

Kindergarten Class of 1998-99

Eighth-Grade Algebra: Findings From the Eighth-Grade Round of the Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K)

Introduction

Algebra is considered a “gateway” course for the sequence of mathematics and science courses that prepares students for success in later schooling (Matthews and Farmer 2008). Mathematics courses are typically organized sequentially with enrollment in progressively more advanced courses dependent upon the successful completion of prerequisite courses. The earlier a student proceeds successfully through algebra, and then on to courses such as geometry and algebra II, the more opportunities he or she has for reaching higher level mathematics courses (e.g., trigonometry, precalculus, and calculus) in high school and completion of higher-level mathematics courses is related to a higher likelihood of entering a 4-year college or university (Schneider, Swanson, and Riegle-Crumb 1998). Recent research has related completion of advanced mathematics courses in high school with entering into science, technology, engineering, and mathematics majors in college (Chen 2009). Algebra may be integral to preparing students for success in college and the labor force, including careers in competitive mathematics- and science-related disciplines. The National Mathematics Advisory Panel (2008) noted that completing algebra II coursework during high school correlates positively with college graduation and employment income. The panel suggested that elementary and middle school mathematics curricula should put students on a path to learn algebra and have more students prepared to enroll in algebra by the eighth grade. Looking at international data, Schmidt (2004) reported that algebra concepts are commonly taught in the eighth grade in many other countries and suggested that U.S. students would benefit from increased opportunities for algebra instruction in the eighth grade.

Eighth-grade algebra enrollment in the United States has been on the rise. While approximately 16 percent of all U.S. 13-year-olds (the age at which many students are in eighth grade) were enrolled in algebra in 1986, this figure rose to 22 percent in 1999 and to 29 percent in 2004 (Perie, Moran, and Lutkus 2005). This trend affects the average level of mathematics course attainment students have achieved by graduation. An example of this trend is provided by Dalton et al. (2007), who compared course-taking information from high school transcripts gathered from three nationally representative studies: the High School and Beyond (HS&B) Longitudinal Study, the National Education Longitudinal Study of 1988 (NELS:88), and the Education Longitudinal Study of 2002 (ELS:2002). They found an increase between 1982 and 2004 in the number of high school graduates taking advanced mathematics courses and a concurrent drop in the percentage of students finishing high school having completed only lower level mathematics courses (e.g., algebra I and plane geometry).

While the overall number of students in advanced mathematics courses is increasing, there are differences between the populations of students who do and who do not take advanced mathematics courses in high school. For example, using the ELS:2002 data, Bozick and Ingels (2008) found that advanced high school mathematics courses (i.e., classes that are part of course sequences containing precalculus) were being taken by larger percentages of Asian students, White students, students of high socioeconomic

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status (SES), students living in two-parent households, students attending Catholic and other private schools, and students expecting to earn a bachelor's degree than by other students. Similar differences in mathematics course participation (e.g., differences by race/ethnicity and SES) were also found by Dalton et al. in their 2007 study. Furthermore, students who enter seventh grade with higher mathematics achievement have been found to be more likely to take advanced mathematics courses earlier than their grade-level peers (Ma and Wilkins 2007). The present Brief examines how various characteristics are related to enrollment in algebra or higher in the eighth grade.

Eighth-grade mathematics course offerings and placement policies differ from school to school (Cogan, Schmidt, and Wiley 2001). Some schools enroll only those with the highest mathematics achievement in algebra by the eighth grade while some schools aim to provide algebra to all eighth-grade students regardless of prior ability level.¹ The implications of different policies related to algebra enrollment for students with various ability levels have been discussed and studied. Loveless (2008) reported that the percentage of low achievers—those at or below the 10th percentile on the eighth-grade National Assessment of Educational Progress (NAEP) mathematics test—in advanced mathematics classes increased between 2000 and 2005. Burriss, Heubert, and Levin (2006) found that the percentage of students who completed various advanced mathematics courses in high school increased after middle schools in one school district eliminated the “tracking” strategy that placed only the highest performing students in algebra in the eighth grade and instead prepared all students for algebra in that grade. The increase in participation in advanced mathematics courses in high school was found for all groups of students within the district, including Black and Hispanic students, low-income students, and students who had relatively low mathematics scores in fifth grade. Ma (2005) reported that low-achieving students placed in algebra showed greater growth in mathematics achievement than either their low- or high-achieving peers in lower level classes. Additionally, Gamoran and Hannigan’s (2000) analysis of national survey data found that algebra enrollment was associated with higher mathematics achievement growth for all students, although the advantage was less pronounced for students with lower initial achievement levels compared with their higher achieving peers.

This Brief examines some of these issues by looking at mathematics performance at the end of eighth grade by algebra enrollment and other characteristics, including prior mathematics ability and schools’ level of eighth-grade algebra enrollment. Not all relationships between the variables are fully investigated and readers are cautioned not to draw causal inferences based on the results presented.

¹ For example, the California Department of Education has been working on issues related to preparing all students for algebra I in the eighth grade (California Department of Education, 2008).

Additionally, it is important to note that there may be variables related to algebra enrollment and mathematics achievement that are not examined in this report.

Focus of This Statistics in Brief

This Brief is intended to provide descriptive statistics about various aspects of algebra enrollment in the eighth grade. The first analyses describe who is taking algebra in the eighth grade; findings compare eighth-grade course enrollment percentages for students with different demographic, family, geographic, and school characteristics (table 1). The second set of findings looks at eighth-grade algebra enrollment levels in the schools and reports the percentage of students who attend schools with relatively low, medium, and high levels of eighth-grade algebra enrollment by demographic, family, geographic, and school characteristics (table 2). The next set of findings incorporates data collected at the end of fifth grade. Enrollment in algebra or higher is compared by varying levels of fifth-grade mathematics achievement (figure 1), and among students with relatively strong fifth-grade mathematics scores, enrollment is compared by sex and race/ethnicity (figure 2). Enrollment in algebra or higher in eighth grade is also compared for students with varying views about mathematics as self-reported in the fifth grade (figure 3). The final set of findings describe mathematics achievement scores and other student measures from the end of eighth grade for students not yet in algebra and those in algebra or higher. First, the eighth-grade mathematics scores for those in algebra by the eighth grade and those not yet in algebra are broken down by demographic, family, geographic, and school characteristics (table 3), and by fifth-grade mathematics score quintiles (figure 4). Findings are then presented that look at student-reported enjoyment of mathematics (figure 5) and future educational expectations (figure 6) by course enrollment.

The ECLS-K Cohort

Data for this Statistics in Brief are drawn from the Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K). This Brief focuses on the experiences of a cohort of children who were in first grade during the 1999–2000 school year and who were in eighth grade during the 2006–07 school year. That is, it studies students who progressed on schedule through schools in the United States from first grade to eighth grade, excluding students who had been retained in a grade between the first and eighth grades and therefore were not yet in eighth grade in spring 2007 (about 13 percent of the first-grade class of 1999–2000) as well as students who had been promoted ahead of schedule and were beyond the eighth grade in spring 2007 (about 0.3 percent of the first-grade class of 1999–2000).

The cohort studied in this Brief does not fully represent all eighth-grade students in the 2006–07 school year. Specifically, it does not represent eighth-grade students in 2006–07 who started first grade before the fall of 1999 and were retained in a later grade, who immigrated to the United States after first grade, or who were home-schooled until after first grade. The cohort represents approximately 80 percent of all eighth-grade students in the 2006–07 school year (Tourangeau et al. 2009b).

Mathematics Course Enrollment

Table 1 shows the distribution of mathematics course enrollment for the eighth-grade students in this cohort. Thirty-three percent were enrolled in an algebra class in the eighth grade and 6 percent were enrolled in an advanced mathematics course other than algebra (i.e., algebra II, geometry, or integrated or sequential mathematics). Forty-four percent were taking an introduction to algebra or pre-algebra class, and 17 percent were in a general mathematics course, which is typically intended for students who are not yet ready for pre-algebra. Many of the findings presented in this report look at students in algebra and students in another advanced mathematics course grouped together (39 percent of the cohort) and students in a general mathematics course or a pre-algebra class grouped together (61 percent of the cohort). Much of the policy discussion about algebra courses focuses on students taking algebra by the eighth grade, so many of the findings presented here consider students who took algebra or moved into a course beyond algebra in the eighth grade as a single analytic group of interest.

Mathematics course enrollment varied by students' race/ethnicity. A larger percentage of Asian students were enrolled in algebra or a course more advanced than algebra (67 percent) than were students in each of the other race/ethnicity groups (19 to 45 percent). A larger percentage of White (45 percent) and Hispanic (38 percent) students were in algebra or higher than were Black students (19 percent), and a larger percentage of White students were in algebra or higher than were students in the "Other" racial/ethnic category² (30 percent).

