

Curriculum Associates RESEARCH

State of Student Learning in 2023

Reading and Mathematics
Annual Report | August 2023

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Research Summary | August 2023

Summary

At the end of the third full school year after initial school closures in March 2020, academic recovery remains stalled. The latest research from Curriculum Associates on the state of student learning in 2023 describes reading and mathematics achievement based on the results of the *i-Ready Diagnostic* assessment, which is administered to more than 11 million students in Grades K-8 in the United States. Results are from a nationally representative sample across three school years—2018–2019, 2021–2022, 2022–2023—and show that at the end of the 2022–2023 school year, academic achievement in Grades 1–8 in both reading and mathematics has been slow to rebound to pre-pandemic levels.

Introduction

In the three years since schools abruptly closed their doors in March 2020, researchers have thoroughly documented the academic impact of the COVID-19 pandemic on students. Curriculum Associates has continued to track student achievement on the *i-Ready Diagnostic* during this time period. Our research indicates substantial declines in the percentage of students achieving grade-level placements immediately after the initial shutdowns and slow academic recovery in the years since (Curriculum Associates, 2021; 2022). Overall, fewer students are placing on grade level while more students were placing more than two grade levels below their chronological grade. In addition, the school disruptions exacerbated historical inequities that existed between schools serving majority Black and Latino students and schools serving majority White students. Similarly, the disruptions worsened preexisting disparities between schools in low-income and high-income communities.

This report is our latest research on achievement among students in Grades K-8 who took the *i-Ready Diagnostic* for Reading and for Mathematics. The *i-Ready Diagnostic* was taken by more than 11 million students in the 2022-2023 school year. In this research, for the first time, Curriculum Associates used a nationally representative sample of students in three school years: 2018-2019, 2021-2022, and 2022-2023. The total sample size included 9,557,535 students for reading and 11,191,393 students for mathematics (inclusive of all grades and school years).

This analysis is a comprehensive look at student achievement in the 2022-2023 school year, compared to last year and one year prior to the pandemic. We examine student grade-level achievement and fall-to-spring growth in scale score points, and we provide data on student achievement in subject-specific domains to provide a deeper look at progress in reading and mathematics.

Methodology

Research Questions

The primary research questions addressed in this report are:

1. By grade level and subject, how does student achievement at the end of the 2022-2023 school year compare to achievement in the year prior (i.e., 2021-2022) and prior to the pandemic (i.e., 2018-2019)?
2. How does student achievement at the end of the 2022-2023 school year vary by the racial or ethnic makeup of schools and the median household income of schools' locations, and how does that compare to achievement in the year prior (i.e., 2021-2022) and prior to the pandemic (i.e., 2018-2019)?
3. By grade level and subject, how does fall-to-spring growth in the 2022-2023 school year compare to growth in the year prior (i.e., 2021-2022) and prior to the pandemic (i.e., 2018-2019)?

4. By grade level and subject, how does student achievement in subject-specific domains at the end of the 2022–2023 school year compare to achievement in the year prior (i.e., 2021–2022) and prior to the pandemic (i.e., 2018–2019)?

Sample Description

To provide a complete picture of student performance across the United States, we selected a sample that approximated the US Grades K–8 public school population on region, locale, and race/ethnicity as represented by the National Center for Education Statistics (NCES) and on median annual household income as represented by the US Census. This process involved three steps: (1) selecting a sampling frame of students and schools eligible for selection, (2) setting sampling targets to reflect the national public-school population, and (3) using stratified sampling at the school level to select a sample such that the frequencies of students in each of the desired demographic categories matched within plus or minus five percentage points of the sampling targets. These steps are described in detail below.

1. Selecting Sampling Frame

We first selected a sampling frame of students and schools eligible for selection. Eligible students had to have completed a Diagnostic in both the fall and spring testing windows.¹ Both Diagnostics were taken in English and were not flagged for rushing. Additionally, for the 2021–2022 and 2022–2023 sampling frames, students had to have self-reported taking both Diagnostics in school.²

The final step, stratified sampling, occurred at the school level and, therefore, required us to identify eligible schools. First, we only used schools where we have an established link between the *i-Ready* and NCES school IDs—more than 80% of the schools in *i-Ready*. Schools had to have non-missing race/ethnicity, locale, and zip code data in NCES (US Department of Education, 2022). Additionally, we required that the number of students in the sampling frame for a given school, subject, and grade level be between 75% and 150% of the NCES-reported enrollment for that school and grade level. Requiring that more than 75% of students took the *i-Ready* assessment ensured that the school-level demographic information could be used as a strong proxy for the demographics of those students in the sampling frame. Finally, the school zip code, as reported by NCES, had to have a matching row with the median annual household income from the US Census dataset (US Census Bureau, 2022).

2. Setting Sampling Targets

Sampling targets define the demographic distribution of the target population. They are used as the criterion against which we compare our stratified sample to ensure representativeness.

To create the sampling targets, we calculated the percentage of Black, Hispanic, and White students, as well as the percentage of students in each combination of geographic region (i.e., East, Midwest, South, and West) and locale (i.e., City, Suburb, and Town/Rural) by grade level from the

¹ The fall testing window is August 1 to November 15, while the spring testing window is March 2 to June 15.

² Starting in fall 2020, we asked students if they were taking the Diagnostic in the school building at the start of each testing session.

NCES data. Ideally, the sampling targets would be based on the population of students in the given school year. However, the NCES data lags by one school year. As such, we used the 2018–2019 NCES data to define the 2018–2019 sampling targets and the 2020–2021 NCES data—the latest data available at the time of this work—to define the 2021–2022 and 2022–2023 sampling targets. Finally, we merged median annual household income data from the US Census with the schools' zip code to create median annual income averages.

3. Using Stratified Sampling

The stratified sampling was conducted at the school level to select a sample of schools such that the frequencies of students in each of the desired demographic categories in the sample matched within plus or minus five percentage points of the sampling targets and the sample median annual household income matched within plus or minus five percentage points of the population value.

This was done as follows:

1. We compared the demographic distributions and median income of the sample against the sampling targets (starting with the sampling frame).

If the sampling criteria were not met:

2. We selected a stratified sample with the sample size equal to 98% of the sample from Step 1.

We repeated Steps 1 and 2 until we arrived at a sample where the demographic distributions matched within plus or minus five percentage points of the sampling targets. In Grades 7 and 8, we could not select a sample within plus or minus five percentage points without losing a very large percentage of schools and students in the sample. To maintain sample size consistency across grade levels, we allowed region and locale to vary within plus or minus seven percentage points in Grades 7 and 8.

We repeated the sampling process 10 times (i.e., 10 iterations with different seeds) per school year to select a total of 30 nationally representative samples per subject and grade level. After selecting the samples, we calculated the percentage of students who scored on grade level or above and the average spring scale score for each sample. Upon reviewing the results for the 10 iterations, we determined that the results were very consistent across the samples. The results reported represent non-weighted averages across the 10 samples in each school year, subject, and grade level.

Sample Description

The total sample size was 9,557,535 students for reading³ and 11,191,393 students for mathematics (inclusive of all grades and school years). The average sample sizes are large across all grades, subjects, and years, ranging from approximately 150,267 to 718,515 students. As illustrated in Table 1, in most cases, more than 90% of the sampling frame was included in the sample with exceptions in Grade 1 in 2021–2022 and Grades 1–5 in reading and Grades 1–5 and 8 in mathematics in 2018–2019.

³ We include Grade K in our Phonics analysis. Including Grade K adds 731,658 students, thereby increasing the overall reading sample to 10,289,193 students in those analyses.

Appendix Tables 1a-c, 2a-c, and 3a-c summarize the demographic, region by locale, and income variables, respectively, for the sampling targets (i.e., population) and the final samples by year, subject, and grade level.

Table 1. Number and Percentage of Students in Sampling Frame and Sample by Year, Grade, and Subject

Grade	2018–2019			2021–2022			2022–2023		
	N Sampling Frame	N Sample	% in Sample	N Sampling Frame	N Sample	% in Sample	N Sampling Frame	N Sample	% in Sample
Reading									
1	375,569	189,895	51%	536,139	374,608	70%	573,877	564,004	98%
2	434,792	225,551	52%	582,623	570,508	98%	538,359	528,491	98%
3	447,656	197,861	44%	627,732	614,840	98%	617,931	606,019	98%
4	447,154	307,203	69%	584,199	572,590	98%	601,257	589,882	98%
5	443,571	391,229	88%	590,244	577,891	98%	583,092	570,842	98%
6	289,417	284,398	98%	416,340	401,150	96%	433,850	348,441	80%
7	235,689	225,604	96%	319,975	312,703	98%	336,141	329,806	98%
8	200,899	186,730	93%	299,574	293,055	98%	299,934	294,234	98%
Mathematics									
1	372,246	204,448	55%	643,484	434,944	68%	707,371	694,926	98%
2	470,352	202,050	43%	708,056	695,000	98%	695,182	682,641	98%
3	487,734	176,120	36%	725,145	712,754	98%	731,206	718,515	98%
4	500,786	182,760	36%	698,358	686,196	98%	716,740	704,392	98%
5	499,801	437,665	88%	711,639	698,712	98%	699,781	687,011	98%
6	343,914	338,357	98%	537,397	528,313	98%	543,312	496,846	91%
7	264,367	242,140	92%	411,829	404,167	98%	429,329	421,767	98%
8	174,641	150,267	86%	342,187	335,833	98%	361,433	355,568	98%

Achievement Measure

Student achievement was measured with Curriculum Associates’ *i-Ready Diagnostic* for Reading and for Mathematics for Grades K–8 students. The Diagnostic is an online, interim, adaptive, and criterion-referenced assessment of student learning for reading and mathematics that is built on the college- and career-readiness standards and provides grade-level placements. In reading, the domains assessed are Phonological Awareness, Phonics, High-Frequency Words, Vocabulary, Comprehension: Literature, and Comprehension: Informational Text. In mathematics, the domains assessed are Number and Operations, Algebra and Algebraic Thinking, Measurement and Data, and Geometry. Most school districts administer the Diagnostic to students three times during the school year—in fall, winter, and spring. To learn more about the *i-Ready Diagnostic*, including a discussion of its reliability and validity, see the Appendices.

When students take the *i-Ready Diagnostic*, they are given a criterion-referenced placement level relative to their chronological grade level that designates their performance as being on grade level, below grade level, or above grade level. For example, a Grade 5 student can place below grade level at the Grade 4 level (i.e., One Grade Level Below), at the Grade 3 level (i.e., Two Grade

Levels Below), and at the Grades K–2 levels (i.e., Three or More Grade Levels Below). A Grade 5 student can also place above grade level at the Grades 6–8 levels (i.e., Above Grade Level). See the Appendices for the *i-Ready* placement-level descriptors.

Students who place Early On Grade Level have partially met grade-level college- and career-readiness standards, and students who are Mid or Above Grade Level have met or exceeded grade-level college- and career-readiness standards. Students who are Two or More Grade Levels Below are not yet close to meeting grade-level college- and career-readiness standards and may need additional instruction to fill in gaps in foundational concepts and knowledge. For the purposes of this report, students who placed Early On Grade Level or higher were designated as performing on grade level, and students who placed Two or More Grade Levels Below were designated as performing below grade level.

Results

Reading

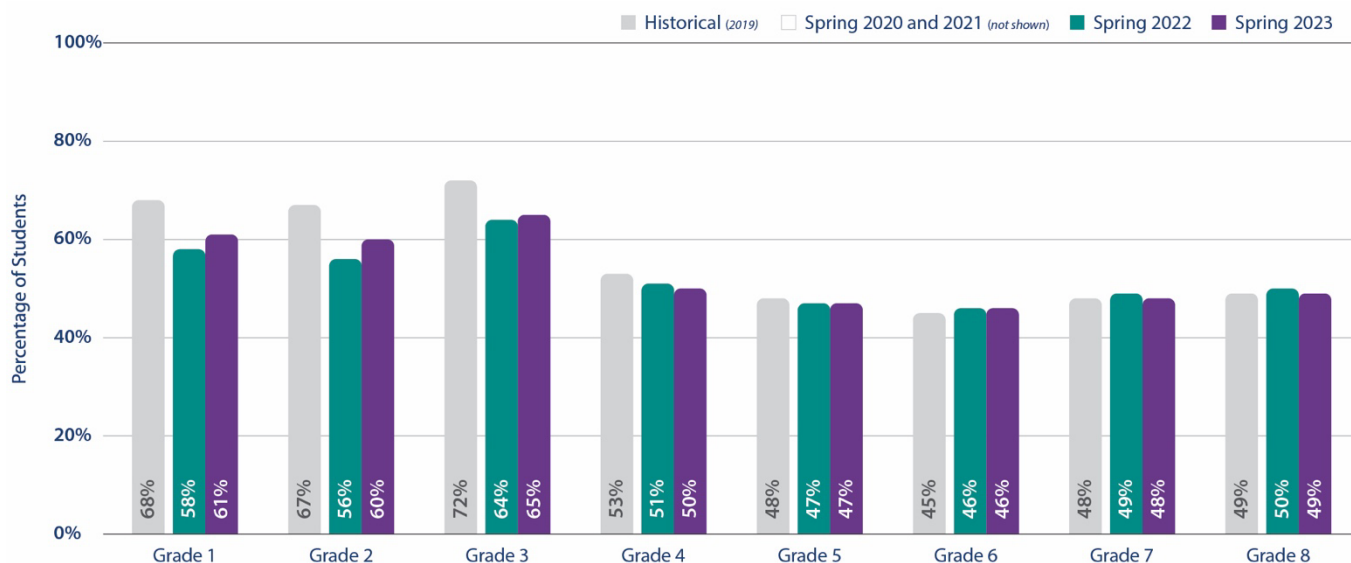
Overall Percentage of Students On and Below Grade Level by Grade

How does student achievement at the end of the 2022–2023 school year compare to achievement in the year prior (i.e., 2021–2022) and prior to the pandemic (i.e., 2018–2019)?

