Learning during COVID-19: Reading and math achievement in the 2020-21 school year

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KEY FINDINGS

- On average, students across most grades (3-8) made reading and math gains in 2020-21.

- However, students' outcomes during the pandemic-affected school year were lower on multiple dimensions:

  - Students made gains during the 2020-21 school year at a lower rate compared to pre-pandemic trends, especially between winter and spring.

  - Students ended the year with lower achievement compared to a typical year, with larger declines relative to historical trends in math (8 to 12 percentile points) than in reading (3 to 6 percentile points).

- Achievement was lower for all student groups in 2020-21; however American Indian and Alaska Native (AIAN), Black, and Latinx students, as well as students in high-poverty schools were disproportionately impacted, particularly in the elementary grades we studied.

At the start of the 2020-21 school year, the COVID-19 pandemic continued to inflict massive disruptions on all aspects of daily life, presenting educators, students, and their families with enormous challenges, even as many schools began to reopen. Although the severity of these challenges varied across schools, districts, and states, the 2020-21 academic year was far from normal for everyone. Thus, a critical question is: to what extent did these disruptions affect students' achievement?

In December of 2020, the NWEA research team released a report[i] summarizing how students fared academically during the early phase of the COVID-19 pandemic, as measured by the NWEA MAP® Growth™ assessment. Our initial findings showed that impacts of the pandemic were concentrated in math: reading achievement in fall of 2020 was consistent with the prior year, but average math achievement was 5 to 10 percentile points lower than the previous fall.[1] We also found that, on average, students made gains during the early phase of the pandemic (between winter of 2020 right before initial school shutdowns and fall of 2020); however, math gains were smaller than pre-pandemic trends.

This brief continues our ongoing research agenda examining the impacts of COVID-19 on education outcomes. Here, we build upon our initial findings to examine students' academic progress one year into the pandemic. The shared goal of this brief and of our broader research agenda is to provide insight to education

Framing

We acknowledge that focusing on differences between race and ethnicity groups, as done in this report, may be seen as adopting a deficit-based perspective. This orientation can be problematic because it can perpetuate victim-blaming and fails to acknowledge academic strengths that are not reflected in standardized metrics. However, disaggregating outcomes by race and ethnicity can help highlight the extent of inequity. As we collectively begin the process of recovery, we must confront the highly inequitable pre-pandemic state of education in this country. This is the time, more than ever, to fundamentally reshape how opportunities and resources are allocated and deploy supports where they are most needed, now and into the future.[2]

leaders and policymakers so, as we work together toward recovery, we can use this critical moment in education to radically rethink how programs, policies, and opportunities are allocated and fiercely commit to distributing resources to communities most impacted by the pandemic.

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1 We use words such as "impact" and "effect" for simplicity, not to suggest causality. Our goal is not to identify the myriad factors that explain how the pandemic impacted achievement, but rather to document current achievement patterns relative to pre-pandemic trends.

2 For policy considerations and recommendations based on the findings, please see the accompanying brief[ii] prepared by the NWEA Policy and Advocacy team.

For this paper, we address two questions aimed at providing education leaders and policymakers with the evidence needed to best support students and schools. As school districts plan for post-pandemic recovery, they must identify which students have been most affected. Thus, we summarize overall trends in achievement in 2020-21 and examine to what extent these trends differ across groups (specifically, race/ethnicity at the student level and percentage of economic disadvantage amongst students at the school level).

Using data from 5.5 million students in grades 3-8 who took MAP Growth assessments in reading and math, we examined two primary research questions:

1. How do gains across the 2020-21 school year compare to pre-pandemic trends?

2. How does student achievement in spring of 2021 compare to pre-pandemic levels?

To contextualize 2020-21 relative to pre-pandemic trends, we use 2018-19 MAP Growth data as a benchmark.[3] The 2018-19 school year is the most appropriate pre-pandemic point of comparison given it is the most recent academic year that was unaffected by COVID-19.

Students made gains in 2020-21, but at a lower rate

To assess students' gains in 2020-21, we calculated mean RIT scores for the fall, winter, and spring of the 2020-21 school year and present them alongside mean test scores for the same test seasons in 2018-19. Figure 1 plots the means of third-, fifth-, and seventh-grade students for each test period (fall, winter, and spring), connecting them with a straight line to show average gains for each school year (2018-19 has a dotted line and 2020-21 has a solid line). We use these three grades to streamline the figure, but note that patterns are similar across all grades 3 to 8 (see technical appendix[iii] figures A1 and A2 for reading and math plots for grades 3-8). Comparing mean trajectories for 2020-21 to 2018-19, we see that, in aggregate, students made some gains (the solid lines show a general upward trajectory across the majority of grades and subject areas), but trajectories were diminished relative to a typical year (the solid and dotted lines are not parallel).