Mathematics course enrollment also differed by poverty status, mother's education, and family type.³ Compared with students living in households below the poverty threshold, a larger percentage of students living in households at or above the poverty threshold were enrolled in algebra or higher (43 vs. 23 percent). A larger

percentage of students whose mothers had a bachelor's degree or higher were enrolled in algebra or higher (56 percent) than were students whose mothers had less than a 4-year college degree (23 to 36 percent). Also, a larger percentage of students whose mother had some college (36 percent) were in algebra or higher than were students whose mother's highest education level was a high school diploma or the equivalent (28 percent) or who did not complete high school (23 percent). Additionally, a larger percentage of students in two-parent households were enrolled in algebra or higher (43 percent) than were those in single-parent homes (31 percent).

Mathematics course enrollment varied in different regions of the country.⁴ Enrollment in algebra or a course more advanced than algebra was least prevalent in the South. Thirty percent of the students in the South were enrolled in algebra or higher, compared with 38 percent in the Midwest, 46 percent in the Northeast, and 54 percent in the West. Additionally, the percentage of students in the West who were in algebra or higher was larger than those in the Midwest (54 vs. 38 percent).⁵

Mathematics course enrollment was also found to differ by school type (i.e., public or private). A larger percentage of private school students were enrolled in algebra or a course more advanced than algebra (52 percent) than were public school students (38 percent).

Eighth-Grade Algebra Enrollment in the Schools

This section looks at students who attend schools with low, medium, and high levels of eighth-grade algebra enrollment to consider differences associated with access to algebra at the student's school. Whether or not a student takes algebra by the eighth grade is associated with the overall level of algebra enrollment at the school a student attends. School principals indicated the percentage of all eighth-grade students at the school who were enrolled in algebra.⁶ Table 2 shows the percentage of students in the cohort who attended schools with eighth-grade algebra enrollment of less than 25 percent, between 25 and 74 percent, and 75 percent or more, by student, family, and school characteristics.

² Here, and throughout this report, "Other" refers to Native Hawaiians, Pacific Islanders, American Indians, Alaska Natives, and other non-Hispanic students of two or more races. Collectively, these students make up about 4 percent of the cohort represented in this report.

³ The apparent difference between the percentage of females and the percentage of males enrolled in algebra or higher was not detectably different when statistical tests of difference were applied.

⁴ States and jurisdictions included in each region are as follows: the Northeast includes CT, ME, MA, NH, RI, VT, NJ, NY, and PA; the Midwest includes IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, and SD; the South includes DE, DC, FL, GA, MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, and TX; and the West includes AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, and WA.

⁵ The apparent differences between the Northeast and the Midwest and between the Northeast and the West were not detectably different when statistical tests of difference were applied.

⁶ The principals were asked about eighth-grade algebra enrollment, but were not asked about eighth-grade enrollment in a course more advanced than algebra.

Table 1. Percentage distribution of mathematics course enrollment of ECLS-K spring 2000 first-grade cohort eighth-graders, by student, family, and school characteristics: Spring 2007

Characteristic	Mathematics course				
	General mathematics	Introduction to algebra/pre-algebra	Algebra or a course more advanced than algebra		
			Total	Algebra	An advanced course other than algebra ¹
Total²	17	44	39	33	6
Sex					
Male	18	45	37	31	6
Female	15	43	42	35	7
Race/ethnicity ³					
White, not Hispanic	14	42	45	37	8
Black, not Hispanic	25	56	19	17	‡
Hispanic	18	44	38	34	4 !
Asian, not Hispanic	16 !	16	67	51	16
Other, not Hispanic	25	44	30	25	5 !
Poverty status ⁴					
Below federal poverty level	25	52	23	21	‡
At or above federal poverty level	15	42	43	36	7
Mother's education					
Less than high school	25	52	23	22	‡
High school diploma or equivalent	19	53	28	25	3 !
Some college or vocational technical degree	19	45	36	31	6
Bachelor's degree or higher	10	35	56	44	11
Family type ⁵					
Two parents	16	42	43	36	7
Single parent	20	49	31	27	4
Region ⁶					
Northeast	11	43	46	36	10
Midwest	18	44	38	34	4
South	22	49	30	25	5
West	10	36	54	46	9
School type					
Public school	18	44	38	32	6
Private school	8 !	40	52	47	5 !

! Interpret data with caution. Coefficient of variation is greater than 30 percent.

‡ Estimate does not meet reporting standards.

¹ "An advanced course other than algebra" includes integrated or sequential mathematics, algebra II, and geometry.

² The total represents all U.S. students who attended first grade in the spring of 2000 and then were in a U.S. eighth grade in the 2006–07 school year.

³ Black, not Hispanic includes African American. Hispanic includes Latino. Other, not Hispanic includes Native Hawaiians, Pacific Islanders, American Indians, Alaska Natives, and non-Hispanic students of two or more races.

⁴ Poverty status is a function of household size and household income. Based on 2006 census information, a household of four with a total income below \$20,615 was considered to be below the federal poverty threshold.

⁵ Children who live with one or more guardians, rather than a parent, are not included because there are too few students in the sample with this family type to produce stable estimates.

⁶ States and jurisdictions included in each region are as follows: the Northeast includes CT, ME, MA, NH, RI, VT, NJ, NY, and PA; the Midwest includes IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, and SD; the South includes DE, DC, FL, GA, MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, and TX; and the West includes AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, and WA.

NOTE: Estimates were weighted by C7CPTM0. Detail may not sum to total due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Kindergarten–Eighth Grade Full Sample Public-Use Data File.

A larger percentage of Asian (24 percent) and Hispanic students (19 percent) attended a school where more than 75 percent of the eighth-grade students were enrolled in algebra than did White, Black, or "Other" students (7 to 8 percent). A larger percentage of Black (70 percent) and "Other" students (64 percent) were in a school where less than 25 percent of the eighth-grade students were in algebra than were White (49 percent), Hispanic (46 percent), or Asian students (36 percent); a larger percentage of White

students were in one of these schools than were Asian students (49 vs. 36 percent).

School algebra enrollment also differed by poverty status, mother's education level, and family type. A larger percentage of students from households below the poverty threshold attended a school with less than 25 percent eighth-grade algebra enrollment than did those at or above the poverty threshold (59 vs. 50 percent). A smaller

Table 2. Percentage distribution of ECLS-K spring 2000 first-grade cohort eighth-graders who attended schools with various levels of eighth-grade student enrollment in algebra, by student, family, and school characteristics: Spring 2007

Characteristic	Principals' report of the percentage of all eighth-grade students at the school enrolled in algebra		
	Less than 25 percent	25 to 74 percent	75 percent or more
Total¹	51	38	10
Sex			
Male	51	38	12
Female	52	39	9
Race/ethnicity ²			
White, not Hispanic	49	43	8
Black, not Hispanic	70	22	8 !
Hispanic	46	36	19
Asian, not Hispanic	36	40	24
Other, not Hispanic	64	29	7 !
Poverty status ³			
Below federal poverty level	59	28	13
At or above federal poverty level	50	40	10
Mother's education			
Less than high school	51	32	18
High school diploma or equivalent	58	35	8
Some college or vocational technical degree	58	33	9
Bachelor's degree or higher	40	49	12
Family type ⁴			
Two parents	49	40	10
Single parent	57	32	11
Region ⁵			
Northeast	41	49	10
Midwest	55	36	9
South	62	34	4
West	37	40	24
School type			
Public school	54	37	9
Private school	29	48	24

! Interpret data with caution. Coefficient of variation is greater than 30 percent.

¹ The total represents all U.S. students who attended first grade in the spring of 2000 and then were in a U.S. eighth grade in the 2006–07 school year.

² Black, not Hispanic includes African American. Hispanic includes Latino. Other, not Hispanic includes Native Hawaiians, Pacific Islanders, American Indians, Alaska Natives, and non-Hispanic students of two or more races.

³ Poverty status is a function of household size and household income. Based on 2006 census information, a household of four with a total income below \$20,615 was considered to be below the federal poverty threshold.

⁴ Children who live with one or more guardians, rather than a parent, are not included because there are too few students in the sample with this family type to produce stable estimates.

⁵ States and jurisdictions included in each region are as follows: the Northeast includes CT, ME, MA, NH, RI, VT, NJ, NY, and PA; the Midwest includes IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, and SD; the South includes DE, DC, FL, GA, MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, and TX; and the West includes AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, and WA.

