

**TECHNICAL BRIEF**

**Technical appendix for:  
Education's long COVID: 2022 – 23 Achievement data reveal stalled  
progress towards pandemic recovery**

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## 1. Introduction

The purpose of this technical appendix is to share more detailed results and to describe more fully the sample and methods used in the research included in the brief, [Education's long COVID: 2022–23 achievement data reveal stalled progress towards pandemic recovery](#).<sup>i</sup> We investigated three main research questions in this brief:

- 1) How does growth in the 2022-23 school year compare to a typical school year?
- 2) How did achievement gaps change in the 2022-23 school year and how much additional schooling will be required to close these gaps?
- 3) How do these patterns differ by race/ethnicity and school poverty?

## 2. Data

### Sample

The data for this study are from the NWEA anonymized longitudinal student achievement database. School districts use [NWEA® MAP® Growth™](#) assessments to monitor elementary and secondary students' reading and math achievement and gains, with assessments typically administered in the fall (usually between August and November), winter (usually December to March), and spring (late March through June). The NWEA data also include demographic information, including student race/ethnicity, gender, and age at assessment. An indicator of student-level socioeconomic status is not available. However, a set of school-level characteristics, including school-level free or reduced priced lunch (FRPL) eligibility was obtained from the 2019-20 school-level Common Core of Data (CCD) files from the National Center for Education Statistics.<sup>ii</sup>

To measure achievement gains across the course of the COVID-19 pandemic, we follow separate cohorts of students across the most recent three school years impacted by the pandemic. The left (dark green) side of the table below illustrates the grades and years used for the "COVID sample" of students. Each cell in this table indicates the grade level that a given cohort is in across the three school years in our panel. In total, our COVID analytic sample consists of approximately 6.7 million students in grades 3-8 in 20,000 public schools who took MAP Growth reading and math assessments across the 2020-21 to 2022-23 school years. We did not require students to be present in all test seasons to be retained in the longitudinal COVID sample (see note below about our treatment of missing data).

Grades	COVID Sample (6.7 million students in 20K schools)			Pre-COVID Composite Sample (11 million students in 23K schools)		
	2020-21	2021-22	2022-23	2016-17 2017-18 2018-19	2016-17 2017-18 2018-19	2016-17 2017-18 2018-19
1-3	1	2	3	1	2	3
2-4	2	3	4	2	3	4
3-5	3	4	5	3	4	5
4-6	4	5	6	4	5	6
5-7	5	6	7	5	6	7
6-8	6	7	8	6	7	8

We also defined a “pre-COVID composite sample” to serve as a reference for each of the grade cohorts from the COVID sample (see the right side of the table above in light green). The pre-COVID sample serves as a counterfactual for the achievement gains that may have been expected if the COVID-19 pandemic had not occurred. Because the sample is a composite, it groups together student data for the same grade across the three full school years that preceded the onset of the pandemic (2016-17, 2017-18, and 2018-19). The pre-COVID sample consisted of 11 million unique students in 23,000 public schools. Descriptive information for the students in our overall sample by cohort, subject, and pre-COVID/COVID sample is provided in Table 1. In comparison to the pre-COVID composite sample, the COVID sample reflects a slightly lower percentage of Black and White students, and a slightly higher percentage of Hispanic students.

Descriptive information for the schools in our sample along with comparison information on the population of U.S. schools is provided in Table 2. The schools in our sample represent roughly one in three U.S. public schools in any given grade. Our sample reflects a diversity of schools from across various locales (urban, suburban, rural, and town). Relative to the population of U.S. schools, our sample reflects schools serving a slightly higher average percentage of White students and a lower average percentage of Hispanic students.

### Measure of achievement

Student test scores from the NWEA MAP Growth reading and math assessments, called RIT scores, were used in this study. MAP Growth is a computer adaptive test that precisely measures achievement even for students above or below grade level and is vertically scaled to allow for the estimation of gains across time. MAP Growth assessments are typically administered three times a year (fall, winter, and spring) and are aligned to state content standards. Test scores are reported on the RIT (Rasch unit) scale, which is a linear transformation of the logit scale units from the Rasch item response theory model.

## Missing data

In prior reports using samples of NWEA data,<sup>iii,iv,v,vi,vii</sup> we found that students of color and historically lower-achieving students who had tested in previous years were less likely to have taken the MAP Growth assessments during the 2020-21 school year. Therefore, focusing only on students who had complete data before and after the pandemic may underestimate the impact of the COVID-19 disruptions on learning. In the analyses presented in this report, we retained students that tested at any point during the three-school year span (2020-21, 2021-22, 2022-23 for the COVID sample; 2016-17, 2017-18, and 2018-19 for the pre-COVID sample), even if they did not test during the most recent school year in the panel.

## 3. Methods

### RQ1: How does growth in the 2022-23 school year compare to a typical school year?

Fall-spring achievement gains are calculated as the average difference between the fall and spring test scores in school year  $y$ , cohort  $g$  (1-3, 2-4, 3-5, 4-6, 5-7, 6-8) for sample  $s$  (where  $s=PC$  for the pre-COVID sample and  $C$  for the COVID sample).<sup>1</sup>

$$\overline{\text{Growth}}_{gys} = \frac{\sum_{i=1}^N RIT_{Si} - RIT_{Fi}}{N}$$

For the pre-COVID period, we created a composite estimate across 2016-17, 2017-18, and 2018-19 by taking a weighted average of  $\overline{\text{Growth}}_{gyPC}$  across all three years. Table 3 displays the average growth rates for the 2022-23 school year (COVID sample) and the pre-COVID composite sample. For reference, Table 3 also includes growth rates in 2021-22. We also calculated the ratio of COVID/pre-COVID fall-to-spring achievement gains. Estimates were found by dividing the mean fall-to-spring growth of the COVID sample by the mean growth of students in the pre-COVID composite sample. Growth ratios for math and reading are reported in Table 3 for both 2021-22 and 2022-23 students. Bar graphs showing the achievement gains of the 2022-23 COVID sample as a percentage of average pre-COVID gains are shown in Figure 1 in the main brief.

### RQ2: How did achievement gaps change in the 2022-23 school year and how much additional schooling will be required to close these gaps?

To track the size of achievement gaps (i.e., the difference between the pre-COVID and COVID sample) and how they have changed, we calculated the average test score ( $\overline{RIT}_{tgs}$ ) in term  $t$  within cohort  $g$  (1-3, 2-4, 3-5, 4-6, 5-7, 6-8) for sample  $s$  (where  $s=PC$  for the pre-COVID sample and  $C$  for the COVID sample). Line plots connecting these mean RIT scores for all cohorts across both subjects are shown in Figure A1 (as well as in Figure 2 in the main brief). RIT score means within each term of the COVID sample (2020-21 to 2022-23) are plotted in darker shaded lines (blue for reading and magenta for math), while the lighter shaded lines represent

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<sup>1</sup> To be included in these gain estimates, students must have an observed test score in both the fall and spring terms of the same school year.

the pre-COVID sample (2016-17 to 2018-19).<sup>2</sup> RIT score means, SDs, and sample sizes are presented for each cohort/grade/term in Table 4 for reading and Table 5 for math.

Achievement gaps were calculated by computing the standardized mean difference between average test scores in a grade/term between the pre-COVID and COVID samples. For example, the achievement gap (as an effect size) in the most recent fall term  $t$  in grade  $g$  was calculated as:

$$ES_{tg} = \frac{\overline{RIT}_{tgC} - \overline{RIT}_{tgPC}}{\sqrt{\frac{(N_{tgC} - 1)SD_{tgC}^2 + (N_{tgPC} - 1)SD_{tgPC}^2}{N_{tgC} + N_{tgPC} - 2}}}$$

where  $\overline{RIT}_{tgC}$  is the average COVID sample ( $t$ =spring 2023) test score in grade  $g$ ;  $\overline{RIT}_{tgPC}$  is the average pre-COVID ( $t$ =spring 2017 to spring 2019) composite test score in grade  $g$ ;  $SD_{tgC}$  and  $SD_{tgPC}$  are the corresponding standard deviation (SD) estimates; and  $N_{tgC}$  and  $N_{tgPC}$  are the observed sample size in grade  $g$  in spring 2023 and 2017-2019, respectively. The standardized effect sizes by grade, term, and subject are reported in Tables 4 and 5, and are displayed below the points in Figure A1 in this technical appendix, as well as in Figure 2 in the main brief.