We first examined the percentage of students on grade level in reading (see Graph 1). In Grades 1–4 reading, fewer students performed on grade level than prior to the pandemic; however, in Grades 5–8, there was minimal change in the percentages of students on grade level pre- and post-pandemic. The largest discrepancies occur in Grades 1–3—school years during which students learn foundational skills. In Grades 1–3, there is a large decline in the percentage of students on grade level from prior to the pandemic to spring 2022, ranging from eight- to 11-percentage-point declines. While the percentage of Grade 3 students on grade level remained roughly the same from spring 2022 to spring 2023 (roughly eight percentage points below spring 2019), the percentage of Grades 1 and 2 students on grade level increased from spring 2022 to spring 2023. Despite these small increases, early-elementary students remain seven percentage points below achievement levels in spring 2019.

In upper-elementary and middle school grades, achievement levels in reading did not drop immediately following the COVID-19 school closures and have remained stagnant with fewer than 50% of students reading on grade level. The one exception is Grade 4. In 2023, 50% of Grade 4 students placed On Grade Level, a three-percentage-point drop from 2019. This is notable because Grade 4 students were in Grade 1 when schools initially closed—a crucial year for the development of foundational reading skills.

Graph 1: On Grade Level by Year—Reading

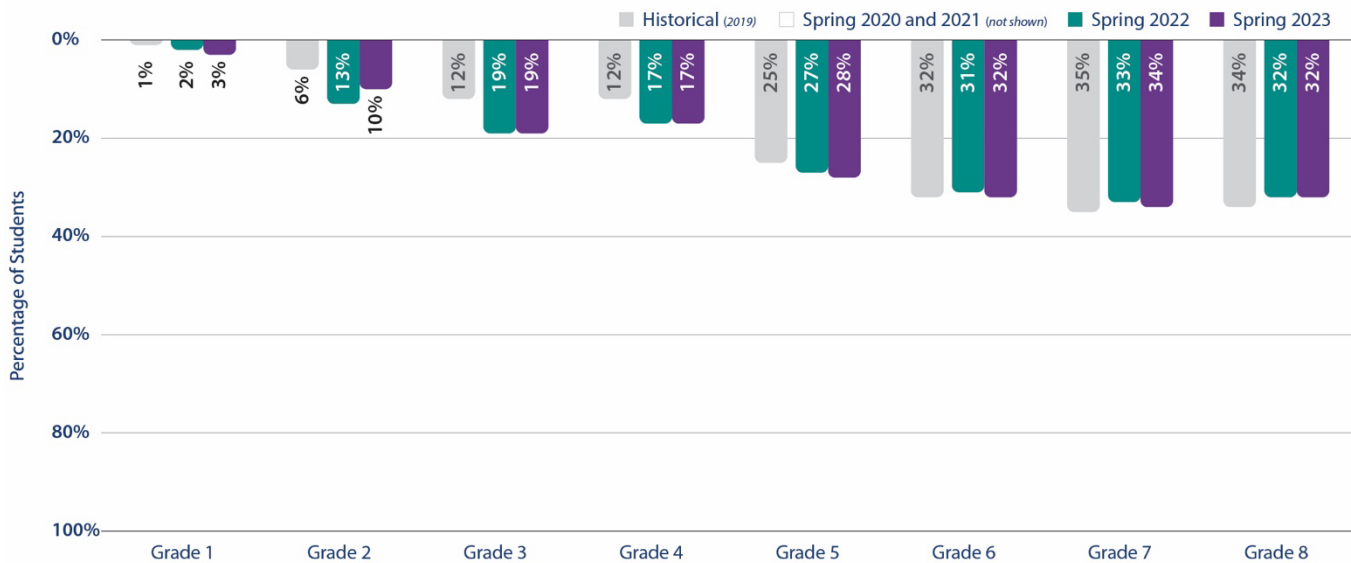


Next, we examined students below grade level (see Graph 2). In Grades 1-5 reading, more students performed below grade level than prior to the pandemic; however, in Grades 6-8, there was minimal change in the percentage of students performing below grade level pre- and post-pandemic.

The largest discrepancies occur in Grades 2-4, where the percentage of students below grade level from prior to the pandemic to spring 2022 increased from five to seven percentage points. While the percentage of Grades 3 and 4 students below grade level remained roughly the same from spring 2022 to spring 2023, this is still approximately seven to five percentage points, respectively, above pre-pandemic (i.e., spring 2019) levels. Examining Grade 2 students, however, we find the percentage below grade level declined from spring 2022 to spring 2023. Though the percentage of Grade 2 students below grade level remained above pre-pandemic levels, the decline from spring 2022 to spring 2023 suggests possible recovery.

For middle school students (i.e., Grades 6-8), there is only a one- to two-percentage-point difference between pre-pandemic and post-pandemic percentages of students on grade level. In other words, for those middle school grades, the percentage of students performing below grade level is roughly identical to percentages pre-pandemic. However, about one-third of students in Grades 6-8 were below grade level before the pandemic hit, suggesting a significant need for targeted, intensive, and effective reading interventions across all grade levels.

Graph 2: Below Grade Level by Year—Reading



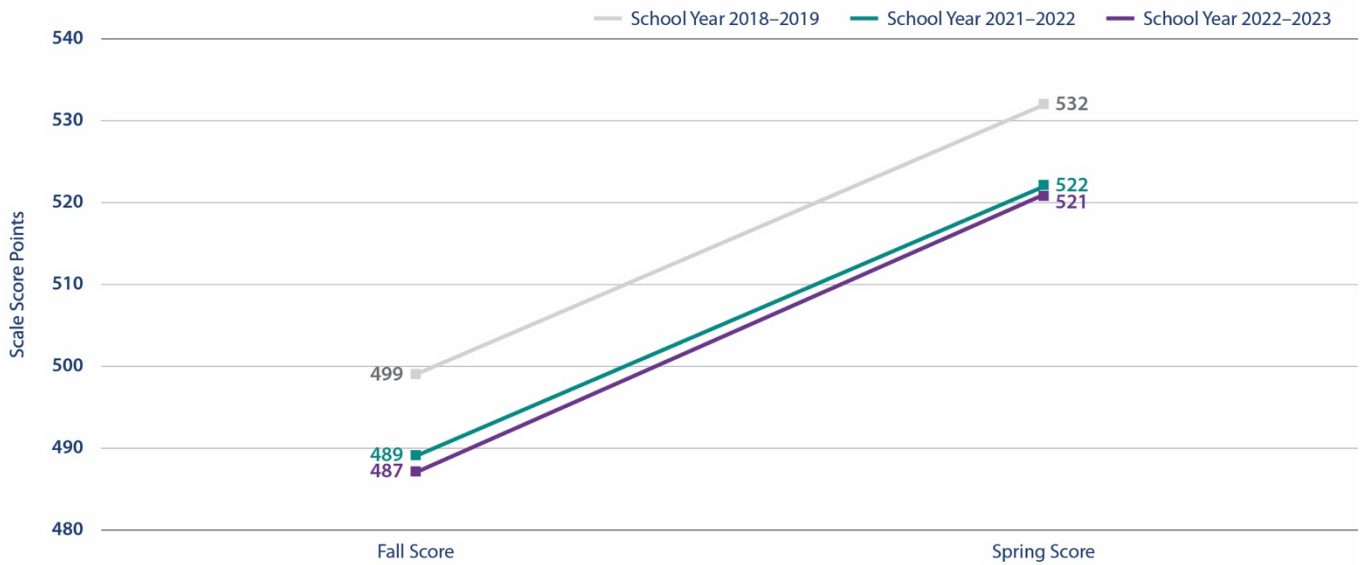
Note: Grade 1 students are considered two years below grade level if their spring Diagnostic placement level is “Emerging K.”

Overall Scale Scores and Growth by Grade

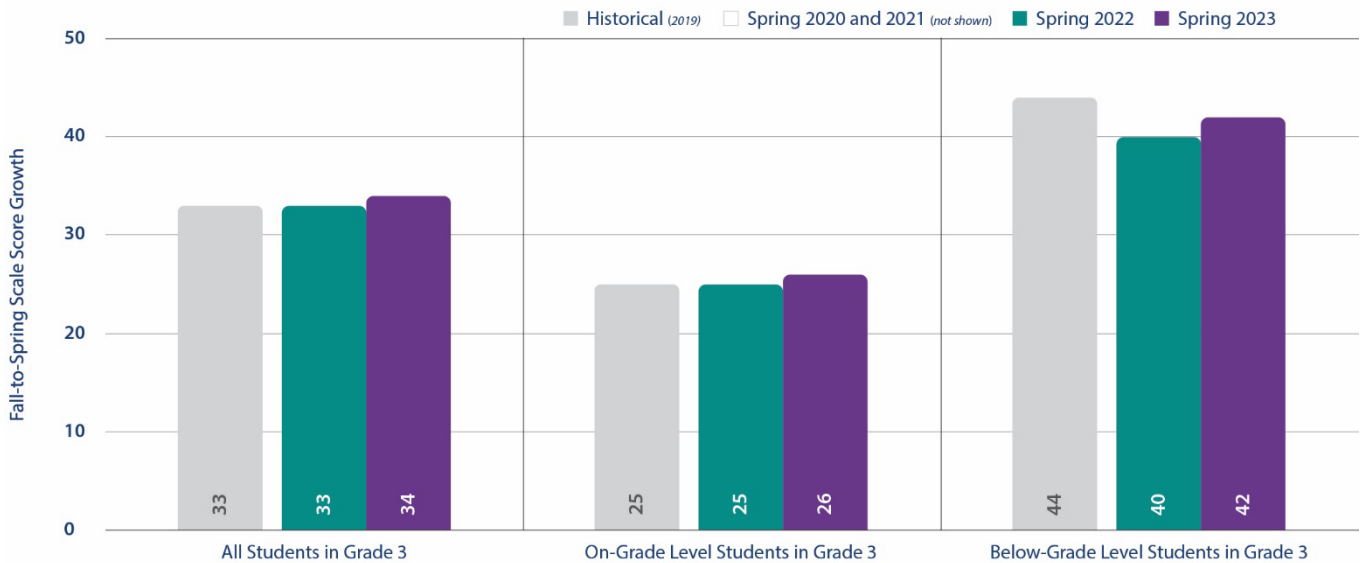
How does fall-to-spring growth in the 2022–2023 school year compare to growth in the year prior (i.e., 2021–2022) and prior to the pandemic (i.e., 2018–2019)?

To complement the placement-level findings, we also examined the average scale scores at each grade level as well as growth from fall to spring. Mirroring our placement-level findings, in Grades 1–5, there was a decline in fall and spring scale scores from pre-pandemic to post-pandemic, while in Grades 6–8, there was minimal change in fall and spring scale scores from pre-pandemic to post-pandemic (see Appendix Table 4). As illustrated in Graph 3, Grade 3 students similarly started and ended the school year below pre-pandemic levels. See Appendix Table 5 to see fall-to-spring growth for all years and grades. It is well documented that student growth varies depending on their starting placement levels (Curriculum Associates, 2018), as evident in Graph 4. However, Grade 3 students, regardless of starting placement level, showed similar growth following the pandemic as prior to the pandemic.

Graph 3: Fall-to-Spring Scale Scores—Reading, Grade 3



Graph 4: Fall-to-Spring Growth for All Students and Students Starting On and Below Grade Level—Reading, Grade 3



Phonics On and Below Grade Level by Grade

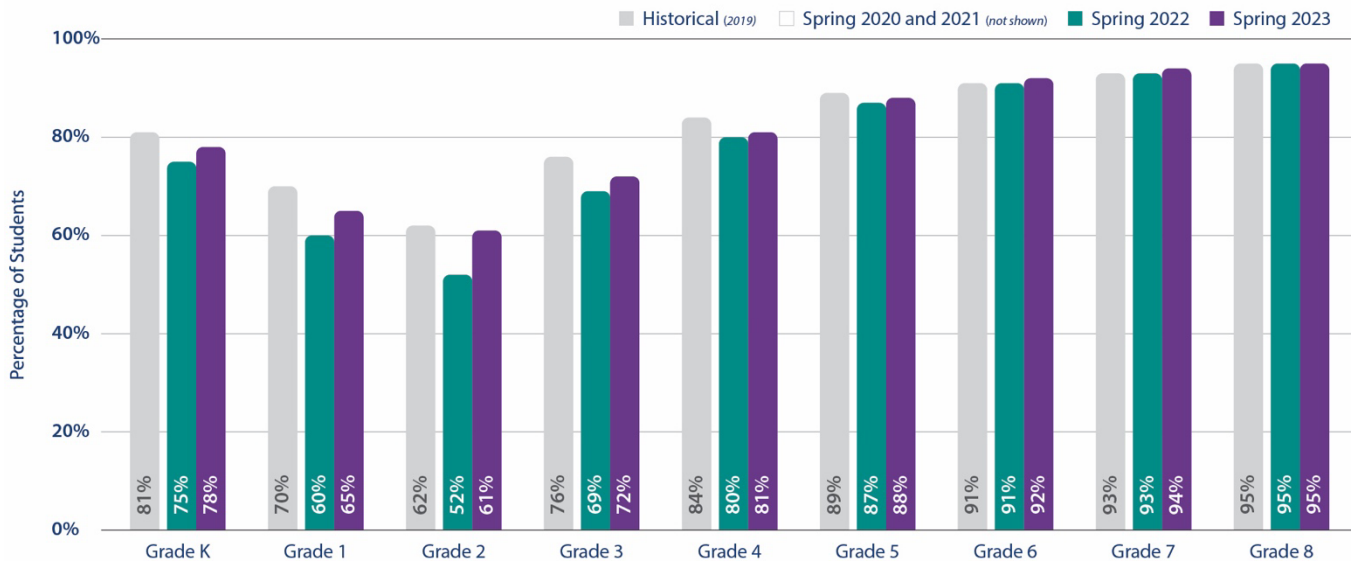
How does student achievement in subject-specific domains at the end of the 2022–2023 school year compare to achievement in the year prior (i.e., 2021–2022) and prior to the pandemic (i.e., 2018–2019)?