NOTE: Estimates were weighted by C7CPTM0. Detail may not sum to total due to rounding.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Kindergarten–Eighth Grade Full Sample Public-Use Data File.

percentage of students whose mothers had a bachelor's degree were in a school where less than 25 percent of their fellow eighth-grade students were in algebra (40 percent) than were those whose mothers had some college (58 percent) or whose highest level of education was a high school diploma or the equivalent (58 percent). Contrary to what might be expected given the finding from table 1 that mother's education is generally positively related to enrollment in algebra or higher, a larger percentage of students whose mothers did not complete high school were in a school where 75 percent or more of the eighth-grade students were in algebra (18 percent) than students whose mother's highest level of education was a high school

diploma or the equivalent (8 percent); however, there was no detectable difference in enrollment levels in these schools between those whose mothers did not complete high school and those whose mothers had a bachelor's degree (12 percent). Fifty-seven percent of students from a single-parent home were in a low-algebra school compared with 49 percent of students from two-parent homes.

The level of algebra enrollment in the schools the eighth-grade students attended also differed by geographical region and school type. Twenty-four percent of students in the West attended a school that had a relatively high eighth-grade algebra enrollment (i.e., 75 percent or more)

compared with 10 percent of those in the Northeast, 9 percent in the Midwest, and 4 percent in the South.⁷ A larger percentage of students in the South (62 percent) and the Midwest (55 percent) attended a school where less than 25 percent of the eighth-grade students were in algebra than did students in the Northeast (41 percent) or the West (37 percent). A larger percentage of students attending a private school were in a school with a high level of eighth-grade algebra enrollment than were public school students (24 vs. 9 percent). Conversely, a smaller percentage of private school students were in a low-algebra school than were students in public schools (29 vs. 54 percent).

Fifth-Grade Mathematics Performance and Enjoyment of Mathematics

Data collected from these students 3 years earlier—at the end of the fifth grade—were used to look at how prior mathematics performance and prior feelings about mathematics may be related to eighth-grade mathematics course placement.⁸ Students’ scores on the ECLS-K mathematics assessment given at the end of fifth grade were used to create five quintiles. As shown in figure 1, higher performance on the fifth-grade assessment was associated with enrollment in algebra or higher in eighth grade. Starting with the students who scored in the lowest 20 percent of the fifth-grade score distribution, each ascending quintile had a larger percentage of students who were in algebra or higher in the eighth grade (13, 24, 37,

49, and 75 percent, respectively). This finding is consistent with research showing that schools are more likely to place students who begin seventh grade with stronger mathematics skills on a track that will lead toward algebra by the eighth grade (Ma and Wilkins 2007). However, about a quarter of the students who had been in the very highest quintile of fifth-grade mathematics scores and about half of the students in the next highest fifth-grade quintile had not moved on to an algebra class by the eighth grade.

Among students in the top two fifth-grade mathematics score quintiles, of which 62 percent went on to algebra by the eighth grade, there were notable differences by sex and race/ethnicity (figure 2). Seventy percent of the girls in this group went on to algebra or higher in the eighth grade, compared with 56 percent of the boys. Among these students with high fifth-grade mathematics scores, a smaller percentage of Black students went on to algebra by the eighth grade (35 percent) than did Asian (94 percent), Hispanic (68 percent), or White (63 percent) students. A larger percentage of Asian students from this group moved on to algebra or higher by the eighth grade (94 percent) than did students from each of the other race/ethnicity groups (35 to 68 percent).

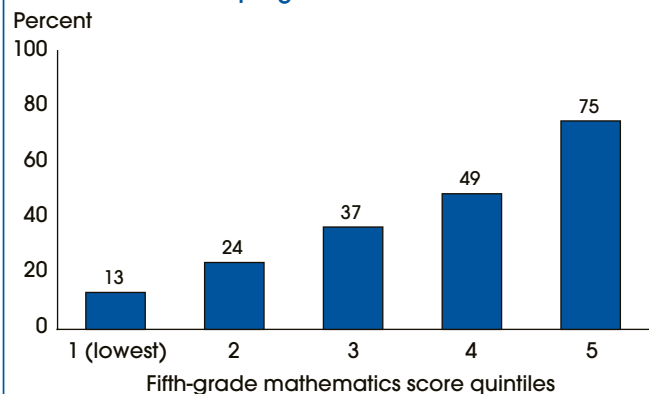
Fifth-grade students also responded to a series of statements by indicating how true each statement was for them: not at all true, a little bit true, mostly true, or very true. Students who indicated in the fifth grade that the statement “I like math” was “very true” for them were more likely to have gone on to algebra or higher in the eighth grade (43 percent) than were students who responded “not at all true” (33 percent) or “a little bit true” (35 percent) (figure 3).

The following sections look at how students who were in algebra or higher in the eighth grade differed from those not in algebra on eighth-grade mathematics performance, enjoyment of mathematics, and future educational expectations, each measured at the end of the eighth grade.

Eighth-Grade Mathematics Performance

Students taking more advanced mathematics courses scored higher on the ECLS-K mathematics assessment⁹ given at the end of the eighth-grade year than did students in less advanced classes. Students in a general mathematics course had the lowest average score, 128 points; those in pre-algebra scored, on average, 138 points; and those in algebra had a higher average score, 153 points. The highest average score (158 points) was obtained by students taking an advanced mathematics course other than algebra (data not shown). As seen in table 3, students

Figure 1. Percentage of ECLS-K spring 2000 first-grade cohort eighth-graders enrolled in algebra or a course more advanced than algebra, by fifth-grade mathematics score quintiles: Spring 2004 and spring 2007



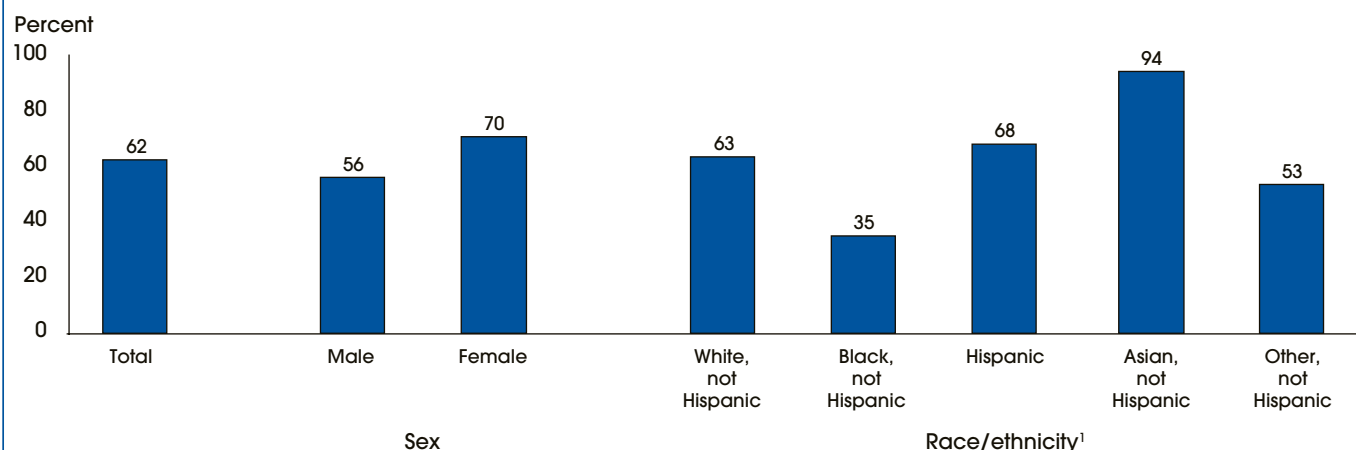
NOTE: The estimates represent all U.S. students who attended first grade in the spring of 2000 and then were in a U.S. eighth grade in the 2006–07 school year. “Algebra or a course more advanced than algebra” includes algebra I, integrated or sequential mathematics, algebra II, and geometry. Estimates were weighted by C7CPTM0. Standard errors are available upon request.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Kindergarten–Eighth Grade Full Sample Public-Use Data File.

⁷ The western region of the country includes California, which has a statewide initiative regarding eighth-grade algebra.

⁸ ECLS-K data were not collected between the end of fifth grade and the end of eighth grade. See “Direct cognitive mathematics assessments” in the glossary of this report for more details about the fifth-grade mathematics assessment.

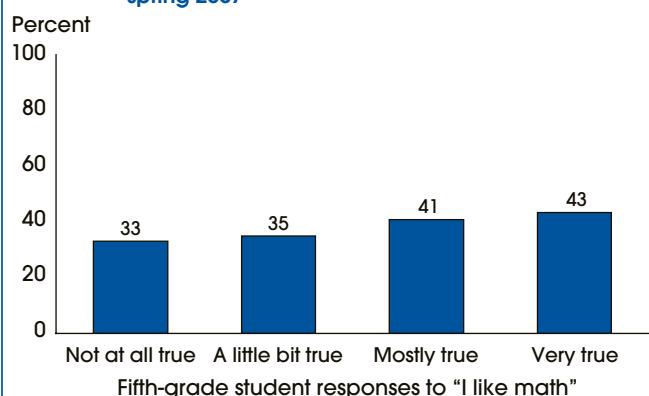
⁹ The ECLS-K mathematics assessment measured broad-based achievement in mathematics; it included algebra concepts, but was not designed as an algebra assessment. See “Direct cognitive mathematics assessments” in the glossary of this report for more details.