In order to contextualize the practical significance of our achievement gaps, we translated the standardized effect sizes into a metric that may be more familiar to educators: months of schooling<sup>3</sup>. This translation is calculated as a ratio of some effect (e.g., achievement gap or treatment effect) to typical growth on the same scale. For example, in spring 2023 we observe a 4.57 RIT score difference in 5<sup>th</sup> grade math and a typical pre-COVID fall-to-spring growth rate of 10.1 RIT points per school year for 5<sup>th</sup> graders. Therefore, we estimate that a student would need  $4.57/10.1 = .45$  additional years of learning to catch up. If we assume 9 months of instruction in a school year, this translates to 4.1 additional months of schooling that students would require to meet pre-pandemic levels of achievement. For a given term  $t$  and cohort  $g$ , the translation formula is:

$$\text{Months of additional schooling} = \frac{\overline{RIT}_{tgC} - \overline{RIT}_{tgPC}}{\overline{\text{Growth}}_{gPC}} * 9,$$

where  $\overline{\text{Growth}}_{gPC}$  is the average fall-to-spring change in RIT score for grade  $g$  across the pre-COVID school years of 2016-17 to 2018-19. The achievement gaps for each subject/grade/term combination, pre-COVID growth rates, and months needed for each cohort to catch up are shown in Table 6. These results are shown in Figure 3 in the main brief which depicts both the standardized achievement gaps for 2022-23 students (dark magenta and blue bar graphs) and the months of additional schooling required for those students to catch up (light green line plot).

<sup>2</sup> Data for students who were in first or second grade during 2020-21 (i.e., the 1-3 and 2-4 cohorts) were redacted because our previous research has shown anomalies for the youngest students when remote testing was more prevalent (Kuhfeld et al., 2020<sup>viii</sup>).

<sup>3</sup> In previous reports, we estimated the years that students would need to close achievement gaps. Given the stalled progress and lack of positive improvement seen across cohorts, this approach was not feasible for this report. Instead, we calculated how many additional months of instruction students would need to offset the widening of these gaps. While months of learning metrics have known limitations (Baird & Pane, 2019<sup>ix</sup>; Kuhfeld, 2021<sup>x</sup>), we chose to still translate our effect sizes into metrics of time to communicate the urgency of the issue in a metric that resonates more with educators and policymakers.

### **RQ3: How do these patterns differ by race/ethnicity and school poverty?**

#### ***Gain scores***

We disaggregated the growth results by race/ethnicity and school poverty level<sup>4</sup>. We first calculated mean fall-to-spring growth by subject, grade, and racial/ethnic subgroup for 2022-23 students. We then divided these values by national average growth rates in the pre-COVID composite sample to calculate a COVID growth ratio for each subgroup. For parsimony in presenting the results, we further aggregated our growth rates and ratios to elementary level (students in grades 3 to 5) and middle school level (students in grades 6 to 8). For each subgroup, mean growth rates, sample sizes, and growth ratios are reported in Table 7 (for reading and math, respectively). Racial/ethnic growth ratios are displayed in Figure 4 in the main paper. We include parallel analyses disaggregating growth ratios by school poverty level in Figure A2 in this paper.

To highlight the pre-existing disparities in gains across subgroups, we also calculated how each subgroup's average pre-COVID gains compared to national pre-COVID average growth rates. Pre-COVID gains for each subject, grade, and subgroup were estimated using the pre-COVID composite sample and dividing by national pre-COVID average growth rates. These estimates are shown as the lighter color bars in Figure 4 of the main brief for race/ethnicity and Figure A2 in this paper for school poverty level.

#### ***Achievement scores***

To understand (a) subgroup differences that existed prior to the pandemic, as well as (b) how the pandemic has exacerbated achievement disparities, we standardized the pre-COVID and spring 2023 average test scores of each subgroup relative to national pre-COVID levels of achievement. Pre-COVID and COVID mean scores, sample sizes and SDs are presented in Table 8 for each grade band/subject/subgroup combination, as well as for the national pre-COVID sample.<sup>5</sup> Standardized estimates were calculated by subtracting mean scores for every subject/grade/subgroup/term combination from the average national pre-COVID achievement levels of that grade/term and dividing by the national pre-COVID SD. The grade-level standardized estimates were then averaged and collapsed across elementary and middle school grade bands.

These statistics are depicted in Figure 6 in the main brief which displays each racial/ethnic subgroup's mean scores in the pre-COVID sample (base of each arrow) and standardized mean scores in spring 2023 (tip of each arrow) standardized relative to pre-COVID national achievement levels (where zero represents the pre-COVID national baseline). The differences between pre-COVID and COVID values are reported below each arrow. Figure A4 displays parallel trends broken out by school poverty level.

#### ***Months of schooling required to close gaps***

Lastly, we examined months of additional schooling that students would require to reach pre-pandemic levels of achievement by racial/ethnic and school poverty demographics. In these

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<sup>4</sup> We reported two school poverty levels: (a) "Low Poverty" - less than 25% FRPL eligibility and (b) "High Poverty" - greater than 75% FRPL eligibility based on school-level Common Core of Data collected in 2019-20.

<sup>5</sup> The national pre-COVID estimates shown in Table 8 are the across-grade average of the spring pre-COVID estimates from Tables 4 & 5. For example, 211.3 for elementary math is the average of the grade 3 (202.2), grade 4 (211.9), and grade 5 (220.1) spring pre-COVID means in Table 5.



calculations, we focused on two different pre-COVID baselines in our months of additional schooling calculations: (a) each subgroup's own pre-pandemic levels of achievement and (b) national pre-pandemic levels of achievement. In the first calculation, we subtracted the average spring 2023 subgroup achievement by the pre-COVID spring *subgroup* achievement and benchmarked against national pre-COVID fall-to-spring growth rates (i.e., how many months would it take to return to a subgroup's pre-COVID achievement level). In the second calculation, we subtracted the average spring 2023 achievement for a subgroup by the pre-COVID *national* spring achievement and then benchmarked against national pre-COVID fall-to-spring growth rates (i.e., how many months would it take for a subgroup to reach parity with national average pre-COVID levels of achievement). In both cases, we assume 9 months of instruction to translate our estimates to additional months of schooling needed.

The additional months of instruction that 2022-23 students would need to catch up to pre-COVID levels of achievement are presented in Figure 5 of the main brief for racial/ethnic subgroups and parallel analyses are included in Figure A3 of this paper for school poverty levels. Mean scores, absolute differences, and additional months required by both racial/ethnic and school poverty subgroups are shown in Table 9.

