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Working Paper

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Upjohn Institute Working Paper, No. 23-385

Provided in Cooperation with:
W. E. Upjohn Institute for Employment Research, Kalamazoo, Mich.

Suggested Citation: Eberts, Randall W. (2023) : The effect of the COVID-19 pandemic on KPS student enrollment and NWEA test scores, Upjohn Institute Working Paper, No. 23-385, W.E. Upjohn Institute for Employment Research, Kalamazoo, MI, https://doi.org/10.17848/wp23-385

This Version is available at:
https://hdl.handle.net/10419/283979

7-12-2023

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July 2023

ABSTRACT

This report focuses on the COVID-19 pandemic in the Kalamazoo Public Schools District in Kalamazoo, Michigan, which closed its doors to students from mid-March 2020 to June 2021. During this time, instruction transitioned from face-to-face to virtual, with students having three options for virtual instruction. In addition to individual KPS student data, the study looks at the NWEA national sample as presented in several publications and technical appendices. The study addresses three basic questions, as well as examining students' race/ethnicity and poverty status, summer learning loss to determine the change in achievement gains, and attendance rates as an example of students not receiving face-to-face instruction. The first question asks whether the pandemic, which began in March of 2020, adversely affected student enrollment. The second question examines how achievement gains based on the NWEA math tests during the 2020–2021 pandemic school year compared to prepandemic and post-school-closure trends. The third question examines the variability of NWEA math test scores during the pandemic compared to the school years before and after the 2020–2021 pandemic school year. We find that student enrollment declined during and after the pandemic school year for at least two years, which is more than appears to be the case in all but the first few years of the century. In addressing the second question, we found that achievement gains rebounded after KPS schools opened, although achievement gains are not as high as in the prepandemic school year. It also appears that the lower grades were more resilient than the upper grades during this period. Regarding the third question, we found that test scores were more variable at the low end of the distribution than at the high end and that variability increased in the year following school closure.

JEL Classification Codes: I21: Analysis of Education, I24: Education and Inequality

Key Words: Education, students, NWEA tests, grades 3 through 8, COVID-19 pandemic

Acknowledgments: The author thanks the Kalamazoo Public Schools for the use of data critical to this study and the City of Kalamazoo for partial funding through a grant the city received from a generous citizen to support research assistants for this project.

The COVID-19 pandemic wreaked havoc on students at all grade levels. Because of health concerns, many schools were closed for extended periods of time, and students did not receive the same level of instruction as that to which they were accustomed. According to many educational researchers, students need face-to-face instruction from certified teachers. Students in the Kalamazoo Public Schools (KPS) district are no exception. However, their school year ended abruptly on March 16, 2020, when Gov. Whitmer announced that all schools would be closed until April 5 due to the COVID outbreak. On April 2, as the pandemic spread, the governor extended Michigan's school closures until the end of the regular school year. For nearly three months, students received instruction from home, with virtual learning through the Internet and with the help of their parents. According to the Institute of Education Sciences, part of the National Center for Education Statistics (IES 2022), 77 percent of public schools nationwide moved to online learning in the spring of 2020.

As COVID–19 became more widespread, KPS school administrators closed schools for the 2020–2021 school year. Before school began in the fall of 2020, KPS students had to choose one of three options: 1) they could follow a self-paced curriculum through an online platform that would help monitor their progress, 2) they could follow a more structured approach by meeting online with their teacher and class at specific times during the weekday, or 3) they could follow an approach similar to the first alternative but through the regional intermediate school district rather than their home district.[1] Regardless of the method chosen, instruction was delivered over the Internet, and most students did not receive the same amount of instructional time as they would have if they had been in class with their teachers.

[1] For the first option, the KPS administrators evaluated student progress at the end of each trimester to see if students were benefiting from such an approach. Each new trimester, after evaluation, administrators decided to continue with this option.

For this study, we define prepandemic years as those prior to 2020–2021, the school year in which KPS students were at home for the entire year rather than in school. The 2019–2020 school year is omitted because KPS did not administer the NWEA test in the spring,[2] as no one was in school during the last three months of the regular school year. The 2020–2021 school year, in which all KPS schools were closed, is considered the "pandemic year." The year after that, school year 2021–2022, is referred to as "the post-school-closure year," when all KPS schools reopened. At times, we include years prior to 2018–2019 to ensure that patterns in this prepandemic year extend to earlier prepandemic years.

Several studies have examined the impact of the pandemic on a national sample of students. For this study, we consider three national NWEA studies, as well as our analysis of KPS students.[3] The national studies are conducted by several NWEA staff members and draw from a sample of up to 8 million students from nearly 24,000 districts. As with the KPS study, the students are in grades 3–8, and all have taken the MAP (Measures of Academic Progress) Growth assessments in reading and math. According to the U.S. Department of Education, the 5.5 million students in one math sample represent nearly 24 percent of the nation's students in grades 3–8, and the 8.0 million students in another sample increase the representation to nearly 35 percent. All three studies examine at least three school years—the 2018–2019 prepandemic school year, the 2020–2021 pandemic year, and the 2021–2022 post-school-closure year. In addition, the three studies compare the test scores of students from different races/ethnicities, genders, and poverty status in grades 3–8, and are administered in the fall, winter, and spring.

[2] The organization that developed the tests, formerly known as the Northwest Education Association, is currently known by its abbreviation, NWEA.

[3] The three technical appendices of primary importance for this study are Kuhfeld and Lewis (2021), Kuhfeld and Lewis (2022b), and Kuhfeld, Langi, and Lewis (2022). The full citations are found in the references.

They highlight the test scores of third and seventh graders, as we do in the KPS study.[4] As a result, direct comparisons of NWEA test scores can be made between the studies.[5]

The focus of this study is on NWEA math test scores, but both math and reading test scores are reported in Appendix Tables A1 through A5 for various combinations of factors. Math test scores are considered more volatile than reading test scores, and many researchers contend that math test scores are more aligned with face-to-face instruction, while reading is as much a home-schooled product as it is a school-based one.[6] In addition to the background offered by the two articles cited in footnote 6, Kuhfeld, Soland, and Lewis (2022) find in a large national sample of students that average math test scores in the fall of 2021 in grades three through eight were 0.20–0.27 standard deviations greater than the average math test score in 2019. The studies show that the lack of school-based instruction led to lower test scores for many students, leaving a lasting impact on these students' academic performance. Although it is impossible to know exactly how much achievement was lost during the pandemic, it *is* possible to examine students' test scores before, during, and after the pandemic school year. NWEA test scores can be used to determine whether students are making progress or falling further behind. KPS administers NWEA tests in at least math and reading at all grade levels, although most KPS students take these two subject-matter tests in grades 3–9.

[4] The NWEA study encompasses third, fifth, and seventh graders, while for the sake of simplicity we highlight from the NWEA study and the KPS study only third and seventh graders. For KPS, third graders are in the middle of elementary school, and seventh graders are in the middle of middle school. Furthermore, we use only math test scores for KPS students, whereas the NWEA study uses both math and reading test scores. As seen in the NWEA study, math test scores provide a slightly greater difference in achievement gains during the prepandemic and pandemic school years.

[5] In addition, we list in the appendix the reading and math NWEA spring tests by race and ethnicity.

[6] See Halloran et al. (2021) and Thorn and Vincent-Lancrin (2021) for information about the home and school environments and their effects on math and reading test scores.

The national studies examine four primary research questions, which we replicate as much as possible for the KPS students. Differences in methodology between the national and KPS studies are noted where appropriate. The four questions are as follows:

1. How do gains in the 2020–2021 school year compare with prepandemic trends?
2. How does student achievement in the spring of 2021 compare with prepandemic levels?
3. To what extent have student reading and math test scores become more variable because of the COVID-19 pandemic?
4. How do achievement gains during the pandemic compare to prepandemic trends for students who were low or high achievers at the beginning of the pandemic?

The national studies examine some of these issues by student race/ethnicity and poverty status. By most measures, the pandemic lowered the test scores of many students, reduced their achievement gains, and increased the variability of spring test scores in the school year in which most schools were open. The essence of these three effects of the pandemic is that many students were disadvantaged, especially those at the lower end of the test-score distribution. This meant that students would have to work harder to raise their test scores in future grades to what they would have been had the pandemic not happened, and that those students at the lowest decile of the distribution would have to work even harder to achieve this goal. This is not to say that the pandemic created dire circumstances for all students, but it did for many. In addition, this scenario provides a picture of how teachers must prepare their students if achievement gains similar to those of the prepandemic years are to be made in future years.

One NWEA national study found that while most students had lower test scores in the 2020–2021 pandemic year, American Indian and Alaska Native, Black, and Latinx students, as well as students in high-poverty schools, were disproportionately impacted, particularly in the

elementary and middle schools studied.[7] The NWEA study also found that while students made achievement gains, the gains were smaller in the 2020–2021 pandemic year than in the 2018–2019 prepandemic school year. In addition, for both the KPS sample of students and the national sample, we found that achievement losses were smaller for students who initially scored high (in the 75th percentile and above in 2018–2019) on the NWEA tests, and that those who scored low (in the 25th percentile and below in 2018–2019) had a greater achievement loss, although all students scored lower in 2021–2022 than they had in 2018–2019. This low achievement has led some researchers and policymakers to argue that the pandemic has been particularly hard on low-achieving students, who have the most ground to make up.

The KPS analysis found patterns in NWEA test scores similar to the national NWEA study. Average NWEA math test scores for KPS students in grades 3 and 7 were lower in the pandemic year than in the prepandemic year. Black/African American and Hispanic students scored lower than White students in both the pandemic and prepandemic years. The achievement gains were smaller in the upper grades than in the lower grades. However, the achievement gains for each grade level were smaller in the pandemic year than in the prepandemic year.

This study also focuses on student enrollment for KPS students by asking how enrollment has changed since the pandemic. We find that in the prepandemic year, KPS enrollment in grades 3 through 8 stood at 6,331. At the end of the 2021–2022 school year, when schools were open for direct instruction, enrollment was at 5,647, a reduction of 10.8 percent. The study also examines enrollment by race/ethnicity.

Before addressing the four research questions listed earlier in this report and questions regarding KPS enrollment, we first review the principles behind the NWEA MAP Growth

[7]See Lewis et al. (2021) and the technical appendix coauthored by Kuhfeld et al. (2021).

assessments, including a brief description of the Rausch Interval Test, which is the basis for the MAP Growth assessments. Next, we construct hypothetical test scores at the beginning and end of the school year, recognizing the importance of these assessments for estimating summer learning loss. Third, we briefly consider ways other than a school closure in which a student may not receive face-to-face instruction from a certified teacher. Specifically, we consider school attendance and look at four measures included in the Community Data System—1) attendance rate, 2) days excused, 3) days unexcused, and 4) days present. Following this discussion and analysis of KPS student attendance, we address the four research questions in three sections. The first section combines the first two research questions, and the second and third sections address the third and fourth questions separately. In addressing these questions, we first list the analysis for KPS students and then follow that discussion with the findings from the NWEA national studies. In addition, the first question is followed by several sections that address student race/ethnicity, gender, and poverty status, as well as the statistical significance of achievement gains.

