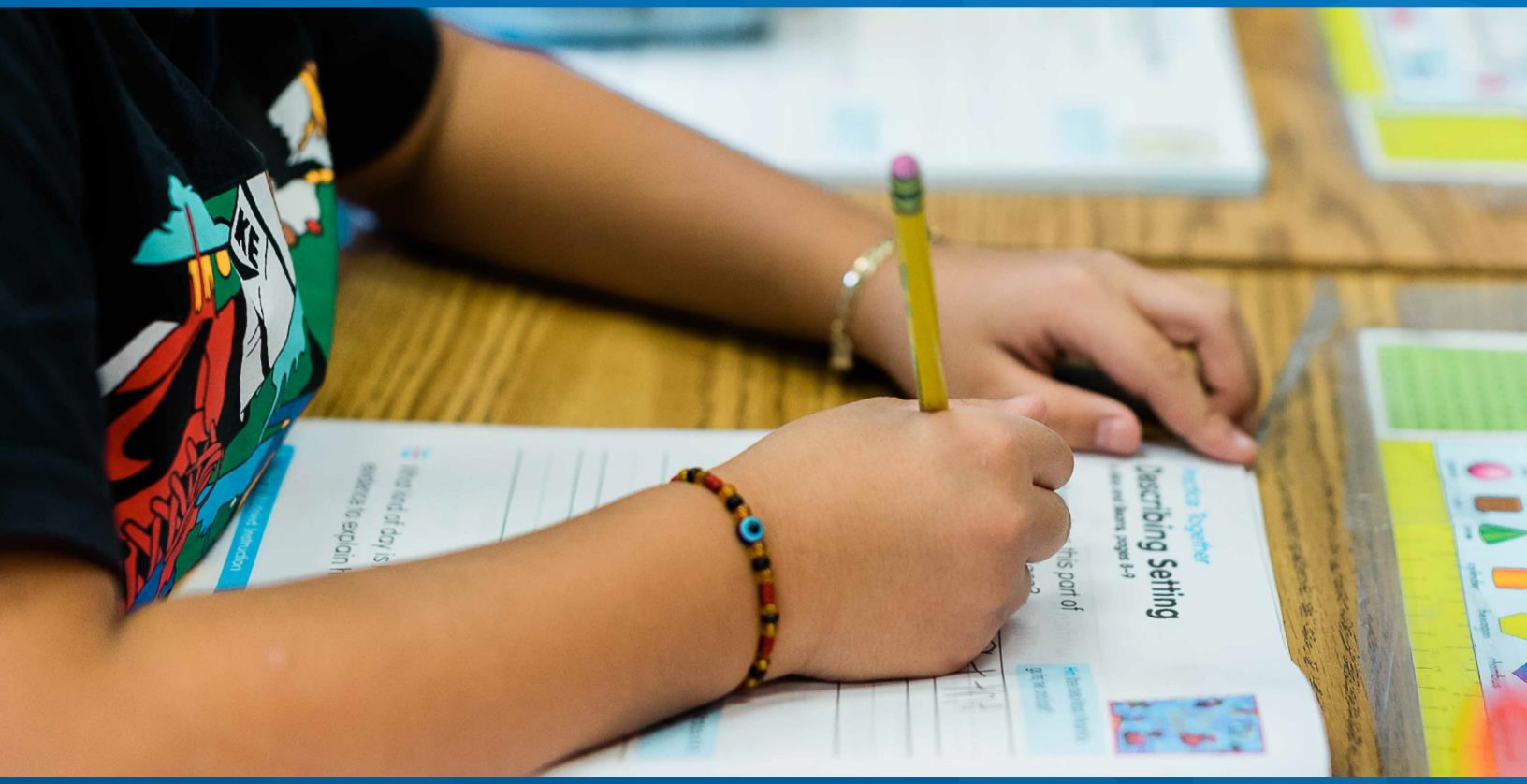
Curriculum Associates® RESEARCH

Student Growth in the Post-COVID Era



Reading and Mathematics
Ethan Young, Ph.D.
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Research Report: June 2024

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SUMMARY

Policymakers and educators continue to closely track post-COVID student recovery, and with COVID-19 relief funds set to expire, decision makers need clear answers and actionable insights. Yet, accurate depictions of student performance have been challenging to gather given the multifaceted and varied ways academic performance is assessed and these data reported. Obtaining more accurate depictions of student performance requires both longitudinal data, to examine the consequences of COVID-19, school closures, and the related recovery efforts, and disaggregated data, to examine how results vary by student, school, and community characteristics. Leveraging three years of longitudinal data in comparison to historical growth patterns reveals disparate trends by student age during the pandemic, prior achievement, and school and community characteristics. We find younger students and students who were already needing academic support are the furthest away from reaching pre-pandemic growth trends. In parallel, students from schools serving lower-income or minoritized communities continue to perform below historical trends. These data suggest some populations or communities have benefited more from recovery efforts, while those most in need continue to require additional support. Results bring into question whether intervention approaches have been as targeted as needed, or whether there is a misalignment between the interventions tried and populations served.

INTRODUCTION

Four years after the COVID-19 pandemic and ensuing education recovery efforts, accurately assessing student academic performance post-pandemic remains challenging. So far, research suggests that older students, certain communities, and districts in which closures lasted longer as the most impacted by lost instructional time and in highest need of recovery efforts (Curriculum Associates, 2023; Fahle et al., 2023; Lewis & Kuhfield, 2023). Yet, other research has shown encouraging signs of recovery for students in Grades 3–8 on state test results (Fahle et al., 2024; Halloran et al., 2023). Making sense of the varied trends and, at times, conflicting headlines, poses challenges for educators and researchers alike. Navigating the post-COVID recovery landscape requires a nuanced approach. Although no single analysis can summarize the diversity of recovery patterns, examinations of post-COVID recovery require designs that can represent key features of students, schools, and communities.

Despite the messy and challenging view of recovery, researchers and educators agree on the profound impact COVID-19 had on student performance immediately post-pandemic. Previous research has repeatedly demonstrated fewer students are performing on grade level at both school entry and year end (Curriculum Associates, 2024; Curriculum Associates, 2023; Lewis & Kuhfield, 2023; US Department of Education, 2023). Other research released at the tail end of the pandemic offers more context: students in grade school during COVID-19 grew less over time than previous cohorts (Dawson, 2022). However, not all students were impacted equally. Students who were the furthest behind prior to COVID-19 showed the largest differences in growth from pre-COVID cohorts.

In addition to initial student performance, age may also play a role in recovery. From a developmental perspective, the timing of exposure to difficult conditions matters. Research shows that particular windows during development are more sensitive to change than others. For example, children between birth and age five undergo significant physical and neural growth (Amso & Casey, 2006; Tsujimoto, 2008), and disruptions and stressors during this time may greatly impact development (Knudsen, 2004). For student learning, periods during which students build foundational skills—the skills most needed to advance learning—may be especially sensitive. Thus, disruptions during foundational skill development could create a compounding effect, making recovery a slow endeavor.

With federal COVID-19 funds expiring this year, many wonder if recovery efforts have been successful in moving students closer to pre-pandemic levels of achievement. These funds had few strings attached, allowing states and districts to offer tailored interventions best suited to their unique circumstances. From an implementation science perspective, individualized and targeted interventions are key for recovery. Yet, to evaluate and understand whether such interventions fit the unique needs of students, schools, and communities, we need equally nuanced analytic and data-driven strategies. Thus, it is critical not only to ask whether there is student recovery but also for whom and under what conditions.

Aggregate data are useful for uncovering general trends but may obscure important underlying patterns. Averaging recovery patterns across key subpopulations smooths over variation. At best, this smoothing is uninformative, and, at worst, it could be misleading. For example, if certain types of students show recovery while others decline, an averaged trend will hide these diverging patterns.

In the worst case, if most student populations show recovery, whereas key groups are falling behind, a general trend will suggest recovery for everyone, which is misleading.

Recovery is also contextualized over time. Most students needed support during and immediately after the pandemic. To track recovery, we must consider where students start in their journey to recovery. This means we need longitudinal study designs to detect the consequences of earlier experiences on later learning and development. Such a design allows us to best understand if achievement is *moving* closer to pre-pandemic levels. Longitudinal data, though challenging to obtain, offers unique insight into "recovery" or academic growth other designs cannot afford.

In this report, we explore post-COVID academic recovery across three school years and by key student and school characteristics. This research is not an evaluation of any specific intervention or recovery effort. Instead, we offer insight into "recovery"—or growth mirroring pre-pandemic trends—by these characteristics. To do so, we modeled longitudinal student growth trends from 2021 to 2024 and compared them with pre-pandemic growth data. This approach allows us to draw a clearer picture of recovery by leveraging longitudinal data—both pre- and post-pandemic—to examine whether student academic growth is accelerating, or falling further behind, historical trends.

METHODOLOGY

Research Questions:

1. How does student academic growth post-pandemic differ from historical growth based on a pre-pandemic trajectory?
2. Are there patterns of growth mirroring or diverging from historical trends by student characteristics, including initial placement level or age during the pandemic?
3. Are there patterns of growth mirroring or diverging from historical trends by school or community characteristics, including demographics, median income, or locale?

Data Collection

Sample Characteristics

To address our research questions, we constructed two longitudinal samples—one for modeling historical (i.e., pre-pandemic) growth and the other for post-COVID growth. We followed both samples for three years. We collected historical student data from fall 2016 to spring 2019 and post-COVID student data from fall 2021 to spring 2024, including assessments completed as of May 24, 2024. For each sample, we created five longitudinal cohorts that differed by starting grade in the fall of 2016 and 2021 for historical and post-COVID samples, respectively. The youngest cohorts (e.g., ages 3-4 during the pandemic), started in Grade K and the oldest started in Grade 4 (see Table 1).

Within each longitudinal cohort, student assessment data were selected using the following criteria: 1) total number of completed assessments was between six and nine (maximum possible was nine); 2) the time lag between any two assessments was shorter than 52 weeks; 3) assessments were completed in English; and 4) showed no evidence of rushing.

Table 1. Sample Characteristics

Period	Sample Sizes		Grade during COVID		Grade during Assessment		
	Reading	Mathematics	2019–2020	2020–2021	2021–2022	2022–2023	2023–2024
Post–COVID 2021–2024	516,094	644,162	3K	Pre-K	Grade K	Grade 1	Grade 2
	576,492	702,271	Pre-K	Grade K	Grade 1	Grade 2	Grade 3
	616,620	738,126	Grade K	Grade 1	Grade 2	Grade 3	Grade 4
	657,337	761,897	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
	526,498	621,403	Grade 2	Grade 3	Grade 4	Grade 5	Grade 6
					2016–2017	2017–2018	2018–2019
Pre–COVID 2016–2019	192,091	203,854	-	-	Grade K	Grade 1	Grade 2
	239,615	254,024	-	-	Grade 1	Grade 2	Grade 3
	260,392	283,784	-	-	Grade 2	Grade 3	Grade 4
	289,750	319,403	-	-	Grade 3	Grade 4	Grade 5
	260,856	294,162	-	-	Grade 4	Grade 5	Grade 6

Measures

Student achievement was measured with Curriculum Associates' *i-Ready Diagnostic* for Reading and for Mathematics. The Diagnostic is an online, adaptive, and criterion-referenced assessment of student learning for reading and mathematics in Grades K-8. It is built on college- and career-readiness standards and provides grade-level placements. Most school districts administer the Diagnostic to students three times during the school year—in fall, winter, and spring. It is recommended schools administer the fall Diagnostic within two weeks of the start of the school year for Grades 1–8 and four to six weeks into the school year for Grade K. This provides educators a baseline of student academic understanding, or their readiness for grade-level learning, early in the year to better inform instruction or targeted supports throughout the year. To learn more about the *i-Ready Diagnostic*, including a discussion of its reliability and validity, see the Appendix.

When students take the *i-Ready Diagnostic,* they receive a scale score that reflects their test performance, which can then be used for comparison across grades and time. Scale scores are used to determine the student's grade-level learning standards relative to their chronological grade level. This placement level provides context for a student's performance that designates their performance as being on grade level, below grade level, or above grade level. For example, a Grade 2 student can place below grade level at the Grade 1 level (i.e., One Grade Level Below), at the Grade K level (i.e., Two Grade Levels Below), or above grade level at the Grades 3–8 level (i.e., Above Grade Level). See the Appendix 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 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.

To best contextualize changes in student growth from pre- to post-pandemic, we report both estimates of average scale scores over time compared to historical scores, and standardized differences (in terms of standard deviations) from historical scores. For the purposes of this report, students who placed Early On Grade Level or higher were designated as performing on grade level. Students below grade level could be one, two, or three grade levels below depending on their chronological grade (i.e., the lowest a student can place in Grade K is One Grade Below or "Emerging K"). In grades in which students can place two or three grade levels below, these two placement categories were grouped into "two or more grade levels below."