**Table 1. Description of the pre-COVID and COVID student samples**

Subject	Sample	School Year	Grade	N	Asian	Black	Hispanic	White	Male
Reading	Pre-COVID	2017-2019	All Grades	10,673,338	4.0	17.4	18.3	47.8	0.51
Math	Pre-COVID	2017-2019	All Grades	10,778,268	4.1	17.0	18.7	47.6	0.51
Both	Pre-COVID	2017-2019	All Grades	11,048,548	4.2	17.6	19.0	46.7	0.51
Reading	COVID	2021-2023	All Grades	6,520,734	4.5	15.8	22.1	45.8	0.51
Math	COVID	2021-2023	All Grades	6,588,486	4.5	15.7	22.4	45.5	0.51
Both	COVID	2021-2023	All Grades	6,683,429	4.6	16.5	22.4	44.3	0.51
Reading	Pre-COVID	2017-2019	1	2,060,966	4.0	19.0	17.8	46.5	0.51
Reading	Pre-COVID	2017-2019	2	2,541,752	4.2	18.3	18.4	46.8	0.51
Reading	Pre-COVID	2017-2019	3	2,715,496	4.1	17.9	18.6	46.9	0.51
Reading	Pre-COVID	2017-2019	4	2,674,023	4.0	17.3	18.1	48.0	0.51
Reading	Pre-COVID	2017-2019	5	2,706,310	4.0	17.1	18.1	48.2	0.51
Reading	Pre-COVID	2017-2019	6	2,681,068	4.0	16.9	18.7	47.8	0.51
Reading	Pre-COVID	2017-2019	7	2,582,253	4.0	16.5	18.3	48.8	0.51
Reading	Pre-COVID	2017-2019	8	2,487,717	3.9	16.5	18.3	49.2	0.51
Reading	COVID	2021-2023	1	624,961	3.8	16.5	20.2	47.0	0.51
Reading	COVID	2021-2023	2	1,486,189	4.3	16.1	20.6	46.8	0.51
Reading	COVID	2021-2023	3	2,372,541	4.6	15.9	22.1	45.5	0.51
Reading	COVID	2021-2023	4	2,387,576	4.6	15.7	22.1	45.8	0.51
Reading	COVID	2021-2023	5	2,417,042	4.5	15.7	22.3	45.8	0.51
Reading	COVID	2021-2023	6	2,420,734	4.5	15.4	22.4	45.8	0.51
Reading	COVID	2021-2023	7	1,628,636	4.5	15.7	22.7	45.3	0.51
Reading	COVID	2021-2023	8	771,722	4.6	16.0	23.6	44.4	0.51
Math	Pre-COVID	2017-2019	1	2,152,594	4.2	18.8	18.6	45.9	0.51
Math	Pre-COVID	2017-2019	2	2,581,160	4.3	17.8	18.7	46.8	0.51
Math	Pre-COVID	2017-2019	3	2,717,311	4.2	17.5	18.8	46.8	0.51
Math	Pre-COVID	2017-2019	4	2,680,909	4.2	16.9	18.3	48.0	0.51
Math	Pre-COVID	2017-2019	5	2,719,582	4.1	16.6	18.4	48.1	0.51
Math	Pre-COVID	2017-2019	6	2,692,309	4.1	16.5	19.1	47.7	0.51
Math	Pre-COVID	2017-2019	7	2,578,484	3.9	16.1	18.8	48.7	0.51
Math	Pre-COVID	2017-2019	8	2,419,602	3.7	16.4	18.9	48.8	0.51
Math	COVID	2021-2023	1	661,832	3.9	16.2	21.1	46.6	0.51
Math	COVID	2021-2023	2	1,563,848	4.4	16.0	21.5	46.1	0.51
Math	COVID	2021-2023	3	2,407,254	4.7	15.7	22.5	45.2	0.51
Math	COVID	2021-2023	4	2,430,003	4.7	15.6	22.5	45.5	0.51
Math	COVID	2021-2023	5	2,466,516	4.6	15.5	22.7	45.5	0.51
Math	COVID	2021-2023	6	2,427,713	4.5	15.5	22.3	45.9	0.51
Math	COVID	2021-2023	7	1,623,141	4.3	15.9	22.9	45.2	0.51
Math	COVID	2021-2023	8	714,233	4.0	16.6	23.8	44.1	0.51

*Note.* N=number of students. The pre-COVID sample includes the 2016-17 to 2018-19 school years, while the COVID sample includes the 2020-21 to 2022-23 school years. Many students tested in both subjects, which is why the combined samples are not a sum of each math and reading sample.

**Table 2. Sample school information relative to U.S. population of schools**

Subject	Sample	Year	Grades	Number of Schools	Average School Enrollment	% FRPL	% White	% Black	% Hispanic	% Asian	City	Suburb	Rural	Town
--	U.S. Public Schools	2019-20	All grades	76,960	472	0.55	0.49	0.15	0.25	0.04	0.28	0.32	0.28	0.12
--	Pre-COVID (Combined)	2016-17 to 2018-19	All grades	23,085	468	0.54	0.52	0.16	0.21	0.04	0.29	0.31	0.29	0.11
--	COVID (Combined)	2020-21 to 2021-23	All grades	20,183	484	0.54	0.53	0.15	0.21	0.04	0.29	0.32	0.29	0.11
Reading	Pre-COVID	2017	All grades	17,926	460	0.53	0.53	0.16	0.19	0.03	0.26	0.33	0.29	0.12
Reading	Pre-COVID	2018	All grades	18,962	466	0.54	0.53	0.16	0.20	0.03	0.28	0.32	0.29	0.11
Reading	Pre-COVID	2019	All grades	19,703	470	0.54	0.53	0.16	0.20	0.03	0.28	0.32	0.29	0.11
Reading	COVID	2021	All grades	16,771	485	0.54	0.53	0.15	0.21	0.04	0.27	0.33	0.29	0.11
Reading	COVID	2022	All grades	17,514	485	0.54	0.53	0.15	0.21	0.03	0.28	0.32	0.29	0.11
Reading	COVID	2023	All grades	15,667	485	0.54	0.52	0.15	0.22	0.04	0.28	0.33	0.28	0.10
Math	Pre-COVID	2017	All grades	17,890	460	0.53	0.54	0.15	0.20	0.04	0.27	0.32	0.30	0.12
Math	Pre-COVID	2018	All grades	19,010	466	0.54	0.53	0.16	0.20	0.04	0.29	0.32	0.29	0.11
Math	Pre-COVID	2019	All grades	19,750	469	0.54	0.53	0.16	0.20	0.04	0.29	0.31	0.29	0.11
Math	COVID	2021	All grades	16,925	485	0.54	0.53	0.15	0.21	0.04	0.27	0.33	0.29	0.11
Math	COVID	2022	All grades	17,825	487	0.54	0.53	0.15	0.22	0.03	0.28	0.32	0.29	0.11
Math	COVID	2023	All grades	15,780	485	0.54	0.52	0.15	0.22	0.04	0.29	0.33	0.28	0.10

*Note:* FRPL=free or reduced priced lunch. The NWEA pre-COVID sample is defined as schools that administered MAP Growth in a given grade (or grade range) during the 2016-17 to 2018-19 school years, while NWEA COVID sample is defined as schools that administered MAP Growth during the 2020-21 to 2022-23 school years. The source of the variables is the Common Core of Data (CCD) collected by the National Center for Educational Statistics. The U.S. public school population comparison for each grade was determined by limiting to the schools that were operational in 2019-20 and enrolled students in that grade level.

**Table 3. Average fall-spring growth rates during the 2021-22 and 2022-23 school year relative to pre-COVID average gains**

Subject	Cohort	School Year	Grade	Pre-COVID			COVID			Growth Ratio	% Above/Below Average
				N	Mean Growth	SD	N	Mean Growth	SD		
Reading	1-3	2021-22	2	2,102,538	13.8	9.6	637,277	14.1	10.1	1.02	2
Reading	1-3	2022-23	3	2,129,697	10.7	9.5	555,564	11.1	9.8	1.04	4
Reading	2-4	2021-22	3	2,129,697	10.7	9.5	662,962	11.0	9.7	1.03	3
Reading	2-4	2022-23	4	2,072,377	7.8	9.0	551,810	7.7	9.0	0.99	-1
Reading	3-5	2021-22	4	2,072,377	7.8	9.0	660,877	7.8	9.1	1.00	0
Reading	3-5	2022-23	5	2,079,196	6.3	8.8	550,793	5.8	8.7	0.92	-8
Reading	4-6	2021-22	5	2,079,196	6.3	8.8	660,488	6.0	8.8	0.95	-5
Reading	4-6	2022-23	6	1,984,214	4.7	8.9	529,529	3.8	8.7	0.81	-19
Reading	5-7	2021-22	6	1,984,214	4.7	8.9	620,775	4.1	8.9	0.87	-13
Reading	5-7	2022-23	7	1,843,967	3.9	9.0	511,545	3.2	8.9	0.84	-16
Reading	6-8	2021-22	7	1,843,967	3.9	9.0	623,219	3.2	9.1	0.83	-17
Reading	6-8	2022-23	8	1,734,390	3.3	9.0	510,492	2.7	9.2	0.82	-18
Math	1-3	2021-22	2	2,103,261	14.8	8.3	677,735	15.2	8.4	1.02	2
Math	1-3	2022-23	3	2,100,720	13.3	7.8	552,689	13.5	7.8	1.02	2
Math	2-4	2021-22	3	2,100,720	13.3	7.8	670,680	13.9	7.7	1.05	5
Math	2-4	2022-23	4	2,056,723	11.3	7.7	549,774	10.5	7.5	0.93	-7
Math	3-5	2021-22	4	2,056,723	11.3	7.7	670,545	11.7	7.5	1.04	4
Math	3-5	2022-23	5	2,069,765	10.1	7.9	550,476	8.5	7.6	0.85	-15
Math	4-6	2021-22	5	2,069,765	10.1	7.9	673,559	9.9	7.6	0.99	-1
Math	4-6	2022-23	6	2,004,747	8.1	7.8	520,114	7.6	7.7	0.94	-6
Math	5-7	2021-22	6	2,004,747	8.1	7.8	626,939	8.0	7.5	0.99	-1
Math	5-7	2022-23	7	1,847,029	6.5	7.9	500,408	5.8	7.9	0.90	-10
Math	6-8	2021-22	7	1,847,029	6.5	7.9	629,166	6.3	7.6	0.97	-3
Math	6-8	2022-23	8	1,684,140	5.4	8.1	458,467	5.0	8.3	0.93	-7

*Note.* N=number of students. Mean Growth=average fall-to-spring change in RIT score for each grade/subject/year. The pre-COVID sample columns show average growth rates from 2016-17 to 2018-19 as a reference to the COVID sample's 2021-22 and 2022-23 achievement gains. Growth ratios are calculated by dividing COVID growth rates by pre-COVID growth rates. Data from this table are referenced in Figure 1 in the main brief.