NWEA Test Scores

NWEA tests are not high-stakes tests of record. Rather, teachers use these computer-adaptive tests as a supplemental tool to help them improve instruction and meet student needs. As a result, as others have argued (e.g., Atteberry and McEachin 2020), the NWEA tests are considered good proxies for student achievement over time. In addition, the NWEA tests are based on the Rasch Interval Test (RIT), which allows one to compare a student's score at different points in his or her education. Each RIT score represents a point on a continuous scale of learning and should be interpreted as a measure of a student's academic achievement over time. The numerical score given to a student taking the NWEA test predicts that a student is

likely to answer approximately 50 percent of the questions correctly at that specific level of difficulty. This scale measures the value of a student's score relative to his or her score on previous tests. In addition, the test is scaled vertically to estimate growth over time. For example, KPS typically administers an NWEA test in the fall (near the beginning of the school year) and another in the spring (near the end of the school year). An individual student's educational growth can be measured as the spring test score minus the fall test score administered in the same school year.[8]

According to the RIT methodology and other researchers (Fitzpatrick, Grissmer, and Hastedt 2011), learning is approximately linear, which fits neatly with the RIT approach. Test scores are reported on the RIT (Rasch UnIT) scale, which is a linear transformation of the logit scale units from the Rasch item-response-theory model. The methodology to compute this percentage and to keep the score centered on the student is quite involved, and interested readers are referred to more comprehensive descriptions.[9]

Student Achievement Growth

MAP Growth assessments are computer-adaptive tests (CATs) designed to measure the academic success of K–12 students as they progress from grade to grade. According to another NWEA study, this one by Thum and Kuhfeld (2020)—which, among other things, describes the MAP Growth assessments—NWEA tests use rich student longitudinal data to better measure student growth."[10] The CAT contains items that are administered to match the student's ability

[8] Although NWEA tests are not given on the first day and last day of the school year, some studies have calculated the test scores of students on those days by assuming that learning growth is approximately linear. See Atteberry and McEachin (2020) for an example of this approach.

[9] See Thum and Kuhfeld (2020). Every few years, the NWEA organization puts out new norms for their tests. The publication listed in this citation is the latest.

[10] See the explanation on p. 11 of Thum and Kuhfeld (2020) of how the NWEA tests measure the difficulty of test items and the ability of students to answer those items.

level. The NWEA tests measure the growth in achievement of each individual student. Using RIT, the NWEA tests do not require percentile mapping to understand students' levels from one year to the next. Rather, the test scores provide an accurate representation of student achievement growth over a school year and between school years. In the RIT scale norming study, developed and reported by NWEA (2011, p. 26), the authors argue that "we measure achievement status and not growth. Growth is an inference, a result that is based solely on an acceptable descriptive model of change in achievement status over time."

The main principle followed by the developers of the NWEA tests recognizes that growth measurement hinges on a strong description of how the scores of individual students change over time. Changes in NWEA test scores are based on the well-established relationship between student achievement and student exposure to instruction. Standard statistical manipulations of multivariate normal distributions can be used to derive norms for achievement at different points in time according to when a test is administered. Furthermore, growth comparisons based on cross-sectional data are no longer adequate for making inferences about learning growth at the student level. Rather, longitudinal data are needed to make these comparisons.

Construction of Test Scores at the Beginning and End of the School Year

We begin with an example of using the fall and spring NWEA tests to determine the length of summer breaks. We know that summer begins when the school year ends, and summer ends when the next school year begins. However, NWEA tests are administered on days that are neither the first nor the last day of the school year. Nationally, the NWEA fall test is typically given 26 days after school begins, and the spring test is given 39 days before the last day of school.[11]

[11] In the online supplement to their paper, Atteberry and McEachin (2020) state that, on average, "students take the fall test about 26 days after the first day of school and the spring test 39 days before the last day of school (p. 4)." We then take these two numbers and extrapolate the additional days of summer recess for a KPS student.

By using the typical test dates instead of the days that mark the beginning and end of the school year, 65 days could be added to the summer break. Adding 65 days to the existing 82 days of summer vacation for KPS students in 2020 increases the number of days during the summer by nearly 80 percent. The extended summer is misleading when trying to measure the amount of time a student receives instruction, which obviously extends beyond the dates of the two tests.

The formula for calculating NWEA test scores at the beginning and end of the school year assumes that learning is linear.[12] Therefore, we first calculate the number of days between the start of the school year and the fall test.[13] Since KPS administers the NWEA tests on different days each year, we calculate the number of days between the day the test is administered and the beginning of each school year. We then calculate the number of days between the fall test and the spring test and divide the number of days by the difference in test scores between the fall and spring NWEA math tests. Knowing the daily test-score change between the fall test and spring test, we can estimate the hypothetical test score at the beginning of the school year by multiplying the daily test-score change by the number of days from the beginning of the school year to the date of the fall test. The same procedure is used for the end of the school year.

Table 1 shows the calculated difference between the average NWEA math test score for the beginning and end of the school year. The table also shows the average test scores on the days the fall and spring tests were taken. Three different school years are shown in the table: a prepandemic year (school year 2018–2019), the pandemic year (school year 2020–2021), and the

[12] The exact method we use to extend the fall test score to the beginning of the year and the spring test score to the end of the school year is described in fuller detail in a subsequent section. Atteberry and McEachin (2020) apply rigorous methodologies to nearly 20 million student tests developed by NWEA across eight grades. The database used in the article is the largest so far to examine the summer learning loss (SLL). Atteberry and McEachin document the full spread of SLL and demonstrate how SLL contributes to the distribution of eight spring test scores.

[13] Weekends are included for the sake of simplicity, even though students do not go to school during that time.

post-school-closure year 2021–2022. It is worth noting that most students during school year 2020–2021 were at home using virtual instruction. We show two grades in the table: third and seventh grades.[14]

Table 1 Average KPS NWEA Math Test Scores, Calculated at Beginning and End of School Year

Grade	3rd			7th		
School year	2018–2019	2020–2021	2021–2022	2018–2019	2020–2021	2021–2022
Fall math test	185.35	185.16	177.67	215.56	218.37	209.82
Spring math test	200.21	192.09	192.93	225.51	222.83	218.20
Beginning-of-school test (SD)	185.20	184.30	176.63	215.49	217.85	209.42
End-of-school test (ED)	201.31	192.80	194.30	226.11	223.31	219.06
Spring test – Fall test	14.86	6.93	15.26	9.95	4.46	8.38
$ED_t - SD_t$	16.11	8.50	17.67	10.62	5.47	9.64
Observations	945	752	845	848	562	762

NOTE: The fall math-test entry and the spring math-test entry represent the average NWEA math-test score for KPS students on the days in which that student actually took the test. The beginning-of-school-year test and end-of-school-year test are the calculated average scores on the NWEA math test for the day the school year began and the day it ended, based on a linear change in test scores as described in the body of the report.
SOURCE: Author's calculation of Community Data System.

Because of the construction of the NWEA math test scores at the beginning and end of the school year, one would expect the average test score at the beginning of the school year to be slightly lower than the fall test score of the same year. One would also expect the end-of-year test score to be higher than the spring test score. Table 1 shows the fall and spring math test scores and the calculated test scores at the beginning and end of the year. Because students spend time in instruction before the fall test and after the spring test, we would expect the difference between the actual test scores and the calculated test scores to be small. The average NWEA math test score is lower at the beginning of the school year than when students took the fall test. The opposite is true for the spring test score compared to the average year-end score.

[14] For KPS, students in third grade are in elementary school, and students in seventh grade are in middle school.

Student Learning Loss and Student Cohorts

Table 2 extends Table 1 to show test scores by student cohort. A student cohort in this case is defined as being made up of the same students in two grades in subsequent years. For example, for third graders in the 2017–2018 school year, we examine the test scores of the same individuals the following year as fourth graders. We note that test scores in the 2017–2018 year, a prepandemic year, were similar to the 2018–2019 scores. The pandemic school year is 2020–2021. To match the same students, but in fourth grade, we examine test scores in the 2021–2022 school year. We do the same thing for seventh graders.

It is important to look at the test scores of the same students when calculating summer learning loss. Otherwise, the results will be contaminated by the scores of students who leave KPS during the summer or who enter the next grade at the beginning of the next school year. We define summer learning loss as the difference between the test score at the beginning of the next school year (SD_{t+1}) and the test score at the end of the previous school year (ED_t). For third graders, it is the summer between third and fourth grade; for seventh graders, it is the summer between seventh and eighth grade. Because of the difference between the beginning- and end-of-the-school-year test scores and the fall and spring test scores, the summer learning loss also varies if one or the other type of score is used. The difference ranges from 1.2 to 1.6 test points, with summer learning loss based on the fall and spring test scores being smaller in absolute value than that based on the beginning and ending scores.

In addition, the absolute value of the summer learning loss in the year before the pandemic is slightly higher for the lower grades than for the upper grades (−5.3 for the summer between grades 3 and 4 compared to −4.9 between grades 7 and 8). The difference in test scores between the two school years is 0.8 for grades 3 and 4 and 0.9 for grades 7 and 8.

From the data in Table 2, it is also possible to calculate the year-to-year achievement gain. Using the calculated scores, one can subtract the score at the beginning of the school year in grade 4 from the score at the beginning of the school year in grade 3. Further subtracting the summer learning loss from this amount yields the change in achievement from the beginning of the school year (in the fall) to the end of the school year (in the late spring). For the third- and fourth-grade cohort in the 2018–2019 school year, we calculate the full-year-achievement gain to be 10.7 and the summer learning loss to be −5.3. Because the full-year-achievement gain includes the summer learning loss, we add the summer learning loss back into the full-year gain to get the difference in achievement gain from the end of the school year to the beginning. The result is 16.0 (10.7 + 5.3). The same can be done as well for seventh and eighth graders for the two years. Both move in the same direction—decreasing the amount of summer learning loss. For third graders, the summer learning loss is reduced from 5.3 to 4.5, and for seventh graders, it declines from 4.9 to 4.0.