Data Analysis

Modeling Strategy

To compare historical and post-COVID trends, we used growth modeling to evaluate student growth over time for each cohort. Our analysis proceeded in three steps. First, we modeled historical data. Second, we modeled post-COVID data using the exact same modeling framework as historical. Lastly, we compared historical trends with post-COVID trends using equivalence testing (Lakens, 2017). This allowed us to evaluate whether post-COVID growth trends mirrored or deviated from historical trends.

We executed steps one and two using piecewise growth modeling. All growth models used the same general format. Each model fit three slopes (one per academic year) to each student to calculate growth over time. We used linear and quadratic terms for each slope to more closely fit the nonlinear learning within and across academic years. All models controlled for the number of weeks that had passed since the first assessment was completed. To account for nested data (i.e., students nested in time), we included random intercepts and slopes for students.

For our third and final step, we conducted equivalence tests to compare post-COVID growth with historical trends. Equivalence tests reframe the traditional null hypothesis test. Instead of assuming that historical and post-COVID trends are equal (e.g., the traditional null hypothesis) and testing if they are different, equivalence tests assume they are different and test whether they are equal. To do so, researchers specify a range of *practical equivalence*. For example, imagine an estimated historical reading score for a typical second grader is between 430 and 435. A post-COVID score falling inside that range is deemed *equivalent* to historical. However, if it falls outside that range, the scores are not practically equivalent. In this sense, if scores are very close to each other, we can be more certain they are indeed equivalent, whereas non-significant results in traditional null hypothesis testing are difficult to explain (Lakens, 2017).

Equivalence tests are especially useful with very large sample sizes. Traditional tests will deem even very small differences significant because standard errors become very small with increased sample sizes. Equivalence tests force our inferences to be tied to the range of practical equivalence we deem important. For the current analysis, we used a range of +/- .15 standard deviations of historical reading and mathematics scores across fall, winter, and spring testing windows from 2016-2019. We based this range using a few general guidelines and field standards for interpreting effect sizes in education research (Kraft, 2020; Lakens, 2017).

Overview of Models

We repeated our modeling strategy for all cohort and subpopulation analyses. More specifically, we fit one general model per cohort (i.e., five historical models compared to five post-COVID models) to estimate general growth trends. We then fit a model to each cohort per starting placement level (placement level as of fall 2016 for historical and fall 2021 for post-COVID) to model growth for each placement. This means we fit 14 models historical and 14 post-COVID placement-specific models: three placement levels for four cohorts, and two placement levels for the youngest cohort.

Finally, we fit growth models examining growth as a function of three school-level variables: median household income by school zip code, demographics, and geographic locale. For each, we modeled growth using interaction terms with each school-level variable. For household income, we modeled growth for students at school zip codes with median household incomes below $50,000, $50,000–$75,000, and above $75,000. For school demographics, we modeled growth for schools with more than 50% Black, more than 50% Hispanic, more than 50% White, and no majority schools. Finally, we fit models for rural, suburban, and urban schools.

In contrast to our placement analyses, we compared each demographic group to the overall sample. That is, we compared subgroup growth in post-COVID with *general* historical growth. We approached these analyses this way for two reasons. First, unlike placement-level analyses, reading and mathematics performance is not implicit in demographic group membership—students in a school serving 50% or more Hispanic students are not automatically in a particular performance bracket. Second, comparing each subpopulation to a general trend allowed us to test if disparities across minoritized groups persist. If we had compared each demographic group to their historical performance, results may distort differences. For example, if students in schools serving 50% Hispanic students are on par with their own historical academic growth, this would indicate within group recovery, but offers little insight into between group improving (or worsening) disparities.

RESULTS

Reading

Overall Growth Comparisons

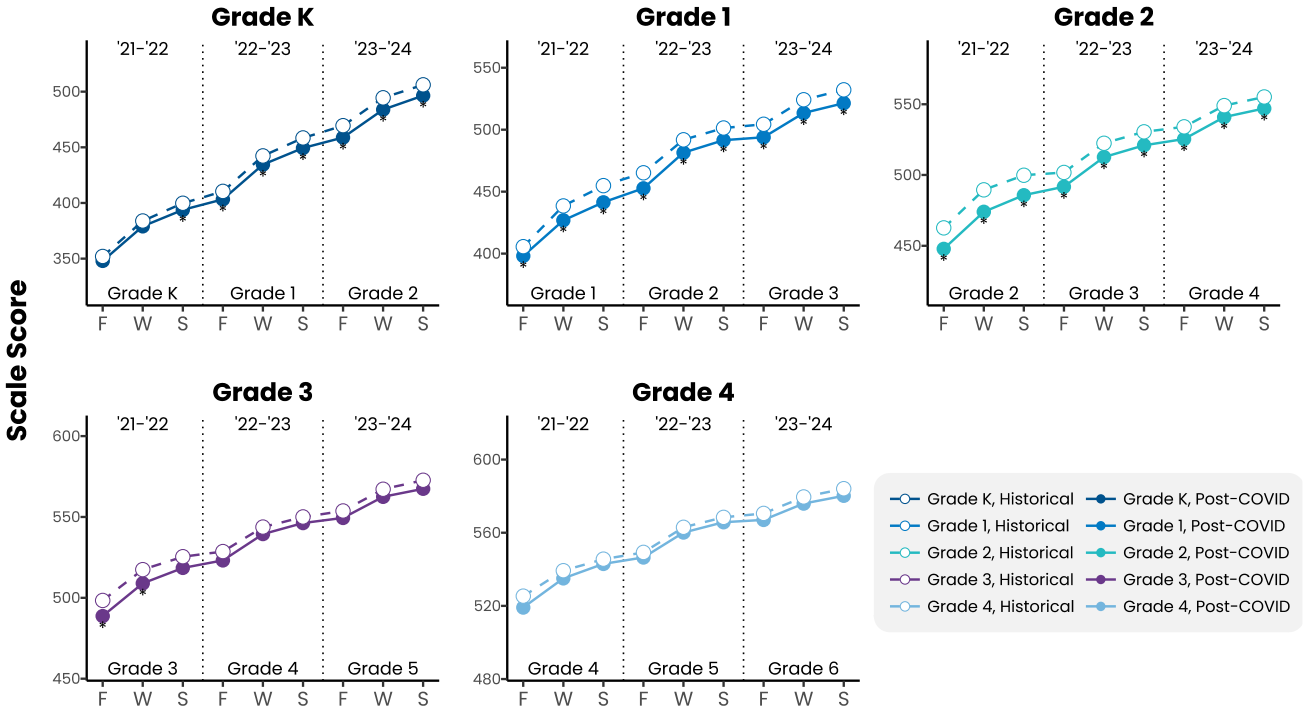
Our first set of growth models focused on growth for all students across each cohort (see Figure 1). We modeled historical student growth using 2016–2019 student data and compared it to post-COVID growth from 2021-2024 (see Figure 2[1]). This comparison uncovered two general patterns. First, older cohorts' growth in reading appears to be recovering, approaching historical trends in more recent years, or less than .1 standard deviations (SD) from historical trends (see Figures 1 and 2). Second, younger cohorts appear to be the furthest behind pre-pandemic growth patterns, with some demonstrating increasing departures from historical trends over time, up to .22 SD below historical trends.

These patterns are striking for several reasons. First, most cohorts were slightly or significantly behind historical growth the first year back from the pandemic in 2021–2022. However, older cohorts

[1]In all standardized difference plots, the 0.0 line represents historical growth, and the plotted lines represent the differences from historical growth at certain time points in terms of standard deviations. The gray bar indicates practical equivalence, or scores that are practically the same as pre-pandemic.

appear to show accelerated growth, making up lost learning over time. In stark contrast, younger cohorts—students beginning Grades K and 1 in 2021—do not demonstrate the same recovery over time (see Figure 2). For example, the Grade K cohort performed close to historical trends in 2021 but has since moved further behind in recent years (.2 SD below historical), whereas the Grade 1 cohort has remained consistently below historical trends (.18–.28 SD below historical).

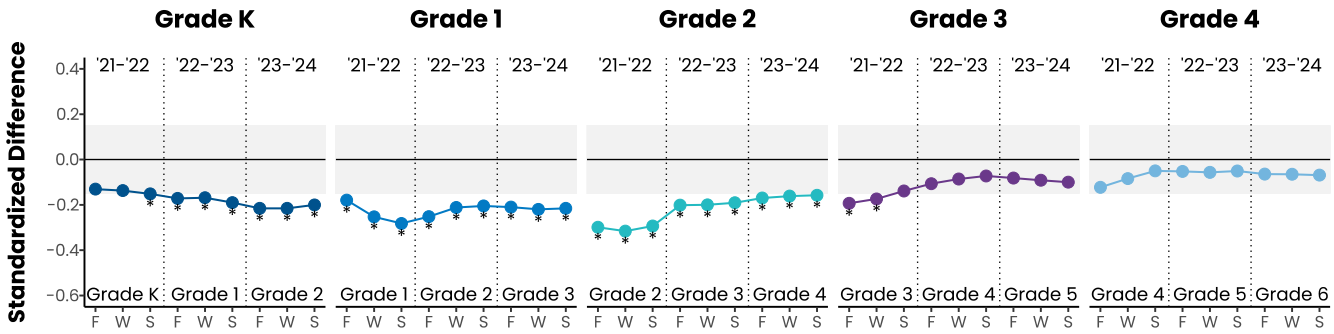
Figure 1. Historical and Post-COVID Scale Score Growth in Reading



Note: *Indicates estimates are significantly different than historical. F = Fall; W = Winter; S = Spring

Taken together, these results indicate there are some encouraging signs of recovery for students in Grades 2–4 in 2021. Recovery is not occurring across all ages, though, with younger cohorts needing support more than others. However, it is well understood that general trend analyses hide the diversity of growth patterns specific to unique student-, school-, and community-level factors. As such, we tease apart growth patterns by initial student placement level and three school/community-level characteristics.

Figure 2. Differences in Historical and Post-COVID Growth in Reading by Cohort



Note: *Indicates estimates are significantly different than historical. F = Fall; W = Winter; S = Spring

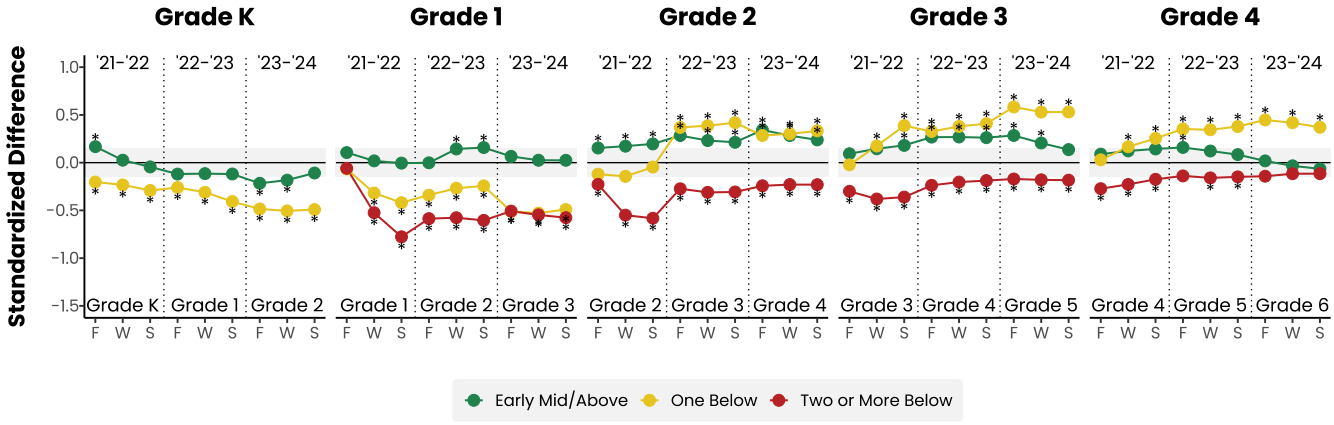
Differences by Student Placement Level

Some cohorts appear to be recovering over time, at least on the surface. Yet we know that pandemic-related disruptions did not impact all students to the same extent (Dawson 2021, 2022). In particular, we know students who were already needing support pre-pandemic fell even further behind compared to students performing close to or on grade level. Our results are consistent with these findings. Across most cohorts, growth diverges substantially as a function of initial student placement level (see Figure 3). Specifically, students who began the 2021–2022 school year on grade level (indicated in green) showed largely no impact of the pandemic. Growth among these students closely mirrors historical trends. In younger cohorts, grade-level students remain on par with their own historical patterns, whereas older cohorts exceed historical trends, at least in some cases.

Conversely, students who began their first year post-pandemic well below grade level (i.e., two or more grade levels below, indicated in red) trended in the opposite direction, falling further behind in 2021-2022, and in some cases, over half an SD. Across all cohorts, students in this placement level were significantly below their own historical growth immediately post-pandemic. Older cohorts again demonstrated small signs of recovery for students who began the year well below grade level. For example, the Grade 4 cohort shows some recovery toward historical trends in 2023-2024, less than .15 SD below in spring 2024. However, younger cohorts consistently hover below historical growth rates, showing limited recovery.