**Table 4. Student reading RIT score means, SDs by cohort and sample**

Cohort	School Year	Term	Grade	Pre-COVID			COVID			Standardized difference between samples
				N	M	SD	N	M	SD	
1-3	2021-22	F21	2	2,332,563	173.0	16.3	703,970	169.8	17.2	-0.19
1-3	2021-22	S22	2	2,325,972	186.7	16.1	693,788	183.7	17.3	-0.18
1-3	2022-23	F22	3	2,502,585	187.4	16.9	705,433	184.5	18.1	-0.17
1-3	2022-23	S23	3	2,359,959	197.9	16.4	599,894	195.4	17.9	-0.15
2-4	2021-22	F21	3	2,502,585	187.4	16.9	781,278	185.0	18.0	-0.14
2-4	2021-22	S22	3	2,359,959	197.9	16.4	714,883	195.8	17.6	-0.13
2-4	2022-23	F22	4	2,471,041	197.6	16.6	713,205	195.7	17.8	-0.11
2-4	2022-23	S23	4	2,280,894	205.3	16.1	590,907	203.4	17.5	-0.12
3-5	2020-21	F20	3	2,502,585	187.4	16.9	692,887	188.2	17.5	0.05
3-5	2020-21	S21	3	2,359,959	197.9	16.4	672,049	195.7	17.4	-0.14
3-5	2021-22	F21	4	2,471,041	197.6	16.6	788,536	195.9	17.3	-0.10
3-5	2021-22	S22	4	2,280,894	205.3	16.1	708,340	203.7	17.0	-0.10
3-5	2022-23	F22	5	2,499,490	205.0	16.4	718,124	203.3	17.3	-0.10
3-5	2022-23	S23	5	2,290,765	211.1	15.9	589,856	209.1	17.0	-0.13
4-6	2020-21	F20	4	2,471,041	197.6	16.6	700,751	197.9	16.7	0.02
4-6	2020-21	S21	4	2,280,894	205.3	16.1	667,326	203.2	16.9	-0.13
4-6	2021-22	F21	5	2,499,490	205.0	16.4	796,796	203.4	16.8	-0.10
4-6	2021-22	S22	5	2,290,765	211.1	15.9	711,551	209.3	16.6	-0.12
4-6	2022-23	F22	6	2,450,709	210.3	16.2	722,768	209.1	16.7	-0.08
4-6	2022-23	S23	6	2,221,746	215.0	15.9	576,168	212.9	16.5	-0.13
5-7	2020-21	F20	5	2,499,490	205.0	16.4	710,105	205.0	16.4	0.00
5-7	2020-21	S21	5	2,290,765	211.1	15.9	670,211	209.0	16.6	-0.13
5-7	2021-22	F21	6	2,450,709	210.3	16.2	785,488	209.0	16.5	-0.09
5-7	2021-22	S22	6	2,221,746	215.0	15.9	684,035	213.0	16.4	-0.12
5-7	2022-23	F22	7	2,348,897	214.6	16.3	716,307	212.7	16.7	-0.12
5-7	2022-23	S23	7	2,084,549	218.4	16.3	560,843	215.8	17.0	-0.16
6-8	2020-21	F20	6	2,450,709	210.3	16.2	683,132	210.7	16.0	0.02
6-8	2020-21	S21	6	2,221,746	215.0	15.9	645,389	213.1	16.6	-0.11
6-8	2021-22	F21	7	2,348,897	214.6	16.3	801,692	213.0	16.5	-0.10
6-8	2021-22	S22	7	2,084,549	218.4	16.3	686,781	216.2	16.8	-0.14
6-8	2022-23	F22	8	2,258,800	218.4	16.4	724,677	216.2	16.9	-0.13
6-8	2022-23	S23	8	1,968,588	221.6	16.3	557,537	218.9	17.0	-0.17

*Note.* N=number of students, M=mean, SD=standard deviation, F20=fall of 2020, S21=spring of 2021. We do not report the estimates for students who were in first or second grade during 2020-21 (i.e., the 1-3 and 2-4 cohorts). This is due to concerns about test score comparability in the youngest grades during this period when many students were still testing at home (see our comparison of remote and in-person testing<sup>viii</sup> for more detail). Data from this table are referenced in Figure 2 in the main brief.

**Table 5. Student math RIT score means, SDs by cohort and sample**

Cohort	School Year	Term	Grade	Pre-COVID			COVID			Standardized difference between samples
				N	M	SD	N	M	SD	
1-3	2021-22	F21	2	2,376,600	175.6	13.6	753,768	172.4	14.7	-0.24
1-3	2021-22	S22	2	2,322,320	190.4	13.8	732,274	187.4	15.1	-0.21
1-3	2022-23	F22	3	2,513,014	188.7	13.6	720,080	186.2	15.1	-0.18
1-3	2022-23	S23	3	2,322,268	202.0	14.3	591,360	199.7	15.8	-0.16
2-4	2021-22	F21	3	2,513,014	188.7	13.6	800,018	185.2	14.8	-0.25
2-4	2021-22	S22	3	2,322,268	202.0	14.3	721,072	199.1	15.8	-0.20
2-4	2022-23	F22	4	2,487,120	200.6	14.3	722,807	198.1	15.9	-0.17
2-4	2022-23	S23	4	2,256,078	211.9	15.8	588,326	208.7	16.9	-0.20
3-5	2020-21	F20	3	2,513,014	188.7	13.6	694,231	187.3	14.1	-0.10
3-5	2020-21	S21	3	2,322,268	202.0	14.3	673,482	198.1	15.5	-0.27
3-5	2021-22	F21	4	2,487,120	200.6	14.3	803,808	196.8	15.4	-0.26
3-5	2021-22	S22	4	2,256,078	211.9	15.8	719,261	208.5	17.1	-0.21
3-5	2022-23	F22	5	2,521,931	210.1	15.7	727,778	207.0	17.1	-0.19
3-5	2022-23	S23	5	2,272,299	220.1	17.6	588,916	215.5	18.2	-0.26
4-6	2020-21	F20	4	2,487,120	200.6	14.3	710,972	198.3	14.3	-0.17
4-6	2020-21	S21	4	2,256,078	211.9	15.8	682,428	207.4	16.5	-0.28
4-6	2021-22	F21	5	2,521,931	210.1	15.7	814,048	205.9	16.4	-0.26
4-6	2021-22	S22	5	2,272,299	220.1	17.6	725,531	215.8	18.4	-0.24
4-6	2022-23	F22	6	2,481,413	214.8	15.9	720,278	211.9	16.1	-0.18
4-6	2022-23	S23	6	2,223,036	222.8	17.5	561,675	219.7	17.9	-0.18
5-7	2020-21	F20	5	2,521,931	210.1	15.7	723,379	207.7	15.5	-0.15
5-7	2020-21	S21	5	2,272,299	220.1	17.6	691,334	215.3	17.8	-0.27
5-7	2021-22	F21	6	2,481,413	214.8	15.9	791,913	211.3	15.8	-0.22
5-7	2021-22	S22	6	2,223,036	222.8	17.5	691,297	219.1	17.6	-0.21
5-7	2022-23	F22	7	2,356,481	221.3	17.6	711,213	217.7	17.4	-0.20
5-7	2022-23	S23	7	2,076,552	227.7	18.8	545,972	223.5	19.1	-0.23
6-8	2020-21	F20	6	2,481,413	214.8	15.9	691,040	212.8	15.1	-0.13
6-8	2020-21	S21	6	2,223,036	222.8	17.5	647,919	219.3	17.4	-0.20
6-8	2021-22	F21	7	2,356,481	221.3	17.6	804,203	217.3	17.0	-0.23
6-8	2021-22	S22	7	2,076,552	227.7	18.8	693,302	223.5	18.6	-0.23
6-8	2022-23	F22	8	2,199,867	226.6	18.7	670,703	221.6	18.3	-0.26
6-8	2022-23	S23	8	1,908,945	231.8	19.8	501,997	226.4	19.7	-0.27

*Note.* N=number of students, M=mean, SD=standard deviation, F20=fall of 2020, S21=spring of 2021. We do not report the estimates for students who were in first or second grade during 2020-21 (i.e., the 1-3 and 2-4 cohorts). This is due to concerns about test score comparability in the youngest grades during this period when many students were still testing at home (see our comparison of remote and in-person testing<sup>viii</sup> for more detail). Data from this table are referenced in Figure 2 in the main brief.

