

Taking Attendance Seriously

How School Absences Undermine Student
and School Performance in New York City



Report prepared by:
The Campaign for Fiscal Equity, Inc.
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The Campaign for Fiscal Equity, Inc. (CFE) is a leading non-profit organization working to protect and promote the constitutional right to a sound basic education - defined as a meaningful high school education - for every public school child in the State of New York. CFE was founded in 1993 by a coalition of concerned parents and education advocates who filed the landmark case *CFE v. State of New York*, which established this right. To make this right a reality, CFE works to ensure that the neediest students in low performing schools make academic progress, graduate high school and become active civic participants who can compete in the global economy. CFE works to educate and engage the public and policy makers to ensure that the historic school budget increases, accountability reform and meaningful public participation that resulted from the landmark CFE court decision and law reform are fully implemented.

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Taking Attendance Seriously: How School Absences Undermine Student and School Performance in New York City

Director: Helaine Doran

Author: Dr. Martha Philbeck Musser

Consulting Editor: Phyllis Jordan

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Executive Summary

TAKING ATTENDANCE SERIOUSLY: HOW SCHOOL ABSENCES UNDERMINE STUDENT AND SCHOOL PERFORMANCE IN NEW YORK CITY

Nearly two decades ago, the Campaign for Fiscal Equity (CFE) set out to ensure that New York’s poorest children received the “sound basic education” guaranteed in the state constitution. A court ruling in 2006 and subsequent state legislation brought new resources to bear on struggling public school systems, and the state began to narrow the equity gap that divides our children. Yet we will never close the achievement gap, even with improved curriculum and instruction, if students are not showing up for school.

Research has documented that as many as 90,000 New York City elementary students missed a month or more of school in 2007-08.¹ CFE’s own rigorous study of the city’s fourth-graders found that this excessive absenteeism is commonplace on elementary campuses: In nearly 300 schools, at least 20 percent of fourth-graders were chronically absent last year. Further, the study shows that these absences are dragging down student achievement, lowering scores on the state’s math and English language arts tests. Even a child with good attendance suffers a small loss academically when the school has a high absentee rate, suggesting that excessive absences across the board can undermine the quality of instruction for all students by creating classroom churn and leaving teachers mired in review and remediation.

Raising attendance rates can boost test scores, for individuals and schools, the analysis shows. In fact, the annual predicted test score gain from simply improving a child’s attendance equals or exceeds the annual gain expected when a child attends a charter school. Improving attendance and, consequently, increasing instructional time for children, is a cost-effective intervention that every school in the city can adopt right now.

CFE’s findings raise several important points for educators:

- ***Attendance and achievement are inextricably linked.*** This research, which focused on the connection between students’ third and fourth grade attendance and their performance on New York State Testing Program grade 4 assessments, confirms that student attendance is a statistically significant predictor of performance. As such, increasing attendance becomes an essential tool for improving achievement.

¹ Nauer, Kim, White, Andrew, and Yerneni, Rajeev. (2008). *Strengthening Schools by Strengthening Families: Community Strategies to Reverse Chronic Absenteeism in the Early Grades and Improve Supports for Children and Families*. Center for New York City Affairs, Milano the New School for Management and Urban Policy.

- ***Attendance data can be an indicator of students and schools at risk.*** Researchers have repeatedly identified chronic absence—defined as missing 10 percent of the school year as a result of unexcused *and* excused absences—as a signal that students are headed off track academically. Our study confirms that poor attendance puts low-performing students at greater risk of educational failure.
- ***Improving attendance can reduce the achievement gap.*** The association between attendance and performance is found across socioeconomic and ethnic backgrounds. It is important to note, however, that Black and Hispanic students, the groups with the highest poverty rates, are more likely than White and Asian students to be chronically absent. More than one in five Black and Hispanic students is chronically absent. Similarly, students from low-income families had lower attendance than their more affluent peers. This suggests that improving attendance can help reduce the achievement gaps among ethnic and socioeconomic groups.
- ***Reducing chronic absence is essential to turning around under-performing schools.*** In 298 New York City schools, at least 20 percent of fourth-graders were chronically absent. These high rates of absenteeism correlated with low performance. We suspect poor overall attendance reflects the lack of a high quality, engaging curriculum. Improvements in curriculum and instruction are critical to school reform. But they aren't going to help if students aren't in the classroom.

WHAT WE DID

National research has established that students who are chronically absent as early as kindergarten have lower achievement in later grades. To demonstrate that connection in New York City schools, the Campaign for Fiscal Equity reviewed the attendance records, state assessment scores and various demographic factors for 64,062 fourth-graders attending 705 New York City public schools in the 2007-08 school year. We chose to look at fourth-graders, since the state's assessments in that grade are longer and, therefore, considered more reliable than those in third and fifth grades.

The study considered attendance in both third and fourth grades. And we analyzed other student factors that can weigh heavily on academic performance, including poverty, ethnicity, disability, English language proficiency, racial or ethnic background, mobility and past performance. We also considered school characteristics such as average attendance and test scores, percentage of minority students, and teacher education and turnover rates. Holding other student and school variables constant to

isolate the role of attendance, we examined the relationship between attendance and performance at the student level.

To give readers a better understanding of the relationship between student demographics, attendance and performance in New York City elementary schools, we also present profiles of student and school statistics on these measures.

WHAT WE FOUND

Overall the best predictor of fourth-grade performance is third-grade performance. But attendance in third and fourth grade played an important role, as well. In addition to documenting the relationship between attendance and performance, the study revealed:

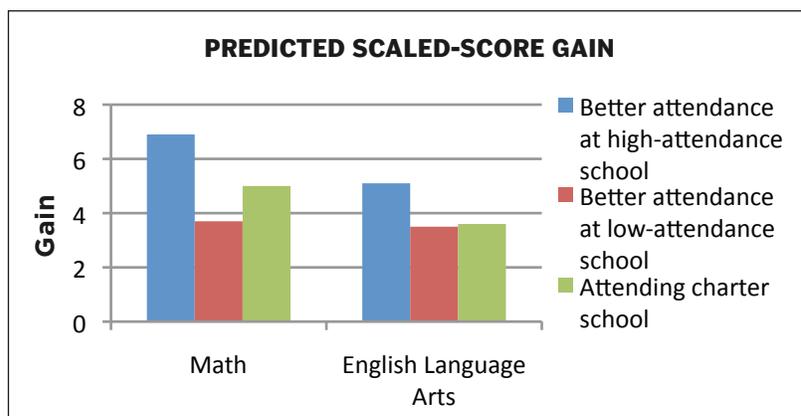
- The average fourth-grade student attended school for almost 94 percent of enrolled school days in third and fourth grades. Half of fourth-graders—about 32,000 students—attended at least 95.4 percent of school days in those grades.
- On the other hand, 18 percent—more than 11,000 students—were chronically absent. That means they missed more than 10 percent of school days during that period—the equivalent of at least 19 days in a 185-day school year. Black, Hispanic, and Native American students were more likely to be chronically absent than White and Asian students.
- Attendance patterns varied among schools. School average attendance in 2006-07 and 2007-08 ranged from 88.1 percent to 98.8 percent. In the seven schools with the lowest attendance, the average student attended only 88 percent of enrolled school days. In the four schools with the highest average attendance, the typical student attended 98 percent of the time. Thus, students in the highest-attendance schools received 18 additional days of instruction a year, compared with those in the lowest-attendance schools.
- Rates of chronic absence varied among schools. In seven schools, no fourth-grader was chronically absent; in the school with the highest rate, 51.8 percent were chronic absentees. In more than three quarters (539) of the 705 study schools, at least 10 percent of the fourth-grade class was chronically absent.

WHAT THE TEST SCORES SHOW

The CFE analysis demonstrates that the school-wide attendance rate affects how much of a boost a student receives from improving his or her own attendance. As such, the research suggests that students will gain more if their school has a higher attendance rate. If a fourth-grader at a school with a high attendance rate (96.3 percent) increased his own attendance rate from 86.8 to 95.4 percent—coming to school 16 more days—we predict he would see a 5.1-point gain in his *English language arts* score. This may seem modest, but consider that three years of reform, from 2006 to 2009, raised the city's average fourth-grade English

language arts score by a total of 6 points. And a study by the New York City Charter Schools Evaluation Project predicted a 3.6-point annual gain for students in fourth through eighth grade who attend charter schools.² In math, the student would see a 6.9-point gain with better attendance, compared with a 5-point annual increase at a charter school.³ For students at schools with low attendance rates (91.4 percent), the predicted gains are not as large: 3.5 points in English language arts and 3.7 points in math.

Good attendance can not only bring better scores for students, but for schools as well. If the seven schools with the worst third- and fourth-grade absentee rates brought their attendance up from 88 percent to the city average of 93.8 percent, the predicted average scaled-score gain would be 4.8 points in English language arts and 6.0 points in math. For some schools, these gains could mean the difference between meeting the standards for yearly progress set under No Child Left Behind and failing.



WHY IT MATTERS

The results of the CFE analysis underscore the vital importance of attending school. A growing body of research demonstrates the same. In Philadelphia, researcher Michael Gottfried found similar associations between attendance and standardized test performance in a study of public school students in third through eighth grade. His research demonstrated that this association exists independent of other family characteristics, such as parent education and involvement in school activities.⁴ His research strongly suggests that there is a direct link between attendance and performance.

In 2008, Hedy Chang and Mariajosé Romero at the National Center for Children in Poverty analyzed U.S. Department of Education data for 21,260 children nationally from kindergarten through fifth grade. They found that one in 10 kindergarten and first-graders were chronically absent. By the end of first grade, these children were already slipping behind in reading, math and general knowledge. Chronic absence in kindergarten was also strongly associated with lower reading and math performance in fifth grade for poor children.⁵ An analysis that considered New York City students' attendance from kindergarten through grade 4 would likely show a stronger correlation of attendance with test scores than documented by the CFE study.

² Hoxby, Caroline M., Murarka, Sonali, and Kang, Jenny. (2009). *How New York City's Charter Schools Affect Achievement*, August 2009 Report. Cambridge, MA: New York City Charter Schools Evaluation Project.

³ Ibid.

⁴ Gottfried, M. A. (2011). The Detrimental Effects of Missing School: Evidence from Urban Siblings. *American Journal of Education*, 117, 147–182

⁵ Chang, H. & Romero, M. (2008). *Present, Engaged, and Accounted for – The Critical Importance of Addressing Chronic Absence in the Early Grades*. National Center for Children in Poverty, Mailman School of Public Health, Columbia University.

Improving attendance and performance are particularly important now that the New York Board of Regents has instituted tougher standards for proficiency in reading and math. These new standards resulted in smaller percentages of fourth-graders scoring at the proficient levels in 2010. The percentage of proficient students decreased 17 points in English language arts and 22 points in math. Based on historical data, we expect that fewer of these fourth-graders will be proficient when they reach eighth grade. This is ominous because a previous CFE study found that high schools with the largest percentage of entering ninth-graders who, as eighth-graders, had frequent absences and failed to reach the State learning standards had the lowest Regents diploma rates.

Clearly, test scores are the coin of the realm when it comes to education reform, measuring school progress and, increasingly, teacher effectiveness. But the value of good attendance extends far beyond standardized testing gains. For students, attending school regularly can be a sign that they are engaged in learning, while poor attendance as early as sixth grade can signal that a student will eventually drop out of high school.^{6,7} For teachers, good attendance means working with a full classroom, rather than having to repeat material for absentee students the next day. For communities, good attendance has been linked to lower crime rates and higher graduation rates, which in turn bring better employment and stronger local economies. The consequences of dropping out on later income, dependence on welfare, and incarceration are widely documented. Each of these consequences has serious implications for the larger community. Anecdotally, schools find that good attendance begets good attendance: Students, especially in secondary school, want to go where their friends are.

Recognizing the value of attendance to school improvement, Mayor Michael Bloomberg's office last fall launched a pilot program aimed at reducing chronic absenteeism and truancy in 25 schools across the city. The program educates parents about the value of good attendance, offers incentives for children to come to school and provides mentors for students who are missing 10 percent or more of the school year. The efforts have already borne fruit: In the first half of the school year, fully 22 of the 25 schools reduced their absentee rates. The 10 elementary schools saw the best results, with a collective 24 percent decline in the percentage of students who were chronically absent. The seven high schools showed little change.

CFE believes that this sort of program, as well as the community schools approach used in many New York City schools, can substantially reduce chronic absence. When attendance rises, performance will follow. If good curriculum and instruction are also in place, we can start to make real progress for all of the city's children.

6 Balfanz, Robert, Herzog, Lisa & MacIver, Douglas J. (2007). Preventing Student Disengagement and Keeping Students on the Graduation Path in Urban Middle-Grades Schools: Early Identification and Effective Interventions. *Educational Psychologist*, 42, 223–235.

7 Ou, Suh-Ruu & Reynolds, Arthur J. (2008). Predictors of Educational Attainment in the Chicago Longitudinal Study. *School Psychology Quarterly*, 23,199-229.

RECOMMENDATIONS

- **Identify and share best practices for improving attendance.** We must ensure that all schools have effective policies for identifying and monitoring chronically absent students, reaching out to those students and their families and ensuring that they are on track academically. Most importantly, schools must create a climate in which all staff, students and families understand the importance of attendance, set high attendance goals and work to minimize absences.
- **Ensure that schools and teachers are looking at the right data.** Schools need to go beyond schoolwide attendance averages to analyze how many absences, excused and unexcused, each student has accrued and to look for patterns in neighborhoods, ethnic groups, grades or classrooms. Especially in the early grades, absentee students often are not willfully skipping school but rather missing days because of health and safety concerns, frequent moves or unreliable transportation. Schools should identify these barriers and work with parents and community organizations to address them.
- **Hold schools accountable for attendance and chronic absence rates at the city, state and federal levels.** It is important that schools be held accountable for improving attendance. To that end, attendance and chronic absence rates should be publicly available and reported for all federal accountability groups, including racial and ethnic groups. We recommend that federal, state and city accountability systems be revised to increase the value of attendance in assessing school progress. Currently New York is one of five states that does not include attendance data in its longitudinal student database. The state should work with school districts to standardize and collect student-level attendance data, and to develop standard definitions of chronic absence and truancy, so that comparable measures are used statewide.
- **Engage parents and the community in improving school attendance.** It goes without saying that parents play an essential role in getting their children out of bed and off to school each morning. Often, especially in kindergarten and first grade, parents simply don't realize the value of attendance. Community organizations can help educate parents, support families who need help with child care or transportation, and provide services to children and families who need extra assistance.
- **Strengthen comprehensive school reform efforts** so that when children come to school they find an excellent curriculum, engaging teachers, a strong principal and periodic assessments that ensure all students are on track toward meeting graduation standards.

Introduction

Nearly two decades ago, the Campaign for Fiscal Equity (CFE) set out to ensure that New York’s poorest children receive the “sound basic education” guaranteed by the State constitution. A court ruling in 2006 and subsequent State legislation brought new resources to bear on struggling public school systems, and the State began to narrow the equity gap that divides our children. Yet we will never close the achievement gap, even with improved curriculum and instruction, if students are not showing up for school.

Regular school attendance is critical to academic success. National research establishes that absence as early as kindergarten has an ongoing negative effect on achievement. In many New York City schools, students are absent far too often and research links these absences to diminished elementary school performance and lower high school graduation rates. We also know that chronic absenteeism in elementary schools is disproportionately a problem in poor and minority communities and contributes to the achievement gaps among ethnic groups.

This rigorous study of fourth-grade students in New York City public schools documents that, for individual students, higher attendance predicts higher performance on State assessments of English language arts (ELA) and mathematics. In addition, higher mean school attendance also predicts higher student performance. Therefore, the predicted performance gain from higher individual attendance is greatest for students who attend a school with high mean attendance. These associations are independent of the relationships of other student and school variables with performance. That is, when all other variables are held constant, there is a significant association between attendance and performance at the student and school level. This report describes the method and findings of this study and discusses their implications for improving performance in New York City Public Schools.

ATTENDANCE PROBLEM IN NEW YORK CITY

Too many students in New York City are absent too often. In New York City, one in five children misses at least a month of school each year—and in many neighborhoods the number is much higher. According to the Center for New York City Affairs (the Center), the City’s elementary schools have far more serious rates of absenteeism than had been previously reported (Nauer, White, & Yerneni, 2008). While City school officials have long been concerned by poor attendance rates in middle and high schools, an analysis by the Center found that attendance problems begin with much younger students.

The Center’s analysis of Department of Education (DOE) data found that more than 90,000 children in grades K through 5—or 20 percent of total enrollment—missed at least a month of school during the 2007–08 school year. They reported that 15.7 percent

of students in grades kindergarten through 5—and 16.2 percent of students in grades 6 through 8—missed 30 or more days of school in the 2007-08 school year. In 165 schools serving students in grades kindergarten through 8, at least 30 percent of students were chronically absent. These schools were concentrated in areas of New York City with the highest poverty rates.

PREVIOUS RESEARCH FINDINGS

Historically, most published research has examined attendance at the school rather than the student level. These studies have generally found that higher average school attendance is associated with higher performance (Roby, 2004). Several recent studies have documented that for individual students being present at school more days is associated with higher performance. Michael A. Gottfried's research, by employing very rigorous statistical methods, substantially advances our understanding of the link between individual student attendance and performance. These rigorous methods allowed him to eliminate alternative explanations of the link between attendance and performance. One such alternative is that the apparent link between attendance and performance results from the strong association of each with family characteristics, such as socioeconomic status, mother's education, and family involvement in education. In this view, there is no direct link between attendance and performance. Gottfried's research discredits this possibility.

Gottfried has published three journal articles based on his analyses of a comprehensive data set for elementary and middle school students in the Philadelphia School District covering the 1994-95 through 2000-01 school years. In one study (Gottfried, 2010), controlling for student, classroom, school, and neighborhood characteristics, as well as past student performance, he found that the number of days the student was present was positively related to both grade point average and standardized test results in the elementary and middle grades. The relationship was somewhat stronger for middle than elementary students and for mathematics than reading. The quasi-experimental approach used in his research supports the premise that there is a causal relationship between attendance and performance.

Using records for students in second through fourth grade from the same data set, Gottfried examined the relationship of kind of absence—excused or unexcused—to performance on reading and mathematics standardized tests (Gottfried, 2009). He found that higher proportions of unexcused to total absences were associated with lower performance, particularly in mathematics.