We also examined the percentage of students on grade level for students' Phonics reading scores. In the test flow of the *i-Ready Diagnostic* for Reading, students in Grades K–2 are automatically assessed in the Phonics domain. However, students in Grades 3–8 are assessed in Phonics only if their scale score in the Vocabulary and Comprehension domains is below a specific benchmark. In Phonics, the highest placement level that can be achieved is Grade 3. In Graph 5, the percentages for students in Grades 5–8 represent the percentage of students in those grades who were assessed in Phonics who received a placement level of Grade 3 or lower. In Grade 4, these percentages represent students who were assessed in Phonics and received a placement level of Grade 2 or lower. In Grade 3, these percentages represent students who were assessed in Phonics and received a placement level of Grade 1 or lower.

Overall, the Phonics findings mirror those found in overall reading levels. In Grades K–4 reading, fewer students performed on grade level in Phonics than prior to the pandemic; however, in Grades 5–8, there was minimal change in the percentage of students performing on grade level pre- and post-pandemic. The largest discrepancies occur in Grades 1–3, where the percentage of students on grade level in Phonics declined seven to 10 percentage points from prior to the pandemic to spring 2022. Encouragingly, from spring 2022 to spring 2023, the percentage of students on grade level increased in these grades in Phonics, with Grade 2 students nearly returning to their pre-pandemic levels (minus one percentage point).

For Grades 5–8, there is only a zero- to one-percentage-point difference between pre-pandemic and post-pandemic percentages of students on grade level. In other words, for those grades, the percentage of students performing on grade level in Phonics is roughly identical to that of pre-pandemic.

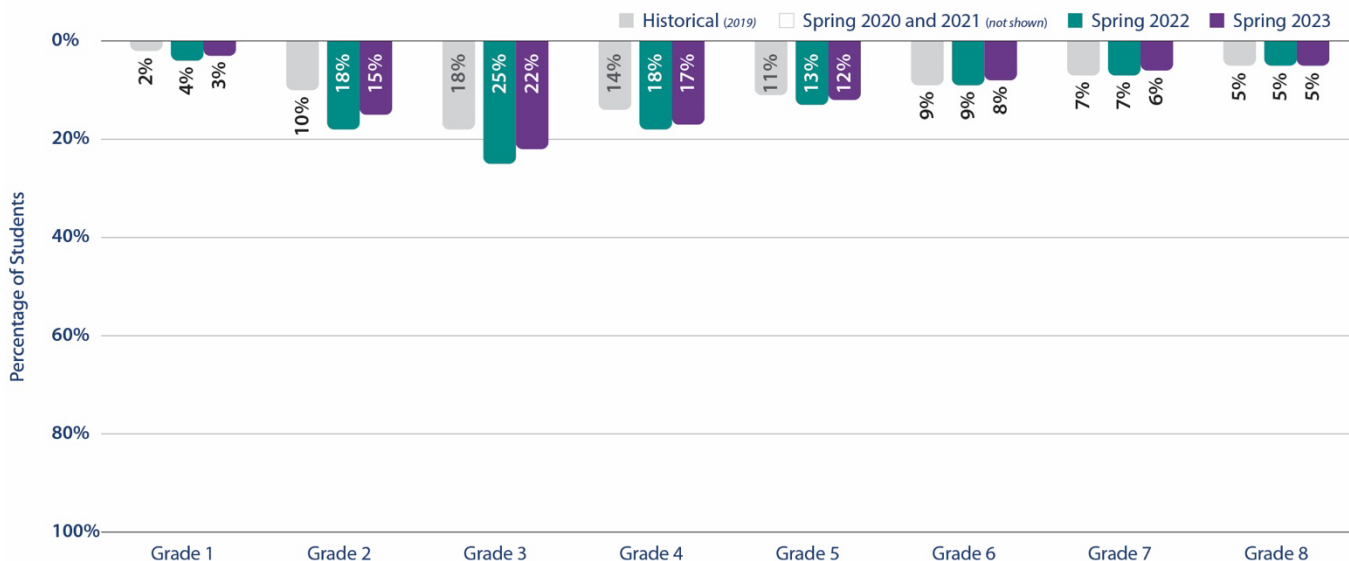
Graph 5: On Grade Level by Year—Phonics



When examining below-grade level Phonics achievement in Graph 6, we find similar patterns to those on grade level with one important exception. While the percentage of Grade 2 students on grade level nearly returned to pre-pandemic levels, there are still more Grade 2 students below grade level in Phonics post-pandemic. More specifically, there was an eight- and five-percentage-point increase in Grade 2 students below grade level in Phonics in the 2021–2022 and 2022–2023 school years, respectively, compared to their pre-pandemic peers.

The Appendices include findings for student performance in the additional reading domains of Phonological Awareness, High-Frequency Words, Vocabulary, Comprehension: Literature, and Comprehension: Informational Text. Similar to our findings in overall reading and Phonics, a smaller percentage of early-elementary students are on grade level in all reading domains compared to pre-pandemic percentages.

Graph 6: Below Grade Level by Year—Phonics



Note: Grade 1 students are considered two years below grade level if their spring Diagnostic placement level is “Emerging K.”

School-Level Demographic Data Findings

How does student achievement at the end of the 2022–2023 school year vary by the racial or ethnic makeup of schools in the year prior (i.e., 2021–2022) and prior to the pandemic (i.e., 2018–2019)?

We also looked at students’ performance in overall reading by school demographics for race and ethnicity. Specifically, we looked at schools in which more than 50% of students are Black, Latino, or White. In Graph 7, we present data for Grade 3 to illustrate variations by school-level demographics. Data for Grades 1–8 are presented in Table 2.

Graph 7 illustrates that there were historical inequities in reading performance among these three school groups, and these inequities persisted throughout the pandemic. Prior to the pandemic, in schools serving majority Black students, 54% of Grade 3 students placed On Grade Level. In schools serving majority Latino students, 62% of Grade 3 students placed On Grade Level, while in schools serving majority White students, 81% of Grade 3 students placed On Grade Level. Those values dropped by seven to 10 percentage points by spring 2022. The percentage of Grade 3 students on grade level experienced minimal change in schools serving majority Latino or White students; however, schools serving majority Black students experienced a slight increase from spring 2022 to spring 2023. As illustrated in Table 2, spring 2023 early-elementary students in schools serving majority Black students showed the greatest increases from spring 2022 to spring 2023. Despite this trend, historical inequities increased between schools serving majority White students and schools serving majority Black or Latino students.

Graph 7: On Grade Level by Schools Serving Majority Black, Latino, or White Students—Reading, Grade 3

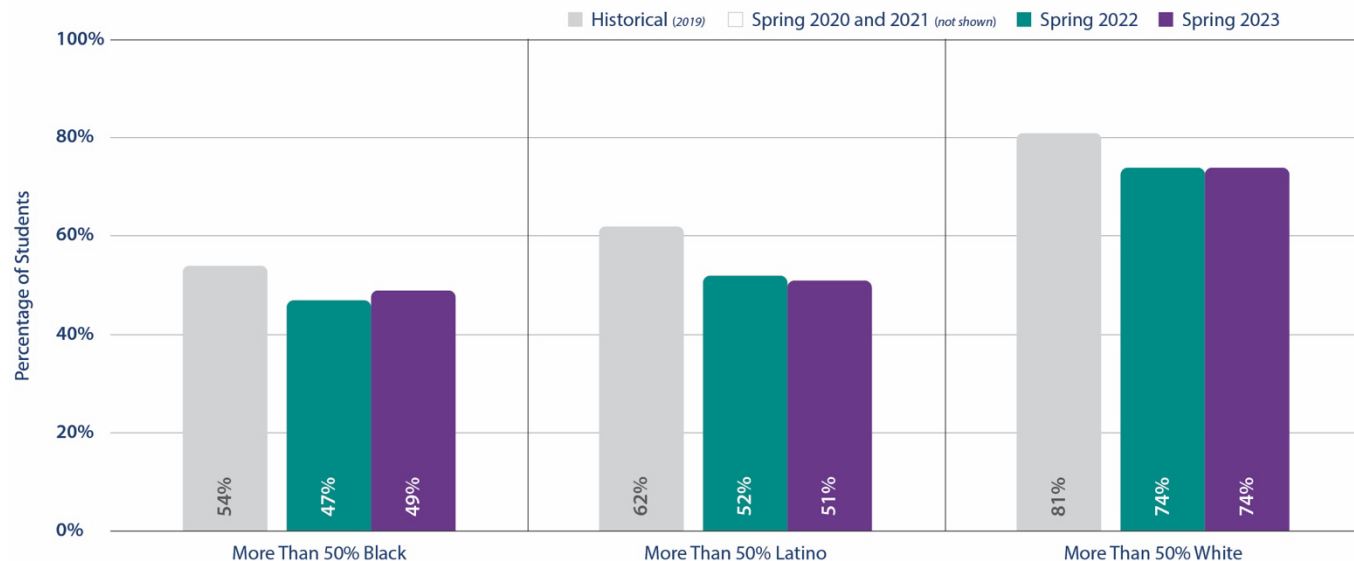


Table 2: On Grade Level by Schools Serving Majority Black, Latino, or White Students—Reading

Grade	More Than 50% Black			More Than 50% Latino			More Than 50% White		
	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023
1	55	42	48	59	44	47	75	66	71
2	50	39	46	57	43	46	75	65	69
3	54	47	49	62	52	51	81	74	74
4	34	33	33	41	39	36	62	60	59
5	30	31	31	38	36	33	57	55	56
6	30	28	29	36	35	34	54	52	52
7	33	33	33	39	40	36	57	54	53
8	36	37	33	41	41	37	56	55	54

School-Level Income Data Findings

How does student achievement at the end of the 2022-2023 school year vary by the median household income of schools' locations, and how does that compare to achievement in the year prior (i.e., 2021-2022) and prior to the pandemic (i.e., 2018-2019)?

Prior to the pandemic, there were differences in grade-level performance by school-level median household income. As median household income increases, so does the percentage of students who score on grade level in reading. As illustrated in Graph 8, prior to the pandemic, the percentage of Grade 3 students by median income group was 61%, 72%, and 80%, respectively. There was a decline in those percentages by spring 2022 in all median household incomes; however, the decline was greater in households earning less than \$50,000 and \$50,000 to \$75,000, compared to those earning more than \$75,000 (an eight- and nine-percentage-point decline compared to minus five percentage points, respectively), thereby increasing existing inequities. Unfortunately, those inequities between schools serving lower-income and higher-income communities continued in spring 2023.

Graph 8: On Grade Level by Median Household Income—Reading, Grade 3

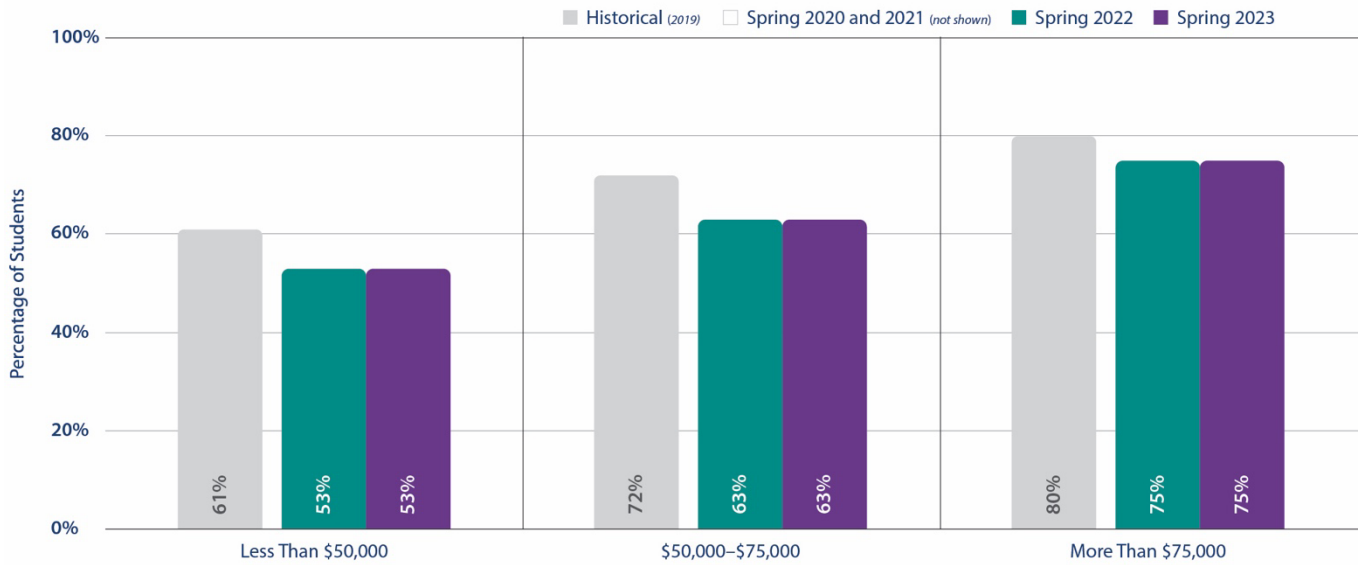


Table 3: On Grade Level by Median Household Income —Reading

Grade	Less Than \$50,000			\$50,000–\$70,000			More Than \$75,000		
	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023
1	59	46	51	67	55	59	77	68	71
2	55	43	49	66	54	58	76	67	71
3	61	53	53	72	63	63	80	75	75
4	41	38	37	51	48	47	64	62	61
5	36	35	35	47	45	44	58	58	58
6	36	35	35	45	43	43	54	55	55
7	38	39	38	48	47	45	57	57	57
8	40	41	40	48	48	47	57	58	57