Figure 2. Percentage of the ECLS-K spring 2000 first-grade cohort in the top two fifth-grade mathematics score quintiles who were enrolled in algebra or a course more advanced than algebra in the eighth grade, by sex and race/ethnicity: Spring 2004 and spring 2007



¹ Black, not Hispanic includes African American. Hispanic includes Latino. Other, not Hispanic includes Native Hawaiians, Pacific Islanders, American Indians, Alaska Natives, and non-Hispanic students of two or more races.
 NOTE: The estimates represent all U.S. students who attended first grade in the spring of 2000 and then were in a U.S. eighth grade in the 2006–07 school year. “Algebra or a course more advanced than algebra” includes algebra I, integrated or sequential mathematics, algebra II, and geometry. Estimates were weighted by C7CPTM0. Standard errors are available upon request.
 SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Kindergarten–Eighth Grade Full Sample Public-Use Data File.

Figure 3. Percentage of ECLS-K spring 2000 first-grade cohort eighth-graders enrolled in algebra or a course more advanced than algebra, by fifth-grade enjoyment of mathematics: Spring 2004 and spring 2007



NOTE: The estimates represent all U.S. students who attended first grade in the spring of 2000 and then were in a U.S. eighth grade in the 2006–07 school year. “Algebra or a course more advanced than algebra” includes algebra I, integrated or sequential mathematics, algebra II, and geometry. Estimates were weighted by C7CPTM0. Standard errors are available upon request.
 SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Kindergarten–Eighth Grade Full Sample Public-Use Data File, and the Kindergarten Through Fifth Grade Approaches to Learning and Self-Description Questionnaire Supplemental Data File.

who were in algebra or a course more advanced than algebra scored higher than those who were not yet in algebra (154 vs. 135 points).¹⁰

Higher eighth-grade mathematics scores were obtained by students who were in algebra or higher than by those not yet in algebra within each subgroup category (sex, race/

ethnicity, poverty status, mother’s education, family type, region, percentage of algebra enrollment in school, and school type). For example, enrollment in algebra or higher was associated with higher scores for Black students (140 vs. 130 points), Hispanic students (146 vs. 129 points), students living in homes with incomes below the poverty threshold (142 vs. 126 points), and students whose mother did not complete high school (136 vs. 121 points) or whose highest level of education was high school completion (150 vs. 132 points).

Overall differences in eighth-grade mathematics achievement (averaged across students in all mathematics courses) were related to many student and family characteristics. For example, Asian (150 points) and White (147 points) students scored higher, on average, than Black (131 points) and Hispanic (135 points) students; students living in poverty scored lower, on average, than students from homes with incomes at or above the federal poverty threshold (129 vs. 145 points); and average scores increased as levels of maternal education increased (less than a high school credential, 126 points; a high school credential, 136 points; some college or a vocational technical degree, 142 points; and a bachelor’s degree or higher, 152 points). The patterns of differences among students in all mathematics courses were generally mirrored among students in algebra or higher as well as among students not yet in algebra. However, among students not yet in algebra, Asian students (128 points) did not score higher than Black (130 points) or Hispanic students (129 points), and among students in algebra or higher, the average score for students whose mother attended some college (151 points) was not measurably different from that for students whose mother’s highest

¹⁰ This difference of 19 points is equal to .86 of the standard deviation associated with the eighth-grade mathematics scores for the cohort of eighth-grade students represented in this report ($SD = 21.6$).

Table 3. Average ECLS-K spring 2000 first-grade cohort's eighth-grade mathematics scores, by mathematics course, student, family, and school characteristics: Spring 2007

Characteristic	Total	Eighth-grade mathematics course	
		Not in algebra ¹	Algebra or a course more advanced than algebra ²
Total³	142	135	154
Sex			
Male	144	137	156
Female	141	133	152
Race/ethnicity ⁴			
White, not Hispanic	147	139	157
Black, not Hispanic	131	130	140
Hispanic	135	129	146
Asian, not Hispanic	150	128	161
Other, not Hispanic	143	138	158
Poverty status ⁵			
Below federal poverty level	129	126	142
At or above federal poverty level	145	138	155
Mother's education			
Less than high school	126	121	136
High school diploma or equivalent	136	132	150
Some college or vocational technical degree	142	137	151
Bachelor's degree or higher	152	144	159
Family type ⁶			
Two parents	145	137	155
Single parent	137	133	148
Region ⁷			
Northeast	146	138	156
Midwest	143	136	156
South	141	135	156
West	141	132	149
School's eighth-grade algebra enrollment			
Less than 25 percent	141	135	155
25 to 74 percent	146	136	156
75 percent or more	143	133	148
School type			
Public school	142	135	154
Private school	147	140	154

¹ "Not in algebra" includes students in a general eighth-grade mathematics course, introduction to algebra, or pre-algebra.

² "Algebra or a course more advanced than algebra" includes algebra I, integrated or sequential mathematics, algebra II, and geometry.

³ The total represents all U.S. students who attended first grade in the spring of 2000 and then were in a U.S. eighth grade in the 2006-07 school year.

⁴ Black, not Hispanic includes African American. Hispanic includes Latino. Other, not Hispanic includes Native Hawaiians, Pacific Islanders, American Indians, Alaska Natives, and non-Hispanic students of two or more races.

⁵ Poverty status is a function of household size and household income. Based on 2006 census information, a household of four with a total income below \$20,615 was considered to be below the federal poverty threshold.

⁶ Children who live with one or more guardians, rather than a parent, are not included because there are too few students in the sample with this family type to produce stable estimates.

⁷ States and jurisdictions included in each region are as follows: the Northeast includes CT, ME, MA, NH, RI, VT, NJ, NY, and PA; the Midwest includes IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, and SD; the South includes DE, DC, FL, GA, MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, and TX; and the West includes AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, and WA.

NOTE: Estimates were weighted by C7CPTM0.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K), Kindergarten-Eighth Grade Full Sample Public-Use Data File.

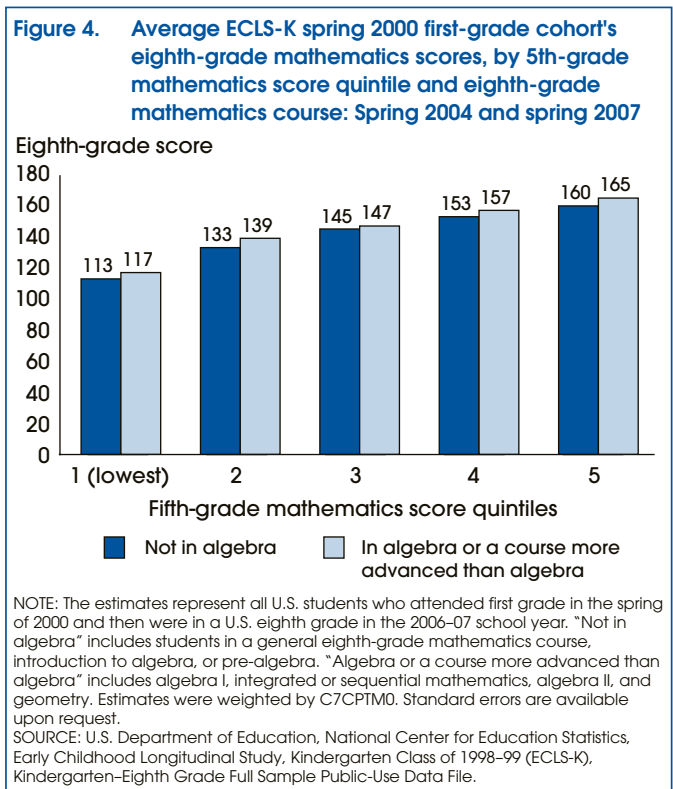
level of education was a high school diploma or the equivalent (150 points).