**Table 6. Mean student RIT scores, achievement gaps, and months of additional instruction by subject and grade**

Subject	School Year	Grade	Term	Pre-COVID Mean	COVID Mean	Standardized Effect Size	Difference	Pre-COVID Growth	Months
Reading	2022-23	3	F22	187.4	184.5	-0.17	2.93	10.7	2.5
Reading	2022-23	3	S23	197.9	195.4	-0.15	2.49	10.7	2.1
Reading	2022-23	4	F22	197.6	195.7	-0.11	1.93	7.8	2.2
Reading	2022-23	4	S23	205.3	203.4	-0.12	1.96	7.8	2.3
Reading	2022-23	5	F22	205.0	203.3	-0.10	1.61	6.3	2.3
Reading	2022-23	5	S23	211.1	209.1	-0.13	2.04	6.3	2.9
Reading	2022-23	6	F22	210.3	209.1	-0.08	1.29	4.7	2.5
Reading	2022-23	6	S23	215.0	212.9	-0.13	2.08	4.7	4
Reading	2022-23	7	F22	214.6	212.7	-0.12	1.92	3.9	4.5
Reading	2022-23	7	S23	218.4	215.8	-0.16	2.55	3.9	5.9
Reading	2022-23	8	F22	218.4	216.2	-0.13	2.19	3.3	5.9
Reading	2022-23	8	S23	221.6	218.9	-0.17	2.75	3.3	7.4
Math	2022-23	3	F22	188.7	186.2	-0.18	2.53	13.3	1.7
Math	2022-23	3	S23	202.0	199.7	-0.16	2.30	13.3	1.6
Math	2022-23	4	F22	200.6	198.1	-0.17	2.54	11.3	2
Math	2022-23	4	S23	211.9	208.7	-0.20	3.20	11.3	2.6
Math	2022-23	5	F22	210.1	207.0	-0.19	3.10	10.1	2.8
Math	2022-23	5	S23	220.1	215.5	-0.26	4.57	10.1	4.1
Math	2022-23	6	F22	214.8	211.9	-0.18	2.88	8.1	3.2
Math	2022-23	6	S23	222.8	219.7	-0.18	3.15	8.1	3.5
Math	2022-23	7	F22	221.3	217.7	-0.20	3.58	6.5	5
Math	2022-23	7	S23	227.7	223.5	-0.23	4.28	6.5	5.9
Math	2022-23	8	F22	226.6	221.6	-0.26	4.91	5.4	8.2
Math	2022-23	8	S23	231.8	226.4	-0.27	5.42	5.4	9.1

*Note.* Standardized Effect Size=standardized difference between COVID and pre-COVID means. Difference=unadjusted difference between COVID and pre-COVID means. Pre-COVID growth=average fall-to-spring change in RIT score for each grade/subject. Months=additional months of schooling that 2022-23 students would require to catch up to pre-COVID means. Months of additional schooling needed are calculated by dividing the unadjusted difference by the pre-COVID average growth rate and multiplying by 9, which is the number of months in a typical school year. Data from this table are referenced in Figure 3 in the main brief.

**Table 7. Average fall-spring growth rates and ratios by school level and subgroup**

Subject	Grade Band	Subgroup	Pre-COVID (National)		Pre-COVID (Subgroup)		COVID (Subgroup)		Pre-COVID Ratio	COVID Ratio	% Above/Below Average	
			N	Mean Growth	N	Mean Growth	N	Mean Growth			Pre-COVID	COVID
Reading	Elementary	Asian	6,281,270	8.3	238,804	8.0	80,633	7.6	0.97	0.92	-3	-8
Reading	Elementary	Black	6,281,270	8.3	1,064,061	8.0	253,215	7.9	0.96	0.95	-4	-5
Reading	Elementary	Hispanic	6,281,270	8.3	1,115,653	8.5	394,938	8.5	1.03	1.02	3	2
Reading	Elementary	White	6,281,270	8.3	3,088,156	8.3	742,267	8.3	1.01	0.99	0	-1
Reading	Middle	Asian	5,562,571	4.0	214,990	4.2	73,054	3.3	1.06	0.84	6	-16
Reading	Middle	Black	5,562,571	4.0	897,738	4.0	237,230	3.3	1.01	0.84	1	-16
Reading	Middle	Hispanic	5,562,571	4.0	972,324	4.1	370,407	3.3	1.04	0.83	4	-17
Reading	Middle	White	5,562,571	4.0	2,818,682	3.9	705,844	3.2	0.98	0.81	-2	-19
Math	Elementary	Asian	6,227,208	11.5	244,028	12.7	81,426	11.4	1.11	0.99	11	-1
Math	Elementary	Black	6,227,208	11.5	1,023,317	10.3	250,621	10.0	0.89	0.86	-11	-14
Math	Elementary	Hispanic	6,227,208	11.5	1,120,669	11.4	401,387	10.9	0.98	0.94	-2	-6
Math	Elementary	White	6,227,208	11.5	3,065,425	11.9	735,226	11.0	1.04	0.95	4	-5
Math	Middle	Asian	5,535,916	6.6	205,579	8.0	64,593	7.6	1.21	1.15	21	15
Math	Middle	Black	5,535,916	6.6	876,673	5.9	230,951	5.3	0.89	0.80	-11	-20
Math	Middle	Hispanic	5,535,916	6.6	1,001,888	6.3	353,123	5.6	0.94	0.84	-6	-16
Math	Middle	White	5,535,916	6.6	2,791,190	6.9	669,446	6.6	1.04	0.99	5	-1
Reading	Elementary	High Poverty	6,281,270	8.3	1,615,300	8.5	429,838	8.5	1.03	1.03	3	3
Reading	Elementary	Low Poverty	6,281,270	8.3	1,268,069	8.0	374,903	7.8	0.96	0.93	-4	-7
Reading	Middle	High Poverty	5,562,571	4.0	1,166,931	4.3	330,748	3.5	1.08	0.89	8	-11
Reading	Middle	Low Poverty	5,562,571	4.0	1,076,340	3.7	339,819	3.0	0.93	0.75	-7	-25
Math	Elementary	High Poverty	6,227,208	11.5	1,590,611	10.9	434,017	10.7	0.94	0.91	-6	-9
Math	Elementary	Low Poverty	6,227,208	11.5	1,281,544	12.2	373,534	11.0	1.06	0.95	6	-5
Math	Middle	High Poverty	5,535,916	6.6	1,172,562	6.2	317,315	5.5	0.94	0.83	-6	-18
Math	Middle	Low Poverty	5,535,916	6.6	1,068,058	7.3	317,013	6.9	1.10	1.04	10	4

*Note.* N=number of unique test events. The pre-COVID national columns show average growth rates from 2016-17 to 2018-19 for all students, while the pre-COVID (subgroup) and COVID (subgroup) columns show growth rates by racial/ethnic and school poverty demographics. COVID (subgroup) columns refer to 2022-23 student data. The pre-COVID growth ratio is pre-COVID (subgroup) divided by pre-COVID (national), and the COVID growth ratio is COVID (subgroup) divided by pre-COVID (national). Data from this table are referenced in Figure 4 in the main brief.



