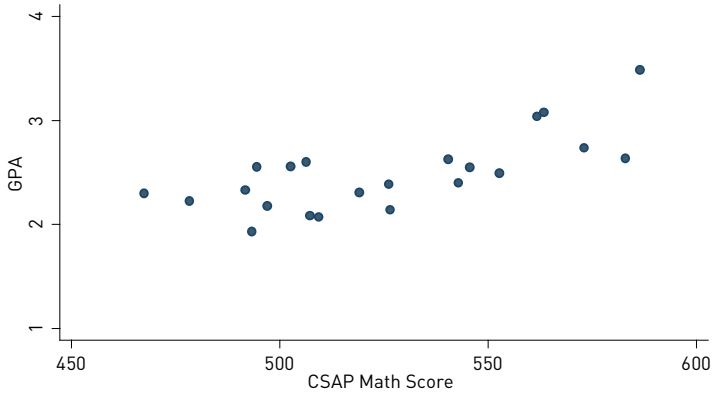
These figures corroborate and extend our previous findings. Related to algebra I, algebra II, and geometry (Figures 3.4, 3.5, and 3.6), we notice that many schools have mean GPAs between 2.0 and 2.5, despite having students with mean eighth-grade CSAP scores that range by up to 100 points, from scores in the mid- to upper-400s to scores in the mid- to upper-500s, in some cases. With regard to algebra II and geometry (Figures 3.5 and 3.6), perhaps six schools stand out as having somewhat different average GPAs than the majority of Denver high schools. A number of schools that have students with similar eighth-grade mathematics CSAP scores have mean GPAs that are a half- to a full-letter grade higher. The other schools that stand out are the group of five high schools with the highest mean GPAs and standardized test scores.

Figure 3.5 School Mean Cumulative Algebra II GPA by School Mean Eighth-Grade CSAP Math Score



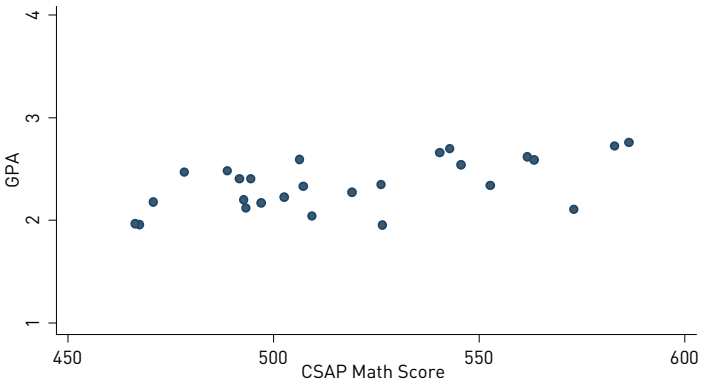
Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: 4,336
Groups with fewer than 20 observations were dropped.

Figure 3.6 School Mean Cumulative Geometry GPA by School Mean Eighth-Grade CSAP Math Score



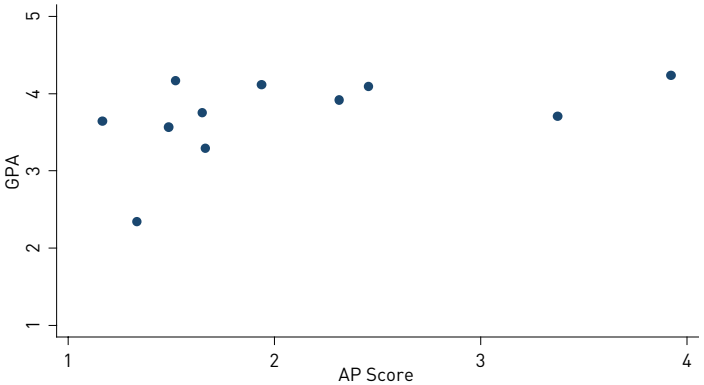
Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: 4,837
Groups with fewer than 20 observations were dropped.

Figure 3.4 School Mean Cumulative Algebra I GPA by School Mean Eighth-Grade CSAP Math Score



Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: 4,528
Groups with fewer than 20 observations were dropped.

Figure 3.7 School Mean Cumulative AP GPA by School Mean Eighth-Grade CSAP Math Score



Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: 538
Groups with fewer than 10 observations were dropped.