In a third study, Gottfried (2011) sought to isolate the effect of missing school on elementary reading and mathematics performance. He controlled the effects of family

variables on both the number of days a student is absent and on student standardized-test performance. Using the Philadelphia School District data set, he tracked five cohorts of siblings for six school years beginning in the 1994-95 school year. As in previous studies, he controlled for student, classroom, school, and neighborhood characteristics. He eliminated family effects by coding each student's absences and standardized test scores as deviations from the family average. To illustrate this method in its simplest form, consider two families. The siblings in one family were absent for four and eight days and siblings in the second family were absent for 16 and 20 days. In each family, one sibling was absent for two days more—and one sibling was absent for two days fewer—than the family average of 6 or 18. The sibling in each family with fewer absences would be coded -2 and the sibling with more absences would be coded +2. Using this method, he eliminated family differences that caused the second set of siblings to be absent for a greater number of days than the first set. By applying the same procedure to standardized test scores, he eliminated family differences that caused some families to achieve higher scores than other families. Using these deviation measures, he then examined whether higher numbers of absences were related to lower test scores. He found that eliminating the family effects resulted in a stronger relationship between attendance and performance than he had found in previous studies without this control.

Hedy Chang and Mariajosé Romero (2008) at the National Center for Children in Poverty (NCCP) reported on the importance of addressing chronic absence in the early grades. They analyzed U.S. Department of Education national data for 21,260 children from kindergarten entry in 1998 to grade 5. Chronic absence was defined as missing 10 percent or more of a school year: at least 18 days out of a 180-day school year. They found that chronic absenteeism is disproportionately a problem in elementary schools that serve mostly poor Black and Hispanic children. It contributes to the achievement gap between these children and their White, Asian, and middle-class peers. Students who have many absences in kindergarten are likely to have similar attendance problems in first grade. By the end of first grade, these children are already slipping behind in reading, math and general knowledge. Chronic absence in kindergarten was also strongly associated with lower reading and math performance in fifth grade for poor children.

Robert Balfanz and Vaughan Byrnes (2006) analyzed records for four cohorts of middle-school students (grades 5-8) attending three high-poverty schools implementing whole-school reform models in the Philadelphia School District. They divided students into two groups according to whether they were closing the gap between achievement and grade-level expectations during the middle school years or continuing to fall behind. Students were counted as closing the gap, if according to standardized test scores, their gain in grade equivalents was greater than their number of years in middle school. Better

attendance was among the factors found to distinguish students who were closing the gap from those who were not. Other factors that achieved similar results were more years in home rooms where larger percentages of children made high gains, better behavior marks, and higher self-rankings of effort in mathematics.

The Campaign for Fiscal Equity (CFE) has completed two analyses of the relationship of school attendance and school performance. In the first study, we found average school attendance to be a significant predictor of school grade 4 ELA performance. The study documented the relationship between attendance and performance on the New York State grade 4 English language arts (ELA) assessment at the school level. The explanatory power of attendance was independent of other school variables: percentages of economically disadvantaged students, English language learners, Black and Hispanic students, and students with disabilities. These variables accounted for almost 78 percent of the variation among schools in the performance of fourth-graders, with attendance and the percentage of economically disadvantaged students being the best predictors of performance.

CFE's recent study, *Diploma Dilemma: Rising Standards, the Regents Diploma, and Schools that Beat the Odds* (Campaign for Fiscal Equity, 2010), documented the importance of attendance in high schools. The study grouped New York City high schools according to the grade 8 performance of entering ninth-graders. Within each group of high schools serving similar students, schools with the lowest and highest Regents diploma rates were distinguished by average daily attendance in the students' expected graduation year. Schools with the highest Regents diploma rates had, on average, the highest attendance rates.

RESEARCH OBJECTIVE

Improving performance is a critical goal and attendance is a key element in achieving that goal. Before 2000, the United States had the largest percentage of college graduates in the world. By 2010, according to the College Board, we had slipped to 12th place out of 36 countries in the percentage of 25 to 34 year olds with at least an associate's degree. A recent report released by the State Education Department (2011) showed that only 23 percent of New York City students who entered grade 9 in 2005-06 had graduated by June 2009 with performance that indicated adequate preparation for college; that is, scores of 75 or higher on the Regents English examination and 80 or higher on a Regents mathematics examination. Our future prosperity depends on better preparing students to meet future challenges, which will surely depend on higher levels of literacy, enhanced technical and scientific skills, and greater problem-solving ability. We cannot afford for students to leave high school without adequate preparation for college and the workplace, as too many New York City students do today.

All students now entering ninth grade in New York State except those with disabilities must meet the more rigorous Regents diploma requirements to graduate. CFE's research suggests that entering ninth grade not having achieved the eighth-grade learning standards substantially reduces a student's chance of earning a Regents diploma. State assessment results show that by third grade many students have fallen far behind grade-level expectations and will fall farther behind without effective interventions, year by year decreasing the probability of earning a Regents diploma.

The research objective is to document the relationship between individual student attendance and performance in New York City elementary schools. To achieve this objective, CFE performed multilevel regression analyses of performance on the grade 4 ELA and mathematics assessments. In examining this relationship, we accounted for the association between previous performance (third grade) and fourth-grade performance and for other student and school factors that are simultaneously related to attendance and performance. These student factors include poverty, ethnicity, gender, disability, English proficiency, and mobility. The school factors include average school attendance, average grade 3 performance, percentage minority enrollment, and teacher qualifications. These analyses define how these explanatory variables are associated with the performance of individual students and how they vary among schools. We will use the results to focus the attention of elementary-school staff and parents on the importance of attendance in enabling students to meet learning standards and to support the continuation and enhancement of comprehensive school reform in New York City schools.

Method

DATA

We analyzed student data for 705 New York City Public Schools that served fourth-graders in 2007-08. These schools enrolled 64,062 fourth-grade students whose records met the following criteria for study inclusion:

- included scores for the 2006-07 third-grade and 2007-08 fourth-grade assessments in ELA and/or mathematics.
- indicated enrollment in fourth-grade in a New York City public school—other than a school in District 75—at the end of the 2007-08 school year.
- included attendance data for 2006-07 and 2007-08.

The New York City Department of Education (DOE) provided the following data for third-graders in 2006-07 and fourth-graders in 2007-08: A non-personally identifiable student tracking number; school identification number where student was registered on October 31 of each school year; school identification number where student was registered on June 30 of each school year; gender; ethnicity; grade level; identifiers of eligibility for free- or reduced-lunch, limited English proficiency, and disability; days absent, present and released; and scaled scores and performance levels for the State grade 3 and 4 assessments in ELA and mathematics.

We also obtained data on the teacher characteristics of study schools in 2007-08 from the State Education Department's Report Card Data Base. These characteristics included lack of appropriate certification, years of experience, graduate education beyond the master's degree, and teacher turnover rate.

The achievement data consisted of scaled scores and performance levels on the 2007 grade 3 and the 2008 grade 4 ELA and mathematics assessments of the New York State Testing Program. These assessments measured the performance of students in grades 3 through 8 relative to the State Learning Standards. In 2008 each of these assessments was graded on a scale consisting of 280 to 360 points, with a scaled score of 650 indicating proficiency at each grade level. The scale is divided into four performance levels: Level 1 identifies students with serious academic deficiencies; Level 2, students partially meeting the

standards; Level 3, students meeting the standards and thus considered proficient; and Level 4, students meeting the standards with distinction. A great majority of students in the City and the State perform at Level 2 or 3 on each assessment.

GRADE 4 STATE ASSESSMENTS
Performance Levels, Corresponding Scaled-Score Ranges, and Percentages of New York City Students Scoring at Each Level in 2007-08

PERFORMANCE LEVEL	ELA		MATHEMATICS	
	SCALED-SCORE RANGE	PERCENT AT LEVEL	SCALED-SCORE RANGE	PERCENT AT LEVEL
1	430-611	10.5	485-621	6.3
2	612-649	28.2	622-649	14.1
3	650-715	55.5	650-701	53.4
4	716-775	5.8	702-800	26.2

Using DOE data elements, we calculated the following attendance variables:

- **Student Days Enrolled** is the sum of **Days Absent**, **Days Present**, and **Days Released**. (Some students were not enrolled for the entire school year.)
- **Student School Year Attendance** was calculated by dividing the number of **Days Present** by **Days Enrolled** in each school year and multiplying by 100.
- **Student Cumulative Attendance** was calculated by dividing the sum of **Days Present** in 2006-07 and 2007-08 by **Days Enrolled** in 2006-07 and 2007-08 and multiplying by 100.
- **School Mean Attendance** is the arithmetic mean of **Student Cumulative Attendance** for fourth-graders enrolled in the school at the end of the 2007-08 school year.
- **A Chronic Absence Identifier** was assigned to students who attended school for fewer than 90 percent of enrolled school days in 2006-07 and 2007-08.

Students were considered to be continuously enrolled if the school identification numbers on their records indicated that they were enrolled in the same school from October 31, 2006 until the end of the 2007-08 school year. Continuous enrollment is the measure of mobility.

ANALYSES

The focus of this research is multilevel regression analyses of the relationships between attendance and performance on the grade 4 ELA and mathematics assessments. These analyses are multilevel in that they consider both student and school characteristics in predicting student performance. This statistical technique allows us to quantify the association of each explanatory variable with performance, independent of the others. The most powerful predictor of assessment performance is previous performance.

Therefore, our analyses controlled for grade 3 ELA and mathematics performance. Including grade 3 performance controlled for the time-invariant characteristics of students that are simultaneously related to attendance and performance. These time-invariant characteristics include those components of motivation, ability, and family support that do not change over time. We also included factors that previous analyses have shown to be associated with performance, that is, eligibility for free- or reduced-price lunches (poverty), ethnicity, gender, disability, English proficiency, and continuous enrollment. Because schools provide the context in which students are educated, school characteristics can be expected to modify the relationship between student attendance and performance. Therefore, these analyses also examined the mediating effects of school contextual factors—mean grade 3 performance, school mean attendance, ethnic composition, and a teacher quality variable. We selected turnover rate for ELA and percentage of teachers with 30 credit hours beyond the master’s degree for mathematics as the best predictors of performance. These analyses produced equations that predict the grade 4 performance of individual students.

PRESENTATION OF FINDINGS

The next section provides an overview of research findings. The following three sections provide background information to assist the reader in understanding the multilevel analyses. “Student Profiles” presents demographic, attendance, and performance profiles of the 64,062 fourth-graders included in the study. We also present similar profiles for each ethnic group to show the associations between ethnicity and eligibility for free-and-reduced-priced lunches, disability, English proficiency, attendance, and performance. “School Profiles” presents enrollments, demographics, attendance, performance, teacher qualifications—lack of appropriate certification, years of experience, graduate education—and teacher turnover rates for the 705 schools included in the study. This section also examines the relationships of student demographics and teacher characteristics with attendance. “Attendance and Performance at the School Level,” examines the relationship of school mean attendance with school mean ELA and mathematics performance. The final section of findings reports on the multilevel analyses of the relationships between individual attendance and performance on the grade 4 ELA and mathematics assessments. The relationship of each explanatory variable to grade 4 performance is described.

Overview of Findings

This study is important because unlike previous studies of New York City students it examines the relationship of attendance and performance at the student level, while considering other student and school characteristics that are related to performance. Our multilevel analyses document that both individual attendance and school mean attendance in grades 3 and 4 are associated with performance on the grade 4 assessments in ELA and mathematics. Higher individual student attendance predicts higher performance and attending a school with higher mean attendance increases the predicted performance gain. These associations are independent of the relationship of other student and school variables with performance. That is, when all other variables are held constant, there is a significant association, for individual students, between attendance and performance. These predicted results are based on data for 64,062 students in 705 schools and are highly reliable. The odds that there is no relationship between attendance in grades 3 and 4 and grade 4 ELA and mathematics performance are less than one in a thousand.

MULTILEVEL ANALYSIS FINDINGS

Individual Student Attendance

Our analyses produced equations that allow us to predict student performance under various conditions. The relationship of individual student attendance with grade 4 performance is not uniform across schools. The relationship is stronger in schools with higher average attendance in grades 3 and 4. To illustrate how performance varies among schools and students with different attendance rates, we compared predicted fourth-grade scaled scores in hypothetical schools with low-attendance—91.4 percent—and high-attendance—96.3 percent. Only 10 percent of schools had lower attendance than 91.4 percent, while 90 percent had lower attendance than 96.3 percent. The average student in the low-attendance school missed more than twice as many days—16 in a 185 day school year—than the average student in the high attendance school—7 days. Within each school, we compared the predicted grade 4 scores of three students with different attendance rates: a chronically absent student (86.8-percent attendance), a typical student (95.4-percent attendance), and a high-attendance student (99.0-percent attendance). Students with different grade 3 performance and different demographic characteristics will have different predicted scores. The predicted gains of students with the same attendance improvement, however, depend only on their schools' mean attendance. For example, students with low and high grade 3 scores attending the school with high mean attendance can expect the same gain by improving their attendance from 86.8 to 95.4. The student with the higher grade 3 score will however have a higher predicted grade 4 score because higher grade 3 performance predicts higher grade 4 performance. Table 1 provides the predicted gains achieved by improving attendance in schools with the specified mean attendance rates, regardless of the student's demographic characteristics and grade 3 performance.

TABLE 1
The Predicted Scaled-Score Gains on the
Grade 4 ELA Assessment as Student Attendance Improves

STUDENT ATTENDANCE	SCHOOL MEAN ATTENDANCE	
	91.4 PERCENT (169 DAYS IN 185 DAY SCHOOL YEAR)	96.3 PERCENT (178 DAYS IN 185 DAY SCHOOL YEAR)
Gain Predicted by Increasing Attendance from 86.8 to 95.4 Percent	3.5	5.1
Gain Predicted by Increasing Attendance from 95.4 to 99.0 Percent	1.5	2.1
Total Gain Predicted by Increasing Attendance from 86.8 to 99.0 Percent	5.0	7.2

As shown in Table 1, in the low-attendance school, the predicted ELA scaled-score difference between the chronically absent student and the student with typical attendance was 3.5 scaled-score points. A student with very high attendance is predicted to score an additional 1.5 points compared with the student with typical attendance. Attendance had a stronger relationship with performance in high- than low-attendance schools. In the high-attendance school, the predicted grade 4 ELA score of the student with typical attendance is 5.1 points higher than that of the chronically absent student. The predicted score of the high-attending student is another 2.1 points higher.¹

These predicted gains can be put in perspective by comparison to other benchmarks. The predicted ELA scaled-score gain from improving a student's attendance from 86.8 to 95.4 percent in a high-attendance school is 5.1 points. The mean grade 4 ELA score for New York City students increased from 657 to 663 between 2006 and 2009; this gain of six points was seen as indicating improvements in the school system. In 2007-08, more than one quarter of fourth-graders scored at ELA Level 2, which includes scores from 612 to 649. The expected gain is 14 percent of that range. To cite another benchmark, the average difference between minority students and White and Asian students on the Grade 4 ELA assessment was about 30 points. The expected gain is 17 percent of that difference. Finally, an evaluation of New York City charter schools (Hoxby, Murarka, & Kang, 2009) estimated that the extra annual gain in ELA scaled score achieved by the average student in grades 4 through 8 attending a charter school—rather than the average City public school—would be 3.6 points.

¹ Note that school average attendance increases when multiple enrolled students improve their attendance. As the average attendance of the school increases, so will the predicted performance gain of individual students with improved attendance. If the low-attendance school succeeds in increasing its average attendance to 92.4 percent, the predicted gain in ELA score increases to 4.5 points and the predicted gain in mathematics score increases to 5.0 points.

TABLE 2
The Predicted Scaled-Score Gains on the
Grade 4 Mathematics Assessment as Student Attendance Improves

STUDENT ATTENDANCE	SCHOOL MEAN ATTENDANCE	
	91.4 PERCENT (169 DAYS IN 185 DAY SCHOOL YEAR)	96.3 PERCENT (178 DAYS IN 185 DAY SCHOOL YEAR)
Gain Predicted by Increasing Attendance from 86.8 to 95.4 Percent	3.7	6.9
Gain Predicted by Increasing Attendance from 95.4 to 99.0 Percent	1.6	2.9
Total Gain Predicted by Increasing Attendance from 86.8 to 99.0 Percent	5.3	8.5

In Table 2, we see a similar pattern when we predict grade 4 mathematics scaled scores. In the low-attendance school, the scaled-score difference between our chronically absent student and our typical student is 3.7 points. The high-attendance student would score an additional 1.6 points. Again the relationship between student attendance and performance is stronger in high- than low-attendance schools. In the high-attendance school, the predicted score of the student with typical attendance is 6.9 points higher than that of the chronically absent student. The high-attendance student would score an additional 2.9 points.

Again we place the gains in perspective. The predicted mathematics scaled-score gain from improving a student's attendance from 86.8 to 95.4 percent in a high-attendance school is 6.9 points. Between 2006 and 2009, the mean grade 4 mathematics scaled score for New York City students improved from 669 to 688.² In 2007-08, almost one in seven fourth-graders scored at math Level 2, which includes scores from 622 to 649. The expected gain is 25 percent of that range. Black, Hispanic, and Native American students scored about 27 points lower than White and Asian students on the Grade 4 mathematics assessment. The expected gain is about 26 percent of that difference. The predicted average annual mathematics gain for students attending a charter school is 5.0 points.

School Attendance

The multilevel analyses results reported above document that higher student attendance predicts better performance on ELA and mathematics assessments. The analyses also document that increased school mean attendance predicts higher school mean scaled scores on these assessments. Each one percentage point increase in school mean attendance corresponds, on average, to a 0.803-point increase in a school's grade 4 ELA mean scaled score. This finding suggests that the seven schools with mean attendance of only 88 percent could improve their mean ELA scaled score by about 4.8 points by increasing their attendance to the mean of the schools' means, 93.8 percent. The improvement to be gained in mathematics by this increase is even larger: 0.991 points for each one percentage point increase in school mean attendance. For the seven schools

² The acknowledged increases in the predictability of mathematics test questions during those years suggest that some portion of that increase does not reflect real increases in achievement.

with the lowest attendance, this amounts to a predicted increase of six scaled-score points.

The multilevel analyses also documented the relationships of student grade 3 performance, student demographic variables, and school variables with grade 4 performance. These relationships are summarized below:

- ***Student variables.*** The analysis of ELA data confirmed that eight student variables are significantly associated with grade 4 performance. Higher attendance, higher grade 3 performance, being female, and being continuously enrolled in the same school in grades 3 and 4 predict better grade 4 performance. Being Black, Hispanic, or Native American; being eligible for free- or reduced-price lunches; being disabled; and having limited English proficiency predict lower grade 4 performance. These associations are independent of the relationships among these explanatory variables.
- ***School variables.*** Three school variables, in addition to school mean attendance, are associated with performance: school grade 3 ELA mean score, percentage of minority students, and teacher turnover rate. A higher mean grade 3 ELA score predicts higher grade 4 performance, while larger percentages of minority students and higher teacher turnover predict lower grade 4 performance.
- ***Cross-level interactions.*** Five cross-level interactions are associated with grade 4 ELA performance. For example, the relationship between individual attendance and grade 4 performance is mediated by school mean attendance. The interaction increases or decreases students' predicted scores depending on the mean attendance of the school they attend. Consider first students whose attendance is above the school mean. If they attend a school with above average school attendance, the interaction will result in a small addition to their predicted scores. For such students who attend a school with below average school attendance, the interaction will result in a small deduction from their predicted scores. The opposite is true for students whose attendance is below their schools' mean.
- ***Mathematics.*** The multilevel analysis of mathematics performance produced similar findings but showed a stronger association between individual attendance and performance. Seven of the eight student-level variables have significant relationships with grade 4 mathematics performance, independent of all other variables. The association of continuous enrollment with grade 4 mathematics performance is not statistically significant. Being female predicts lower rather than higher performance. Further, no teacher quality variable is significantly related to performance, once we account for all other explanatory variables. Only three cross-level interaction variables meet the statistical criteria for inclusion in the model.