For students beginning the 2021 school year one grade level below (indicated in yellow), post-pandemic recovery or departure from historical growth trends appears to depend on the cohort. In younger cohorts, students placing one grade level below appear to fall further behind or consistently hover below historical growth. Grades 2-4 cohorts show signs of accelerated growth, suggesting that older cohorts appear less impacted by the pandemic. In fact, growth exceeded historical trends for students in this placement level in some cases.

Figure 3. Differences in Historical and Post-COVID Growth in Reading by Placement Level



Note: *Indicates estimates are significantly different than historical. F = Fall; W = Winter; S = Spring

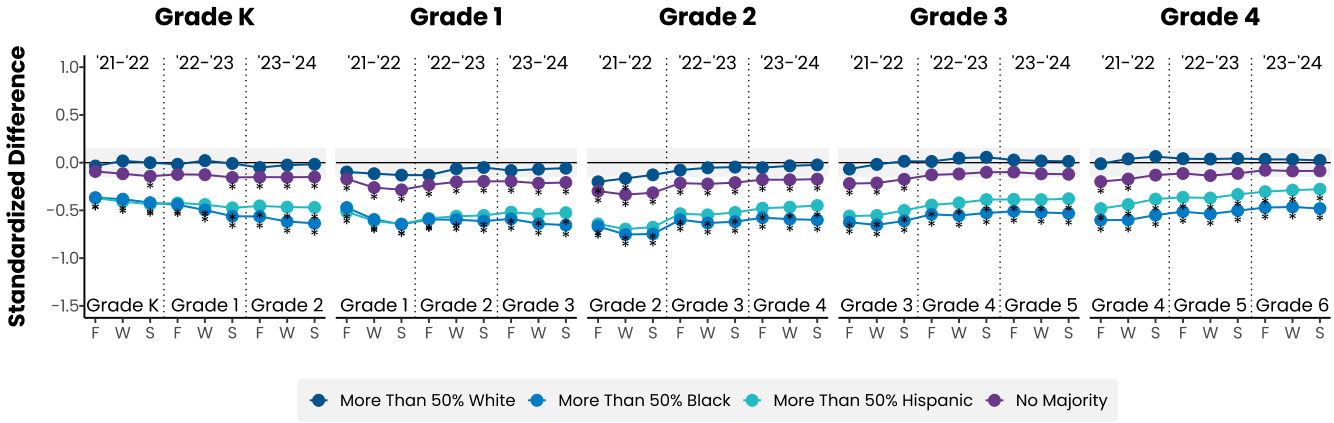
Differences by Community Income

We also evaluated reading growth differences between historical and post-COVID cohorts across median income by school zip code. Specifically, we compared growth for students at school zip codes with median household incomes below $50,000, $50,000–$75,000, and above $75,000 to *overall* historical trends. Students at schools in zip codes where the median income fell above $75K demonstrated growth trends on par with historical trends for the overall sample (see Figure A1 in the Appendix). Though this could indicate students in these schools were largely unaffected by the pandemic, it is also possible this population was previously performing above overall sample trends and are now not exceeding to the same extent. Unfortunately, the other two income brackets demonstrate growth trends far behind historical, and in some cases, more than half a standard deviation below, indicating continued disparities for lower-income communities.

Differences by School Demographics

For school demographics, we modeled growth for schools with more than 50% Black, more than 50% Hispanic, more than 50% White, and no majority schools. These analyses parallel the above income results; schools serving more than 50% White students demonstrate growth trends on par with historical growth (see Figure 4). This again could indicate these schools were less impacted by the pandemic, though not completely unaffected. It is likely these schools were previously outperforming overall sample trends and are now on par with these historical patterns. We see similar, though not as strong of patterns, in schools with no majority demographic group. Unfortunately, schools serving majority Black or Hispanic students show continued, and in some cases widening, disparities, remaining far behind overall sample trends from historical patterns (ranging from .37 to .75 SD below). Similar to overall growth patterns, however, older cohorts in these schools offer evidence of accelerated growth, moving closer to historical trends for the overall sample, and indicating some disparities may be narrowing.

Figure 4. Differences in Historical and Post-COVID Growth in Reading by School Demographics



Note: *Indicates estimates are significantly different than historical. F = Fall; W = Winter; S = Spring

Differences by School Locale

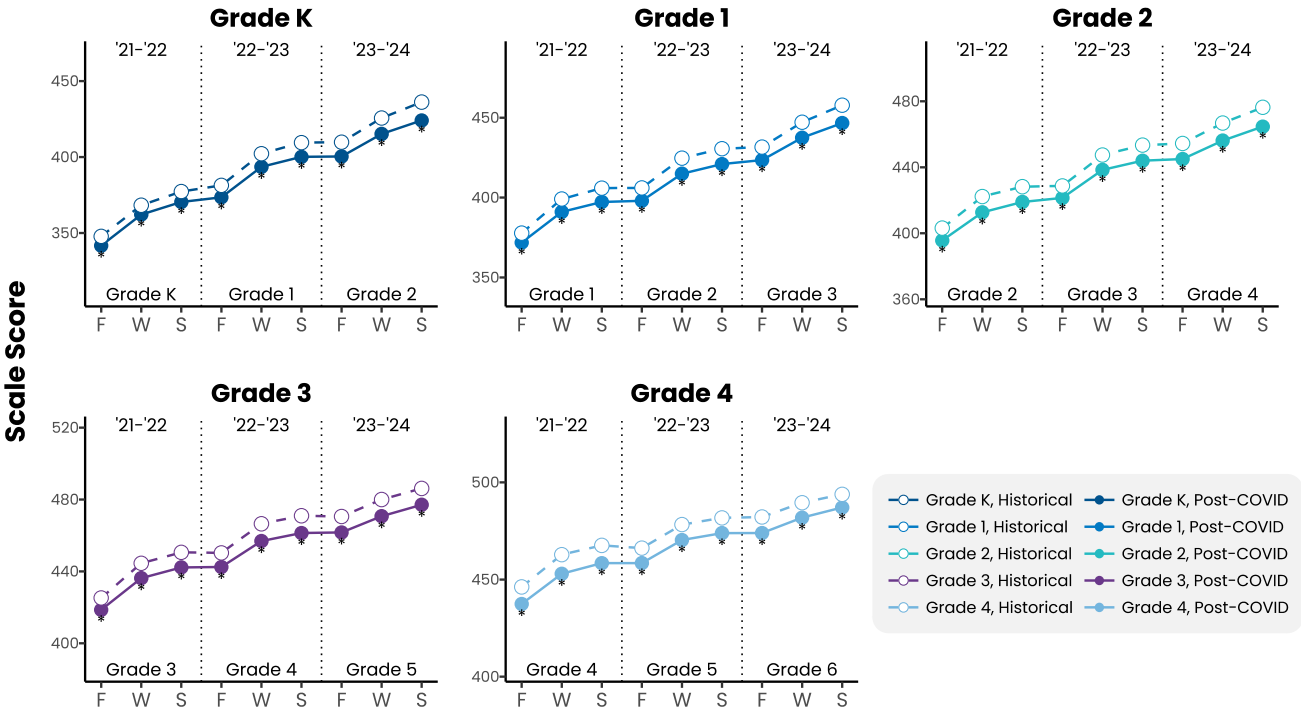
Finally, we fit models for rural, suburban, and urban schools. These analyses show that each school locale mirrors overall cohort trends—younger cohorts are further from historical patterns than older cohorts. However, the relative difference varies locale to locale. Schools in suburban areas showed some impact of COVID-19, with four of five cohorts below historical growth trends in the 2021–2022 school year (see Figure A2 in the Appendix). Over time, older cohorts in suburban areas have begun performing on par with historical trends. We observe the same recovery pattern for both urban and rural locales, but to a lesser extent. Again, though older cohorts have recovered as of 2024, schools in these areas remain significantly below historical growth. Unfortunately, younger cohorts demonstrate stagnation in growth relative to historical trends across all three locales.

Mathematics

Overall Growth Comparisons

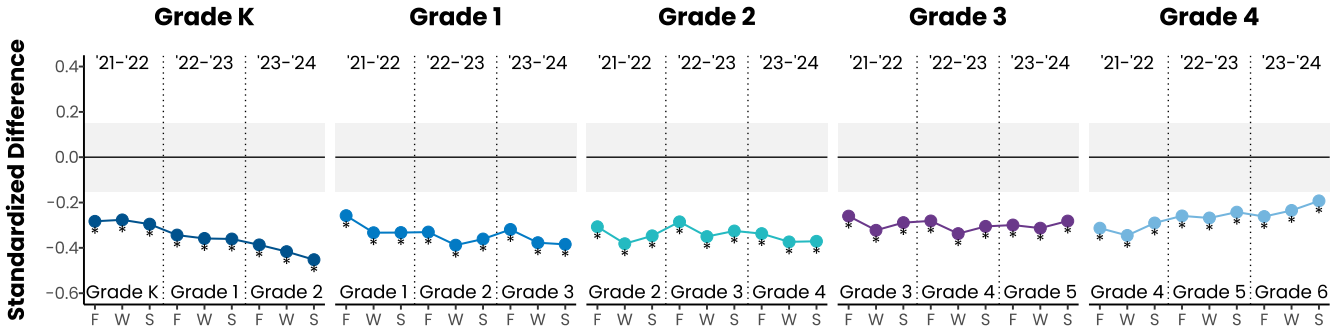
Our general cohort analyses revealed dramatic differences in student post-COVID growth compared to historical across all cohorts, with limited signs of recovery. Similar to growth in reading, there were significant deviations from historical growth in the first year post-pandemic for all mathematics cohorts (see Figures 5 and 6). We observed considerably less recovery over time, with all cohorts remaining below historical growth in spring 2024. The only cohort to demonstrate small signs of recovery are those students beginning Grade 4 in 2021. Unfortunately, the Grades 2 and 3 cohorts show stagnation in recovery, while the Grades K and 1 cohorts demonstrate growing departures from historical trends. Across time, all cohorts have demonstrated growth significantly below historical growth patterns, ranging from .19 to .45 SD below pre-pandemic trends.

Figure 5. Historical and Post-COVID Scale Score Growth in Mathematics



Note: *Indicates estimates are significantly different than historical. F = Fall; W = Winter; S = Spring

Figure 6. Differences in Historical and Post-COVID Growth in Mathematics by Cohort



Note: *Indicates estimates are significantly different than historical. F = Fall; W = Winter; S = Spring

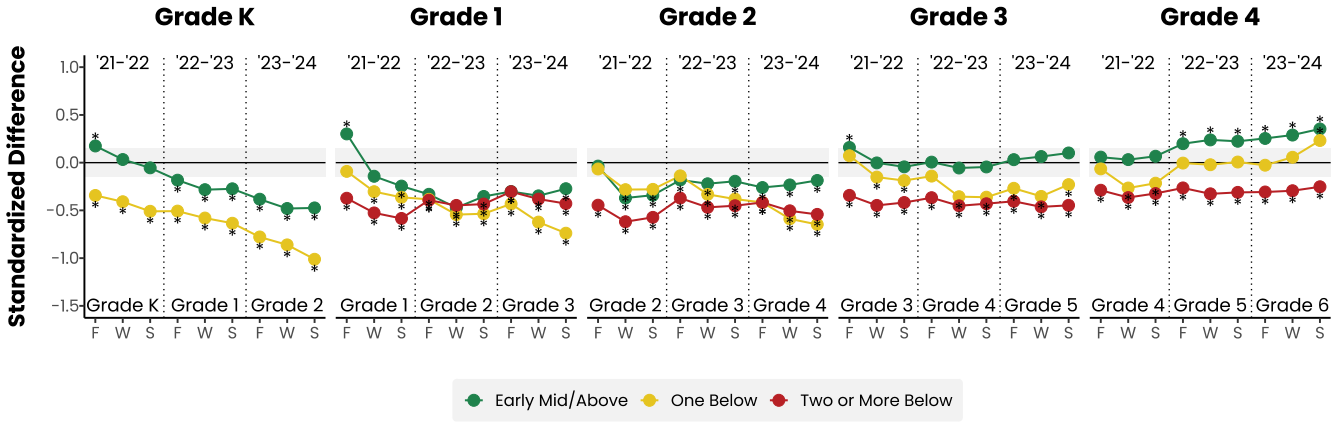
Differences by Student Placement Level

Analyses examining growth in mathematics by initial placement level revealed more nuance. Similar to reading, growth diverges substantially by student placement level and cohort (see Figure 7). In the two oldest cohorts, students on grade level (indicated in green) have remained on par, and in some cases, exceeded historical growth patterns for this group. By contrast, younger cohorts showed the opposite pattern. However, unlike reading—in which only one cohort trended behind historical growth—mathematics growth for students on grade level trended behind historical for the three youngest cohorts (nearly .5 SD below for the Grade K cohort). As of spring 2024, each of these three younger cohorts of students on grade level were still significantly behind historical patterns.