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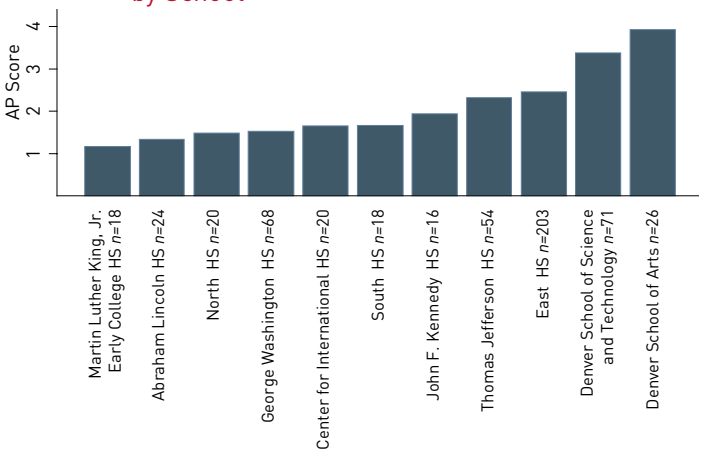
Analyses: Differences in GPA by High School and Courses

Both DPS and SDP were particularly interested in the findings related to AP calculus (Figure 3.7). It is important to note that the AP analyses and the findings depicted in Figure 3.7 differ in one important way from the analyses of other math courses. Unlike the other analyses, which examine the relationship between a student's score on a pretest (eighth-grade math CSAP) and grade in a specific math subject, the AP analyses examine the relationship between a student's grade in the course and a test that is taken at the end of the coursework. While this is an important difference, one would still expect to see that a student's grade in AP calculus would be related to her score on the related exam. However, our analyses reveal that, with a few exceptions, most schools award AP calculus students grades between 3.5 and 4.0, while students' mean AP calculus test scores range considerably (from the low 1s to 4.0). Arguably, of the mathematics classes that we examined, AP calculus has the most established standards for evaluating students' competency in the related skills and capacities; further, one might anticipate that AP calculus teachers would be less inclined to elevate students' GPAs on account of nonacademic contributions (e.g., level of effort, completing homework, etc.) since the explicit purpose of the course is to prepare students to do well on the exam in order to receive college credit for the course. Thus, of the evidence gathered, these findings seem to present the most compelling evidence in support of DPS administrators' hypothesis that grading policies across high schools may not be consistent, nor rooted in common standards.

Conclusions

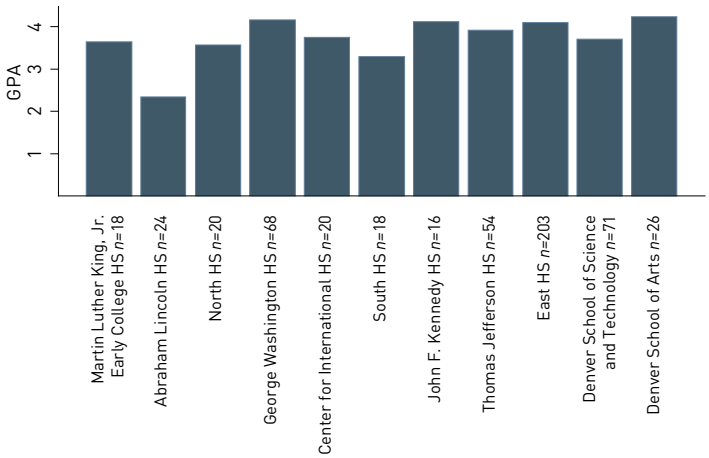
- Mean GPAs differ across DPS high schools, with most schools having mean GPAs that range between 2.0 and 3.0; however, the differences in schools' mean GPAs do not appear to be strongly related to the average COACT, CSAP, or AP test performance of students in DPS high schools.
- Specifically with regard to AP, the vast majority of students who enroll in AP calculus receive high GPAs of over 3.0—this despite students receiving scores on the AP calculus exam that range considerably from 1.0 to 4.0.

Figure 3.8 Mean Cumulative AP Calculus Test Score by School



Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: 538
Groups with fewer than 10 observations were dropped.

Figure 3.9 Mean Cumulative AP Calculus GPA by School



Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: 538
Groups with fewer than 10 observations were dropped.