OTHER STUDY FINDINGS

The findings listed below provide a context for understanding the results of the multilevel analyses, summarized above.

The 64,062 fourth-graders in New York City Public Schools in 2007-08 were ethnically and economically diverse. The prevalence of disability, English proficiency, and mobility and patterns of attendance and performance varied among ethnic groups. (See “Student Profiles” for details.)

- The majority of fourth-graders (71 percent) were Hispanic or Black and 84 percent came from low-income families.
- 18 percent of fourth-graders were disabled and 15.2 percent were limited English proficient.
- About 87 percent were continuously enrolled in the same school from October 31, 2006 to the end of the 2007-08 school year.
- The average student attended school for almost 94 percent of enrolled school days in grades 3 and 4. Half of fourth-graders—about 32,000 students—attended at least 95.4 percent of school days in grades 3 and 4.
- Eighteen percent—over 11,000 students—however were chronically absent; that is, they missed more than 10 percent of school days during that period—the equivalent of at least 19 days in a 185-day school year.
- Each ethnic group had distinctive demographic characteristics. White students were much less likely than other students to come from low-income families and be eligible for free- or reduced-price lunches. Asian students were less likely to be classified as disabled. Asian and Hispanic students were most likely to be English language learners. Native American, Black, and Hispanic students were at least five times as likely as Asian students to be chronically absent. White students were most likely to be continuously enrolled in the same school in third and fourth grade.
- The average student scored at the proficient level (650 or higher) on the grades 3 and 4 State assessments in ELA and math in both third and fourth grade. Underlying these average scores lies a continuum moving from scores signifying no mastery of grade-level learning objectives to perfect test performance.

Most of the 705 schools had student enrollments that did not reflect the City’s ethnic and economic diversity; rather their enrollments were drawn primarily from one or two ethnic groups and families with similar income levels. Schools varied widely on demographic indicators, on teacher qualifications, and in attendance rate and performance. (See “School Profiles” for details.)

- In half of study schools, 90 percent or more of fourth-graders were Native American, Black, or Hispanic. In contrast, in 19 schools at least 90 percent were White or Asian.
- Schools diverged demographically: 5 enrolled no students with disabilities; 44 no English language learners. In seven schools, all fourth-graders were continuously enrolled; in six, none was continuously enrolled. In 219 schools, all fourth-graders were eligible for free- and reduced-price lunches; in one school at the other extreme fewer than four percent were eligible.
- Attendance patterns varied among schools. School mean attendance in 2006-07 and 2007-08 ranged from 88.1 to 98.8 percent. In the seven schools with the lowest attendance, students, on average, attended only 88 percent of enrolled school days in 2006-07 and 2007-08. These students missed about 22 days in the 185-day school year. In the four schools with the highest average attendance, students, on average, attended 98 percent of enrolled schools days, missing no more than four days. Students in the highest-attendance schools received 18 additional days of instruction compared with those in the lowest-attendance schools.
- Similarly, rates of chronic absence varied among schools. In seven schools, no fourth-grader was chronically absent; in the school with the highest rate of chronic absence, 51.8 percent of fourth-graders attended school fewer than 90 percent of enrolled days in third and fourth grades; that is, they missed more than 18 days in a 185-day school year. In more than three quarters (539) of the 705 study schools, at least 10 percent of fourth-graders were chronically absent.
- Schools showed a range of performance on the State ELA and math assessments. In schools with the lowest performance on the ELA assessment, the average student barely scored at Level 2, indicating very limited achievement of the learning standards; in the highest-performing schools, the average student scored at Level 4. Students, on average, performed better on the mathematics than the ELA assessment, but the range of performance among schools was almost as great in mathematics as in ELA.

These differences among schools predict differences in attendance and performance. (See “Attendance and Performance at the School Level” for details).

- Demographic variables are significantly correlated with attendance at the school level: larger percentages of fourth-graders who were eligible for free- and reduced-priced lunches; who were Native American, Black, or Hispanic; and who were classified as disabled are associated with lower attendance rates. Larger percentages of students who were continuously enrolled are associated with higher attendance.

- The percentages of teachers without appropriate certification, the percentage without three years' experience, and the teacher turnover rate each have small but highly significant negative associations with school attendance. As each measure increased, school attendance decreased. The percentage of teachers with a master's degree plus at least 30 credit hours is significantly associated with higher attendance.
- Both school mean attendance in 2006-07 and 2007-08 and the percentage of chronically absent students have moderate correlations with mean scaled scores on the grades 3 and 4 assessments in ELA and mathematics. As average school attendance increased, performance improved. As the percentage of chronically absent students increased, school performance declined.
- When schools are ranked according to attendance and divided on attendance into five groups of equal size, the groups differ significantly on fourth-grade performance even when third-grade performance is accounted for. The group with the highest attendance, achieved an unadjusted mean grade 4 ELA score 32 points higher—and a mean grade 4 math score 35 points higher—than the group with the lowest attendance.

Student Profiles

These profiles reveal the diversity of fourth-graders in New York City Public Schools. Table 3 shows the demographic profiles of 64,062 fourth-graders in 2007-08. The largest ethnic group was Hispanic (40.4 percent), followed by Black (30.6 percent). The smallest group—with only 0.4 percent of study group enrollment—was Alaskan Native or Native American. In later analyses these three ethnic groups were combined and referred to as the minority group. White and Asian students together made up 28.5 percent of the study group,³ which included slightly fewer females than males.

A great majority of fourth-graders came from low-income families; 85 percent were eligible for free- or reduced-price lunches. In fourth grade, 18 percent were classified as disabled and 15.2 percent were limited English proficient. Over 87 percent were continuously enrolled in the same school from October 31, 2006 through the end of the 2007-08 school year. Eighteen (18) percent—over 11,000 students—were chronically absent; that is, they attended school for fewer than 90 percent of enrolled school days in 2006-07 and 2007-08—they missed the equivalent of at least 19 days in a 185-day school year.

TABLE 3
Demographic Profile of 64,062 Fourth-Grade Students in 2007-08

STUDENT CHARACTERISTIC	PERCENT
Native American	0.4%
Black	30.6%
Hispanic	40.4%
Asian	14.0%
White	14.5%
Female	49.5%
FRPL Eligible	85.0%
Students with Disabilities	18.0%
Limited English Proficient	15.2%
Continuously Enrolled	87.3%
Chronically Absent	18.0%

³ All but seven students were identified by DOE as belonging to a single ethnic category as, in compliance with federal regulations, the State Education Department did not require the multi-racial classification in the 2007-08 school year. In total, records for 52 students did not have a useable ethnic identity.

Table 4 shows the mean 2006-07 and 2007-08 attendance rates of students in the study sample. It also shows their mean cumulative attendance for the two school years. Mean attendance in 2007-08 was 0.4 percentage points higher than in 2006-07.

TABLE 4
Attendance Profile of 2007-08 Fourth-Grade Students

ATTENDANCE	MEAN	STANDARD DEVIATION
2006-07	93.7%	5.99%
2007-08	94.1%	5.80%
Cumulative	93.9%	5.51%

Figure 1 shows the percentage of students at each of five levels of attendance, ranging from severe chronic absence to good attendance. Three percent of fourth-graders (1,821 students) had severe attendance problems; they attended fewer than 80 percent of enrolled days—fewer than 148 days in a 185-day school year. One student attended only 44 percent of school days in grades 3 and 4. The remaining group of chronically absent students (9,714 students) attended at least 80 percent—but fewer than 90 percent—of school days. The third group attended fewer than 92.5 percent of school days; these 7,018 students were not chronic absentees but their low attendance may have compromised their performance. The fourth group (10,759 students) attended at least 92.5 but fewer than 95 percent of school days. The final and largest group, 54.3 percent of fourth-graders (34,763 students) attended school regularly—at least 95 percent of enrolled days.

THE STANDARD DEVIATION (SD)

measures the variation of values around the mean value. A small SD indicates that values tend to be close to the mean, while a large SD indicates that the values are spread over a larger range.

FIGURE 1
The Percentage of Students at Each Attendance Level

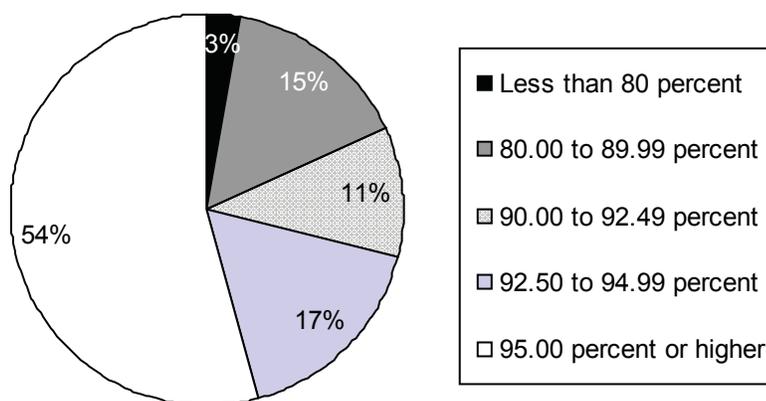


Table 5 reports the mean scaled score achieved by study students on the State assessments in ELA and mathematics in third and fourth grades. On each test, the average student scored at the proficient level, 650 or above. In both grades, mean mathematics scores were substantially higher than mean ELA scores. Note that the percentages of students meeting the proficiency standards increased substantially statewide in 2008 and 2009, leading the Board of Regents to raise standards on the 2010 tests. The rationale for this decision is described in the Discussion.

TABLE 5
Performance Profile of 2007-08 Fourth-Grade Students

ASSESSMENT	MEAN SCALED SCORE	STANDARD DEVIATION	NUMBER TESTED
Grade 3 ELA (2006-07)	658.8	39.7	62,651
Grade 3 Math (2006-07)	685.8	37.4	63,919
Grade 4 ELA (2007-08)	658.2	39.3	63,778 ⁴
Grade 4 Math (2007-08)	681.0	38.5	64,944

STUDENT PROFILES BY ETHNICITY

Ethnic groups varied substantially in the prevalence of disability, limited English proficiency, and eligibility for free- and reduced-price lunches. Table 6 shows that White students were less likely than others to be eligible for free- or reduced-price lunches (FRPL Eligible), 52.6 percent compared with 85.0 percent of all students. Asian students were less likely than other students to be classified as disabled; only 7.5 percent of Asians were classified compared with 18.0 percent of all fourth-graders. Hispanic students were more likely than others to be limited English proficient; more than a quarter of Hispanic students were so identified. The Asian group had the second highest prevalence of limited English proficient students; 16.9 percent.

TABLE 6
The Incidence of Free- and-Reduced-Price-Lunch Eligibility, Disability, and Limited English Proficiency among 2007-08 Fourth-Graders by Ethnic Group

ETHNIC GROUP	NUMBER	FRPL ELIGIBLE		STUDENTS WITH DISABILITIES		LIMITED ENGLISH PROFICIENT	
		NUMBER	PERCENT	NUMBER	PERCENT	NUMBER	PERCENT
Native American	253	224	88.5%	63	24.9%	22	8.7%
Asian	8,993	7,613	84.7%	675	7.5%	1,517	16.9%
Black	19,575	17,497	89.4%	3,706	18.9%	470	2.4%
Hispanic	25,894	24,216	93.5%	5,480	21.2%	7,187	27.8%
White	9,295	4,886	52.6%	1,601	17.2%	544	5.9%
All Students	64,062	54,472	85.0%	11,528	18.0%	9,742	15.2%

⁴ The increase in the number of students tested in 2008 compared with 2007 can be accounted for by the revised No Child Left Behind requirement to test limited English proficient students with fewer years of English instruction.

Table 7 shows differences among ethnic groups in the percentage of fourth-graders who were continuously enrolled in the same school from fall 2006 until the end of the 2007-08 school year. White students were most likely—and Black students least likely—to be continuously enrolled.

TABLE 7
The Number and Percentage of Continuously Enrolled Fourth-Graders by Ethnic Group

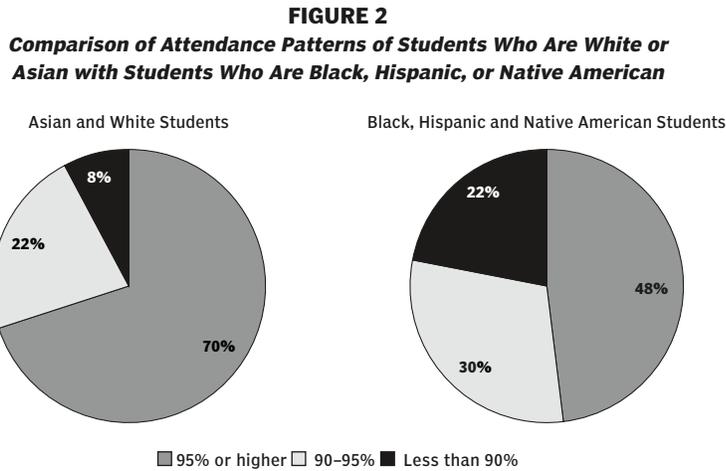
ETHNIC GROUP	CONTINUOUSLY ENROLLED	
	NUMBER	PERCENT
Native American	225	88.9%
Asian	8,067	89.1%
Black	16,470	84.1%
Hispanic	22,472	86.8%
White	8,675	93.3%
All Students	55,955	87.3%

Students of different ethnic backgrounds had different attendance patterns (Table 8). Asian students had the highest mean and median cumulative attendance and were least likely to be chronically absent. Half of Asian students attended school at least 98.1 percent of school days. Native American, Black, and Hispanic students were five times as likely as Asian students and almost twice as likely as White students to be chronically absent. The Black student group included the largest percentage of students who were chronically absent. This being said, many students in each ethnic group attended school regularly. While more than one-fifth of Black and Hispanic students were chronically absent, almost half (48 percent) of each group attended school regularly; that is, they were present on 95 percent of enrolled days. While almost one quarter of Native American students were chronically absent, more than half attended at least 95 percent of enrolled days.

TABLE 8
Student Attendance in 2006-07 and 2007-08 by Ethnic Group

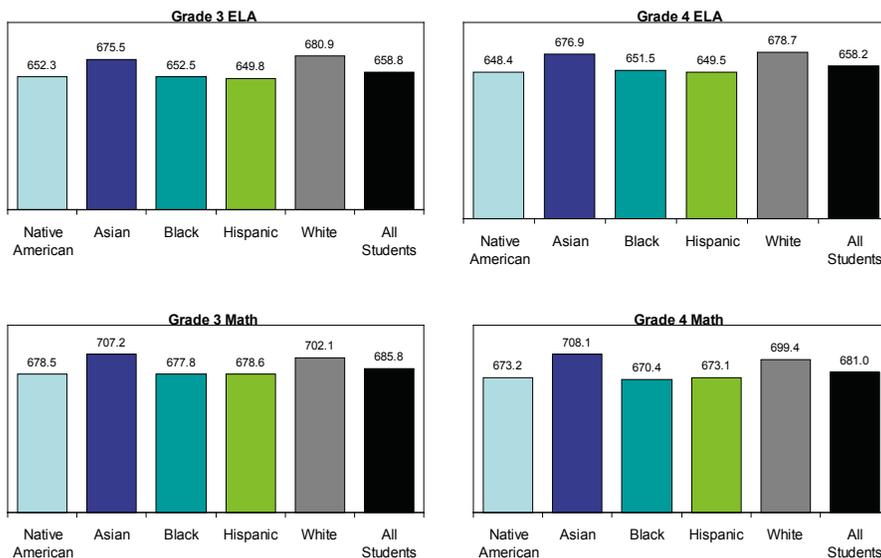
ETHNIC GROUP	COUNT	CUMULATIVE ATTENDANCE 2006-07 AND 2007-08					
		MEAN	MEDIAN	NUMBER 95 PERCENT OR ABOVE	PERCENT 95 PERCENT OR ABOVE	NUMBER CHRONICALLY ABSENT	PERCENT CHRONICALLY ABSENT
Native American	253	93.3%	95.1%	131	51.8%	63	24.9%
Asian	8,993	96.9%	98.1%	7,279	80.9%	381	4.2%
Black	19,575	93.0%	94.8%	9,398	48.0%	4,477	22.9%
Hispanic	25,894	93.3%	94.8%	12,450	48.1%	5,473	21.1%
White	9,295	94.7%	95.8%	5,486	59.0%	1,114	12.0%
All Students	64,062	93.9%	95.4%	34,763	54.3%	11,522	18.0%

Figure 2 graphically displays the differences in average attendance between students who are White and Asian and students who are Black, Hispanic, and Native American. White and Asian students were more likely to attend school regularly—at least 95 percent of school days—and less likely to be chronically absent than other ethnic groups.



On average, Hispanic, Black, and Native American students achieved similar scores on the grades 3 and 4 ELA and mathematics assessments (Figure 3).⁵ Their mean scores on each assessment were 25 to 35 points lower than those of Asian and White students. With the exception of Asian students, the average score of each ethnic group was lower in fourth than third grade. The improving scores of Asian students may reflect the increasing English proficiency of students who began kindergarten as English language learners.

FIGURE 3
Grade 3 (2006-07) and Grade 4 (2007-08) School Mean Scaled Scores



⁵ Performance levels and corresponding score ranges are shown on page 13.

School Profiles

Our examination of schools shows that the enrollment in many schools was not representative of the demographic, performance, and attendance profiles of the fourth-grade population. Many schools instead served only segments of this population—students with similar demographic, attendance, and performance patterns. This segregation of students reflects the neighborhoods from which schools draw students, neighborhoods that are frequently segregated by ethnicity and income. We find that school minority composition is significantly associated with attendance. We show that schools varied in the qualifications and experience of their teachers and their ability to retain teachers and that these teacher characteristics are significantly associated with attendance.

The profile in Table 9 reveals substantial variations among schools in enrollment and student demographics. These variations are described below.