**Table 8. Mean student RIT scores, achievement gaps, and SDs by school level and subgroup**

Subject	Grade Band	Subgroup	Pre-COVID (National)			Pre-COVID (Subgroup)			COVID (Subgroup)			Pre-COVID	COVID	Difference
			N	M	SD	N	M	SD	N	M	SD	Effect Size	Effect Size	
Math	Elementary	Asian	6,850,645	211.3	15.9	277,857	221.3	16.8	89,298	218.5	17.4	0.62	0.45	-0.17
Math	Elementary	White	6,850,645	211.3	15.9	3,300,883	215.0	14.6	775,431	212.3	15.1	0.24	0.06	-0.17
Math	Elementary	Black	6,850,645	211.3	15.9	1,150,519	203.4	15.2	274,269	199.4	16.9	-0.50	-0.75	-0.25
Math	Elementary	Hispanic	6,850,645	211.3	15.9	1,258,959	207.1	15.2	431,262	203.5	16.6	-0.26	-0.48	-0.22
Math	Middle	Asian	6,208,533	227.5	18.7	235,432	239.8	20.1	70,955	237.0	20.8	0.66	0.51	-0.15
Math	Middle	White	6,208,533	227.5	18.7	3,050,605	231.9	17.3	717,517	228.3	17.6	0.25	0.05	-0.20
Math	Middle	Black	6,208,533	227.5	18.7	1,011,641	218.1	17.5	257,119	213.7	17.1	-0.51	-0.74	-0.23
Math	Middle	Hispanic	6,208,533	227.5	18.7	1,168,721	222.0	17.9	387,236	217.5	17.6	-0.29	-0.53	-0.24
Reading	Elementary	Asian	6,931,618	204.8	16.1	272,764	211.2	15.7	87,696	210.1	16.5	0.40	0.33	-0.07
Reading	Elementary	White	6,931,618	204.8	16.1	3,330,165	208.5	14.8	784,548	206.8	15.8	0.24	0.13	-0.11
Reading	Elementary	Black	6,931,618	204.8	16.1	1,202,377	198.5	16.0	279,577	196.1	17.6	-0.39	-0.54	-0.15
Reading	Elementary	Hispanic	6,931,618	204.8	16.1	1,261,357	199.8	16.2	426,887	197.5	17.8	-0.31	-0.45	-0.14
Reading	Middle	Asian	6,274,883	218.3	16.2	245,983	225.2	16.0	79,656	224.6	15.8	0.43	0.39	-0.04
Reading	Middle	White	6,274,883	218.3	16.2	3,086,938	221.8	14.8	757,693	219.8	15.3	0.22	0.09	-0.13
Reading	Middle	Black	6,274,883	218.3	16.2	1,049,612	212.1	16.0	266,393	210.0	16.4	-0.38	-0.51	-0.13
Reading	Middle	Hispanic	6,274,883	218.3	16.2	1,148,388	213.5	16.6	407,933	210.6	17.3	-0.30	-0.47	-0.17
Math	Elementary	Low Poverty	6,850,645	211.3	15.9	1,413,046	219.4	14.4	394,675	216.6	14.8	0.52	0.34	-0.18
Math	Elementary	High Poverty	6,850,645	211.3	15.9	1,794,973	204.5	15.5	468,650	200.5	17.1	-0.43	-0.67	-0.25
Math	Middle	Low Poverty	6,208,533	227.5	18.7	1,189,618	237.1	17.1	338,828	233.1	17.9	0.52	0.31	-0.22
Math	Middle	High Poverty	6,208,533	227.5	18.7	1,379,434	219.3	18.0	349,303	214.6	17.5	-0.44	-0.69	-0.25
Reading	Elementary	Low Poverty	6,931,618	204.8	16.1	1,399,703	212.3	13.6	395,342	210.4	14.7	0.48	0.35	-0.13
Reading	Elementary	High Poverty	6,931,618	204.8	16.1	1,835,233	198.2	16.5	470,181	195.4	18.1	-0.41	-0.58	-0.17
Reading	Middle	Low Poverty	6,274,883	218.3	16.2	1,200,682	225.4	13.7	362,383	223.0	14.5	0.45	0.29	-0.16
Reading	Middle	High Poverty	6,274,883	218.3	16.2	1,391,600	211.8	16.7	367,036	208.9	17.3	-0.40	-0.58	-0.18

*Note.* N=number of unique test events, M=mean, SD=standard deviation, Difference=difference between COVID and pre-COVID effect size. Pre-COVID (national) means are average RIT scores for all students across 2016-17 to 2018-19. Pre-COVID (subgroup) and COVID (subgroup) refer to means by racial/ethnic and school poverty demographics. COVID columns refer to 2022-23 student data. Effect sizes were calculated for each grade and subgroup, and then pooled across each grade band. Estimates may be slightly different if calculated with already pooled means and SDs. Data from this Table are referenced in Figure 6 in the main brief.

**Table 9. Mean student RIT scores, achievement gaps, and months of additional instruction by school level and subgroup**

Subject	Grade Band	Subgroup	M (Pre-COVID National)	M (Pre-COVID Subgroup)	M (COVID Subgroup)	Difference (Pre- COVID)	Difference (COVID)	Difference (Within Subgroup)	Months (Pre-COVID National)	Months (Pre-COVID Subgroup)
Reading	Elementary	Asian	204.8	211.2	210.1	6.4	5.3	-1.1	6.1	1.2
Reading	Elementary	Black	204.8	198.5	196.1	-6.3	-8.7	-2.4	9.7	2.6
Reading	Elementary	Hispanic	204.8	199.8	197.5	-5.0	-7.3	-2.4	8.2	2.6
Reading	Elementary	White	204.8	208.5	206.8	3.7	2.0	-1.7	2.3	1.9
Reading	Middle	Asian	218.3	225.2	224.6	6.9	6.3	-0.6	14.5	1.4
Reading	Middle	Black	218.3	212.1	210.0	-6.2	-8.3	-2.1	19.3	4.9
Reading	Middle	Hispanic	218.3	213.5	210.6	-4.8	-7.7	-2.8	17.9	6.7
Reading	Middle	White	218.3	221.8	219.8	3.5	1.5	-2.1	3.3	4.9
Math	Elementary	Asian	211.3	221.3	218.5	10.0	7.2	-2.8	5.7	2.2
Math	Elementary	Black	211.3	203.4	199.4	-7.9	-11.9	-4.0	9.6	3.2
Math	Elementary	Hispanic	211.3	207.1	203.5	-4.2	-7.8	-3.6	6.3	2.9
Math	Elementary	White	211.3	215.0	212.3	3.7	1.0	-2.7	0.7	2.3
Math	Middle	Asian	227.5	239.8	237.0	12.4	9.5	-2.9	13.1	4.3
Math	Middle	Black	227.5	218.1	213.7	-9.4	-13.7	-4.4	19.4	6.2
Math	Middle	Hispanic	227.5	222.0	217.5	-5.4	-9.9	-4.5	14.1	6.4
Math	Middle	White	227.5	231.9	228.3	4.5	0.9	-3.6	1.0	5.3
Reading	Elementary	High Poverty	204.8	198.2	195.4	-6.6	-9.4	-2.8	10.7	3.1
Reading	Elementary	Low Poverty	204.8	212.3	210.4	7.5	5.6	-1.9	6.4	2.2
Reading	Middle	High Poverty	218.3	211.8	208.9	-6.5	-9.4	-2.9	21.8	6.7
Reading	Middle	Low Poverty	218.3	225.4	223.0	7.1	4.6	-2.5	10.6	5.8
Math	Elementary	High Poverty	211.3	204.5	200.5	-6.8	-10.8	-4.0	8.7	3.3
Math	Elementary	Low Poverty	211.3	219.4	216.6	8.1	5.3	-2.9	4.1	2.3
Math	Middle	High Poverty	227.5	219.3	214.6	-8.1	-12.9	-4.8	18.2	6.8
Math	Middle	Low Poverty	227.5	237.1	233.1	9.7	5.7	-4.0	7.7	5.9

*Note.* M=mean. The pre-COVID national column shows mean scores from 2016-17 to 2018-19 for all students, while the pre-COVID (subgroup) and COVID (subgroup) columns show means by racial/ethnic and school poverty demographics. The COVID (subgroup) columns refer to 2022-23 student data. Difference (Pre-COVID)=difference between pre-COVID subgroup and national. Difference (COVID)=difference between COVID subgroup and pre-COVID national. Difference (Within Subgroup)=difference between COVID subgroup and pre-COVID subgroup. Months=months of additional schooling that 2022-23 students need to catch up to pre-COVID subgroup and national trends. Months are reported as an absolute value. Gray shading denotes instances where a subgroup's pre-COVID achievement levels exceeded national averages, and the value shown is the equivalent months of schooling that a subgroup was ahead of pre-COVID trends. Data from this table are referenced in Figure 5 in the main brief.