Table 2 Average KPS NWEA Math Test Scores at Beginning and End of the School Year, by Student Cohort Pairs

Student cohort	Same		Same		Same		Same	
Grade	3rd	4th	3rd	4th	7th	8th	7th	8th
School year	17–18	18–19	20–21	21–22	17–18	18–19	20–21	21–22
Fall math test	185.4	195.8	185.8	189.8	215.2	222.1	219.5	220.8
Spring math test	199.5	208.3	192.9	201.9	225.8	231.3	224.1	229.1
Beginning-of-school-year test	184.9	195.6	184.9	189.1	215.1	222.0	219.0	220.6
End-of-school-year test	200.9	209.1	193.6	203.1	226.9	232.1	224.6	229.8
Spring test – Fall test	14.1	12.5	7.1	12.1	10.6	9.2	4.6	8.3
End-of-year test – Beginning-of-year test	16.0	13.5	8.7	14.0	11.8	10.1	5.6	9.2
$SD_{t+1}–SD_t$	10.7		4.2		6.9		1.6	
$F_{t+1}–F_t$	10.4		4.0		6.9		1.3	
SLL: ($SD_t–ED_{t-1}$)		–5.3		–4.5		–4.9		–4.0
Observations	864	864	668	668	821	821	491	491

NOTE: The term $SD_{t+1}–SD_t$ represents average math test-score gains for the entire school year, whereas the term SLL ($SD_t–ED_{t-1}$) is the summer learning loss during the summer between third and fourth grades and the one between seventh and eighth grades.
SOURCE: Author's calculation of the Community Data System.

In summary, in contrast to the large differences in achievement gains from the beginning to the end of the school year, summer learning loss is much smaller. As shown in Table 2, it can vary by as much as three times the difference in scores from the end of the year to the beginning of the year, or as little as 7.2 percent of the calculated score difference. Unlike the change in achievement gains from the prepandemic to the pandemic periods, summer learning loss changes very little for these two grades. For the two grades shown in Table 2, the difference is less than one test point.

Attendance Rates and NWEA Test Scores

Another way that classroom instruction gets reduced is for students to be absent from school for longer than usual. In this section, we examine the effect of absenteeism on NWEA test scores. We use the spring math test score because it is measured near the end of the school year and attendance is cumulative over the entire school year. Consistent with the other sections of this study, we use the 2018–2019 school year as the prepandemic year. We do not have more recent school years to draw on, because 2019–2020 and 2020–2021 were not typical years, as schools were essentially closed from March to the end of the year in the first year, and students were not in school at all in the second year.[15]

To ensure that we are looking at the full range of attendance rates and not just those that are at one extreme or the other, we divide attendance rates into five categories. The attendance categories range from less than 85 percent of school days to perfect attendance of 100 percent. In grades 3 and 7, 5.4 and 6.1 percent of students, respectively, had 100 percent attendance, while

[15] The lack of attendance rates beyond the 2018–2019 school year means that it is not possible to determine whether the pandemic had an impact on attendance rates. The reduced number of students taking the NWEA tests in the 2020–2021 school year seems to indicate that attendance and absenteeism could be a factor, but without attendance rates for the pandemic year and the following year, it is not possible to determine by how much.

9.7 percent of third graders and 17.6 percent of seventh graders attended school less than 85 percent of the time.

To determine whether absenteeism affects test scores, we first look at the effect of attendance rates on NWEA math test scores. We examine the full range of attendance rates by dividing them into five categories, which are then regressed on the test-score measure. In each case, Table 4 shows that attendance rates have a statistically significant effect on test scores. We find a positive and statistically significant effect of the variable measuring attendance on test scores, as shown in Table 4. In this table, we also show the effect of attendance-rate categories on test scores by regressing test scores on attendance rates within each category. However, when test scores are regressed on attendance rates within each of the five categories, we find that only the regression within category 3 for third graders (which represents being in school between 95 and 98 percent of the time) is statistically significant. None of the categories in which test scores are regressed on the continuous attendance-rate variable for seventh graders is statistically significant. Table 3 presents the different attendance rates by race and ethnicity. We see that Black students have the highest percentage of students with an attendance rate of less than 85 percent. Hispanic students have the lowest percentage at that rate. Black students have the highest percentage of perfect attendance, while White students have the highest percentage in the category of attendance between 98 percent and above.

The Community Data System (CDS) includes two measures of attendance and two measures of absences. Attendance is measured by the number of days enrolled or present in the classroom. For each student, the number of days enrolled is greater than the number of days present, because of the construction of the variables. With respect to absences, the CDS includes two variables that capture this side of attendance—excused and unexcused absences. Excused

Table 3 Attendance Rates by Race/Ethnicity for Third and Seventh Grade KPS Students, 2018–2019

	Third graders				Seventh graders			
% students	Black/ Af American	Hispanic	White	% total students	Black/ Af American	Hispanic	White	% total students
Attendance rate < 0.85	57.3%	9.7%	12.6%	9.7%	58.3%	9.7%	16.6%	17.6%
Rate ≥ 0.85 & < 0.90	56.5	11.3	20.9	10.8	52.4	16.2	21.1	10.6
Rate ≥ 0.90 & < 0.95	39.2	12.2.	34.2	20.8	36.1	14.8	34.8	23.2
Rate ≥ 0.95 & < 0.98	36.7	13.1	35.8	29.4	29.9	9.2	44.1	26.3
Rate ≥ 0.98 & < 1.0	32.9	15.7	40.4	24.0	37.9	14.9	39.1	16.2
Rate = 1.0	38.6	21.1	31.6	5.4	32.8	16.4	34.4	6.1
Total students	432	143	346	1,065	399	126	330	993

NOTE: The row labeled "Total students" does not add up to the total number of students because it includes other racial/ethnic categories, such as the one for "Asian, Native American, and Pacific Islander." Another included category is "Two or more races," which is not in the tables. This is the largest racial/ethnic category, with up to 128 students. Because some Black/African American students are included in the "Two or more races" category, the Black/African American student category may show fewer students than it actually has.
SOURCE: Author's calculations of Community Data System.

Table 4 Regression of Test Scores on Attendance Rates for KPS Third and Seventh Graders, 2018–2019

	Third grade				Seventh grade			
	Categorical variables		Attendance rate (within each category)		Categorical variables		Attendance rate (within each category)	
	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value	Coeff.	*t*-value
Attendance (continuous)			78.7	9.83			105.2	12.83
Categories								
0			6.37	0.26			4.8	0.18
1	4.32	1.48	31.44	0.55	8.42	2.86	32.5	0.65
2	10.0	3.54	60.6	0.72	20.05	7.19	152.05	1.54
3	15.8	5.72	346.6	3.40	26.39	9.63	136.6	0.89
4	17.3	6.24	−76.9	−0.57	29.63	10.64	156.0	0.76

NOTE: The first two columns for third graders labeled "Coefficient" and "*t*-value" report the difference between the test-score value for that category and the omitted value of category 0, which is the intercept term. The next two columns report the coefficient and *t*-value for the effect of the continuous variable measuring attendance rate on test scores for the 2018–2019 school year. The attendance rate is continuous across the entire spectrum of values and then for the values within each of the five categories. Seventh graders follow the same sequence of values. Because attendance rates are cumulative for the school year, the spring NWEA math test score is used.
SOURCE: Author's calculations of the Community Data System.

absences indicate the number of days a student is absent, with the absence reported to the school by the parent or guardian. Unexcused absences also indicate the number of days a student is absent, but the absence is not reported to the school by the parent or guardian. When absences are subtracted from the total number of instructional days in a school year, we arrive at the number of days a student receives instruction in that year. According to the teachers, a major problem with absenteeism is its chronic nature. From year to year, there are certain students who

are absent much more often than others. We begin by looking at absences during a single year and then move on to students who have many absences over a three-year period.

Table 5 shows the results for various attendance variables by the three prepandemic years and by grade level.[16] All variables are statistically significant with the expected signs. "Unexcused absence" has the largest coefficient and is greater than the coefficient for "Excused absence." As shown in the first few rows of Table 5, the means of unexcused absences are larger than those of excused absences. Similarly, the number of days enrolled is greater than the number of days present in class. In most cases, the days recorded under the four variables are larger for seventh graders than for third graders. The regression results for seventh graders reflect the larger means.

Table 5 Regression Results for KPS Test Scores on Measures of Attendance, by Year and Grade

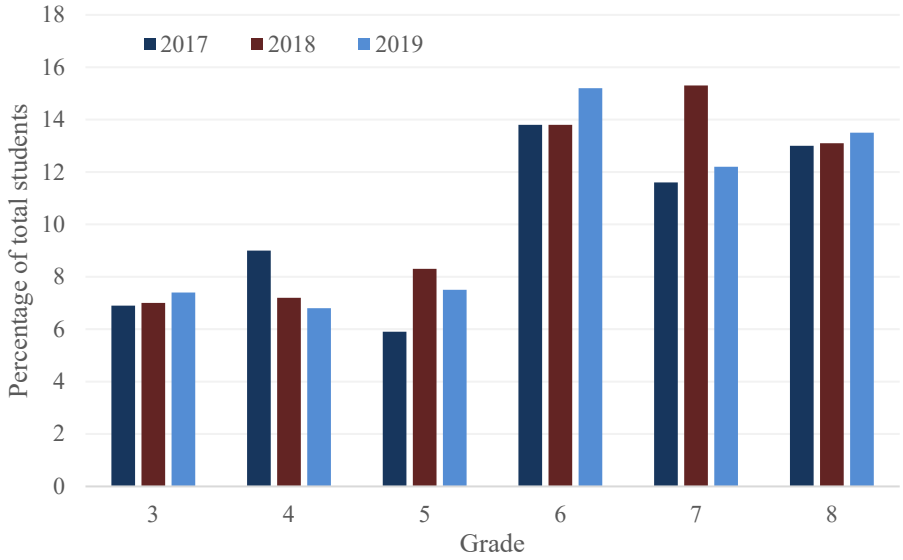
	Means (days)					
	3rd grade			7th grade		
	2016–2017	2017–2018	2018–2019	2016–2017	2017–2018	2018–2019
Enrolled	160.7	161.9	157.0	163.2	161.5	156.7
Present	150.4	152.4	147.5	150.3	147.9	143.8
Unexcused absence	7.0	5.9	6.1	7.0	7.3	6.9
Excused absence	3.3	3.6	3.4	5.9	6.3	5.9
	Coefficients/*t*-statistics					
	3rd grade			7th grade		
Enrolled	0.11	0.07	0.17	0.19	0.17	0.29
	(4.13)	(2.80)	(6.34)	(3.85)	(5.37)	(8.14)
Present	0.17	0.13	0.23	0.35	0.28	0.38
	(6.80)	(6.04)	(10.18)	(9.62)	(10.76)	(13.67)
Unexcused absence	–0.50	–0.68	–0.59	–0.80	–0.77	–0.86
	(–7.2)	(–10.59)	(–9.64)	(–9.70)	(–11.58)	(–11.78)
Excused absence	–0.24	–0.05	–0.35	–0.66	–0.51	–0.58
	(–2.04)	(–0.46)	(–2.96)	(–6.29)	(–5.67)	(–5.48)

NOTE: The top four rows under the heading "Means" include the means of the various measures of attendance by grade and school year. The regressions are run individually on each of the four attendance variables. *t*-values at the 95 percent confidence level are included under the regression coefficients in parentheses.
SOURCE: Authors' calculations of the Community Data System.