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Analyses: Differences in College Remediation Rates

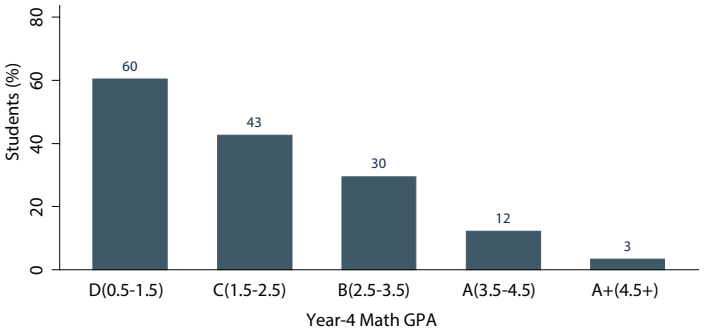
4. Differences in College Remediation Rates by High School and GPA

One of the primary motivations for this research diagnostic was DPS administrators' concern that Denver high schools might be sending high school graduates off to postsecondary institutions without the skills they need to be successful in these settings. If this were the case, it might prompt administrators to reevaluate the extent to which increases in high schools' four-year graduation rates were an adequate measure of district-wide improvement. Naturally, this concern relates to our current work, as students' GPAs and test scores are among the primary metrics that practitioners use to evaluate whether a student should advance from one grade to the next. If grading policies are drastically different across schools, it stands to reason that schools' promotion/retention standards for students may also differ.

To gather important contextual information related to remediation, we first examined the percentage of DPS graduates who took mathematics remediation courses in college. Our analyses of this topic are constrained to the group of DPS graduates who enroll in public institutions of higher education in Colorado. Figure 4.1 depicts how the percentage of DPS graduates who enrolled in remedial mathematics courses differs depending on students' GPAs in their Year-4 mathematics courses. As we would expect, a smaller percentage of students who received high GPAs in their Year-4 mathematics course attended remedial courses relative to their peers who received lower GPAs. For example, 12% of DPS students who received a 3.5–4.5 GPA (the equivalent of an "A" letter grade) on their Year-4 mathematics course enrolled in remedial mathematics courses; by contrast, 60% of students who received a 0.5–1.5 GPA (a "D" letter grade) attended remedial mathematics courses.

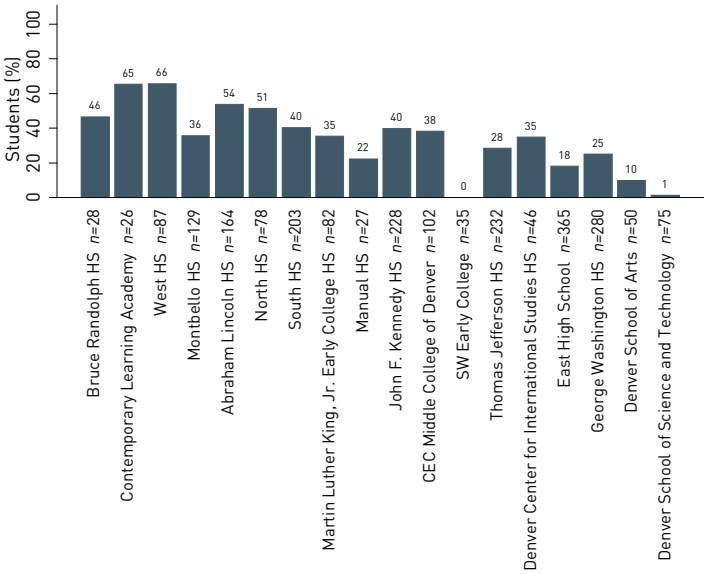
While this figure represents the general relationship one might anticipate, DPS administrators voiced concern about the high percentages of students who enrolled remedial courses despite having received fairly high GPAs in their Year-4 mathematics courses. Many students who earned a C or better in mathematics courses are taking remedial courses in college. For instance, nearly one-third (30%) of DPS students who received a 2.5-3.5 (B) on their Year-4 mathematics courses enrolled in mathematics remediation. Should this be? We conducted similar analyses for other subjects. We found generally similar results. For instance, the percentage of students taking language arts remediation was slightly lower but still substantial.

Figure 4.1 Percentage of Students Taking Mathematics Remediation in Colorado Public Higher Education Institutions by Year-4 Mathematics GPA



Sample: 2006–07 and 2007–08 DPS first-time ninth graders who continued on to a public postsecondary institution in Colorado.
Sample size: 1,767. D: *n*=270; C: *n*=517; B: *n*=583; A: *n*=278; A+: *n*=119
Observations without eighth-grade CSAP math scores were dropped.

