Denton, K., & West, J. (2002). Children's reading and mathematics achievement in kindergarten and first grade. Executive summary. Washington, DC: National Center for Education Statistics.

Executive Summary

Children's experiences with school are almost as varied as children themselves. This report is the third in a series based on findings about young children's early experiences with school from the Early Childhood Longitudinal Study, Kindergarten Class of 1998–99 (ECLS-K). Sponsored by the U.S. Department of Education, National Center for Education Statistics (NCES), the ECLS-K selected a nationally representative sample of kindergartners in the fall of 1998 and is following these children through the spring of fifth grade. The study collects information directly from the children, their families, teachers, and schools. The full ECLS-K base-year sample is comprised of approximately 22,000 children who attended about 1,000 kindergarten programs during the 1998–99 school year.

The first two reports, *America's Kindergartners* (West, Denton, and Germino Hausken 2000) and *The Kindergarten Year* (West, Denton, and Reaney 2001)**,** provided a national picture of the knowledge and skills of children at kindergarten entry and across the kindergarten year. Both reports revealed that while first-time kindergartners are similar in many ways, their knowledge and skills differ in relation to their age at school entry, race/ethnicity, health status, home educational experiences, and child care histories.

This report presents a picture of these children as first-graders.[1] The first two reports laid the foundation for a basic understanding of children's achievement across the kindergarten year. This report continues the story by providing information about children's knowledge and skills in the first-grade year. The report looks at children's school performance in terms of their reading and mathematical knowledge and skills. To address the multifaceted nature of children's development, this report relates children's reading and mathematical knowledge and skills to child, family, and school characteristics. Whereas prior reports (i.e., *The Kindergarten Year)* specifically addressed the gains children made in reading and mathematics across the school year, this report will focus more on the status of children's reading and mathematics achievement in the spring of kindergarten and the spring of first grade. Taking a broad view of child development, the report explores how children's literacy, approaches to learning, and general health status at kindergarten entry relate to their spring kindergarten and first grade reading and mathematics knowledge and skills.

[1] First-graders refers to first-time kindergartners who were promoted to first grade in the fall of 1999. For further detail, see the *Analytic Sample* section of this report.

When conceptualizing literacy in young children, since young children's reading and mathematical ability are highly related, it is important to consider not only their reading skills but also their reading environment and their mathematical reasoning skills (West, Denton, and Germino Hausken 2000; National Research Council 1989; National Institutes of Health 2000). Recognizing numbers (i.e., math skills) and recognizing letters (i.e., reading skills) both represent a child's ability to understand that symbols have meaning. Therefore, this report provides information on multiple aspects of children's early literacy, such as their ability to recognize letters, the frequency with which they are read to, and their ability to recognize numbers, shapes, and understand the relative size of objects.

Findings[2]

This section presents highlights of the findings. The report uses data from the ECLS-K to address the following questions:

- What reading and mathematics knowledge and skills do children demonstrate in the spring of first grade? Do children's knowledge and skills differ by certain child, family, and school characteristics?
- What is the relationship of children's early literacy, approaches to learning, and general health status as they enter kindergarten to their spring kindergarten and first grade reading and mathematics achievement? In particular, how do the following resources relate to children's spring kindergarten and spring first-grade achievement:
  - proficiency in recognizing letters,
  - being read to at least three times a week,
  - proficiency in recognizing numbers and basic shapes,
  - proficiency in the mathematical concept of relative size,
  - demonstrating a positive approach to learning often or very often, and
  - being in very good to excellent general health?

