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June 2009

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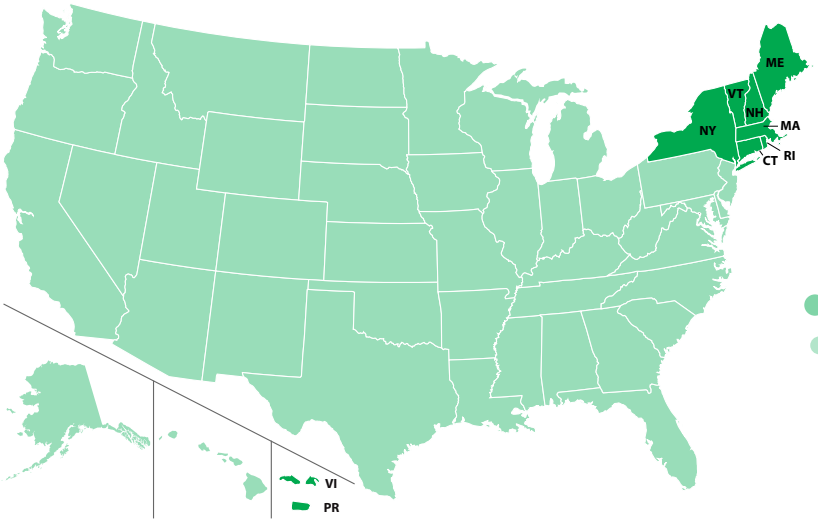

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Summary

REL 2009–No. 071

Analyzing performance by grade 10 Hispanic high school students on the Massachusetts state assessment

The report examines Hispanic high school students' performance on the Massachusetts Comprehensive Assessment System tests in English language arts and mathematics over 2002/03–2005/06. It compares the scores of grade 10 Hispanic and non-Hispanic students and uses multilevel regressions to examine associations between the Hispanic students' scores and student- and school-level characteristics.

Massachusetts policymakers have been concerned about the consistently lower scores of Hispanic students compared with students in other subgroups on the state assessment—the Massachusetts Comprehensive Assessment System (MCAS) tests. To better understand Hispanic student characteristics and achievement patterns, the Massachusetts Department of Elementary and Secondary Education asked the Regional Educational Laboratory Northeast and Islands to analyze the performance of Hispanic students on the MCAS tests in English language arts and mathematics in high school.

Two research questions drove this study:

- How did the performance of grade 10 Hispanic students on the MCAS English language arts and mathematics tests over 2002/03–2005/06 compare with that of grade 10 non-Hispanic students?
- Among grade 10 Hispanic students, which student- and school-level characteristics were associated with performance on the MCAS English language arts and mathematics tests over 2002/03–2005/06?

Descriptive analyses and *t*-tests were conducted to examine MCAS test performance for grade 10 Hispanic and non-Hispanic students in Massachusetts. Multilevel regression modeling was then used to analyze associations between Hispanic student MCAS achievement and student- and school-level characteristics. A different cohort of grade 10 Hispanic students was assessed for each school year.

For the multilevel regressions the Office of Strategic Planning, Research, and Evaluation of the Massachusetts Department of Elementary and Secondary Education provided student-level MCAS test performance data and background data for all grade 10 Hispanic students in Massachusetts over 2002/03–2005/06. Publicly available school-level performance and background data on all high schools in Massachusetts for the same period were accessed through the Massachusetts Department of Elementary and Secondary Education web site (profiles.doe.mass.edu) and the Common

Core of Data of the U.S. Department of Education, National Center for Education Statistics (2006).

In each school year from 2002/03 through 2005/06 grade 10 Hispanic students scored significantly lower on the MCAS English language arts and mathematics tests than did grade 10 non-Hispanic students. However, the average scores for grade 10 Hispanic students in Massachusetts did increase over time by a statistically significant amount in both content areas—a trend that has helped narrow this performance gap.

The data for grade 10 Hispanic students were analyzed using multilevel regressions to determine which student- and school-level variables showed a statistically significant relationship with student performance on the MCAS test over 2002/03–2005/06. For each school year statistically significant associations were found between several student-level variables and MCAS test scores:

- Female Hispanic students scored significantly higher on the English language arts test than did male Hispanic students. Male Hispanic students scored significantly higher on the mathematics test than did female Hispanic students.

- Hispanic students who were from low-income households, in special education, or limited English proficient or formerly limited English proficient—categorized as English proficient in the previous two years—scored significantly lower on both the English language arts and mathematics tests than did students without those characteristics. (These associations mirror those typically reported in research on academic achievement for all racial/ethnic groups.)

- Hispanic students from Caribbean countries, Central American countries, and Mexico scored significantly lower on the English language arts test than did U.S.-born Hispanic students. Hispanic students from South American countries other than Brazil scored significantly higher on the mathematics test than did U.S.-born Hispanic students.

For each year from 2002/03 through 2005/06 a statistically significant association was found between MCAS test performance and only one school-level variable:

- Hispanic students in schools with higher attendance rates scored significantly higher on both the English language arts and mathematics tests than did Hispanic students in schools with lower attendance rates, all other variables held constant.

The study has several limitations, four of them especially important. The multilevel regressions describe statistical associations rather than causal relationships between student- and school-level characteristics and Hispanic students' MCAS test scores. The large share of data excluded from the analyses—most of it missing data—might have biased the findings, since excluded students appear to have lower achievement than included students. Many variables that could help to explain differences in academic achievement patterns for Hispanic students were not analyzed. And the analyses do not account for possible associations between

Hispanic students' test scores from 2002/03 through 2005/06 and a change in federal testing policy in February 2004.

To better understand the academic achievement of Hispanic high school students, further research is suggested. Such research should examine additional statistical relationships—both among various demographic and student- and school-level characteristics (some of which this study did not consider) and between certain characteristics and the MCAS test scores of Hispanic and non-Hispanic students.

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The report examines Hispanic high school students' performance on the Massachusetts Comprehensive Assessment System tests in English language arts and mathematics over 2002/03–2005/06. It compares the scores of grade 10 Hispanic and non-Hispanic students and uses multilevel regressions to examine associations between the Hispanic students' scores and student- and school-level characteristics.

WHY THIS STUDY?

Massachusetts policymakers recently expressed a desire to better understand Hispanic student achievement patterns in their state. Scores on the Massachusetts Comprehensive Assessment System (MCAS) tests have consistently revealed a gap in performance between Hispanic students and students from other subgroups, a gap corresponding to national trends. Yet studies that look closely at achievement in the national Hispanic student population are rare, and no previous analyses of Massachusetts data have been done for this subgroup.

To reveal achievement patterns for the diverse group of Hispanic students in Massachusetts and to inform policy and program decisions, the Massachusetts Deputy Commissioner of Education and staff at the Massachusetts Department of Elementary and Secondary Education asked the Regional Educational Laboratory Northeast and Islands to analyze the scores of grade 10 Hispanic students on MCAS tests in English language arts and mathematics over 2002/03–2005/06. The department wished to learn about associations between the scores and school- and student-level characteristics, such as school attendance rate, English proficiency status, country of origin, first language, and school attended. (See appendix A on the characteristics identified in research on Hispanic student academic achievement.)

The report compares the MCAS test performance of grade 10 Hispanic students with that of grade 10 non-Hispanic students over 2002/03–2005/06, looking at both English language arts and mathematics. Multilevel regressions are used to examine relationships between Hispanic students' MCAS test performance and student- and school-level characteristics. (Key terms, including *Hispanic student,* are defined in box 1.)

Two research questions drove the study:

- How did the performance of grade 10 Hispanic students on the MCAS English language

BOX 1

Definitions of key terms

Limited English proficient student. A student with a first or native language other than English and who is incapable of performing ordinary classwork in English.

Hispanic student. A student who identifies his or her culture or origin as Central American, Cuban, Mexican, Puerto Rican, South American, or other Spanish culture or origin. A Hispanic student can come from a non-Spanish-speaking country. (This definition, at www.doe.mass.edu/infoservices/data/guides/race_faq.html, is identical to that used by the U.S. Census Bureau, at www.census.gov/population/www/socdemo/hispanic/hispdef.html. Differences in reporting data on Hispanic students for 2006 and prior years are discussed in appendix A. For information on how the Massachusetts Department of Elementary and Secondary Education categorizes Hispanic students, see appendix B.)

Low income. Low income is defined as meeting any one of three criteria—eligible for free or reduced-price lunch, receiving Transitional Aid to Needy Families benefits, or eligible for food stamps. The information is collected from students by the Massachusetts Department of Elementary and Secondary Education.

Multilevel regression modeling. A set of regression-based procedures used to analyze data with a nested or hierarchical structure (such as students nested within schools). Multilevel regression modeling accounts for correlated errors among individuals, allows the relationship between independent and dependent variables to vary across groups, and allows individual and group characteristics to be included in predictive models of individual outcomes.

Non-Hispanic student. Any student not self-identified as Hispanic.

Performance level. The degree to which a student shows mastery of state standards as measured by the Massachusetts Comprehensive Assessment System (MCAS) tests. The four levels, based on scale scores, are warning, needs improvement, proficient, and advanced. The minimum scale score needed for each proficiency level varies by year (see table B6 in appendix B).

Raw score. A student's total score across all items for each MCAS test, without scaling. Possible raw score ranges vary by test and year. (For an explanation of how raw scores were used, see appendix B.)

Scale score. An MCAS raw score converted to a common scale through a standard-setting process, MCAS scale scores are the minimum scores for partial, solid, and sophisticated understanding of curriculum frameworks for any grade content standard (Massachusetts Department of Elementary and Secondary Education 2003). The scale for grade 10 MCAS scores ranges from 200 to 280. (See tables B4 and B5 in appendix B for conversion charts for raw to scale scores.)

School. A Massachusetts school with publicly available school-level data on the Massachusetts Department of Elementary and Secondary Education web site. (The web site did not have school-level data for designated special education schools so they are excluded from the samples.)

School-level characteristics. These variables—such as dropout rate and percentage of students from low-income families—are defined in appendix B.

Standard deviation. This is a measure of how widely or narrowly data are dispersed around the mean for the distribution. A student's test score can be described in terms of standard deviation units by subtracting the mean from the student's score and dividing that figure by the standard deviation.

Standard error. This is a measure of the amount of error between a statistic estimated from a sample and the true value for the population.

Student. A student is a grade 10 Massachusetts student for whom two types of data are available: MCAS test performance data for English language arts and mathematics and corresponding school-level data.

Student-level characteristics. These variables—for example, first language and low-income status—are defined in appendix B.

Variance. Variance is the squared standard deviation.

arts and mathematics tests over 2002/03–2005/06 compare with that of grade 10 non-Hispanic students?

- Among grade 10 Hispanic students, which student- and school-level characteristics were associated with performance on the MCAS English language arts and mathematics tests over 2002/03–2005/06?

The study methods are summarized in box 2. A large percentage of data were removed before the final analyses. (The datasets are described in appendix B. The data removal procedures are described in appendix C.)

HOW DID PERFORMANCE BY GRADE 10 HISPANIC STUDENTS ON THE STATE ASSESSMENT OVER 2002/03–2005/06 COMPARE WITH PERFORMANCE BY GRADE 10 NON-HISPANIC STUDENTS?

To answer the first research question, scale scores (based on mean raw scores) for Hispanic and non-Hispanic students were examined to find variations in the performance gap between them over 2002/03–2005/06 (see box 3 for a summary of characteristics of Hispanic and non-Hispanic students). Then *t*-tests were used to determine whether average raw scores for Hispanic and non-Hispanic students showed statistically significant differences and whether scores for Hispanic students improved significantly over time.

Differences in performance on the state assessment by grade 10 Hispanic and non-Hispanic students

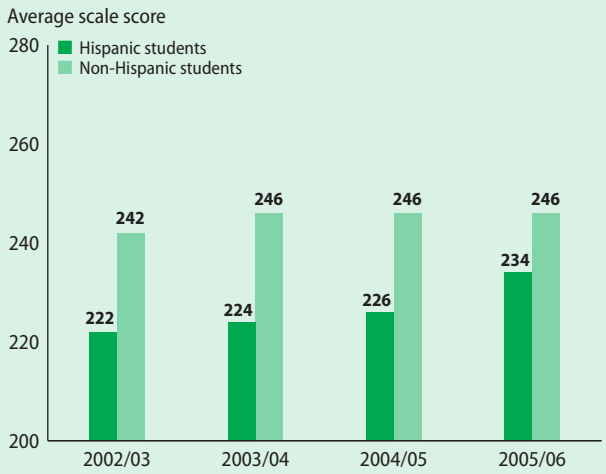
In each study year the average scale score of Hispanic students on the MCAS English language arts test was lower than that of non-Hispanic students by a statistically significant amount (figure 1 and table 1). However, the average scale scores in English language arts for Hispanic students improved significantly between 2002/03 and 2005/06, by 12 points (from 222 to 234). Between 2002/03 and 2004/05 non-Hispanic students' scale scores also improved significantly, by 4 points (from 242 to 246), but their scale scores then remained constant until 2005/06.

Similarly, in each study year the average scale score for Hispanic students on the MCAS mathematics test was lower than that for non-Hispanic students by a statistically significant amount (figure 2 and table 2). However, between 2002/03 and 2005/06 the average scale scores in mathematics for both Hispanic and non-Hispanic students increased significantly. The average scale score for Hispanic students rose 10 points, while that for non-Hispanic students rose 8 points.

The changes in MCAS test performance gaps between Hispanic and non-Hispanic students are shown in figure 3. The gap for English language arts was 20 points in 2002/03, 22 points in 2003/04, 20 points in 2004/05, and 12 points in 2005/06. The gap for mathematics was 20 points in 2002/03, 2003/04, and 2004/05, and 18 points in 2005/06. The declines in both performance gaps between 2003/04 and 2005/06 are attributable to

FIGURE 1

Average scale scores on the Massachusetts Comprehensive Assessment System English language arts for grade 10 Hispanic and non-Hispanic students in Massachusetts, 2002/03–2005/06



Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research and Evaluation 2007.

BOX 2

Methods

The study used two types of data:

- Background and MCAS performance data on grade 10 Hispanic students in Massachusetts for 2002/03–2005/06, provided by the Massachusetts Department of Elementary and Secondary Education, Office of Strategic Planning, Research, and Evaluation (2007).
- Publicly available data on all high schools in Massachusetts for 2002/03–2005/06, accessed through the Massachusetts Department of Elementary and Secondary Education web site (Massachusetts Department of Elementary and Secondary Education 2007b) and the U.S. Department of Education, National Center for Education Statistics (2006) Common Core of Data. (Special education schools and their students were not included in the analyses.)

A large share of data was removed from the study, mainly because of missing student- or school-level data (see appendix C for details). Comparisons of included and removed cases for each student- and school-level variable revealed that the removal of so much data might have biased the findings, since removed students appeared to have lower achievement than included students.

Descriptive analyses compared the performance of grade 10 Hispanic students on the English language arts and mathematics MCAS tests with that of grade 10 non-Hispanic students. *T*-tests were used to determine whether the two groups' scores differed significantly on each subject in each school year and whether significant improvements occurred over time. To examine associations between student- and school-level characteristics and Hispanic student MCAS performance, multilevel regression modeling was used for the population of students self-reporting as Hispanic.

This study did not follow any student cohort over time. Therefore, it makes no claims about whether differences in cohort characteristics are associated with student performance over time. In the multilevel regression modeling, the regression coefficient for a given variable in the model assumes that all other variables are held constant—so although previous research might have found an association between the given variable and student test performance, this study might not find that association to be significant after accounting for other variables (see appendix A for review of previous literature). Results of the multilevel regressions are provided as standard deviation differences for each variable and as absolute changes in raw score points for each variable.

yearly increases in Hispanic student scale scores (see figures 1 and 2)—with the increases being greater for the English language arts test (see figure 1).

AMONG GRADE 10 HISPANIC STUDENTS, WHICH STUDENT- AND SCHOOL-LEVEL CHARACTERISTICS WERE ASSOCIATED WITH PERFORMANCE ON THE STATE ASSESSMENT OVER 2002/03–2005/06?

To answer the second research question, multilevel regression modeling was used to analyze statistical relationships between student- and school-level variables and Hispanic students' MCAS test scores. Such relationships are termed statistically significant when the regression coefficient associated with a variable is statistically significantly different from zero.