Among students taking algebra or higher in the eighth grade, those attending schools where 75 percent or more of the eighth-graders were taking algebra scored lower (148 points) than those in schools with less than 25 percent (155 points) or between 25 and 74 percent

eighth-grade algebra enrollment (156 points). This reflects the fact that schools with higher algebra enrollment often enroll students with a much broader range of mathematics ability levels in their algebra classes. Among students with relatively strong fifth-grade mathematics scores (i.e., in the top two quintiles) who went on to algebra by the eighth grade, there were no differences detected in the average eighth-grade mathematics scores for students attending

schools with various levels of algebra enrollment (the average score was 162 for each category of school algebra enrollment (<25 percent, 25 to 74 percent, and 75 or more percent)). Overall differences in eighth-grade mathematics achievement were also related to school type. Students in private schools scored higher than those in public schools (147 vs. 142 points). Among students who were not yet in algebra by the eighth grade, students in private schools also scored higher than those in public schools (140 vs. 135 points). However, eighth-grade students in public schools taking algebra or higher and eighth-grade students in private schools taking algebra or higher both had an average mathematics score of 154 points.

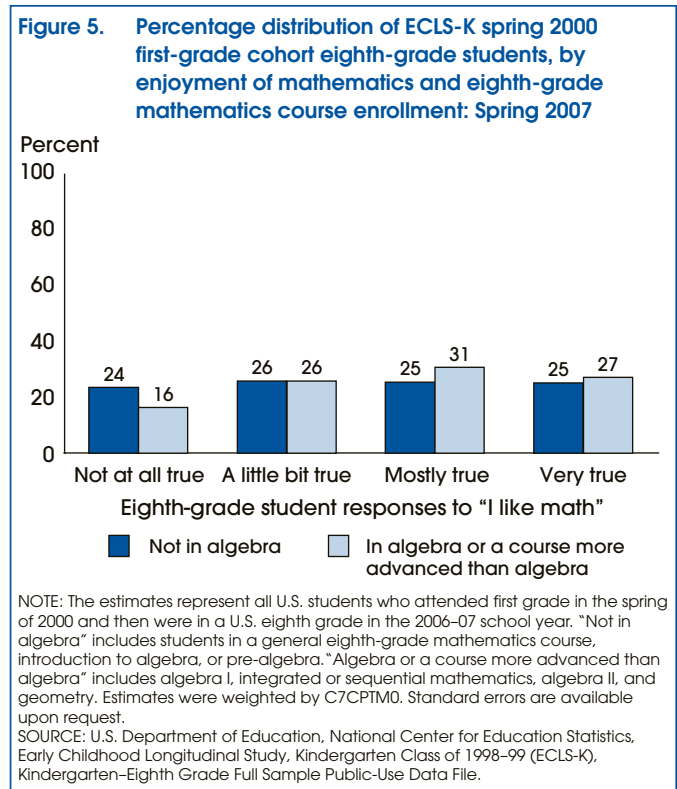
Figure 4 illustrates the eighth-grade scores for students who were in algebra and those not in algebra by the eighth grade within fifth-grade score quintiles. Higher average scores were obtained by students who had moved to algebra by the eighth grade compared to students who were not yet in algebra in the eighth grade for students within each of the fifth-grade mathematics score quintiles except the very lowest quintile.¹¹



¹¹ The apparent difference in eighth-grade mathematics scores between those in algebra and those not in algebra by the eighth grade for students in the lowest quintile is not statistically significant. This is due to the relatively large standard error for the estimate for students in this group who were in algebra or higher.

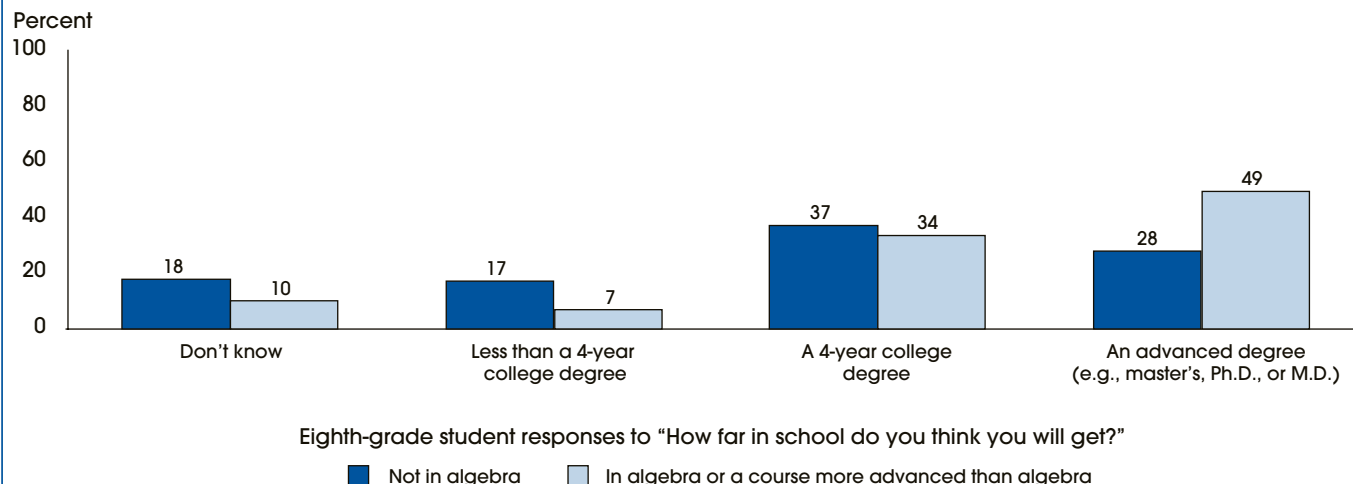
Enjoyment of Mathematics and Educational Expectations in the Eighth Grade

Past research has found that eighth-grade students' future educational expectations (Bui 2007) and enjoyment of mathematics (Beaton et al. 1996) are important educational variables. These next two sections investigate how these two student characteristics compare for those students who are enrolled in algebra by the eighth grade and those who are not yet enrolled in algebra. Figure 5 shows the responses made when students were near the end of the eighth grade to the statement, "I like math," for those in algebra or higher and those not yet in algebra. Compared with those not yet in algebra, a larger percentage of students in algebra or higher responded that this statement was "mostly true" for them (31 vs. 25 percent) and a smaller percentage indicated that this statement was "not at all true" (16 vs. 24 percent).



The eighth-grade students were also asked to report the level of education they expected to attain. Figure 6 illustrates the differences in educational expectations for students who were enrolled in algebra or higher by the eighth grade and those not enrolled in algebra. A larger percentage of students in algebra or higher envisioned themselves with an advanced degree than did students not in algebra (49 vs. 28 percent). A smaller percentage of those in algebra or higher reported that they would not complete a 4-year college degree (7 vs. 17 percent) or selected "don't know" (10 vs. 18 percent) as their response to the question about their educational expectations than did students not in algebra.

Figure 6. Percentage distribution of ECLS-K spring 2000 first-grade cohort as eighth-grade students, by future educational expectations and eighth-grade mathematics course enrollment: Spring 2007



NOTE: The estimates represent all U.S. students who attended first grade in the spring of 2000 and then were in a U.S. eighth grade in the 2006–07 school year. "Not in algebra" includes students in a general eighth-grade mathematics course, introduction to algebra, or pre-algebra. "Algebra or a course more advanced than algebra" includes algebra I, integrated or sequential mathematics, algebra II, and geometry. Estimates were weighted by C7CPTM0. Standard errors are available upon request. SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Kindergarten–Eighth Grade Full Sample Public-Use Data File.

Summary

Some policymakers and researchers have recommended advancing more students to algebra classes by the eighth grade, placing these students on a mathematics course trajectory that would prepare them for the challenging college coursework necessary for science, technology, engineering, and mathematics degrees, which in turn are associated with high income careers (e.g., Riley 1997). This would also result in U.S. students being placed in mathematics course trajectories more like those of many of their international peers (e.g., Schmidt 2004). The present report finds that among the cohort of students in the first-grade class of 1999–2000 who had progressed to eighth grade in the 2006–07 school year (representing about 80 percent of the eighth-grade class of 2006–07), nearly 4 in 10 were enrolled either in algebra or a higher mathematics course in the eighth grade. Consistent with other studies' findings (e.g., Bozick and Ingels 2008; Dalton et al. 2007), algebra enrollment was more common for Asian students, students not living in poverty, students whose mother had a bachelor's degree or higher, students living in a two-parent home, and private school students than their respective counterparts. In some schools, eighth-grade algebra coursework was relatively common (i.e., more than 75 percent of the school's eighth-graders were enrolled in algebra); students living in the western region of the country were more likely to be attending one of these schools than students in other regions of the country.

Algebra enrollment was also related to prior mathematics ability; higher scores on the ECLS-K mathematics assessment in the fifth grade were associated with higher levels of algebra enrollment by the eighth grade. However, about a quarter of the students who had been in the

very highest quintile of fifth-grade mathematics scores and about half of the students in the next highest fifth-grade quintile had not moved on to an algebra class by the eighth grade. Furthermore, among students in these top two fifth-grade mathematics score quintiles, male students and Black students proceeded on to algebra by the eighth grade at lower rates than their counterparts. These findings suggest that some students with relatively strong mathematics skills at the end of elementary school are not in algebra by the eighth grade.