Figure 1 also shows that mean trajectories between fall and winter of the 2020-21 school year were more consistent with trajectories in the comparison year than were the winter-to-spring trajectories; in other words, the trajectories become more divergent over time, suggesting that gains stalled later in the year.

Using MAP Growth data to understand COVID-19 education impacts

MAP Growth is a computer adaptive test that is vertically scaled across grades K-12 and measures student achievement in reading and math on the RIT (Rasch unit) scale. Because the RIT scale is an equal-interval, cross-grade scale and the assessment adapts above and below grade level, RIT scores can be used to compare achievement across students and time—within an academic year and over multiple years. In addition, NWEA's nationally representative norms[iv] (which were calculated with a pre-pandemic sample of students) can be used to convert RIT scores to percentile rankings, which helps situate student performance relative to academic peers (for example, a third-grade student at the 40th percentile scored equal to or above 40% of other third-graders).

In this study, we used both students' RIT scores and their achievement percentile ranks in reading and math. We examined RIT scores across the 2020-21 school year to address our first research question about gains over the course of the year. For this analysis, we averaged RIT scores for a given term. By looking at differences in average RIT scores over the fall, winter, and spring testing seasons of 2020-21, we infer patterns of **"gains"** and can compare these to the 2018-19 baseline year.[4]

We examined percentile ranks to address our second research question about end-of-year achievement in reading and math. For this analysis, we compared spring percentiles for students in 2021 to the cohort of students who tested in spring of 2019. For simplicity, given in all grades and subjects we find that spring 2021 percentiles are lower than spring 2019 percentiles, we use **"decline"** to denote percentile rank differences between the two cohorts of students. Accordingly, these analyses describe cohort differences and not within-student change over time.

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3 We limited our sample of schools to a consistent set of US public schools that tested at least 10 students in a given grade in both 2018-19 and 2020-21. This restriction reduces the degree to which changes in the NWEA partner base may affect the results we observed. See the technical appendix[iii] for more details about the analytic samples.

4 More detailed analyses, currently underway, are necessary to examine within-student patterns of growth. We provide a simple estimate of student "gains" by measuring the average within-student RIT score change (gain = spring RIT – fall RIT) and report these numbers in the accompanying technical appendix[iii] in the final two columns of Table 4.