Overview of findings

For each year from 2002/03 through 2005/06 multilevel regression modeling revealed statistically significant associations between several student-level variables and MCAS test scores (see box 3 for a summary of student-level characteristics):

- Female Hispanic students scored significantly higher on the English language arts test than did male Hispanic students. Male Hispanic students scored significantly higher on the mathematics test than did female Hispanic students.

BOX 3

Characteristics of grade 10 Hispanic and grade 10 non-Hispanic students in Massachusetts in 2005/06

In 2005/06 there were 7,394 grade 10 Hispanic students in Massachusetts (see table), or 10.6 percent of the state's 10th graders, up from 9.0 percent in 2002/03. (Characteristics of grade 10 Hispanic and non-Hispanic students in Massachusetts for 2002/03–2005/06 are in appendix D.)

There were several similarities between the Hispanic and non-Hispanic students in 2005/06:

- Each group was about evenly split between male and female students.
- Special education students made up similar shares of the Hispanic (16.8 percent) and non-Hispanic (14.0 percent) student populations.
- More than 90 percent of students in each group were born in the United States.

There were also notable differences in characteristics between Hispanic and non-Hispanic students:

- Among Hispanic students, 67.6 percent were from low-income

(CONTINUED)

Characteristics of grade 10 Hispanic and non-Hispanic students in Massachusetts, 2005/06

	Hispanic students (N = 7,394)		Non-Hispanic students (N = 62,139)	
Student characteristic	Percent	Number	Percent	Number
Gender				
Female	50.6	3,738	49.8	30,973
Male	49.4	3,656	50.2	31,166
Socioeconomic status				
Low income	67.6	4,997	18.3	11,341
Not low income	32.4	2,397	81.7	50,798
Special education status				
Special education	16.8	1,244	14.0	8,681
Not special education	83.2	6,150	86.0	53,458
English proficiency status				
English proficient	78.3	5,787	97.9	60,571
Limited English proficient	8.0	1,015	1.5	928
Former limited English proficient[a]	8.0	592	1.0	640
First language				
English	40.7	3,008	92.5	57,497
Portuguese	2.9	218	1.1	689
Spanish	55.4	4,009	0.2	119
Other languages	0.9	69	6.2	3,834
Country of origin				
Brazil	0.5	40	0.1	70
Caribbean country	2.2	164	0.2	126
Central American country or Mexico	2.2	166	0.0	5
South American country other than Brazil	0.9	70	0.0	2
United States	93.9	6,940	98.5	61,197
Other countries	0.2	14	1.2	739

a. Students newly categorized as English proficient during the previous two years.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007).

BOX 3 (CONTINUED)

Characteristics of grade 10 Hispanic and grade 10 non-Hispanic students in Massachusetts in 2005/06

households. Among non-Hispanic students 18.3 percent were from low-income households.

- Among Hispanic students, 78.3 percent were English proficient and 8.0 percent were limited English proficient. Among non-Hispanic students, 97.9 percent were English proficient.
- Among Hispanic students, 55.4 percent reported speaking Spanish, and 40.7 percent English, as their first language. Among non-Hispanic students, 92.5 percent reported speaking English as their first language.

TABLE 1

Scores on the Massachusetts Comprehensive Assessment System English language arts test for grade 10 Hispanic and non-Hispanic students, 2002/03–2005/06

Statistic	2002/03	2003/04	2004/05	2005/06
Hispanic students				
Number of observations	5,917	5,956	6,648	7,394
Average raw score	42.17	44.28	44.21	46.59
Standard deviation of raw scores	13.84	13.15	13.32	11.54
Converted scale score	222	224	226	234
Non-Hispanic students				
Number of observations	59,736	60,498	62,452	62,139
Average raw score	53.45	54.83	54.50	54.82
Standard deviation of raw scores	10.55	9.94	10.19	8.90
Converted scale score	242	246	246	246
t-test using raw scores				
Value	76.06***	75.59***	75.74***	72.54***
Degrees of freedom	65,641	66,452	69,098	69,531
t-tests on change in raw scores from 2002/03 through 2005/06				
Hispanic students	$t(13{,}309) = 20.09$***			
Non-Hispanic students	$t(121{,}863) = 24.43$***			

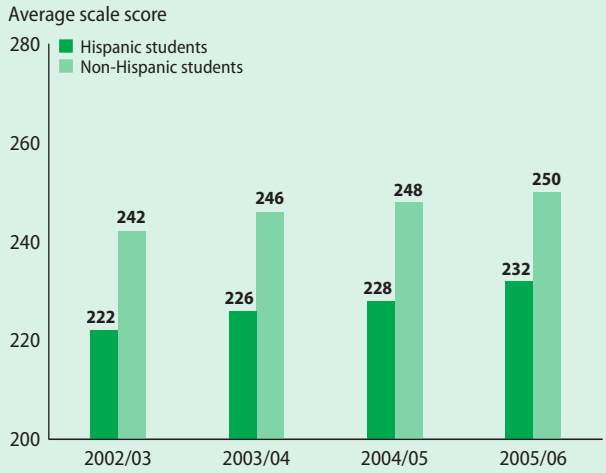
*** Significant at the 0.1 percent level.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007).

- Hispanic students who were from low-income households, in special education, or limited English proficient or formerly limited English proficient—categorized as English proficient in the previous two years—scored significantly lower on both the English language arts and mathematics tests than did students without those characteristics. (These associations mirror those typically reported in research on academic achievement for all racial/ethnic groups.)
- Hispanic students from Caribbean countries, Central America, and Mexico scored significantly lower on the English language arts test than did U.S.-born Hispanic students.
- Hispanic students from South American countries other than Brazil scored significantly higher on the mathematics test than did U.S.-born Hispanic students.

FIGURE 2

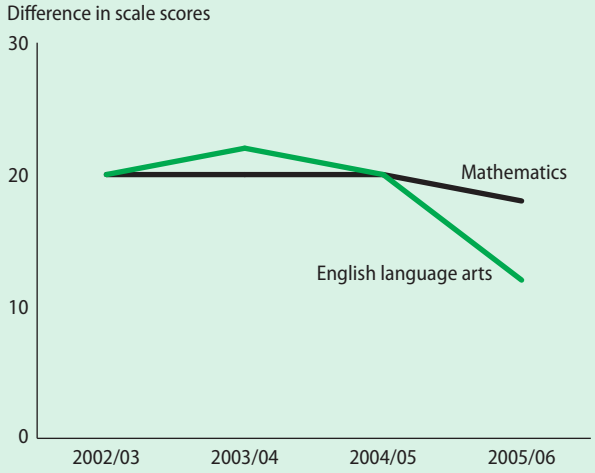
Average scale scores on the Massachusetts Comprehensive Assessment System mathematics test for grade 10 Hispanic and non-Hispanic students in Massachusetts, 2002/03–2005/06



Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007).

FIGURE 3

Differences in average scale scores on the Massachusetts Comprehensive Assessment System English language arts and mathematics tests for grade 10 Hispanic and non-Hispanic students, 2002/03–2005/06



Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007).

TABLE 2

Scores on the Massachusetts Comprehensive Assessment System mathematics test for grade 10 Hispanic and non-Hispanic students, 2002/03–2005/06

Statistic	2002/03	2003/04	2004/05	2005/06
Hispanic students				
Number of observations	5,917	5,956	6,648	7,394
Average raw score	21.99	27.74	26.03	29.20
Standard deviation of raw scores	12.30	13.69	13.67	13.57
Converted scale score	222	226	228	232
Non-Hispanic students				
Number of observations	59,736	60,498	62,452	62,139
Average raw score	33.49	39.84	38.70	40.41
Standard deviation of raw scores	13.48	13.60	14.16	13.16
Converted scale score	242	246	248	250
t-test using raw scores				
Value	63.04***	64.48***	49.58***	59.04***
Degrees of freedom	65,641	66,452	69,098	69,531
t-tests on change in raw scores from 2002/03 through 2005/06				
Hispanic students	$t(13{,}309) = 31.72$***			
Non-Hispanic students	$t(121{,}863) = 90.75$***			

*** Significant at the 0.1 percent level.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007).

BOX 4

Characteristics of Massachusetts schools with grade 10 Hispanic students

From 2002/03 through 2005/06 the percentage of the total grade 10 school population in Massachusetts self-reporting as Hispanic increased from 10.3 percent to 11.8 percent (see table).

In schools with Hispanic students the average share of low-income students increased by 4.6 percentage points—from 23.0 percent to 27.6 percent—over the same period.

In each year more than 50 percent of schools with Hispanic students were in suburban locales.

Characteristics of Massachusetts high schools, 2002/03–2005/06

School characteristic	2002/03	2003/04	2004/05	2005/06
Number of observations	277	296	306	317
Percentage of Hispanic students	10.3	10.9	11.1	11.8
Percentage of low-income students	23.0	26.4	26.7	27.6
Percentage of students in special education	—	17.4	16.7	17.1
Percentage of limited English proficient students	3.5	3.6	3.0	3.1
Attendance rate (percent)	91.7	91.3	91.7	92.0
Dropout rate (percent)	4.5	5.1	5.6	4.9
Student–teacher ratio	—	13.4	13.8	13.2
School size (number of students)	967	943	948	938
Locale				
Percentage of rural schools	17.3	17.6	16.7	18.6
Percentage of suburban schools	55.2	53.7	55.6	52.7
Percentage of urban schools	27.4	28.7	27.8	28.7

— is not available.

Note: Except in the locale category, percentages are averages for the characteristic in a given school and year (each school is given equal weight in the calculation). For definitions of the variables used in the analyses see appendix B.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

For each year from 2002/03 through 2005/06 a statistically significant association was found between MCAS test performance and only one school-level variable (see box 4 for a summary of school-level characteristics):

- Hispanic students in schools with higher attendance rates scored significantly higher on both the English language arts and mathematics tests than did Hispanic students in schools with lower attendance rates, all other variables held constant.

Multilevel regression modeling results

The multilevel regression models predicted raw scores for grade 10 Hispanic students on the MCAS English language arts and mathematics tests for each year from 2002/03 through 2005/06, using student-level characteristics (such as gender) and school-level characteristics (such as locale). The raw scores were standardized around the minimum raw scores needed to achieve proficiency on each year's tests (see appendix B for details).

Results of the multilevel regressions are provided in two formats: as standard deviation differences for each variable and as absolute changes in raw score points for each variable. Readers with a less technical understanding of statistics may find the absolute changes in raw score points easier to understand.

The student- and school-level characteristics included in the models as independent variables are shown in table 3.

Two models were created for each year and subject: model 1 contained only student-level variables, and model 2 contained both student- and school-level variables. All results and interpretations presented in the body of this report are from model 2. (Results from both models are reported in full in appendix E.) (See next section of the report for some limitations of these analyses.)

TABLE 3

Independent variables used for multilevel regression modeling

Variable	Explanation of coding[a]
Student-level variables	
Gender	0 = male; 1 = female
From low-income household	0 = not from a low-income household; 1 = from a low-income household
In special education	0 = not in special education; 1 = in special education
Limited English proficient[b]	0 = not limited English proficient; 1 = limited English proficient
Former limited English proficient[b]	0 = not former limited English proficient; 1 = former limited English proficient
First language Portuguese[c]	0 = first language not Portuguese; 1 = first language Portuguese
First language Spanish[c]	0 = first language not Spanish; 1 = first language Spanish
First language other[c]	0 = first language not other; 1 = first language other
Immigrant from Brazil[d]	0 = not from Brazil; 1 = immigrant from Brazil
Immigrant from Caribbean country[d]	0 = not from Caribbean country; 1 = immigrant from Caribbean country
Immigrant from Central American country or Mexico[d]	0 = not from Central American country or Mexico; 1 = immigrant from Central American country or Mexico
Immigrant from South American country other than Brazil[d]	0 = not from other South American country; 1 = immigrant from other South American country
Immigrant from other country[d]	0 = not from other country; 1 = immigrant from other country
School-level variables	
Percentage of Hispanic students	Continuous, centered around the average percentage of Hispanics across all schools in sample (unit of change = 10 percent)
Percentage of students from low-income households	Continuous, centered around the average percentage of students from low-income households across all schools in sample (unit of change = 10 percent)
Percentage of students in special education	Continuous, centered around the average percentage of students in special education across all schools in sample (unit of change = 10 percent)
Percentage of limited English proficient students	Continuous, centered around the average percentage of limited English proficient students across all schools in sample (unit of change = 10 percent)
Attendance rate	Continuous, centered around the average attendance rate across all schools in sample (unit of change = 1 percent)
Dropout rate	Continuous, centered around the average dropout rate across all schools in sample (unit of change = 1 percent)
Student–teacher ratio	Continuous, centered around the average student–teacher ratio across all schools in sample (unit of change = 1 student per teacher)
School size	Continuous, centered around the average school size across all schools in sample (unit of change = 100 students)
Rural locale[e]	0 = not rural school; 1 = rural school
Urban locale[e]	0 = not urban school; 1 = urban school

a. All variables are discrete, with values of either 0 or 1, except when identified as continuous.

b. Reference group is not "limited English proficient" or "former limited English proficient."

c. Reference group is "first language English."

d. Reference group is "U.S.-born."

e. Reference group is "suburban locale."

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007).

TABLE 4

Regression results for multilevel modeling of associations between student- and school-level variables and standardized performance on Massachusetts Comprehensive Assessment System English language arts test, 2002/03–2005/06

Statistic and variable	2002/03	2003/04	2004/05	2005/06
Minimum raw score to achieve proficiency	52	53	52	51
Standard deviation of raw scores	9.86	9.63	9.85	10.33
Intercept	−0.509** (0.091)	−0.337** (0.080)	−0.309** (0.069)	−0.046 (0.059)
Student-level variables				
Gender	0.184** (0.030)	0.113 ** (0.029)	0.177** (0.027)	0.182** (0.020)
From low-income household	−0.227** (0.035)	−0.136** (0.033)	−0.204** (0.032)	−0.146** (0.023)
In special education	−1.029** (0.043)	−1.200** (0.042)	−0.993** (0.037)	−0.992** (0.027)
Limited English proficient	−0.998** (0.051)	−1.294** (0.049)	−1.311** (0.047)	−1.212** (0.036)
Former limited English proficient	−0.415** (0.060)	−0.491** (0.050)	−0.482** (0.048)	−0.263** (0.040)
First language Portuguese	−0.227 (0.122)	0.106 (0.124)	0.176 (0.099)	0.142** (0.070)
First language Spanish	−0.080** (0.040)	0.040 (0.039)	−0.013 (0.035)	−0.054** (0.025)
First language other	0.217 (0.192)	0.027 (0.214)	0.103 (0.181)	−0.012 (0.110)
Immigrant from Brazil	−0.289 (0.179)	0.002 (0.173)	−0.162 (0.167)	−0.193 (0.149)
Immigrant from Caribbean country	−0.790** (0.091)	−0.398** (0.090)	−0.357** (0.093)	−0.554** (0.073)
Immigrant from Central American country or Mexico	−0.894** (0.102)	−0.592** (0.096)	−0.581** (0.100)	−0.355** (0.074)
Immigrant from South American country other than Brazil	−0.165 (0.113)	0.076 (0.127)	0.271** (0.129)	0.299** (0.105)
Immigrant from other country	−0.725** (0.352)	−0.743** (0.372)	−0.363 (0.423)	−0.394 (0.238)
School-level variables				
Percentage of Hispanic students	−0.121** (0.028)	−0.095** (0.030)	−0.017 (0.026)	−0.031 (0.023)
Percentage of students from low-income households	0.024 (0.027)	0.022 (0.027)	−0.026 (0.023)	−0.042** (0.021)
Percentage of students in special education	—	−0.030 (0.031)	−0.100** (0.033)	−0.032 (0.027)
Percentage of limited English proficient students	0.196** (0.052)	0.056 (0.047)	−0.020 (0.036)	0.025 (0.036)
Attendance rate	0.053** (0.010)	0.035** (0.012)	0.050** (0.009)	0.025** (0.008)

(CONTINUED)

TABLE 4 (CONTINUED)

Regression results for multilevel modeling of associations between student- and school-level variables and standardized performance on Massachusetts Comprehensive Assessment System English language arts test, 2002/03–2005/06

Statistic and variable	2002/03	2003/04	2004/05	2005/06
Dropout rate	–0.005 (0.006)	–0.011 (0.009)	–0.009 (0.005)	–0.010** (0.005)
Student–teacher ratio	—	0.026** (0.011)	–0.002 (0.012)	–0.001 (0.006)
School size	–0.005 (0.005)	–0.009 (0.005)	–0.004 (0.004)	–0.006 (0.004)
Rural locale	–0.151 (0.109)	0.084 (0.101)	–0.120 (0.093)	–0.131 (0.075)
Urban locale	–0.107 (0.093)	–0.026 (0.096)	0.076 (0.082)	0.098 (0.072)
Percentage of variance explained by the model	30	32	37	39

— is not available.