Additionally, enrollment in algebra or higher was associated with higher mathematics scores on the assessment given at the end of the eighth grade, and this was true within each subgroup category—sex, race/ethnicity, poverty status, mother's education, family type, region, school type, and school's algebra enrollment (e.g., Black students in algebra or higher courses outperformed Black students not in algebra). Higher average eighth-grade mathematics scores for students in algebra or higher compared to students in other classes were found within each of the fifth-grade mathematics score quintiles except the lowest fifth-grade quintile. Students in algebra by the eighth grade in schools where this was commonplace (i.e., more than 75 percent of the eighth-grade students in the school were taking algebra) had lower average scores than algebra students in schools where algebra in the eighth grade was less common. However, among students with relatively strong mathematics skills at the end of fifth grade, there were no differences in average eighth-grade mathematics scores by school algebra level.

The overall mathematics achievement gaps found among eighth-grade students were generally also found among students in algebra or higher and among students not yet

in algebra. However, there were some exceptions: private school students taking algebra or higher coursework did not have higher scores than public school students taking algebra or higher coursework. Additionally, among those not in algebra, Asian students did not score higher than Black or Hispanic students.

In addition to higher average mathematics scores, students taking algebra by the eighth grade had higher expectations about their own future educational attainment and liked mathematics more than those not in algebra classes by the eighth grade.

Methodology and Technical Notes

Overview of the ECLS-K

The ECLS-K is sponsored by the National Center for Education Statistics (NCES), which is part of the Institute of Education Sciences within the U.S. Department of Education. The purpose of the ECLS-K is to provide detailed information on the school achievement and experiences of students from kindergarten entry to middle school. Westat, Inc. assisted with the design of the study and collected the data upon which this report is based. The students participating in the ECLS-K were followed longitudinally from kindergarten in the fall of 1998 through the spring of 2007 when most were in eighth grade. The sample was freshened for first grade in the spring of 2000. About 87 percent of the students were in the eighth grade in the 2006–07 school year; 13 percent were enrolled below eighth grade because they had been retained at least once since they were in kindergarten in 1998–99.¹² About one-third of 1 percent of the students had, at some time, been promoted a grade ahead of schedule and were above eighth grade in the 2006–07 school year. The cohort referred to in this report represents approximately 80 percent of all eighth-grade students in the 2006–07 school year. Estimates in this report are based on data collected from about 3,750 students who were in eighth grade in the spring of 2007 and who had complete mathematics assessment data, parent interview data, and mathematics teacher questionnaire data. When properly weighted, information about these students represents all students who were in first grade in the 1999–2000 school year and the eighth grade in the 2006–07 school year. Information about obtaining the ECLS-K data and publications can be found at the ECLS-K website, <http://nces.ed.gov/ecls/kindergarten.asp>.

Sample design

A nationally representative sample of 21,260 students enrolled in 944 kindergarten programs during the 1998–99 school year participated in the ECLS-K. To improve the

precision of estimates for these students, oversamples of Asians/Pacific Islanders and kindergartners attending private schools were built into the study.

Sampling for the ECLS-K involved a dual-frame, multistage sampling design. The first stage of sampling involved the selection of 100 primary sampling units (PSUs) from a national sample of PSUs. The PSUs were counties and county groups. Public and private schools were then selected within the PSUs, and students were sampled from the selected schools. Approximately 23 kindergartners were selected in each of the sampled schools. In the spring of first grade, the sample was freshened to obtain a nationally representative sample of first-graders by bringing into the study first-graders who were not enrolled in kindergarten during the 1998–99 school year and therefore did not have an opportunity for selection in the base year. Freshening was carried out during the first-grade year because a small, but significant, number of children began formal schooling in first grade as opposed to kindergarten when the cohort was initiated. The sample was not freshened in grades 3, 5, or 8.

All students still enrolled in their previous-year schools were recontacted for subsequent rounds of data collection, while students who had transferred from their previous-year schools were subsampled in grades 1, 3, and 5. In the eighth-grade collection, ineligible students were those who had moved out of the country, who were deceased, or who had moved to another school and were not subsampled for follow-up in an earlier grade. In eighth grade, there was no subsampling of movers for follow-up as in previous rounds since the majority of students did not remain in the same school from fifth through eighth grade (having moved out of elementary school into middle school).

For information on the sampling design and sampling procedures at each round from kindergarten through eighth grade, refer to the *Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Combined User's Manual for the ECLS-K Eighth-Grade and K–8 Full Sample Data Files and Electronic Codebooks* (Tourangeau et al. 2009b).

Data collection

The data used in this report come from the fifth- and eighth-grade direct mathematics assessments, the fifth- and eighth-grade student questionnaires, the eighth-grade mathematics teacher questionnaires, the eighth-grade school administrator questionnaire, and the eighth-grade parent interviews. Spring fifth-grade data were collected from February through June 2004, with over 75 percent of the student assessments completed by the end of April; the eighth-grade direct student assessments were conducted from March through early June 2007, with about 81 percent of the eighth-grade assessments completed between March and April. In the eighth-grade data collection, students completed a student questionnaire during their

¹² The kindergarten 1998–99 data collection also included students who were in their second year of kindergarten during that school year and because of the sample freshening in first grade, the sample includes those who were repeating first grade in 1999–2000. These repeaters are included in the analyses in this report if they did not repeat another school year (i.e., if they were in eighth grade in the 2006–07 school year).

assessment time. The student questionnaire covered many topics related to the students' school experiences, school-sponsored and out-of-school activities, self-perceptions of social and academic competence and interests, weight and exercise, and diet. Eighth-graders' teachers were given questionnaires in the spring that covered information about themselves, their students, and their classrooms. All students' English teachers received a questionnaire, but due to limited resources, a random half of the students' mathematics teachers received questionnaires and the other half of the students' science teachers received questionnaires. School administrators completed questionnaires in the spring and provided details about the students and programs at their school. In the eighth-grade data collection during the fall and winter of 2006, parents completed a computer-assisted telephone interview that focused on a range of topics including sociodemographic characteristics and home activities.

Response rates and nonresponse bias analysis

A total of 944 of the 1,277 originally sampled schools participated during the base year of the study. This translates into a weighted response rate (weighted by the base weight) of 74 percent for the base year of the study. The weighted student base-year survey response rate was 88 percent (i.e., 88 percent of the students were assessed at both rounds in kindergarten). The weighted parent base-year unit response rate was 84 percent (i.e., a parent interview was completed at both rounds in kindergarten) (Tourangeau et al. 2009b). Thus, the overall base-year response rate for students was 65 percent (i.e., 74 percent of schools x 88 percent of sampled students), and the overall base-year response rate for the parent interview was 62 percent (i.e., 74 percent of schools x 84 percent of parents of sampled students). About 87 percent of the students and 84 percent of students' parents eligible for the first-grade data collection (spring 2000) participated; about 80 percent of students and 77 percent of students' parents eligible for the third-grade data collection (spring 2002) participated; about 84 percent of the students and 88 percent of students' parents eligible for the fifth-grade data collection (spring 2004) participated; and about 75 percent of students and 71 percent of students' parents eligible for the eighth-grade data collection (spring 2007) participated (Tourangeau et al. 2009b). The overall eighth-grade response rate for students was 55 percent and the overall response rate for the parent interview was 53 percent.

A nonresponse bias analysis was conducted to determine if substantial bias was introduced as a result of the base-year school nonresponse. Findings from this analysis suggest that there was not a substantial bias due to nonresponse. For information on the nonresponse bias analysis, refer to the *ECLS-K, Base Year Public-Use Data File, Kindergarten Class of 1998–99: Data Files and Electronic Code Book (Child, Teacher, School Files), and User's Manual* (U.S. Department of Education

2001). As in most longitudinal surveys, nonresponse in the ECLS-K generally increased as the sample aged. Chapter 6 of the *Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Eighth-Grade Methodology Report* (Tourangeau et al. 2009a) and the *Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Fifth-Grade Methodology Report* (Tourangeau, Lê, and Nord 2005) include an examination of the potential for nonresponse bias using three methods: (1) a comparison of respondents and nonrespondents using data available from the sampling frame, (2) a multivariate analysis to identify the characteristics of cases most likely to respond, and (3) an analysis of attrition bias applicable to longitudinal studies. Nonresponse bias of the estimates from the fifth- and eighth-grade samples was present, but small, and was corrected, at least in part, through weight adjustments.