Figure A1. Average MAP Growth achievement across three school years for even cohorts in both subjects

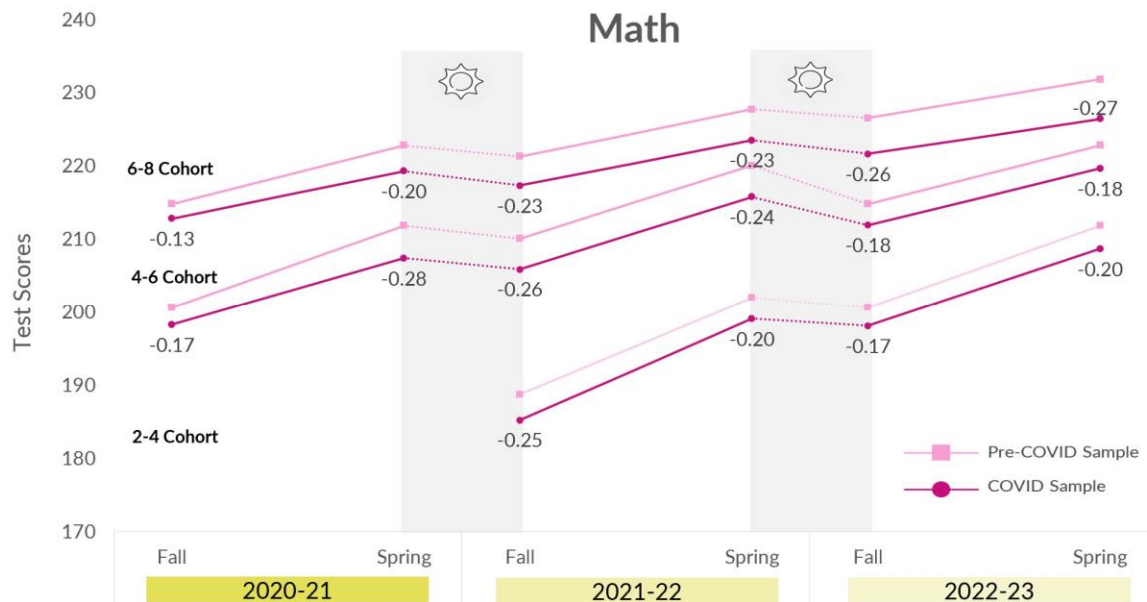
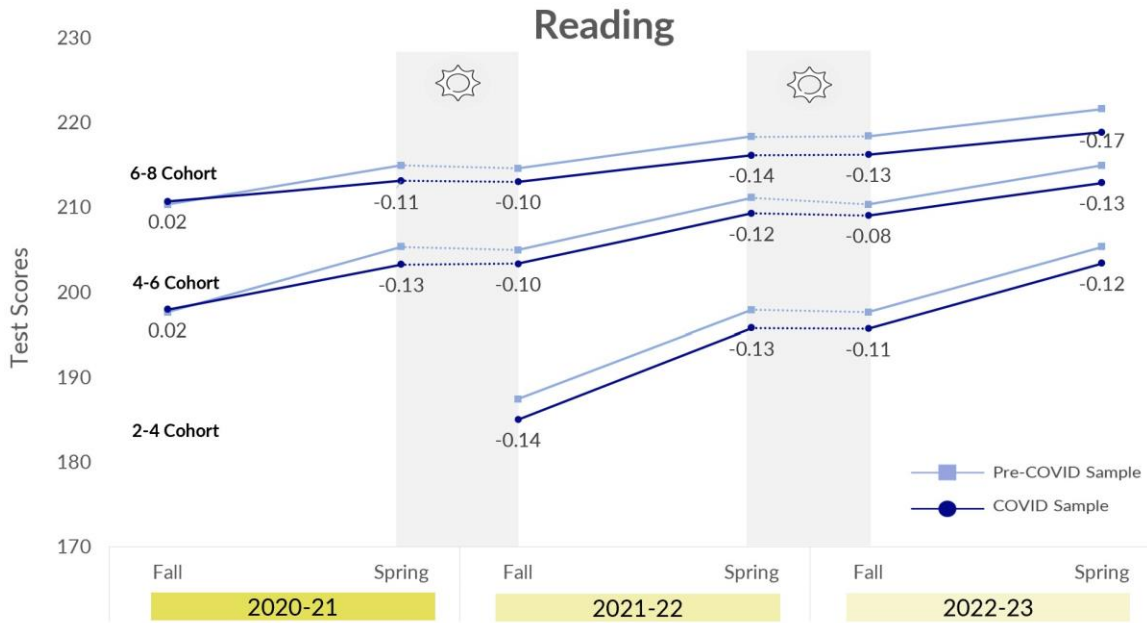


Figure A2. Achievement gains in 2022–23 and pre-COVID relative to overall pre-COVID national average by school poverty level

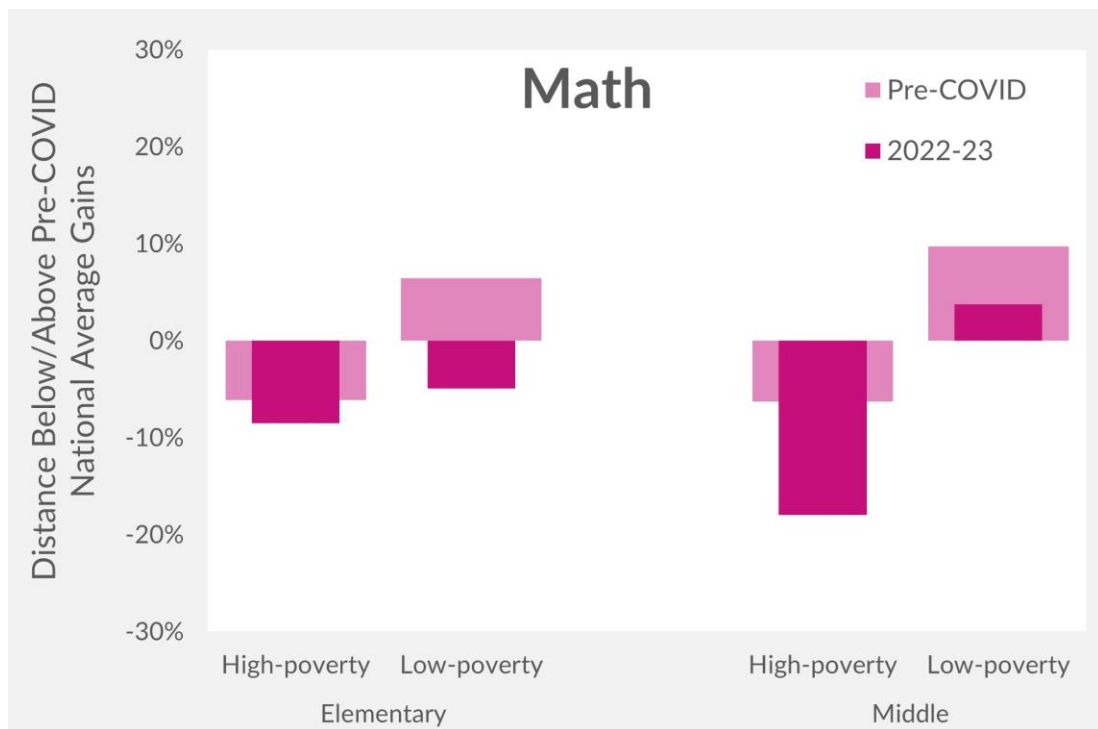


Figure A3. Months of schooling required to catch up to pre-COVID achievement by school poverty level