TABLE 9
Demographic Profile of 705 Study Schools

SCHOOL CHARACTERISTIC	MEAN	MINIMUM	MAXIMUM	STANDARD DEVIATION
Fourth-Grade Enrollment	91	14	287	42.7
Percent Minority	72.9%	3.7%	100.0%	31.3%
Percent Native American	4.3%	0.0%	11.8%	1.0%
Percent Black	33.1%	0.0%	98.3%	30.8%
Percent Hispanic	39.3%	0.0%	100.0%	27.0%
Percent Asian or White	27.0%	0.0%	96.3%	31.3%
Percent Asian	12.2%	0.0%	89.8%	18.1%
Percent White	14.8%	0.0%	91.8%	22.6%
FRPL Eligible 2007-08	84.2%	3.6%	100.0%	22.5%
Percent SwD	18.9%	0.0%	58.3%	9.4%
Percent ELL	14.0%	0.0%	81.8%	12.5%
Percent Continuously Enrolled	86.8%	0.0%	100.0%	10.8%

- The average school enrolled 91 fourth-graders meeting the study inclusion criteria. Eighty-six (86) percent of study schools had enrollments between 31 and 150.
- Ethnic composition varied from school to school, with many schools enrolling students almost exclusively from one or two ethnic groups. In half of study schools, 90 percent or more of fourth-graders were Native American, Black, or Hispanic. In 19 schools at least 90 percent were White or Asian.

- In the average school, 84.2 percent of fourth-graders were eligible for free- or reduced-price lunches. Some schools, however, served relatively affluent students. In one such school, only 3.6 percent were eligible.
- Similarly, students with disabilities and limited English proficient students were not equally distributed among schools. Five schools enrolled no students with disabilities while in five other schools the majority of fourth-graders were disabled. Forty-four (44) schools served no limited English proficient students, while in one school almost 82 percent of students were limited English proficient.
- Some schools had stable enrollments; others served more mobile populations. We counted the number of fourth-graders who were continuously enrolled from October 31, 2006 to the end of the 2007-08 school year. At one extreme, a school enrolled no such students; at the other extreme, almost 87 percent were continuously enrolled.

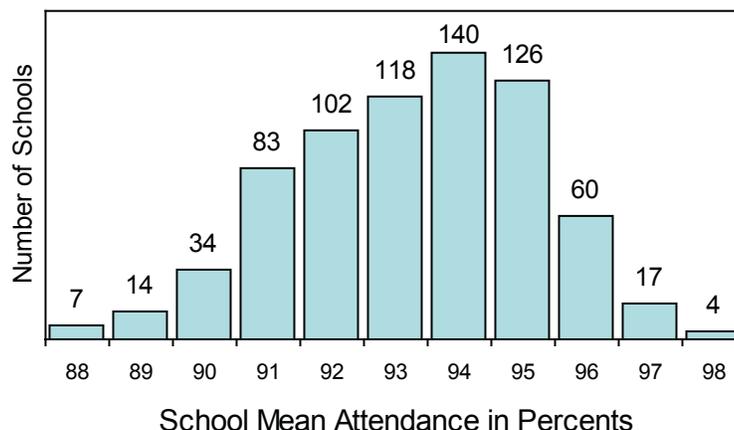
Attendance varied substantially among schools. We calculated the school mean attendance in third and fourth grade of 2007-08 fourth-graders (Table 10). Figure 4 shows the number of schools by the school mean attendance in one-percentage-point bands. School mean attendance ranged from a low of 88.1 percent to a high of 98.8 percent. In 21 schools, the average student was chronically absent. In more than three quarters (539) of the 705 study schools, at least 10 percent of fourth-graders were chronically absent.

In the seven schools with the lowest attendance, students attended only 88 percent of enrolled school days in 2006-07 and 2007-08. These students missed about 22 days—or a month—in the 185-day school year. In the four schools with the highest average attendance, students attended at least 98 percent of enrolled schools days, missing no more than four days. Students in the highest-attendance schools received 18 additional days of instruction, on average, compared with those in the lowest-attendance schools.

TABLE 10
Attendance Profile of 705 Study Schools

SCHOOL CHARACTERISTIC	MEAN	MINIMUM	MAXIMUM	STANDARD DEVIATION
2006-07 Attendance	93.6%	87.9%	98.4%	2.0%
2007-08 Attendance	94.0%	88.0%	99.2%	1.9%
Cumulative Attendance	93.8%	88.1%	98.8%	1.9%
Chronic Absence Rate	18.8%	0.0%	51.8%	11.1%

FIGURE 4
Distribution of Schools by Mean Attendance



The range of school performance on the ELA and mathematics assessments was wide (Table 11). On all tests except grade 3 mathematics, students in the highest-performing school scored more than 100 point higher, on average, than students in the lowest-performing. On the grade 3 mathematics test, the difference was 95 points. In the lowest-performing schools, the average student scored at the bottom of the Level 2 range⁶ on the ELA assessments, indicating that the majority of students had significant deficiencies in reading, writing, and listening comprehension.

TABLE 11
Performance Profile of 705 Study Schools

STATE ASSESSMENT	MEAN SCORE	MINIMUM	MAXIMUM	STANDARD DEVIATION
Grade 3 ELA	658.5	619.4	738.9	17.7
Grade 3 Math	684.8	645.1	740.5	16.1
Grade 4 ELA	657.8	612.1	729.2	17.7
Grade 4 Math	680.2	636.7	745.4	18.3

TEACHER CHARACTERISTICS

Teachers were not distributed equally among schools by education and experience (Table 12). In one school, 45 percent of teachers were not appropriately certified for the class or classes they were teaching. In 89 schools, all teachers were appropriately certified. In one school, 54 percent of teachers had fewer than three years' experience. In 14 schools, all teachers had at least three years' experience. In the school with the greatest percentage of highly educated teachers, 87 percent had earned at least 30 credits beyond the master's degree; three schools had no teachers with such credentials.

⁶ On the grade 3 ELA assessment, Level 2 included scores from 616 to 649. On the grade 4 ELA assessment, Level 2 included scores from 612 through 649.

Teacher turnover also varied from school to school. In the school with the highest rate, 55 percent of teachers employed in 2007-08 had not been employed in that school in the previous year. Four schools experienced no turnover of teachers from 2006-07 to 2007-08.

TABLE 12
The Characteristics of Teachers in Study Schools

TEACHER CHARACTERISTIC	MEAN	MINIMUM	MAXIMUM	STANDARD DEVIATION
Percent without Appropriate Certification	8.3%	0.0%	45.0%	6.8%
Percent Fewer than 3 Years' Experience	14.1%	0.0%	54.0%	8.4%
Percent Master's Plus 30 Credit Hours	38.2%	0.0%	87.0%	13.3%
Turnover Rate	14.5%	0.0%	55.0%	7.3%

ATTENDANCE, PERFORMANCE, AND STUDENT DEMOGRAPHICS

School mean attendance in 2006-07 and 2007-08 is associated with a number of the demographic indicators that distinguish schools (Table 13). We examined the relationship between attendance and the following variables: the percentages of students eligible for free- or reduced-price lunches (FRPL eligible), of minority students, of students with disabilities, of limited English proficient students, of females, and of students who were continuously enrolled in 2006-07 and 2007-08.

School mean attendance decreased as the percentages of students who were minority or who came from families in poverty increased. The scatter plot in Figure 5 illustrates the relationship between minority composition and attendance. The regression line on this figure shows the best estimate of attendance as minority enrollment increased from 0 to 100 percent. As the percentage of minority students increased, attendance fell. Note, however, the greater variability in attendance among schools with high rather than low percentages of minority students. Among schools with no more than 70 percent minority students, the lowest attendance rate was 92 percent. Among schools where at least 95 percent of fourth-graders were minority, attendance ranged from 88 to 97 percent. Some schools with large percentages of minority students had high attendance; 65 of the 308 schools in this category had attendance rates of 94 percent or greater; 20 had attendance rates of 95 percent or higher.

Similarly, there is a negative relationship between disability and attendance: As the percentage of students with disabilities increased, attendance decreased. There is, however, no significant correlation at the school level between the percentages of either limited English proficient students or females and attendance. One explanatory variable was positively correlated with attendance: Schools with the highest percentages of students who were continuously enrolled in the 2006-07 and 2007-08 school years tended to have the highest attendance.

FIGURE 5
**Relationship between School Percent Black, Hispanic,
or Native American and School Mean Attendance**

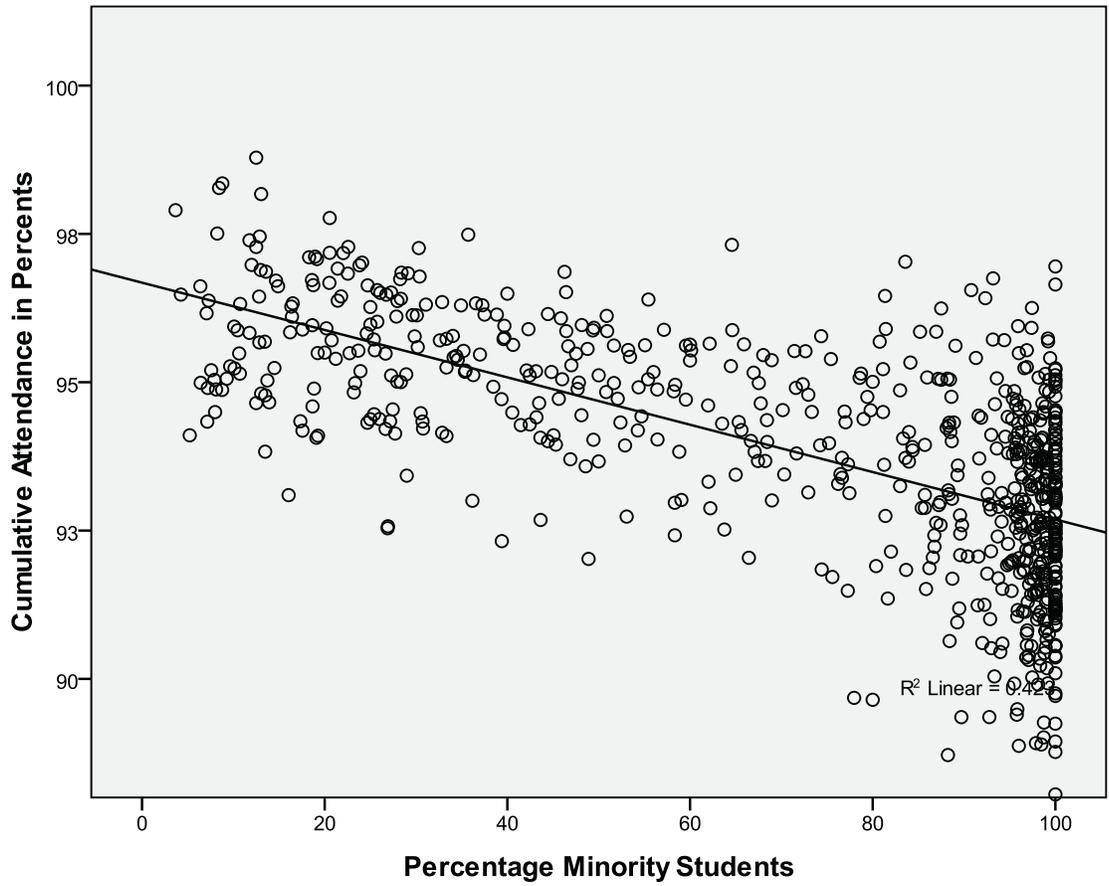


TABLE 13
Correlations of School Mean Attendance with
School Demographic Characteristics

PERCENT OF STUDENTS WITH CHARACTERISTIC	PEARSON CORRELATION	SIGNIFICANCE (2-TAILED)
FRPL Eligible	-.408	.0005
Minority Students	-.644	.0005
Students with Disabilities	-.365	.0005
Limited English Proficient	-.036	.337
Female	.019	.609
Continuously Enrolled	.263	.0005

Teacher credentials, experience, and education have small, but highly significant correlations with school attendance (Table 14). Schools with the highest percentages of teachers who lacked appropriate certification or who had fewer than three years' experience tended to have the lowest attendance rates. Schools with the highest percentage of teachers with 30 credit hours beyond the master's degree and schools with the lowest rates of teacher turnover tended to have higher attendance. The positive relationship between teacher education and attendance is illustrated in Figure 6. These variations in teacher qualifications and turnover rate are likely to play a role in perpetuating differences in attendance and performance.

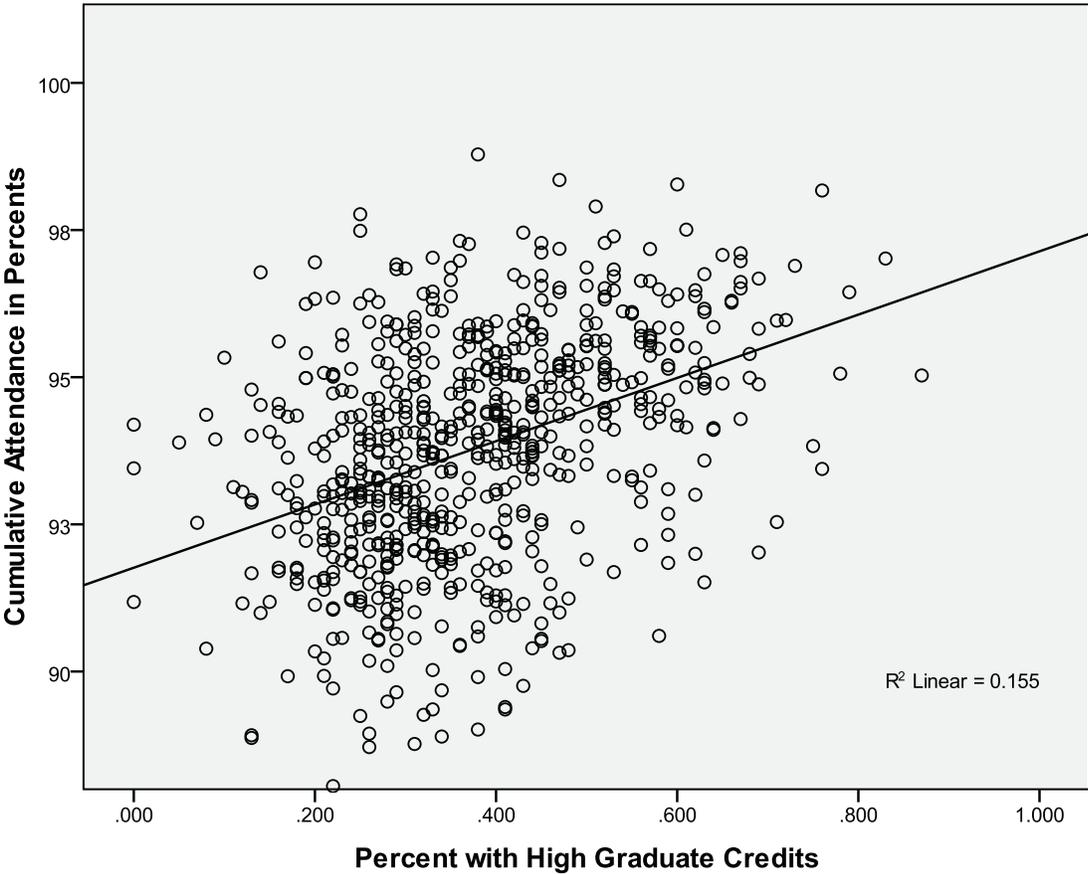
TABLE 14
Correlations of Teacher Characteristics with School Mean Attendance

PERCENT OF TEACHERS WITH CHARACTERISTIC	PEARSON CORRELATION	SIGNIFICANCE (2-TAILED)
Without Appropriate Certification	-.292	.0005
Without Three Years' Experience	-.148	.0005
Master's Degree + 30 Hours	.393	.0005
School Turnover Rate	-.244	.0005

THE PEARSON CORRELATION

describes the degree of relationship between two variables on a scale from -1 to +1. It indicates how well a straight line describes the relationship between the variables. Positive correlations, such as that between the percentage of continuously enrolled students and school mean attendance, indicate that two variables increase and decrease together. Negative correlations, such as that between the percentage of minority students and school mean attendance, indicate that as one variable increases the other decreases. A correlation of +1 indicates that for every one-unit increase in Variable A, Variable B increases by one unit. A correlation of -1 indicates that for every one-unit increase in Variable A, Variable B decreases by one unit. A correlation of 0 indicates no relationship between two variables. The significance level of a correlation coefficient indicates the probability that the correlation coefficient would be obtained by chance if there were no relationship between the two variables.

FIGURE 6
Relationship between Teacher Education and School Mean Attendance



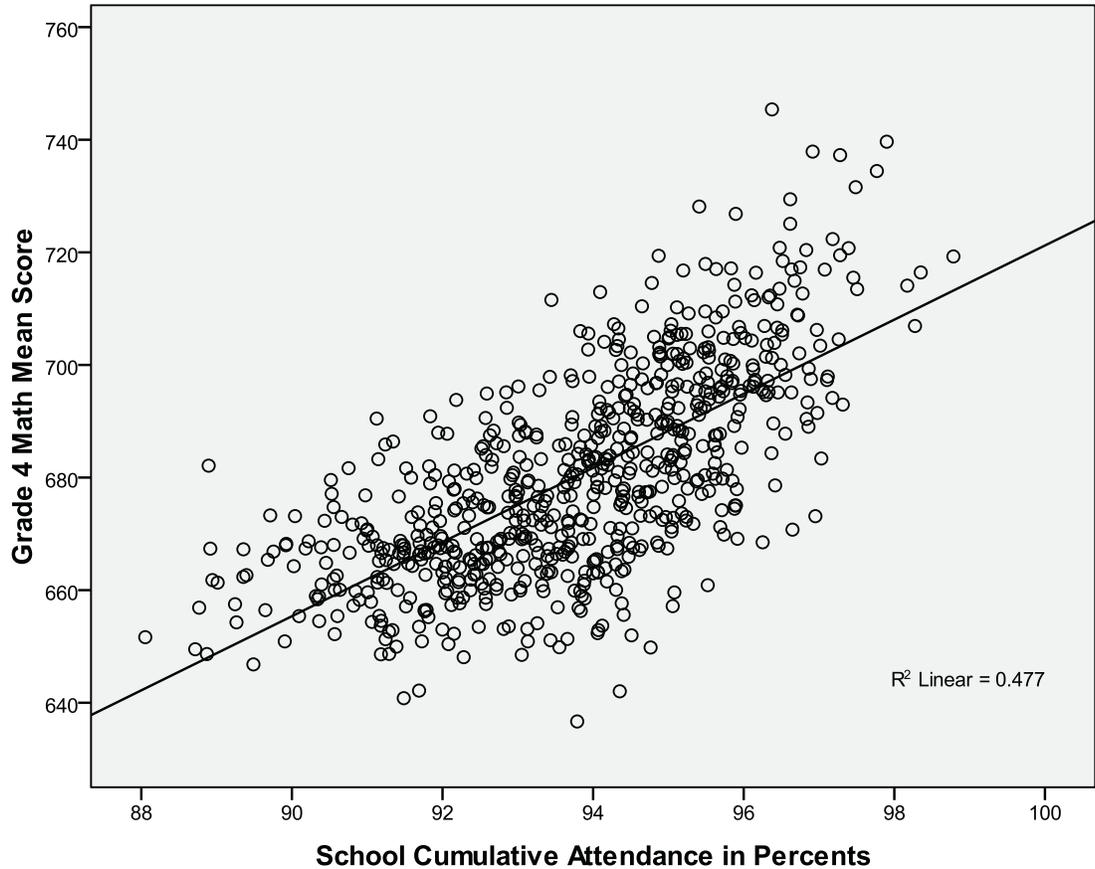
Attendance and Performance at the School Level

School grade 4 performance is strongly correlated with school attendance, when the relationships of other variables with both attendance and performance are not considered. Over 43 percent of the variability among schools in performance on each assessment can be accounted for by school mean attendance (Table 15). (Percentage of variability accounted for is calculated by squaring the correlation coefficient; for example, the square of the correlation between grade 3 ELA scores and cumulative attendance, .657, equals .43.) The correlations between chronic absence rate and performance are equally strong. The relationship between school mean attendance and performance on the 2007-08 grade 4 mathematics assessment is illustrated in Figure 7. As school mean attendance increased from 88 to 99 percent, the predicted grade 4 mean score increased from 640 to 720. These relationships are *not* independent of the simultaneous relationships of poverty, disability, ethnicity and other variables with attendance and performance. Therefore, only a part of the 80-point difference can be attributed to attendance.