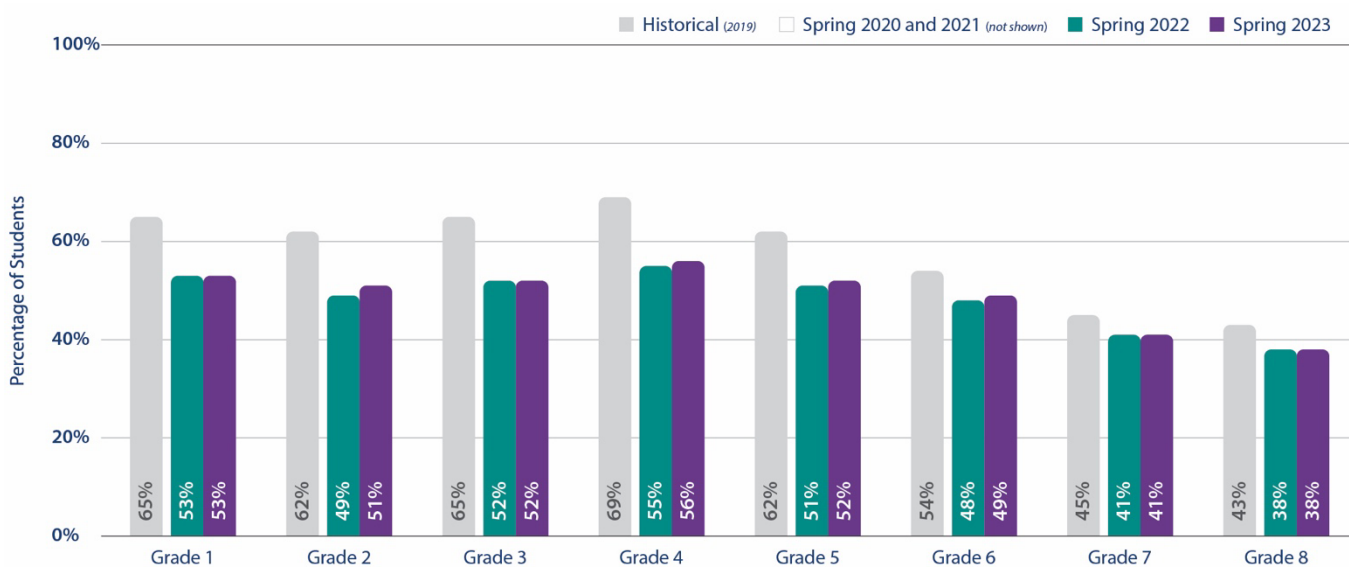
Mathematics

Overall Percent On and Below Grade Level by Grade

How does student achievement at the end of the 2022–2023 school year compare to achievement in the year prior (i.e., 2021–2022) and prior to the pandemic (i.e., 2018–2019)?

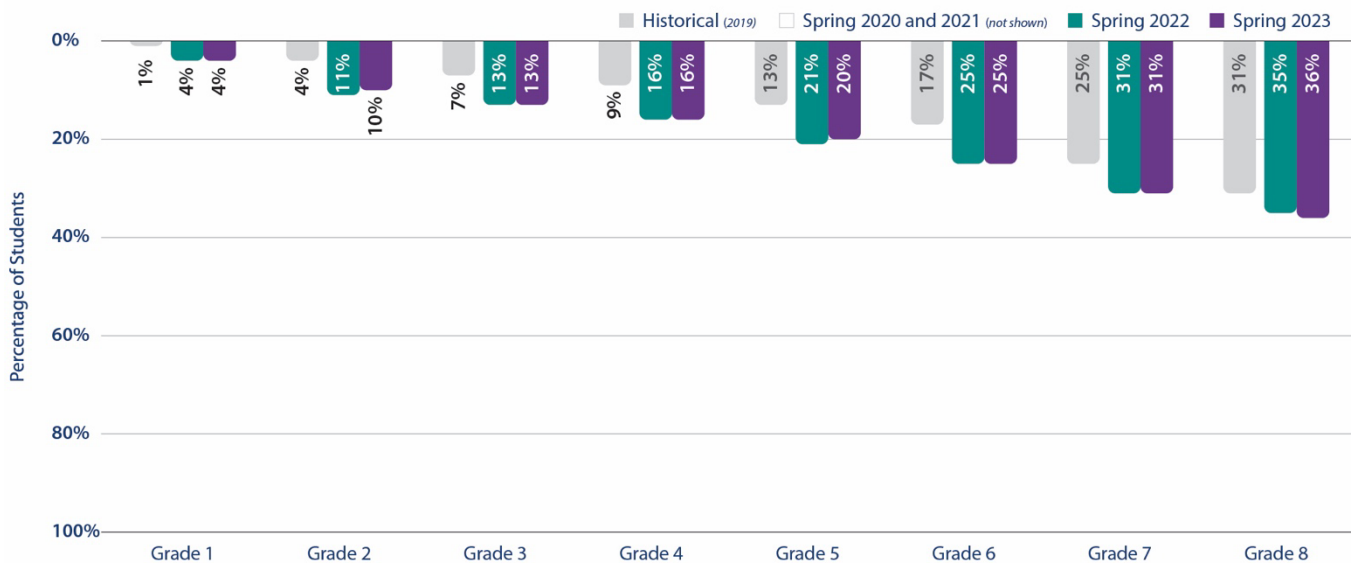
Across all Grades 1–8, there are fewer students placing on grade level in mathematics than there were prior to the pandemic (see Graph 9). The largest discrepancies occur in the elementary grades (i.e., Grades 1–5), for which there are 11 to 14 percentage points fewer students whose mathematics assessment indicates they have met minimum grade-level college- and career-readiness standards. Approximately two-thirds of students in Grades 1–5 placed On Grade Level prior to the pandemic; however, roughly half of Grades 1–5 students have placed On Grade Level since the pandemic. In Grades 6–8, there are four to five percentage points fewer students on grade level, with roughly 50% to 40% of students on grade level post-pandemic.

Graph 9: On Grade Level by Year—Mathematics



Next, we examined students below grade level (see Graph 10). In all Grades 1–8, there is a higher percentage of students who are placing below grade level post-pandemic. In Grade 1, students below grade level increased by three percentage points, compared to pre-pandemic. In Grades 2–8, these differences were greater, with the percentage of students placing below grade level increasing from five to eight percentage points depending on grade. In Grades 6–8, one-fourth to more than one-third of students placed below grade level post-pandemic. There was very little change in the percentage who scored below grade level from spring 2022 to spring 2023. These unfortunate findings highlight the need for continued efforts to address math recovery.

Graph 10: Below Grade Level by Year—Mathematics



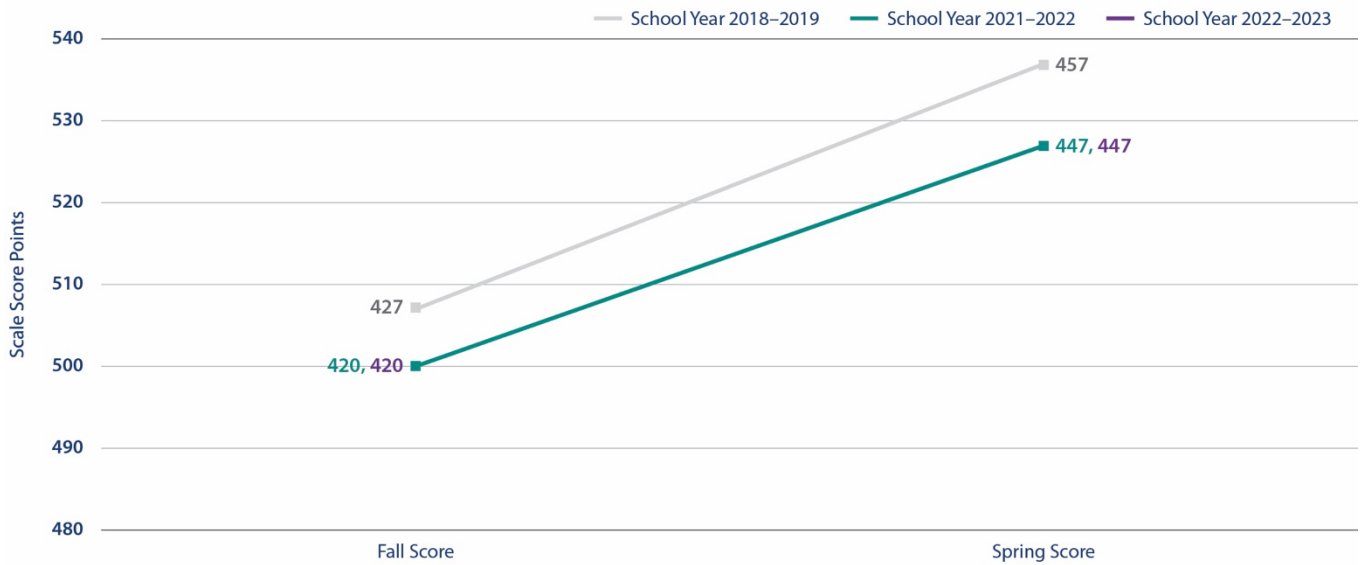
Note: Grade 1 students are considered two years below grade level if their spring Diagnostic placement level is “Emerging K.”

Overall Scale Scores and Growth by Grade

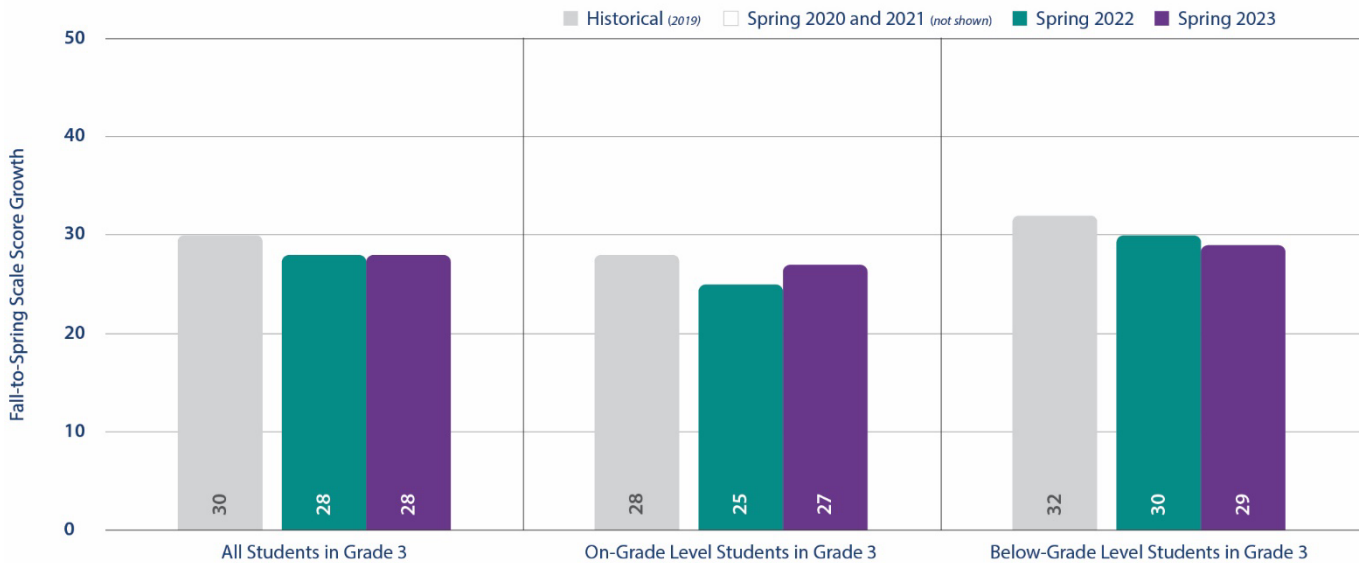
How does fall-to-spring growth in the 2022–2023 school year compare to growth in the year prior (i.e., 2021–2022) and prior to the pandemic (i.e., 2018–2019)?

To complement the placement-level findings, we also examined the average scale scores at each grade level as well as growth from fall to spring. Mirroring our placement-level findings, across all grade levels, there is a decline in fall and spring scale scores from pre-pandemic to post-pandemic. See Appendix Table 4 to see fall and spring scale scores for all years and grades. Students in Grade 3 started and ended the school year below the pre-pandemic levels (see Graph 11). Further, they illustrated slightly lower growth from fall to spring following the pandemic than they did pre-pandemic (see Graph 12). However, examining further, we found that Grade 3 students who started the fall on grade level demonstrated similar growth following the pandemic by spring 2023, while Grade 3 students who started the fall below grade level demonstrated a continued decline in growth following the pandemic. These results are concerning as they illustrate a growing divide between students who start on and below grade level. See Appendix Table 5 to see fall-to-spring growth for all years and grades.