** Significant at the 5 percent level.

Note: Numbers in parentheses are standard errors.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

TABLE 5

Regression results for multilevel modeling of associations between student- and school-level variables and standardized performance on Massachusetts Comprehensive Assessment System mathematics test, 2002/03–2005/06

Statistic and variable	2002/03	2003/04	2004/05	2005/06
Minimum raw score to achieve proficiency	32	37	33	33
Standard deviation of raw scores	13.44	13.70	14.18	14.04
Intercept	–0.326** (0.085)	–0.245** (0.075)	–0.170** (0.067)	0.076 (0.071)
Student-level variables				
Gender	–0.073** (0.021)	–0.061** (0.022)	–0.082** (0.020)	–0.096** (0.019)
From low-income household	–0.066** (0.024)	–0.080** (0.026)	–0.117** (0.024)	–0.107** (0.022)
In special education	–0.576** (0.030)	–0.714** (0.032)	–0.588** (0.028)	–0.681** (0.026)
Limited English proficient	–0.322** (0.035)	–0.587** (0.038)	–0.548** (0.035)	–0.621** (0.034)
Former limited English proficient	–0.184** (0.041)	–0.232** (0.039)	–0.243** (0.036)	–0.117** (0.038)
First language Portuguese	–0.072 (0.085)	0.068 (0.097)	0.192** (0.076)	0.182** (0.066)
First language Spanish	–0.016 (0.028)	–0.005 (0.030)	0.037 (0.027)	–0.025 (0.024)

(CONTINUED)

TABLE 5 (CONTINUED)

Regression coefficients for multilevel modeling of associations between student- and school-level variables and standardized Massachusetts Comprehensive Assessment System mathematics test performance, 2002/03–2005/06

Statistic and variable	2002/03	2003/04	2004/05	2005/06
First language other	0.271** (0.132)	0.209 (0.166)	0.046 (0.137)	0.122 (0.104)
Immigrant from Brazil	0.080 (0.125)	0.149 (0.135)	0.122 (0.126)	–0.128 (0.141)
Immigrant from Caribbean country	–0.198** (0.062)	0.044 (0.069)	–0.118 (0.070)	–0.206** (0.069)
Immigrant from Central American country or Mexico	–0.280** (0.070)	–0.123 (0.074)	–0.263** (0.075)	–0.317** (0.070)
Immigrant from South American country other than Brazil	0.191** (0.078)	0.370** (0.098)	0.306** (0.097)	0.411** (0.099)
Immigrant from other country	–0.136 (0.241)	–0.042 (0.287)	–0.709** (0.320)	0.177 (0.225)
School-level variables				
Percentage of Hispanic students	–0.091** (0.029)	–0.073** (0.028)	–0.027 (0.026)	–0.011 (0.028)
Percentage of students from low-income households	0.005 (0.026)	0.021 (0.025)	–0.021 (0.022)	–0.046 (0.025)
Percentage of students in special education	—	0.003 (0.027)	–0.079** (0.030)	–0.005 (0.029)
Percentage of limited English proficient students	0.147** (0.053)	0.031 (0.042)	–0.006 (0.036)	0.020 (0.042)
Attendance rate	0.032** (0.010)	0.023** (0.011)	0.039** (0.009)	0.031** (0.009)
Dropout rate	–0.001 (0.006)	–0.014 (0.008)	–0.004 (0.004)	–0.007 (0.005)
Student–teacher ratio	—	0.040** (0.010)	0.014 (0.012)	–0.001 (0.007)
School size	–0.004 (0.005)	–0.007 (0.005)	–0.009** (0.004)	–0.008 (0.004)
Rural locale	–0.033 (0.096)	–0.019 (0.088)	–0.043 (0.084)	–0.121 (0.084)
Urban locale	–0.071 (0.093)	–0.100 (0.090)	0.035 (0.081)	0.087 (0.087)
Percentage of variance explained by the model	17	21	27	23

— is not available.

** Significant at the 5 percent level.

Note: Numbers in parentheses are standard errors.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

Model results presented as standard deviation differences for each variable. Tables 4 and 5 present the regression coefficients of model 2 for student- and school-level variables (defined in table 3) on the MCAS tests in English language arts and mathematics.

The intercepts. Each intercept can be used to predict an estimated standardized raw score—on a given MCAS test in a given year—for a student:

- Whose characteristics have a value of 0 for all discrete variables. That is, he is male, not from a low-income household, not in special education, not limited English proficient, and not formerly limited English proficient; his first language is English; he is U.S.-born; and he attends a suburban school.

- Who attends a school with average characteristics for all schools included in the model—that is, one with the average percentages of students who are Hispanic, from low-income households, in special education, and limited English proficient; average attendance and dropout rates; average student–teacher ratio; and average school size.

The intercept estimates how many standard deviations, or what proportion of a standard deviation, a student with these characteristics would score above or below the minimum raw score needed to achieve proficiency. For example, the minimum raw score to achieve proficiency for the MCAS mathematics test in 2004/05 was 33. The intercept for the same test and year is –0.170, indicating that the student described would score, on average, 0.170 standard deviations below 33. The standard deviation is 14.18 (see table 5). Multiplying –0.170 by 14.18 yields –2.41. So, the student's raw score on the MCAS mathematics test for 2004/05 is predicted to be 2.41 points below 33, or 30.59 points.

The standardized regression coefficients for discrete variables. Discrete variables consist of all student-level variables in addition to the school locale variables, rural and urban. For each such variable the standardized regression coefficient gives the change in the standard deviation of raw scores when the value for that variable is changed from 0 to 1 (for descriptions of 0 and 1 for each variable see table 3). For example, assume that for a female student the values for all variables, except gender (which changes from 0 to 1), match those of the male student described earlier (the student whose standardized raw score was estimated using the intercept). For the MCAS mathematics test in 2004/05 the standardized regression coefficient for gender is –0.082 (see table 5). Multiplying that by the standard deviation, 14.18, yields –1.16. So, the female student's raw score on the MCAS mathematics test for 2004/05 is predicted—all other variables being equal—to be 1.16 points below her male counterpart's 30.59 points, or 29.43 points.

A female student's raw score on the MCAS mathematics test for 2004/05 is predicted—all other variables being equal—to be 1.16 points below her male counterpart's

The standardized regression coefficients for continuous variables. Continuous variables consist of all school-level variables other than school locale (see table 3). For each such variable the standardized regression coefficient gives the change in the standard deviation of raw scores when the value is one unit of change more than the average value for that variable across all schools included in the study (for units of change for continuous variables see table 3). For example, the standardized regression coefficient for the percentage of Hispanics in a school for the MCAS mathematics test in 2004/05 was –0.027, and the unit of change for this variable is 10 percent. So, for a student in a school where the percentage of Hispanic students is 10 percentage points higher than the average for schools in the dataset, –0.027 is the change in the standard deviation of the MCAS raw score above or below the score for a student in a school with the average percentage of Hispanic students (which is represented by the intercept, or the standard deviation above or below the minimum raw score needed for proficiency).

In 2002/03, 2003/04, and 2004/05 the reference group of male Hispanic students performed significantly below the minimum raw scores required for proficiency on the MCAS English language arts and mathematics tests

Model results presented as absolute changes in raw score points. The following discussion gives results from the analyses as absolute changes in raw score points on a given test in a given school year rather than as coefficients indicating standard deviation differences from minimum raw scores needed to achieve proficiency (the more technical format used in tables 4 and 5). For example, for the 2005/06 MCAS English language arts test the standardized regression coefficient for gender is 0.182 (see table 4). Multiplying that by the standard deviation, 10.33, yields an absolute change of 1.88 raw score points. (When standardized regression coefficients are converted into changes in raw score points, absolute raw score point differences for mathematics are greater than those for English language arts, given the same standardized regression coefficient. That difference reflects the greater variability in student performance on the mathematics test.)

As a reminder, the reference group was defined by the intercept for the multilevel regression models. It consists of Hispanic students who are male, not from low-income households, not in special education, and not limited English proficient or former limited English proficient; whose first language was English; who are U.S.-born; and who attend suburban schools at the average of all schools included in the model for each school-level variable.

In 2002/03, 2003/04, and 2004/05 this reference group performed significantly below the minimum raw scores required for proficiency on the MCAS English language arts and mathematics tests (see the intercept rows in tables 4 and 5). In contrast, the reference group's MCAS test scores in 2005/06 showed no statistically significant difference from the minimum raw scores required for proficiency. Because a different student cohort was studied for each school year, it is unknown whether the change in 2005/06 resulted from changed conditions—for example, in teaching—or whether the 2005/06 grade 10 Hispanic student cohort has consistently performed higher than other Hispanic student cohorts.

Student-level variables. Model 2 found statistically significant associations for all four years between grade 10 Hispanic students' raw scores and six student-level variables: gender, socioeconomic status, special education status, limited English proficient status, former limited English proficient status, and emigrated from Caribbean country, Central American country, or Mexico. (See the final section of the report for limitations of this analysis.)

- *Gender.* On the English language arts test female students were predicted to score 1.09 to 1.88 points higher than male students were. On the mathematics test male students were predicted to score 0.84 to 1.35 points higher than female students were.

- *Socioeconomic status.* Students from low-income households were predicted to score 1.31– 2.24 points lower on the English language arts test and 0.89–1.66 points lower on the mathematics test than students who were not from low-income households.

- *Special education status.* Students who were in special education were predicted to score 9.78–11.56 points lower on the English language arts test and 7.74–9.78 points lower on the mathematics test than students who were not in special education.

- *English proficiency status.* Limited English proficient students were predicted to score 9.84–12.91 points lower on the English language arts test and 4.33–8.72 points lower on the mathematics test than were English proficient students. Former limited English proficient students were predicted to score 2.72–4.75 points lower on the English language arts test and 1.64–3.45 points lower on the mathematics test than were English proficient students.

- *Country of origin.* Students who had emigrated from a Central American country or Mexico were predicted to score 3.67–8.81 points lower on the English language arts test than were U.S.-born students. Students who had emigrated from a Caribbean country were predicted to score 3.52–7.79 points lower on the English language arts test than were U.S.-born students. Students who had emigrated from a South American country other than Brazil were predicted to score 2.57–5.77 points higher on the mathematics test than were U.S.-born students.

Statistically significant associations were found for some years between two types of student-level variables and students' MCAS performance: first language and country of origin.

- *First language.* Three statistically significant associations for some years were found between students' first language and the included students' MCAS test scores.
    - For 2005/06 students whose first language was Portuguese were predicted to score 1.47 points higher on the English language arts test and 2.56 points higher on the mathematics test than were students whose first language was English. For 2004/05 students whose first language was Portuguese were predicted to score 2.72 points higher than were students whose first language was English.
    - Students whose first language was Spanish were predicted to score 0.79 point lower on the English language arts test in 2002/03 and 0.51 point lower in 2005/06 than were students whose first language was English.
    - For 2002/03 students whose first language was not English, Portuguese, or Spanish were predicted to score 3.64 points higher on the mathematics test than were students whose first language was English.
- *Country of origin.* Four statistically significant associations for some years were found between students' country of origin and the included students' MCAS test scores (see tables 4 and 5 and B3 in appendix B).
    - For 2002/03, 2004/05, and 2005/06 students who had emigrated from a Central American country or Mexico were predicted to score 3.73–4.45 points lower on the mathematics test than were U.S.-born students.
    - Students who had emigrated from a Caribbean country were predicted to score 2.66 points lower on the MCAS mathematics test in 2002/03 and 2.86 points lower in 2005/06 than were U.S.-born students.
    - Students who had emigrated from a South American country other than Brazil were predicted to score 2.67 points higher on the MCAS English language arts test in 2004/05 and 3.09 points higher in 2005/06 than were U.S.-born students.
    - Students who emigrated from a country other than Mexico or countries in the Caribbean, Central America, or South America (including Brazil) (see table B3 in appendix B for other reported countries of origin in the "Other" category) were predicted to score 7.15 points lower on the English language arts test in 2002/03 and 7.16 points lower in 2003/04 than were U.S.-born students. Students whose country of origin was in this category were predicted to score 10.05 points lower on the mathematics test in 2004/05

Statistically significant associations were found for some years between two types of student-level variables and students' MCAS performance: first language and country of origin

A statistically significant association for all four years was found between school attendance rate and Hispanic students' raw scores on both MCAS tests

than were U.S.-born students. However, the number of students was small.

School-level variables. A statistically significant association for all four years was found between just one school-level variable and Hispanic students' raw scores on both MCAS tests.

- *Attendance rate.* For every 1 percentage point increase in a school's average attendance rate above the mean attendance rate of all schools, Hispanic students were predicted to score 0.25–0.50 point higher on both MCAS tests.

A statistically significant association was found for some years for seven additional school-level variables:

- *Percentage of Hispanic students.* For 2002/03 and 2003/04 for every 10 percentage point increase in the proportion of Hispanic students in a school over the mean for all schools, grade 10 Hispanic students in the school were predicted to score about 1 point lower on the English language arts test and about 1 point lower on the mathematics test.

- *Percentage of students from low-income households.* For 2005/06 for every 10 percentage point increase in the proportion of students from low-income households in a school over the mean for all schools, grade 10 Hispanic students were predicted to score about 0.4 point lower on the MCAS English language arts test.

- *Percentage of students in special education.* This variable was not available for 2002/03. For 2004/05 for every 10 percentage point increase in the proportion of students in special education in a school over the mean for all schools, grade 10 Hispanic students were predicted to score about 1 point lower on the English language arts test and 0.8 point lower on the mathematics test.

- *Percentage of limited English proficient students.* For 2002/03 for every 10 percentage point increase in the proportion of limited English proficient students in a school over the mean for all schools, grade 10 Hispanic students were predicted to score 1.5–2.0 points higher on both MCAS tests.

- *Dropout rate.* For 2005/06 for every 1 percentage point increase in a school's dropout rate over the mean for all schools, grade 10 Hispanic students were predicted to score 0.1 point lower on the English language arts test.

- *Student–teacher ratio.* For 2003/04 every increase of 1 student per teacher over the average student-teacher ratio across schools was associated with a 0.25 point increase in English language arts test raw scores and a 0.55 point increase in mathematics test scores.

- *School size.* For 2004/05 for every 100 student increase in school size over the mean for all schools, grade 10 Hispanic students were predicted to score 0.13 points lower on the mathematics test.

No statistically significant association was found between a school's locale—rural, suburban, or urban—and included students' raw scores on either MCAS test (again, with all other variables held constant).

For each school year the variables included in the analyses explain a smaller proportion of the variability in grade 10 Hispanic students' mathematics test scores than in their English language arts test scores (17–23 percent for mathematics, 30–39 percent for English language arts).

LIMITATIONS AND CONSIDERATIONS FOR INTERPRETING RESULTS

The multilevel regression modeling results have several limitations.

- The multilevel regression analysis describes statistical associations rather than causal relationships. Every association that is found to be statistically significant must be interpreted as a relationship between an independent variable and the dependent variable, with all other variables in the model held constant. Such an association can never prove that a given student- or school-level characteristic caused a particular change in Hispanic students' MCAS test scores.

- The regression coefficient for a given variable in the model assumes that all other variables are held constant. So, although previous research might have found an association between a certain variable in the model (for example, school locale) and student test performance, this study might not find that association to be significant after accounting for other variables in the model (such as the percentage of students from low-income households, which is highly correlated with school locale).

- The analyses here cannot indicate whether the performance differences between Hispanic and non-Hispanic students found in the descriptive analysis (answering the first research question) would remain if the analysis controlled for student- and school-level variables.

- A large number of significance tests were done to examine associations, and about 5 percent of the resulting estimates will have resulted from chance alone. No statistical adjustments were made to account for this.