Figure 1. Mean MAP Growth RIT scores for selected grades in reading (top panel) and math (bottom panel)
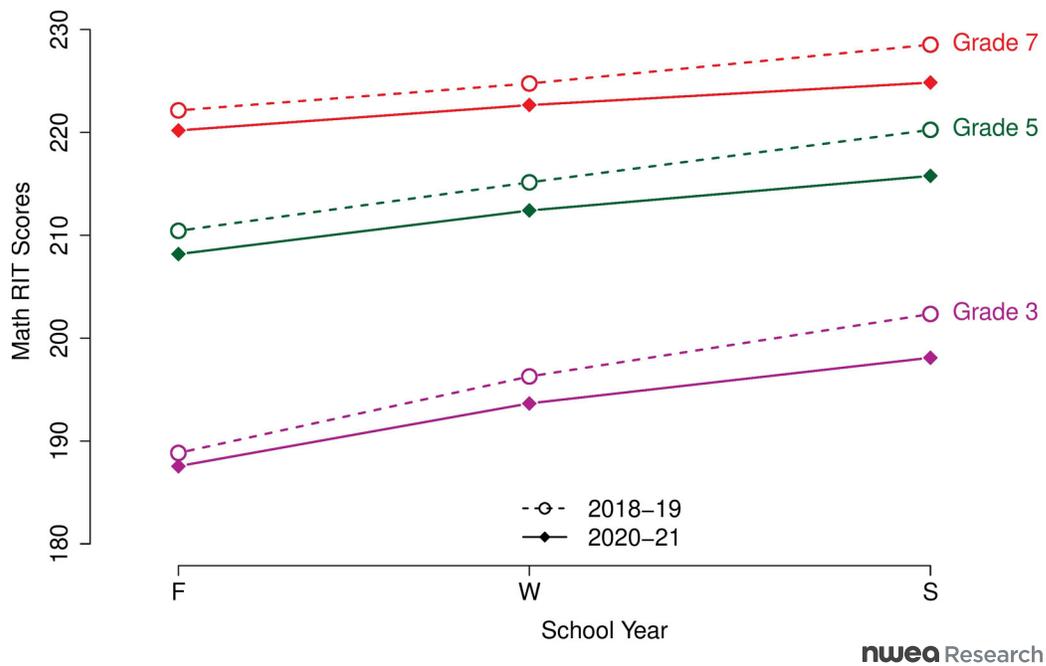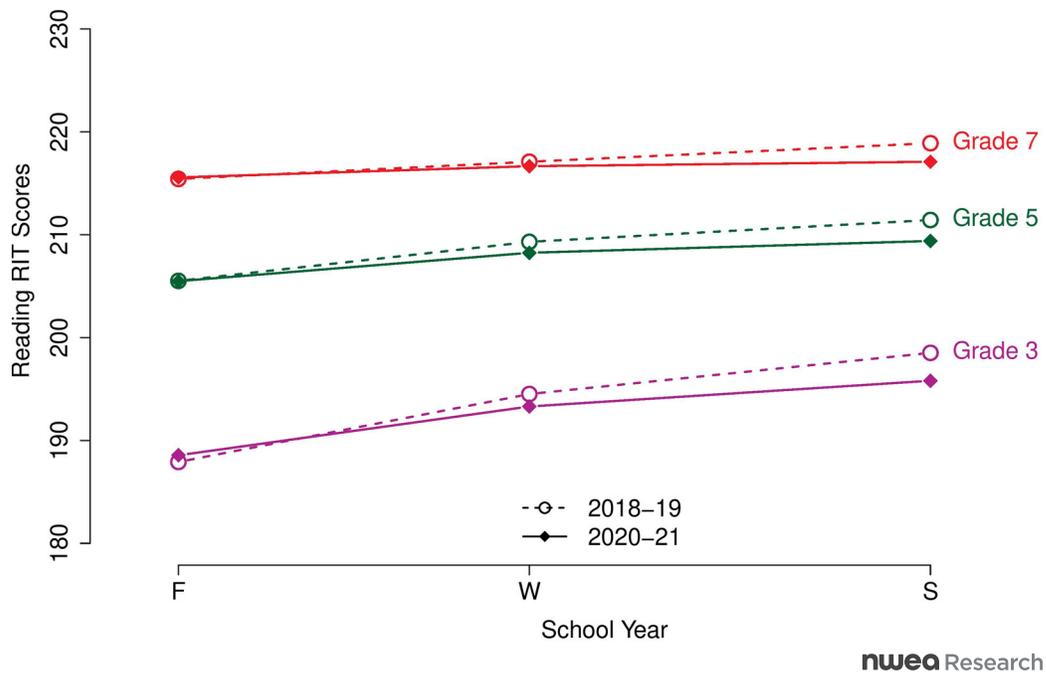
Note. For simplicity, these figures depict results for fall, winter, and spring in grades 3, 5, and 7 (non-depicted grades show similar trends). See technical appendix[iii] figures A1 and A2 for all grades.

Students' achievement at the end of the 2020-21 school year was lower compared to pre-pandemic levels, with larger declines in math

In addition to asking how students' gains over the 2020-21 school year compared to 2018-19, it is important to understand where students ended the school year in order to plan for what to expect when students return to the classroom in the fall of 2021. Accordingly, we examined spring 2021 achievement levels (based on NWEA 2020 MAP Growth norms[iv]) compared to spring 2019.

To summarize end-of-year achievement this year relative to a typical year, we calculated the median achievement percentiles for students in spring 2021 and spring 2019 as well as the difference in percentile rank between these years. Figure 2 displays the achievement levels of the pre-pandemic and pandemic cohorts, as well as the difference between the two, separately by grade level for reading (left panel) and math (right panel). To illustrate, in the spring of 2019, median math achievement for third-graders was at the 55th percentile, but in the spring of 2021, median math achievement was at the 43rd percentile, a difference of 12 percentile points.

In contrast to our previous findings, where students began fall 2020 with reading achievement roughly comparable to historical averages, we observe declines of between 3 to 6 percentile points in reading achievement in the spring of 2021 relative to pre-pandemic spring achievement levels. In math, students entered the 2020-21 school year achieving 5 to 10 percentile points lower than same-grade students in a pre-pandemic year. We find that the differences in math achievement relative to pre-pandemic trends have increased over the 2020-21 school year and students' average spring 2021 math achievement is now between 8 to 12 percentile points lower than a typical year.

Spring achievement declines were particularly evident for students in grades 3-5

Achievement was lower in math and reading for all grade levels, but slightly larger differences were observed in the earliest grade levels we examined, corresponding to the late elementary school period. The declines for third- to fifth-graders were larger in magnitude than those for older students by 1 to 3 percentile points in reading and 3 to 4 percentile points in math (see Figure 2).