Graph 11: Fall-to-Spring Scale Scores—Mathematics, Grade 3



Graph 12: Fall-to-Spring Growth for All Students and Students Starting On and Below Grade Level—Mathematics, Grade 3

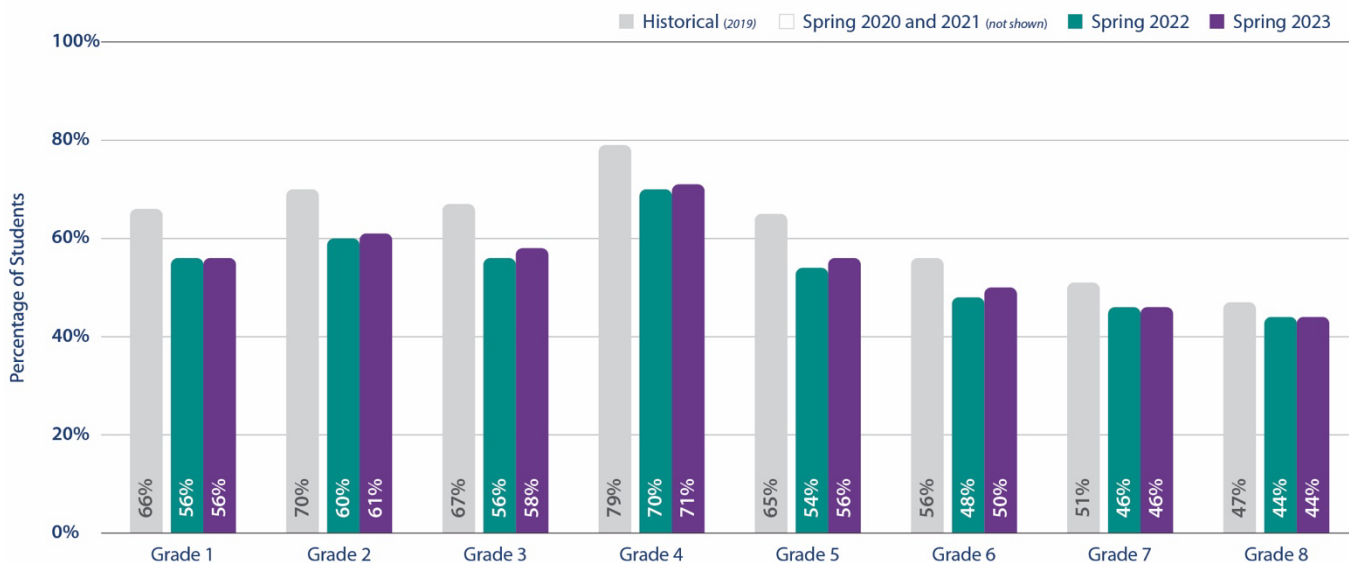


Number and Operations On and Below Grade Level by Grade

How does student achievement in subject-specific domains at the end of the 2022–2023 school year compare to achievement in the year prior (i.e., 2021–2022) and prior to the pandemic (i.e., 2018–2019)?

We also examined the percentage of students on grade level for students’ Number and Operations math scores (see Graph 13). This domain is foundational to students’ understanding and performance in mathematics. Defined by the National Council for Teachers of Mathematics (NCTM), Number and Operations is the mathematical domain of understanding number systems, the relationships between numbers, mathematical operations such as addition, subtraction, multiplication, and division, and the skills of computation and estimation. Some specific skills included in this foundational domain include fractions, base-ten, and place value. The Number and Operations findings echo those found in overall mathematics placement levels. Across Grades 1–8, fewer students performed on grade level following the pandemic than before the pandemic. The differences range from three to 11 percentage points fewer than pre-pandemic percentages. The largest discrepancies occur in the elementary grades.

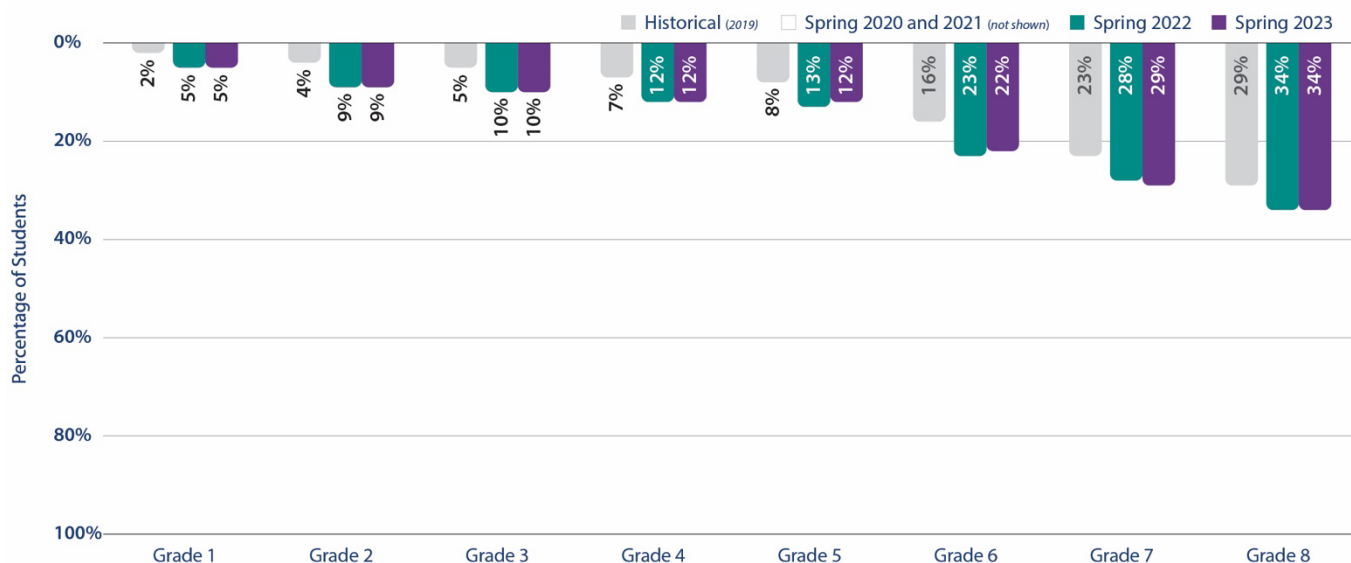
Graph 13: On Grade Level by Year—Number and Operations



When examining below-grade level Number and Operations achievement, we found similar patterns to those for on grade level (see Graph 14). Across Grades 1–8, there are more students below grade level following the pandemic than before the pandemic. There was minimal change between spring 2022 and spring 2023, which suggests much more needs to be done to accelerate student learning to return to pre-pandemic achievement levels.

The Appendices include findings for student performance in the additional mathematics domains of Algebra and Algebraic Thinking, Measurement and Data, and Geometry. Similar to our findings in overall mathematics and Number and Operations, a smaller percentage of students are on grade level in all mathematics domains compared to pre-pandemic percentages.

Graph 14: Below Grade Level by Year—Number and Operations



Note: Grade 1 students are considered two years below grade level if their spring Diagnostic placement level is “Emerging K.”

School-Level Demographic Data Findings

How does student achievement at the end of the 2022–2023 school year vary by the racial or ethnic makeup of schools in the year prior (i.e., 2021–2022) and prior to the pandemic (i.e., 2018–2019)?

We also looked at students’ performance in overall mathematics by school demographics for race and ethnicity. In Graph 15, we presented data for Grade 3 to illustrate variations by school-level demographics. The data for Grades 1–8 is presented in Table 3. For all groups, whether the schools serving majority Black, Latino, or White students, there are fewer students performing on grade level in mathematics than pre-pandemic.

Graph 15 illustrates that there were historical inequities in mathematics performance among these three school groups, and these inequities persisted and increased throughout the pandemic. That is, prior to the pandemic, in schools serving majority Black students, 49% of Grade 3 students placed On Grade Level. In schools serving majority Latino students, 55% of Grade 3 students placed On Grade Level, while in schools serving majority White students, 72% of Grade 3 students placed On Grade Level. Those values dropped by 11 to 18 percentage points by spring 2022, and there is minimal change from spring 2022 to spring 2023. The decreases were larger for schools serving majority Black or Latino students (minus 18 and minus 16 percentage points, respectively) than the decrease for schools serving majority White students (minus 11 percentage points). As illustrated in Table 4, spring 2023 elementary students in schools serving majority Black students demonstrated a small increase from spring 2022 to spring 2023. Despite this trend, historical inequities increased between schools serving majority White students and schools serving majority Black or Latino students.

Graph 15: On Grade Level by Schools Serving Majority Black, Latino, or White Students—Mathematics, Grade 3



Table 4: On Grade Level by Schools Serving Majority Black, Latino, or White Students—Mathematics

Grade	More Than 50% Black			More Than 50% Latino			More Than 50% White		
	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023
1	50	33	36	55	39	38	73	62	62
2	44	29	32	51	36	35	69	59	60
3	49	31	33	55	39	38	72	61	61
4	54	32	35	60	41	41	76	64	65
5	45	30	31	52	38	37	71	60	62
6	38	28	28	44	36	34	63	56	56
7	30	24	26	33	30	27	55	47	48
8	32	25	25	30	27	27	50	44	44

School-Level Income Data Findings

How does student achievement at the end of the 2022–2023 school year vary by the median household income of schools’ locations, and how does that compare to achievement in the year prior (i.e., 2021–2022) and prior to the pandemic (i.e., 2018–2019)?

Additionally, we examined students’ performance in mathematics using the school-level variable median household income. Prior to the pandemic, there were differences in grade-level performance by school-level median household income, where high-income communities had a greater percentage of students on grade level compared to lower-income communities. Prior to the pandemic, the percentage of Grade 3 students by median income group was 54%, 64%, and 74%, respectively. There was a decline in those percentages by spring 2022 in all median household incomes; however, the decline was slightly greater in households earning less than \$50,000 and \$50,000 to \$75,000, compared to those earning more than \$75,000 (a 15-percentage-point decline

compared to an 11-percentage-point decline, respectively). As a result, historical inequities increased following the pandemic. Further, given minimal change in the percentage on grade level from spring 2022 to spring 2023 in all median household income groups, those increased inequities have persisted.

Graph 16: On Grade Level by Median Household Income—Mathematics, Grade 3

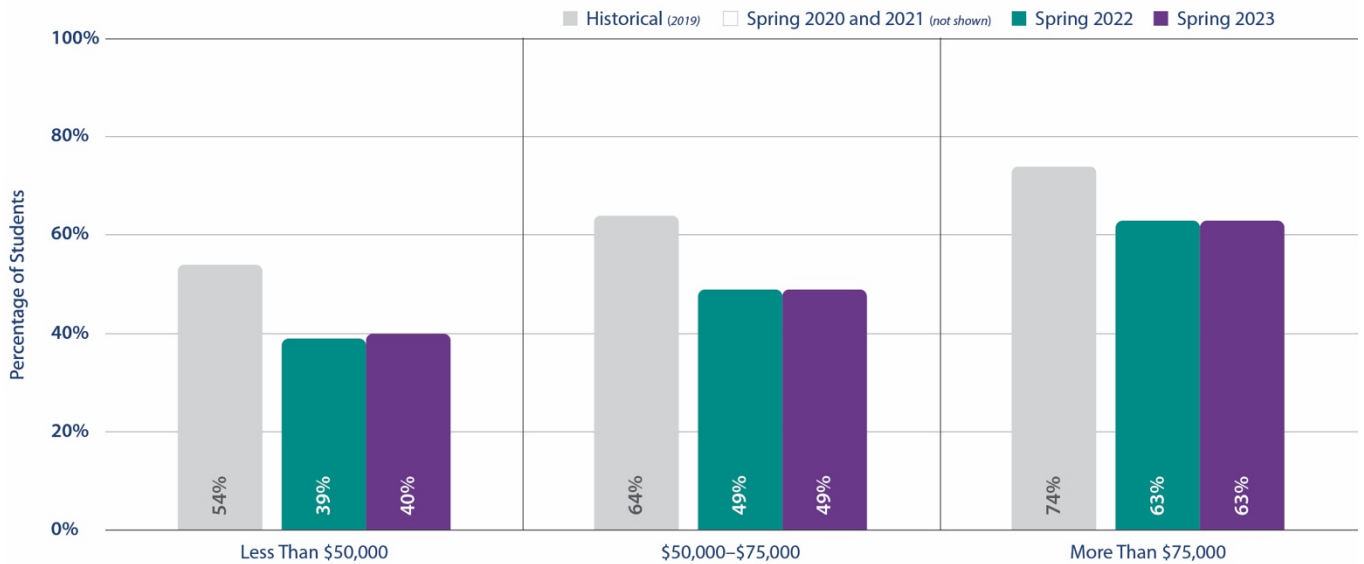


Table 5: On Grade Level by Median Household Income—Mathematics

Grade	Less Than \$50,000			\$50,000–\$70,000			More Than \$75,000		
	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023
1	56	41	42	64	50	50	74	62	62
2	50	37	39	60	47	48	70	60	61
3	54	39	40	64	49	49	74	63	63
4	60	42	43	68	52	53	77	65	67
5	52	38	39	61	49	49	72	62	63
6	45	36	37	54	45	46	63	58	59
7	37	32	32	45	39	38	53	50	50
8	36	30	31	42	36	36	49	47	46

Conclusion

Achievement results from more than nine million students representative of the US Grades 1–8 student population underscore the urgent need to stay focused on academic recovery following the COVID-19 pandemic. Students' reading and mathematics achievement from the two most recent school years continues to fall short of pre-pandemic performance. There are fewer students finishing the school year able to demonstrate grade-level performance, and there are more students striving to reach their chronological grade level.

Students in the early-elementary grades (i.e., Grades 1–2) did not experience the same academic disruptions at the start of the pandemic; however, their reading results remain persistently lower than pre-pandemic levels. While there is a small glimmer of hope in early-elementary reading where Grades 1 and 2 students showed a small increase in grade-level attainment from 2022 to 2023, for the most part, achievement levels at the end of the 2022–2023 school year remain far below pre-pandemic levels. We find similar trends in phonics, a foundational reading skill that can have long-term implications on student achievement.

In upper-elementary grades, achievement levels in reading did not drop following the initial school closures of the COVID-19 pandemic and have remained stagnant with fewer than 50% of students reading on grade level. The one exception is fourth grade. In 2023, 50% of fourth grade students placed On Grade Level, a three-percentage-point drop from 2019. This is notable because Grade 4 students were in Grade 1 when schools initially closed—a crucial year for the development of foundational reading skills.

While the percentage of middle school students on grade level in reading has remained roughly the same over time, this still means that about half of students in Grades 6–8 are one or more grade levels below their chronological grade.

Achievement in mathematics is more concerning. The percentage of students placing On Grade Level in mathematics decreased substantially after the pandemic and remains stalled in spring 2023. Across all Grades 1–8, there are fewer students placing On Grade Level in mathematics than there were prior to the pandemic. At the same time, more students are placing below grade level in mathematics than there were prior to the pandemic. The results from spring 2022 to spring 2023 remained flat.