- Sample sizes for some of the variables were small. Country of origin is one example: just 40 Hispanic students reported being born in Brazil (see box 3). Such small sample sizes may have limited the power to detect some associations.

- The large share of data excluded from the analyses—most of it missing data—might have biased the findings, since excluded students appear to have lower achievement than included students. Obtaining full data on every student and school would allow for more precise analysis.

The multilevel regression analysis describes statistical associations rather than causal relationships

- This study did not follow student cohorts over time, so it makes no claims about whether differences in cohort characteristics are associated with student performance over time. Relationships between student- and school-level characteristics and Hispanic students' MCAS test scores might not be consistent across school years. And associations identified in this report pertain only to grade 10 Hispanic students—not to Hispanic students in other grades. Thus, if a positive association between a given student- or school-level characteristic and test scores is consistent for grade 10 Hispanic students across school years, a negative association (or no association) might be found for Hispanic students in another grade across the same years.

- The variables considered in this report were collected by the Massachusetts Department of Elementary and Secondary Education and do not represent all the characteristics that might explain differences in Hispanic students' academic achievement patterns (Hess 2000). Other characteristics have been shown to play a role in those patterns: the number of generations that have elapsed since members of a student's family arrived in the United States (Kao and Tienda 1995), the involvement of parents in a student's education (Hong and Ho 2005), and the expectations of parents for the student's education (Yan and Lin 2005). Measures of these characteristics were not available. Furthermore, all student- and school-level characteristics are interwoven with each student's unique abilities, behaviors, and personality (Hess 2000)—characteristics that

this study did not consider. Including such measures in the analyses might have strengthened the models and accounted for a greater proportion of the variance in the scores of Hispanic students for each school year.

- Changes in policies and practices in Massachusetts schools and districts between 2002/03 and 2005/06 might have affected Hispanic students' test scores. Researchers are aware of one such change: a modification in federal guidelines for including limited English proficient students in MCAS tests. Before February 2004 limited English proficient students who had been enrolled in U.S. schools for fewer than three years were not required to take the MCAS tests. After that, all limited English proficient students—no matter how many years they had been enrolled in U.S. schools—were required to take the mathematics test. Also, the modified guidelines made the English language arts test optional for limited English proficient students in their first year of school enrollment but a requirement thereafter. The implications of these policy changes were not considered for this study, though they might be associated with MCAS test performance of limited English proficient students. (For revised requirements for participation by limited English proficient students in state-mandated assessments see Massachusetts Department of Elementary and Secondary Education 2004b.)

To clarify the finding that student- and school-level characteristics accounted for more variability in English language arts test scores than in mathematics test scores, studies could look at subsets of MCAS mathematics test items that require more language-based skills

ISSUES FOR FURTHER RESEARCH

Future research could fruitfully explore several areas. First, an analysis similar to this study could be done with non-Hispanic students, contextualizing the multilevel modeling findings for Hispanic as well as non-Hispanic students. The non-Hispanic subgroup could be broken down further by racial/ethnic subgroup to mirror how subgroups of students are analyzed under the federal No Child Left Behind Act of 2001.

To clarify the finding that student- and school-level characteristics accounted for more variability in English language arts test scores than in mathematics test scores, studies could look at subsets of MCAS mathematics test items that require more language-based skills. For example, might the student- and school-level characteristics included in this project explain more variance in grade 10 Hispanic students' performance on language-based items (such as word problems) than on other items (such as calculation)?

Studies could examine whether demographic changes in the grade 10 Hispanic student population are associated with changes in academic achievement over time. For example, in this study the proportion of Hispanic limited English proficient students in the grade 10 Hispanic student population fell nearly 10 percent from 2002/03 to 2005/06. So, a study might ask—after controlling for other demographic, student-level, and school-level variables—whether the decrease in the proportion of limited English proficient students among grade 10 Hispanic students is related to increases in the grade 10 Hispanic students' MCAS test scores during the same period.

To clarify the finding of a statistically significant association between school attendance rates and grade 10 Hispanic students' MCAS test scores, studies might ask how schools with large percentages of Hispanic students and high attendance rates maintain those rates. Also, because various student, parent, school, and community factors may influence school attendance rates (Lamdin 1996; Roby 2004), studies could examine the relationships between attendance rates and factors such as parent involvement, student engagement, and school leadership.

This study suggests that further research on the relationships between certain student- and school-level characteristics—such as country

of origin, first language, and the percentages of Hispanic students and limited English proficient students in a school—and Hispanic students' MCAS test scores could be useful. Researchers could account for more variance by adding variables, such as age, years enrolled in a Massachusetts school, immigrant generation, course-taking patterns, schooling experiences, and parent involvement. Although data on these additional variables are not currently collected by the Massachusetts Department of Elementary and Secondary Education, data could be collected through surveys and other qualitative methods.

APPENDIX A
RESEARCH ON HISPANIC STUDENTS' ACADEMIC ACHIEVEMENT

Hispanic or Latino students are students who identify themselves as Hispanic. The definition of Hispanic used by the Massachusetts Department of Elementary and Secondary Education is the same as that used by the U.S. government: "a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race" (Executive Office of the President of the United States 1997).[1] Hispanic students have a wide range of language proficiencies: they can be monolingual in English, have varying degrees of bilingualism, or have limited English proficiency. They also have a range of other characteristics, varying in their country of origin, first language, number of years and generations in the United States, socioeconomic status, and previous schooling. A Hispanic student's family may have come to the United States from a country that is not Spanish-speaking.

In recent years the proportion of public high school students who are Hispanic has risen. Hispanic students were 20 percent of public school students nationwide in 2006, up from 6 percent in 1972 and 11 percent in 1986—greater increases over time than for any other minority group (Planty et al. 2008). Meanwhile, the gap between Hispanic and White students in achievement on state assessments has persisted or widened (Kao and Thompson 2003; Llagas 2003; Reardon and Galindo 2007). And dropout rates for Hispanic students nationwide are twice those for non-Hispanic Whites (Fry 2003).[2]

Schools not only collect student performance data but also routinely collect extensive information on their students' demographic and other characteristics, interests, and attitudes. But analyses of such data are limited (Burstein 1984; Palaich, Good, and van der Ploeg 2004).

Studies disaggregating Hispanic student populations have found that Hispanic student achievement was associated with several student-level characteristics, including:

- Gender (Freeman 2004; McGraw, Lubienski, and Struchens 2006).
- Socioeconomic status (Battle and Pastrana 2007; Kao and Thompson 2003; Reardon and Galindo 2007; Warren 1996).
- English language proficiency status (Eamon 2005; Reardon and Galindo 2007; Rumberger and Larson 1998; Terwilliger and Magnuson 2005).
- Country of origin (Eamon 2005; Hernandez and Charney 1998; Kao and Tienda 1995; Leventhal, Xue, and Brooks-Gunn 2006; Reardon and Galindo 2007).

The relationship between gender and student achievement has received much attention and has been shown to be consistent across several studies. Female students achieve higher average scores than male students do in writing (Cole 1997; Freeman 2004) and in reading (Freeman 2004). But male students perform higher than female students do in mathematics (Freeman 2004). Two studies that disaggregate gender by race/ethnicity have shown that the male advantage in mathematics is sustained within the Hispanic student population, especially for students with higher socioeconomic status (Freeman 2004; McGraw, Lubienski, and Struchens 2006). However, one study found that gender differences did not have a statistically significant relationship to reading performance for Hispanic high school students (LoGerfo, Nichols, and Chaplin 2006).

Another student-level characteristic that has been found to predict academic achievement, including that of Hispanic students, is socioeconomic status. Typically measured using household income and parents' education levels (Sirin 2005; White 1982), it has been found a strong predictor of student-level achievement and an even stronger predictor of school-level achievement (Rumberger and

Palardy 2005; Sirin 2005). Sirin (2005) finds that socioeconomic status predicted achievement for minority students, though less strongly than it did for White students (the study, which reanalyzed 35 journal articles published between 1990 and 2000, did not disaggregate by minority groups). When data are disaggregated by racial/ethnic groups, Hispanic students' academic achievement is similar to that of White students with similar socioeconomic status (Battle and Pastrana 2007; Kao and Thompson 2003; Warren 1996).

English proficiency status has also been found to predict Hispanic students' academic achievement. Limited English proficient students have lower achievement in reading and mathematics than English proficient students do (Eamon 2005; Reardon and Galindo 2007; Terwilliger and Magnuson 2005). Strikingly, Hispanic students who start elementary school as limited English proficient, but reach proficiency in later years, perform higher—both in mathematics (Reardon and Galindo 2007) and in overall academic achievement, measured by grade point average (Rumberger and Larson 1998)—than do their Hispanic peers whose first language is English.

Several studies have examined country of origin as a characteristic related to Hispanic student achievement. Immigrant students' standardized test scores in vocabulary and reading generally are lower than those of their U.S.-born peers (Hernandez and Charney 1998; Kao and Tienda 1995; Leventhal, Xue, and Brooks-Gunn 2006). Disaggregating data by country of origin, Reardon and Galindo (2007) find heterogeneous mathematics proficiency rates for elementary school students with Hispanic national and regional origins. Among Hispanic subgroups, Cuban and South American students had the highest overall mathematics proficiency rates; Mexican and Central American students, including students from the Dominican Republic, had the lowest.

Fewer studies examine school-level characteristics than examine student-level characteristics. Stevens and Dial (1993) analyze the percentage of Hispanic students in a school—a characteristic considered in this study—in relation to Hispanic students' academic performance. Among other studies of relationships between student achievement and school-level characteristics, most consider all minority students, not just Hispanics or other racial/ethnic groups; such studies do not disaggregate by race/ethnicity, and they do not mention whether Hispanic students were considered in the composition of minority groups. Still, studies have examined the socioeconomic status of the school population (Rumberger and Palardy 2005; Sirin 2005), the percentage of special education students in a school (Kalambouka et al. 2007), the percentage of minority students in a school (Coleman 1966; Hess and Warden 1988; Rumberger and Willms 1992), the student–teacher ratio (Hanushek 2002; Krueger 2002; Ready 2008), and school size (McMillen 2004). Researchers found no studies examining the relationships between minority students' academic achievement and school attendance or dropout rates.

Research on school-level characteristics defined by a school's student population—for example, the percentage of a school's students who are from low-income households—has found a strong association between socioeconomic status and student achievement. Sirin (2005) finds that greater proportions of students eligible for free or reduced-price lunch in a school were associated with lower test scores for the school. One study of the proportion of special education students in a school and its statistical associations with student achievement found that students without special education needs did not perform lower when surrounded by students receiving special education services (Kalambouka et al. 2007). Although only one study, with null results, the study points to a variable that might be important to examine in relation to student performance.

Several studies, examining relationships between student outcomes and the percentage of Hispanic students in a school, have found that students in schools with higher percentages of minority students had lower achievement than students

in schools with lower percentages of minority students (Coleman 1966; Hess and Warden 1988; Rumberger and Willms 1992). Looking at this relationship within various minority groups, Stevens and Dial (1993) find that, in schools with higher Hispanic student populations, Hispanic students generally perform lower—especially in reading.

School size has received increasing attention over the past decade and a half (Stevenson 2006). Some studies find no significant relationship between school size and students' achievement in elementary and high school (Gardner 2001; Milesi and Gamoran 2006). However, other studies find that students in smaller elementary and high schools tend to perform higher (Caldas 1993; Fowler and Walberg 1991; Lee and Smith 1995; McMillen 2004). McMillen (2004) finds that academic achievement gaps among three racial/ethnic groups—White students, Black students, and other minority students—are wider in larger schools.

Evidence for the relationship between student academic achievement and class size, measured by the student–teacher ratio, is also inconsistent. Although Hanushek's (2002) meta-analysis finds the effect of class size is invariably small, Krueger (2002) reanalyzed Hanushek's data using a different technique and finds relationships between higher achievement and smaller class sizes. According to Rice (2002), Hanushek and Krueger agree that small class size can make a difference, especially for minority students and students with low socioeconomic status (both Hanushek and Krueger's meta-analyses used class-size studies that compared Black or Asian students with White students).

Researchers still need to clarify Hispanic students' achievement patterns by considering associations between such students' achievement and multiple, coexisting student- and school-level characteristics. This study takes a step in that direction.

APPENDIX B
STUDY METHODS

Descriptive analyses, inferential analyses, and multilevel modeling were used to answer the two research questions:

- How did the performance of grade 10 Hispanic students on the MCAS English language arts and mathematics tests over 2002/03–2005/06 compare with that of grade 10 non-Hispanic students?
- Among grade 10 Hispanic students, which student- and school-level characteristics were associated with performance on the MCAS English language arts and mathematics tests over 2002/03–2005/06?

The variables included student- and school-level characteristics as independent variables and test outcomes as the dependent variables.

Datasets used for the analyses

Student-level MCAS test performance data and background data for all grade 10 Hispanic students in Massachusetts were provided by the Office of Strategic Planning, Research, and Evaluation at the Massachusetts Department of Elementary and Secondary Education in July 2007. Publicly available school-level performance and background data on all high schools in Massachusetts for 2002/03–2005/06 were accessed through the Massachusetts Department of Elementary and Secondary Education web site (profiles.doe.mass.edu) and the U.S. Department of Education, National Center for Education Statistics (2006) Common Core of Data.

Massachusetts Department of Elementary and Secondary Education reporting code information for Hispanic students. Before 2005/06, in compliance with federal reporting guidelines, the Massachusetts Department of Elementary and Secondary Education collected data on students according to five racial/ethnic categories: American Indian or Alaskan Native, Asian or Pacific Islander, Black, White, and Hispanic. Each student self-identified with just one racial/ethnic category. In 2005/06 federal requirements changed to enable individuals to select one or more races and to consider race and Hispanic origin separately.

For this report the racial/ethnic coding from the years before 2005/06 was used to determine which students were Hispanic for all study years, including 2005/06. All students who identified themselves as Hispanic were coded as Hispanic regardless of race. All students who identified themselves as non-Hispanic were considered non-Hispanic regardless of race.

Student-level data. Student-level variables comprise academic performance variables (such as English language arts and mathematics raw scores) and student background variables (such as country of origin and low income). Such data were obtained for 2002/03, 2003/04, 2004/05, and 2005/06 for all grade 10 students in Massachusetts. They were gathered from the Office of Strategic Planning, Research, and Evaluation at the Massachusetts Department of Elementary and Secondary Education, which provided data for each school year examined from two datasets:

- The Student Information Management System (SIMS), which includes background data on all students attending public school or receiving public funds for education in Massachusetts.
- The Massachusetts Comprehensive Assessment System (MCAS), which includes data on state tests given annually to students in grades 3–8 and 10.

The student-level variables included in the analyses are listed in table B1.

School-level data. School-level data included information on each school (for example, locale) and its population (for example, percentage of students receiving special education services). Such data

TABLE B1
Student-level variables included in the multilevel regression modeling

Student Information Management System	Massachusetts Comprehensive Assessment System
• Race/ethnicity—Hispanic only • Gender • Socioeconomic status • Special education • First language • Country of origin	• English language arts test raw score • Mathematics test raw score • English proficiency status

Source: Authors' compilation based on information described in the text.

TABLE B2
School-level variables included in the multilevel regression modeling

Massachusetts Comprehensive Assessment System	National Center for Education Statistics Common Core of Data
• Percentage of Hispanic students • Percentage of students from low-income households[a] • Percentage of students in special education[b] • Percentage of limited English proficient students • Attendance rate • Dropout rate • Student–teacher ratio[b] • School size (full school student population)	• Geographic locale

a. Low income is defined as meeting any one of three criteria—eligible for free or reduced-price lunch, receiving Transitional Aid to Needy Families benefits, or eligible for food stamps—with the information being collected from students.

b. Data were not available for 2002/03 and so these variables were not included in analyses for that year.

Source: Authors' compilation based on information described in the text.

were obtained for 2002/03–2005/06 for all public schools in Massachusetts with grade 10 students that were not designated special education schools. These data were gathered from two sources:

- The Massachusetts Department of Elementary and Secondary Education web site, which contains publicly available school-level data on the Massachusetts Comprehensive Assessment System (MCAS) tests (profiles.doe.mass.edu).

- National Center for Education Statistics, whose Common Core of Data—a comprehensive, yearly, national database of all public elementary and secondary schools and districts, with comparable data across all states—contains geographic locale data for Massachusetts schools with grade 10 students (U.S. Department of Education, National Center for Education Statistics 2006).