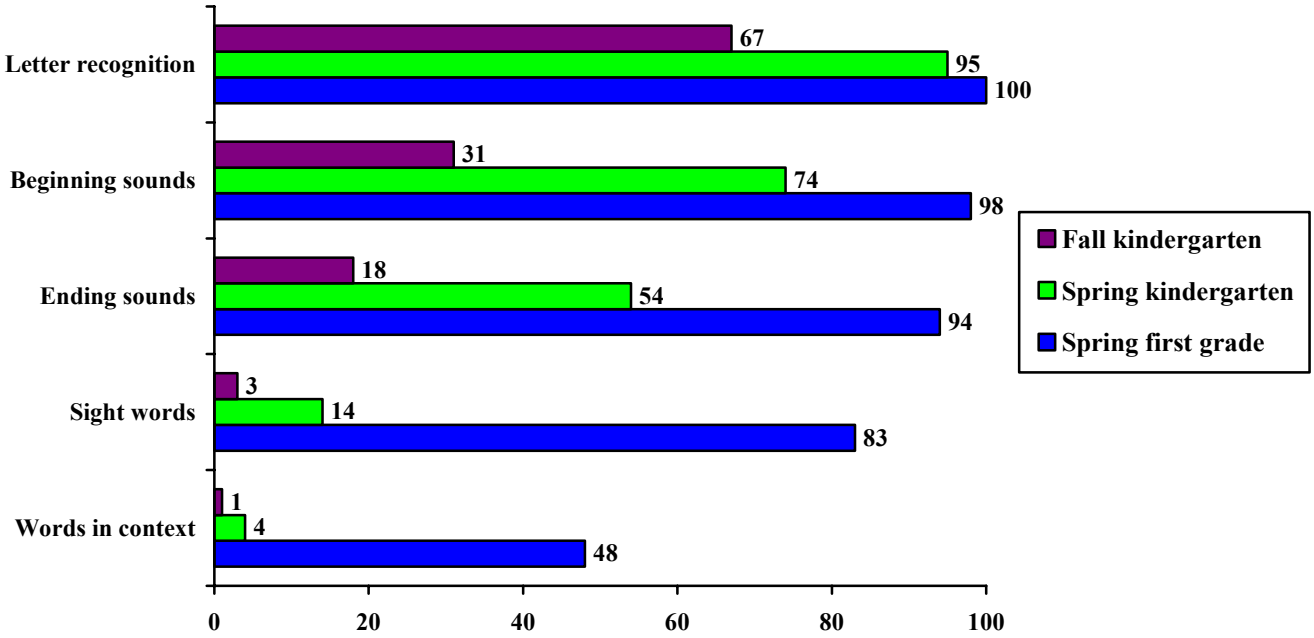
[2] In an effort to provide information on the early education experiences of the typical child (i.e., one who spent 1 year in kindergarten and then continued on to first grade), the children included in the analysis entered kindergarten for the first time in fall of 1998 and were promoted on time to first grade in the fall of 1999. Further, since this report provides information on children's early reading achievement, and the reading assessment was administered in English, the analyses in this report are limited to those children who were administered the English reading assessment. For more information, see the *Analytic Sample* section of the report. To achieve consistency in the sample across rounds (i.e., fall kindergarten, spring kindergarten and spring first grade), the analyses in this report are limited to those children who were assessed in English in all three rounds of data collection.

What reading and mathematics knowledge and skills do children demonstrate in the spring of first grade? Do children's knowledge and skills differ by certain child, family, and school characteristics?

What Children Know

When children begin kindergarten, 67 percent recognize their letters. By the spring of kindergarten, most (95 percent) know the letters of the alphabet; and after 2 years of school, essentially all children (100 percent) can recognize the letters of the alphabet. At kindergarten entry, about one-third (31 percent) of children understand the letter-sound relationship at the beginning of words and about one in six children (18 percent) understand the letter-sound relationship at the end of words. By the spring of kindergarten, about three-quarters (74 percent) of children make the letter-sound connection at the beginning of words and just over half (54 percent) of children make this connection at the ending of words. By the spring of first grade, almost all children have mastered these reading skills (98 and 94 percent, respectively) (figure A). By the spring of first grade, about five in six children (83 percent) recognize common words by sight (sight words), and about one-half (48 percent) of children understand words in context (compared to 14 and 4 percent, respectively, in the spring of kindergarten) (figure A, table 1).