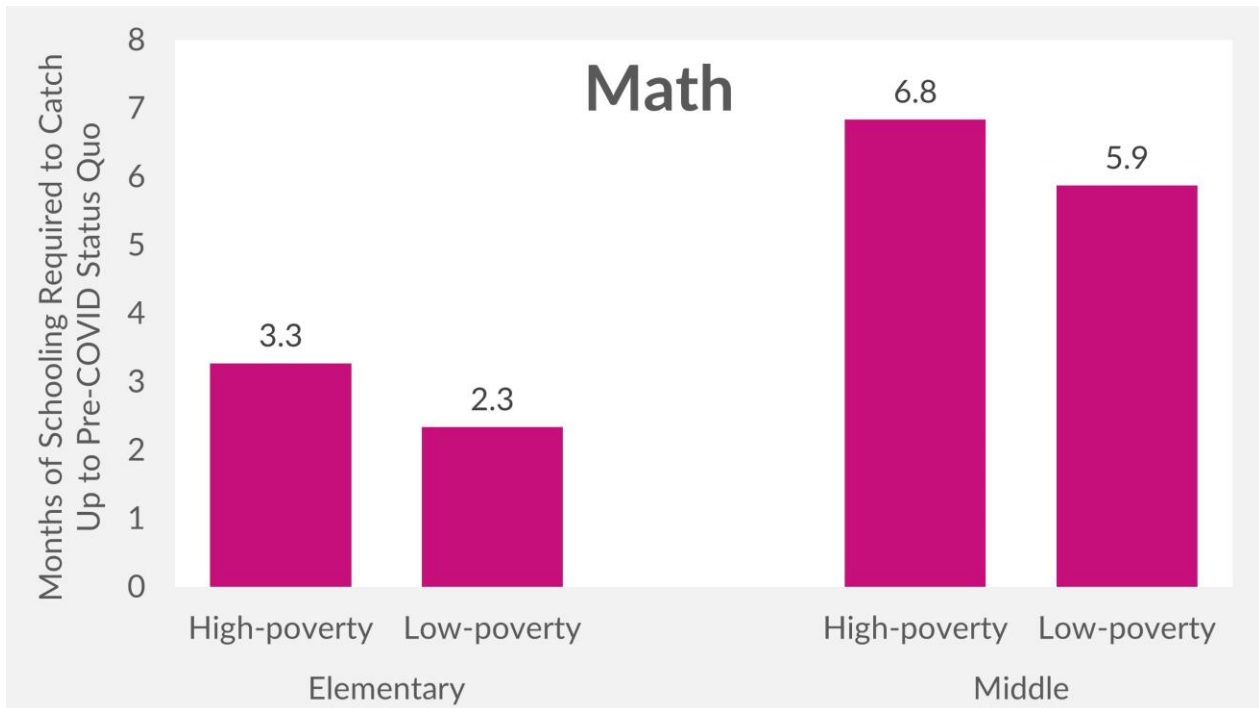
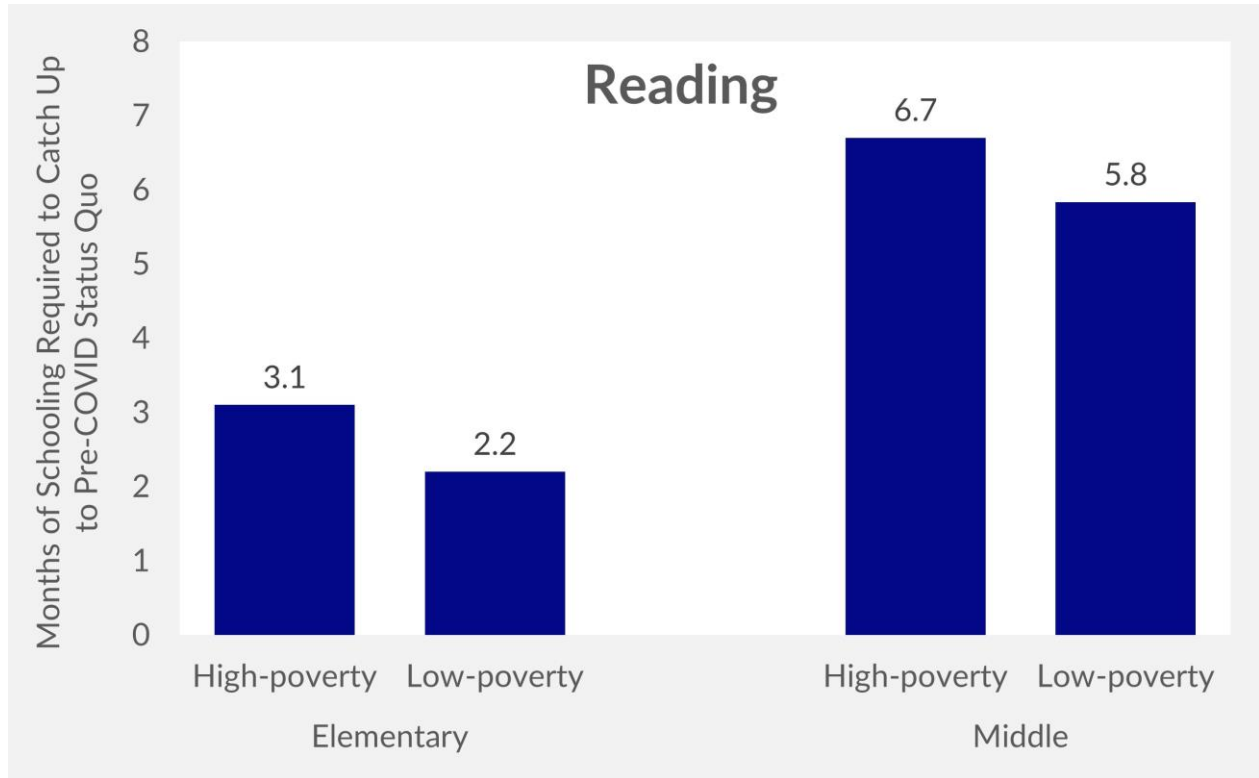
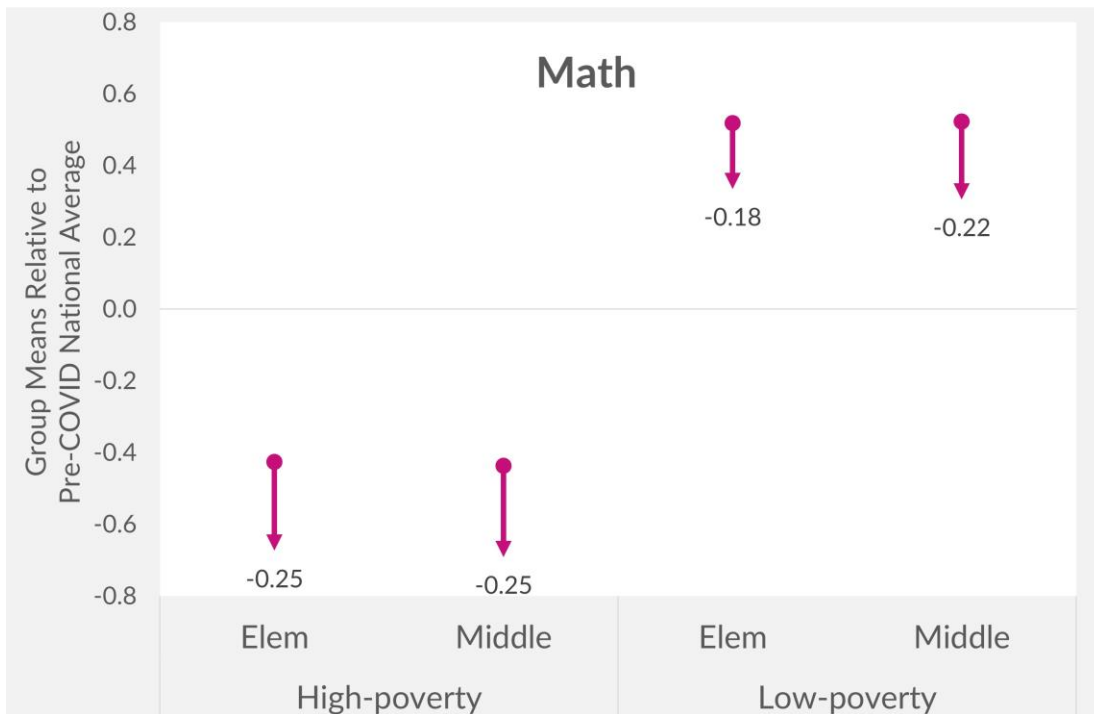


Figure A4. Average spring achievement levels pre-COVID and in 2022–23 relative to national pre-COVID averages by school poverty level



## 4. References

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