School-level data were used for the multilevel modeling and to describe the student population of schools included in the multilevel modeling analyses. School-level variables used in these analyses are listed in table B2.

Definitions of variables used for the analyses

The Massachusetts Department of Elementary and Secondary Education requested that this study address all the characteristics listed as variables below and in tables B1 and B2. (Some of them, such as country of origin and first language, may overlap.) Multilevel modeling was used to measure the independent contribution of each variable.

Student-level variables—used in both descriptive and hierarchical linear modeling analyses—include:

- *Hispanic.* Whether a student is Hispanic, as self-described.

- *Gender.* Whether a student is male or female.

- *Low income.* Whether a student comes from a low-income household. Low income is defined as meeting any one of three criteria—eligible for free or reduced-price lunch, receiving Transitional Aid to Needy Families benefits, or eligible for food stamps—with the information being collected from students.

- *Special education.* Whether a student has received an individualized education program.

- *English proficiency.* Whether a student is English proficient, has been classified as limited English proficient, or is former limited English proficient (has tested out of the limited English proficient classification within the previous two years).

- *First language.* Students' self-reported first language. This study used four categories: English, Portuguese, Spanish, and other.[3]

- *Country of origin.* The country where a Hispanic student reports being born. This study used six categories: Brazil, Caribbean country, Central American country and Mexico, South American country other than Brazil, United States, and other country. Countries were categorized based on country location, except in the case of Brazil. (The Massachusetts Department of Elementary and Secondary Education asked the researchers to categorize students from Brazil separately to examine their performance patterns.) The countries in each subgroup are listed in table B3.

School-level variables—used in hierarchical linear modeling analyses—include:

- *Percentage of Hispanic students.* The percentage of Hispanic students in the school.

- *Percentage of students from low-income households.* The percentage of students from low-income households in the school.

TABLE B3
Categorization of country of origin variable

Country category	Country or countries of origin
Brazil	Brazil
Caribbean country	Antigua and Barbuda, Bahamas, Barbados, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Netherlands Antilles, Puerto Rico, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, Virgin Islands (U.K.)
Central American country and Mexico	Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama
South American country other than Brazil	Argentina, Bolivia, Chile, Columbia, Ecuador, Guyana, Paraguay, Peru, Uruguay, Venezuela
United States	United States
Other country	Afghanistan, Albania, Algeria, Andorra, Angola, Armenia, Australia, Austria, Azerbaijan, Bahrain, Bangladesh, Belarus, Bosnia and Herzegovina, Botswana, British Indian Ocean Territory, Bulgaria, Burkina Faso, Burma, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Central African Republic, China, Congo, Democratic Republic of Congo, Côte d'Ivoire, Croatia, Czech Republic, Denmark, Egypt, Eritrea, Estonia, Ethiopia, Fiji, Finland, France, The Gambia, Georgia, Germany, Ghana, Greece, Guinea, Guinea-Bissau, Hong Kong (China), India, Indonesia, Iran, Iraq, Ireland, Israel, Italy, Japan, Jordan, Kazakhstan, Kenya, Democratic People's Republic of Korea, Republic of Korea, Kuwait, Kyrgyzstan, Latvia, Lebanon, Liberia, Libya, Liechtenstein, Lithuania, Macedonia, Malaysia, Mali, Marshall Islands, Micronesia, Moldova, Mongolia, Morocco, Nepal, Netherlands, Nigeria, Norway, Pakistan, Papua New Guinea, Philippines, Poland, Portugal, Romania, Russian Federation, Rwanda, Samoa, Saudi Arabia, Senegal, Sierra Leone, Singapore, Slovakia, Solomon Islands, Somalia, South Africa, Spain, Sri Lanka, Sudan, Sweden, Switzerland, Syria, Taiwan (China), Tajikistan, Tanzania, Thailand, Togo, Turkey, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States Minor Outlying Islands, Uzbekistan, Vietnam, West Sahara, former Yugoslavia, Zambia, Zimbabwe

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007).

- *Percentage of students in special education.* The percentage of students with an individualized education program.

- *Percentage of limited English proficient students.* The percentage of limited English proficient students in the school.

- *Attendance rate.* The average percentage of days in attendance for students enrolled in all grades in a school.

- *Dropout rate.* The percentage of grade 9–12 students who left school before graduation for reasons other than transferring to another school and did not re-enroll before the following October 1.

- *Student–teacher ratio.* The ratio of the number of students enrolled on October 1 to the number of teachers in the school.

- *School size.* The number of students enrolled in the school.

- *School locale.* The National Center for Education Statistics uses two sets of locale categories: metrocentric categories, based on population alone, and urbancentric categories, defined by a combination of population and distance from an urban area. The metrocentric categories were used—because urbancentric categories were not available for all years—and were collapsed into three categories representing suburban, urban, and rural locales.

Although the multilevel modeling in this report examines outcomes for grade 10 Hispanic students, the school-level variables refer to all students in a school. For example, dropout rate is the school's overall dropout rate, not just the rate for grade 10 Hispanic students.

Outcome variables include:

- *MCAS scale scores, based on raw scores (used in the descriptive analysis).* Descriptive performance results for Hispanic and non-Hispanic students were reported as scale scores derived from raw scores. Raw scores were used to run the descriptives (for example, the average English language arts score for Hispanic students in 2003/04) and the *t*-tests (for example, in examining differences between Hispanic and non-Hispanic student performance). The average raw score was rounded to the nearest whole point, and the rounded number was converted to a scale score. Using the scale score allowed direct comparisons across the years. For example, if a mean English language arts raw score for Hispanic students in 2005/06 was 46.59, rounded to 47, the research team reported that the Hispanic students' average scale score was 234 in that year—the needs improvement performance level. (A justification of this approach, with raw to scale score conversion tables for each test and year, appears below.)

- *Standardized raw scores (used in hierarchical linear modeling analyses).* A standardized raw score is a raw score converted to a standardized score. Raw scores for this analysis were standardized around the minimum raw score required to achieve proficiency on each test for each year, rather than around the mean score (as are z-scores).

Why were raw assessment scores used as outcome variables, and how were the standardized raw scores calculated?

The performance variables examined in the descriptive analyses were raw English language arts and mathematics MCAS test scores. The performance variables employed in the multilevel modeling were standardized scores around the lowest raw score required to be considered proficient.

The Massachusetts Department of Elementary and Secondary Education requested that the researchers use raw scores rather than scale scores. For descriptive statistics, MCAS raw scores are a better measure of student performance than MCAS scale

scores. The scale scores, based on the raw scores and the results of a standard-setting process, are minimum scores for partial, solid, and sophisticated understanding of the curriculum frameworks for any grade-content standard (Massachusetts Department of Elementary and Secondary Education 2003, 2004a, 2005, 2006). But those minimum scores are based on four different linear equations, yielding substantially different intervals between the scores that bind different proficiency levels. For example, the interval, based on standard deviations, between the scale scores 220 and 240 (needs improvement) is similar to the interval between 240 and 260 (proficient)—but the interval between 200 and 220 (warning) is between three and four times as wide as the others.

For the descriptive analyses, therefore, raw scores were used rather than scale scores to report more accurate standard deviations. However, the corresponding scale scores were reported to give meaning to the average raw score calculations. For example, if the mean MCAS English language arts test raw score for grade 10 Hispanic students in 2002/03 was 35, this mean raw score was reported as the scale score to which it corresponds, or 218. Raw to scale score conversions for each year and test are in tables B4 and B5.

TABLE B4

Raw to scale score conversions for Massachusetts Comprehensive Assessment System English language arts test, 2002/03–2005/06

Raw scores				
2002/03	2003/04	2004/05	2005/06	Scale score
0–2	0–2	0–2	0	200
3–6	3–6	3–6	2–5	202
7–10	7–10	7–10	6–9	204
11–14	11–14	11–14	10–13	206
15–17	15–16	15–18	14–15	208
18–19	17–19	19–20	16–17	210
20–22	20–22	21–23	18–19	212
23–26	23–26	24–26	20–23	214
27–31	27–32	27–30	24–28	216
32–37	33–38	31–37	29–34	218
38–41	39–41	38–41	35–38	220
42	42–43	42	39	222
43	44	43	40–41	224
44	45	44	42	226
45–46	46	45	43–44	228
47	47	46–47	45	230
48	48	48	46	232
49	49–50	49	47–48	234
50	51	50	49	236
51	52	51	50	238
52	53	52	51–52	240
53	54	53–54	53	242
54	55	55	54–55	244

(CONTINUED)

TABLE B4 (CONTINUED)

Raw to scale score conversions for Massachusetts Comprehensive Assessment System English language arts test, 2002/03–2005/06

Raw scores				
2002/03	2003/04	2004/05	2005/06	Scale score
55	56	56	56	246
56	57	57	57	248
57	58	58	58	250
58	59	59	59	252
59	60	60	60	254
60	61	61	61	256
61	62	—	62	258
62	63	62	63	260
63	64	63	64	262
64	65	64	65	264
65	66	65	—	266
66	67	66	66	268
—	—	—	67	270
67	68	67	68	272
68	—	—	—	274
—	69	68	69	276
69	—	—	—	278
70–72	70–72	69–72	–72	280

— indicates no score at this level.

Source: Massachusetts Department of Elementary and Secondary Education 2003, 2004a, 2005, 2006.

TABLE B5

Raw to scale score conversions for Massachusetts Comprehensive Assessment System mathematics test, 2002/03–2005/06

Raw scores				
2002/03	2003/04	2004/05	2005/06	Scale score
0–1	0–1	0–1	0–1	200
2–3	2–3	2–3	2–3	202
4–5	4–6	4–5	4–5	204
6	7	6–7	6–7	206
7	8	8–9	8	210
8	9	10	9	212
9–10	10–12	11	10–11	214
11–13	13–15	12–13	12–14	216
14–18	16–20	14–18	15–19	218
19–21	21–24	19–22	20–22	220
22	25–26	23	23	222
23	27	24	24	224

(CONTINUED)

TABLE B5 (CONTINUED)

Raw to scale score conversions for Massachusetts Comprehensive Assessment System mathematics test, 2002/03–2005/06

Raw scores				
2002/03	2003/04	2004/05	2005/06	Scale score
24	28	25	25	226
25	29	26	26	228
26	30	27	27–28	230
27	31–32	28	29	232
28–29	33	29–30	30	234
30	34	31	31	236
31	35–36	32	32	238
32	37	33	33	240
33	38	34–35	34–35	242
34	39	36	36	244
35–36	40–41	37	37	246
37	42	38–39	38	248
38	43	40	39–40	250
39	44	41	41	252
40	45–46	42–43	42	254
41–42	47	44	43	256
43	48	45	44	258
44–45	49–50	46–48	45–47	260
46–48	51–52	49–51	48–50	262
49–51	53–54	52–53	51–52	264
53	55–56	54–55	53–54	266
54–55	57	56	55–56	268
56	58	57	57	270
57	—	58	58	272
—	59	—	—	274
58	—	59	59	276
—	—	—	—	278
59–60	60	60	60	280

— indicates no score at this level.

Source: Massachusetts Department of Elementary and Secondary Education 2003, 2004a, 2005, 2006.

Because the degree of difficulty for tests varied across years, the correspondence between raw scores and proficiency categories also varied. For example, the lowest raw score on the English language arts test that showed proficient performance differed from one year to the next (table B6). Because cross-year comparisons were desirable for the multilevel modeling, raw scores were converted into standardized scores around the minimum raw score required for proficiency. The standardized scores were then used as the outcome variable. In other words, all the intercepts of the models for both English language arts and mathematics texts are interpreted as estimates of the standard deviation difference in raw scores above or below the minimum raw score required

TABLE B6

Raw to scale score conversion for Massachusetts Comprehensive Assessment System English language arts and mathematics tests, by subject, performance level, and school year, 2002/03–2005/06

	Raw scores				
Subject and performance level	2002/03	2003/04	2004/05	2005/06	Scale scores
English language arts					
Warning	0–37	0–38	0–37	0–34	200–218
Needs improvement	38–51	39–52	38–51	35–50	220–238
Proficient	52–61	53–62	52–61	51–62	240–258
Advanced	62–72	63–72	62–72	63–72	260–280
Mathematics					
Warning	0–18	0–20	0–18	0–19	200–218
Needs improvement	19–31	21–36	19–32	20–32	220–238
Proficient	32–43	37–48	33–45	33–44	240–258
Advanced	44–60	49–60	46–60	45–60	260–280

Source: Massachusetts Department of Elementary and Secondary Education (2003, 2004a, 2005, 2006).

to achieve proficiency. The following formula was used to calculate the standardized scores:

$$\frac{\textit{Raw score} - \textit{minimum raw score required for proficiency}}{\textit{standard deviation of raw scores}}$$

Both the minimum raw score required for proficiency and the standard deviations of raw scores varied for each year of data and for each subject. Standard deviations were taken from MCAS technical reports for each year (Massachusetts Department of Elementary and Secondary Education 2003, 2004a, 2005, 2006).

Descriptive analyses

Descriptive analyses provided information on the MCAS test performance of Hispanic and non-Hispanic students. In addition, descriptive statistics for the student and school populations examined in the study were run for all student- and school-level variables.

For all discrete variables—that is, all student-level variables and school-level locale variables—descriptive data are presented as percentages (for example, percentage of Hispanic students who are male). For the remaining school-level variables—all continuous—descriptive analyses produced means, standard deviations, and ranges for Hispanic and non-Hispanic student populations.

Inferential analyses

To compare MCAS test performance by grade 10 Hispanic students and non-Hispanic students in Massachusetts, independent sample *t*-tests were used. The *t*-tests examined whether the average raw MCAS scores of Hispanic students differed statistically from those of non-Hispanic students in each year and whether significant improvements in scores were made over time. All *t*-tests were two-tailed, and statistically significant differences were defined by *p* values below .05.

Multilevel regression modeling was used to examine the association between student- and school-level variables and Hispanic students' performance on the MCAS for three reasons:

- Similar to traditional regression analyses, multilevel modeling enabled the relationship between the independent and dependent

variables to be examined while holding other variables in the model constant.

- Multilevel modeling enabled nested data to be taken into account. Because Hispanic students are nested within schools, a clustering effect could lead to correlated residuals among students from the same school. Multilevel regression modeling accounts for the correlated errors among individuals and produce unbiased estimates of the standard errors associated with the regression coefficients.

- Multilevel modeling enabled performance outcomes to be predicted for Hispanic students using the characteristics of individual Hispanic students as well as characteristics of the entire school population using a single model.

To explore whether there was a clustering effect for the outcome data (MCAS scores in English language arts and mathematics), the intraclass correlation coefficient was examined. That allowed estimation of the proportion of the total variability in the outcome variable between schools. In all cases there was a nonzero intraclass correlation coefficient—indicating a dependence among the standardized scores for students in the same school—so multilevel regression modeling was considered the most appropriate data analysis procedure.

All student- and school-level variables listed below were included in the models. Models were run separately for 2002/03, 2003/04, 2004/05, and 2005/06—four cohorts of students—and individually for English language arts and mathematics test performance, resulting in eight final models. All reported regression coefficients are significant at the 5 percent level.

Multilevel modeling procedures

Examining the proportion of total variability in students' standardized raw scores across schools—or the intraclass correlation coefficient—researchers found that for each school year examined, and for both English language arts and mathematics, the intraclass correlation coefficient was nonzero. That indicated a dependence among the standardized scores for students in the same school.

The intraclass correlation coefficients for English language arts were 0.17 for 2002/03, 0.16 for 2003/04, 0.21 for 2004/05, and 0.18 for 2005/06. The intraclass correlation coefficients for mathematics were 0.27 for 2002/03, 0.22 for 2003/04, 0.28 for 2004/05, and 0.24 for 2005/06. These intraclass correlation coefficients suggested the use of multilevel regression modeling to look for associations between student- and school-level characteristics and MCAS test performance.

A two-level modeling approach was adopted, with Hispanic students (level 1) modeled as nested within schools (level 2). After exploratory data analyses examined variability in the intercept and among the level 1 slopes, significant variability was found in the mean standardized raw score across schools (the level 1 intercept) in each school year and for both English language arts and mathematics. However, no significant variation was found in the level 1 slopes across schools. That is, relationships between the Hispanic students' background characteristics and their standardized raw scores did not vary significantly across schools. For that reason the level 1 slopes were fixed and an intercepts-only model was used to examine associations of interest.