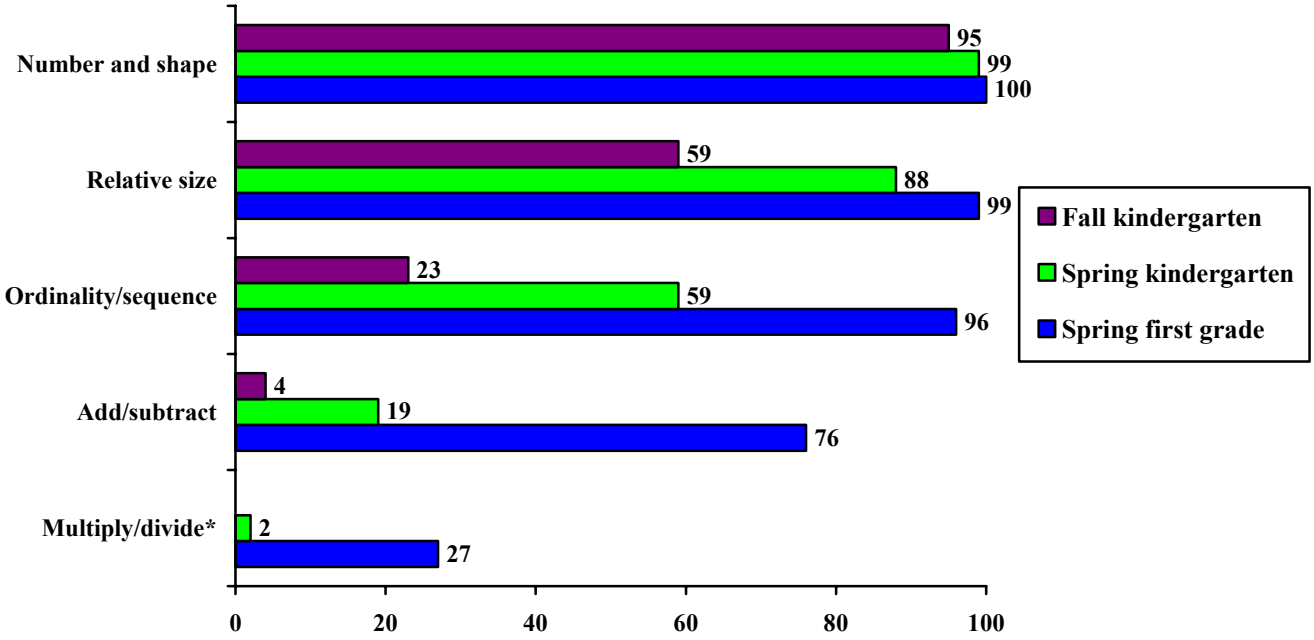
Figure A.—Percentage of children demonstrating specific reading knowledge and skills for fall kindergarten, spring kindergarten, and spring first grade: 1998–99 and 2000



NOTE: Estimates reflect children assessed in English in all three rounds of data collection and who entered kindergarten for the first time in the fall of 1998 and were promoted to first grade in the fall of 1999. The estimates in this report do not exactly match those found in previous reports based on the same data. This report uses a different weight in making the estimates, which is stricter in its response requirements and utilizes a slightly smaller sample of children. For more information, see the *Analytic Sample* section of this report.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99, Base Year Public-Use and First Grade Restricted-Use data files.

By the spring of kindergarten, a large percentage (88 percent) of children understand the concept of relative size (e.g., can count beyond 10 and understand and can use nonstandard units of length to compare objects). By the spring of first grade, most children (96 percent) have mastered ordinality and sequence (the understanding of the relative position of objects); and about three-quarters (76 percent) demonstrate proficiency in adding and subtracting basic whole units. Moreover, by the spring of first grade, about one-quarter (27 percent) demonstrate proficiency in multiplying and dividing simple whole units (figure B, table 2).