[16]Examining attendance variables during and after the pandemic school year would provide a misleading perspective. Because all KPS schools were closed during the 2020–2021 school year and most students were receiving virtual instruction, it is not useful to track attendance during this time. In addition, many students gradually returned to school during the year following the pandemic school year, 2021–2022, which also makes it difficult to get an accurate picture.

For the absenteeism rate, we look at students who were in attendance for less than 85 percent of the school year. Figure 1 shows the percentage of students who were absent for this unusually large number of days for each of the three prepandemic years. We find that the number of KPS students who were in class less than 85 percent of the year is similar across the three prepandemic years. There appears to be a fairly large increase in the percentage (and number) of students with unusually high absences after elementary school, which for KPS students ends after fifth grade.

Figure 1 Percentage of KPS Students with Attendance Rates Less Than 85 Percent, by Year and Grade



NOTE: Missing values of students not taking the spring NWEA math test are deleted.
SOURCE: Author's calculations of Community Data System.

Thus, the large increase begins in middle school, either because absences are taken more seriously or because teachers are more diligent about keeping records.

To account for the chronic nature of attendance rates, we look at four cohorts of students. The number of students in these cohorts is smaller than the single-year numbers because the cohorts are constructed to include only students who remain in KPS for three years. It is also possible that those students who leave the district during the three-year period may have higher

absenteeism rates than those who remain in the district. Table 6 shows that the percentage of students in the cohort is much higher than the percentage of students with high absenteeism rates. For example, in the 2018–2019 school year, we find that the total number of students in the third-grade cohort is 73.4 percent of the total number of students for the single year, while the total number of students in the cohort who are present for less than 85 percent of the year is only 23.0 percent of the total number of students for the single-year results. Taken together, we find that the percentage of students with high absenteeism is less than one-third of the percentage of students in the cohort compared to those in the single year. The same relationship is found for

Table 6 Attendance and NWEA Math Test Scores by Year, Grade, and Cohort

	Single-year results					
	Grade 3			Grade 7		
	2016–2017	2017–2018	2018–2019	2016–2017	2017–2018	2018–2019
No. of students w/ less than 85% of days present	61 (6.9%)	70 (7.0%)	74 (7.4%)	100 (11.6%)	149 (15.3%)	109 (12.2%)
Total no. students	886	992	996	860	976	892
NWEA math w/ less than 85% attendance	191.1	189.5	188.3	208.2	209.6	206.9
NWEA math w/ greater than or equal to 85 % attendance	202.0	199.6	200.4	224.2	226.8	227.0
	Three-year cohorts					
	Grade 3,4,5			Grades 7,8,9		
No. of students w/ less than 85% attendance	17	15	17	42	37	22
Total no. students	740	744	731	687	695	584
NWEA math w/ less than 85% attendance	189.3	193.4	196.3	206.4	214.7	212.1
NWEA math w/ greater than or equal to 85% attendance	203.0	211.4	217.7	226.9	233.5	231.1
	Grades 2,3,4			Grades 6,7,8		
No. of students w/ less than 85% attendance	17	19	18	61	56	41
Total no. students	775	771	768	741	740	704
NWEA math w/ less than 85% attendance	179.0	189.3	200.6	198.0	205.5	210.8
NWEA math w/ greater than or equal to 85% attendance	189.8	200.6	209.3	220.9	228.7	234.1

NOTE: The first row under "Single-year results" shows the number and percentage of students who attended less than 85 percent of the school year. The second row shows the total number of students in that grade for that year. The third row shows the NWEA spring math test score when the attendance rate is less than 85 percent of the school year (A = 0). The next two sets of test scores are shown for cohorts of students to get a better sense of the chronic attendance rate for some students. We look at three grades. For example, we consider third, fourth, and fifth grades for the first cohort to see how many students who have attended all three grades in KPS also have an attendance rate of less than 85 percent for each of the three years. SOURCE: Author's calculations of Community Data System.

seventh graders, and the ratio of the two percentages is slightly less than a third for both third and seventh graders.

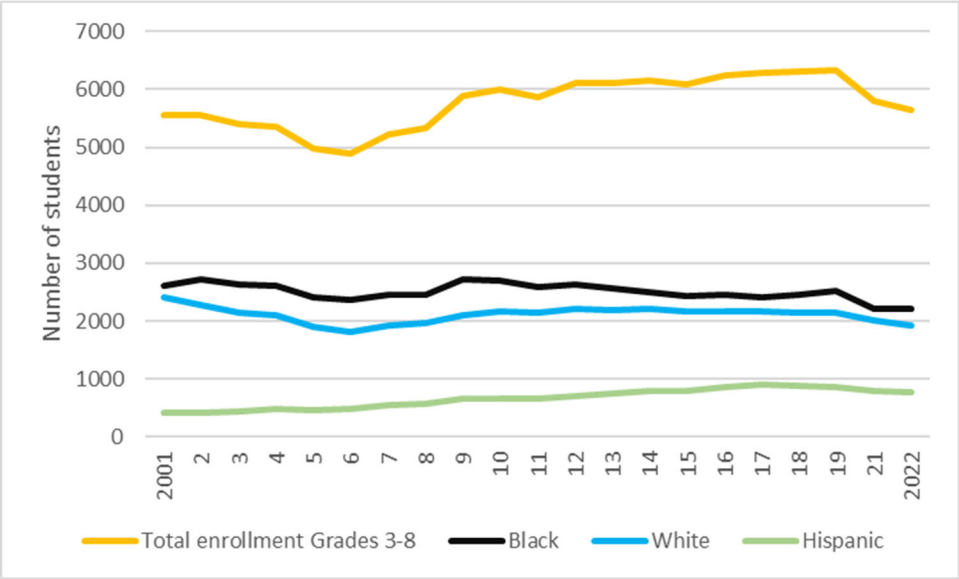
DID KPS ATTENDANCE INCREASE IN THE YEAR FOLLOWING SCHOOL CLOSURE?

This section focuses on attendance of KPS students for the three years before, during, and after the pandemic year, and the next section examines NWEA math test taking. Both sections are related to enrollment. They also examine KPS students by different racial and ethnic groups and for selected years. Enrollment in grades 3 through 8 during the prepandemic school year was 6,331 students. This represents the highest student enrollment for grades 3 through 8 since the turn of the century. However, enrollment declined during both the pandemic school year and the following school year. Enrollment declined by 540 students in the first year, then by another 144 students in the second year. The two-year decline left the district with 5,647 students in those two grades, a reduction of 684 students, or 10.8 percent. This is the first time since the inception of the Kalamazoo Promise in 2005 that enrollment has declined for two consecutive years. KPS had been in a steady decline for several decades prior to the Kalamazoo Promise.[17]

Figure 2 shows that Black/African American students dominate the various racial/ethnic groups. Since the turn of the century, Black/African American students have outnumbered White students. Yet Black/African American students in grades 3 through 8 have experienced a 15.3 percent decline in enrollment, while White students have experienced an even greater decline in enrollment of 20.1 percent. Different racial/ethnic groups have different enrollment experiences.

[17] The Kalamazoo Promise was established in November 2005 as a scholarship for KPS graduates to attend any public college or university in Michigan. Please see Bartik, Eberts, and Huang (2010) for an analysis of KPS enrollment trends before and after the Kalamazoo Promise and for a description of the scholarship program.

Figure 2 KPS Enrollment in Grades 3 through 8 by Race/Ethnicity since 2001



NOTE: KPS enrollment in grades 3 through 8 from the turn of the century onward. The year 2020 is skipped on the x-axis scale because the school year ended abruptly that March due to the outbreak of COVID-19. The Kalamazoo Promise was announced in November 2005, and students in school year 2006–2007 became eligible for the scholarship. The scholarship is based on a sliding scale depending on the grade at which a student enters Kalamazoo Public Schools and lives within its borders. The Promise pays for the tuition and fees at any of the public colleges and universities, community colleges, and eligible apprenticeships and skilled trades programs in Michigan. Later on, select private liberal arts colleges in Michigan were added to the list of Michigan postsecondary institutions.
SOURCE: Author's calculations of Community Data System.

The enrollment of Black/African American students peaked in 2009 and fluctuated for several years until their enrollment dropped by 300 students during the pandemic year. The school year that followed saw a slight increase of nine students. The most recent peak in White student enrollment occurred in 2012. As with their Black/African American peers, their numbers bounced around before losing 120 students during the pandemic year and another 102 students the following year. While the enrollment of Black/African American students appears to be leveling off, White students continue to leave the district. Hispanic students followed the same pattern as White students, showing a decline of 60 students during the pandemic year and another 30 the following school year.

Number of Students Taking the NWEA Math Test, for Selected Years

The number of students taking the NWEA math test dropped dramatically during the year that schools were closed. In the prepandemic school year (2018–2019), 5,472 students attended KPS in grades 3 through 8 and took the NWEA math test. In 2020–2021, when schools were closed, 4,130 students took the NWEA math test, presumably at home, and the next year (2021–2022), when schools were open and students were back in the classroom, 144 fewer students were enrolled, but 598 additional students took the math test. Black/African American students accounted for the largest increase in test taking, with 388 additional students taking the test. Hispanic students and White students registered far fewer additional test takers—75 and 60, respectively. In the school year following the school closure (2021–2022), 4,728 students took the test out of the 5,647 students enrolled in the six grades, a percentage of 84 percent, which is above the average since KPS started to administer the NWEA test in 2014.

As difficult as it may have been to stay enrolled in KPS during the pandemic, it appears to have been even more difficult to take the NWEA math test. Table 7 shows the number of students who were enrolled but did not take the NWEA math test. The district adopted the NWEA tests in 2014, and it took a few years for most students to take the tests. The largest number of recent students who did not take the test was reached during the pandemic, when 1,661 KPS students, or 28.6 percent of those enrolled, did not take the math test. Of the 2,211

Table 7 Number of KPS Students in Attendance Who Did Not Take the NWEA Math Test, by Race and Ethnicity, for Selected Years

	Black/African American		Hispanic		White		Total
	Number	% enrolled students	Number	% enrolled students	Number	% enrolled students	
2018–2019	435	17.3	85	9.9	220	10.3	859
2020–2021	835	37.8	212	26.5	382	18.9	1661
2021–2022	456	20.5	107	13.9	220	11.5	919

NOTE: Information about enrollment comes from KPS records. The number taking the NWEA math test is measured by the variable for the test score not equal to a missing value. The number not taking the test is the enrollment minus those taking the test. The total in the last column is the number of students who have not taken the NWEA math test but are enrolled.
SOURCE: Author's analysis of Community Data System.

Black/African American students who were enrolled in KPS, 37.8 percent did not take the math test. For White students, 18.9 percent did not take the math test. Hispanic students who did not take the test represent 26.5 percent of enrolled Hispanic students.