While all students experienced declines, we recognize those declines are not evenly distributed based on school characteristics. Historical inequities persist between schools serving majority Black and Latino students and schools serving majority White students. Schools serving majority Black and Latino students experienced larger drops following the initial school closures of the pandemic than schools serving majority White students. In 2023, early-elementary students in schools serving majority Black students demonstrated the biggest increases from spring 2022. Despite these encouraging increases, achievement levels in schools serving majority Black and Latino students remain far below achievement levels in schools serving majority White students. Similarly, historical inequities persisted and increased between schools in low-income communities and schools in higher-income communities.

Ultimately, assessment results in spring 2023 show that academic recovery is slow and will require more support and more time. The spring 2023 results from the *i-Ready Diagnostic* tell a story that is consistent with results seen on NAEP, state assessments, and in other research (US Department of Education, 2023; Lewis & Kuhfeld, 2023). Despite the significant and unending efforts of devoted educators across the country, academic recovery has been slow and inconsistent. Even cohorts entering elementary schools in 2021 and 2022 remain below academic achievement levels seen in Grades 1 and 2 cohorts prior to the pandemic. This points to the persistent and unprecedented impact of the pandemic on all parts of children’s lives, from preschool through their elementary school years, and likely beyond.

These results are disheartening, but we know from other research that students can reach grade-level proficiency despite falling behind. Research released by Curriculum Associates in August 2023 tracked student growth across multiple cohorts and found that setting ambitious growth goals, alongside classroom instruction and supplemental academic support, is a viable pathway to achieving grade-level proficiency (Rome & Daisher, 2023).

Limitations

The findings presented in this report are descriptive. Descriptive analyses can be used to identify and discuss trends in the data, but they do not allow us to consider statistical significance nor draw conclusions about the functional significance of the findings. These findings also do not provide causal evidence of the recovery efforts taking place nationwide.

These findings also rely on school-level demographics, which is not the same as using student-level demographics. Schools consisting of more than 50% of one racial or ethnic group may still be fairly diverse, and we recognize that using school-level demographics does not capture that diversity nor the variability in unfinished learning within each school-level demographic group nor at the student-level demographic group. We were unable to include the demographic data necessary to be able to report out on disaggregated data for English Learners and students with disabilities—two student groups that are widely recognized to have had challenges with remote learning during the pandemic.

Despite these limitations, the descriptive trends on a nationally representative sample of students presented in this report can still act as a pulse check on how students are performing academically nationwide. Ultimately, the trends suggest we have much more work to do to reach pre-pandemic levels of achievement, and even more work to do to erase historical inequities that existed well before the pandemic.

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Appendix

Assessment Measure

The *i-Ready Diagnostic* was developed to serve several purposes: Establish a metric that will allow for an accurate assessment of student knowledge that can be monitored over a period of time to gauge student improvement; Accurately assess student knowledge for different content strands within each subject; Provide information on what skills students are likely to have mastered and likely need to work on next; Link the assessment results to instructional advice (Curriculum Associates, 2018).

Upon completion of the Diagnostic, each student's results are reported as scale scores, placement levels, and norm-referenced percentile scores. *i-Ready Diagnostic* scale scores are linear transformations of logit values. For each assessment in reading and mathematics, an overall score is calculated, as are domain scores for each content strand. Scale scores can range in value from 100 to 800. In *i-Ready*, the placement is an on-grade level interpretation of the scale score (Curriculum Associates, 2018). When a student's scale score is within the range for their grade level, their placement level is designated as Early On Grade Level, Mid On Grade Level, or Late On Grade Level. If the scale score is below or above the range for the grade level, the placement level is designated as Grade X (with X corresponding to the appropriate grade level). The scale score ranges that correspond to each placement level by subject, domain, and grade are listed in the *i-Ready* scale score placement tables (Curriculum Associates, 2021).

The mean standard error of measurement (SEM) for overall scores across grade levels is low in both the reading (9.3–10.9) and mathematics assessments (6.3–6.5), with many approaching the theoretical minimum SEM. The item response theory analogue to classical reliability estimation is called marginal reliability and operates on the variance of the theta scores and the mean of the expected error variance (Samejima, 1977; Sireci et al., 1991). This marginal reliability uses the classical definition of reliability as proportion of variance in the total observed score due to true score. The true score variance is computed as the observed score variance minus the error variance. Like a classical reliability coefficient, the marginal reliability estimate increases as the SEM decreases; it approaches 1 when the standard error of measurement approaches 0. The estimated reliability for reading is .97, and the estimated reliability for mathematics is .96 (Curriculum Associates, 2018). The results from several linking studies support the strong external validity of the *i-Ready Diagnostic*. Not only did the *i-Ready* scores correlate closely with Lexiles®, Quantiles®, and state assessments when the tests were taken within a short period of time, but the results on the fall and winter *i-Ready* test correlations with spring state assessments also show high correlations (most of .90 and higher).

i-Ready Placement-Level Descriptors

	Three or More Grade Levels Below	Two Grade Levels Below	One Grade Level Below	Early On Grade Level	Mid or Above Grade Level
Placement relative to grade-level college- and career-readiness standards	Are not close to meeting			Only partially met	Met
Instructional recommendations	Likely need intensive intervention of foundational concepts. Students who perform below grade level are not likely to be proficient on their state summative test, though it is possible.	May need intensive intervention of material that is two grade levels below to help fill in gaps in students' foundational knowledge.	May benefit from review or remediation of material that is one grade level below.	Will benefit from on-grade level instruction to help them meet the expectations of college- and career-readiness standards for their grade level.	<p>Mid On Grade Level: Will benefit from instruction in late on-grade level topics.</p> <p>Late On Grade Level: Will benefit from late on-grade level enrichment and will be ready for instruction focused on topics typically covered in the beginning of the subsequent grade level.</p> <p>Above Grade Level: Will benefit from above-grade level instruction.</p>

School-Level Race/Ethnicity Distributions for Sampling Targets and Sample by Year, Subject, and Grade

Appendix Table 1a. School-Level Race/Ethnicity Distributions for Sampling Targets and Sample in 2022–2023

Grade	% White		% Black		% Hispanic		% Asian		% Hawaiian or Pacific Islander		% American Indian or Alaskan		% Two or More Races	
	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample
Reading														
1	44.9%	43.3%	15.1%	17.5%	27.9%	26.9%	5.5%	5.9%	.4%	.6%	.9%	.5%	5.3%	5.3%
2	44.8%	43.9%	15.1%	16.9%	28.0%	27.3%	5.7%	5.9%	.4%	.5%	.9%	.5%	5.1%	5.1%
3	44.8%	42.6%	15.1%	16.8%	28.1%	28.1%	5.7%	6.1%	.4%	.6%	.9%	.6%	5.0%	5.2%
4	44.8%	43.6%	15.3%	15.7%	28.3%	28.0%	5.5%	6.4%	.4%	.6%	.9%	.5%	4.8%	5.2%
5	45.0%	43.8%	15.2%	15.7%	28.3%	28.0%	5.4%	6.4%	.4%	.6%	.9%	.5%	4.7%	5.1%
6	45.1%	48.2%	15.4%	13.8%	28.4%	25.9%	5.2%	6.4%	.3%	.5%	.9%	.5%	4.5%	4.6%
7	45.4%	47.6%	15.3%	12.6%	28.3%	27.6%	5.3%	6.9%	.4%	.5%	.9%	.5%	4.4%	4.3%
8	45.9%	48.6%	15.1%	13.2%	28.2%	26.7%	5.2%	6.6%	.4%	.3%	.9%	.5%	4.2%	4.1%
Mathematics														
1	44.9%	46.0%	15.1%	16.5%	27.9%	25.0%	5.5%	5.9%	.4%	.6%	.9%	.6%	5.3%	5.4%
2	44.8%	46.5%	15.1%	15.4%	28.0%	25.6%	5.7%	6.1%	.4%	.5%	.9%	.6%	5.1%	5.3%
3	44.8%	45.4%	15.1%	15.6%	28.1%	26.5%	5.7%	5.9%	.4%	.6%	.9%	.6%	5.0%	5.3%
4	44.8%	45.8%	15.3%	14.7%	28.3%	26.9%	5.5%	6.1%	.4%	.6%	.9%	.6%	4.8%	5.3%
5	45.0%	45.6%	15.2%	15.0%	28.3%	27.0%	5.4%	6.1%	.4%	.6%	.9%	.6%	4.7%	5.2%
6	45.1%	47.7%	15.4%	13.8%	28.4%	26.3%	5.2%	6.3%	.3%	.6%	.9%	.6%	4.5%	4.7%
7	45.4%	48.1%	15.3%	13.6%	28.3%	27.0%	5.3%	5.8%	.4%	.5%	.9%	.6%	4.4%	4.3%
8	45.9%	47.7%	15.1%	14.9%	28.2%	27.0%	5.2%	5.3%	.4%	.3%	.9%	.6%	4.2%	4.2%

Appendix Table 1b. School-Level Race/Ethnicity Distributions for Sampling Targets and Sample in 2021-2022

Grade	% White		% Black		% Hispanic		% Asian		% Hawaiian or Pacific Islander		% American Indian or Alaskan		% Two or More Races	
	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample
Reading														
1	44.9%	45.0%	15.1%	16.2%	27.9%	27.4%	5.5%	5.4%	.4%	.4%	.9%	.4%	5.3%	5.1%
2	44.8%	43.0%	15.1%	17.0%	28.0%	28.4%	5.7%	5.5%	.4%	.5%	.9%	.5%	5.1%	5.2%
3	44.8%	42.0%	15.1%	16.8%	28.1%	29.3%	5.7%	5.9%	.4%	.5%	.9%	.5%	5.0%	5.1%
4	44.8%	42.6%	15.3%	15.8%	28.3%	29.6%	5.5%	6.0%	.4%	.5%	.9%	.5%	4.8%	5.0%
5	45.0%	42.7%	15.2%	15.9%	28.3%	29.6%	5.4%	5.9%	.4%	.5%	.9%	.5%	4.7%	5.0%
6	45.1%	44.6%	15.4%	13.1%	28.4%	30.1%	5.2%	6.5%	.3%	.6%	.9%	.5%	4.5%	4.5%
7	45.4%	47.2%	15.3%	13.0%	28.3%	29.2%	5.3%	5.6%	.4%	.3%	.9%	.5%	4.4%	4.1%
8	45.9%	45.4%	15.1%	13.2%	28.2%	30.5%	5.2%	6.0%	.4%	.3%	.9%	.5%	4.2%	4.1%
Mathematics														
1	44.9%	45.7%	15.1%	15.8%	27.9%	26.8%	5.5%	5.6%	.4%	.4%	.9%	.5%	5.3%	5.2%
2	44.8%	44.8%	15.1%	16.1%	28.0%	27.0%	5.7%	5.8%	.4%	.5%	.9%	.5%	5.1%	5.3%
3	44.8%	44.2%	15.1%	16.0%	28.1%	27.6%	5.7%	5.9%	.4%	.5%	.9%	.5%	5.0%	5.2%
4	44.8%	44.4%	15.3%	15.2%	28.3%	28.1%	5.5%	6.1%	.4%	.5%	.9%	.5%	4.8%	5.2%
5	45.0%	44.3%	15.2%	15.3%	28.3%	28.5%	5.4%	5.8%	.4%	.5%	.9%	.5%	4.7%	5.1%
6	45.1%	45.4%	15.4%	13.9%	28.4%	28.9%	5.2%	6.1%	.3%	.6%	.9%	.6%	4.5%	4.6%
7	45.4%	47.3%	15.3%	14.3%	28.3%	28.0%	5.3%	5.3%	.4%	.3%	.9%	.6%	4.4%	4.2%
8	45.9%	45.5%	15.1%	14.6%	28.2%	28.8%	5.2%	5.7%	.4%	.5%	.9%	.6%	4.2%	4.2%

Appendix Table 1c. School-Level Race/Ethnicity Distributions for Sampling Targets and Sample in 2018–2019

Grade	% White		% Black		% Hispanic		% Asian		% Hawaiian or Pacific Islander		% American Indian or Alaskan		% Two or More Races	
	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample
Reading														
1	46.2%	45.1%	15.1%	15.9%	27.2%	27.4%	5.5%	5.6%	.4%	.6%	.9%	.6%	4.9%	4.8%
2	46.0%	44.7%	15.2%	16.1%	27.5%	27.7%	5.3%	5.5%	.4%	.6%	.9%	.6%	4.7%	4.7%
3	45.9%	44.5%	15.4%	16.4%	27.6%	28.2%	5.3%	5.1%	.4%	.6%	.9%	.7%	4.5%	4.6%
4	46.1%	44.3%	15.4%	16.5%	27.7%	28.8%	5.2%	4.7%	.3%	.5%	1.0%	.7%	4.4%	4.5%
5	46.2%	42.5%	15.3%	17.1%	27.7%	29.8%	5.2%	4.7%	.4%	.6%	.9%	.7%	4.3%	4.5%
6	46.6%	43.7%	15.2%	16.6%	27.6%	29.2%	5.1%	5.0%	.4%	.8%	1.0%	.7%	4.1%	4.1%
7	47.1%	44.7%	15.0%	16.6%	27.5%	29.6%	5.2%	4.2%	.4%	.5%	1.0%	.7%	3.9%	3.7%
8	47.8%	46.0%	14.7%	15.8%	27.1%	29.3%	5.3%	3.8%	.4%	.6%	1.0%	.8%	3.7%	3.7%
Mathematics														
1	46.2%	45.9%	15.1%	15.8%	27.2%	27.1%	5.5%	5.3%	.4%	.6%	.9%	.6%	4.9%	4.7%
2	46.0%	45.8%	15.2%	15.7%	27.5%	27.3%	5.3%	5.3%	.4%	.6%	.9%	.6%	4.7%	4.7%
3	45.9%	45.2%	15.4%	16.0%	27.6%	28.3%	5.3%	4.8%	.4%	.5%	.9%	.6%	4.5%	4.5%
4	46.1%	45.8%	15.4%	16.0%	27.7%	28.0%	5.2%	4.6%	.3%	.5%	1.0%	.7%	4.4%	4.5%
5	46.2%	43.9%	15.3%	16.7%	27.7%	29.0%	5.2%	4.6%	.4%	.6%	.9%	.7%	4.3%	4.5%
6	46.6%	43.8%	15.2%	17.6%	27.6%	28.6%	5.1%	4.6%	.4%	.7%	1.0%	.7%	4.1%	4.0%
7	47.1%	45.0%	15.0%	16.9%	27.5%	28.2%	5.2%	4.6%	.4%	.7%	1.0%	.7%	3.9%	3.9%
8	47.8%	46.8%	14.7%	15.5%	27.1%	27.8%	5.3%	4.3%	.4%	.7%	1.0%	.8%	3.7%	4.1%