Students well below grade level (indicated in red) in these cohorts have not fared any better, with growth significantly behind historical trends (up to a full SD behind historical) and stagnating over time. Though growth *rates* may be comparable to pre-pandemic trends (i.e., the line appears parallel with the historical line) when beginning with lower scores, it takes accelerated growth for students to "catch up" or demonstrate recovery and move closer to pre-pandemic patterns for this group.

Similar to reading growth, older cohorts of students one grade below (indicated in yellow) show small signs of recovery, whereas younger cohorts are falling further behind. Given these patterns by placement level, it appears that recovery at the aggregate level may be driven by pooling together these two diverging trends.

Figure 7. Differences in Historical and Post-COVID Growth in Mathematics by Placement Level



Note: *Indicates estimates are significantly different than historical. F = Fall; W = Winter; S = Spring

Differences by Community Income

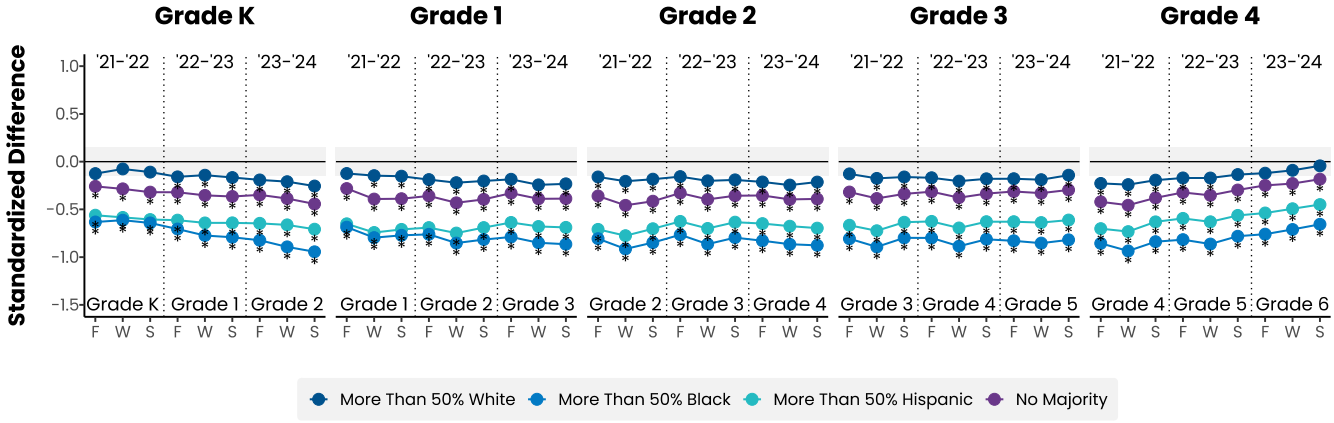
Mathematics growth results by community median income were largely the same as reading; lower income brackets appear further behind historical trends than higher income brackets. Yet, even in communities in which the median income is greater than $75,000, all cohorts were significantly behind overall historical sample trends. The Grades 3 and 4 cohorts have made some recovery as of spring 2024, while the youngest three cohorts remain significantly behind overall historical growth patterns (see Figure A3 in the Appendix). The magnitude of these differences increases with each lower income bracket (up to .8 SD below in the lowest income bracket). In the Grade 4 cohort, both lower income brackets demonstrate small signs of recovery, but are still well below overall historical growth patterns, indicating continued disparities. These disparities appear to remain stagnant in the Grades 2 and 3 cohorts, and potentially worsening in the Grades K and 1 cohorts.

Differences by School Demographics

School demographic trends for mathematics growth mirror reading results and follow the same pattern as community median income. The oldest cohort demonstrates some recovery, while younger cohorts show stagnation or continued departure from historical trends, regardless of school demographics (see Figure 8). In reading, schools serving majority White students showed growth remaining on par with historical trends, but in mathematics, students across most cohorts in these schools were significantly below overall pre-pandemic trends and remained below as of

spring 2024. Other demographic groups show comparable trends but with larger differences from historical patterns. Schools serving majority Black students, for example, remain between a half and a full SD below overall historical trends across all five cohorts. In younger cohorts, these differences have grown over time, indicating a widening of disparities.

Figure 8. Differences in Historical and Post-COVID Growth in Mathematics by School Demographics



Note: *Indicates estimates are significantly different than historical. F = Fall; W = Winter; S = Spring

Differences by School Locale

Results by school locale are also largely comparable to overall trends by cohorts, with younger cohorts declining over time, middle cohorts remaining stagnant, and the oldest cohorts demonstrating small recovery, regardless of locale (see Figure A4 in the Appendix). As in reading, these differences appear larger for schools in urban areas (consistently over .5 SD below historical) and smaller for schools in suburban areas. Unfortunately, all locales and cohorts remain significantly behind historical growth patterns despite the small signs of recovery in the oldest cohorts.

DISCUSSION

After an unprecedented surge of funding poured into education to combat lost instructional time from the COVID-19 pandemic, many are left wondering, have these efforts worked? Like any intervention, researchers are wondering *if* they have worked, have they worked for everyone or in specific conditions? Though this research does not serve as an evaluation of any instructional programs, or address if any specific intervention "worked," it can offer a general temperature check: what does student academic growth look like post-pandemic in reference to historical trends?

To paint a clearer picture, we leveraged longitudinal data to trace paths of academic growth and evaluate if students who were intended to benefit from recovery efforts have indeed "recovered," or moved closer to historical patterns of academic growth. We also teased results apart by student, school, and community characteristics to obtain a more nuanced picture of growth across key groups. Though many factors may have influenced recovery efforts and students, schools, and communities are highly diverse, this initial parsing offers more insight to national trends in recovery. Overall, results suggest there has been some recovery. Yet, when disaggregated into key student and school factors, general recovery appears to be driven by specific subgroups. Other groups, and often those most in need of recovery efforts, are clearly far from historical patterns of growth.

Key Findings

Our analyses revealed three general patterns. First, across both reading and mathematics, older cohorts are the closest to historical growth patterns. For example, as of spring 2024, the Grade 4 cohort (in Grade 6 by spring 2024) is on par with historical trends in reading and approaching historical trends in mathematics. By stark contrast, younger cohorts are either falling behind or consistently hovering below historical trends in both subjects. The differences by cohort could occur for a variety of reasons, including the disruption to early childhood experiences (Barnett & Jung, 2020; Lee & Parolin, 2021; McCoy et al., 2021), challenges building foundational skills, young students being less responsive to virtual instruction (Ford et al., 2021; Prananda et al., 2021; Safrizal et al., 2021), or simply the interventions utilized targeted students in older grades. Given young cohorts missed their pre-K to Grade 1 school years, or received instruction virtually at this time, they may have missed a critical window during which foundational skills develop. Less developed foundational skills may lead to compounded gaps in learning over time. It is also possible interventions utilized targeted students who were in middle to later elementary, or grades participating in state exams, and so younger learners simply received less intervention support.

Second, student growth differed markedly by student placement level. Students on grade level rarely fell behind historical growth in reading and were closer to historical patterns than other placement levels in mathematics. One possibility is that many of these students had continued access to some educational services, had greater parental support, or other resources that supported their learning and growth. Conversely, students well below grade level were almost always significantly behind historical trends for this group in reading and mathematics. Growth trajectories for students one grade level below varied greatly by cohort but showed greater signs of recovery than students two or more grade levels below. These patterns could indicate targeted interventions are working well for students close to grade level who require only supplemental support (i.e., Tier 2 designation). Unfortunately, the students requiring the most support, those two or more grade levels behind, may be benefitting the least from current intervention strategies. By and large, this group of students demonstrated very little recovery in either subject, and in some cases showed continued departure from historical growth trends. This group of students may require an entirely different approach from current recovery efforts. It is important district leaders continually evaluate and revisit what's working for whom and under what conditions.

The last area we see varying trends in recovery is by school and community characteristics. Though most trends mimic those in the overall sample, the magnitude of differences is exaggerated for schools in lower-income communities, those serving majority Black or Hispanic students, and in urban areas. These trends may reveal that some school communities either respond differently to the interventions utilized, given varying trends between majority White and Black schools (i.e., reading growth in Grades K and 1 cohorts), or that they benefit equally, but not enough to remedy existing disparities.

Limitations

The current study has several strengths and limitations to note. First, our analyses leveraged large, longitudinal samples to model academic growth. Despite our large sample sizes, they are not nationally representative. Often, these two features are difficult to ascertain at the same time. Our central research questions focused on growth over time, so we prioritized constructing the largest longitudinal samples given our constraints. Second, though we built our historical and post-COVID cohorts using the same sampling criteria, they are not matched samples. Third, our analyses did not track the same students pre- to post-COVID. Thus, we cannot speak to *within* student changes in academic achievement from pre- to -post-COVID. Instead, we sampled different students historical and post-COVID, and compared them. Finally, our study is correlational. We cannot make any causal claims about the impact of COVID-19, interventions, or any other causal factors that may account for differences between historical and post-COVID trends. Although we only studied associations, our longitudinal design, large samples, and analytic strategy give weight to the differences observed. Our goal is to document these differences and to prompt closer examinations to help recovery efforts.

Conclusion

Examining for whom and where recovery may be occurring brings into question which students and what schools are responding best to recovery efforts. For districts, this means taking an equally nuanced approach to their data to evaluate if intervention efforts have made an impact. Though interventions may lack impact for a variety of reasons, it is important to consider the fit between the intervention strategy and the communities they serve, whether schools have the infrastructure to support its implementation, or whether the required dosage is feasible given the many barriers schools face. Thus, given the results from this report and elsewhere, we argue that future research, interventions, and evaluations heavily consider and weigh the diversity of students, schools, and communities when designing, choosing, and evaluating the interventions implemented.

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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; and 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. The mean standard error of measurement (SEM) for overall scores across grade levels is low in both the reading (e.g., 9.3–10.9) and mathematics assessments (e.g., 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 SEM 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 Diagnostic* correlations with spring state assessments also show high correlations (most at .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**	**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	**Mid On Grade Level:**	Will benefit from instruction in late on-grade level topics
					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
					Above Grade Level:	Will benefit from above-grade level instruction

Figure A1. Differences in Historical and Post-COVID Growth in Reading by Community Income Level

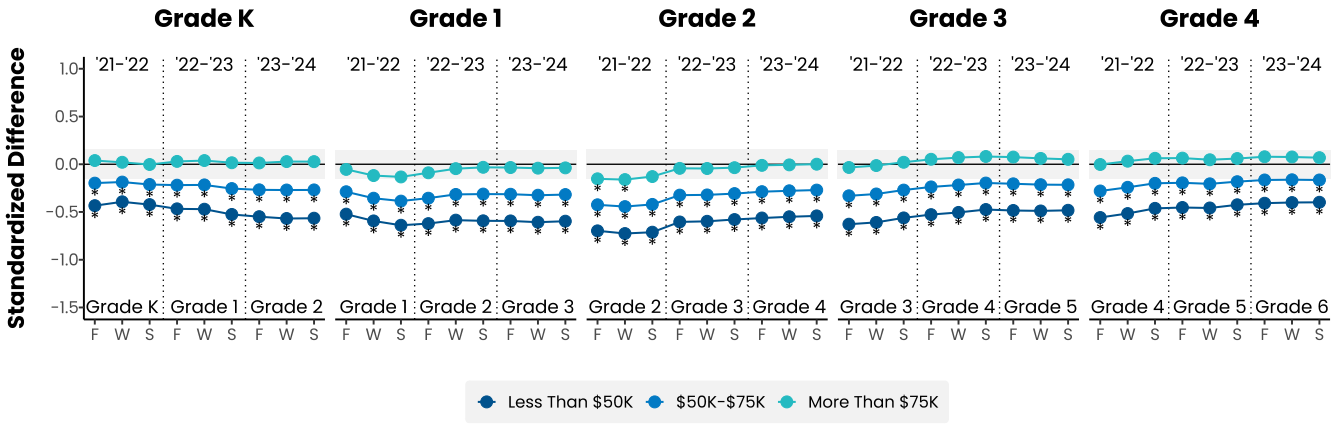

Figure A2. Differences in Historical and Post-COVID Growth in Reading by School Locale