HOW DO ACHIEVEMENT GAINS IN THE PANDEMIC 2020–2021 SCHOOL YEAR COMPARE TO PREPANDEMIC AND POST-SCHOOL-CLOSURE TRENDS?

KPS Sample

Table 8 presents the average fall and spring NWEA math test scores for third and seventh graders before the pandemic, during the pandemic, and in the year after the pandemic, when KPS reopened schools.[18] Figures 3 and 4 present these test scores as achievement gains, with each panel representing one grade. Each line connects the fall and spring NWEA math test scores and represents approximately one school year. Because the number of days between the fall and spring tests for KPS students is approximately the same for each student each year, the slope of

Table 8 Math Test Scores and Gains of NWEA Study Compared with KPS Study by Grade and Year

		NWEA study				KPS study			
	School year	Obs.	Fall	Spring	Gain	Obs.	Fall	Spring	Gain
3rd grade	2018–2019	>580,000	188.8	202.3	13.5	932	185.3	200.2	14.9
	2020–2021	>462,000	187.6	198.1	10.5	749	185.2	192.1	6.9
	2021–2022	>810,000	188.6	201.9	13.3	845	177.6	192.9	15.3
7th grade	2018–2019	>518,000	222.1	228.5	6.4	844	215.6	225.5	9.9
	2020–2021	>408,000	220.2	224.8	4.6	562	218.4	222.8	4.4
	2021–2022	>710,000	217.4	223.7	6.3	762	209.9	218.2	8.3

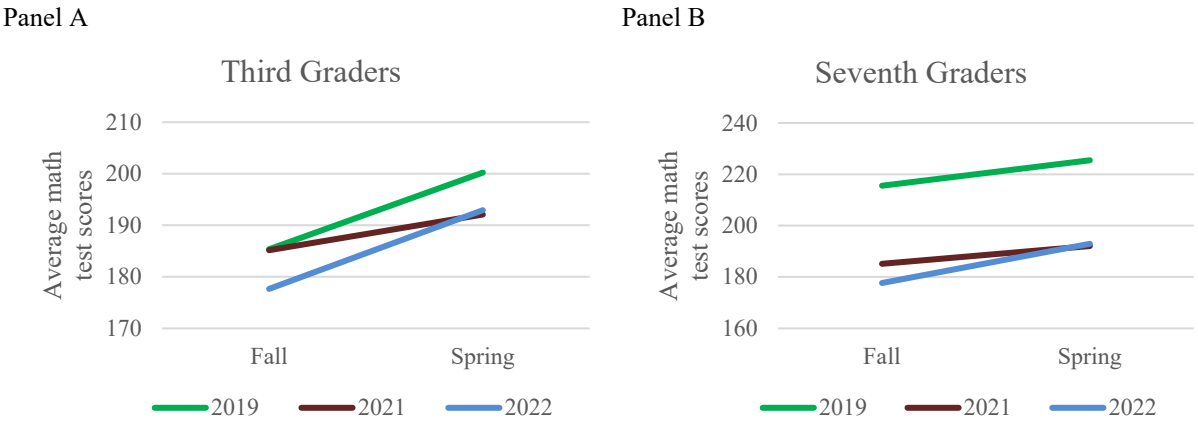
NOTE: The table shows that average math scores on the NWEA tests for third and seventh graders for the NWEA studies and the KPS study for the school years 2018–2019 (prepandemic year), 2020–2021 (pandemic year) and 2021–2022 (post-school-closure year).
SOURCE: Author's analysis of Community Data System, Kuhfeld et al. (2021), and Kuhfeld, Langi, and Lewis (2022). The later citation is the technical report for the article by Lewis et al. (2022).

[18]Because the NWEA study did not adjust students' NWEA math test scores for the beginning and the end of the school year, we use fall and spring test scores for both studies. In addition, as in the NWEA study, we do not use cohorts of students for the remainder of this study. We use only 3rd and 7th graders, each from a single year. However, the NWEA study reflects a diversity of schools from different locations (urban, suburban, rural, and town), rather than just one district as in the KPS study. In addition, because the NWEA national sample is more representative of the nation's school districts, it reflects a slightly higher percentage of White students and a slightly lower percentage of students eligible for the free and reduced-price lunch (FRPL) program.

the line represents the gain in achievement from the time of the fall test to the time of the spring test.

Thus, four trends hold for the three years shown in Figure 3: 1) the achievement gain for both third and seventh graders during the pandemic is lower than in the prepandemic school year (the dark line is less steep than the blue line), 2) the achievement gain for both grades after the pandemic year is greater than during the pandemic year, 3) the achievement gain in the school year after the pandemic year is about the same as the achievement gain in the prepandemic year, and 4) the achievement gain for third graders is greater than for seventh graders for all three years.[19]

Figure 3 NWEA Math Test Scores for KPS Students by Year



NOTE: The data for these two panels are from Table 1 in this report.
SOURCE: Author's calculations of the Community Data System.

National Sample

The NWEA national sample shows similar trends:

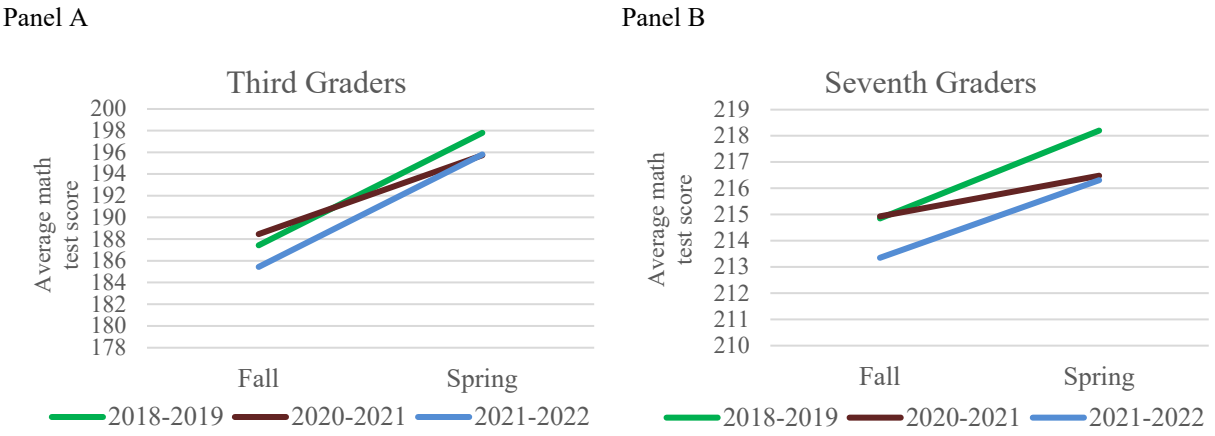
- The achievement gain during the pandemic is lower than in the prepandemic school year.

[19] It should be noted that we are comparing achievement gains from the prepandemic to the post-school-closure school years. Here, achievement gains are measured as the difference between the average fall and spring test scores for both third and seventh graders, not as a percentage difference.

- The achievement gain after the pandemic year is greater than during the pandemic year.
- The achievement gain in the school year after the pandemic year is about the same as the achievement gain in the prepandemic year for both third and seventh graders.
- The achievement gain for third graders is greater than for seventh graders.

In addition, we see in Figure 4 that the average NWEA math test scores and achievement gains for third graders are approximately back to where they were the year before the pandemic, but seventh graders are not as resilient. NWEA math test scores for seventh graders are still lower after the pandemic than before. Third graders appear to recover more quickly than seventh graders, as average NWEA math achievement gains are lower for seventh graders than for third graders.

Figure 4 NWEA Math Test Scores for Students from the National Sample by Year



SOURCE: Kuhfeld et al. (2021) and Kuhfeld and Lewis (2022a).

Comparing Figure 4 with Figure 3, we see that the average math-test scores for the KPS sample are lower than for the national sample on both the fall and spring tests for each year. These lower test scores for KPS students mean that these students score lower than the average national student on both the fall and spring tests. The next section discusses some of the factors that may explain these differences.

Separate Categories of Race/Ethnicity, Gender, and Poverty Status

KPS sample

The lower average math test scores for KPS students noted in the previous section may be due in part to their race/ethnicity, gender, and/or poverty status.[20] We take the conventional approach of presenting each category of students separately, which allows for direct comparisons with the NWEA national samples. Before examining the achievement gains of the three categories, however, we look at the characteristics of the two student samples. Table 9 shows the percentages of Black/African American students, Hispanic students, and White students in the KPS and national student samples. The KPS population of third and seventh graders includes more Black/African American students than any other racial and ethnic group in the prepandemic year and significantly more than the national sample. Black/African American students in KPS represent 39.5 percent of third-grade students and 38.2 percent of seventh-grade students in 2018–2019. The pandemic school year shows a marked decrease in the percentage of Black/African American students. Black/African American students represented 34.2 percent of third graders and 30.6 percent of seventh graders in the pandemic year, 2020–2021. In the next school year, 2021–2022, Black/African American students regained some but not all of their prepandemic levels: they increased their share of third graders to 37.5 percent and their share of seventh graders to 36.1 percent. White students, on the other hand, accounted for a higher percentage of students after the pandemic than before, rising from 33.5 percent before to 36.1 percent afterward for third graders and from 34.3 percent before to 38.1 percent afterward for seventh graders.

[20]Poverty status is measured by a student's eligibility for the free and reduced-price lunch (FRPL) program.

Table 9 Percentage of Black, Hispanic, and White Students in the KPS Sample and in the NWEA National Sample for Students in Third and Seventh Grade Who Took the NWEA Math Test in School Years 2018–2019, 2020–2021, and 2021–2022

	KPS		National NWEA study	
Grade	3rd grade	7th grade	3rd grade	7th grade
2018–2019				
Black/African Americans	39.5	38.2	16.0	15.1
Hispanics	13.1	13.6	18.3	17.7
Whites	33.5	34.3	48.6	50.8
2020–2021				
Black/African Americans	34.2	30.6	15.8	15.2
Hispanics	12.2	16.4	18.9	18.7
Whites	39.1	42.2	48.6	50.2
2021–2022				
Black/African Americans	37.5	36.1	15.0	15.0
Hispanics	13.0	13.1	19.0	19.0
Whites	36.1	38.1	49.0	49.0

NOTE: As with the studies using the national sample, we count only those students who have taken the NWEA math test in third and seventh grades.
SOURCE: Author's calculations of Community Data System, Table 2, in Kuhfeld et al. (2021), and Table 1 in Kuhfeld, Langi, and Lewis (2022).