TABLE 15
Correlations of School Mean Attendance and School Percentage Chronically Absent with Mean Scaled Score on State Assessments

STATE ASSESSMENT	CUMULATIVE ATTENDANCE	PERCENT CHRONICALLY ABSENT	SIG. (2-TAILED)
Grade 3 ELA	.657	-.647	.0005
Grade 3 Math	.674	-.652	.0005
Grade 4 ELA	.678	-.662	.0005
Grade 4 Math	.691	-.666	.0005

FIGURE 7
Relationship between School Mean Attendance and Performance
on the Grade 4 Mathematics Assessment



To further examine the relationship between school attendance and performance on the grades 3 and 4 ELA assessments, we divided schools into quintiles—five groups of equal size—according to school mean attendance. Table 16 shows the ELA mean and standard deviations in grades 3 and 4 by quintile. In both years, the quintile with the lowest attendance (below 92.040 percent) achieved the lowest mean score and the quintile with the highest attendance (above 95.490 percent) achieved the highest mean score. Performance improved systematically with increases in attendance: As the attendance of the quintile increased, so did the mean scaled score on each assessment. In both grades, schools in the highest quintile achieved unadjusted mean scores about 32 points higher than those in the lowest quintile.

TABLE 16
Grade 4 ELA Mean Scaled Score and Standard Deviation by School-Mean-Attendance Quintile

ATTENDANCE QUINTILE	NUMBER OF SCHOOLS	GRADE 3 ELA		GRADE 4 ELA	
		MEAN	STD. DEVIATION	MEAN	STD. DEVIATION
88.05 – 92.039	141	644.4	8.5	643.3	10.1
92.040 – 93.32	141	649.8	9.9	648.4	10.5
93.34 – 94.38	141	655.4	14.0	655.2	13.8
94.39 – 95.490	141	666.5	14.9	666.3	14.2
95.492 – 98.78	141	676.3	17.8	675.6	16.1
All Schools	705	658.5	17.7	657.8	17.7

Table 17 presents the same analysis for school performance on the grades 3 and 4 mathematics assessments. Again, performance at both grade levels increased with each higher attendance quintile. The unadjusted mean grade 3 score of schools in the highest attendance quintile was 30 points higher than that of schools in the lowest attendance quintile. The difference between these quintiles increased in grade 4 to more than 35 points.

TABLE 17
Grade 4 Math Mean Scaled Score and Standard Deviation by School-Mean-Attendance Quintile

ATTENDANCE QUINTILE	NUMBER OF SCHOOLS	GRADE 3 MATH		GRADE 4 MATH	
		MEAN	STD. DEVIATION	MEAN	STD. DEVIATION
88.05 – 92.039	141	671.8	9.0	664.9	9.6
92.041 – 93.32	141	676.9	11.1	671.4	11.1
93.34 – 94.38	141	682.3	13.4	676.8	14.9
94.39 – 95.490	141	691.3	12.9	687.8	14.3
95.492 – 98.78	141	701.9	13.2	700.0	16.2
All Schools	705	684.8	16.1	680.2	18.3

To more accurately estimate the relationship between attendance and performance, we need to control for previous performance, the most powerful predictor of grade 4 performance. We examined the differences among attendance quintiles in grade 4 ELA scores controlling for school grade 3 performance; that is, we asked whether the attendance quintiles would still differ if all quintiles had the same grade 3 performance. This analysis shows that 76 percent of the variance in grade 4 ELA mean scores is explained by the school's grade 3 ELA mean score. An additional 4.7 percent is explained by the attendance quintile to which the school belongs. The model explains more than 86 percent of the variance among schools.

We also analyzed the relationship between attendance quintiles and mean grade 4 math score, controlling for grade 3 math scores. The analysis shows that 66 percent of the variance in grade 4 math mean scores is explained by the school's grade 3 math mean score. An additional 6.4 percent is explained by the attendance quintile to which the school belongs. The model explains more than 82 percent of the variation in grade 4 math performance among schools. (The details of these analyses are presented in Appendix A.)

Attendance and Performance at the Student Level

We have established that attendance and grade 4 performance are related at the school level, even when grade 3 performance is controlled. These multilevel analyses will examine this relationship at the student level for ELA and for mathematics. The goal is to create an equation that predicts student performance on each grade 4 assessment from a set of student- and school-level variables.

These analyses differ from those reported in previous sections in that they tell us the relationship of each variable to performance independent of all other specified variables. For example, we documented that the percentage of minority students and poverty (measured as eligibility for free- and reduced-price lunches) are each negatively related to attendance. But minority percentage and poverty are also correlated ($r = .572$, $p < .0005$, 2-tailed). The higher absence rate of minority students is at least partly attributable to the greater incidence of poverty in minority populations. Controlling for poverty—that is, statistically holding poverty constant in all schools—reduces the correlation between minority percentage and attendance from $-.647$ to $-.583$. Another portion of the relationship between minority percentage and attendance is explained by the relationship between teacher characteristics and minority percentage. To provide an example, higher percentages of minority students are associated with smaller percentage of teachers with master’s degree plus 30 credit hours ($r = -.548$, $p < .0005$, 2-tailed). Controlling for both poverty and teacher education further reduces the correlation between percent minority and attendance to $-.499$. This exercise is intended to illustrate the difficulty of disentangling the complex associations among these explanatory variables. The higher absence rates of Black, Hispanic, and Native American students can be attributed to a variety of school, environmental, and cultural factors only some of which are directly measurable. If all of the relevant variables were controlled, the correlation between percentage minority and attendance might be reduced to zero.

These are multilevel analyses in that they consider the relationships of both student- and school-level variables to performance. They employ student data, but account for the effect of the school on student performance. The school provides the context in which students learn and that context influences both attendance and performance. We hypothesize, for example, that average attendance in a school has an association with student performance independent of individual student attendance. Multilevel modeling accounts for school contextual variables and for the interaction between school and student characteristics in predicting student performance. It acknowledges that students with the same grade 3 score may achieve different grade 4 scores based on the quality of curricula and instruction in the school they attend or on the composition of its student body. Further, the predicted gain from improving individual attendance or grade 3 performance may vary among students attending the same school because of the interaction between student and school variables. The quality of a school’s instructional

and support programs determine its potential ability to improve students' performance from year to year. In these analyses, we use school mean attendance, mean grade 3 performance, and teacher quality variables as measures of program quality.

THE ELA MODEL

Based on correlations found previously between demographic variables and performance, we selected the following student-level variables as predictors of grade 4 ELA performance: grade 3 ELA performance, cumulative attendance, minority status (Black, Hispanic or Native American), gender, free- or reduced-price lunch eligibility, disability status, limited English proficient status, and being continuously enrolled. The relationships of the first three variables with grade 4 ELA performance were assumed to depend on the school context and, in the final model, were allowed to vary among schools. Four school-level variables, school mean grade 3 ELA score, school mean attendance, school percent minority, and teacher turnover rate were selected as potentially affecting the relationship of these three variables with students' grade 4 performance. We also assumed that these school-level variables might interact with the student-level variables to predict performance. The multiplication of the three student-level variables with the four school-level variables creates 12 potential interactions. In a series of statistical tests, we eliminated all but five as not improving the explanatory power of the model. The remaining interactions were 1) student grade 3 ELA score with school mean grade 3 ELA score, 2) student attendance with school mean attendance, 3) student minority status with school percent minority, and 4) student minority status with teacher turnover rate, and 5) student minority status with mean school grade 3 ELA score. (The theoretical model tested is provided in Appendix B along with details of the analysis.)

We developed the model to predict grade 4 ELA scaled scores in four steps, each building on the results of the previous (Table 18). In the first step, we entered no explanatory variables, only the 705 schools. This procedure tells us that the mean predicted grade 4 ELA scaled score across schools is 658.38. It also tells us that some of the variation among students results from differences among schools. As documented in the school profiles, students in a given school tend to be more similar to each other than to students in other schools. In Step 3, we entered school-level variables to account for some of this intraschool similarity.

In the second step, we entered the eight student level-variables, but we did not allow the coefficient of any variable to vary across schools. A coefficient tells you how much the grade 4 ELA score is expected to change when that explanatory variable increases by one unit, *holding all the other variables constant*. We confirmed that each student variable

has a highly significant association with the grade 4 ELA scaled score. As predicted, four variables tend to decrease the predicted scaled score—being Black, Hispanic or Native American; being eligible for free- or reduced-price lunches; being disabled; and being limited English proficient. The other four variables—higher attendance, a higher grade 3 ELA score, being female, and being continuously enrolled—predict better grade 4 ELA scores.

In the third step, we added the four school contextual variables. Each student- and school-level variable is a highly significant predictor of grade 4 ELA scaled score.

In the final model, we allowed the relationship between three student-level variables—grade 3 ELA score, attendance, and minority status—and performance to vary among schools. We examined the way that the relationships of these variables with grade 4 ELA performance were modified by the four school-level variables. For example, we asked whether the relationship between a student’s grade 3 and grade 4 ELA performance changed when we controlled for measures of school quality, that is, mean school score, school attendance, and teacher turnover. This is tantamount to asking the following: given students with the same grade 3 performance, will the students attending the higher quality school reliably achieve higher scores in grade 4? The cross-level interactions we entered allowed us to determine if the change in grade 4 performance predicted by a student’s attendance, grade 3 performance, or minority status depended on the school they attended. For example, did the increase in a student’s grade 4 performance predicted by a higher grade 3 score depend on the mean grade 3 score of the student’s school?

Each of the five cross-level interactions has a significant relationship with grade 4 ELA performance. The addition of these interactions modified the coefficients of the student-level and school-level variables slightly, but they remained highly significant. The estimated coefficient for each variable—describing its association with grade 4 ELA performance—at each step is provided in Table 18.

TABLE 18
Model Predicting A Student's Grade 4 ELA Scaled Score

	COEFFICIENT ESTIMATES			
	STEP 1	STEP 2	STEP 3	STEP 4
Intercept	658.38	658.2	658.240	658.236
STUDENT VARIABLES				
Grade 3 ELA score		0.574	0.574	0.580
Cumulative Attendance		0.486	0.486	0.498
Minority Status		-4.731	-4.714	-5.204
Female		3.177	3.174	3.159
Free- or Reduced-Price Lunch Eligible		-2.798	-2.777	-3.099
Student with Disability		-15.300	-15.304	-14.759
Limited English Proficient		-7.718	-7.741	-7.320
Continuously Enrolled		1.436	1.435	1.560
SCHOOL VARIABLES				
Grade 3 ELA Mean Score			0.786	0.794
Mean Attendance			0.871	0.803
Percentage Minority			-0.045	-0.043
Teacher Turnover Rate			-0.159	-0.148
CROSS-LEVEL INTERACTIONS				
Grade 3 ELA Student Score by School Mean Score				-0.003
Student Attendance by School Mean Attendance				0.038
Student Minority Status by School Percent Minority				-0.054
Student Minority Status by Teacher Turnover Rate				-0.109
Student Minority Status by School Grade 3 ELA Mean				-0.143

Note. The standard errors, degrees of freedom, t-values, and probability values for each model can be found in Appendix B. Each step produced a better fit than the previous step as confirmed by deviance differences. All coefficients for individual and school variables were significant at the .0005 level. The significance levels for the cross-level interactions were as follows:

Grade 3 ELA Student Score by School Mean Score:	.0005
Student Attendance by School Mean Attendance:	.0010
Student Minority Status by School Percent Minority:	.0010
Student Minority Status by Teacher Turnover Rate:	.0380
Student Minority Status by School Grade 3 ELA Mean:	.0005

INTERPRETATION OF ELA RESULTS

The intercept and coefficients in the final model (Table 18) allow us to build an equation for predicting student performance on the grade 4 ELA assessment based on the explanatory variables considered in the analysis. The intercept (658.236) is our best estimate of the value of the student's grade 4 ELA score when the value of all student

and school variables is zero. The coefficient of each variable helps to explain why students score above or below the school mean. It predicts the change in performance as the value of the explanatory variable increases or decreases, independent of the association of that variable with all other explanatory variables. The coefficient for student attendance (0.498), for example, represents the predicted change in grade 4 ELA score for each one percentage point increase in attendance. The coefficients of the different variables are not directly comparable because the variables are measured on different scales.

Predicting Attendance

In the analysis, student variables were not entered as raw scores, but rather were represented as deviations from the school mean. Each student's grade 3 scaled score, for example, was represented as the difference between the student's score and the school mean. Similarly, school variables were represented as the difference between the school mean and the mean of all school means. Because deviation scores were used, the mean of each student and school explanatory variable is zero. Therefore, the grade 4 score of a student at the school mean on all variables except student attendance who attends a school at the mean on all school-level variables can be predicted by the following equation:

$$Y_{\text{GR4ELA}} = 658.236 + 0.498X_{\text{ATTEND}}$$

Where: Y_{GR4ELA} is the predicted Grade 4 ELA scaled score and X_{ATTEND} is the difference between the student's cumulative attendance and school mean attendance. (If the school mean is 93.8 percent and the student's attendance is 95.8 percent, the value of X_{ATTEND} is +2.) We assume that the value of all other explanatory variables is 0.

Figure 8(a) (page 43) illustrates the predicted grade 4 ELA scores based on this equation. The graph shows the predicted increase in scores as student attendance improves. The predicted grade 4 ELA score of a student whose attendance is 12 percentage points below the school mean attendance is 652.3. The predicted score of a student whose attendance is equal to the school mean is the intercept, 658.236. The predicted score of the student whose attendance is six points above the school mean is 661.3. We assume that these students are identical on all explanatory variables except student attendance and attend a school with mean attendance equal to the mean of school means.

Effect Size

Researchers calculate effect size to provide a standardized estimate of the strength of the relationship between two variables. Standardization is important because it allows comparison of effects among studies with different outcome measures and is achieved by measuring the change in the dependent variable in standard deviations achieved by a change of one standard deviation in the explanatory variable. The effect size of attendance on ELA performance is calculated by dividing the product of the coefficient

and standard deviation of attendance by the standard deviation of the grade 4 ELA scaled scores. We see that one standard deviation change in individual attendance yields a change in grade 4 ELA scaled score equal to .07 standard deviations.

$$\text{Effect Size} = (.498 * 5.510) / 39.28 = .070$$

Variations among Schools

Multilevel analysis estimates the range of intercepts and random coefficients among schools that we would obtain if we created regression equations for each school. Because they are normally distributed, we can construct an interval to capture school-to-school variability in the intercept and coefficients. We find that 95 percent of all intercept values fall in the range 648.411 to 669.182. These intercepts represent the range of schools on mean grade 4 performance for students at the school mean on all explanatory variables. Among schools, ninety-five percent of the coefficient values for the three random variables fall in the following ranges:

Grade 3 ELA: 0.382 to 0.777

Cumulative attendance: 0.097 to 0.898

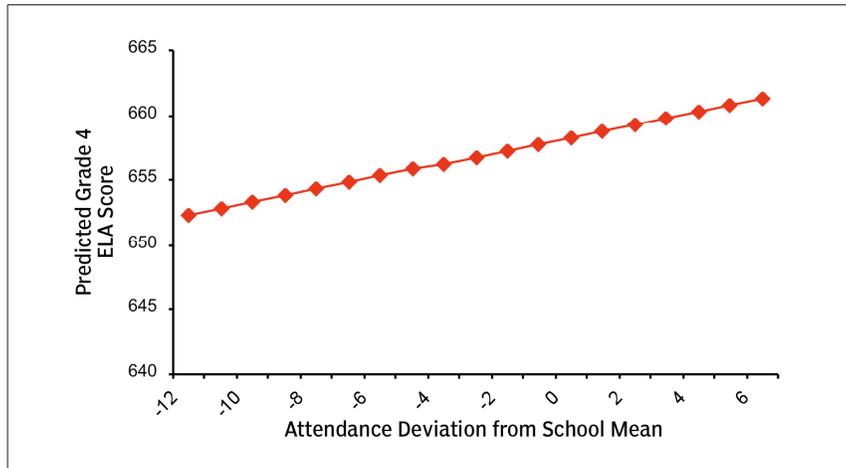
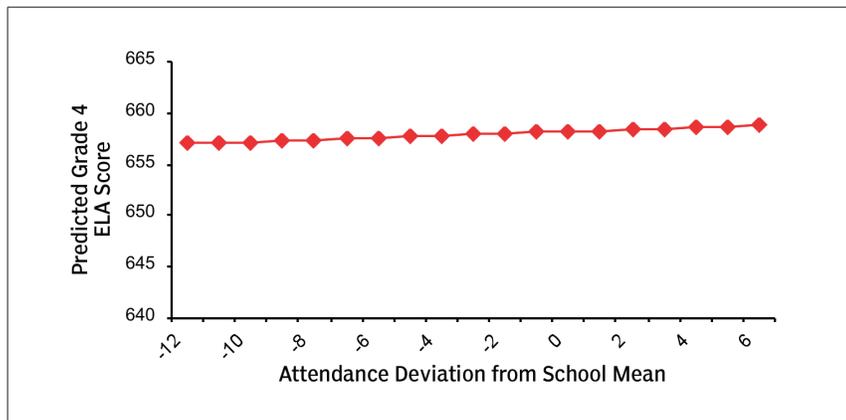
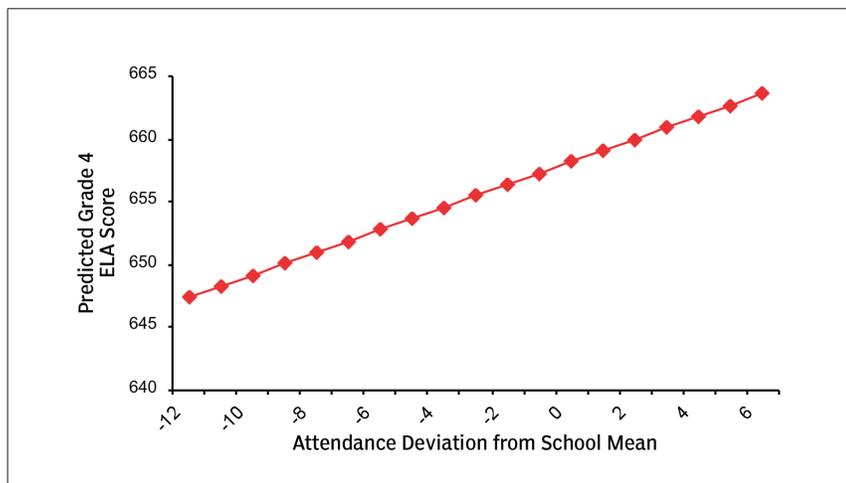
Minority status: -9.903 to -0.505

We see that the relationship of each variable to grade 4 ELA performance is greater in some schools than others. It appears that some schools were more effective than others in building on students' past strengths or overcoming obstacles that reduced achievement in grade 3.