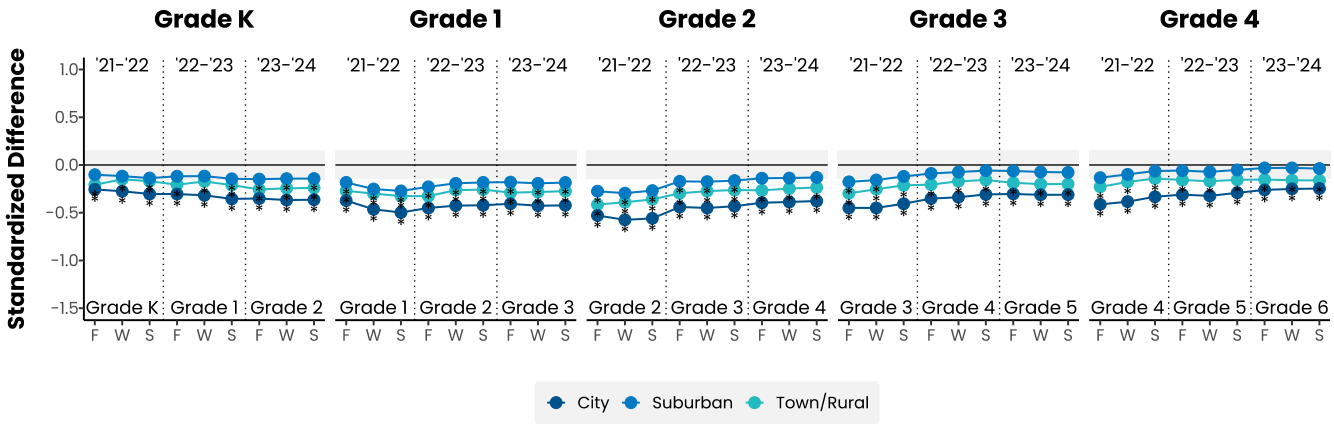

Figure A3. Differences in Historical and Post-COVID Growth in Mathematics by Community Income Level

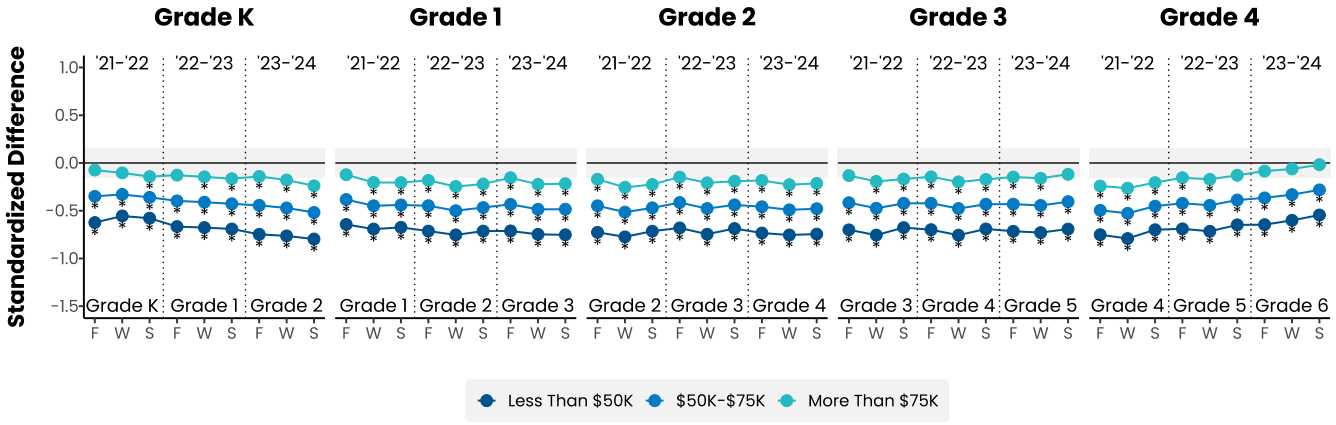

Figure A4. Differences in Historical and Post-COVID Growth in Mathematics by School Locale

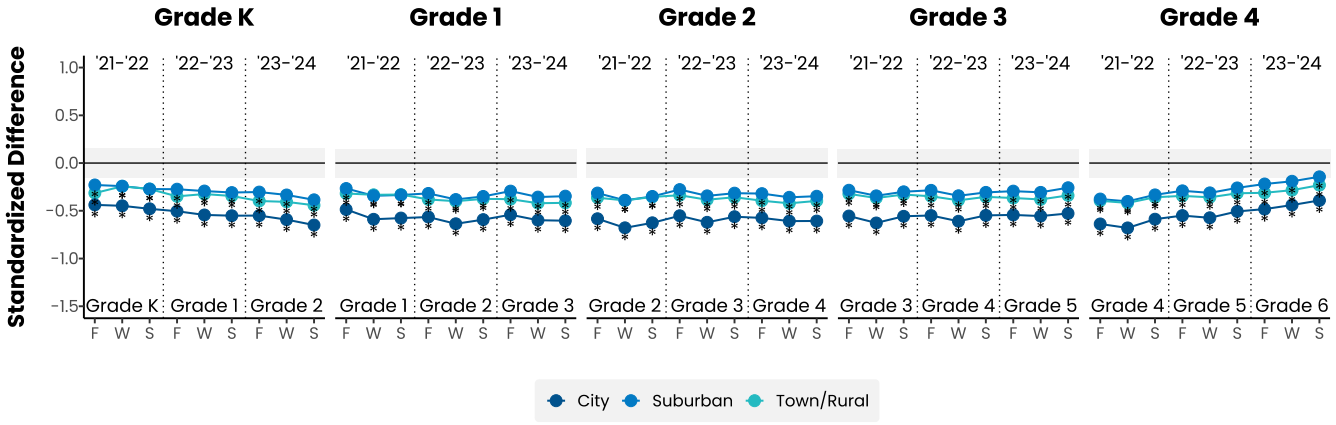

Table A1. Differences in Historical and Post-COVID Scores (SDs) over Time in Reading and Mathematics by Cohort

Cohort	2021-2022			2022-2023			2023-2024		
	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring
Reading									
Grade K	-4.03 (-0.13)	-4.81 (-0.14)	**-5.97 (-0.15*)**	**-7.12 (-0.17*)**	**-7.74 (-0.17*)**	**-9.05 (-0.19*)**	**-10.68 (-0.22*)**	**-10.57 (-0.22*)**	**-9.63 (-0.2*)**
Grade 1	**-7.44 (-0.18*)**	**-11.61 (-0.25*)**	**-13.44 (-0.28*)**	**-12.5 (-0.25*)**	**-10.38 (-0.21*)**	**-9.86 (-0.2*)**	**-10.49 (-0.21*)**	**-10.73 (-0.22*)**	**-10.72 (-0.22*)**
Grade 2	**-14.82 (-0.3*)**	**-15.5 (-0.32*)**	**-14.12 (-0.29*)**	**-10.06 (-0.2*)**	**-9.76 (-0.2*)**	**-9.49 (-0.19*)**	**-8.65 (-0.17*)**	**-8.1 (-0.16*)**	**-8.16 (-0.16*)**
Grade 3	**-9.65 (-0.19*)**	**-8.49 (-0.17*)**	-6.91 (-0.14)	-5.43 (-0.11)	-4.32 (-0.09)	-3.75 (-0.07)	-4.27 (-0.08)	-4.67 (-0.09)	-5.3 (-0.1)
Grade 4	-6.25 (-0.12)	-4.22 (-0.08)	-2.59 (-0.05)	-2.75 (-0.05)	-2.88 (-0.06)	-2.69 (-0.05)	-3.53 (-0.06)	-3.58 (-0.06)	-3.88 (-0.07)
Mathematics									
Grade K	**-6.12 (-0.28*)**	**-6.11 (-0.28*)**	**-6.86 (-0.3*)**	**-7.84 (-0.34*)**	**-8.68 (-0.36*)**	**-9.37 (-0.36*)**	**-9.42 (-0.39*)**	**-10.46 (-0.42*)**	**-12.07 (-0.45*)**
Grade 1	**-5.89 (-0.26*)**	**-8.06 (-0.33*)**	**-8.64 (-0.33*)**	**-8.04 (-0.33*)**	**-9.74 (-0.39*)**	**-9.63 (-0.36*)**	**-8.14 (-0.32*)**	**-9.68 (-0.38*)**	**-11.16 (-0.38*)**
Grade 2	**-7.47 (-0.31*)**	**-9.58 (-0.38*)**	**-9.26 (-0.35*)**	**-7.27 (-0.29*)**	**-8.98 (-0.35*)**	**-9.45 (-0.33*)**	**-9.45 (-0.34*)**	**-10.63 (-0.37*)**	**-11.7 (-0.37*)**
Grade 3	**-6.63 (-0.26*)**	**-8.27 (-0.32*)**	**-8.38 (-0.29*)**	**-7.88 (-0.28*)**	**-9.6 (-0.34*)**	**-9.63 (-0.31*)**	**-8.91 (-0.3*)**	**-9.29 (-0.31*)**	**-9.08 (-0.28*)**
Grade 4	**-8.78 (-0.31*)**	**-9.83 (-0.35*)**	**-9.15 (-0.29*)**	**-7.71 (-0.26*)**	**-7.96 (-0.27*)**	**-7.82 (-0.24*)**	**-8.26 (-0.26*)**	**-7.7 (-0.23*)**	**-6.8 (-0.19*)**

Table A2. Differences in Historical and Post-COVID Scores (SDs) over Time in Reading by Cohort and Placement Level

Cohort	2021-2022			2022-2023			2023-2024		
	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring
Early Mid/Above									
Grade K	**4.01 (0.17*)**	0.71 (0.03)	-1.49 (-0.04)	-3.08 (-0.12)	-3.35 (-0.12)	-3.77 (-0.12)	**-4.83 (-0.22*)**	**-4.58 (-0.18*)**	-2.99 (-0.11)
Grade 1	2.72 (0.11)	0.53 (0.02)	-0.16 (-0.01)	-0.04 (0)	**3.58 (0.14*)**	**4.36 (0.16*)**	1.59 (0.07)	0.69 (0.03)	0.73 (0.02)
Grade 2	**3.44 (0.15*)**	**4.31 (0.17*)**	**5.4 (0.2*)**	**6.84 (0.28*)**	**6.25 (0.23*)**	**6.34 (0.21*)**	**7.25 (0.34*)**	**6.54 (0.28*)**	**5.98 (0.24*)**
Grade 3	2.25 (0.09)	3.93 (0.15)	**5.37 (0.18*)**	**5.68 (0.27*)**	**6.19 (0.27*)**	**6.56 (0.26*)**	**5.89 (0.28*)**	**4.63 (0.21*)**	3.36 (0.14)
Grade 4	1.89 (0.09)	2.83 (0.12)	3.6 (0.14)	**3.29 (0.16*)**	2.75 (0.12)	2.08 (0.08)	0.4 (0.02)	-0.77 (-0.03)	-1.54 (-0.06)
One Below									
Grade K	**-3.81 (-0.2*)**	**-3.98 (-0.23*)**	**-5 (-0.29*)**	**-5.74 (-0.26*)**	**-6.38 (-0.31*)**	**-8.2 (-0.41*)**	**-10.06 (-0.48*)**	**-10.24 (-0.51*)**	**-9.66 (-0.49*)**
Grade 1	-1.45 (-0.07)	**-6.56 (-0.32*)**	**-8.43 (-0.42*)**	**-7.06 (-0.34*)**	**-5.42 (-0.27*)**	**-4.78 (-0.24*)**	**-5.14 (-0.51*)**	**-5.34 (-0.53*)**	**-4.94 (-0.49*)**
Grade 2	-2.5 (-0.12)	-2.91 (-0.14)	-0.91 (-0.05)	**3.71 (0.37*)**	**3.9 (0.39*)**	**4.21 (0.42*)**	**4.84 (0.28*)**	**5.08 (0.3*)**	**5.62 (0.33*)**
Grade 3	-0.23 (-0.02)	**1.77 (0.18*)**	**3.9 (0.39*)**	**5.55 (0.33*)**	**6.4 (0.38*)**	**6.9 (0.41*)**	**6.46 (0.58*)**	**5.86 (0.53*)**	**5.89 (0.53*)**
Grade 4	0.51 (0.03)	**2.8 (0.17*)**	**4.29 (0.25*)**	**3.9 (0.35*)**	**3.81 (0.34*)**	**4.2 (0.38*)**	**4.02 (0.45*)**	**3.78 (0.42*)**	**3.34 (0.37*)**
Two or More Below									
Grade 1	-0.93 (-0.06)	**-8.7 (-0.52*)**	**-13.37 (-0.78*)**	**-13.41 (-0.59*)**	**-13.26 (-0.58*)**	**-14.36 (-0.6*)**	**-15.18 (-0.51*)**	**-16.53 (-0.55*)**	**-17.91 (-0.58*)**
Grade 2	**-5.2 (-0.23*)**	**-12.65 (-0.55*)**	**-13.82 (-0.58*)**	**-8.17 (-0.27*)**	**-9.41 (-0.31*)**	**-9.55 (-0.31*)**	**-8.04 (-0.24*)**	**-7.67 (-0.23*)**	**-7.85 (-0.23*)**
Grade 3	**-8.98 (-0.3*)**	**-11.5 (-0.38*)**	**-11.21 (-0.36*)**	**-7.86 (-0.24*)**	**-6.8 (-0.2*)**	**-6.4 (-0.19*)**	**-6.41 (-0.17*)**	**-6.51 (-0.18*)**	**-6.86 (-0.18*)**
Grade 4	**-9.03 (-0.27*)**	**-7.62 (-0.23*)**	**-5.96 (-0.18*)**	-5.19 (-0.14)	**-5.77 (-0.16*)**	**-5.55 (-0.15*)**	-5.67 (-0.14)	-4.66 (-0.12)	-4.72 (-0.12)