National sample

Table 9 also shows the percentage of students from the three most prevalent racial/ethnic groups for the NWEA national sample. Notably, Black/African American students represent slightly less than half of the share of KPS students in all years. Only in the pandemic school year do Black/African American students make up more than half of all students. In the national sample, White students dominate, while in the KPS sample their share is less than that of Black/African American students. The table shows that the share of Hispanic students is higher in the national sample than in the KPS sample. We see that for the three race/ethnicity groups, the third-grade achievement gain is higher than the seventh-grade achievement gain for the prepandemic school year and the pandemic school year.

Tables 10 and 11 show the same categories of racial/ethnic groups for the prepandemic and pandemic school years; the first table displays the NWEA math test scores for KPS students, and the second table looks at the scores for the NWEA national sample. Unfortunately, it was not

possible to construct achievement gains from the national sample for the 2021–2022 school year. In the first two years, Black/African American third graders in KPS lagged behind their racial group in the national sample. In contrast, White students performed better in the KPS sample than they did in the national sample, in both grades and years, except for the spring test of the pandemic year. While the KPS fall math test results fell for third graders in the last year shown, the spring test results picked up somewhat in that same year. KPS Hispanic third graders did worse on average in the NWEA math test than did students in the national sample. The only period for which they showed a higher average test score was in the spring of 2018–2019. However, the achievement gains for the KPS sample were lower than for the national sample only for third graders in the pandemic year; for the other testing periods, in both grades and years, the achievement gains for KPS were higher than for the national sample.

Table 10 NWEA Math Test Scores for Race/Ethnicity by Year and Grade for KPS Students

	3rd grade			7th grade		
Students by category	Fall	Spring	Gain	Fall	Spring	Gain
2018–2019						
Black/African Americans	178.0	193.0	15.0	207.3	216.8	9.5
Hispanics	184.4	199.7	15.3	212.9	221.9	9.0
Whites	193.9	208.7	14.8	226.3	236.6	10.3
2020–2021						
Black/African Americans	177.5	183.1	5.6	210.0	213.2	3.2
Hispanics	181.7	186.1	4.4	214.0	218.0	4.0
Whites	192.3	200.9	8.6	225.4	231.4	6.0
2021–2022						
Blacks/African Americans	168.2	182.6	14.4	200.2	207.8	7.6
Hispanics	174.5	189.4	14.9	206.8	215.5	8.7
Whites	187.9	203.8	15.9	219.0	228.1	9.1

NOTE: Achievement gain is calculated differently from the NWEA study. Instead of using statistical means, achievement gain for the KPS study is calculated by taking the difference between the spring and fall test scores.

SOURCE: Author's computation using Community Data System.

Table 11 NWEA Math Test Scores for Race/Ethnicity by Year and Grade for the NWEA National Sample

	3rd grade			7th grade		
Students by category:	Fall	Spring	Gain	Fall	Spring	Gain
2018–2019						
Black/African Americans	182.9	195.3	12.4	212.8	218.3	5.5
Hispanics	184.6	198.1	13.7	216.4	221.9	5.5
Whites	191.6	205.5	13.9	225.9	232.7	6.8
2020–2021						
Black/African Americans	182.5	189.5	7.0	212.0	215.0	3.0
Hispanics	183.5	192.2	8.7	214.7	218.6	3.9
Whites	189.7	202.2	12.5	223.3	228.8	5.5

NOTE: The Technical Appendix uses statistical means to calculate the difference in the two test scores, which leads to slightly different results.
SOURCE: Kuhfeld et al. (2021).

Interactions of race/ethnicity, gender, and poverty status for KPS students

We examine students' race and ethnicity as it interacts with their gender and poverty status. For example, we show the NWEA math scores for female students who are eligible for free and reduced-price lunch for three groups of students: Black/African American students, Hispanic students, and White students. Table 12 shows these interactions for the KPS sample, but the same interactions are not available for the national sample. For the KPS sample, the average fall math tests for Black/African American female students in poverty in 2018–2019 for grades 3 and 7 had scores of 179.1 and 208.0, and the average spring test scores for these groups were 193.4 and 216.4.

For students in poverty, achievement gains were higher in the lower grades than they were in the upper grades. For example, achievement gains for Black/African American male and female students in poverty were higher for third graders than for seventh graders. The same was true for Hispanic and White male and female students in poverty. However, students out of poverty followed an erratic pattern, with higher achievement gains in some years and testing periods, and lower gains in others.

Table 12 Average Scores of KPS NWEA Math Tests by Race, Ethnicity, Gender, and Poverty Status

	Third grade			Seventh grade		
Panel A: 2018–2019	Fall	Spring	Gain	Fall	Spring	Gain
Males in poverty						
Black/African Americans	176.5	191.8	15.3	206.5	216.3	9.8
Hispanics	180.1	196.0	15.9	211.6	220.9	9.3
Whites	190.4	204.3	13.9	218.7	230.0	11.3
Females in poverty						
Black/African Americans	179.1	193.4	14.3	208.0	216.4	8.4
Hispanics	184.9	200.0	15.1	210.9	218.1	7.2
Whites	189.5	205.2	15.7	222.5	231.6	9.1
Males out of poverty						
Black/African Americans	192.5	209.4	16.9	222.3	230.3	8.0
Hispanics	187.7	202.0	14.3	229.0	244.7	15.7
Whites	199.8	215.5	15.7	235.1	246.0	13.9
Females out of poverty						
Black/African Americans	187.0	202.1	15.1	221.5	236.8	15.3
Hispanics	196.9	210.7	13.8	231.8	246.3	14.5
Whites	199.2	213.1	13.9	231.8	241.9	10.1
	Third grade			Seventh grade		
Panel B: 2020–2021	Fall	Spring	Gain	Fall	Spring	Gain
Males in poverty						
Black/African Americans	176.7	182.5	5.8	207.1	210.2	3.1
Hispanics	183.1	187.5	4.4	213.2	218.3	5.1
Whites	191.3	198.7	7.4	219.6	227.4	7.8
Females in poverty						
Black/African Americans	177.4	182.8	5.4	210.5	213.3	2.8
Hispanics	176.7	179.6	2.9	211.5	214.3	2.8
Whites	188.3	195.9	7.6	217.6	222.6	5.0
Males out of poverty						
Black/African Americans	192.2	195.0	2.8	229.6	234.9	5.3
Hispanics	187.5	197.5	10.0	224.7	229.9	5.2
Whites	196.3	206.1	9.8	233.0	240.4	7.4
Females out of poverty						
Black/African Americans	188.3	194.7	6.4	216.1	221.5	5.4
Hispanics	190.2	198.1	7.9	227.8	232.0	4.2
Whites	193.9	204.0	10.1	230.2	234.3	4.1

NOTE: The values for each category were computed using Stata's linear regression program with the margins program. The "if statement" for each regression included either grade 3 or 7, and it included a statement that the NWEA math test scores for the fall and the spring do not equal missing (e.g., NWEAmS2019~=).
SOURCE: Author's calculations of the Community Data System.

In the 2020–2021 pandemic school year, the average achievement gain for each group of KPS students was lower than in the prepandemic year, and, as before, the achievement gain for the upper grade was lower than that of the lower grade. For KPS third-grade female students in poverty in this school year, the achievement gain was 5.4 for Black/African American students, 2.9 for Hispanic students, and 7.6 for White students. For seventh-grade female students in

poverty, the achievement gain was 2.8 for Black/African American students, 2.8 for Hispanic students, and 5.0 for White students. Although the differences are much smaller, it can be seen that the achievement gain for this category is higher for third graders than for seventh graders.

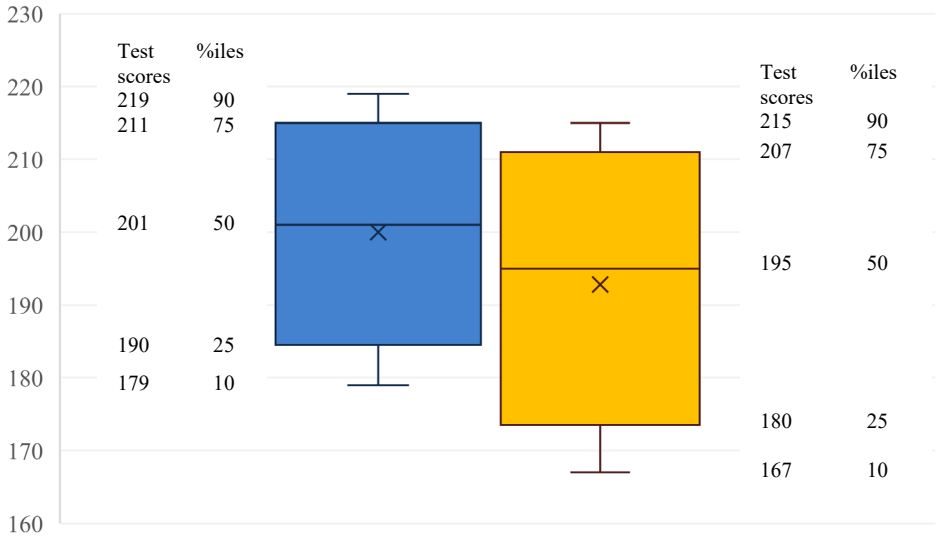
TO WHAT EXTENT HAVE STUDENT MATH TEST SCORES BECOME MORE VARIABLE BECAUSE OF THE COVID-19 PANDEMIC?

KPS Sample

This section examines the variation, as measured by the standard deviation of test scores, in NWEA math test scores for the 2018–2019 prepandemic school years and the 2021–2022 school year. Although the achievement gain in 2021-2022 approaches its prepandemic peak, math test scores in 2021–2022 are still lower than in the prepandemic year. Looking more closely at the two years around the pandemic, the standard deviation of the NWEA spring math test scores is larger in the 2021–2022 school year than in the 2018–2019 prepandemic school year. For third graders, the standard deviation in the prepandemic period is 16.31, and the standard deviation after the pandemic school year is 18.58. For seventh graders, the numbers are slightly larger at 17.77 and 19.77, respectively. The difference between the standard deviations is about 2.00 for each grade. In addition, most of the difference in the standard deviations between the two years is at the lower end of the distribution for the 2021–2022 school year.

Figure 5 shows the difference in percentiles between the two standard deviations, one for the 2018–2019 prepandemic school year and the other for the 2021–2022 school year. For third graders, the standard deviation of test scores is larger for the 2021–2022 school year than for the 2018–2019 school year. Much of the difference between the two standard deviations occurs in the lower part of the test-score distribution. Figure 5 shows a whisker diagram with five selected percentiles of the test-score distribution for KPS third graders. The 90th percentile is indicated

Figure 5 Math Test Score Changes between Spring 2019 and Spring 2022 for KPS Third Graders, at Five Selected Test-Score Percentiles



SOURCE: Author's calculations using the Community Data System.

by the horizontal bar at the top of the whisker, the 75th through 25th percentiles form the box of the graph, and the 10th percentile is the bottom whisker. The 90th and 75th percentiles of the standard deviation of test scores for the 2018–2019 school year are more similar than the 25th and 10th percentiles of the two standard deviations. We find that the achievement gain for the 10th percentile is 12 points lower in 2021–2022 than in 2018–2019, while the achievement gain for the 90th percentile is only 4 points lower for the same years.