The variables, taken from the Massachusetts Department of Elementary and Secondary Education SIMS and MCAS student and school data collection system, are listed in table 4 in the main report, which explains the coding of each. Much of the demographic information for students was in dichotomous variables (gender, socioeconomic status, and the like). Where data were categorical (for example, country of origin, first-language status), dummy variables were created to compare groups with nonimmigrant students whose first language was English. Several school-level variables were

rescaled to ease interpretation of regression coefficients: the percentage of Hispanic students, the percentage of students from low-income households, the percentage of special education students, the percentage of limited English proficient students, and school-size variables were rescaled by dividing by 100. This rescaling of the original variables is taken into account in interpreting the regression coefficients.

The multilevel models were constructed in two stages. Model 1 included only student-level characteristics at level 1. Model 2 included both student- and school-level characteristics. The level 1 variables, being dichotomous dummy variables, were entered into the model uncentered. At level 2 rescaled continuous variables were grand-mean centered, and the dichotomous variables were included uncentered. The final two-level regression model, model 2, took the following form:

$$
\begin{aligned}
Y_{ij} &= \beta_{0j} + \beta_{1j}(Gender)_{ij} + \beta_{2j}(Low-income)_{ij} \\
&\quad + \beta_{3j}(SPED)_{ij} + \beta_{4j}(LEP)_{ij} + \beta_{5j}(FLEP)_{ij} \\
&\quad + \beta_{6j}(Lang-Port)_{ij} + \beta_{7j}(Lang-Span)_{ij} \\
&\quad + \beta_{8j}(Lang-Other)_{ij} + \beta_{01j}(Country-Caribbean)_{ij} \\
&\quad + \beta_{9j}(Country-Mex\,\&\,CentralAm)_{ij} \\
&\quad + \beta_{1\,j}(Country-Brazil)_{ij} \\
&\quad + \beta_{12j}(Country-OtherSouthAm)_{ij} \\
&\quad + \beta_{13j}(Country-Other)_{ij} + r_{ij} \\
\beta_{0j} &= \gamma_{00} + \gamma_{01}(\%Hispanic)_j + \gamma_{02}(\%LEP)_j \\
&\quad + \gamma_{03}(\%Low-income)_j + \gamma_{04}(\%SPED)_j \\
&\quad + \gamma_{05}(Dropout)_j + \gamma_{06}(Attendance)_j \\
&\quad + \gamma_{07}(Student-teacher)_j \\
&\quad + \gamma_{08}(School-size)_j + \gamma_{09}(Locale-Urban)_j \\
&\quad + \gamma_{010}(Locale-Rural)_j + u_{0j} \\
\beta_{1\to13\,j} &= \gamma_{1\to13\;0}
\end{aligned}
$$

Model 2, the final model for each school year in each subject area (English language arts and mathematics), included both student- and school-level variables (see table 4 in the main report for variable coding). Model 2 accounted for more variance than model 1, which included only student-level variables. (The variance explained by models 1 and 2 is shown in the tables in appendix E.)

All models included the same student- and school-level variables for each year and each subject—except in 2002/03, when no data were available on the student–teacher ratio or the percentage of special education students in a school.

APPENDIX C
DATA REMOVAL PROCESS FOR THE DESCRIPTIVE ANALYSES AND MULTILEVEL REGRESSION MODELING

Separate datasets were used for the descriptive analyses and the multilevel regression modeling. The only difference between them was that the datasets used for multilevel regression modeling contained only Hispanic students. The data removal process produced clean datasets with no data missing for any variable.

Initial datasets used for descriptive analyses

For the descriptive analyses four datasets were prepared, one for each year. The student- and school-level data (described in appendix B) were merged into the four datasets. Data on students were then removed from those datasets for five reasons, in the following order:

- Missing student identification (not being included in a Student Information Management System file or a Massachusetts Comprehensive Assessment System student-level file).
- Missing English language arts or mathematics scale or raw score data.
- Missing classification information, such as special education status and limited English proficient status.
- Missing school-level data. (The majority of the schools without Massachusetts Department of Elementary and Secondary Education data were defined by the state as special education schools.)
- Attending a school that did not meet school inclusion criteria (for example, a middle school).

After these data were removed, six schools were missing attendance rates for 2002/03, and two schools were missing student–teacher ratios for 2004/05. Attendance rates and student–teacher ratios for these schools were imputed using stochastic regression (Little and Rubin 1987), an approach that estimates the missing values based on predicted values generated by a regression model plus a residual term to reflect uncertainty in the predicted values. Here the predicted values came from all other school-level variables (such as percent of limited English proficient students and geographic locale) that were in the dataset for the school year in question. As a check, the mean and standard deviations of the imputed missing values were compared with the attendance rate and student–teacher ratio means of the remaining schools. For 2002/03 attendance rates the nonimputed mean was 91.50 (5.07 standard deviations) and the imputed mean was 84.93 (7.10 standard deviations). For 2004/05 student–teacher ratios the nonimputed mean was 12.95 (2.92 standard deviations) and the imputed mean was 12.79 (0.37 standard deviation).

Table C1 contains data removal information for the descriptive analyses. Data were removed in the order in which the criteria are presented.

For each student-level variable data were compared for students removed and students included in the analyses. For each school-level variable data were compared for schools removed and schools included in the analyses. These comparisons revealed that the large percentage of removed data may have biased the findings. For example, removed students appear to have lower achievement than included students. However, since only a portion of the removed students and schools had data on any given variable or outcome measure, data presented in table C1 for removed students and schools do not fully represent the students and schools removed before the final analyses.

Information on all student-level variables, including the outcome measures (MCAS English language arts and mathematics scores), is shown in tables C2 and C3 for cases included in the final analyses and those removed before the final analyses. Between 15.7 percent and 17.9 percent of cases

TABLE C1
Data removal information for descriptive analysis, 2002/03–2005/06

Data element	2002/03	2003/04	2004/05	2006/07
Initial number of students	79,957	80,624	81,996	82,767
Missing student identification	519	537	27	129
Missing complete Student Information Management System (SIMS) data	3,368	2,630	2,565	2,186
Missing complete Massachusetts Comprehensive Assessment System (MCAS) data	7,633	7,921	6,794	5,384
Missing English language arts scale scores	2,131	2,449	2,597	3,741
Missing English language arts raw scores	6	54	25	0
Missing mathematics scale scores	100	2	85	1,014
Missing mathematics raw scores	0	0	1	0
Missing school-level data	557	571	802	780
Attended middle school	0	6	0	0
Number of students removed	14,314	14,170	12,896	13,234
Final number of students	65,643	66,454	69,100	69,533

Source: Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

were missing for each school year of data. Table C2 shows the percentages of included and removed cases for each student-level characteristic (male, limited English proficient, special education, and so forth) and the mean MCAS scores in English language arts and mathematics for included and removed cases. Since only a portion of the removed cases had data on any given variable or outcome measure, table C2 does not fully represent cases that were removed from the analyses.

The percentage of cases with the following characteristics were higher—by a statistically significant amount—for removed cases with available data than for included cases:

- Male.
- From a low-income household.
- In special education.
- Limited English proficient.
- Former limited English proficient.
- First language Spanish.

In addition, the percentage of cases with the characteristic U.S.-born was lower—by a statistically significant amount—for removed cases with available data than for included cases.

In each school year scores on both English language arts and mathematics tests were significantly lower—by at least 20 scale points—for removed students with available performance data than for students included in the analyses.

Tables C2 and C3 indicate that some biases may affect this report's findings. A more precise statement about biases could be made if more of the removed cases had available data.

Datasets used for multilevel linear modeling

The datasets for the multilevel regression modeling were subsets of the initial descriptive datasets for each year. The only difference was that multilevel modeling datasets contained only Hispanic students and corresponding school-level data.

TABLE C2

Student-level variables for included and removed cases with available data for Hispanic and non-HIspanic students used in descriptive analysis, 2002/03–2005/06

	2002/03		2003/04		2004/05		2005/06	
Variable	Included	Removed	Included	Removed	Included	Removed	Included	Removed
Gender[a]								
Number of observations	65,643	10,427	66,454	11,003	69,100	10,304	69,533	10,919
Female (percent)	49.89	40.39	50.22	41.41	49.87	40.86	49.92	41.45
Male (percent)	50.11	59.61	49.78	58.59	50.13	59.14	50.08	58.55
Socioeconomic status[a]								
Number of observations	65,643	10,427	66,454	11,003	69,100	10,304	69,533	1,0919
From a low-income household (percent)	20.38	32.11	20.86	36.78	22.71	39.83	23.50	41.52
Not from a low-income household (percent)	79.62	67.89	79.14	63.22	77.29	60.17	76.50	58.48
Special education status[a]								
Number of observations	65,643	10,427	66,454	11,003	69,100	10,304	69,533	10,919
In special education	13.55	32.80	13.30	34.38	14.30	38.12	14.27	37.25
Not in special education (percent)	86.45	67.20	86.70	65.62	85.70	61.88	85.73	62.75
English proficiency status[a]								
Number of observations	65,643	6,681[b]	66,454	6,223[b]	69,100	6,102[b]	69,533	7,617[b]
English proficient (percent)	93.70	90.76	94.10	83.46	95.07	86.87	95.43	86.66
Limited English proficient (percent)	4.67	6.93	3.42	12.52	2.93	10.49	2.79	10.99
Former limited English proficient (percent)	1.63	2.33	2.48	3.50	1.99	2.64	1.77	2.35
First language[a]								
Number of observations	65,643	10,427	66,454	11,003	69,100	10,304	69,533	10,919
English (percent)	86.85	79.54	87.92	76.18	87.28	74.61	87.02	73.92
Portuguese (percent)	1.47	3.14	1.25	3.14	1.29	3.03	1.30	3.21
Spanish (percent)	5.52	10.79	5.49	13.56	5.83	14.93	6.07	15.26
All other languages (percent)	6.16	6.53	5.35	7.13	5.61	7.43	5.61	7.61
Country of origin[a]								
Number of observations	65,643	10,427	66,454	11,003	69,100	10,304	69,533	10,919
Brazil (percent)	0.38	1.28	0.34	1.12	0.27	0.77	0.16	1.84
Caribbean country	0.68	1.40	0.56	1.84	0.49	1.48	0.42	2.05
Central American country or Mexico (percent)	0.25	0.59	0.27	1.06	0.22	1.37	0.25	1.65

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TABLE C2 (CONTINUED)

Student-level variables for included and removed cases with available data for Hispanic and non-HIspanic students used in descriptive analysis, 2002/03–2005/06

	2002/03		2003/04		2004/05		2005/06	
Variable	Included	Removed	Included	Removed	Included	Removed	Included	Removed
Other South America (percent)	0.19	0.34	0.14	0.55	0.12	0.33	0.10	0.41
United States (percent)	97.16	94.14	97.57	92.96	97.78	93.70	97.99	93.33
All other countries (percent)	1.34	2.26	1.12	2.48	1.12	2.35	1.08	3.61
English language arts score[c]								
Number of observations	65,643	4,205	66,464	4,388	69,100	4,088	69,533	3,828
Raw score *(standard deviation)*	52.44 *(11.35)*	36.91 *(17.49)*	53.88 *(10.70)*	34.85 *(17.38)*	53.51 *(10.96)*	32.38 *(19.42)*	53.94 *(9.56)*	40.52 *(15.29)*
Converted scale score	240	218	242	218	242	218	244	224
Math score[c]								
Number of observations	65,643	3,975	66,464	3,874	69,100	3,441	69,533	3,265
Raw score *(standard deviation)*	32.45 *(13.78)*	19.71 *(14.21)*	38.76 *(14.04)*	23.96 *(15.22)*	37.48 *(14.60)*	21.73 *(15.90)*	39.22 *(13.65)*	25.45 *(14.75)*
Converted scale score	240	220	244	216	246	218	250	226

Note: Numbers of observations are numbers of removed students with available data (not total numbers of students removed). Percentages may not sum to 100 because of rounding.

a. Significant differences are suggested for all school years examined at the 0.1 percent level using X^2 analyses (see table C3 for statistic reports).

b. Numbers are lower than for other student-level variables because data are from a different source.

c. Significant differences are suggested for all school years examined at the 0.1 percent level using *t*-tests (see table C5 for statistic reports).

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007); U.S. Department of Education, National Center for Education Statistics (2006).

TABLE C3

Significance values for comparing student-level characteristics of included and removed students with available data, all students, 2002/03–2005/06

Student information	2002/03	2003/04	2004/05	2005/06
Student-level characteristic (X^2)				
Gender	325.25	293.19	293.40	270.94
Socioeconomic status	722.29	1,346.83	1,403.43	1,596.26
Special education status	2,458.21	3,074.27	3,543.78	3,466.68
English proficiency status	85.46	1,240.54	952.98	1,347.63
First language	604.23	1,353.36	1,458.30	1,564.32
Country of origin	309.43	724.15	681.39	965.88
Massachusetts Comprehensive Assessment System test score (*t*-value)				
English language arts score	$t(69,846) = 82.61$	$t(70,840) = 108.73$	$t(73,186) = 113.18$	$t(73,359) = 81.35$
Mathematics score	$t(69,616) = 56.53$	$t(70,326) = 63.47$	$t(72,539) = 61.46$	$t(72,796) = 56.12$

Note: All values are significant at the 0.1 percent level.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007).

All school-level information refers to all students in a school, not just Hispanic students (for example, the percentage of students from low-income households is the percentage of such students in an entire school population, not just in the Hispanic student population). Table C4 contains data removal information for the multilevel modeling datasets for each year. Data removal began with the final dataset used for the descriptive analyses (so that the initial numbers of students in table C2 equal the final numbers of students in table C1). At that point all non-Hispanic students were removed from the dataset.

Whereas removed cases were described for the entire population of students in table C2, tables C5 and C6 describe the characteristics of Hispanic students who were included and those who were removed from the multilevel analyses. Table C5 shows the percentages of included and removed cases for each student-level characteristic (gender, special education status, English proficiency status, and the like)

TABLE C4

Multilevel modeling data removal information, 2002/03–2005/06

Student- and school-level data	2002/03	2003/04	2004/05	2005/06
Student-level data				
Initial number of students	65,643	66,454	69,100	69,533
Students removed for being non-Hispanic	59,726	60,498	62,452	62,139
Final number of Hispanic students	5,917	5,956	6,648	7,394
School-level data				
Initial number of schools with Hispanic students	330	347	367	393
Schools removed[a]	53	51	61	76
Final number of schools with Hispanic students	277	296	306	317

a. Removed because all Hispanic students were removed (for one of the reasons listed in table C1) or because no school-level data were available (also described in table C1).

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007); U.S. Department of Education, National Center for Education Statistics (2006).