Similarly, student attendance has a much stronger relationship with grade 4 performance in some schools than in others. We suggest that attendance is more important in schools where instruction is effective and fast-paced than in schools where it is less effective.

Finally, some schools were much more effective than others at overcoming the deficits associated with minority status. The predicted decrease in grade 4 ELA scores for Black, Hispanic, and Native American students is about 20 times as great in some schools than others.

The differences in attendance coefficients are illustrated in Figures 8(b) and (c) for schools with coefficients near the end points of the expected range, that is, coefficients of 0.1 and 0.9. For schools with a coefficient of 0.1, the predicted grade 4 ELA scaled score increases by only 0.1 for each one point increase in attendance. For schools with a coefficient of 0.9, the increase is 0.9 for each one point increase in attendance. These graphs are interpreted in the same way as Figure 8(a) but illustrate the effects of smaller and larger coefficients on the relationship between student attendance and performance.

FIGURE 8A.***Predicting Grade 4 ELA Scores from Student Attendance with Coefficient =0.486*****FIGURE 8B.*****Predicting Grade 4 ELA Scores from Student Attendance with Coefficient =0.1*****FIGURE 8C.*****Predicting Grade 4 ELA Scores from Student Attendance with Coefficient =0.9***

The predicted effect of each explanatory variable on grade 4 ELA performance is described below.

Student Level

1. Each one point increase in grade 3 ELA scaled score corresponds, on average, to a 0.580 increase in grade 4 ELA scaled score.
2. Each one percentage point increase in a student's grade 3 and 4 cumulative attendance corresponds, on average, to a 0.498 increase in grade 4 ELA scaled score.
3. Native American, Black, and Hispanic students, on average, score 5.204 points lower than White and Asian students.
4. Female students, on average, score 3.159 points higher than male students.
5. Students who are eligible for free- or reduced-price lunches, on average, score 3.099 points lower than students who are not eligible.
6. Students with disabilities, on average, score 14.759 points lower than students who are not disabled.
7. Limited English proficient students, on average, score 7.320 points lower than English proficient students.
8. Students who are continuously enrolled score 1.560 points higher, on average, than students who were not continuously enrolled.

Contextual Variables

9. Each one point increase in a school's grade 3 ELA mean scaled score corresponds, on average, to a 0.794-point increase in the school's grade 4 ELA mean scaled score.
10. Each one percentage point increase in school mean attendance rate, on average, corresponds to a 0.803-point increase in the school's grade 4 ELA mean scaled score.
11. Each one percentage point increase in the percentage of Native American, Black, and Hispanic students, on average, corresponds to a 0.043-point decrease in the school's grade 4 ELA mean scaled score.
12. Each one percentage point increase in school teacher turnover rate corresponds, on average, to a 0.148-point decrease in the school's grade 4 ELA mean scaled score.

Cross-Level Interactions

- 13. Grade 3 ELA Student Score by School Mean Score.** For each one point increase in school mean score, the grade 4 ELA scaled score is modified by the product of the grade 3 ELA scaled score (school-mean centered) and -0.003. This table illustrates the effect of the interaction on the predicted score of students at the mean on all variables except grade 3 ELA student score and school mean score in schools at the 10th and 90th percentiles with students at the 10th, 50th, and 90th percentiles on the grade 3 ELA assessment.

GRADE 3 ELA SCHOOL MEAN SCORE	GRADE 3 ELA SCORE		
	614	657	708
680	641.7	663.6	689.6
640	626.9	654.4	687.0
Difference	14.8	9.2	2.6

For students below the grade 3 ELA school mean, the negative coefficient on this interaction increases the advantage of attending a high-performing school and the disadvantage of attending a low-performing school. The opposite is true for students above the mean: their advantage of attending a school above the mean and their disadvantage of attending a school below the mean are diminished. The table shows the differential effect of attending a school with a high mean scaled score (680) versus a school with a low mean scaled score (640) on low-performing students with grade 3 score of 614. The predicted score of students in the high-performing school is nearly 15 points higher than that of students in the low-performing school. In contrast, for students who achieved a score of 708 in grade 3, school performance makes little difference.

- 14. Student Attendance by School Mean Attendance.** For each one point increase in school mean attendance, the grade 4 ELA score is modified by the product of the student attendance rate (school-mean centered) and 0.038. This table illustrates the effect of the interaction on the predicted score of students at the mean on all variables except student attendance and school mean attendance in schools at the 10th and 90th percentiles and with students at the 10th, 50th, and 90th percentiles of student attendance.

MEAN SCHOOL ATTENDANCE	STUDENT ATTENDANCE		
	86.8%	95.4%	99.0%
96.3%	654.63	659.7	661.9
91.4%	654.45	658.0	659.4
DIFFERENCE	0.2	1.8	2.4

For students with very low attendance, school mean attendance matters little. The predicted grade 4 score of students with very low attendance (86.8 percent) attending a high attendance school (96.3 percent) is almost identical to that of similar students attending a low attendance school. For very high attendance students, attending a high-attendance school (96.3 percent) increases their predicted grade 4 score.

- 15. Student Minority Status by School Percent Minority.** For each one percentage point increase in Native American, Black, and Hispanic enrollment, the grade 4 ELA score is modified by the product of minority status (school-mean centered) and -0.054 . The difference between the predicted grade 4 ELA scores of minority students and other students increases as the percentage of minority students in a school increases. This table illustrates the effect of the interaction on the predicted score of students at the mean on all variables except student minority status and school percent minority in schools at the 10th and 50th percentiles of minority enrollment.

% MINORITY	OTHER ETHNIC	MINORITY	DIFFERENCE
20%	661.0	658.6	2.3
88%	662.9	656.9	6.0

In schools with low-percentages of minority students, the difference between minority and other students is small. In schools with large percentages of minority students, the difference is greater.

- 16. Student Minority Status by Teacher Turnover Rate.** For each one point increase in teacher turnover rate, the grade 4 ELA score is modified by the product of minority status (school-mean centered) and -0.109 . This table illustrates the effect of the interaction on the predicted score of students at the mean on all variables except student minority status and teacher turnover rate in schools at the 10th, 50th, and 90th percentiles.

TURNOVER RATE	OTHER ETHNIC	MINORITY	DIFFERENCE
6%	662.6	658.4	4.2
14%	662.0	657.0	5.1
24%	661.3	655.2	6.1

As the school turnover rate increases, the difference between the predicted grade 4 ELA score of Native American, Black, and Hispanic students compared with that of other students increases. Attending a school with low teacher turnover increases the predicted score of minority students (658.4 compared

with 655.2). For other students, turnover rate makes a smaller difference in predicted score. The difference between minority and other students increases with turnover rate.

- 17. Student Minority Status by School Grade 3 ELA Mean.** For each one point increase in grade 3 ELA mean scaled score, the grade 4 ELA score is modified by the product of minority status (school-mean centered) and -0.143. This table illustrates the effect of the interaction on the predicted score of students at the mean on all variables except student minority status and school grade 3 ELA mean in schools at the 10th, 50th, and 90th percentiles.

GRADE 3 ELA SCHOOL MEAN SCORE	OTHER ETHNIC	MINORITY	DIFFERENCE
640	645.1	642.6	2.5
657	660.6	655.6	5.0
680	681.8	673.5	8.4

For Native American, Black, and Hispanic students, the interaction decreases the predicted effect of school grade 3 ELA mean; for other students the effect is increased. The higher the overall school grade 3 ELA performance, the better minority students perform. However, the gap between minority students and others widens as school grade 3 ELA mean scaled score increases.

MATHEMATICS MODEL

We developed this model (Table 19) using the same procedures and variables used in the development of the ELA model but found some differences from the ELA model. (The details of this analysis are presented in Appendix C.) While seven of the student-level variables were significant predictors of grade 4 math performance, the eighth, continuous enrollment, fell short of reaching significance at the .05 level. We selected the percentage of teachers with 30 credit hours beyond the master's degree, rather than teacher turnover rate, as the fourth school-level variable because it had the highest correlation with grade 4 math performance. This variable was not a significant predictor of grade 4 performance, when all other explanatory variables were accounted for. Only three interactions significantly improved the explanatory power of the model: 1) student grade 3 mathematics score with school mean grade 3 math score, 2) student attendance with school mean attendance, and 3) student minority status with mean school grade 3 math score.

TABLE 19
Model Predicting A Student's Grade 4 Mathematics Scaled Score

	COEFFICIENT ESTIMATES			
	STEP 1	STEP 2	STEP 3	STEP 4
Intercept	680.243	680.194	680.100	680.124
STUDENT VARIABLES				
Grade 3 Math Score		0.639	0.639	0.640
Cumulative Attendance		0.569	0.569	0.613
Minority Status		-7.561	-7.561	-6.972
Female		-2.700	-2.698	-2.674
Free- or Reduced-Price Lunch Eligible		-2.095	-2.094	-2.011
Student with Disability		-11.448	-11.449	-11.146
Limited English Proficient		-4.256	-4.256	-4.340
Continuously Enrolled		0.205	0.206	0.352
SCHOOL VARIABLES				
Grade 3 Math Mean Score			0.779	0.785
Mean Attendance			1.008	0.991
Percentage Minority			-0.123	-0.119
Teachers with Master's + 30 Credits			-0.043	-0.041
CROSS-LEVEL INTERACTIONS				
Grade 3 Math Student Score by School Mean Score				-0.002
Student Attendance by School Mean Attendance				0.076
Student Minority Status by School Grade 3 Math Mean				-0.088

Note. The standard errors, degrees of freedom, t-values, and probability values for each model can be found in Appendix C. Each step produced a better fit than the previous step as confirmed by deviance differences. All coefficients for individual variables except Continuously Enrolled were significant at the .0005 level. The Continuously Enrolled variable was not statistically significant in any step. All coefficients for school variables except Teachers with Master's Plus 30 credits were significant at the .0005 level. The significance level of the latter variable was .069 in Step 3 and .083 in Step 4. The significance levels for the cross-level interactions were as follows:

<i>Grade 3 Math Student Score by School Mean Score:</i>	<i>.0005</i>
<i>Student Attendance by School Mean Attendance:</i>	<i>.0005</i>
<i>Student Minority Status by School Grade 3 Math Mean:</i>	<i>.0010</i>

INTERPRETATION OF MATHEMATICS RESULTS

The coefficient for student attendance was somewhat higher in the mathematics model than in the ELA model: all else being equal, a one percentage point change in student attendance predicts a greater change in the grade 4 mathematics score than in the grade 4 ELA score. The decrement in predicted grade 4 score for students with disabilities is smaller for mathematics than for ELA, 11.146 compared with 14.749. In the ELA model, being female is positively associated with grade 4 performance; in the math model, the association is negative, -2.674 compared with 3.159. The coefficient associated with being in a school with a large minority enrollment is more than twice as large for math as for ELA, -0.119 compared with -0.043. The coefficient for the interaction of student minority status and school percentage minority, however, is not significant in the mathematics model. This finding indicates that the association of student minority status and mathematics performance is independent of the percentage of minority students in the school.

Effect Size

The effect size of attendance on mathematics performance is calculated by dividing the product of the coefficient and standard deviation of attendance by the standard deviation of the grade 4 mathematics scaled scores. We see that one standard deviation change in individual attendance yields a predicted change in grade 4 mathematics scaled score equal to .088 standard deviations.

$$\text{Effect Size} = (.613 * 5.510) / 38.483 = .088$$

Variations Among Schools

The analysis estimated the range of intercepts and random coefficients among schools that would be obtained by doing school-by-school analyses. We found that 95 percent of all intercept values fall in the range 666.908 to 693.340. These intercepts represent the range of predicted grade 4 math school mean scores for students at the school mean on all explanatory variables. Among schools, ninety-five percent of the coefficient values fall in the following ranges:

Grade 3 mathematics:	0.461 to 0.820
Cumulative attendance:	0.341 to 0.885
Minority status:	-15.903 to 1.171

The range of coefficients for cumulative attendance is smaller in the math than the ELA model. The range of coefficients for minority status is greater and includes some positive values, indicating that the school-level explanatory variables that we employed were not sufficient to account for the association between minority status and grade 4 math

performance. Additional explanatory variables are necessary to describe this relationship.

The associations of each explanatory variable and interaction with grade 4 mathematics are described below.

Student Level

1. Each one point increase in grade 3 math scaled score corresponds, on average, to a 0.640 increase in grade 4 math scaled score.
2. Each one percentage point increase in a student's grade 3 and 4 cumulative attendance corresponds, on average, to a 0.613 increase in grade 4 math scaled score.
3. Native American, Black, and Hispanic students, on average, score 6.972 points lower than White and Asian students.
4. Female students, on average, score 2.674 points lower than male students.
5. Students who are eligible for free- or reduced-price lunches, on average, score 2.011 points lower than students who are not eligible.
6. Students with disabilities, on average, score 11.146 points lower than students who are not disabled.
7. Limited English proficient students, on average, score 4.340 points lower than English proficient students.
8. Students who are continuously enrolled score 0.352 points higher, on average, than students who were not continuously enrolled. This coefficient is not statistically significant.

Contextual Variables

9. Each one point increase in a school's grade 3 math mean scaled score corresponds, on average, to a 0.785-point increase in the school's grade 4 math mean scaled score.
10. Each one percentage point increase in school mean attendance, on average, corresponds to a 0.991-point increase in the school's grade 4 math mean scaled score.
11. Each one percentage point increase in the percentage of Native American, Black, and Hispanic students, on average, corresponds to a 0.119-point decrease in the school's grade 4 math mean scaled score.

12. Each one percentage point increase in the percentage of teachers with 30 credits beyond the master's degree corresponds, on average, to a 0.041-point decrease in the school's grade 4 math mean scaled score. This coefficient is not statistically significant.

Cross-Level Interactions

13. **Grade 3 Math Student Score by School Mean Score.** For each one point increase in school mean score, the grade 4 math scaled score is modified by the product of the grade 3 math scaled score (school-mean centered) and -0.002. This table illustrates the effect of the interaction on the predicted score of students at the mean on all variables except grade 3 math student score and school mean score in schools at the 10th and 90th percentiles with students at the 10th, 50th, and 90th percentiles on the grade 3 math assessment.

GRADE 3 MATH SCHOOL MEAN SCORE	GRADE 3 MATH SCORE		
	642	685	739
707	663.3	688.4	719.9
667	653.1	681.9	718.0
Difference	10.2	6.6	1.9

For students below the grade 3 math school mean, the negative coefficient on this interaction increases the advantage of attending a high-performing school and the disadvantage of attending a low-performing school. The opposite is true for students above the mean: their advantage of attending a school above the mean is diminished and their disadvantage of attending a school below the mean is diminished. (Remember that the product of two negative numbers is positive.) The table shows the differential effect of attending a school with a high mean scaled score (707) versus a school with a low mean scaled score (667) on low-performing students with grade 3 scores of 642. The predicted score of the student in the high-performing school is over 10 points higher than that of the student in the low-performing school. In contrast, for students who achieved a score of 739 in grade 3, school performance makes little difference.

- 14. Student Attendance by School Mean Attendance.** For each one point increase in school attendance rate, the grade 4 math score is modified by the product of the student attendance rate (school-mean centered) and 0.076. This table illustrates the effect of the interaction on the predicted score of students at the mean on all variables except student attendance and school mean attendance in schools at the 10th and 90th percentiles and with students at the 10th, 50th, and 90th percentiles.

MEAN SCHOOL ATTENDANCE	STUDENT ATTENDANCE		
	86.8%	95.4%	99.0%
96.3%	675.0	681.9	684.8
91.4%	675.8	679.5	681.1
Difference	-0.8	2.4	3.7

For students with very low attendance, school mean attendance matters little. The predicted grade 4 score of students with very low attendance (86.8 percent) attending a high attendance school (96.3 percent) is almost identical to that of similar students attending a low attendance school (91.4 percent). For very high attendance students, attending a high-attendance school increases their predicted grade 4 score.

- 15. Student Minority Status by School Grade 3 Math Mean.** For each one point increase in grade 3 math mean scaled score, the grade 4 math score is modified by the product of minority status (school-mean centered) and -0.088. This table illustrates the effect of the interaction on the predicted score of students at the mean on all variables except student minority status and school grade 3 math mean in schools at the 10th, 50th, and 90th percentiles.

GRADE 3 MATH SCHOOL MEAN SCORE	OTHER ETHNIC	MINORITY	DIFFERENCE
667	669.2	663.8	5.3
685	689.2	681.8	7.4
707	703.9	695.0	8.9

The higher the overall school grade 3 math performance, the better minority students perform. The gap between minority students and others, however, widens as school grade 3 math mean scaled score increases.

Discussion

This research confirms that student and school attendance are related to performance on the grade 4 State assessments in ELA and mathematics; that is, as individual student and school mean attendance increase so does performance. The relationship between an individual student's attendance and grade 4 performance depends on the school the student attends. Comparing two students with the same attendance, the student attending the school with higher mean attendance will have better grade 4 performance, all else being equal. These associations are independent of other explanatory variables measured in these analyses; that is, they do not result from the simultaneous association of any measured variable with both attendance and performance.