Figure 2. MAP Growth percentile rank difference between same-grade students in spring 2019 (circles) and students in spring 2021 (arrows) in reading (left panel) and math (right panel)
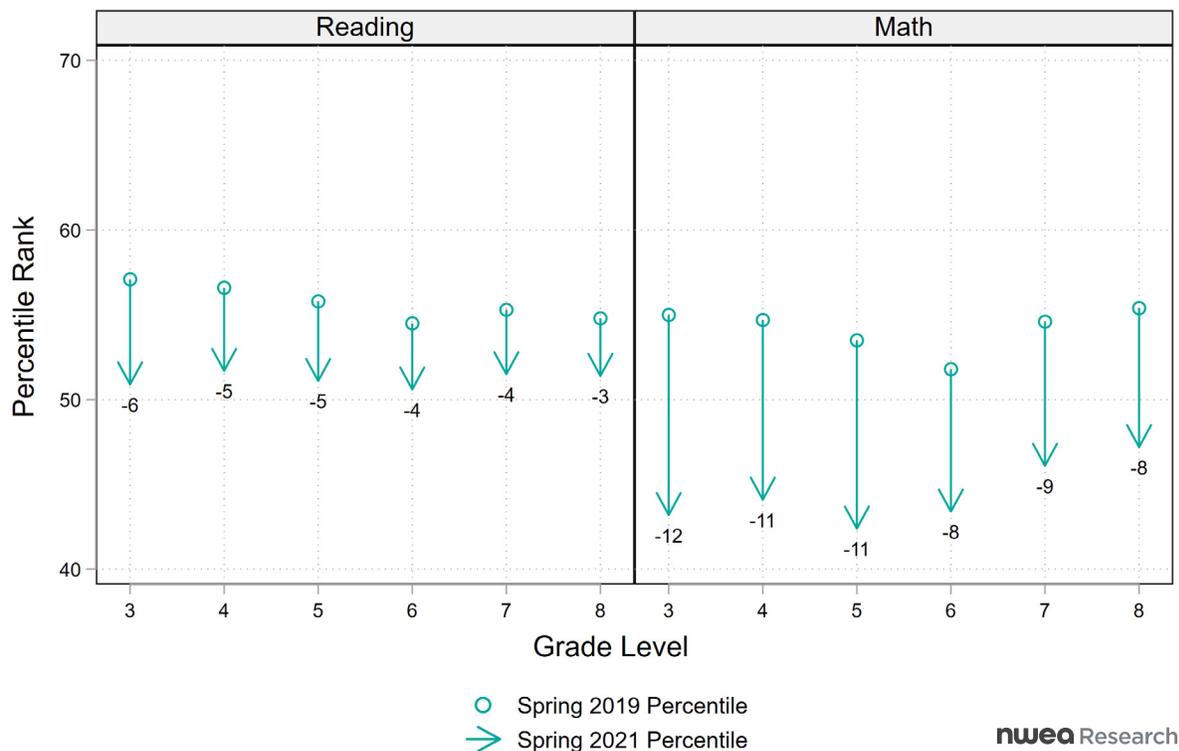
Note. The circles represent the median percentile rank for the pre-pandemic (spring 2019) cohort and the arrows represent the change in median student percentile rank for the spring 2021 cohort.

Remote testing

The majority of fall 2020 MAP Growth tests were administered remotely, but remote testing decreased over the course of the year (down to 54% of tests in the winter and 46% in the spring) as more schools returned to in-person instruction. We previously released evidence for comparability across testing modalities for students in grades 3-8 (see our comparability study[v]). For the purposes of this brief, we examined basic metrics of test quality across the 2020-21 school year and found a consistent pattern across test seasons (see technical appendix[iii] for more details) which further bolsters our confidence in the quality of remote test scores for the grades included in this analysis.

Historically marginalized and economically disadvantaged students had larger declines in math and reading relative to advantaged peers

In Figure 3 we show percentile rank changes disaggregated by student race/ethnicity. This allows us, for example, to situate the achievement of Asian American students in spring of 2021 relative to the achievement of a cohort of Asian American same-grade students in the spring of 2019.

Figure 3 shows that all student groups were impacted in reading and math. However, the magnitude of these differences was uneven across student groups. Asian American and white students showed declines of a smaller magnitude relative to overall averages and relative to other student groups; AIAN, Black, and Latinx students showed declines of a greater magnitude. The disproportionate size of these declines is particularly concerning given the differential spring 2019 achievement among these student groups. Put simply, the students who could least afford to lose ground relative to other students are those who were the most impacted, and especially so in math.