The item nonresponse rates for the variables used in this report are low, ranging from 0 to about 2.5 percent for the analysis sample. A few of the variables were imputed to replace missing data (e.g., mother's education). More information on item nonresponse can be found in the *Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Combined User's Manual for the ECLS-K Eighth-Grade and K–8 Full Sample Data Files and Electronic Codebooks* (Tourangeau et al. 2009b).

Weighting, variance estimation, and tests of significance

The ECLS-K data are weighted to account for unequal probabilities of selection at each sampling stage and to adjust for the effects of school, student, teacher, and parent nonresponse. A brief description of the weighting process follows. The first stage of the weighting process assigns weights to the sampled PSUs that are equal to the inverse of their probability of selection.¹³ The second stage of the weighting process assigns weights to the schools sampled within PSUs. The base weight for each sampled school is the PSU weight multiplied by the inverse of the school's probability of selection. The base weights for eligible schools are adjusted for nonresponse. These adjustments are made separately for public and private schools.

The base weight for each student in the sample is the school nonresponse-adjusted weight for the school the student attends multiplied by a poststratified within-school student weight (total number of students in the school divided by the number of students sampled in the school). The child cross-sectional weight (C7CPTM0), which is the weight used to produce the estimates found in this report, is the base-year child weight adjusted for nonresponse to the student assessments, the parent interviews, and the mathematics teacher questionnaire at the eighth-grade

¹³ The approach used to develop weights for the ECLS-K is described in the *Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Combined User's Manual for the ECLS-K Eighth-Grade and K–8 Full Sample Data Files and Electronic Codebooks* (Tourangeau et al. 2009b).

round.¹⁴ This weight sums to the population of all students who attended kindergarten in the fall of 1998 or first grade in the spring of 2000.

In addition to properly weighting the responses, special procedures for estimating the statistical significance of the estimates were employed because the data were collected using a complex sample design.¹⁵ Complex sample designs, like that used in the ECLS-K, result in data that violate the assumptions that are normally required to assess the statistical significance of results. Frequently, standard errors of estimates based on complex samples are larger than those based on simple random samples. Replication methods of variance estimation were used to reflect the multistage sample design used in the ECLS-K. Using AM statistical software,¹⁶ the jackknife replication method (JK2) was used with 90 ECLS-K replicate weights to compute approximately unbiased estimates of the standard errors of the estimates in this report.¹⁷

Statistical procedures

Comparisons made in the text were tested for statistical significance at the $p < .05$ level to ensure that the differences were larger than might be expected due to sampling variation. When comparing estimates between categorical groups (e.g., sex, race/ethnicity), t statistics were calculated. The formula used to compute the t statistic was

$$t = Est_1 - Est_2 / (\text{SQRT}[(se_1)^2 + (se_2)^2])$$

where Est_1 and Est_2 are the estimates being compared and se_1 and se_2 are their corresponding standard errors. No adjustments were made for multiple comparisons. In this report, a “substantive difference” for comparisons of percentages is defined as a difference of 5 percentage points or greater. Differences discussed in the text of this report are both statistically significant and substantive.

It is important to note that many of the variables examined in this Brief may be related to one another and to other variables not included in the analyses. The complex interactions and relationships among the variables were not fully explored in this report and warrant more extensive analysis. Furthermore, the variables examined here are just a few of those that could be examined in these data and other variables related to algebra enrollment may not

be represented in this report. Readers are cautioned not to draw causal inferences based on the results presented.

The coefficient of variation (C_v) represents the ratio of the standard error to the estimate. The C_v is an important measure of the reliability and accuracy of an estimate. In this report, the C_v was calculated for all estimates, and in cases where the C_v was at least 30 percent the estimates were noted with a ! symbol (interpret data with caution). In cases where the C_v was greater than 50 percent, the estimate was determined not to meet reporting standards and was suppressed.

Standard errors can be found in appendix A.

Glossary: Constructs and Variables Used in the Analysis

Direct cognitive mathematics assessments

The ECLS-K fifth- and eighth-grade direct cognitive assessment batteries were designed to assess students’ academic achievement in reading, mathematics, and science in the fifth and eighth grades and to provide a means of measuring growth since kindergarten entry.¹⁸ The cognitive assessments used in the study (for K–1 and grades 3, 5, and 8) were administered using two-stage adaptive tests with multiple test forms of varying difficulties to maximize the accuracy of measurement and reduce administration time. Overlapping items for the test forms within a grade as well as across grades link the forms to a vertical scale for measuring longitudinal gains. The assessments for K–1 and grades 3 and 5 were individually administered by trained assessors using computer-assisted technology and small easel test books of the test items. The assessor first administered a routing test for a particular content area followed by a second-stage test at the level determined by the student’s scores on the routing test. In the eighth grade, students completed the two-stage assessments in proctored groups, with a routing test followed by a second-stage test. Unlike the assessments administered at earlier grades, the eighth-grade assessments were self-administered paper-and-pencil tests.

The fifth- and eighth-grade mathematics assessments included increasingly difficult items that addressed the following content strands: number sense, properties, and operations; measurement; geometry and spatial sense; data analysis, statistics, and probability; and patterns, algebra, and functions. Cognitive processes (conceptual, procedural, and problem solving) were assessed in each of the strands. Some of the items drew upon knowledge from more than one strand. For example, an item might require that a student apply knowledge about geometry, measurement, and number operations to answer the question correctly. For some of the analyses in this report, the students’ fifth-grade mathematics scores are converted

¹⁴ Students received a valid student assessment weight if they participated in any part of the student assessment, such as the height and weight measurements. Thus, students who were unable to take the cognitive assessments because of a disability could still have a valid student assessment weight.

¹⁵ For more details about sampling error and nonsampling error, please see the *Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Combined User’s Manual for the ECLS-K Eighth-Grade and K–8 Full Sample Data Files and Electronic Codebooks* (Tourangeau et al. 2009b).

¹⁶ AM statistical software is designed to calculate estimates and appropriate standard errors for multistage, stratified, and unequal probability sample designs.

¹⁷ Details about the paired jackknife replication method are provided in the *Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Combined User’s Manual for the ECLS-K Eighth-Grade and K–8 Full Sample Data Files and Electronic Codebooks* (Tourangeau et al. 2009b).

¹⁸ Science achievement was assessed in third grade as well as in the fifth and eighth grades.

into quintiles; that is, the weighted distribution of the fifth-grade scores is grouped into five ordered groups, each representing about 20 percent of the cohort of students who were in the eighth grade in 2007.

School characteristics

Region. The state or jurisdiction of the school was used to create a variable to reflect the four geographical regions of the country according to the Bureau of the census classification scheme. States and jurisdictions included in each region are as follows: the Northeast includes CT, ME, MA, NH, RI, VT, NJ, NY, PA; the Midwest includes IL, IN, MI, OH, WI, IA, KS, MN, MO, NE, ND, SD; the South includes DE, DC, FL, GA, MD, NC, SC, VA, WV, AL, KY, MS, TN, AR, LA, OK, TX; and the West includes AZ, CO, ID, MT, NV, NM, UT, WY, AK, CA, HI, OR, WA.

School type. This variable indicates whether a student attended a public or private school in the spring of eighth grade. Public schools included Bureau of Indian Education and tribal schools, public schools of choice (e.g., charter schools), and public schools with magnet programs. Private schools included Catholic schools, other religious private schools, and nonreligious private schools.

School's level of algebra enrollment. An item in the school administrator questionnaire had school principals indicate the percentage of all eighth-grade students at the school who were enrolled in algebra. For some analyses presented in this paper, this variable was changed from a continuous (0 to 100 percent) variable to a categorical variable of eighth-grade algebra enrollment levels (i.e., less than 25 percent, between 25 and 74 percent, and 75 percent or more).

Students' course enrollment, educational expectations, and enjoyment of mathematics

Mathematics course enrollment. Students' mathematics teachers indicated the name of the course in which the student was enrolled. The options were general mathematics, introduction to algebra/pre-algebra, algebra I, integrated or sequential mathematics, algebra II, and geometry.

Educational expectations. Students were asked the question, "As things stand now, how far in school do you think you will get?" The eight response options were less than high school graduation; high school graduation or GED only; attend or complete a 2-year program in a community college or vocational school; attend college, but not complete a 4-year degree; graduate from a 4-year college; obtain a master's degree or the equivalent; obtain a Ph.D., M.D., or other advanced degree; and don't know. For this report, these responses were collapsed into four categories: less than a 4-year college degree; a 4-year college degree; beyond a 4-year college degree; and don't know.

Enjoyment of mathematics. In both the fifth and eighth grades, students responded to a series of questionnaire

statements by indicating how true each statement was for them: not at all true, a little bit true, mostly true, or very true. This report analyzes student responses to the statement "I like math" at both grades.