Figure B.—Percentage of children demonstrating specific mathematics knowledge and skills for fall kindergarten, spring kindergarten, and spring first grade: 1998–99 and 2000



*The fall kindergarten estimate for the percentage of children demonstrating proficiency in multiplication and division is less than .5 percent.
NOTE: Estimates reflect children assessed in English in all three rounds of data collection and who entered kindergarten for the first time in the fall of 1998 and were promoted to first grade in the fall of 1999. The estimates in this report do not exactly match those found in previous reports based on the same data. This report uses a different weight in making the estimates, which is stricter in its response requirements and utilizes a slightly smaller sample of children. For more information, see the *Analytic Sample* section of this report.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99, Base Year Public-Use and First Grade Restricted-Use data files.

What Children Know, by Child, Family, and School Characteristics

Differences in children's achievement (as represented by their overall achievement score) by their family's poverty status, race/ethnicity, and school type persist from kindergarten through the spring of first grade. However, children's overall reading and mathematics achievement does not vary by their sex (tables 3 and 4).

Differences (or lack of differences) in overall achievement scores only tell part of the story. Another way to think about how certain child and family characteristics relate to their spring achievement is in terms of children's acquisition of *specific* reading and mathematics knowledge and skills. Whether or not certain groups of children acquire certain skills or sets of skills may add meaning to an overall achievement score difference.

In terms of specific first-grade reading and mathematics skills and knowledge, females are more likely to recognize words by sight and understand words in context than males. Males and females are equally likely to be adding and subtracting; but, in the spring of first grade, males are more likely than females to solve problems that require multiplication and division. Simply stated, by the spring of first grade, females are more likely to be reading and males are more likely to be successful at advanced mathematical operations (i.e., multiplication and division) (tables 1 and 2).

When considering the poverty status of children's families from the kindergarten year, first-graders from nonpoor families are more likely to recognize words by sight than first-graders from poor families. The same is true for addition and subtraction. Moreover, about twice as many first-graders from nonpoor families are proficient at understanding words in context and performing multiplication and division as first-graders from poor families (tables 1 and 2).

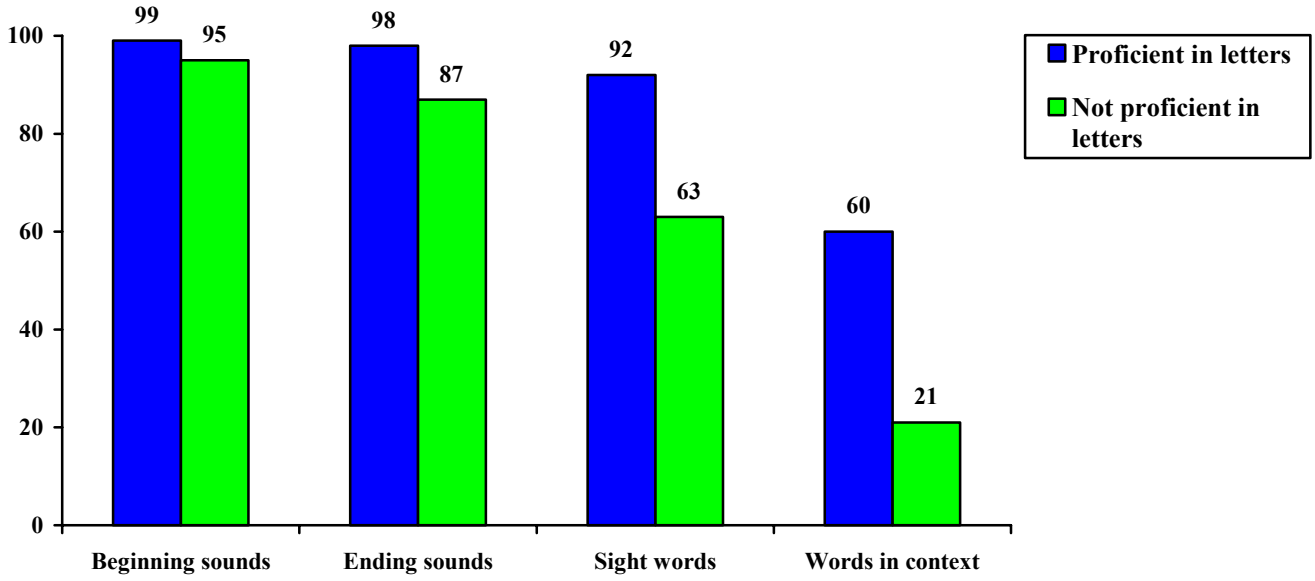
There are also differences by children's race/ethnicity. White children are more likely than Black or Hispanic children to recognize words by sight, understand words in context, solve addition and subtraction problems, and solve multiplication and division problems by the spring of first grade. Asian children are more likely than Black or Hispanic children to recognize words by sight, understand words in context, and solve multiplication and division problems. In the spring of first grade, Hispanic children are more likely than Black children to demonstrate proficiency in these particular reading and mathematics areas (tables 1 and 2).