Similar to the overall trends noted above suggesting differences between older and younger students, the largest percentile differences were generally more concentrated in the late elementary school period.

Who is missing from our data?

One worry with our 2020-21 test data is whether it is reflective of all the students we serve. In the fall of 2020, we reported systematic patterns of missingness in our data showing that the demographic makeup of the current year's data is different from that of prior years because of higher rates of attrition for some student groups (see our attrition analysis brief[vi]). Unfortunately, we know that particular student populations were more likely to encounter learning barriers throughout the year and this may have prevented them from participating in testing.

To examine this in our data, we calculated attrition rates to measure the percentage of students who were tested in the prior year but were *not* tested in the current year. We found that the overall attrition rate in 2020-21 was about 20% (that is, about 1 in 5 students who tested in the prior year were missing from this year's assessment data). This rate is higher than normal (for instance, the overall attrition rate in 2018-19 was 13%), which is to be expected given the challenges of this past year. However, we see even higher attrition rates during 2020-21 for AIAN, Black, and Latinx students (ranging from roughly 22% to 25%) and for students who scored in the lowest achievement quintile in the 2019-20 fall test administration (roughly 22%).

There is more work to do to understand the implications of these patterns. However, for the results we present in this brief, the patterns of missing data may mean that we have overestimated academic achievement and gains in 2020-21 compared to prior school years. In other words, the true impacts of the pandemic on academic achievement this year may be even more pronounced than what we report. We present a more detailed look at the missing data patterns in our technical appendix.[iii]

Figure 3. MAP Growth percentile rank difference by cohort and race/ethnicity in reading (top panel) and math (bottom panel)
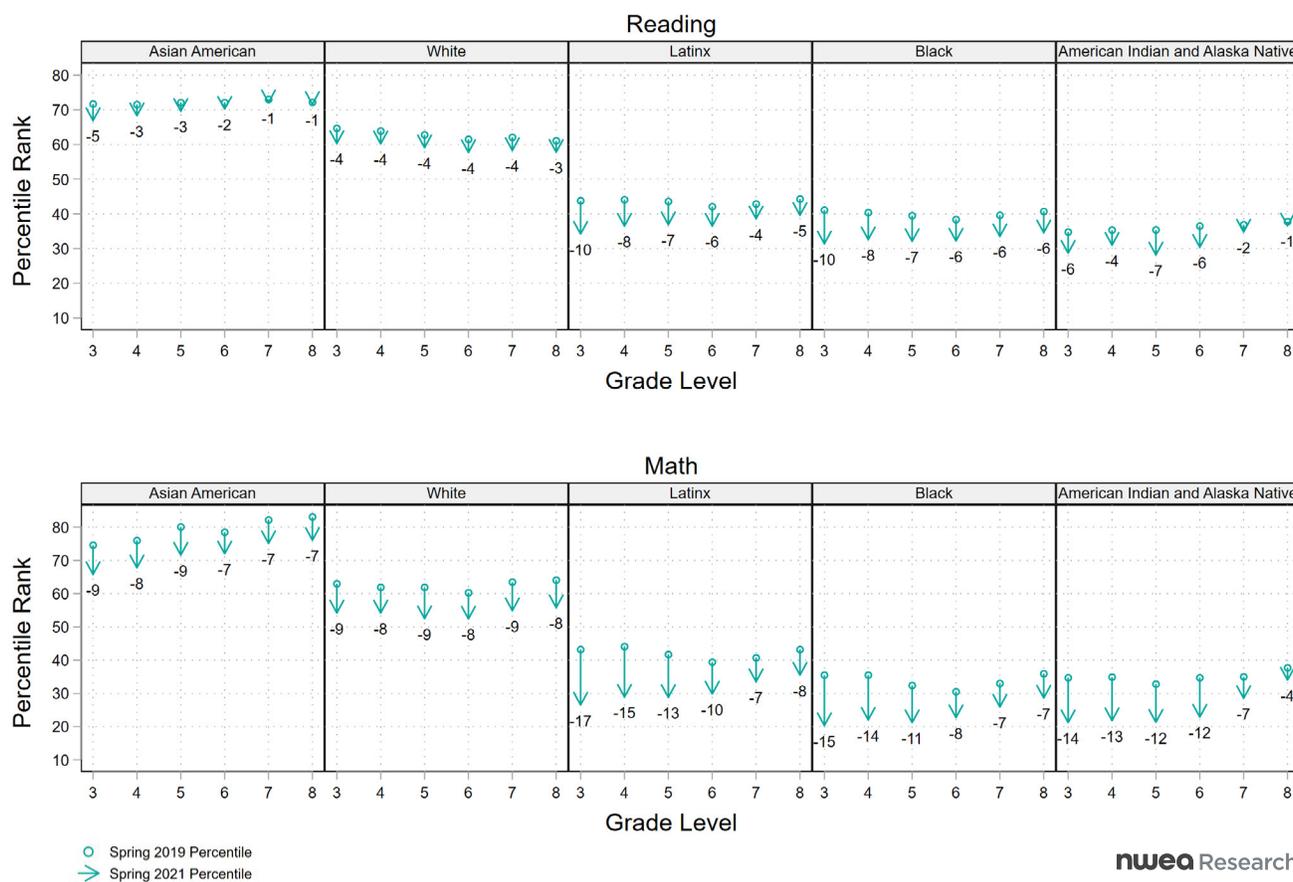
Note. The circles represent the median percentile rank for the pre-pandemic (spring 2019) cohort and the arrows represent the decline in median student percentile rank for the spring 2021 cohort.