Region by Locale Distributions for Sampling Targets and Sample by Year, Subject, and Grade

Appendix Table 2a: Region by Locale Distributions for the Sampling Targets and Sample in **2022–2023**

	Midwest						Northeast					
	City		Suburb		Town/Rural		City		Suburb		Town/Rural	
Grade	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample
Reading												
1	5.5	4.0	7.3	5.4	7.7	4.9	4.4	4.0	8.1	8.4	2.8	2.5
2	5.4	3.9	7.3	5.9	7.7	5.3	4.4	4.5	8.1	9.3	2.8	2.9
3	5.4	3.7	7.3	5.5	7.7	4.7	4.4	5.7	8.1	8.9	2.8	2.7
4	5.3	3.2	7.4	5.4	7.7	4.8	4.4	5.8	8.2	9.2	2.9	2.8
5	5.3	3.1	7.4	5.4	7.8	4.6	4.3	6.0	8.2	9.6	2.8	2.8
6	5.2	3.8	7.5	8.3	7.8	6.1	4.3	5.7	8.1	12.6	2.9	2.9
7	5.1	3.5	7.5	8.0	8.0	5.3	4.2	5.9	8.0	12.1	3.1	3.4
8	5.0	3.7	7.5	8.6	8.1	5.8	4.2	6.8	8.1	11.7	3.1	3.2
Mathematics												
1	5.5	4.0	7.3	5.0	7.7	5.3	4.4	4.8	8.1	8.7	2.8	2.6
2	5.4	3.6	7.3	5.3	7.7	5.4	4.4	4.9	8.1	9.0	2.8	2.7
3	5.4	3.3	7.3	5.5	7.7	5.1	4.4	5.5	8.1	9.0	2.8	2.7
4	5.3	3.2	7.4	5.4	7.7	5.3	4.4	5.5	8.2	9.3	2.9	2.8
5	5.3	3.0	7.4	5.6	7.8	5.0	4.3	5.9	8.2	9.4	2.8	2.8
6	5.2	3.9	7.5	6.8	7.8	5.3	4.3	5.8	8.1	11.9	2.9	2.8
7	5.1	3.8	7.5	7.4	8.0	5.2	4.2	6.1	8.0	11.7	3.1	3.1
8	5.0	4.1	7.5	8.0	8.1	5.5	4.2	6.3	8.1	10.7	3.1	2.6

Grade	South						West					
	City		Suburb		Town/Rural		City		Suburb		Town/Rural	
	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample
Reading												
1	11.8	8.7	14.2	18.5	14.1	15.8	9.4	9.3	9.5	13.6	5.1	4.8
2	11.8	9.1	14.2	17.0	14.0	15.7	9.5	9.2	9.7	12.8	5.1	4.2
3	11.6	9.1	14.4	14.9	13.9	15.1	9.5	10.3	9.8	14.1	5.1	5.3
4	11.6	8.9	14.5	14.4	13.9	15.3	9.5	10.4	9.8	14.7	5.1	5.2
5	11.5	8.7	14.5	14.1	13.9	15.6	9.5	10.5	9.8	14.4	5.1	5.4
6	11.5	6.5	14.3	10.4	14.5	15.7	9.3	9.8	9.4	12.7	5.2	5.5
7	11.3	4.9	14.3	8.3	14.5	17.0	9.3	9.7	9.6	16.0	5.3	5.9
8	11.0	5.1	14.3	8.8	14.5	18.2	9.3	9.0	9.7	14.0	5.3	5.1
Mathematics												
1	11.8	9.6	14.2	15.7	14.1	15.8	9.4	9.7	9.5	13.1	5.1	5.5
2	11.8	9.0	14.2	15.3	14.0	15.2	9.5	10.2	9.7	13.8	5.1	5.5
3	11.6	9.5	14.4	14.4	13.9	14.9	9.5	10.3	9.8	14.1	5.1	5.8
4	11.6	9.2	14.5	13.8	13.9	14.7	9.5	10.5	9.8	14.6	5.1	5.8
5	11.5	8.7	14.5	13.9	13.9	15.0	9.5	10.4	9.8	14.5	5.1	5.9
6	11.5	6.5	14.3	11.2	14.5	15.6	9.3	11.0	9.4	13.4	5.2	5.7
7	11.3	5.8	14.3	8.7	14.5	17.1	9.3	9.9	9.6	14.6	5.3	6.5
8	11.0	6.1	14.3	8.7	14.5	18.4	9.3	9.8	9.7	13.7	5.3	6.1

Appendix Table 2b: Region by Locale Distributions for the Sampling Targets and Sample in 2021–2022

Grade	Midwest						Northeast					
	City		Suburb		Town/Rural		City		Suburb		Town/Rural	
	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample
Reading												
1	5.5	3.2	7.3	6.1	7.7	6.0	4.4	4.0	8.1	8.4	2.8	2.3
2	5.4	3.4	7.3	4.7	7.7	4.2	4.4	4.0	8.1	8.4	2.8	2.5
3	5.4	3.2	7.3	4.6	7.7	4.3	4.4	5.6	8.1	8.0	2.8	2.5
4	5.3	2.7	7.4	4.4	7.7	4.3	4.4	5.4	8.2	8.8	2.9	2.6
5	5.3	2.7	7.4	4.6	7.8	4.4	4.3	5.6	8.2	8.7	2.8	2.6
6	5.2	3.0	7.5	5.6	7.8	4.6	4.3	6.0	8.1	10.8	2.9	3.1
7	5.1	2.7	7.5	6.8	8.0	5.4	4.2	5.9	8.0	10.2	3.1	3.2
8	5.0	3.0	7.5	7.2	8.1	5.5	4.2	5.9	8.1	9.3	3.1	2.9
Mathematics												
1	5.5	3.3	7.3	5.9	7.7	6.1	4.4	4.3	8.1	8.3	2.8	2.3
2	5.4	3.3	7.3	4.5	7.7	4.8	4.4	4.6	8.1	8.3	2.8	2.4
3	5.4	2.9	7.3	4.6	7.7	4.7	4.4	5.2	8.1	8.2	2.8	2.4
4	5.3	2.7	7.4	4.4	7.7	4.7	4.4	5.7	8.2	8.8	2.9	2.4
5	5.3	2.7	7.4	4.7	7.8	4.5	4.3	5.4	8.2	8.7	2.8	2.6
6	5.2	3.2	7.5	5.1	7.8	4.5	4.3	5.7	8.1	10.0	2.9	2.9
7	5.1	3.4	7.5	6.1	8.0	5.3	4.2	6.1	8.0	10.9	3.1	3.0
8	5.0	3.7	7.5	7.0	8.1	5.6	4.2	6.4	8.1	9.8	3.1	2.5

Grade	South						West					
	City		Suburb		Town/Rural		City		Suburb		Town/Rural	
	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample
Reading												
1	11.8	12.8	14.2	19.1	14.1	14.7	9.4	9.3	9.5	10.1	5.1	4.1
2	11.8	11.2	14.2	18.9	14.0	14.9	9.5	9.9	9.7	13.2	5.1	4.8
3	11.6	10.7	14.4	18.8	13.9	14.9	9.5	9.8	9.8	13.0	5.1	4.7
4	11.6	10.0	14.5	18.8	13.9	14.8	9.5	10.1	9.8	13.3	5.1	4.8
5	11.5	9.7	14.5	19.2	13.9	15.1	9.5	9.9	9.8	12.7	5.1	4.7
6	11.5	7.8	14.3	13.7	14.5	15.6	9.3	10.7	9.4	13.7	5.2	5.3
7	11.3	8.5	14.3	13.3	14.5	17.8	9.3	8.8	9.6	12.6	5.3	5.0
8	11.0	8.3	14.3	13.2	14.5	17.6	9.3	9.6	9.7	12.8	5.3	4.5
Mathematics												
1	11.8	12.5	14.2	19.2	14.1	14.6	9.4	9.2	9.5	10.1	5.1	4.1
2	11.8	11.2	14.2	18.8	14.0	14.9	9.5	9.9	9.7	12.2	5.1	5.1
3	11.6	10.7	14.4	18.8	13.9	14.9	9.5	9.8	9.8	12.8	5.1	5.1
4	11.6	10.0	14.5	18.0	13.9	14.7	9.5	10.1	9.8	13.4	5.1	5.2
5	11.5	9.5	14.5	18.9	13.9	14.9	9.5	10.1	9.8	12.8	5.1	5.2
6	11.5	7.4	14.3	15.7	14.5	15.2	9.3	11.3	9.4	13.3	5.2	5.9
7	11.3	7.3	14.3	12.6	14.5	18.0	9.3	9.9	9.6	11.9	5.3	5.5
8	11.0	6.6	14.3	8.7	14.5	18.3	9.3	11.8	9.7	14.0	5.3	5.8

Appendix Table 2c: Region by Locale Distributions for the Sampling Targets and Sample in 2018–2019

Grade	Midwest						Northeast					
	City		Suburb		Town/Rural		City		Suburb		Town/Rural	
	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample
Reading												
1	5.5	3.6	7.3	5.7	7.6	5.8	4.6	4.4	8.0	7.4	2.8	2.3
2	5.4	3.4	7.3	5.9	7.6	5.6	4.5	4.5	8.0	7.6	2.8	2.4
3	5.4	3.5	7.3	6.3	7.7	5.7	4.4	4.3	8.0	8.2	2.8	2.3
4	5.3	2.7	7.4	5.1	7.7	5.3	4.4	4.8	8.1	8.3	2.9	2.5
5	5.2	2.7	7.4	4.6	7.8	4.4	4.3	5.0	8.1	7.4	2.9	2.8
6	5.1	3.2	7.5	5.3	7.9	5.4	4.3	6.2	8.1	8.6	3.0	3.8
7	5.0	3.4	7.6	6.4	8.0	5.8	4.2	4.9	8.1	8.3	3.2	3.6
8	4.9	3.8	7.7	6.3	8.1	6.3	4.2	4.3	8.2	8.5	3.2	3.5
Mathematics												
1	5.5	3.2	7.3	5.9	7.6	6.1	4.6	4.2	8.0	7.6	2.8	2.2
2	5.4	3.2	7.3	6.8	7.6	6.0	4.5	4.3	8.0	7.6	2.8	2.4
3	5.4	3.5	7.3	7.1	7.7	6.0	4.4	4.3	8.0	7.6	2.8	2.3
4	5.3	3.3	7.4	7.3	7.7	6.0	4.4	4.3	8.1	7.9	2.9	2.4
5	5.2	2.4	7.4	5.0	7.8	4.8	4.3	4.7	8.1	7.4	2.9	2.7
6	5.1	3.0	7.5	5.2	7.9	5.4	4.3	5.9	8.1	8.5	3.0	3.3
7	5.0	3.6	7.6	6.0	8.0	6.0	4.2	4.8	8.1	8.8	3.2	3.3
8	4.9	3.8	7.7	7.0	8.1	7.5	4.2	4.1	8.2	9.1	3.2	3.0

Grade	South						West					
	City		Suburb		Town/Rural		City		Suburb		Town/Rural	
	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample	Target	Sample
Reading												
1	11.6	13.0	14.4	19.3	13.8	14.7	9.5	9.3	9.9	10.5	5.0	4.1
2	11.5	12.4	14.5	19.4	13.7	14.4	9.6	9.6	10.0	10.8	5.1	4.1
3	11.5	12.3	14.7	19.5	13.8	14.6	9.4	9.2	10.0	10.3	5.0	3.9
4	11.5	12.3	14.7	19.7	14.0	14.4	9.3	9.8	9.8	10.9	5.0	4.3
5	11.3	12.3	14.7	19.6	14.0	14.5	9.4	10.0	9.9	12.0	5.1	4.6
6	11.1	7.2	14.3	15.8	14.3	15.1	9.4	9.7	9.8	14.6	5.1	5.1
7	10.8	7.1	14.3	15.5	14.0	16.4	9.5	9.6	10.1	13.8	5.2	5.2
8	10.7	6.2	14.3	15.4	14.1	16.2	9.5	9.9	10.1	14.0	5.1	5.6
Mathematics												
1	11.6	12.8	14.4	19.3	13.8	15.0	9.5	9.3	9.9	10.4	5.0	4.0
2	11.5	12.2	14.5	19.4	13.7	14.5	9.6	9.1	10.0	10.5	5.1	4.0
3	11.5	12.5	14.7	19.6	13.8	14.4	9.4	8.8	10.0	10.2	5.0	3.8
4	11.5	12.0	14.7	19.6	14.0	14.6	9.3	8.8	9.8	9.9	5.0	3.9
5	11.3	12.6	14.7	19.7	14.0	14.4	9.4	10.0	9.9	11.5	5.1	4.8
6	11.1	10.1	14.3	16.5	14.3	14.7	9.4	9.0	9.8	12.9	5.1	5.5
7	10.8	9.0	14.3	13.8	14.0	15.2	9.5	10.3	10.1	13.5	5.2	5.8
8	10.7	6.5	14.3	9.2	14.1	15.1	9.5	12.6	10.1	16.5	5.1	5.5