The finding that student attendance is related to performance is consistent with findings obtained by Gottfried (2009, 2010, 2011), using data for students in the Philadelphia School District. In fact, this study's effect sizes—standardized measures of the relationship of attendance with performance—are very similar to those in his sibling study, described in the Introduction. The sibling study also strongly suggests that the documented association between attendance and grade 4 performance is direct and not the result of simultaneous relationships of unmeasured family characteristics—such as parent education and family involvement in school activities—with attendance and performance. The convergence of these results with Gottfried's increases our confidence that there is a direct causal link between attendance and performance.

Gottfried's research strongly suggests that the relationship between attendance and performance is not confined to grade 4 but exists in grades 3 through 8. He originally studied five student cohorts for a six-year period and found that attendance was linked to performance in the elementary and middle grades. His research also suggests that attendance may become more important as students progress through the elementary and middle grades.

Our analyses also suggest that the improvement in grade 4 performance gained through increased attendance would be further accelerated in grade 5 by virtue of both higher grade 4 performance and sustained or improved attendance in grade 5. Students who master more of the learning standards in a grade have a better foundation for achievement in the next grade. As such, we may expect that the achievement gap between persistently low- and high-attending students will widen over time.

We acknowledge that a substantial increase in attendance is required to obtain moderate increases in performance. We also know that rates of chronic absence are alarmingly high: 18 percent of fourth-graders were chronically absent; 3 percent attended fewer than 80 percent of school days. In three-quarters of schools, at least 10 percent of students were chronically absent. CFE believes that intensive and

comprehensive school reform measures can substantially reduce chronic absence. Performance improvements will then accrue directly from increased attendance and from more effective curricula and instruction.

HOW ATTENDANCE AFFECTS PERFORMANCE

While CFE's results are based on correlations and cannot prove a causal relationship between attendance and performance, the potential causal mechanism is readily evident: students who attend school regularly receive more instruction. A study of charter schools by Caroline Hoxby, Sonali Murarka, and Jenny Kang, discussed in the Introduction, found that one characteristic of successful charter schools is increased instructional time through a longer school day or year. Improving attendance is an efficient way of increasing effective instructional time in an era of limited budgets.

While the preponderance of evidence strongly supports an association, probably causal, between attendance and performance, it is likely that this association varies from student to student. Attendance measures time in school. Time in school however does not equate perfectly to hours of instruction in the skills and knowledge assessed on standardized tests of ELA and mathematics. The amount, quality, and pace of such instruction vary from day to day and school to school. On some days no such instruction may be given. Further, a student's ability to focus on and benefit from instruction varies from day to day and student to student. Therefore, the value of an instructional day as measured by assessments varies across days, students, and schools. Similarly, the performance decrement caused by missing a day will vary depending on several factors: what relevant instruction did the student miss? Were missed lessons made up? What did the student do when out of school? A student who spends hours at home reading challenging text will experience a smaller decrement, if any, than a student who spends that time watching cartoons. Gottfried's finding that higher proportions of unexcused absences are associated with lower performance supports the hypothesis that the decrement associated with missing school varies from student to student. We suggest two mechanisms that contribute to the difference between excused and unexcused absences: teachers are more likely to assist students with excused absences and students are more likely to make up work when their absence is excused rather than unexcused.

We examined two indicators of school quality—school mean attendance and mean grade 3 performance—that are significant predictors of both grade 4 ELA and mathematics performance. We found that the gain in individual performance predicted by increased attendance is greater in schools with higher mean attendance. Similarly, the predicted scores of students with the same grade 3 scores depend on the average performance of the school they attend. Those attending schools with higher mean grade 3 scores are predicted to have higher grade 4 scores. The lower the student's grade 3

score, the more grade 4 performance is influenced by the school they attend. For students with very high performance in grade 3, the school they attend makes little difference in their predicted grade 4 scores. We can predict from these findings that students with low grade 3 performance and attendance who improve their grade 4 attendance will make greater performance gains if they attend a high performing, high attendance school. This makes sense because the benefits of attendance can only be fully realized on days when the student is engaged in high-quality instruction targeted to the ELA and mathematics learning standards. As such, we suggest that students will benefit fully from improved attendance only if schools provide high quality instruction and if they and the community ensure that obstacles to student engagement in learning, such as ill health, lack of family involvement, and family and personal difficulties, are minimized.

WHY ATTENDANCE IMPROVEMENTS ARE CRITICAL

The strengthening of the State standards in 2010 substantially decreased the percentage of fourth-graders scoring at the proficient level and suggests that the 2008 results used in this study overestimate the percentage of fourth-graders who were proficient and on track toward meeting the grade 8 learning standards. In 2008, citywide, 61.4 percent of New York City fourth-graders scored at the proficient level or higher in ELA; 79.6 percent did so in mathematics. Under the strengthened standards, in 2010, the percentage scoring at the proficient level or higher in ELA decreased by 17 percentage points; in math, by 22 points. Further, under the strengthened standards, the achievement gap among ethnic groups increased.

Based on past trends, we can expect, even without more rigorous standards, that when these fourth-graders reach eighth grade, fewer will meet the State standards in ELA and mathematics. Comparison of grade 4 and 8 results on 2008 State assessments shows that smaller percentages of students met the learning standards in grade 8; 61.3 percent met the ELA standards in grade 4, compared with 43.1 percent in grade 8. In mathematics, 79.6 percent met the standards in grade 4, compared with 59.8 percent in grade 8.

The strengthening of learning standards by the Board of Regents makes improving grade 8 performance both more challenging and more important. CFE's study of high school graduation and Regents diploma rates found that schools with the largest percentages of entering ninth-graders who, in grade 8, failed to reach the State learning standards and attended irregularly had the lowest Regents diploma rates. The data indicate that attendance drops during the high school years, particularly in schools with low-graduation rates, and better school attendance is associated with higher Regents diploma rates. Several studies provide evidence that poor attendance as early as grade 6 indicates a high risk of dropping out before graduation (Balfanz, Herzog & McIver, 2007; Ou & Reynolds, 2008). Ruth Neild and colleagues (2007) documented that students in Philadelphia with attendance below 80 percent in sixth grade had a three in four chance of dropping out of high school. The consequences of dropping out on later income,

dependence on welfare, and incarceration are widely documented. Each of these consequences has serious implications for the larger community. CFE believes that making the necessary changes to improve and sustain attendance from the elementary to the high school years is an important step in increasing graduation rates and preparing students for the future.

MINORITY STUDENTS

In an era of rising standards, the performance of minority students is of particular concern. We found that, all else being equal, the predicted scores of Native American, Black, and Hispanic students were about five points lower in ELA—and seven points lower in mathematics—than those of White and Asian students. In both subjects, these predicted decrements are independent of additional decrements applied to some minority students for poor grade 3 performance, inadequate attendance, low family income, disability, and limited English proficiency. In ELA, they are also independent of decrements for changing schools and attending schools with high teacher turnover rates.

The unexplained decrements for minority students merit further research to identify remedial steps to close the achievement gap. Other potential causes of the gap lie in the school, the student, the home, and the community. They include school programs not designed to meet the needs of minority students, ineffective teachers, poor communication with parents, teacher attendance, inadequate student effort and behavior problems, health or nutritional status, maternal education, unsafe neighborhoods, and persistent poverty—which subsidized lunch eligibility cannot distinguish from transient poverty.

While these performance decrements for minority students were independent of decrements in predicted scores attributable to poor attendance, 22 percent of minority students were chronically absent, further diminishing their ability to achieve at their full potential. We believe that increasing the attendance rates of minority students and eliminating chronic absence will reduce the achievement gaps documented among ethnic groups. For minority students to fully benefit from improved attendance, schools must ensure that they are engaged in learning through high quality instruction and curricula.

CITY EFFORTS TO IMPROVE ATTENDANCE

DOE in cooperation with school staff are implementing many programs to improve attendance, including one of the most sophisticated attendance tracking systems in the country. Principals have access to a daily report that can instantly show them which students are chronically absent or in danger of becoming so. Top DOE officials point out, accurately, that overall attendance has been improving and that citywide, fourth-grade attendance improved from 93 to 94 percent between 1999-00 and 2007-08.

Recognizing the value of attendance to school improvement, in June 2010 Mayor Michael Bloomberg's office created the Interagency Task Force on Truancy and Chronic Absenteeism (Bloomberg, 2011). In September 2010, the task force launched a pilot program aimed at reducing chronic absenteeism and truancy in 25 schools across the City. The program educates parents about the value of good attendance, offers incentives for children to come to school and provides mentors for students who are on track to miss more than 10 percent of the school year. The efforts have already borne fruit: In the first half of the school year, fully 22 of the 25 schools reduced their absentee rates. The 10 elementary schools saw the best results, with a collective 24 percent decline in the percentage of students who are chronically absent. The seven high schools showed little change. In February 2011, the Mayor announced the expansion of this pilot to include a multimedia campaign in which the media and celebrities stress the importance of attendance to students and parents. Students with excessive absences receive inspirational wake-up messages and congratulatory messages for improved attendance. Parents and students receive warning messages if attendance does not improve. Media participants air public service announcements stressing the importance of attendance to educational success.

CONCLUSION

In recent years, New York City has made significant strides in hiring qualified staff, providing professional development, placing effective curricula in schools, and providing supplemental programs to increase time on task. These changes have translated into improved performance. Still, too many New York City students are below the State learning standards and too many leave school without earning a high school diploma. To realize the full benefit of these ongoing improvement efforts, schools must place greater focus on improving attendance.

Despite the City's ongoing effort to improve attendance, 18 percent of students in our study group were absent for more than 10 percent of school days in third and fourth grade and in 539 schools at least 10 percent of fourth-graders were chronically absent. These findings suggest that many schools must re-invigorate their efforts to improve attendance. It is too soon to evaluate the effectiveness of Mayor Bloomberg's latest initiatives. We applaud his attention to this important issue.

We believe that substantially reducing the number of students who are chronically absent and increasing the attendance of all students would raise achievement, reduce the percentage of students retained in grade, and increase graduation rates. To benefit fully from increased attendance, however, students must be fully engaged in high-quality instruction.

Recommendations

DEVELOP STRONG ATTENDANCE PROGRAMS

The results of this study are intended to inform the discussion about the role of attendance improvement in New York City's comprehensive school reform effort. New York City must begin by setting clear standards and high expectations for attendance. We recommend that DOE identify schools that have been most successful in improving attendance and ensure that their best practices are shared among schools.

At a minimum DOE must ensure that schools do the following:

- Value high attendance in the school and classroom.
- Use the attendance tracking system to promptly identify students who are missing too many days of school.
- Examine patterns of attendance in neighborhoods, ethnic groups, grades or classrooms to identify and address systemic causes of absence.
- Develop and implement policies for reaching out to identified students and their families to determine the reasons for absence and to mitigate those reasons where possible. Especially in the early grades, absentee students often are not willfully skipping school but rather miss days because of health and safety concerns, frequent moves or unreliable transportation. Where poverty or homelessness is identified as a cause of excessive absence, we advocate efforts to mitigate their consequences through health and nutrition programs, parent education, preschool and prekindergarten, homework centers, extended-day and other programs specifically designed to meet the needs of such children.
- Put policies in place to minimize the effect of missing school by ensuring that students make up missed work and are kept on track toward acquiring the skills and knowledge expected for their grades.

Most importantly, schools must create a climate in which all staff, students and families understand the importance of attendance and work to minimize absences.

ACCOUNTABILITY FOR ATTENDANCE

It is important that schools be held accountable for improving attendance. To that end, attendance rates and chronic absence rates should be publicly available and, reported for all federal accountability groups, including racial/ethnic groups. We recommend that federal, State, and City accountability systems be revised to increase the value of attendance in assessing school progress. New York is one of five states that does not include attendance data in its longitudinal student database. The State should work with school districts to standardize and collect student-level attendance data, and to develop standard definitions of chronic absence and truancy, so that comparable measures are used statewide.

COMPREHENSIVE SCHOOL REFORM

Attendance is only one of many factors linked to performance. Programs to improve attendance in the elementary and middle school grades should be part of comprehensive school-wide reforms designed to ensure that all students enter ninth grade prepared for coursework leading to a Regents diploma. The importance of challenging curricula and effective teaching cannot be overestimated. To be fully effective, attendance improvement programs should be part of comprehensive programs that include initiatives in the following areas.

This research shows that the most important predictor of student performance in grade 4 is grade 3 performance. Therefore, we believe that to improve student achievement, schools must improve both attendance and the quality of instruction. Chang and Romero (p. 17) suggest that “...chronic absence might be, at least partially, remedied by high-quality educational programs. ...[Data from one locality suggest] that when school quality was high, children were less likely to be chronically absent in the early grades despite living in a high risk neighborhood in which many of their peers are missing extended periods of school.” To ensure academic success, children from such families need high-quality schools with effective academic programs and experienced, highly qualified teachers appropriately trained to meet their needs.

We also recommend that student achievement be monitored periodically—rather than annually—using standardized tests to identify students who are not on track to master the skills and knowledge expected for their grade. Students may fall behind because of absence, failure to engage in learning and complete assignments, or from inadequate instruction. Whatever the cause, early identification is most likely to lead to successful intervention.

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Appendix A

Tests of Differences in Performance Among Attendance Quintiles Controlling for Grade 3 Performance

GRADE 4 ELA SCHOOL MEAN SCORE WITH CO-VARIATE SCHOOL MEAN GRADE 3 ELA SCORE AND FACTOR SCHOOL ATTENDANCE QUINTILE

TESTS OF BETWEEN-SUBJECTS EFFECTS Dependent Variable: Grade 4 ELA Mean Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	189,922.565 ^a	5	37,984.513	903.378	.000	.866
Intercept	2796.574	1	2796.574	66.510	.000	.087
Grade 3 ELA Mean Score	91,546.005	1	91,546.005	2,177.219	.000	.757
Attend Quintile	1,719.280	4	429.820	10.222	.000	.055
Error	29,391.000	699	42.047			
Total	305,232,693.796	705				
Corrected Total	219,313.565	704				

^a R Squared = .866 (Adjusted R Squared = .865)

GRADE 4 MATHEMATICS SCHOOL MEAN SCORE WITH CO-VARIATE SCHOOL MEAN GRADE 3 MATH SCORE AND FACTOR SCHOOL ATTENDANCE QUINTILE

TESTS OF BETWEEN-SUBJECTS EFFECTS Dependent Variable: Grade 4 Math Mean Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	193,044.319 ^a	5	38,608.864	632.156	.000	.819
Intercept	711.549	1	711.549	11.650	.001	.016
Grade 3 Math Mean Score	84,321.398	1	84,321.398	1380.624	.000	.664
Attend Quintile	2931.308	4	732.827	11.999	.000	.064
Error	42,691.328	699	61.075			
Total	326,413,287.477	705				
Corrected Total	235,735.647	704				

^a R Squared = .819 (Adjusted R Squared = .818)

Appendix B

ELA Multilevel Model

The model for predicting grade 4 ELA performance includes eight student variables. Three student variables are allowed random coefficients; that is, they are allowed to vary among schools: grade 3 ELA scaled score (GR3ELA1), attendance in grades 3 and 4 (ATTEND1), and identification as Black, Hispanic, or Native American (MINOR1). Historically, Black, Hispanic, and Native American students have demonstrated very similar performance in New York City. Therefore, for parsimony, students in these three ethnic groups are coded 1. In addition, the model includes five student-level variables with fixed coefficients. All have documented associations with ELA performance. These variables are gender ($X_{\text{GENDER}1}$), eligibility for free and reduced-price lunch ($X_{\text{FRPL}1}$), identification as a student with disability ($X_{\text{SWD}1}$), identification as limited English proficient ($X_{\text{LEP}1}$), and being continuously enrolled in a school from October 31, 2006 until the end of the 2007-08 school year ($X_{\text{CONT_ENROLL}1}$). Four contextual (school-level) variables are considered: school mean grade 3 ELA scale score for study cohort ($X_{\text{3ELA}2}$); school mean attendance in grades 3 and 4 for the study cohort ($X_{\text{ATTEND}2}$); school percentage Black, Hispanic or Native American ($X_{\text{MINOR}2}$); and teacher turnover rate ($X_{\text{TURNOVER}2}$). Teacher turnover rate correlates significantly with the percentage of teachers having fewer than three years experience ($r = .559, p < .0005$), having significant graduate credits beyond the master's degree ($r = -.383, p < .0005$), and without appropriate certification for teaching assignment ($r = .292, p < .0005$). The study includes 705 schools with a total cohort enrollment of 64,062. Because of missing data, not all students were included in the multivariate analyses.