In Figure 4 we show percentile rank changes by school poverty level.[5] Here we see that students in more economically disadvantaged schools were the most impacted by the pandemic. In many grades, students attending high-poverty schools showed more than double the declines of students attending low-poverty schools. This uneven pattern of declines occurred amidst already unequal starting status differences between students in high- versus low-poverty schools. Students in low-poverty schools in 2020-21 still achieve well above the national average, even with percentile point declines ranging from 6 to 9 percentile points. In contrast, the pre-pandemic cohort of students in high-poverty schools achieves well below national averages and the declines we see in the 2020-21 cohort have served to widen already significant achievement disparities between these two groups.

These results also show evidence of the trend highlighted above suggesting younger students were more impacted than older students. For instance, third-graders in high-poverty schools showed an 11 percentile point decline in reading and a 17 percentile point decline in math, whereas seventh-graders in high-poverty schools showed a 3 percentile point decline in reading and a 6 percentile point decline in math.

5 Data on school poverty comes from the Stanford Education Data Archive (SEDA).[vii] For simplicity, we present data for schools defined as low poverty (less than 25% of students receiving free- and reduced-price lunch) and high poverty (more than 75% of students receiving free- and reduced-price lunch).

Figure 4. MAP Growth percentile rank change by school poverty level in reading (upper panel) and math (lower panel).
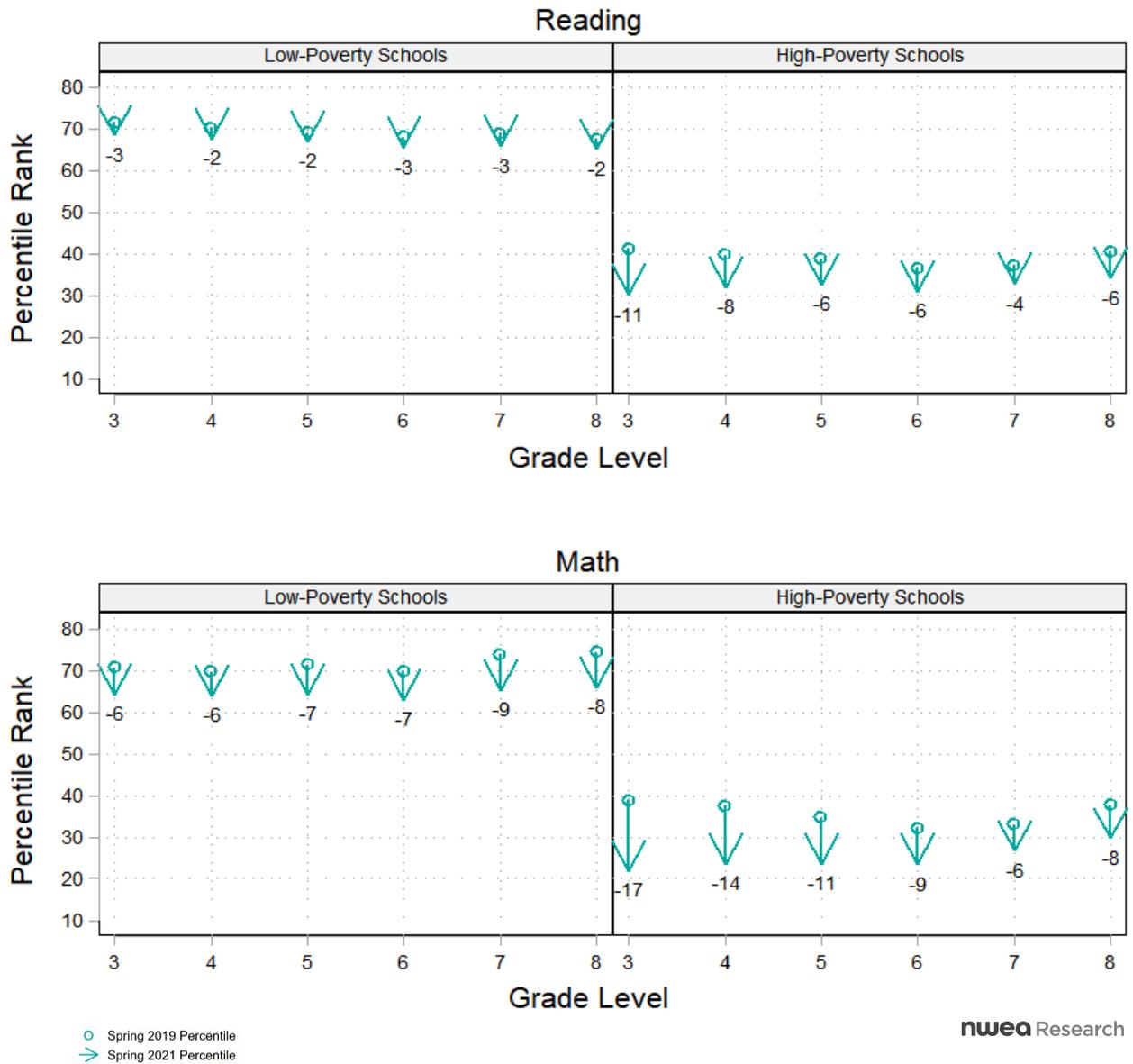
Note. The circles represent the median percentile rank for the pre-pandemic (spring 2019) cohort and the arrows represent the decline in median student percentile rank for the spring 2021 cohort.