What is the relationship of children's early literacy, approaches to learning, and general health status as they enter kindergarten to their spring kindergarten and first grade reading and mathematics achievement?

Children who recognize their letters, who are read to at least three times a week, who recognize their basic numbers and shapes, and who demonstrate an understanding of the mathematical concept of relative size as they enter kindergarten demonstrate significantly higher overall reading and mathematics knowledge and skills (in terms of an overall scale score) in the spring of kindergarten and the spring of first grade than children who do not have these resources. The same pattern is true for children who frequently demonstrate a positive approach to learning and who are in very good to excellent health as they enter kindergarten (tables 6 and 7).

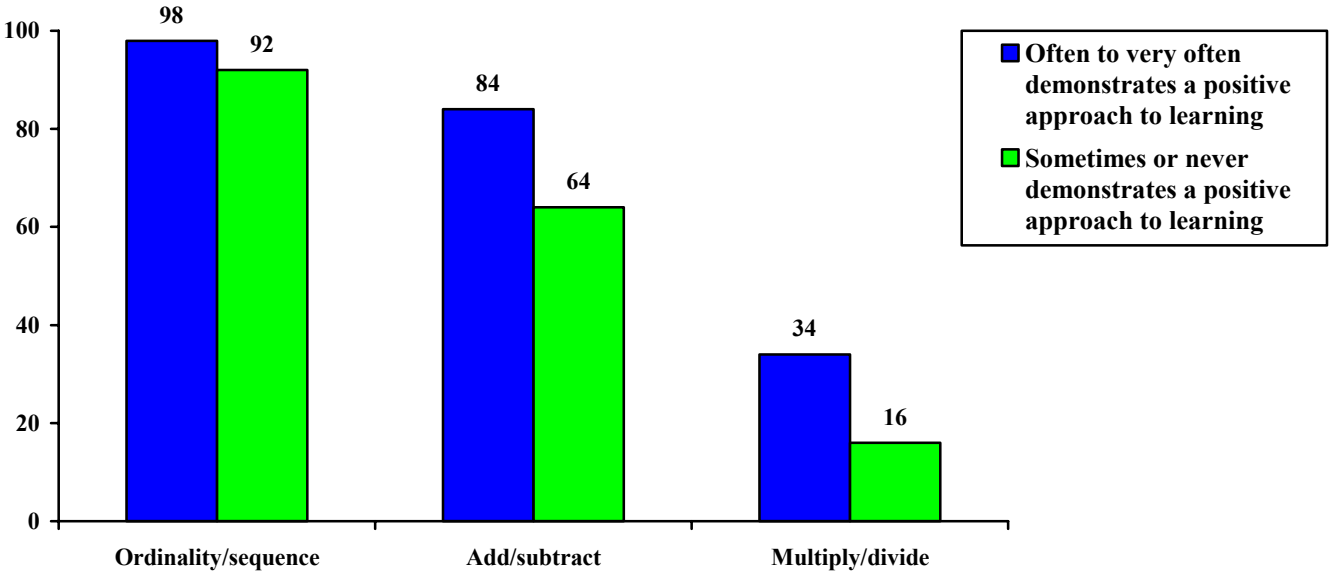
An analysis of the specific skills children acquire shows that children who recognize their letters, who are read to at least three times a week, who recognize their basic numbers and shapes, and who demonstrate an understanding of the mathematical concept of relative size as they enter kindergarten are more likely to understand the letter-sound relationship at the beginning and ending of words, read words by sight, and understand words in context by the spring of first grade (figure C, table 8). In mathematics, children who recognize their letters, who are read to at least three times a week, who recognize their basic numbers, and shapes, and who demonstrate an understanding of the mathematical concept of relative size as they enter kindergarten are more likely to understand the mathematical concept of ordinality and sequence, successfully solve addition and subtraction problems, and successfully solve multiplication and division problems. The same pattern is true for children who frequently demonstrate a positive approach to learning and for those who are in very good to excellent health as they enter kindergarten (tables 8 and 9, figure D).