Table A3. Differences in Historical and Post-COVID Scores (SDs) over Time in Reading by Cohort and School Demographics

Cohort	2021-2022			2022-2023			2023-2024		
	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring
More Than 50% White									
Grade K	-1.08 (-0.03)	0.64 (0.02)	0 (0)	-0.7 (-0.02)	0.97 (0.02)	-0.41 (-0.01)	-2.54 (-0.05)	-1.25 (-0.03)	-0.83 (-0.02)
Grade 1	-4.05 (-0.1)	-5.3 (-0.12)	-6.23 (-0.13)	-6.49 (-0.13)	-3.13 (-0.06)	-2.45 (-0.05)	-4.13 (-0.08)	-3.32 (-0.07)	-2.89 (-0.06)
Grade 2	**-9.94 (-0.2*)**	**-8.07 (-0.16*)**	-6.17 (-0.13)	-3.92 (-0.08)	-2.62 (-0.05)	-2.32 (-0.05)	-2.69 (-0.05)	-1.67 (-0.03)	-1.22 (-0.02)
Grade 3	-3.35 (-0.07)	-0.89 (-0.02)	0.72 (0.01)	0.65 (0.01)	2.39 (0.05)	2.93 (0.06)	1.43 (0.03)	0.93 (0.02)	0.71 (0.01)
Grade 4	-0.59 (-0.01)	1.96 (0.04)	3.33 (0.06)	2.17 (0.04)	1.93 (0.04)	2.29 (0.04)	1.91 (0.03)	1.82 (0.03)	1.34 (0.02)
More Than 50% Hispanic									
Grade K	**-11.41 (-0.37*)**	**-14.33 (-0.41*)**	**-17.14 (-0.44*)**	**-17.53 (-0.42*)**	**-20.15 (-0.44*)**	**-22.56 (-0.47*)**	**-22.47 (-0.45*)**	**-22.85 (-0.47*)**	**-22.59 (-0.47*)**
Grade 1	**-21.4 (-0.52*)**	**-28.02 (-0.61*)**	**-30.67 (-0.64*)**	**-29 (-0.58*)**	**-27.52 (-0.56*)**	**-26.62 (-0.55*)**	**-25.95 (-0.52*)**	**-26.41 (-0.54*)**	**-26.12 (-0.52*)**
Grade 2	**-31.84 (-0.64*)**	**-34.13 (-0.7*)**	**-32.54 (-0.68*)**	**-26.74 (-0.53*)**	**-26.7 (-0.55*)**	**-26.01 (-0.52*)**	**-24.34 (-0.48*)**	**-23.41 (-0.47*)**	**-23.25 (-0.45*)**
Grade 3	**-27.97 (-0.56*)**	**-27.03 (-0.55*)**	**-24.96 (-0.5*)**	**-22.59 (-0.44*)**	**-21.17 (-0.42*)**	**-20.07 (-0.39*)**	**-20.13 (-0.38*)**	**-19.78 (-0.39*)**	**-20.08 (-0.38*)**
Grade 4	**-24.54 (-0.48*)**	**-22.05 (-0.44*)**	**-19.76 (-0.38*)**	**-19.01 (-0.36*)**	**-18.9 (-0.37*)**	**-17.7 (-0.33*)**	**-16.75 (-0.3*)**	**-15.88 (-0.29*)**	**-15.68 (-0.28*)**
More Than 50% Black									
Grade K	**-11.34 (-0.37*)**	**-13.42 (-0.38*)**	**-16.51 (-0.42*)**	**-18.31 (-0.44*)**	**-22.8 (-0.5*)**	**-26.78 (-0.56*)**	**-27.95 (-0.56*)**	**-30.26 (-0.62*)**	**-30.56 (-0.63*)**
Grade 1	**-19.52 (-0.47*)**	**-27.36 (-0.6*)**	**-30.81 (-0.65*)**	**-29.52 (-0.6*)**	**-29.35 (-0.6*)**	**-29.45 (-0.61*)**	**-29.5 (-0.59*)**	**-31.25 (-0.64*)**	**-32.6 (-0.65*)**
Grade 2	**-33.1 (-0.67*)**	**-36.93 (-0.75*)**	**-35.97 (-0.75*)**	**-29.89 (-0.6*)**	**-30.87 (-0.63*)**	**-30.82 (-0.62*)**	**-29.41 (-0.58*)**	**-29.72 (-0.59*)**	**-31.07 (-0.6*)**
Grade 3	**-31.23 (-0.62*)**	**-31.87 (-0.65*)**	**-30.38 (-0.61*)**	**-27.61 (-0.54*)**	**-27.86 (-0.55*)**	**-27.27 (-0.53*)**	**-26.68 (-0.51*)**	**-26.6 (-0.52*)**	**-28.21 (-0.53*)**
Grade 4	**-30.69 (-0.6*)**	**-30.16 (-0.6*)**	**-28.45 (-0.55*)**	**-26.89 (-0.51*)**	**-27.44 (-0.54*)**	**-26.68 (-0.5*)**	**-25.94 (-0.47*)**	**-25.63 (-0.46*)**	**-27.15 (-0.48*)**
No Majority									
Grade K	-2.84 (-0.09)	-4.09 (-0.12)	**-5.61 (-0.14*)**	-5.1 (-0.12)	-5.81 (-0.13)	**-7.39 (-0.16*)**	**-7.52 (-0.15*)**	**-7.52 (-0.15*)**	**-7.24 (-0.15*)**
Grade 1	**-7.12 (-0.17*)**	**-11.97 (-0.26*)**	**-13.56 (-0.28*)**	**-11.56 (-0.23*)**	**-9.92 (-0.2*)**	**-9.45 (-0.2*)**	**-9.78 (-0.2*)**	**-10.53 (-0.22*)**	**-10.37 (-0.21*)**
Grade 2	**-14.8 (-0.3*)**	**-16.42 (-0.33*)**	**-15.17 (-0.32*)**	**-10.73 (-0.21*)**	**-10.88 (-0.22*)**	**-10.43 (-0.21*)**	**-9.07 (-0.18*)**	**-9 (-0.18*)**	**-8.97 (-0.17*)**
Grade 3	**-10.95 (-0.22*)**	**-10.43 (-0.21*)**	**-8.68 (-0.17*)**	-6.53 (-0.13)	-5.94 (-0.12)	-5.21 (-0.1)	-5.18 (-0.1)	-6 (-0.12)	-6.46 (-0.12)
Grade 4	**-10.17 (-0.2*)**	**-8.62 (-0.17*)**	-6.77 (-0.13)	-5.95 (-0.11)	-6.95 (-0.14)	-5.98 (-0.11)	-4.35 (-0.08)	-4.83 (-0.09)	-4.86 (-0.09)

Table A4. Differences in Historical and Post-COVID Scores (SDs) over Time in Reading by Cohort and Median Household Income by School Zip Code

Cohort	2021-2022			2022-2023			2023-2024		
	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring
Less Than $50,000									
Grade K	**-13.4 (-0.43*)**	**-13.81 (-0.39*)**	**-16.64 (-0.42*)**	**-19.41 (-0.47*)**	**-21.63 (-0.47*)**	**-25.07 (-0.53*)**	**-27.24 (-0.55*)**	**-27.88 (-0.57*)**	**-27.2 (-0.57*)**
Grade 1	**-21.72 (-0.52*)**	**-27.26 (-0.59*)**	**-30.46 (-0.64*)**	**-30.81 (-0.62*)**	**-28.72 (-0.59*)**	**-28.51 (-0.59*)**	**-29.66 (-0.59*)**	**-29.67 (-0.61*)**	**-29.71 (-0.6*)**
Grade 2	**-34.59 (-0.7*)**	**-35.61 (-0.73*)**	**-34.28 (-0.71*)**	**-30.21 (-0.6*)**	**-29.2 (-0.6*)**	**-28.82 (-0.58*)**	**-28.71 (-0.56*)**	**-27.63 (-0.55*)**	**-28.02 (-0.54*)**
Grade 3	**-31.4 (-0.63*)**	**-29.76 (-0.61*)**	**-27.98 (-0.56*)**	**-26.88 (-0.53*)**	**-25.35 (-0.5*)**	**-24.56 (-0.47*)**	**-25.35 (-0.48*)**	**-24.99 (-0.49*)**	**-25.63 (-0.48*)**
Grade 4	**-28.43 (-0.56*)**	**-25.93 (-0.52*)**	**-23.93 (-0.46*)**	**-23.74 (-0.45*)**	**-23.4 (-0.46*)**	**-22.55 (-0.42*)**	**-22.5 (-0.41*)**	**-22.12 (-0.4*)**	**-22.49 (-0.4*)**
$50,000–$75,000									
Grade K	**-6.1 (-0.2*)**	**-6.55 (-0.19*)**	**-8.37 (-0.21*)**	**-9.08 (-0.22*)**	**-9.93 (-0.22*)**	**-12.15 (-0.25*)**	**-13.28 (-0.27*)**	**-13.25 (-0.27*)**	**-12.94 (-0.27*)**
Grade 1	**-11.98 (-0.29*)**	**-16.34 (-0.36*)**	**-18.4 (-0.39*)**	**-17.62 (-0.36*)**	**-15.49 (-0.32*)**	**-15.03 (-0.31*)**	**-15.69 (-0.31*)**	**-15.84 (-0.32*)**	**-15.8 (-0.32*)**
Grade 2	**-21.07 (-0.42*)**	**-21.75 (-0.44*)**	**-20.24 (-0.42*)**	**-16.18 (-0.32*)**	**-15.68 (-0.32*)**	**-15.3 (-0.31*)**	**-14.65 (-0.29*)**	**-13.97 (-0.28*)**	**-14 (-0.27*)**
Grade 3	**-16.54 (-0.33*)**	**-15.22 (-0.31*)**	**-13.47 (-0.27*)**	**-12.12 (-0.24*)**	**-10.92 (-0.22*)**	**-10.17 (-0.2*)**	**-10.71 (-0.2*)**	**-10.92 (-0.21*)**	**-11.44 (-0.22*)**
Grade 4	**-14.28 (-0.28*)**	**-12.15 (-0.24*)**	**-10.34 (-0.2*)**	**-10.18 (-0.19*)**	**-10.49 (-0.21*)**	**-9.68 (-0.18*)**	**-9.08 (-0.16*)**	**-8.95 (-0.16*)**	**-9.3 (-0.16*)**
More Than $75,000									
Grade K	1.2 (0.04)	0.72 (0.02)	-0.1 (0)	1.24 (0.03)	1.78 (0.04)	0.76 (0.02)	0.67 (0.01)	1.38 (0.03)	1.31 (0.03)
Grade 1	-2.24 (-0.05)	-5.43 (-0.12)	-6.33 (-0.13)	-4.42 (-0.09)	-2.27 (-0.05)	-1.54 (-0.03)	-1.71 (-0.03)	-2.01 (-0.04)	-1.88 (-0.04)
Grade 2	**-7.56 (-0.15*)**	**-7.88 (-0.16*)**	-6.21 (-0.13)	-2.15 (-0.04)	-2.17 (-0.04)	-1.78 (-0.04)	-0.59 (-0.01)	-0.31 (-0.01)	0.03 (0)
Grade 3	-1.68 (-0.03)	-0.67 (-0.01)	1.04 (0.02)	2.64 (0.05)	3.51 (0.07)	4.21 (0.08)	3.93 (0.08)	3.14 (0.06)	2.74 (0.05)
Grade 4	-0.14 (0)	1.63 (0.03)	3.24 (0.06)	3.37 (0.06)	2.42 (0.05)	3.18 (0.06)	4.34 (0.08)	4.21 (0.08)	3.89 (0.07)

Table A5. Differences in Historical and Post-COVID Scores (SDs) over Time in Reading by Cohort and Locale