Figure 4.2 Percentage of Students Taking Mathematics Remediation in Colorado Public Higher Education Institutions by School



Sample: 2006–07 and 2007–08 DPS first-time ninth graders who continued on to a public postsecondary institution in Colorado.
Sample size: 2,237
Observations without COACT math scores were dropped.
Groups with fewer than 20 observations were dropped.

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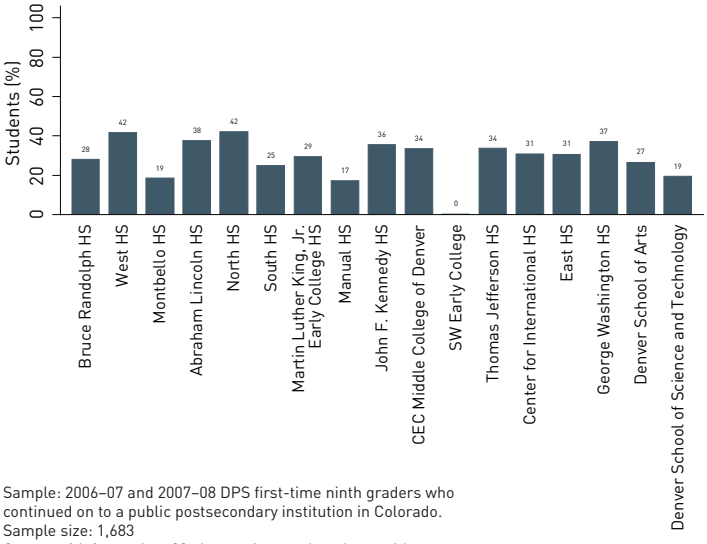
Analyses: Differences in College Remediation Rates

Next, we examined whether remediation rates differed across DPS high schools and appeared related to schools' average test scores on a related standardized mathematics assessment. Figure 4.2 depicts these findings. Like many other figures in this brief, the schools in Figure 4.2 are ordered from left to right (lowest to highest) by the average school-level COACT mathematics score. Figure 4.2 reveals two findings of note. First, there is substantial variation in remediation rates across Denver high schools, from schools where 10% or fewer students enroll in remedial mathematics courses to schools where more than 60% of students receive mathematics remediation. The second finding of note is that schools' remediation rates appear to be related to schools' average COACT mathematics score—in other words, the schools with lower-scoring students are associated with higher remediation rates. This is to be expected given that the decision about whether students receive remediation is determined, in part, by their test scores.[10]

Of course, DPS schools serve different students with varying needs and, thus, it makes sense that remediation rates would differ across schools. Further, it is not self-evident what remediation rates we should expect to see across schools. To help put schools' remediation rates in context, we estimated schools' predicted remediation rates, controlling for the test scores and demographic characteristics of the students who attend these schools (Figure 4.3). One way to interpret Figure 4.3 is that it estimates the percentage of students in each DPS high school who would need mathematics remediation if average DPS students were enrolled in the school—in other words, students who possess the same demographic profile and standardized test scores as the average Denver high school student. We still note substantial differences in predicted remediation rates after controlling for differences in students' test scores and demographic characteristics. If all of the differences in schools' remediation rates were due to the characteristics and prior performance of students, we would expect to see estimated percentages of students needing remediation that were quite similar across DPS high schools.

Figure 4.3 Predicted Mathematics Remediation Rate for a Prototypical Student by School



Sample: 2006–07 and 2007–08 DPS first-time ninth graders who continued on to a public postsecondary institution in Colorado.
Sample size: 1,683
Groups with fewer than 20 observations and students without eighth-grade CSAP math scores were dropped.

Conclusions

- Many students who earn a C or better in their Year-4 mathematics courses end up taking remedial courses in college.
- Remediation rates are related to school-level average test scores, and there is substantial variation in remediation rates across schools, from high schools with less than 10% of students receiving remediation to those with remediation rates over 60%.
- After controlling for students' prior test scores and demographic characteristics, predicted remediation rates across DPS high schools differ notably, suggesting the need for more in-depth research on DPS students' high-school-to-postsecondary transition.