Summary

Together, these findings suggest that students fared worse academically by the end of the 2020-21 school year compared to what we first reported in the fall. Reading achievement was a bright spot in the fall of 2020. However, we now see that reading achievement is no longer holding steady, but rather showing evidence of impacts, although these declines were not as dramatic as those in math. Math achievement was doubly impacted this year: students started the school year with lower achievement than prior years and made less than typical gains over the course of the year. As a result, spring 2021 math achievement fell even further behind historical trends—the difference of 5 to 10 percentile points in fall of 2020 widened to a difference of 8 to 12 percentile points in spring of 2021.

Early learning experts worried that younger students would be more severely impacted by disruptions to traditional instruction and the transition to online learning.[viii] Our data show some evidence in support of these concerns in that we see larger achievement impacts for the lower grades in our sample. These differences are small, but the trend is consistent across reading and math.

Overall, students made some gains in reading and math during the 2020-21 school year; however, these gains were lower relative to a typical year and the rate of average gains stalled more between winter and spring. Our data cannot explain the causes, but one possible explanation is increasing pandemic fatigue. A recent study from California's CORE districts[ix] found that students reported improvements to their online learning environment over the past academic year (which underscores the heroic efforts of educators to improve virtual instruction); but the continued strain of the pandemic took its toll on students and their families throughout the school year. One indicator of this is that students reported liking school less in the winter compared to the beginning of the year. This point is especially relevant given that schools began remote instruction in spring 2020, and by the end of winter 2021, many students had nearly a full academic year of remote schooling.

Finally, and most importantly, our findings help us understand where the education impacts of the pandemic have been most acute. As we summarized in a recent paper,[x] the pandemic has exacerbated longstanding educational inequalities for marginalized students: over the last year, students of color were less likely to be learning in person and more likely to encounter obstacles in accessing instruction compared to white students. The unequal impacts of the pandemic extend beyond education: communities of color were more likely to bear the economic and health consequences of the pandemic. The compounding toll of these burdens appears to be borne out in our findings. We report the largest achievement declines for AIAN, Black, and Latinx students, and for students attending high-poverty schools. These declines are of greater magnitude in math than reading and for younger students. Altogether, these results highlight that the COVID-19 pandemic impacted marginalized students more, and as a result, exacerbated pre-existing inequities in educational opportunities and outcomes.

Call to action

Academic achievement is only one dimension of students' education, and these data alone cannot paint a complete picture of how young people fared this past year. For instance, our results cannot speak to the many ways students, families, and teachers have shown incredible resiliency and adaptability in the face of immense challenges that completely upended normal life. We look forward to learning from these bright spots in the coming months.