TABLE C5

Student-level variables for included and removed cases with available data for Hispanic students used in multilevel analysis, 2002/03–2005/06

	2002/03		2003/04		2004/05		2005/06	
Variable	Included	Removed	Included	Removed	Included	Removed	Included	Removed
Gender[a]								
Number of observations	5,917	2,045	5,956	2,529	6,648	2,400	7,394	2,800
Female (percent)	50.74	42.44	50.64	44.21	50.71	40.88	50.55	43.07
Male (percent)	49.26	57.56	49.60	55.79	49.29	59.13	49.45	56.93
Socioeconomic status								
Number of observations[a]	5,917	2,045	5,956	2,529	6,648	2,400	7,394	2,800
From low-income household (percent)	66.27	53.74	67.56	57.02	69.42	61.17	67.58	61.36
Not from low-income household (percent)	33.73	46.26	32.44	42.98	30.58	38.83	32.42	38.64
Special education status[a]								
Number of observations	5,917	2,045	5,956	2,529	6,648	2,400	7,394	2,800
In special education	15.67	25.67	15.68	25.58	18.01	28.63	16.82	29.21
Not in special education (percent)	84.33	74.33	84.32	74.42	81.99	71.38	83.18	70.79
English proficiency status[a]								
Number of observations	5,917	507[b]	5,956	657[b]	6,648	766[b]	7,394	1,355[b]
English proficient (percent)	69.12	64.10	69.36	50.68	74.65	55.35	78.27	66.49
Limited English proficient (percent)	23.29	28.01	18.52	36.68	15.48	37.86	13.73	26.64
Former limited English proficient (percent)	7.59	7.89	12.14	12.63	9.87	6.79	8.01	6.86
First language[c]								
Number of observations	5,917	2,045	5,956	2,529	6,648	2,400	7,394	2,800
English (percent)	37.06	42.49	37.39	38.28	37.52	33.08	40.68	36.68
Portuguese (percent)	3.04	3.33	3.02	3.76	3.01	3.17	2.95	4.57
Spanish (percent)	59.19	53.79	59.12	57.53	58.89	63.08	55.44	57.54
All other languages (percent)	70.98	39.11	0.47	0.43	0.59	0.67	0.93	1.21
Country of origin[d]								
Number of observations	5,917	2,045	5,956	2,529	6,648	2,400	7,394	2,800
Brazil (percent)	1.30	1.42	1.41	1.70	0.87	1.00	0.54	2.11
Caribbean country	3.21	3.47	3.06	4.74	2.48	4.38	2.22	3.46
Central American country or Mexico (percent)	2.65	2.98	2.92	4.55	2.20	5.79	2.25	4.39

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TABLE C5 (CONTINUED)

Student-level variables for included and removed cases with available data for Hispanic students used in multilevel analysis, 2002/03–2005/06

	2002/03		2003/04		2004/05		2005/06	
Variable	Included	Removed	Included	Removed	Included	Removed	Included	Removed
South American country other than Brazil (percent)	1.96	1.52	1.39	2.10	1.16	1.38	0.95	0.93
United States (percent)	90.67	90.42	91.07	86.71	93.19	87.25	93.86	88.96
All other countries (percent)	0.20	0.20	0.15	0.20	0.11	0.21	0.19	0.14
English language arts score[a]								
Number of observations	5,917	190	5,956	354	6,648	390	7,394	515
Raw score *(standard deviation)*	42.17 *(13.84)*	21.06 *(13.55)*	44.28 *(13.15)*	21.62 *(12.85)*	44.21 *(13.32)*	19.84 *(14.38)*	46.59 *(11.54)*	32.70 *(15.06)*
Converted scale score	222	212	224	212	224	212	230	218
Math score[a]								
Number of observations	5,917	186	5,956	305	6,648	310	7,394	368
Raw score (standard deviation)	21.99 *(12.30)*	10.08 *(8.85)*	27.74 *(13.69)*	16.92 *(12.06)*	26.03 *(13.67)*	14.80 *(10.75)*	29.20 *(13.57)*	19.92 *(12.39)*
Converted scale score	222	214	226	218	228	218	232	220

Note: Numbers of observations for removed students are numbers of removed students with available data (not total numbers of students removed).

a. Differences for all school years examined are significant at the 0.1 percent level using X^2 and *t*-test analyses (see table C6 for statistic reports).

b. Numbers are lower than for other student-level variables because the English proficiency data came from a different source.

c. Differences and significance levels for 2002/03, 2004/05, and 2005/06 using X^2 analyses are shown in table C6.

d. Differences and significance levels for 2003/04, 2004/05, and 2005/06 using X^2 analyses are shown in table C6.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

TABLE C6

Significance values for comparing characteristics of included and removed cases with available data for Hispanic students, 2002/03–2005/06

Hispanic student information	2002/03	2003/04	2004/05	2005/06
Student-level characteristic (X^2)				
Gender	41.8***	29.4***	68.3***	45.5***
Socioeconomic status	102.4***	86.1***	54.5***	35.0***
Special education status	102.0***	114.8***	120.6***	193.2***
English proficiency status	6.2*	127.0***	235.4***	144.1***
First language	22.2***	4.1	15.0**	27.2***
Country of origin	2.8	38.5***	102.7***	102.2***
Massachusetts Comprehensive Assessment System test score (*t*-value)				
English language arts score	$t(6,105) = 20.7$***	$t(6,308) = 31.5$***	$t(7,036) = 35.0$***	$t(7,907) = 25.8$
Mathematics score	$t(6,101) = 13.1$***	$t(6,259) = 13.5$***	$t(76,956) = 14.3$***	$t(7,760) = 12.9$

* Significant at the 5 percent level; ** significant at the 1 percent level; *** significant at the 0.1 percent level.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007).

and the mean MCAS scores in English language arts and mathematics for included and removed cases. Because only a portion of the removed cases had data on any given variable or outcome measure, table C5 does not fully represent Hispanic students who were removed from the analyses.

Included schools had higher percentages of U.S.-born students than did removed schools with available data. Removed schools with available data had higher percentages of male students, students from low-income households, students in special education, limited English proficient students, formerly limited English proficient students, and students whose first language was Spanish than included schools did. In all years students at removed schools with available data scored significantly lower—by at least 8 scale points—on both the English language arts and mathematics tests than did students at included schools.

Tables C5 and C6 indicate that some biases may affect this report's findings. A more precise statement about biases could be made if more of the removed cases had available data.

Information on the school-level variables included in the multilevel model is shown in tables C7–C10 for schools with Hispanic students that were included in the analyses and for those that were removed from the analyses. The removed schools with grade 10 Hispanic students generally had higher percentages of high-need students (such as Hispanic students, students from low-income households, students in special education, and limited English proficient students) than the included schools with grade 10 Hispanic students did, and they were smaller. In addition, the removed schools with Hispanic students had higher dropout rates in 2002/03 and 2003/04 and lower attendance rates in all school years except 2004/05 than their included counterparts did. But information for schools removed from the analyses is limited. Most of these schools were removed because school-level data were missing from the Massachusetts Department of Elementary and Secondary Education web site. Therefore, whether the differences in characteristics were statistically significant could not ascertained.

The information in tables C7–C10 indicates that some biases may affect this report's findings. However, since only a portion of the removed cases had data on any given variable or outcome measure, the data presented in the table for removed schools do not fully represent the students or schools that were removed before the final analyses.

TABLE C7

School-level variables for included and removed schools with available data, 2002/03

	Included			Removed		
Variable	Number of observations	Mean	Standard deviation	Number of observations[a]	Mean	Standard deviation
Percentage of Hispanic students	277	10.33	15.47	6	16.15	19.24
Percentage of students from low-income households	277	22.95	23.58	6	39.48	33.67
Percentage of students in special education	—	—	—	—	—	—
Percentage of limited English proficient students	277	3.54	6.07	6	8.03	13.61
Attendance rate (percent)	277	91.67	4.99	6	82.68	12.65
Dropout rate (percent)	277	4.47	8.33	6	25.95	49.58
Student–teacher ratio	—	—	—	—	—	—
School size (number of students)	277	966.45	570.50	6	390.17	422.43
Locale						
Percentage of rural schools		17			10	
Percentage of suburban schools		55			70	
Percentage of urban schools		27			20	

— is not available.

Note: Percentages may not sum to 100 because of rounding.

a. Data for removed schools are very limited; for most of them, school-level data were missing from the Massachusetts Department of Elementary and Secondary Education web site. Therefore, numbers of observations are numbers of removed schools with available data—not total numbers of schools removed.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

TABLE C8

School-level variables for included and removed schools with available data, 2003/04

	Included			Removed		
Variable	Number of observations	Mean	Standard deviation	Number of observations[a]	Mean	Standard deviation
Percentage of Hispanic students	296	10.86	15.44	7	18.23	28.39
Percentage of students from low-income households	296	26.42	25.44	7	34.86	32.26
Percentage of students in special education	296	17.43	15.64	7	38.74	41.87
Percentage of limited English proficient students	296	3.61	8.12	7	5.46	10.99
Attendance rate (percent)	296	91.29	5.60	7	89.89	5.23
Dropout rate (percent)	296	5.07	8.06	6	16.93	35.29
Student–teacher ratio	296	13.35	3.30	7	10.17	2.84
School size (number of students)	296	942.84	595.61	7	291.57	247.15
Locale						
Percentage of rural schools		18			10	
Percentage of suburban schools		54			40	
Percentage of urban schools		29			50	

— is not available.

Note: Percentages may not sum to 100 because of rounding.

a. Data for removed schools are very limited; for most of them, school-level data were missing from the Massachusetts Department of Elementary and Secondary Education web site. Therefore, numbers of observations are numbers of removed schools with available data—not total numbers of schools removed.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

TABLE C9

School-level variables for included and removed schools with available data, 2004/05

	Included			Removed		
Variable	Number of observations	Mean	Standard deviation	Number of observations[a]	Mean	Standard deviation
Percentage of Hispanic students	306	11.05	15.63	6	9.10	18.75
Percentage of students from low-income households	306	26.67	25.37	6	21.68	20.74
Percentage of students in special education	306	16.67	0.13	6	16.40	7.18
Percentage of limited English proficient students	306	3.04	7.40	6	4.83	11.60
Attendance rate (percent)	306	91.68	5.93	6	94.12	0.52
Dropout rate (percent)	306	5.62	10.82	5	2.62	2.23
Student–teacher ratio	306	12.95	2.91	6	10.82	1.35
School size (number of students)	306	947.88	591.36	6	534.67	142.10
Locale						
Percentage of rural schools		17			17	
Percentage of suburban schools		56			50	
Percentage of urban schools		28			33	

— is not available.

Note: Percentages may not sum to 100 because of rounding.

a. Data for removed schools are very limited; for most of them, school-level data were missing from the Massachusetts Department of Elementary and Secondary Education web site. Therefore, numbers of observations are numbers of removed schools with available data—not total numbers of schools removed.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

TABLE C10

School-level variables for included and removed schools with available data, 2005/06

	Included			Removed		
Variable	Number of observations	Mean	Standard deviation	Number of observations[a]	Mean	Standard deviation
Percentage of Hispanic students	317	11.84	15.36	10	17.26	0.23
Percentage of students from low-income households	317	27.58	25.26	10	43.02	30.29
Percentage of students in special education	317	17.12	13.62	10	49.44	43.13
Percentage of limited English proficient students	317	3.07	7.04	10	1.16	1.39
Attendance rate (percent)	317	92.00	5.24	10	88.16	10.18
Dropout rate (percent)	317	5.05	9.67	8	3.88	12.44
Student–teacher ratio	317	13.19	4.09	10	9.28	3.40
School size (number of students)	317	937.78	586.05	10	274.20	240.08
Locale						
Percentage of rural schools		19			20	
Percentage of suburban schools		53			60	
Percentage of urban schools		29			20	

— is not available.

Note: Percentages may not sum to 100 because of rounding.

a. Data for removed schools are very limited; for most of them, school-level data were missing from the Massachusetts Department of Elementary and Secondary Education web site. Therefore, numbers of observations are numbers of removed schools with available data—not total numbers of schools removed.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

APPENDIX D
CHARACTERISTICS OF GRADE 10 HISPANIC AND NON-HISPANIC STUDENTS IN MASSACHUSETTS, 2002/03–2005/06

TABLE D1

Characteristics of grade 10 Hispanic and non-Hispanic students in Massachusetts, 2002/03–2005/06 (percent, unless otherwise indicated)

	2002/03 (n = 65,643)		2003/04 (n = 66,454)		2004/05 (n = 69,106)		2005/06 (n = 69,533)	
Student characteristic	Hispanic students	Non-Hispanic students	Hispanic students	Non-Hispanic students	Hispanic students	Non-Hispanic students	Hispanic students	Non-Hispanic students
Number of students	5,917	59,726	5,956	60,498	6,648	62,452	7,394	62,139
Gender								
Female	50.7	49.8	50.6	50.2	50.7	49.8	50.6	49.8
Male	49.3	50.2	49.4	49.8	49.3	50.2	49.4	50.2
Socioeconomic status								
From low-income household	66.3	15.8	67.6	16.3	69.4	17.7	67.6	18.3
Not from low-income household	33.7	84.2	32.4	83.7	30.6	82.3	32.4	81.7
Special education status								
In special education	15.7	13.3	15.7	13.1	18.0	13.9	16.8	14.0
Not in special education	84.3	86.7	84.3	86.9	82.0	86.1	83.2	86.0
English proficiency status								
English proficient	69.2	96.1	69.4	96.5	74.7	97.2	78.3	97.9
Limited English proficient	23.2	2.8	18.5	1.9	15.5	1.6	8.0	1.5
Former limited English proficient[a]	7.6	1.0	12.1	1.5	9.9	1.2	8.0	1.0
First language								
English	37.1	91.8	37.4	92.9	37.5	92.8	40.7	92.5
Portuguese	3.0	1.3	3.0	1.1	3.0	1.1	2.9	1.1
Spanish	59.2	0.2	59.1	0.2	58.9	0.2	55.4	0.2
Other	0.7	6.7	0.5	5.8	0.6	6.1	0.9	6.2
Country of origin								
Brazil	1.3	0.3	1.4	0.2	0.9	0.2	0.5	0.1
Caribbean country	3.2	0.4	3.1	0.3	2.5	0.3	2.2	0.2
Central American country or Mexico	2.7	0.0	2.9	0.0	2.2	0.0	2.2	0.0
South American country other than Brazil	2.0	0.0	1.4	0.0	1.2	0.0	0.9	0.0
United States	90.7	97.8	91.1	98.2	93.2	98.3	93.9	98.9
Other country	0.2	1.5	0.2	1.2	0.1	1.2	0.2	1.2

a. Students newly categorized as English proficient during the previous two years.

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

APPENDIX E
MULTILEVEL REGRESSION MODELING RESULTS

TABLE E1

Multilevel model results for Hispanic students on the Massachusetts Comprehensive Assessment System English language arts test, 2002/03 (n = 5,917)

	Unconditional model			Model 1			Model 2		
Statistic and variable	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level
Intercept	–0.641	0.049	0.000	–0.368	0.066	0.000	–0.509	0.091	0.000
Student-level variable									
Gender				0.187	0.030	0.000	0.184	0.030	0.000
From low-income household				–0.252	0.034	0.000	–0.227	0.035	0.000
In special education				–1.025	0.043	0.000	–1.029	0.043	0.000
Limited English proficient				–1.002	0.051	0.000	–0.998	0.051	0.000
Former limited English proficient				–0.413	0.060	0.000	–0.415	0.060	0.000
First language Portuguese				–0.176	0.124	0.155	–0.227	0.122	0.064
First language Spanish				–0.085	0.040	0.036	–0.080	0.040	0.045
First language other				0.212	0.193	0.272	0.217	0.192	0.258
Immigrant from Brazil				–0.271	0.182	0.136	–0.289	0.179	0.107
Immigrant from Caribbean				–0.787	0.091	0.000	–0.790	0.091	0.000
Immigrant from Central American country or Mexico				–0.893	0.102	0.000	–0.894	0.102	0.000
Immigrant from South American country other than Brazil				–0.156	0.113	0.168	–0.165	0.113	0.145
Immigrant from all other countries				–0.702	0.353	0.047	–0.725	0.352	0.040
School-level variable									
Percentage of Hispanic students							–0.121	0.028	0.000
Percentage of students from low-income households							0.024	0.027	0.384
Percentage of limited English proficient students							0.196	0.052	0.000
Attendance rate							0.053	0.010	0.000
Dropout rate							–0.005	0.006	0.426
School size							–0.005	0.005	0.332
Rural locale							–0.151	0.109	0.169
Urban locale							–0.107	0.093	0.249
Variance	Existing variance (r^2)			Variance (r^2) explained					
Within-school variance (percent)	82								
Between-school variance (percent)	18								
Total variance (percent)				17.6			30.1		

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

TABLE E2

Multilevel model results for Hispanic students on the Massachusetts Comprehensive Assessment System mathematics test, 2002/03 (n = 5,917)

Statistic and variable	Unconditional model			Model 1			Model 2		
	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level
Intercept	–0.505	0.037	0.000	–0.191	0.049	0.000	–0.326	0.085	0.000
Student-level variable									
Gender				–0.071	0.021	0.001	–0.073	0.021	0.000
From low-income household				–0.080	0.024	0.001	–0.066	0.024	0.005
In special education				–0.573	0.030	0.000	–0.576	0.030	0.000
Limited English proficient				–0.322	0.035	0.000	–0.322	0.035	0.000
Former limited English proficient				–0.183	0.041	0.000	–0.184	0.041	0.000
First language Portuguese				–0.056	0.085	0.513	–0.072	0.085	0.400
First language Spanish				–0.021	0.028	0.457	–0.016	0.028	0.570
First language other				0.266	0.133	0.045	0.271	0.132	0.041
Immigrant from Brazil				0.087	0.126	0.491	0.080	0.125	0.522
Immigrant from Caribbean				–0.196	0.062	0.002	–0.198	0.062	0.001
Immigrant from Central American country or Mexico				-0.279	0.070	0.000	–0.280	0.070	0.000
Immigrant from South American country other than Brazil				0.196	0.078	0.012	0.191	0.078	0.014
Immigrant from all other countries				–0.129	0.241	0.593	–0.136	0.241	0.574
School-level variable									
Percentage of Hispanic students							–0.091	0.029	0.002
Percentage of students from low-income households							0.005	0.026	0.849
Percentage of limited English proficient students							0.147	0.053	0.006
Attendance rate							0.032	0.010	0.001
Dropout rate							–0.001	0.006	0.839
School size							–0.004	0.005	0.470
Rural locale							–0.071	0.093	0.450
Urban locale							–0.033	0.096	0.734