THE THEORETICAL MODEL

ELA LEVEL 1 MODEL

$$Y_{4\text{ELA}} = \beta_{01} + \beta_{1j}\text{GR3ELA1} + \beta_{2j}\text{ATTEND1} + \beta_{3j}\text{MINOR1} + \gamma_{40}X_{\text{GENDER}1} + \gamma_{50}X_{\text{FRPL}1} \\ + \gamma_{60}X_{\text{SWD}1} + \gamma_{70}X_{\text{LEP}1} + \gamma_{80}X_{\text{CONT_ENROLL}1} + (\mu_{0j} + \mu_{1j}\text{3ELA1} + \mu_{2j}\text{ATTEND1} + \mu_{3j}\text{MINOR1} + e_{1j})$$

ELA LEVEL 2 MODEL

$$\beta_{0j} = \gamma_{00} + \gamma_{01}X_{\text{3ELA}2} + \gamma_{02}X_{\text{ATTEND}2} + \gamma_{03}X_{\text{MINOR}2} + \gamma_{04}X_{\text{TURNOVER}2} + \mu_{0j} \\ \beta_{1j} = \gamma_{10} + \gamma_{11}X_{\text{3ELA}2} + \gamma_{12}X_{\text{ATTEND}2} + \gamma_{13}X_{\text{MINOR}2} + \gamma_{14}X_{\text{TURNOVER}2} + \mu_{1j} \\ \beta_{2j} = \gamma_{20} + \gamma_{21}X_{\text{3ELA}2} + \gamma_{22}X_{\text{ATTEND}2} + \gamma_{23}X_{\text{MINOR}2} + \gamma_{24}X_{\text{TURNOVER}2} + \mu_{2j} \\ \beta_{3j} = \gamma_{30} + \gamma_{31}X_{\text{3ELA}2} + \gamma_{32}X_{\text{ATTEND}2} + \gamma_{33}X_{\text{MINOR}2} + \gamma_{34}X_{\text{TURNOVER}2} + \mu_{3j}$$

ELA FULL EQUATION

$$\begin{aligned}
 Y_{4ELA} = & \gamma_{00} + \gamma_{10}GR3ELA1 + \gamma_{20}ATTEND1 + \gamma_{30}MINOR1 + \gamma_{40}X_{GENDER1} + \gamma_{50}X_{FRPL1} \\
 & + \gamma_{60}X_{SWD1} + \gamma_{70}X_{LEP1} + \gamma_{80}X_{CONT_ENROLL1} + \gamma_{01}X_{3ELA2} + \gamma_{02}X_{ATTEND2} + \gamma_{03}X_{MINOR2} \\
 & + \gamma_{04}X_{TURNOVER2} + \gamma_{11}X_{3ELA2} * GR3ELA1 + \gamma_{12}X_{ATTEND2} * GR3ELA1 + \gamma_{13}X_{MINOR2} * GR3ELA1 \\
 & + \gamma_{14}X_{TURNOVER2} * GR3ELA1 + \gamma_{21}X_{3ELA2} * ATTEND1 + \gamma_{22}X_{ATTEND2} * ATTEND1 \\
 & + \gamma_{23}X_{MINOR2} * ATTEND1 + \gamma_{24}X_{TURNOVER2} * ATTEND1 + \gamma_{31}X_{3ELA2} * MINOR1 \\
 & + \gamma_{32}X_{ATTEND2} * MINOR1 + \gamma_{33}X_{MINOR2} * MINOR1 + \gamma_{34}X_{TURNOVER2} * MINOR1 + \mu_{0j} + \mu_{1j}3ELA1 \\
 & + \mu_{2j}ATTEND1 + \mu_{3j}MINOR1 + e_{1j}
 \end{aligned}$$

THE ELA EMPIRICAL MODEL (STEP 4)

Using the SPSS Mixed Model procedure, we first determined the intraclass correlation for the null model with a random intercept (0.187). Second, we entered the eight level 1 variables with fixed coefficients. Third, we added the school contextual variables, X_{GR3ELA} , $X_{ATTEND2}$, X_{MINOR2} , and $X_{TURNOVER2}$, with fixed coefficients. This step reduced the intraclass correlation to 0.046. In the fourth iteration, three student variables, GR3ELA1, ATTEND1, and MINOR1, were allowed random coefficients and five cross-level interaction terms implied by the school contextual variables were entered. In each case, there are statistically significant increases in $-2 \text{ Log Likelihood}$ using χ^2 with degrees of freedom equal to the change in number of parameters from the previous model. Seven potential cross-level interactions were eliminated from the model because they did not result in statistically significant increases in $-2 \text{ Log Likelihood}$.

The methodology described above resulted in the following empirical model:

$$\begin{aligned}
 Y_{4ELA1} = & 658.236 + 0.580GR3ELA1 + 0.498ATTEND1 - 5.204MINOR1 + 3.159X_{GENDER1} \\
 & (0.225) \quad (0.005) \quad (0.022) \quad (0.409) \quad (0.194) \\
 & - 3.099X_{FRPL1} - 14.759X_{SWD1} - 7.320X_{LEP1} + 1.560X_{CONT_ENROLL1} + 0.794X_{GR3ELA2} + 0.803X_{ATTEND2} \\
 & (0.345) \quad (0.285) \quad (0.316) \quad (0.317) \quad (0.020) \quad (1.164) \\
 & - 0.043X_{MINOR2} - 0.148X_{TURNOVER2} - 0.003X_{GR3ELA2} * GR3ELA1 + 0.038X_{ATTEND2} * ATTEND1 \\
 & (0.011) \quad (0.030) \quad (0.0003) \quad (0.011) \\
 & - 0.054X_{MINOR2} * MINOR1 - 0.109X_{TURNOVER2} * MINOR1 - 0.143X_{GR3ELA2} * MINOR1 \\
 & (0.016) \quad (0.052) \quad (0.028)
 \end{aligned}$$

Note. The standard error of each coefficient is shown in parenthesis.

ELA MULTILEVEL ANALYSIS RESULTS

TABLE 18 EXPANSION: MODEL PREDICTING GRADE 4 ELA SCALED SCORE

Step 1: Estimates of ELA Fixed Effects

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	658.382	.656588	694.697	1002.732	.000

Step 2: Estimates of ELA Fixed Effects

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	658.232	.658864	699.062	999.042	.000
Grade 3 ELA score	.574	.003096	61739.866	185.259	.000
Cumulative Attendance	.486	.019366	61740.783	25.081	.000
Minority Status	-4.731	.300347	61740.372	-15.750	.000
Female	3.177	.195932	61740.208	16.213	.000
Free- or Reduced-Price Lunch Eligible	-2.798	.343743	61740.487	-8.139	.000
Student with Disability	-15.300	.284658	61740.480	-53.750	.000
Limited English Proficient	-7.718	.312807	61744.969	-24.673	.000
Continuously Enrolled	1.43	.319400	61742.451	4.495	.000

Step 3: Estimates of ELA Fixed Effects

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	658.240	.225317	655.476	2921.394	.000
Grade 3 ELA score	0.574	.003101	61571.089	184.999	.000
Cumulative Attendance	0.486	.019388	61578.373	25.084	.000
Minority Status	-4.714	.300715	61575.478	-15.676	.000
Female	3.174	.196250	61573.902	16.173	.000
Free- or Reduced-Price Lunch Eligible	-2.777	.344604	61574.028	-8.059	.000
Student with Disability	-15.304	.285014	61575.458	-53.695	.000
Limited English Proficient	-7.741	.313212	61610.984	-24.716	.000
Continuously Enrolled	1.435	.319686	61592.305	4.490	.000
Grade 3 ELA Mean Score	0.786	.020596	706.522	38.168	.000
Mean Attendance	0.871	.166821	667.559	5.221	.000
Percentage Minority	-0.045	.011363	663.074	-3.996	.000
Teacher Turnover Rate	-0.159	.030092	702.797	-5.296	.000

Step 4: Estimates of ELA Fixed Effects

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	658.236295	.225320	656.369	2921.340	.000
Grade 3 ELA score	.579627	.005066	762.161	114.419	.000
Cumulative Attendance	.497796	.022391	724.557	22.232	.000
Minority Status	-5.203857	.409285	571.067	-12.715	.000
Female	3.159457	.194059	61209.312	16.281	.000
Free- or Reduced-Price Lunch Eligible	-3.099032	.344816	60077.988	-8.988	.000
Student with Disability	-14.759274	.284736	61560.638	-51.835	.000
Limited English Proficient	-7.320015	.316212	60747.472	-23.149	.000
Continuously Enrolled	1.559966	.317424	61151.041	4.914	.000
School Grade 3 ELA Mean Score	.794325	.020405	714.878	38.928	.000
School Mean Attendance	.802870	.164392	665.945	4.884	.000
Percentage Minority	-.043270	.011191	659.535	-3.866	.000
Teacher Turnover Rate	-.147979	.029665	701.510	-4.988	.000
Grade 3 ELA Student Score by School Mean Score	-.003228	.000276	656.636	-11.696	.000
Student Attendance by School Mean Attendance	.037628	.011273	557.826	3.338	.001
Student Minority Status by School Percent Minority	-.054057	.016457	527.785	-3.285	.001
Student Minority Status by Teacher Turnover Rate	-.108660	.052255	385.664	-2.079	.038
Student Minority Status by School Grade 3 ELA Mean	-.143197	.027988	446.581	-5.116	.000

Information Criteria for Determining Differences in Model Fit between Stages

Stage	Number of Parameters	-2 Restricted Log Likelihood
Stage 1	3	624,485.257*
Stage 2	11	577,222.923*
Stage 3	15	574,358.615*
Stage 4	29	573,329.739*

*p < .001

Appendix C

Mathematics Multilevel Model

The model for predicting grade 4 mathematics performance includes eight student variables. Three student variables are allowed random coefficients; that is, they are allowed to vary among schools: grade 3 math scaled score (GR3MATH1), attendance in grades 3 and 4 (ATTEND1), and identification as Black, Hispanic, or Native American (MINOR1). Historically, Black, Hispanic, and Native American students have demonstrated very similar performance in New York City. Therefore, for parsimony, students in these three ethnic groups are coded 1. In addition, the model includes five student-level variables with fixed coefficients. All have documented associations with mathematics performance. These variables are gender (X_{GENDER1}), eligibility for free and reduced-price lunch (X_{FRPL1}), identification as a student with disability (X_{SWD1}), identification as limited English proficient (X_{LEP1}), and being continuously enrolled in a school from October 31, 2006 until the end of the 2007-08 school year ($X_{\text{CONT_ENROLL1}}$). Four contextual variables are considered: school mean grade 3 mathematics scale score for study cohort (X_{3MATH2}); school mean attendance in grades 3 and 4 for the study cohort (X_{ATTEND2}); school percentage Black, Hispanic or Native American (X_{MINOR2}); and percentage of teachers with a master's degree plus 30 hours of graduate credit ($X_{\text{MA+30_2}}$). The study includes 705 schools with a total cohort enrollment of 64,062. Because of missing data, not all students were included in the multivariate analyses.

MATH LEVEL 1 MODEL

$$Y_{4\text{MATH}} = \beta_{0j} + \beta_{1j} \text{GR3MATH1} + \beta_{2j} \text{ATTEND1} + \beta_{3j} \text{MINOR1} + \gamma_{40} X_{\text{GENDER1}} + \gamma_{50} X_{\text{FRPL1}} \\ + \gamma_{60} X_{\text{SWD1}} + \gamma_{70} X_{\text{LEP1}} + \gamma_{80} X_{\text{CONT_ENROLL1}} + (\mu_{0j} + \mu_{1j} \text{3MATH1} + \mu_{2j} \text{ATTEND1} + \mu_{3j} \text{MINOR1} \\ + e_{1j})$$

MATH LEVEL 2 MODEL

$$\beta_{0j} = \gamma_{00} + \gamma_{01} X_{\text{3MATH2}} + \gamma_{02} X_{\text{ATTEND2}} + \gamma_{03} X_{\text{MINOR2}} + \gamma_{04} X_{\text{MA+30_2}} + \mu_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11} X_{\text{3MATH2}} + \gamma_{12} X_{\text{ATTEND2}} + \gamma_{13} X_{\text{MINOR2}} + \gamma_{14} X_{\text{MA+30_2}} + \mu_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21} X_{\text{3MATH2}} + \gamma_{22} X_{\text{ATTEND2}} + \gamma_{23} X_{\text{MINOR2}} + \gamma_{24} X_{\text{MA+30_2}} + \mu_{2j}$$

$$\beta_{3j} = \gamma_{30} + \gamma_{31} X_{\text{3MATH2}} + \gamma_{32} X_{\text{ATTEND2}} + \gamma_{33} X_{\text{MINOR2}} + \gamma_{34} X_{\text{MA+30_2}} + \mu_{3j}$$

MATH FULL EQUATION

$$\begin{aligned}
 Y_{4\text{MATH}} = & \gamma_{00} + \gamma_{10} \text{GR3MATH1} + \gamma_{20} \text{ATTEND1} + \gamma_{30} \text{MINOR1} + \gamma_{40} X_{\text{GENDER1}} + \gamma_{50} X_{\text{FRPL1}} \\
 & + \gamma_{60} X_{\text{SWD1}} + \gamma_{70} X_{\text{LEP1}} + \gamma_{80} X_{\text{CONT_ENROLL1}} + \gamma_{01} X_{\text{3MATH2}} + \gamma_{02} X_{\text{ATTEND2}} + \gamma_{03} X_{\text{MINOR2}} \\
 & + \gamma_{04} X_{\text{MA+30_2}} + \gamma_{11} X_{\text{3MATH2}} * \text{GR3MATH1} + \gamma_{12} X_{\text{ATTEND2}} * \text{GR3MATH1} \\
 & + \gamma_{13} X_{\text{MINOR2}} * \text{GR3MATH1} + \gamma_{14} X_{\text{MA+30_2}} * \text{GR3MATH1} + \gamma_{21} X_{\text{3MATH2}} * \text{ATTEND1} \\
 & + \gamma_{22} X_{\text{ATTEND2}} * \text{ATTEND1} + \gamma_{23} X_{\text{MINOR2}} * \text{ATTEND1} + \gamma_{24} X_{\text{MA+30_2}} * \text{ATTEND1} \\
 & + \gamma_{31} X_{\text{3MATH2}} * \text{MINOR1} + \gamma_{32} X_{\text{ATTEND2}} * \text{MINOR1} + \gamma_{33} X_{\text{MINOR2}} * \text{MINOR1} \\
 & + \gamma_{34} X_{\text{MA+30_2}} * \text{MINOR1} + \mu_{0j} + \mu_{1j} \text{3MATH1} + \mu_{2j} \text{ATTEND1} + \mu_{3j} \text{MINOR1} + e_{1j}
 \end{aligned}$$

MATH EMPIRICAL MULTILEVEL MODEL (STEP 4)

Using the SPSS Mixed Model procedure, I first determined the intraclass correlation for the null model with a random intercept (0.208). Second, I entered the eight level 1 variables with fixed coefficients. Third, I added the school contextual variables, X_{gr3MATH2} , X_{ATTEND2} , X_{MINOR2} , and $X_{\text{MA+30_2}}$, with fixed coefficients. This step reduced the intraclass correlation to 0.078. In the fourth iteration, three student variables, GR3MATH1, ATTEND1, and MINOR1, were allowed random coefficients and three cross-level interaction terms implied by the school contextual variables were entered. In each case, there are statistically significant increases in $-2 \text{ Log Likelihood}$ using χ^2 with degrees of freedom equal to the change in number of parameters from the previous model. Nine potential cross-level interactions were eliminated from the model because they did not result in statistically significant increases in $-2 \text{ Log Likelihood}$.

The methodology described above resulted in the following empirical model:

$$\begin{aligned}
 Y_{4\text{MATH1}} = & 680.124 + 0.640\text{GR3MATH1} + 0.613\text{ATTEND1} - 6.972\text{MINOR1} - 2.674 X_{\text{GENDER1}} \\
 & \quad (0.274) \quad (0.005) \quad (0.021) \quad (0.404) \quad (0.185) \\
 & - 2.011 X_{\text{FRPL1}} - 11.146 X_{\text{SWD1}} - 4.340 X_{\text{LEP1}} + 0.352 X_{\text{CONT_ENROLL1}} + 0.785 X_{\text{gr3MATH2}} \\
 & \quad (0.329) \quad (0.267) \quad (0.285) \quad (0.294) \quad (0.027) \\
 & + 0.991 X_{\text{ATTEND2}} - 0.119 X_{\text{MINOR2}} - 0.041 X_{\text{MA+30_2}} - 0.002 X_{\text{GR3MATH2}} * \text{GR3MATH1} \\
 & \quad (0.202) \quad (0.015) \quad (0.023) \quad (0.0003) \\
 & + 0.076 X_{\text{ATTEND2}} * \text{ATTEND1} - 0.088 X_{\text{GR3MATH2}} * \text{MINOR1} \\
 & \quad (0.010) \quad (0.026)
 \end{aligned}$$

Note. The standard error of each coefficient is shown in parenthesis.

MATH MULTILEVEL MODEL RESULTS

TABLE 19 EXPANSION: MODEL PREDICTING GRADE 4 MATHEMATICS SCALED SCORE

Step 1: Estimates of Math Fixed Effects

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	680.243	.685692	697.268	992.053	.000

Step 2: Estimates of Math Fixed Effects

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	680.194	.688795	698.648	987.512	.000
Grade 3 Math Score	0.639	.003064	62998.055	208.418	.000
Cumulative Attendance	0.569	.018679	62998.761	30.467	.000
Minority Status	-7.561	.285269	62998.013	-26.506	.000
Female	-2.700	.185893	62998.003	-14.523	.000
Free- or Reduced-Price Lunch Eligible	-2.095	.327134	62997.998	-6.405	.000
Student with Disability	-11.448	.266895	62998.150	-42.895	.000
Limited English Proficient	-4.256	.283521	62998.126	-15.012	.000
Continuously Enrolled	0.205	.295035	62998.218	.695	.487

Step 3: Estimates of Math Fixed Effects

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	680.100	.273795	662.568	2483.979	.000
Grade 3 Math Score	0.639	.003064	62973.462	208.390	.000
Cumulative Attendance	0.569	.018681	62977.560	30.484	.000
Minority Status	-7.561	.285303	62973.142	-26.500	.000
Female	-2.698	.185915	62973.119	-14.515	.000
Free- or Reduced-Price Lunch Eligible	-2.094	.327172	62973.079	-6.400	.000
Student with Disability	-11.449	.266926	62974.069	-42.892	.000
Limited English Proficient	-4.256	.283554	62973.816	-15.009	.000
Continuously Enrolled	0.206	.295069	62974.405	.698	.485
Grade 3 Math Mean Score	0.779	.027630	696.805	28.208	.000
Mean Attendance	1.008	.203940	673.184	4.945	.000
Percentage Minority	-0.123	.014853	667.103	-8.258	.000
Teachers with Master's + 30 Credits	-0.043	.023670	684.087	-1.820	.069

Step 4: Estimates of Math Fixed Effects

Parameter	Estimate	Std. Error	df	t	Sig.
Intercept	680.124	.274105	661.457	2481.255	.000
Grade 3 Math Score	0.640	.004768	739.766	134.306	.000
Cumulative Attendance	0.613	.020772	699.476	29.502	.000
Minority Status	-6.972	.404143	497.109	-17.251	.000
Female	-2.674	.184647	62568.378	-14.482	.000
Free- or Reduced-Price Lunch Eligible	-2.011	.328620	61188.184	-6.120	.000
Student with Disability	-11.146	.266871	62827.836	-41.765	.000
Limited English Proficient	-4.340	.284995	62067.750	-15.228	.000
Continuously Enrolled	0.352	.293910	62393.793	1.196	.232
School Grade 3 Math Mean Score	0.785	.027483	700.951	28.571	.000
School Mean Attendance	0.991	.202388	673.181	4.895	.000
Percentage Minority	-0.119	.014723	664.818	-8.065	.000
Teachers with Master's + 30 Credits	-0.041	.023437	677.843	-1.733	.083
Grade 3 Math Student Score by School Mean Score	-0.002	.000295	716.543	-7.251	.000
Student Attendance by School Mean Attendance	0.076	.010481	550.466	7.207	.000
Student Minority Status by School Grade 3 Math Mean	-0.088	.025593	626.261	-3.433	.001

Information Criteria for Determining Differences in Model Fit between Stages

Stage	Number of Parameters	-2 Restricted Log Likelihood
Stage 1	3	636,772.746*
Stage 2	11	583,532.713*
Stage 3	15	582,258.873*
Stage 4	27	580,907.294*

*p < .001

Report prepared by:
The Campaign for Fiscal Equity, Inc.
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