Median Income by School Zip Code Distributions by Year, Subject, and Grade

Appendix Table 3a: Median Income by School Zip Code Distributions for Sampling Targets and Sample in 2022–2023

Grade	Target Median Income Mean	Target Median Income Standard Deviation	Sample Median Income Mean	Target Mean – Sample Mean	(Target Mean – Sample Mean) ÷ Target Standard Deviation
Reading					
1	70,676	29,295	71,097	-421	-.01
2	70,887	29,466	70,997	-109	.00
3	71,139	29,597	70,298	841	.03
4	71,269	29,665	71,129	140	.00
5	71,327	29,598	71,275	52	.00
6	71,445	29,517	73,148	-1,703	-.06
7	71,693	29,509	73,976	-2,283	-.08
8	71,893	29,549	73,015	-1,122	-.04
Mathematics					
1	70,676	29,295	71,023	-347	-.01
2	70,887	29,466	72,065	-1,178	-.04
3	71,139	29,597	71,554	-415	-.01
4	71,269	29,665	72,060	-792	-.03
5	71,327	29,598	71,783	-456	-.02
6	71,445	29,517	73,369	-1,924	-.07
7	71,693	29,509	72,277	-583	-.02
8	71,893	29,549	70,107	1,786	.06

Appendix Table 3b: Median Income by School Zip Code Distributions for Sampling Targets and Sample in 2021–2022

Grade	Target Median Income Mean	Target Median Income Standard Deviation	Sample Median Income Mean	Target Mean – Sample Mean	(Target Mean – Sample Mean) ÷ Target Standard Deviation
Reading					
1	70,676	29,295	71,111	-435	-.01
2	70,887	29,466	70,216	671	.02
3	71,139	29,597	69,599	1,540	.05
4	71,269	29,665	70,943	326	.01
5	71,327	29,598	70,528	799	.03
6	71,445	29,517	72,816	-1,371	-.05
7	71,693	29,509	72,916	-1,222	-.04
8	71,893	29,549	72,192	-299	-.01
Mathematics					
1	70,676	29,295	71,311	-635	-.02
2	70,887	29,466	70,999	-111	.00
3	71,139	29,597	70,986	153	.01
4	71,269	29,665	71,851	-583	-.02
5	71,327	29,598	71,292	35	.00
6	71,445	29,517	72,703	-1,258	-.04
7	71,693	29,509	71,091	602	.02
8	71,893	29,549	70,049	1,844	.06

Appendix Table 3c: Median Income by School Zip Code Distributions for Sampling Targets and Sample in 2018–2019

Grade	Target Median Income Mean	Target Median Income Standard Deviation	Sample Median Income Mean	Target Mean – Sample Mean	(Target Mean – Sample Mean) ÷ Target Standard Deviation
Reading					
1	70,524	29,369	70,497	28	.00
2	70,869	29,589	71,145	-276	-.01
3	70,829	29,618	69,736	1,093	.04
4	70,852	29,566	68,874	1,977	.07
5	71,013	29,536	67,748	3,265	.11
6	71,494	29,586	67,523	3,972	.13
7	71,867	29,597	67,797	4,069	.14
8	72,136	29,767	67,564	4,573	.15
Mathematics					
1	70,524	29,369	69,983	542	.02
2	70,869	29,589	70,886	-17	.00
3	70,829	29,618	69,587	1,242	.04
4	70,852	29,566	69,454	1,398	.05
5	71,013	29,536	67,921	3,093	.10
6	71,494	29,586	67,098	4,397	.15
7	71,867	29,597	67,913	3,954	.13
8	72,136	29,767	67,891	4,245	.14

Fall and Spring Scale Scores and Fall-to-Spring Growth by Year, Subject, and Grade

Appendix Table 4: Fall and Spring Scale Scores

Grade	School Year 2018–2019		School Year 2021–2022		School Year 2022–2023	
	Fall	Spring	Fall	Spring	Fall	Spring
Reading						
1	405	460	398	448	396	449
2	462	504	448	491	449	495
3	499	532	489	522	487	521
4	530	554	523	549	522	548
5	551	572	547	568	547	568
6	568	585	568	583	568	583
7	583	596	584	597	584	596
8	596	607	597	609	596	608
Mathematics						
1	378	411	372	401	370	401
2	405	434	396	423	396	424
3	427	457	420	447	420	447
4	451	476	440	465	442	466
5	467	486	457	477	458	478
6	480	495	472	489	473	489
7	489	502	483	496	483	497
8	498	509	493	504	492	505

Appendix Table 5. Fall-to-Spring Growth Overall and by Fall Grade Level

Grade	All Students			Students Starting Fall On Grade Level			Students Starting Fall Below Grade Level		
	Fall 2018–Spring 2019	Fall 2021–Spring 2022	Fall 2022–Spring 2023	Fall 2018–Spring 2019	Fall 2021–Spring 2022	Fall 2022–Spring 2023	Fall 2018–Spring 2019	Fall 2021–Spring 2022	Fall 2022–Spring 2023
Reading									
1	55	49	53	48	44	49	68	56	58
2	42	43	46	30	31	36	50	45	51
3	33	33	34	25	25	26	44	40	42
4	25	26	26	18	17	17	35	35	36
5	21	21	21	15	12	12	28	29	28
6	16	15	15	9	8	7	22	23	23
7	13	13	12	6	6	5	20	20	20
8	11	12	12	3	5	4	20	20	20
Mathematics									
1	33	29	32	28	18	23	44	40	42
2	29	27	28	22	18	21	33	31	33
3	30	28	28	28	25	27	32	30	29
4	26	25	24	24	24	24	28	25	24
5	19	20	20	18	20	20	22	20	20
6	16	17	17	16	18	18	17	16	16
7	12	13	13	14	16	15	13	13	13
8	11	12	13	11	12	13	12	12	14

School-Level Demographic Groups

To answer the research questions pertaining to race and ethnicity and median household income, we developed the following reporting groups based on available school-level demographics for the population of students who tested in school. Students were grouped based on whether their school:

- Served less than 25% Black students, 25% to 50% Black students, or more than 50% Black students
- Served less than 25% Latino students, 25% to 50% Latino students, or more than 50% Latino students
- Served less than 25% White students, 25% to 50% White students, or more than 50% White students
- Was located in zip codes where the median annual household income is less than \$50,000, ranges from \$50,000 to \$75,000, or is more than \$75,000

While the more than 50% Black, Latino, and White schools may contain varying levels of diversity, we chose to group schools this way to ensure we had a sufficient sample size for each school-level demographic group. The school-level data on race and ethnicity used in this analysis was sourced from the NCES, which asks students to identify as American Indian or Alaska Native, Asian, Black or African American, Hispanic, Native Hawaiian or Other Pacific Islander, White, or Two or More Races. Throughout this paper, we use the term “Black” to refer to the NCES category of Black or African American and the term “Latino” to refer to the NCES category of Hispanic. We recognize language changes with time, and each demographic group described is not monolithic, nor are all individuals within any designated demographic group in agreement on preferred language. As a company, we will continue to review, reflect on, and evolve the terminology with the goal of using bias-free, inclusive, and sensitive language labels.

Appendix Table 6. Percentage of Students for School-Level Demographics by Year and Subject

Grade	2018-2019	2021-2022	2022-2023
Reading	N = 2,008,471	N = 3,717,345	N = 3,831,720
More Than 50% Black	10.1	8.8	9.4
More Than 50% Latino	21.0	21.4	19.9
More Than 50% White	45.3	44.2	45.8
Mathematics	N = 1,933,808	N = 4,495,918	N = 4,761,667
More Than 50% Black	9.9	8.5	8.7
More Than 50% Latino	20.2	20.0	18.4
More Than 50% White	46.3	46.1	48.1

Appendix Table 7. Student Sample Size for School-Level Median Household Income by Year and Subject

Grade	2018-2019	2021-2022	2022-2023
Reading	N = 2,008,471	N = 3,717,345	N = 3,831,720
Less Than \$50,000	25.0	23.0	22.9
\$50,000-\$75,000	41.6	41.4	40.3
More Than \$75,000	33.4	35.6	36.9
Mathematics	N = 1,933,808	N = 4,495,918	N = 4,761,667
Less Than \$50,000	25.6	23.1	22.8
\$50,000-\$75,000	41.5	40.7	39.8
More Than \$75,000	32.9	36.2	37.3

Appendix Table 8. Percentage of Students On Grade Level in Reading by Demographic Group

Grade	Less Than 25% Black			Less Than 25% Latino			Less Than 25% White		
	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023
1	71	61	65	72	63	67	58	45	49
2	70	59	63	71	61	65	55	43	48
3	75	68	68	76	69	70	60	52	52
4	56	54	53	57	56	55	39	39	37
5	51	50	50	52	52	52	36	36	35
6	48	48	49	50	50	50	35	36	35
7	51	51	50	52	53	53	37	39	39
8	51	52	51	53	54	53	39	42	40
Grade	25%–50% Black			25%–50% Latino			25%–50% White		
	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023
1	63	50	55	67	56	59	69	59	63
2	61	48	54	66	55	59	69	58	63
3	66	56	57	71	64	63	74	67	67
4	45	42	41	51	50	48	55	53	52
5	40	38	39	47	46	45	49	49	49
6	38	37	37	43	45	44	46	47	47
7	41	42	40	47	48	47	47	51	50
8	43	43	41	48	50	48	48	53	50

Appendix Table 9. Percentage of Students On Grade Level in Mathematics by Demographic Group

Grade	Less Than 25% Black			Less Than 25% Latino			Less Than 25% White		
	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023
1	68	56	56	69	57	58	54	39	39
2	65	53	54	65	54	56	50	35	36
3	68	55	56	68	57	57	54	38	38
4	72	58	59	73	60	62	59	41	42
5	65	54	56	66	56	58	51	38	38
6	58	51	52	59	53	54	42	36	36
7	48	44	44	50	45	46	33	31	30
8	44	40	41	47	42	42	32	30	29
Grade	25%–50% Black			25%–50% Latino			25%–50% White		
	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023	Spring 2019	Spring 2022	Spring 2023
1	57	44	45	63	49	49	66	53	53
2	53	40	43	59	47	47	62	50	51
3	58	42	44	64	50	49	66	53	53
4	63	46	47	68	53	53	70	56	57
5	55	41	43	61	49	49	63	52	53
6	48	38	39	51	45	45	55	49	50
7	40	34	33	43	39	39	44	41	42
8	39	32	32	41	38	37	42	39	39

Subject-Specific Domain Results

Appendix Table 10. Reading Domains—Percentage On Grade Level

Domain and Grade	2018-2019	2021-2022	2022-2023
High-Frequency Words			
K	79	71	71
1	79	69	73
Phonological Awareness			
K	86	81	81
1	77	70	66

Appendix Table 11. Reading Domains—Percentage Below Grade Level

Domain and Grade	2018-2019	2021-2022	2022-2023
High-Frequency Words			
K	0	0	0
1	2	5	5
Phonological Awareness			
K	0	0	0
1	2	4	4

Appendix Table 12. Reading Domains—Percentage On Grade Level

Domain and Grade	2018–2019	2021–2022	2022–2023
Vocabulary			
1	61	53	53
2	58	52	53
3	66	62	61
4	50	51	50
5	44	45	45
6	45	44	45
7	50	48	48
8	52	50	49
Comprehension: Literature			
1	65	56	55
2	65	54	54
3	70	62	60
4	59	55	54
5	54	53	53
6	47	48	48
7	47	49	49
8	46	49	49
Comprehension: Informational Text			
1	65	56	55
2	64	52	51
3	67	58	57
4	53	49	47
5	48	47	46
6	44	44	44
7	45	47	46
8	45	48	47

Appendix Table 13. Reading Domains—Percentage Below Grade Level

Domain and Grade	2018–2019	2021–2022	2022–2023
Vocabulary			
1	2	5	5
2	8	14	14
3	14	19	20
4	13	16	17
5	24	26	26
6	31	31	30
7	33	32	33
8	32	32	32
Comprehension: Literature			
1	2	4	4
2	8	14	14
3	14	21	22
4	14	19	20
5	22	25	27
6	29	30	30
7	36	34	35
8	35	33	33
Comprehension: Informational Text			
1	2	5	5
2	9	15	14
3	15	23	24
4	17	21	23
5	29	31	32
6	36	35	36
7	39	36	38
8	39	35	36

Appendix Table 14. Mathematics Domain—Percentage On Grade Level

Domain and Grade	2018–2019	2021–2022	2022–2023
Algebra and Algebraic Thinking			
1	76	65	65
2	64	55	55
3	72	61	61
4	72	59	60
5	56	48	49
6	55	49	50
7	45	40	41
8	43	39	39
Geometry			
1	69	53	56
2	66	51	54
3	57	45	44
4	64	48	47
5	59	47	49
6	52	45	44
7	43	38	37
8	43	38	38
Measurement and Data			
1	65	53	52
2	65	54	55
3	69	56	55
4	70	55	56
5	70	57	57
6	61	52	53
7	54	49	49
8	49	46	47

Appendix Table 15. Mathematics Domains—Percentage Below Grade Level

Domain and Grade	2018–2019	2021–2022	2022–2023
Algebra and Algebraic Thinking			
1	2	4	4
2	3	8	7
3	6	12	12
4	10	16	16
5	12	19	19
6	19	24	24
7	28	32	32
8	32	38	38
Geometry			
1	2	6	6
2	7	15	14
3	8	13	13
4	13	22	22
5	16	24	24
6	21	29	28
7	28	36	35
8	33	38	38
Measurement and Data			
1	2	7	7
2	6	12	12
3	9	16	16
4	11	19	19
5	13	20	21
6	17	24	24
7	23	29	29
8	27	32	32