Cohort	2021-2022			2022-2023			2023-2024		
	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring
Town/Rural									
Grade K	**-6.4 (-0.21*)**	**-5.25 (-0.15*)**	**-6.7 (-0.17*)**	**-8.55 (-0.21*)**	**-7.93 (-0.17*)**	**-10.03 (-0.21*)**	**-12.7 (-0.26*)**	**-12.02 (-0.25*)**	**-11.56 (-0.24*)**
Grade 1	**-11.25 (-0.27*)**	**-13.76 (-0.3*)**	**-15.53 (-0.33*)**	**-16.2 (-0.33*)**	**-12.89 (-0.26*)**	**-12.43 (-0.26*)**	**-14.47 (-0.29*)**	**-13.85 (-0.28*)**	**-13.67 (-0.27*)**
Grade 2	**-20.57 (-0.41*)**	**-19.14 (-0.39*)**	**-17.33 (-0.36*)**	**-14.82 (-0.3*)**	**-13.37 (-0.27*)**	**-13.06 (-0.26*)**	**-13.58 (-0.27*)**	**-12.39 (-0.25*)**	**-12.22 (-0.24*)**
Grade 3	**-14.85 (-0.3*)**	**-12.38 (-0.25*)**	**-10.65 (-0.21*)**	**-10.49 (-0.21*)**	**-8.61 (-0.17*)**	**-8.1 (-0.16*)**	**-9.79 (-0.19*)**	**-10.23 (-0.2*)**	**-10.58 (-0.2*)**
Grade 4	**-11.69 (-0.23*)**	**-8.92 (-0.18*)**	**-7.34 (-0.14*)**	**-8.26 (-0.16*)**	**-8.67 (-0.17*)**	**-8.29 (-0.16*)**	**-8.43 (-0.15*)**	**-8.83 (-0.16*)**	**-9.15 (-0.16*)**
City									
Grade K	**-7.9 (-0.26*)**	**-9.67 (-0.28*)**	**-11.97 (-0.3*)**	**-12.64 (-0.3*)**	**-14.6 (-0.32*)**	**-16.92 (-0.36*)**	**-17.43 (-0.35*)**	**-18.03 (-0.37*)**	**-17.53 (-0.36*)**
Grade 1	**-15.49 (-0.37*)**	**-21.32 (-0.46*)**	**-23.72 (-0.5*)**	**-22.34 (-0.45*)**	**-20.88 (-0.43*)**	**-20.33 (-0.42*)**	**-20.32 (-0.41*)**	**-20.84 (-0.43*)**	**-21.04 (-0.42*)**
Grade 2	**-26.24 (-0.53*)**	**-28.21 (-0.57*)**	**-26.9 (-0.56*)**	**-22.01 (-0.44*)**	**-22 (-0.45*)**	**-21.49 (-0.43*)**	**-20.17 (-0.4*)**	**-19.48 (-0.39*)**	**-19.54 (-0.38*)**
Grade 3	**-22.45 (-0.45*)**	**-22.01 (-0.45*)**	**-20.22 (-0.41*)**	**-17.93 (-0.35*)**	**-16.96 (-0.34*)**	**-16 (-0.31*)**	**-15.87 (-0.3*)**	**-15.95 (-0.31*)**	**-16.54 (-0.31*)**
Grade 4	**-21.03 (-0.41*)**	**-19.29 (-0.38*)**	**-17.26 (-0.33*)**	**-16.26 (-0.31*)**	**-16.53 (-0.32*)**	**-15.47 (-0.29*)**	**-14.4 (-0.26*)**	**-13.83 (-0.25*)**	**-13.92 (-0.25*)**
Suburban									
Grade K	-3.15 (-0.1)	-4.1 (-0.12)	**-5.41 (-0.14*)**	-4.9 (-0.12)	-5.36 (-0.12)	**-6.91 (-0.14*)**	**-7.37 (-0.15*)**	**-7.02 (-0.14*)**	**-6.87 (-0.14*)**
Grade 1	**-7.59 (-0.18*)**	**-11.59 (-0.25*)**	**-12.96 (-0.27*)**	**-11.36 (-0.23*)**	**-9.45 (-0.19*)**	**-8.78 (-0.18*)**	**-9 (-0.18*)**	**-9.4 (-0.19*)**	**-9.16 (-0.18*)**
Grade 2	**-13.64 (-0.27*)**	**-14.49 (-0.3*)**	**-12.91 (-0.27*)**	**-8.57 (-0.17*)**	**-8.54 (-0.17*)**	**-8.15 (-0.16*)**	-7.09 (-0.14)	-6.88 (-0.14)	-6.79 (-0.13)
Grade 3	**-8.83 (-0.18*)**	**-7.7 (-0.16*)**	-5.99 (-0.12)	-4.53 (-0.09)	-3.71 (-0.07)	-3.02 (-0.06)	-3.29 (-0.06)	-3.74 (-0.07)	-4.14 (-0.08)
Grade 4	-6.8 (-0.13)	-4.95 (-0.1)	-3.27 (-0.06)	-3.09 (-0.06)	-3.67 (-0.07)	-2.77 (-0.05)	-1.73 (-0.03)	-1.7 (-0.03)	-2.13 (-0.04)

Table A6. Differences in Historical and Post-COVID Scores (SDs) over Time in Mathematics by Cohort and Placement Level

Cohort	2021-2022			2022-2023			2023-2024		
	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring
Early Mid/Above									
Grade K	**2.2 (0.17*)**	0.47 (0.03)	-0.95 (-0.05)	**-2.43 (-0.18*)**	**-4.12 (-0.28*)**	**-4.69 (-0.27*)**	**-4.51 (-0.38*)**	**-6.11 (-0.48*)**	**-7.21 (-0.47*)**
Grade 1	**3.99 (0.3*)**	-2.08 (-0.14)	**-4.21 (-0.25*)**	**-3.91 (-0.33*)**	**-6.01 (-0.47*)**	**-5.38 (-0.35*)**	**-3.53 (-0.3*)**	**-4.6 (-0.35*)**	**-4.5 (-0.27*)**
Grade 2	-0.43 (-0.04)	**-4.71 (-0.37*)**	**-5.19 (-0.34*)**	**-2.13 (-0.18*)**	**-2.92 (-0.22*)**	**-3.22 (-0.2*)**	**-3.27 (-0.26*)**	**-3.44 (-0.23*)**	**-3.26 (-0.19*)**
Grade 3	**1.87 (0.16*)**	-0.03 (0)	-0.72 (-0.04)	0.07 (0.01)	-0.82 (-0.06)	-0.79 (-0.05)	0.43 (0.03)	0.95 (0.06)	1.75 (0.1)
Grade 4	0.73 (0.06)	0.47 (0.03)	1.17 (0.07)	**2.71 (0.2*)**	**3.56 (0.24*)**	**3.87 (0.22*)**	**3.51 (0.25*)**	**4.61 (0.29*)**	**6.59 (0.35*)**
One Below									
Grade K	**-5.29 (-0.34*)**	**-5.39 (-0.41*)**	**-6.14 (-0.51*)**	**-7.08 (-0.51*)**	**-7.57 (-0.58*)**	**-8.19 (-0.63*)**	**-8.46 (-0.78*)**	**-9.44 (-0.86*)**	**-10.95 (-1.01*)**
Grade 1	-1.27 (-0.09)	**-3.96 (-0.3*)**	**-4.68 (-0.36*)**	**-4.18 (-0.38*)**	**-5.97 (-0.54*)**	**-5.8 (-0.54*)**	**-4.41 (-0.43*)**	**-6.19 (-0.62*)**	**-7.31 (-0.74*)**
Grade 2	-0.72 (-0.07)	**-3.1 (-0.28*)**	**-3.02 (-0.28*)**	-1.4 (-0.14)	**-3.3 (-0.33*)**	**-3.77 (-0.38*)**	**-3.72 (-0.42*)**	**-5.31 (-0.59*)**	**-5.76 (-0.65*)**
Grade 3	0.74 (0.07)	**-1.51 (-0.15*)**	**-1.86 (-0.19*)**	-1.26 (-0.14)	**-3.21 (-0.36*)**	**-3.23 (-0.36*)**	**-2.25 (-0.27*)**	**-2.86 (-0.35*)**	**-1.86 (-0.23*)**
Grade 4	-0.58 (-0.06)	**-2.4 (-0.27*)**	**-1.92 (-0.22*)**	-0.04 (0)	-0.18 (-0.02)	0.06 (0.01)	-0.23 (-0.03)	0.49 (0.06)	**2.01 (0.23*)**
Two or More Below									
Grade 1	**-4.07 (-0.37*)**	**-5.83 (-0.53*)**	**-6.42 (-0.58*)**	**-5.35 (-0.39*)**	**-6.09 (-0.45*)**	**-6.05 (-0.43*)**	**-4.76 (-0.3*)**	**-6.12 (-0.38*)**	**-7.34 (-0.43*)**
Grade 2	**-6.07 (-0.45*)**	**-8.41 (-0.62*)**	**-7.99 (-0.57*)**	**-5.8 (-0.37*)**	**-7.52 (-0.47*)**	**-7.73 (-0.45*)**	**-7.43 (-0.42*)**	**-8.86 (-0.5*)**	**-10.08 (-0.54*)**
Grade 3	**-5.36 (-0.34*)**	**-7.19 (-0.45*)**	**-7.16 (-0.42*)**	**-6.55 (-0.37*)**	**-7.94 (-0.45*)**	**-7.99 (-0.43*)**	**-7.98 (-0.4*)**	**-8.78 (-0.46*)**	**-8.88 (-0.45*)**
Grade 4	**-5.16 (-0.29*)**	**-6.42 (-0.37*)**	**-6.01 (-0.32*)**	**-5.22 (-0.26*)**	**-6.19 (-0.33*)**	**-6.19 (-0.31*)**	**-6.54 (-0.31*)**	**-6.32 (-0.29*)**	**-5.6 (-0.25*)**

Table A7. Differences in Historical and Post-COVID Scores (SDs) over Time in Mathematics by Cohort and School Demographics

Cohort	2021-2022			2022-2023			2023-2024		
	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring
More Than 50% White									
Grade K	-2.71 (-0.13)	-1.69 (-0.08)	-2.54 (-0.11)	**-3.63 (-0.16*)**	**-3.44 (-0.14*)**	**-4.32 (-0.17*)**	**-4.67 (-0.19*)**	**-5.27 (-0.21*)**	**-6.82 (-0.26*)**
Grade 1	-2.83 (-0.12)	**-3.54 (-0.15*)**	**-3.96 (-0.15*)**	**-4.58 (-0.19*)**	**-5.54 (-0.22*)**	**-5.41 (-0.2*)**	**-4.71 (-0.18*)**	**-6.23 (-0.24*)**	**-6.75 (-0.23*)**
Grade 2	**-3.9 (-0.16*)**	**-5.17 (-0.21*)**	**-4.91 (-0.18*)**	**-3.99 (-0.16*)**	**-5.17 (-0.2*)**	**-5.54 (-0.19*)**	**-5.96 (-0.21*)**	**-6.99 (-0.25*)**	**-6.74 (-0.21*)**
Grade 3	-3.27 (-0.13)	**-4.5 (-0.18*)**	**-4.66 (-0.16*)**	**-4.73 (-0.17*)**	**-5.81 (-0.2*)**	**-5.67 (-0.18*)**	**-5.32 (-0.18*)**	**-5.6 (-0.19*)**	**-4.57 (-0.14*)**
Grade 4	**-6.39 (-0.23*)**	**-6.86 (-0.24*)**	**-6.12 (-0.19*)**	**-5.09 (-0.17*)**	**-5.09 (-0.17*)**	-4.36 (-0.14)	-3.82 (-0.12)	-2.98 (-0.09)	-1.55 (-0.04)
More Than 50% Hispanic									
Grade K	**-12.13 (-0.56*)**	**-12.91 (-0.58*)**	**-14.07 (-0.61*)**	**-13.99 (-0.61*)**	**-15.54 (-0.64*)**	**-16.66 (-0.64*)**	**-15.74 (-0.65*)**	**-16.62 (-0.66*)**	**-18.89 (-0.71*)**
Grade 1	**-14.87 (-0.65*)**	**-17.97 (-0.74*)**	**-18.44 (-0.71*)**	**-16.82 (-0.69*)**	**-18.79 (-0.75*)**	**-18.43 (-0.69*)**	**-16.25 (-0.64*)**	**-17.43 (-0.68*)**	**-20.01 (-0.69*)**
Grade 2	**-17.27 (-0.71*)**	**-19.47 (-0.78*)**	**-18.75 (-0.7*)**	**-15.98 (-0.63*)**	**-17.96 (-0.7*)**	**-18.41 (-0.63*)**	**-18.19 (-0.65*)**	**-19.25 (-0.68*)**	**-21.97 (-0.7*)**
Grade 3	**-17.01 (-0.67*)**	**-18.58 (-0.72*)**	**-18.43 (-0.63*)**	**-17.54 (-0.63*)**	**-19.77 (-0.69*)**	**-19.85 (-0.63*)**	**-18.74 (-0.63*)**	**-18.93 (-0.64*)**	**-19.72 (-0.61*)**
Grade 4	**-19.68 (-0.7*)**	**-20.85 (-0.73*)**	**-19.89 (-0.63*)**	**-17.71 (-0.59*)**	**-18.7 (-0.63*)**	**-18.15 (-0.56*)**	**-16.98 (-0.54*)**	**-16.19 (-0.49*)**	**-15.85 (-0.45*)**
More Than 50% Black									
Grade K	**-13.67 (-0.63*)**	**-13.55 (-0.61*)**	**-14.91 (-0.64*)**	**-16.11 (-0.71*)**	**-18.73 (-0.77*)**	**-20.58 (-0.79*)**	**-20.06 (-0.82*)**	**-22.42 (-0.89*)**	**-25.19 (-0.94*)**
Grade 1	**-15.67 (-0.69*)**	**-19.27 (-0.8*)**	**-20.05 (-0.77*)**	**-18.54 (-0.76*)**	**-21.41 (-0.85*)**	**-21.77 (-0.82*)**	**-20.13 (-0.79*)**	**-21.8 (-0.85*)**	**-25.1 (-0.86*)**
Grade 2	**-19.65 (-0.81*)**	**-22.95 (-0.91*)**	**-22.62 (-0.85*)**	**-19.53 (-0.77*)**	**-22.16 (-0.86*)**	**-23.1 (-0.8*)**	**-23.23 (-0.83*)**	**-24.64 (-0.87*)**	**-27.67 (-0.88*)**
Grade 3	**-20.6 (-0.81*)**	**-22.91 (-0.89*)**	**-23.19 (-0.8*)**	**-22.41 (-0.8*)**	**-25.22 (-0.89*)**	**-25.65 (-0.81*)**	**-24.69 (-0.83*)**	**-25.34 (-0.85*)**	**-26.41 (-0.82*)**
Grade 4	**-24 (-0.86*)**	**-26.64 (-0.94*)**	**-26.44 (-0.84*)**	**-24.33 (-0.82*)**	**-25.62 (-0.86*)**	**-25.19 (-0.78*)**	**-23.98 (-0.76*)**	**-23.3 (-0.71*)**	**-23.14 (-0.66*)**
No Majority									
Grade K	**-5.6 (-0.26*)**	**-6.3 (-0.29*)**	**-7.42 (-0.32*)**	**-7.31 (-0.32*)**	**-8.55 (-0.35*)**	**-9.48 (-0.36*)**	**-8.48 (-0.35*)**	**-9.7 (-0.39*)**	**-11.83 (-0.44*)**
Grade 1	**-6.43 (-0.28*)**	**-9.49 (-0.39*)**	**-10.08 (-0.39*)**	**-8.73 (-0.36*)**	**-10.82 (-0.43*)**	**-10.54 (-0.4*)**	**-8.41 (-0.33*)**	**-9.98 (-0.39*)**	**-11.24 (-0.39*)**
Grade 2	**-8.76 (-0.36*)**	**-11.48 (-0.46*)**	**-11.07 (-0.41*)**	**-8.38 (-0.33*)**	**-10.14 (-0.4*)**	**-10.36 (-0.36*)**	**-9.92 (-0.35*)**	**-11.26 (-0.4*)**	**-12.32 (-0.39*)**
Grade 3	**-8.13 (-0.32*)**	**-9.9 (-0.39*)**	**-9.8 (-0.34*)**	**-8.82 (-0.31*)**	**-10.73 (-0.38*)**	**-10.57 (-0.33*)**	**-9.3 (-0.31*)**	**-9.79 (-0.33*)**	**-9.54 (-0.3*)**
Grade 4	**-11.79 (-0.42*)**	**-13 (-0.46*)**	**-11.97 (-0.38*)**	**-9.62 (-0.32*)**	**-10.47 (-0.35*)**	**-9.57 (-0.3*)**	**-7.84 (-0.25*)**	**-7.52 (-0.23*)**	**-6.48 (-0.18*)**