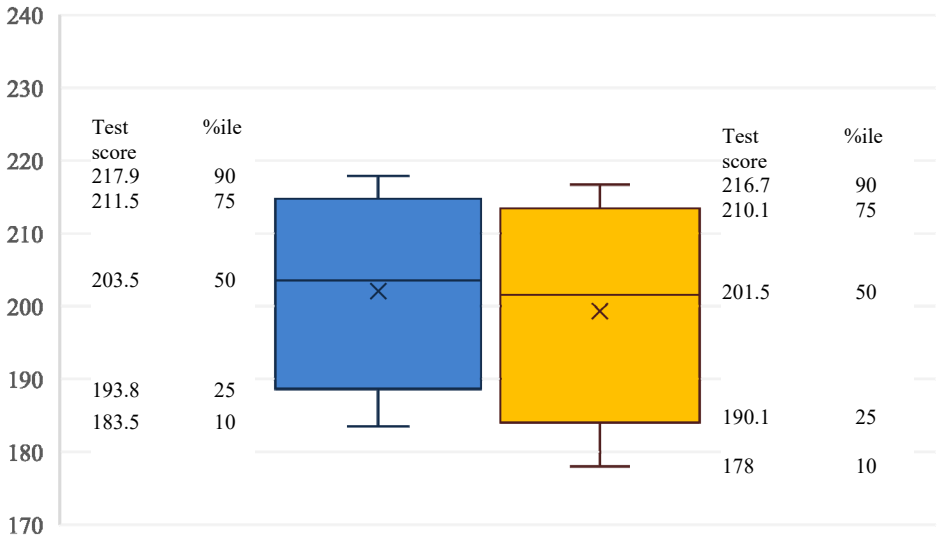
Table A5 in the Technical Appendix of this report examines the difference between the five percentiles for each grade, rather than simply showing the results for grades 3 and 7. In Table A5, the means and standard deviations for the 2021–2022 school year are subtracted from those for the 2018–2019 school year. The difference between these two measures is typically negative, as test scores are lower in the first year than in the second. Grades 3–5 show a monotonic progression of test scores from the lowest percentile to the highest. For grades 6–8,

the pattern is less pronounced, with much less variation at the low end of the distribution than at the high end, compared to grades 3–5.

National Sample

Figure 6 shows box-whisker plots of percentiles similar to those in Figure 5. The largest difference between the lowest percentiles in Figure 6 is −5.5, with values becoming smaller (less negative) as one moves to the upper end of the distribution. In Figure 5, the ratio of the achievement gain for the 10th percentile and the 90th percentile is 4.5, which is slightly higher than the ratio of the lowest-to-highest percentile in Figure 5.

Figure 6 Math Test-Score Changes between Spring 2019 and Spring 2022 for Third-Graders in the National Sample, at Five Selected Test-Score Percentiles



SOURCE: Kuhfeld, Langi, and Lewis (2022). Technical appendix for the widening achievement divide during COVID-19, from NWEA.

Differences between the Lowest and Highest Decile by Race/Ethnicity and Poverty Status

To sharpen the issue of high- and low-percentile test scores, we look at KPS students eligible for the free and reduced-price lunch (FRPL) program and by their racial composition in the bottom and top deciles. As shown in Table 13, a higher percentage of students eligible for

FRPL are in the bottom decile than in the top decile, meaning that poverty is a good indicator of low test scores. We also find that the percentage of KPS Black/African American third and seventh graders in the lowest decile (10th percentile or below) far exceeds that of any other racial/ethnic group, meaning that they dominate the lower end of the test-score distribution. On the other hand, Black/African American students are underrepresented at the upper end of the distribution. This is true for both NWEA math test scores and NWEA reading test scores and for the 2018–2019 and 2021–2022 school years. The situation is similar, but not as pronounced, for KPS Hispanic students. White students, however, have the highest percentage and number of students in the top decile. The percentage of Black/African American students in the bottom decile and the percentage of White students in the top decile are higher in the 2021–2022 school year than in the 2018–2019 school year.

Table 13 Percentage of KPS Students in Grades 3 and 7 by Lowest and Highest Deciles of NWEA Test Scores, 2018–2019 and 2021–2022

	Grade 3				Grade 7			
Percentile	FPRL	Black/Afr Am	Hispanic	White	FRPL	Black/Afr Am	Hispanic	White
				2018–2019				
Math test								
10	88	55	27	9	100	58	21	5
90	51	21	13	53	36	15	10	61
Reading test								
10	97	56	15	12	98	58	11	16
90	43	16	10	62	38	13	7	65
				2021–2022				
Math test								
10	85	67	5	24	84	59	5	26
90	36	16	9	59	21	12	5	70
Reading test								
10	94	71	12	6	84	53	16	27
90	28	12	9	63	18	7	6	74

NOTE: FRPL stands for the free and reduced-price lunch program and is the typical measure of poverty when considering K–12 students. The table shows the percentage of students for each of the categories. NWEA math test scores are listed alongside NWEA reading test scores. While the report focuses on math test scores, reading test scores are listed in the appendix for most important categories.
SOURCE: Author's calculations of the Community Data System.

Comparing the results of the KPS sample with those of the NWEA national sample shows similar trends. Unfortunately, Table A2 of the technical appendix to "The Widening Achievement Divide during COVID-19" (Kuhfeld, Langi, and Lewis 2022) is based on the longitudinal analysis, not the cross-sectional analysis of KPS students that we used to construct Table 13. Therefore, we cannot directly compare the KPS results with the NWEA sample. However, when we look at the two tables, we see a similar pattern: a higher percentage of students in poverty (as measured by FPRL) is found in the bottom decile, and a lower percentage of students in poverty is found in the top decile. We also find that Black/African American students are more prevalent in the bottom decile than in the top decile, and a higher percentage of White students dominate the top decile more than the bottom decile. However, it is impossible to tell from these percentages whether poverty or race is the more important factor.

STATISTICAL SIGNIFICANCE OF ACHIEVEMENT GAINS

In this section, we consider the statistical significance of achievement gains at the 95 percent confidence level. When one confidence interval does not overlap another, the two means are statistically significantly different. Tables 14 and 15 show the 95 percent confidence intervals for all categories of students (race/ethnicity, gender, poverty status) and for both samples of students. In Panel A of Table 14, only White third graders have significantly different average NWEA math scores from Black/African American students and Hispanic students during the pandemic year. For seventh graders during the pandemic year, the average NWEA math test scores of White students are significantly different from those of Black/African American students, but not from those of Hispanic students. Only one other combination of means overlapped in Table 12: the difference between the achievement gains of students in poverty and

Table 14 95% Confidence Interval of Average Achievement by Race/Ethnicity, Gender, and Poverty for KPS Students, 2018–2019, 2020–2021, and 2021–2022

	Third grade			Seventh grade		
	Lower bound	Mean	Upper bound	Lower bound	Mean	Upper bound
Panel A: Race/ethnicity						
2018–2019						
Blacks/Afri	14.02	15.03	16.03	8.51	9.47	10.42
Hispanics	13.53	15.27	17.00	7.46	9.06	10.66
Whites	13.72	14.80	15.89	9.32	10.33	11.33
2020–2021						
Blacks/Afri	4.26	5.57	6.89	1.95	3.16	4.36
Hispanics	2.22	4.41	6.61	2.28	3.92	5.57
Whites	7.31	8.54	9.77	5.00	6.03	7.05
2021–2022						
Blacks/Afri	13.46	14.40	15.35	6.63	7.59	8.55
Hispanics	13.29	14.89	16.50	7.07	8.67	10.27
Whites	14.92	15.89	16.85	8.12	9.05	9.99
Panel B: Gender						
2018–2019						
Female	13.67	14.57	15.47	8.45	9.29	10.13
Male	14.26	15.14	16.03	9.76	10.59	11.42
2020–2021						
Female	6.00	7.11	8.21	2.73	3.66	4.60
Male	5.64	6.74	7.84	4.34	5.31	6.28
2021–2022						
Female	14.14	14.96	15.78	7.85	8.69	9.53
Male	14.74	15.57	16.39	7.31	8.10	8.90
Panel C: Poverty status						
2018–2019						
No poverty	13.48	15.00	16.32	9.72	11.07	12.42
Poverty	14.07	14.80	15.52	8.76	9.45	10.13
2020–2021						
No poverty	7.70	9.29	10.88	4.40	5.66	6.91
Poverty	5.31	6.19	7.08	3.18	3.98	4.77
2021–2022						
No poverty	14.83	15.99	17.15	8.98	10.09	11.20
Poverty	14.35	15.03	15.71	7.20	7.88	8.57

SOURCE: Author's calculations of the Community Data System.

those not in poverty was statistically significantly different during the pandemic year. No other combination of means was statistically significantly different.

The NWEA national sample shows the same patterns as the KPS sample. The NWEA national sample has very tight confidence intervals, primarily due to the large sample size in each

category. In all cases, the confidence intervals do not overlap, indicating that the achievement gains are significantly different from each other. In addition, achievement gains are lower in the upper grades and higher in the lower grades, and achievement gains are higher in the prepandemic year and lower in the pandemic year. Table 15 includes only two years—the 2018–2019 prepandemic school year and the 2020–2021 pandemic school year.

Table 15 95% Confidence Interval of Average Achievement by Race/Ethnicity, Gender, and Poverty for the NWEA Study, 2018–2019, 2020–2021

	Third grade			Seventh grade		
	Lower bound	Mean	Upper bound	Lower bound	Mean	Upper bound
Panel A: Race/ethnicity						
2018–2019						
Blacks/Afri	12.55	12.6	12.65	5.64	5.7	5.76
Hispanics	13.65	13.7	13.75	3.54	5.8	3.66
Whites	13.87	13.9	13.93	6.87	6.9	6.93
2020–2021						
Blacks/Afri	7.51	7.6	7.69	3.54	3.6	3.66
Hispanics	9.03	9.1	9.17	4.64	4.7	4.76
Whites	12.96	13.0	13.04	6.07	6.1	6.13
Panel B: Gender						
2018–2019						
Female	13.27	13.3	13.33	6.57	6.6	6.63
Male	13.87	13.9	13.93	6.37	6.4	6.43
2020–2021						
Female	10.96	11.0	11.04	5.36	5.4	5.44
Male	11.26	11.3	11.34	5.46	5.5	5.54
Panel C: Poverty status						
2018–2019						
Low poverty	13.86	13.9	13.94	7.36	7.4	7.44
High poverty	13.16	13.2	13.24	5.34	5.4	5.46
2020–2021						
Low poverty	12.75	12.8	12.85	6.55	6.6	6.65
High poverty	8.23	8.3	8.37	3.75	3.8	3.85

NOTE: In Panel C, poverty status is measured in the same way as it is for KPS, except that it is determined at the district level rather than at the student level. Thus, "low poverty" is defined as less than 25 percent eligibility for the free and reduced price lunch (FRPL) program, and "high poverty" is measured as greater than 75 percent FRPL eligibility.
SOURCE: Author's calculations of the Community Data System.