In the meantime, our latest findings underscore that there is much work to be done on the path to recovery. As daily life increasingly returns to "normal," we must confront what this means in the context of education. As our findings show, even if recovery is swift and students return to pre-pandemic levels of achievement, significant inequities will persist. Thus, our collective call to action is clear: **next year cannot be a "normal" year.** We cannot return to the classroom and do things the same as they have always been done and expect to see a different outcome. Instead, we must use this critical moment in education to radically rethink how programs, policies, and opportunities are designed and fiercely commit to prioritizing the communities most impacted by the pandemic and distributing resources accordingly. We hope that our findings equip education leaders and policymakers with the evidence needed to do this and we look forward to being a partner in the hard work ahead.

References

i. Kuhfeld, M., Tarasawa, B., Johnson, A., Ruzek, E., & Lewis, K. (2020). Learning during COVID-19: Initial findings on students' reading and math achievement and growth. NWEA.

ii. Dworkin, L., & Carroll, K. (2021). Informing COVID-19 recovery: Insights from NWEA's MAP Growth assessment and policy recommendations. NWEA.

iii. Kuhfeld, M., Ruzek, E., Lewis, K., & McEachin, A. (2021). Technical appendix for: Learning during COVID-19: Reading and math achievement in the 2020-21 school year. NWEA.

iv. Thum, Y. M., & Kuhfeld, M. (2020). NWEA 2020 MAP Growth achievement status and growth norms for students and schools. NWEA Research Report. Portland, OR: NWEA.

v. Kuhfeld, M., Lewis, K., Meyer, P., & Tarasawa, B. (2020). Comparability analysis of remote and in-person MAP Growth testing in fall 2020. NWEA.

vi. Johnson, A. & Kuhfeld, M. (2020). Fall 2019 to fall 2020 MAP Growth attrition analysis. NWEA.

vii. Reardon, S. F., Ho, A. D., Shear, B. R., Fahle, E. M., Kalogrides, D., Jang, H., & Chavez, B. (2021). Stanford Education Data Archive (Version 4.0). Retrieved from http://purl.stanford.edu/db586ns4974.

viii. Levinson, M., Cevik, M., & Lipsitch, M. (2020). Reopening primary schools during the pandemic. New England Journal of Medicine 383:981-985.

ix. Wang, C., Pier, L., Meyer, R. H., & Webster, N. (2021). Student well-being and learning conditions during the pandemic: Evidence from the CORE districts [Report]. Policy Analysis for California Education. https://edpolicyinca.org/publications/student-well-being-and-learning-conditions-pandemic

x. Kuhfeld, M., Ruzek, E., Lewis, K., Soland, J., Johnson, A., Tarasawa, B, & Dworkin, L. (2021). Understanding the initial educational impacts of COVID-19 on communities of color. NWEA.

Details on the methodology behind these analyses can be found in:

Kuhfeld, M., Ruzek, E., Lewis, K., McEachin, A. (2021). Technical appendix for: Learning during COVID-19: Reading and math achievement in the 2020-21 school year. NWEA.

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ABOUT NWEA

For more than 40 years, NWEA® has been a pioneer in educational research and assessment methodology with a focus on improving learning outcomes for every student. NWEA continues this discovery through dedicated research that explores foundational issues in education, practical challenges in today's schools, and the evolving role of technology in the lives of students. As a mission-based not-for-profit educational research organization, NWEA's research agenda reflects our commitment to attacking big challenges in education and measurement and empowering education stakeholders with actionable insights.

ABOUT THE
CENTER FOR SCHOOL AND STUDENT PROGRESS

The Center for School and Student Progress (CSSP) engages directly with NWEA partner schools to influence education practices and policies that promote student success. The CSSP focuses on issues that impact the daily work of educators and the students they serve, such as achievement and growth patterns for traditionally underserved students, the integrity of testing systems, supporting college and career readiness, and school accountability. CSSP researchers also serve as consultative partners, offering advanced technical support, custom research projects, and analysis to school leadership, educators, and policymakers.

ABOUT THE
COLLABORATIVE FOR STUDENT GROWTH

The Collaborative for Student Growth at NWEA is devoted to transforming education research through advancements in assessment, growth measurement, and the availability of longitudinal data. The work of our researchers spans a range of educational measurement and policy issues including achievement gaps, assessment engagement, social-emotional learning, and innovations in how we measure student learning. Core to our mission is partnering with researchers from universities, think tanks, grant-funding agencies, and other stakeholders to expand the insights drawn from our student growth database—one of the most extensive in the world.

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