Table A8. Differences in Historical and Post-COVID Scores (SDs) over Time in Mathematics by Cohort and Median Household Income Level

Cohort	2021-2022			2022-2023			2023-2024		
	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring
Less Than $50,000									
Grade K	**-13.5 (-0.62*)**	**-12.26 (-0.56*)**	**-13.42 (-0.58*)**	**-15.22 (-0.67*)**	**-16.38 (-0.68*)**	**-17.96 (-0.69*)**	**-18.2 (-0.75*)**	**-19.18 (-0.76*)**	**-21.27 (-0.8*)**
Grade 1	**-14.69 (-0.64*)**	**-16.77 (-0.69*)**	**-17.52 (-0.67*)**	**-17.37 (-0.71*)**	**-18.91 (-0.75*)**	**-19.04 (-0.71*)**	**-18.17 (-0.71*)**	**-19.18 (-0.75*)**	**-21.84 (-0.75*)**
Grade 2	**-17.69 (-0.73*)**	**-19.43 (-0.77*)**	**-19.07 (-0.71*)**	**-17.37 (-0.68*)**	**-19.14 (-0.75*)**	**-19.94 (-0.69*)**	**-20.57 (-0.73*)**	**-21.48 (-0.75*)**	**-23.5 (-0.74*)**
Grade 3	**-17.86 (-0.7*)**	**-19.39 (-0.76*)**	**-19.66 (-0.68*)**	**-19.59 (-0.7*)**	**-21.54 (-0.76*)**	**-21.81 (-0.69*)**	**-21.31 (-0.72*)**	**-21.65 (-0.73*)**	**-22.32 (-0.69*)**
Grade 4	**-21.06 (-0.75*)**	**-22.53 (-0.79*)**	**-22.06 (-0.7*)**	**-20.55 (-0.69*)**	**-21.24 (-0.72*)**	**-20.89 (-0.65*)**	**-20.39 (-0.65*)**	**-19.69 (-0.6*)**	**-19.23 (-0.55*)**
$50,000–$75,000									
Grade K	**-7.55 (-0.35*)**	**-7.28 (-0.33*)**	**-8.36 (-0.36*)**	**-9.06 (-0.4*)**	**-9.95 (-0.41*)**	**-11.12 (-0.43*)**	**-10.81 (-0.44*)**	**-11.83 (-0.47*)**	**-13.82 (-0.52*)**
Grade 1	**-8.75 (-0.38*)**	**-10.86 (-0.45*)**	**-11.43 (-0.44*)**	**-10.91 (-0.45*)**	**-12.55 (-0.5*)**	**-12.46 (-0.47*)**	**-11.05 (-0.43*)**	**-12.45 (-0.49*)**	**-14.07 (-0.48*)**
Grade 2	**-10.92 (-0.45*)**	**-12.91 (-0.51*)**	**-12.54 (-0.47*)**	**-10.57 (-0.41*)**	**-12.24 (-0.48*)**	**-12.74 (-0.44*)**	**-12.86 (-0.46*)**	**-13.97 (-0.49*)**	**-15.12 (-0.48*)**
Grade 3	**-10.62 (-0.42*)**	**-12.17 (-0.47*)**	**-12.27 (-0.42*)**	**-11.83 (-0.42*)**	**-13.59 (-0.48*)**	**-13.62 (-0.43*)**	**-12.85 (-0.43*)**	**-13.2 (-0.44*)**	**-13.07 (-0.41*)**
Grade 4	**-13.91 (-0.5*)**	**-15.02 (-0.53*)**	**-14.28 (-0.45*)**	**-12.57 (-0.42*)**	**-13.16 (-0.44*)**	**-12.52 (-0.39*)**	**-11.54 (-0.37*)**	**-10.87 (-0.33*)**	**-9.93 (-0.28*)**
More Than $75,000									
Grade K	-1.61 (-0.07)	-2.29 (-0.1)	**-3.31 (-0.14*)**	-2.91 (-0.13)	**-3.52 (-0.15*)**	**-4.27 (-0.16*)**	**-3.43 (-0.14*)**	**-4.48 (-0.18*)**	**-6.38 (-0.24*)**
Grade 1	-2.8 (-0.12)	**-4.94 (-0.2*)**	**-5.35 (-0.21*)**	**-4.44 (-0.18*)**	**-6.19 (-0.25*)**	**-5.88 (-0.22*)**	**-3.94 (-0.15*)**	**-5.72 (-0.22*)**	**-6.3 (-0.22*)**
Grade 2	**-4.16 (-0.17*)**	**-6.4 (-0.25*)**	**-6.02 (-0.23*)**	**-3.78 (-0.15*)**	**-5.34 (-0.21*)**	**-5.54 (-0.19*)**	**-5.15 (-0.18*)**	**-6.46 (-0.23*)**	**-6.74 (-0.21*)**
Grade 3	-3.38 (-0.13)	**-4.96 (-0.19*)**	**-4.88 (-0.17*)**	**-4.07 (-0.15*)**	**-5.64 (-0.2*)**	**-5.44 (-0.17*)**	**-4.38 (-0.15*)**	**-4.75 (-0.16*)**	-3.82 (-0.12)
Grade 4	**-6.76 (-0.24*)**	**-7.51 (-0.26*)**	**-6.49 (-0.21*)**	**-4.59 (-0.15*)**	**-5.08 (-0.17*)**	-4.16 (-0.13)	-2.69 (-0.09)	-2.04 (-0.06)	-0.63 (-0.02)

A9. Differences in Historical and Post-COVID Scores (SDs) over Time in Mathematics by Cohort and Locale

Cohort	2021-2022			2022-2023			2023-2024		
	Fall	Winter	Spring	Fall	Winter	Spring	Fall	Winter	Spring
Town/Rural									
Grade K	-6.8 (-0.31*)	-5.38 (-0.24*)	-6.31 (-0.27*)	-7.97 (-0.35*)	-7.85 (-0.32*)	-8.96 (-0.34*)	-9.67 (-0.4*)	-10.2 (-0.41*)	-11.8 (-0.44*)
Grade 1	-7.26 (-0.32*)	-8.06 (-0.33*)	-8.58 (-0.33*)	-9.29 (-0.38*)	-10.04 (-0.4*)	-10 (-0.37*)	-9.66 (-0.38*)	-10.79 (-0.42*)	-12.11 (-0.42*)
Grade 2	-8.83 (-0.36*)	-9.84 (-0.39*)	-9.49 (-0.36*)	-8.6 (-0.34*)	-9.86 (-0.38*)	-10.41 (-0.36*)	-11.07 (-0.39*)	-12.01 (-0.42*)	-12.52 (-0.4*)
Grade 3	-8.23 (-0.32*)	-9.39 (-0.37*)	-9.58 (-0.33*)	-9.75 (-0.35*)	-11.11 (-0.39*)	-11.18 (-0.35*)	-10.91 (-0.37*)	-11.31 (-0.38*)	-10.94 (-0.34*)
Grade 4	-11.09 (-0.4*)	-11.89 (-0.42*)	-11.31 (-0.36*)	-10.25 (-0.34*)	-10.64 (-0.36*)	-10.21 (-0.32*)	-9.84 (-0.31*)	-9.34 (-0.28*)	-8.17 (-0.23*)
City									
Grade K	-9.47 (-0.44*)	-9.9 (-0.45*)	-11.12 (-0.48*)	-11.51 (-0.5*)	-13.16 (-0.54*)	-14.34 (-0.55*)	-13.41 (-0.55*)	-14.88 (-0.59*)	-17.33 (-0.65*)
Grade 1	-11.12 (-0.49*)	-14.26 (-0.59*)	-14.98 (-0.58*)	-13.76 (-0.57*)	-15.96 (-0.64*)	-15.82 (-0.59*)	-13.81 (-0.54*)	-15.36 (-0.6*)	-17.55 (-0.6*)
Grade 2	-14.21 (-0.58*)	-17.03 (-0.68*)	-16.71 (-0.63*)	-14.09 (-0.55*)	-15.93 (-0.62*)	-16.32 (-0.56*)	-16.09 (-0.57*)	-17.3 (-0.61*)	-19.16 (-0.61*)
Grade 3	-14.17 (-0.56*)	-16.1 (-0.63*)	-16.2 (-0.56*)	-15.41 (-0.55*)	-17.36 (-0.61*)	-17.3 (-0.55*)	-16.17 (-0.54*)	-16.5 (-0.56*)	-17.02 (-0.53*)
Grade 4	-17.89 (-0.64*)	-19.35 (-0.68*)	-18.55 (-0.59*)	-16.39 (-0.55*)	-17.01 (-0.57*)	-16.34 (-0.51*)	-15.25 (-0.48*)	-14.42 (-0.44*)	-13.83 (-0.39*)
Suburban									
Grade K	-4.96 (-0.23*)	-5.35 (-0.24*)	-6.33 (-0.27*)	-6.26 (-0.27*)	-7.1 (-0.29*)	-8.02 (-0.31*)	-7.39 (-0.3*)	-8.38 (-0.33*)	-10.28 (-0.39*)
Grade 1	-6.08 (-0.27*)	-8.3 (-0.34*)	-8.7 (-0.33*)	-7.74 (-0.32*)	-9.58 (-0.38*)	-9.34 (-0.35*)	-7.49 (-0.29*)	-9.14 (-0.36*)	-10.07 (-0.35*)
Grade 2	-7.65 (-0.31*)	-9.8 (-0.39*)	-9.33 (-0.35*)	-7.08 (-0.28*)	-8.81 (-0.34*)	-9.17 (-0.32*)	-8.96 (-0.32*)	-10.22 (-0.36*)	-10.96 (-0.35*)
Grade 3	-7.26 (-0.28*)	-8.81 (-0.34*)	-8.74 (-0.3*)	-8.01 (-0.29*)	-9.76 (-0.34*)	-9.7 (-0.31*)	-8.76 (-0.29*)	-9.11 (-0.31*)	-8.33 (-0.26*)
Grade 4	-10.57 (-0.38*)	-11.44 (-0.4*)	-10.51 (-0.33*)	-8.65 (-0.29*)	-9.26 (-0.31*)	-8.39 (-0.26*)	-6.92 (-0.22*)	-6.25 (-0.19*)	-5.07 (-0.14*)