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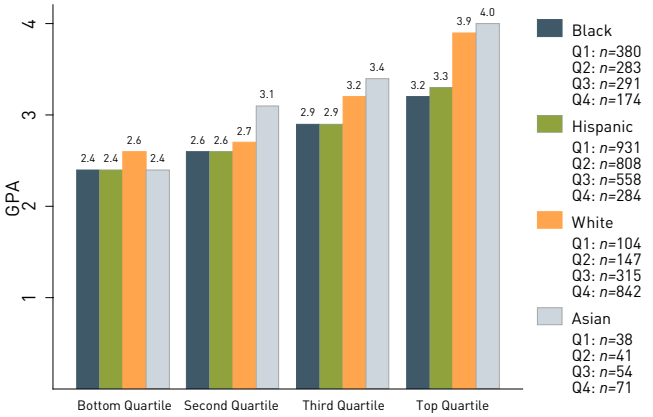
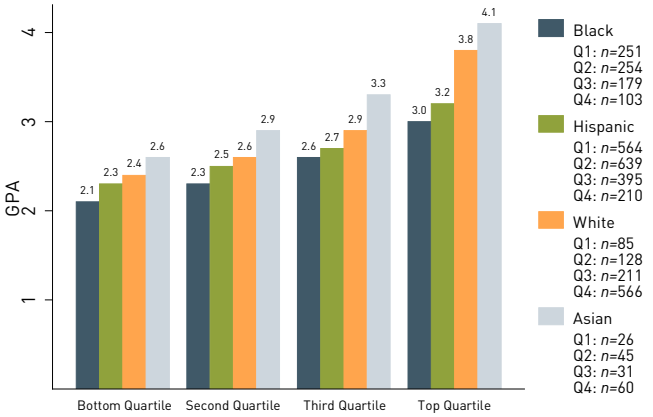
APPENDIX

Figure 5.1 Average Year-4 Language Arts GPA by Race/ Ethnicity and 11th-Grade COACT English Score



Sample: 2006-07 and 2007-08 DPS first-time ninth graders.
Sample size: 5,321

Figure 5.2 Average Year-4 Language Arts GPA by Race/ Ethnicity and 11th-Grade COACT Science Score



Sample: 2006–07 and 2007–08 DPS first-time ninth graders.
Sample size: 3,747

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ENDNOTES

1. Denver Public Schools. (2006). The Denver Plan. Retrieved from http://denverplan.dpsk12.org/uploads/2014/02/Final2010Denver-Plan.pdf

2. Remediation data for 2011–12 were not available when we conducted these analyses.

3. Throughout this document, "GPA" refers to weighted GPA unless specified otherwise.

4. The ANOVA estimator of the intraclass correlation of students' Year-4 math GPAs is 0.13. This means that 13% of the variation in students' GPAs is across schools while 87% of the variation is within schools. The intraclass correlations of Year-4 language arts and science GPAs are 0.08 and 0.11 respectively.

5 Denver Public Schools, Financial Services—Student Submission Team. (2011). Report of Free and Reduced Lunch Based on the 2011 Pupil Count Submission, 2011–2012. Retrieved from http://planning.dpsk12.org/wp-content/uploads/2011/02/OC_FRL_Report_2011.pdf

6. Although four years of mathematics are required to graduate, in these data only about 80% of fourth-year students took mathematics in their fourth year. For more information on graduation requirements, please see http://www.dpsk12.org/pdf/grad_req_proposal_6-16-06.pdf and http://webdata.dpsk12.org/policy/pdf/GradRequirementsUpdated1109.pdf

7. Although there may be multiple ways to define a difficult course, in this brief we classify a course as difficult if (a) at least 5% of students district-wide taking that course earn a weighted GPA or (b) at least 10 students district-wide taking that course earn a weighted grade that is different from their unweighted grade. If a course is not a weighted course, a student's weighted grade will be the same as their unweighted grade. By setting the cutoffs at 5% or 10 students, we prevent courses with a small number of differences between weighted and unweighted grades from being counted as a difficult course. Examples of math courses flagged as difficult include "ap a geomcalc2," "ap calculus ab s2," and "ap statistics s2." Examples of math courses not flagged as difficult include "probability/statistics s1," "pre-calculus s1," and "geometry s1."

8. Note that Asian students were removed from these analyses due to small sample sizes.

9. This is likely a function of two things. The first is that students who take difficult courses are enrolled in courses with weighted GPAs. Generally, this means that an A grade in a difficult course yields a GPA of 5.0 while an A in a nondifficult course yields a GPA of 4.0. The second is that students who take difficult courses tend to be students who are stronger academically and, thus, who receive higher letter grades.

10. For more information, please see http://highered.colorado.gov/Publications/Policies/Current/i-parte.pdf

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