Figure C.—Percentage of children demonstrating specific reading knowledge and skills in the spring of first grade by whether they were proficient in recognizing their letters at kindergarten entry: 2000



NOTE: Estimates reflect children assessed in English in all three rounds of data collection and who entered kindergarten for the first time in the fall of 1998 and were promoted to first grade in the fall of 1999. The estimates in this report do not exactly match those found in previous reports based on the same data. This report uses a different weight in making the estimates, which is stricter in its response requirements and utilizes a slightly smaller sample of children. For more information, see the *Analytic Sample* section of this report.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99, Base Year Public-Use and First Grade Restricted-Use data files.

Figure D.—Percentage of children demonstrating specific mathematics knowledge and skills in the spring of first grade by their approach to learning at kindergarten entry: 2000



NOTE: Estimates reflect children assessed in English in all three rounds of data collection and who entered kindergarten for the first time in the fall of 1998 and were promoted to first grade in the fall of 1999. The estimates in this report do not exactly match those found in previous reports based on the same data. This report uses a different weight in making the estimates, which is stricter in its response requirements and utilizes a slightly smaller sample of children. For more information, see the *Analytic Sample* section of this report.
SOURCE: U.S. Department of Education, National Center for Education Statistics, Early Childhood Longitudinal Study, Kindergarten Class of 1998–99, Base Year Public-Use and First Grade Restricted-Use data files.

Summary

Children begin kindergarten with different sets of knowledge and skills. Children's reading and mathematics knowledge and skills that differ by child, family, and school characteristics at the beginning of kindergarten persist into the spring of kindergarten and the spring of first grade. The findings in this report also suggest the beginnings of differences in children's reading and mathematics performance by their sex. By the spring of first grade, females are more likely to be reading, whereas males are more likely to be proficient at advanced mathematics (i.e., multiplication and division). The longitudinal nature of the ECLS-K will enable researchers to track these differences in terms of children's third and fifth grade reading and mathematics performance.

Children who begin kindergarten with certain resources seem to be at an advantage. Children who demonstrate early literacy skills and who come from a positive literacy environment, who possess a positive approach to learning, and who enjoy very good or excellent general health seem to perform better

after 1 and even 2 years of formal schooling than children who do not have these resources. Specifically, these children perform better in spring kindergarten and spring first-grade reading and mathematics.

This third report from the ECLS-K, in conjunction with *America's Kindergartners* and *The Kindergarten Year*, provides descriptive information on young children's achievement across kindergarten and first grade. The ECLS-K will continue to follow these children into third and fifth grades. The study will provide researchers not only with an understanding of how children's early literacy, approaches to learning, and general health status at kindergarten entry shape their later achievement but also of how these resources need to be maintained and further developed for continued scholastic success. The valuable information collected through this study will help us better understand the early education and elementary school experience of our nation's children.