Student and family characteristics

A number of the variables used in this report were derived by combining information from one or more questions in the ECLS-K study instruments. More information on the derivation of key variables is contained in chapter 7 of the *Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Combined User's Manual for the ECLS-K Eighth-Grade and K–8 Full Sample Data Files and Electronic Codebooks* (Tourangeau et al. 2009b).

Grade level of student. To create the grade-level composite, two sources of grade-level data were used: information from the special education teacher part B questionnaire (for those students who had a special education teacher) and information collected about each student from the schools by the field staff.

Student's sex. This composite is brought forward from information originally confirmed in the fall kindergarten parent interview. If the parent interview indicated a sex different from that in the field management system, the parent interview information took priority.

Student's race/ethnicity. In the spring of eighth grade, the race/ethnicity of the focal student was no longer collected in the parent interview; thus, race/ethnicity information is based on the race/ethnicity collected in previous parent interviews and the field management system. The race/ethnicity composite is constructed from two parent-reported variables: ethnicity and race. Following the 1997 Office of Management and Budget guidelines, respondents were allowed to indicate that their child belonged to more than one of the following race categories: White, Black or African American, American Indian or Alaska Native, Asian, or Native Hawaiian or other Pacific Islander. In addition, each respondent was asked to identify whether the student was Hispanic. The following are the five composite race/ethnicity categories presented in this report: White, not Hispanic; Black, not Hispanic; Hispanic; Asian, not Hispanic; and Other, not Hispanic (which includes Native Hawaiians, Pacific Islanders, American Indians, Alaska Natives, and non-Hispanic students of two or more races). When race/ethnicity differences are presented in this report, White refers to White, not Hispanic; Black refers to Black, not Hispanic; Asian refers to Asian, not Hispanic; and Other refers to other, not Hispanic.

Poverty status. The federal poverty-level status composite variable is derived from household income and the total number of household members. Federal poverty thresholds are used to define households below the poverty level. Households whose income fell below the appropriate threshold based on census information from 2006 were classified as living in poverty. For example, if a household

contained four members, and the household income was lower than \$20,614, the household was considered to be below the poverty threshold.

Mother's highest level of education. This composite is derived from parent interview information on the mother's educational attainment. Missing data were imputed using hot-deck procedures. The 406 students without a mother in the household in the eighth-grade year do not have data for this variable and are excluded from analyses related to mother's education. For this report, the composite was collapsed into a four-category variable: less than high school, high school diploma or the equivalent, some college or vocational technical degree, and bachelor's degree or higher. Those with an associate's degree are included with "some college or vocational technical degree."

Family type. This composite is derived from parent interview information on the number of parents in the home. For this report, the composite was collapsed into a three-category variable: two parents, single parent, and other. "Other" households include related and/or unrelated guardians. The tables do not include estimates for the "other" category because there are too few students in the sample with this family type to produce stable estimates.

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For more information on the Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), visit <http://nces.ed.gov/ecls/>. To order additional copies of this Statistics in Brief or other NCES publications, call 1-877-4ED-PUBS or visit <http://www.edpubs.gov>. NCES publications are also available on the Internet at <http://nces.ed.gov>.

Appendix A. Standard Error Tables

Table A-1. Standard errors for table 1: Percentage distribution of mathematics course enrollment of ECLS-K spring 2000 first-grade cohort eighth-graders, by student, family, and school characteristics: Spring 2007

Characteristic	Mathematics course				
	General mathematics	Introduction to algebra/pre-algebra	Algebra or a course more advanced than algebra		
			Total	Algebra	An advanced course other than algebra
Total	1.1	1.6	1.3	0.8	1.4
Sex					
Male	1.4	2.2	1.9	1.8	0.8
Female	1.5	2.1	1.9	1.8	1.1
Race/ethnicity					
White, not Hispanic	1.0	1.9	2.0	1.8	1.0
Black, not Hispanic	3.3	4.0	3.6	3.4	†
Hispanic	3.2	3.4	3.1	2.9	1.2
Asian, not Hispanic	6.4	3.4	6.1	5.4	4.1
Other, not Hispanic	6.8	7.8	6.3	5.7	2.6
Poverty status					
Below federal poverty level	3.7	3.9	2.6	2.5	†
At or above federal poverty level	1.0	1.7	1.6	1.5	0.8
Mother's education					
Less than high school	3.5	5.1	3.3	3.3	†
High school diploma or equivalent	3.0	3.4	2.6	2.3	1.0
Some college or vocational technical degree	1.7	2.4	2.3	2.1	1.2
Bachelor's degree or higher	1.4	2.4	2.4	2.4	1.5
Family type					
Two parents	1.3	1.9	1.8	1.6	0.8
Single parent	1.9	3.3	3.0	2.9	1.3
Region					
Northeast	1.7	2.9	3.1	3.0	2.0
Midwest	2.0	3.6	3.1	2.7	0.9
South	2.4	2.6	1.8	1.5	1.4
West	2.4	4.0	3.8	3.7	1.8
School type					
Public school	1.2	1.8	1.6	1.4	0.8
Private school	2.8	3.4	3.7	3.8	1.9

† Not applicable.

NOTE: Standard errors were estimated with replicate weights C7CPTM1 through C7CPTM90.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K), Kindergarten-Eighth Grade Full Sample Public-Use Data File.

Table A-2. Standard errors for table 2: Percentage distribution of ECLS-K spring 2000 first-grade cohort eighth-graders who attended schools with various levels of eighth-grade student enrollment in algebra, by student, family, and school characteristics: Spring 2007

Characteristic	Principals' report of the percentage of all eighth-grade students at the school enrolled in algebra		
	Less than 25 percent	25 to 74 percent	75 percent or more
Total	1.9	1.9	1.0
Sex			
Male	2.4	2.5	1.5
Female	2.2	2.1	1.0
Race/ethnicity			
White, not Hispanic	2.3	2.3	1.1
Black, not Hispanic	5.7	5.0	2.9
Hispanic	3.3	3.6	2.8
Asian, not Hispanic	6.0	6.2	5.9
Other, not Hispanic	7.1	6.0	3.4
Poverty status			
Below federal poverty level	3.4	3.3	2.5
At or above federal poverty level	2.1	2.1	1.0
Mother's education			
Less than high school	6.1	6.1	4.2
High school diploma or equivalent	3.3	2.7	1.8
Some college or vocational technical degree	3.0	2.9	1.6
Bachelor's degree or higher	2.6	3.0	1.6
Family type			
Two parents	2.2	2.2	1.1
Single parent	3.1	2.8	1.7
Region			
Northeast	3.6	3.6	2.2
Midwest	3.8	3.1	2.1
South	3.5	3.4	1.1
West	3.1	3.4	3.1
School type			
Public school	2.1	2.0	1.1
Private school	4.0	4.1	3.5

NOTE: Standard errors were estimated with replicate weights C7CPTM1 through C7CPTM90.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K), Kindergarten–Eighth Grade Full Sample Public-Use Data File.

Table A-3. Standard errors for table 3: Average ECLS-K spring 2000 first-grade cohort's eighth-grade mathematics scores, by mathematics course, student, family, and school characteristics: Spring 2007

Characteristic	Total	Eighth-grade mathematics course	
		Not in algebra	Algebra or a course more advanced than algebra
Total	0.65	0.84	0.70
Sex			
Male	0.96	1.22	0.86
Female	0.90	1.07	1.08
Race/ethnicity			
White, not Hispanic	0.84	1.18	0.70
Black, not Hispanic	1.66	1.83	3.82
Hispanic	1.17	1.30	1.79
Asian, not Hispanic	3.71	7.33	1.79
Other, not Hispanic	3.06	3.39	2.60
Poverty status			
Below federal poverty level	1.56	1.79	2.36
At or above federal poverty level	0.61	0.93	0.68
Mother's education			
Less than high school	1.71	1.93	4.08
High school diploma or equivalent	1.45	1.73	1.51
Some college or vocational technical degree	0.91	1.01	1.40
Bachelor's degree or higher	0.72	1.35	0.72
Family type			
Two parents	0.69	0.91	0.65
Single parent	1.36	1.66	1.79
Region			
Northeast	1.35	2.06	1.21
Midwest	1.75	1.89	1.16
South	1.14	1.35	1.52
West	1.26	2.00	1.61
School's eighth-grade algebra enrollment			
Less than 25 percent	1.01	1.23	1.35
25 to 74 percent	1.09	1.72	0.83
75 percent or more	1.85	4.51	2.24
School type			
Public school	0.67	0.85	0.73
Private school	1.63	2.35	1.77

NOTE: Standard errors were estimated with replicate weights C7CPTM1 through C7CPTM90.

SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998-99 (ECLS-K), Kindergarten-Eighth Grade Full Sample Public-Use Data File.

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