Variance	Existing variance (r^2)	Variance (r^2) explained	
Within-school variance (percent)	72.9		
Between-school variance (percent)	27.1		
Total variance (percent)	100.0	6.1	16.9

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

TABLE E3

Multilevel model results for Hispanic students on the Massachusetts Comprehensive Assessment System English language arts test, 2003/04 (n = 5,956)

Statistic and variable	Unconditional model			Model 1			Model 2		
	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level
Intercept	–0.562	0.044	0.000	–0.112	0.045	0.014	–0.337	0.080	0.000
Student-level variable									
Gender				0.118	0.029	0.000	0.113	0.029	0.000
From low-income household				–0.161	0.033	0.000	–0.136	0.033	0.000
In special education				–1.218	0.042	0.000	–1.200	0.042	0.000
Limited English proficient				–1.303	0.050	0.000	–1.294	0.049	0.000
Former limited English proficient				–0.500	0.050	0.000	–0.491	0.050	0.000
First language Portuguese				0.142	0.125	0.256	0.106	0.124	0.393
First language Spanish				0.029	0.039	0.450	0.040	0.039	0.301
First language other				0.039	0.216	0.856	0.027	0.214	0.899
Immigrant from Brazil				–0.586	0.097	0.000	–0.592	0.096	0.000
Immigrant from Caribbean				–0.400	0.090	0.000	–0.398	0.090	0.000
Immigrant from Central American country or Mexico				0.003	0.175	0.987	0.002	0.173	0.992
Immigrant from South American country other than Brazil				0.085	0.128	0.507	0.076	0.127	0.552
Immigrant from all other countries				–0.768	0.373	0.040	–0.743	0.372	0.046
School-level variable									
Percentage of Hispanic students							–0.095	0.030	0.002
Percentage of students from low-income households							0.022	0.027	0.427
Percentage of students in special education							–0.030	0.031	0.336
Percentage of limited English proficient students							0.056	0.047	0.233
Attendance rate							0.035	0.012	0.004
Dropout rate							–0.011	0.009	0.192
Student-teacher ratio							0.026	0.011	0.014
School size							–0.009	0.005	0.064
Rural locale							–0.026	0.096	0.782
Urban locale							0.084	0.101	0.404

Variance	Existing variance (r^2)	Variance (r^2) explained	
Within-school variance (percent)	84.1		
Between-school variance (percent)	15.9		
Total variance (percent)	100.0	21.8	32.0

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

TABLE E4

Multilevel model results for Hispanic students on the Massachusetts Comprehensive Assessment System mathematics test, 2003/04 (n = 5,956)

Statistic and variable	Unconditional model			Model 1			Model 2		
	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level
Intercept	–0.415	0.036	0.000	–0.123	0.039	0.002	–0.245	0.075	0.001
Student-level variable									
Gender				–0.058	0.022	0.009	–0.061	0.022	0.006
From low-income household				–0.096	0.026	0.000	–0.080	0.026	0.002
In special education				–0.727	0.032	0.000	–0.714	0.032	0.000
Limited English proficient				–0.590	0.038	0.000	–0.587	0.038	0.000
Former limited English proficient				–0.237	0.039	0.000	–0.232	0.039	0.000
First language Portuguese				0.085	0.097	0.382	0.068	0.097	0.479
First language Spanish				–0.011	0.030	0.709	–0.005	0.030	0.858
First language other				0.221	0.167	0.184	0.209	0.166	0.207
Immigrant from Brazil				0.141	0.136	0.300	0.149	0.135	0.270
Immigrant from Caribbean				0.041	0.069	0.550	0.044	0.069	0.529
Immigrant from Central American country or Mexico				–0.123	0.075	0.098	–0.123	0.074	0.097
Immigrant from South American country other than Brazil				0.376	0.099	0.000	0.370	0.098	0.000
Immigrant from all other countries				–0.040	0.288	0.890	–0.042	0.287	0.885
School-level variable									
Percentage of Hispanic students							–0.073	0.028	0.011
Percentage of students from low-income households							0.021	0.025	0.402
Percentage of students in special education							0.003	0.027	0.902
Percentage of limited English proficient students							0.031	0.042	0.455
Attendance rate							0.023	0.011	0.034
Dropout rate							–0.014	0.008	0.071
Student-teacher ratio							0.040	0.010	0.000
School size							–0.007	0.005	0.136
Rural locale							–0.019	0.088	0.830
Urban locale							–0.100	0.090	0.269

Variance	Existing variance (r^2)	Variance (r^2) explained	
Within-school variance (percent)	77.5		
Between-school variance (percent)	22.5		
Total variance (percent)	100.0	9.7	21.4

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

TABLE E5

Multilevel model results for Hispanic students on the Massachusetts Comprehensive Assessment System English language arts test, 2004/05 (n = 6,648)

Statistic and variable	Unconditional model			Model 1			Model 2		
	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level
Intercept	–0.485	0.048	0.000	–0.074	0.046	0.107	–0.309	0.069	0.000
Student-level variable									
Gender				0.185	0.027	0.000	0.177	0.027	0.000
From low-income household				–0.233	0.032	0.000	–0.204	0.032	0.000
In special education				–1.009	0.037	0.000	–0.993	0.037	0.000
Limited English proficient				–1.320	0.047	0.000	–1.311	0.047	0.000
Former limited English proficient				–0.493	0.049	0.000	–0.482	0.048	0.000
First language Portuguese				0.200	0.102	0.049	0.176	0.099	0.076
First language Spanish				–0.029	0.036	0.415	–0.013	0.035	0.723
First language other				0.092	0.183	0.617	0.103	0.181	0.570
Immigrant from Brazil				–0.130	0.170	0.445	–0.162	0.167	0.334
Immigrant from Caribbean				–0.361	0.094	0.000	–0.357	0.093	0.000
Immigrant from Central American country or Mexico				–0.570	0.100	0.000	–0.581	0.100	0.000
Immigrant from South American country other than Brazil				0.285	0.130	0.028	0.271	0.129	0.036
Immigrant from all other countries				–0.256	0.430	0.552	–0.363	0.423	0.390
School-level variable									
Percentage of Hispanic students							–0.017	0.026	0.513
Percentage of students from low-income households							–0.026	0.023	0.270
Percentage of students in special education							–0.100	0.033	0.003
Percentage of limited English proficient students							–0.020	0.036	0.585
Attendance rate							0.050	0.009	0.000
Dropout rate							–0.009	0.005	0.080
Student-teacher ratio							–0.002	0.012	0.900
School size							–0.004	0.004	0.309
Rural locale							–0.120	0.093	0.201
Urban locale							0.076	0.082	0.357
Variance	Existing variance (r^2)			Variance (r^2) explained					
Within-school variance (percent)	79.1								
Between-school variance (percent)	20.9								
Total variance (percent)	100.0			20.0			36.5		

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

TABLE E6

Multilevel model results for Hispanic students on the Massachusetts Comprehensive Assessment System mathematics test, 2004/05 (n = 6,648)

Statistic and variable	Unconditional model			Model 1			Model 2		
	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level
Intercept	–0.217	0.038	0.000	0.063	0.039	0.107	–0.170	0.067	0.013
Student-level variable									
Gender				–0.076	0.020	0.000	–0.082	0.020	0.000
From low-income household				–0.135	0.024	0.000	–0.117	0.024	0.000
In special education				–0.597	0.028	0.000	–0.588	0.028	0.000
Limited English proficient				–0.549	0.035	0.000	–0.548	0.035	0.000
Former limited English proficient				–0.246	0.036	0.000	–0.243	0.036	0.000
First language Portuguese				0.205	0.077	0.008	0.192	0.076	0.011
First language Spanish				0.022	0.027	0.412	0.037	0.027	0.167
First language other				0.046	0.137	0.738	0.046	0.137	0.736
Immigrant from Brazil				0.127	0.127	0.320	0.122	0.126	0.336
Immigrant from Caribbean				–0.120	0.070	0.086	–0.118	0.070	0.092
Immigrant from Central American country or Mexico				–0.259	0.075	0.001	–0.263	0.075	0.000
Immigrant from South American country other than Brazil				0.308	0.097	0.002	0.306	0.097	0.002
Immigrant from all other countries				–0.657	0.324	0.042	–0.709	0.320	0.027
School-level variable									
Percentage of Hispanic students							–0.027	0.026	0.297
Percentage of students from low-income households							–0.021	0.022	0.340
Percentage of students in special education							–0.079	0.030	0.009
Percentage of limited English proficient students							–0.006	0.036	0.862
Attendance rate							0.039	0.009	0.000
Dropout rate							–0.004	0.004	0.394
Student-teacher ratio							0.014	0.012	0.219
School size							–0.009	0.004	0.033
Rural locale							–0.043	0.084	0.611
Urban locale							0.035	0.081	0.665
Variance	Existing variance (r^2)			Variance (r^2) explained					
Within-school variance (percent)	71.6								
Between-school variance (percent)	28.4								
Total variance (percent)	100.0			8.4			26.9		

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

TABLE E7

Multilevel model results for Hispanic students on the Massachusetts Comprehensive Assessment System English language arts test, 2005/06 (n = 7,394)

Statistic and variable	Unconditional model			Model 1			Model 2		
	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level
Intercept	0.226	0.028	0.000	0.179	0.033	0.000	–0.046	0.059	0.440
Student-level variable									
Gender				0.182	0.020	0.000	0.182	0.020	0.000
From low-income household				–0.170	0.023	0.000	–0.146	0.023	0.000
In special education				–0.999	0.027	0.000	–0.992	0.027	0.000
Limited English proficient				–1.212	0.036	0.000	–1.212	0.036	0.000
Former limited English proficient				–0.261	0.040	0.000	–0.263	0.040	0.000
First language Portuguese				0.155	0.070	0.027	0.142	0.070	0.042
First language Spanish				–0.073	0.025	0.004	–0.054	0.025	0.034
First language other				–0.028	0.110	0.799	–0.012	0.110	0.912
Immigrant from Brazil				–0.185	0.150	0.216	–0.193	0.149	0.195
Immigrant from Caribbean				–0.559	0.073	0.000	–0.554	0.073	0.000
Immigrant from Central American country or Mexico				–0.359	0.074	0.000	–0.355	0.074	0.000
Immigrant from South American country other than Brazil				0.317	0.105	0.003	0.299	0.105	0.004
Immigrant from all other countries				–0.392	0.239	0.100	–0.394	0.238	0.098
School-level variable									
Percentage of Hispanic students							–0.031	0.023	0.179
Percentage of students from low-income households							–0.042	0.021	0.045
Percentage of students in special education							–0.032	0.027	0.225
Percentage of limited English proficient students							0.025	0.036	0.489
Attendance rate							0.025	0.008	0.002
Dropout rate							–0.010	0.005	0.030
Student-teacher ratio							–0.001	0.006	0.922
School size							–0.006	0.004	0.096
Rural locale							–0.131	0.075	0.084
Urban locale							0.098	0.072	0.176

Variance	Existing variance (r^2)	Variance (r^2) explained	
Within-school variance (percent)	82.3		
Between-school variance (percent)	17.7		
Total variance (percent)	100.0	27.3	39.0

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

TABLE E8

Multilevel model results for Hispanic students on the Massachusetts Comprehensive Assessment System mathematics test, 2005/06 (n = 7,394)

Statistic and variable	Unconditional model			Model 1			Model 2		
	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level	Coefficient	Standard error	Significance level
Intercept	–0.024	0.034	0.485	0.280	0.035	0.000	0.076	0.071	0.284
Student-level variable									
Gender				–0.096	0.019	0.000	–0.096	0.019	0.000
From low-income household				–0.126	0.022	0.000	–0.107	0.022	0.000
In special education				–0.684	0.026	0.000	–0.681	0.026	0.000
Limited English proficient				–0.621	0.034	0.000	–0.621	0.034	0.000
Former limited English proficient				–0.114	0.038	0.002	–0.117	0.038	0.002
First language Portuguese				0.191	0.067	0.004	0.182	0.066	0.006
First language Spanish				–0.038	0.024	0.111	–0.025	0.024	0.306
First language other				0.113	0.104	0.276	0.122	0.104	0.240
Immigrant from Brazil				–0.123	0.142	0.385	–0.128	0.141	0.366
Immigrant from Caribbean				–0.209	0.069	0.002	–0.206	0.069	0.003
Immigrant from Central American country or Mexico				–0.316	0.070	0.000	–0.317	0.070	0.000
Immigrant from South American country other than Brazil				0.422	0.099	0.000	0.411	0.099	0.000
Immigrant from all other countries				0.172	0.225	0.444	0.177	0.225	0.433
School-level variable									
Percentage of Hispanic students							–0.011	0.028	0.701
Percentage of students from low-income households							–0.046	0.025	0.068
Percentage of students in special education							–0.005	0.029	0.858
Percentage of limited English proficient students							0.020	0.042	0.645
Attendance rate							0.031	0.009	0.001
Dropout rate							–0.007	0.005	0.207
Student-teacher ratio							–0.001	0.007	0.823
School size							–0.008	0.004	0.094
Rural locale							–0.121	0.084	0.148
Urban locale							0.087	0.087	0.324

Variance	Existing variance (r^2)	Variance (r^2) explained	
Within-school variance (percent)	75.8		
Between-school variance (percent)	24.2		
Total variance (percent)	100.0	11.9	22.7

Source: Authors' analysis based on data from Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research, and Evaluation (2007) and U.S. Department of Education, National Center for Education Statistics (2006).

NOTES

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1. A more detailed description of the U.S. Census definition of race/ethnicity is at www.whitehouse.gov/omb/fedreg/ombdir15.html.

2. However, the definitions of race/ethnicity used by Kao and Thompson (2003); Llagas (2003); Reardon and Galindo (2007); and Fry (2003) all differ from the definition used for this report.

3. The complete list of reported first languages was: Aboriginal, Afrikaans, Albanian, American Sign Language, Amharic, Arabic, Armanian, Bahasa Indonesian, Bengali, Berber, Bulgarian, Burmese, Canton dialect, Cape Verdean, Caucasian, Chichewa, Chinese, Creole (Haitian), Crioulo, Czech, Danish, Dari Persian, Dutch, Dzongkha Tibetan, Farsi, Fijian, Filipino, Flemish, Frang, French, French Patois, French/African Patois, Fukien, Galician, German, Gollato, Greek, Guarani, Gujarati, Hausa, Hebrew, Hindi, Hmong, Hungarian, Ibo, Icelandic, Indian, Indo-European, Italian, Jamaican Creole, Japanese, Khaikha Mongolian, Khmer, Kinyarwandu, Kirundi, Korean, Krio, Kurdish, Lao, Latin, Latvian, Lesotho, Lithuanian, Luganda, Macedonian, Malagasy dialect, Malay, Mandarin Chinese, Maori, Maya-Quiche dialect, More, Ndebele, Nepali, Niger-Congo, Norwegian, Other, Papuan, Patois, Persian, Pidgin English, Police Moto, Polish, Portuguese, Punjabi, Pushtu, Quechua dialect, Romanian, Russian, Samoan, Serbo-Croatian, Shona, Sinhala, Slovak, Slovene, Somali, Spanish, Sudanic Tribal, Swahili, Swedish, Tagalog, Taiwanese, Tamil, Thai, Tibetan, Tigre, Turkish, Tuvaluan, Ukranian, Urdu, Uzbec, Valencian, Vietnamese, Welsh, Yoruba (Massachusetts Elementary and Secondary Education Department, Office of Strategic Planning, Research and Evaluation 2007).

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