CONCLUSION

This study examines average NWEA math test scores for KPS students during the 2018–2019 prepandemic school year, the 2020–2021 pandemic school year, and the 2021–2022 post-school-lockdown school year. For KPS students, the pandemic school year was essentially a year without face-to-face instruction. School buildings were closed, and most students relied on virtual options. For the 2020–2021 school year, the school year immediately following the pandemic outbreak, KPS students were given three instructional options: 1) they could follow a self-paced curriculum through an online platform to help monitor their progress, 2) they could follow a more structured approach by meeting virtually with their teacher and class at specific times during the day, or 3) they could follow an approach similar to the first alternative but through the regional intermediate school district rather than their home district. Regardless of their choice, once they chose one option, they could not choose another. And none of the options included face-to-face instruction with a teacher; it was all virtual.

With students having been out of school for almost a full year and a half, the 2021–2022 school year marked the first time they were back in school with their certified teacher of record. It should be noted that even though students were at home during the 2020–2021 school year, they still took the NWEA math and reading tests. Because the tests are interactive and administered on a computer, it was easy for KPS to administer the tests when they were taken at home. However, there is no way to know whether parents helped their children take the test. The NWEA national studies noted that they found no reduction in the fidelity of test taking in their large sample of students. Similarly, we do not see any change in KPS students' response to the tests, even though the number of KPS students taking the fall and spring tests dropped significantly during the pandemic school year. Another feature of this study is the use of the

NWEA national sample along with the KPS sample. While the NWEA national sample does not include all students in the U.S., it does include up to eight million students in nearly 24,000 districts.

Before addressing the basic questions of the report, we examined ways to calculate three things: 1) test scores at the beginning and end of the school year, 2) summer learning loss to determine the change in achievement gains, and 3) attendance rates as an example of students not receiving face-to-face instruction. These issues are considered as background to the basic questions addressed in the study.

So, then, this study addresses three fundamental questions. The first question is whether KPS enrollment has increased in the year following the school closure. We find that it continues to decline after the pandemic year of school closings. Only Black/African American student enrollment increased slightly, while the other major racial/ethnic groups of students—Hispanic students and White students—continued to decline.

The second question has to do with achievement gains and associated test scores over the three years of the study. We find that achievement gains are higher in the lower elementary grades than in the upper middle-school grades. We also find that achievement gains rebounded after the KPS schools opened, although achievement gains were not as high as in the prepandemic school year. It also appears that the lower grades were more resilient than the upper grades during this period.

The third question concerns the variability of test scores over the three years. We find that test scores were more variable at the low end of the distribution than at the high end, which is the same conclusion drawn from the NWEA national sample. In addition, they were more

variable in the school year following the school closure year than in the school year immediately preceding it.

Addressing the second and third questions led to the conclusion that, on average, KPS students did not perform as well on NWEA math tests as students in the national sample for the three years considered in this study. White KPS students may have outperformed their national peers, but this is somewhat uneven across the tables of numbers. However, KPS students appear to be more resilient, based on their average NWEA scores. With a few exceptions, achievement gains for KPS students are higher than the national average.

In addition, this study examined the race/ethnicity, gender, and poverty status of students in both samples. We found that students of color were more likely to be overrepresented in the lower tails of the distribution, and that White students dominated the higher end of the distribution. The same was true for poverty status, with a higher percentage of students in poverty at the low end of the distribution and less poverty at the high end. It was not possible to determine which of the two factors—1) poverty status or 2) race and ethnicity—was more important. We also examined these factors in terms of the variability of test scores, looking at the variability as measured by the standard deviations of the school year before the pandemic and the school year after schools were reopened. We found that poverty and students of color tended to dominate the lower end of the test-score distribution and that White students and those less likely to be in poverty tended to dominate the upper end.

KPS students faced several challenges during the pandemic and the resulting school closure, which went on for more than a school year. Although the district is part of a medium-sized city, it faces many of the same challenges larger urban centers experience, including a lack of access to technology, lack of access to reliable Internet, and lack of adequate support from

students' families. These challenges have caused many students to fall behind in their coursework, and the remote learning environment has reduced the opportunities for students to receive direct instruction. Students are not enrolled in school at the same level they were before the pandemic, their test-taking ability has declined, and their test scores have dropped. Although the district has implemented several programs to address these challenges, it will take time and effort to mitigate the impact of the pandemic on student learning.

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Appendix A: Technical Appendix

The Technical Appendix contains tables of KPS's NWEA math and reading average test scores and achievement gains. Comparable average test scores and achievement gains for the national sample can be found in the technical appendices of the publications cited in the references and below many of the tables.

Table A1 Achievement Gains, All Students

Subject	Year	Grade	Fall	Spring	Achievement gain
Math	2018–2019	3	185.3	200.2	14.9
Math	2020–2021	3	185.2	192.1	6.9
Math	2021–2022	3	177.7	192.9	15.2
Math	2018–2019	4	195.4	208.0	12.6
Math	2020–2021	4	194.0	200.9	5.9
Math	2021–2022	4	187.9	199.9	12.0
Math	2018–2019	5	205.1	215.3	10.2
Math	2020–2021	5	204.4	208.7	4.3
Math	2021–2022	5	197.3	207.8	10.5
Math	2018–2019	6	208.9	218.5	9.6
Math	2020–2021	6	210.9	215.4	4.5
Math	2021–2022	6	203.6	212.5	8.9
Math	2018–2019	7	215.5	225.5	10.0
Math	2020–2021	7	218.4	222.8	4.4
Math	2021–2022	7	209.8	218.2	8.4
Math	2018–2019	8	221.4	230.5	9.1
Math	2020–2021	8	227.2	230.2	3.0
Math	2021–2022	8	216.7	224.7	8.0
Reading	2018–2019	3	184.1	195.8	11.7
Reading	2020–2021	3	188.0	191.8	3.8
Reading	2021–2022	3	179.9	192.8	12.9
Reading	2018–2019	4	193.8	202.8	9.0
Reading	2020–2021	4	195.7	199.6	3.9
Reading	2021–2022	4	189.3	199.0	9.7
Reading	2018–2019	5	202.5	209.5	7.0
Reading	2020–2021	5	203.0	206.0	3.0
Reading	2021–2022	5	198.2	204.6	6.4
Reading	2018–2019	6	207.7	211.8	4.1
Reading	2020–2021	6	209.2	211.1	1.9
Reading	2021–2022	6	204.5	209.8	5.3
Reading	2018–2019	7	211.2	216.7	5.5
Reading	2020–2021	7	214.3	217.2	2.9
Reading	2021–2022	7	208.5	213.5	5.0
Reading	2018–2019	8	214.6	220.6	6.0
Reading	2020–2021	8	218.9	220.9	2.0
Reading	2021–2022	8	213.8	217.7	3.9

SOURCE: Author's calculations of the Community Data System.

Table A2 Achievement Gains of KPS Students by Race and Ethnicity for Selected Years

Subject	Year	Grade	Race/ethnicity	Fall	Spring	Achievement gain
Math	2018–2019	3	Black/Afri Am	178.0	193.0	15.0
Math	2020–2021	3	Black/Afri Am	177.5	183.1	5.6
Math	2021–2022	3	Black/Afri Am	168.2	182.6	14.4
Math	2018–2019	3	Hispanic	184.4	199.7	15.3
Math	2020–2021	3	Hispanic	181.7	186.1	4.4
Math	2021–2022	3	Hispanic	174.5	189.3	14.9
Math	2018–2019	3	White	193.8	208.7	14.8
Math	2020–2021	3	White	192.3	200.9	8.5
Math	2021–2022	3	White	187.9	203.8	15.9
Math	2018–2019	4	Black/Afri Am	188.8	199.9	11.1
Math	2020–2021	4	Black/Afri Am	186.3	190.7	4.4
Math	2021–2022	4	Black/Afri Am	179.4	190.7	11.3
Math	2018–2019	4	Hispanic	193.7	205.6	11.9
Math	2020–2021	4	Hispanic	190.6	195.0	4.5
Math	2021–2022	4	Hispanic	183.9	194.5	10.7
Math	2018–2019	4	White	202.5	216.9	14.4
Math	2020–2021	4	White	204.6	212.4	7.8
Math	2021–2022	4	White	197.3	210.9	13.6
Math	2018–2019	5	Black/Afri Am	197.0	206.9	9.9
Math	2020–2021	5	Black/Afri Am	195.8	198.5	2.7
Math	2021–2022	5	Black/Afri Am	187.6	196.4	8.8
Math	2018–2019	5	Hispanic	202.3	212.7	10.4
Math	2020–2021	5	Hispanic	202.4	206.7	4.3
Math	2021–2022	5	Hispanic	193.3	202.2	8.9
Math	2018–2019	5	White	215.2	225.6	10.4
Math	2020–2021	5	White	214.2	220.2	6.0
Math	2021–2022	5	White	209.0	222.0	13.0
Math	2018–2019	6	Black/Afri Am	199.1	208.0	8.9
Math	2020–2021	6	Black/Afri Am	203.1	205.2	2.2
Math	2021–2022	6	Black/Afri Am	193.6	201.9	8.3
Math	2018–2019	6	Hispanic	209.2	218.4	9.2
Math	2020–2021	6	Hispanic	207.8	211.2	3.4
Math	2021–2022	6	Hispanic	202.8	210.6	7.8
Math	2018–2019	6	White	217.6	228.7	11.1
Math	2020–2021	6	White	216.7	222.4	5.8
Math	2021–2022	6	White	214.5	224.3	9.8
Math	2018–2019	7	Black/Afri Am	207.3	216.7	9.5
Math	2020–2021	7	Black/Afri Am	210.0	213.1	3.2
Math	2021–2022	7	Black/Afri Am	200.2	207.8	7.6
Math	2018–2019	7	Hispanic	212.8	221.9	9.1
Math	2020–2021	7	Hispanic	214.0	218.0	3.9
Math	2021–2022	7	Hispanic	206.8	215.4	8.7
Math	2018–2019	7	White	226.3	236.6	10.3
Math	2020–2021	7	White	225.4	231.4	6.0
Math	2021–2022	7	White	219.0	228.0	9.0
Math	2018–2019	8	Black/Afri Am	211.5	220.1	8.6
Math	2020–2021	8	Black/Afri Am	215.0	217.1	2.1
Math	2021–2022	8	Black/Afri Am	207.2	214.9	7.6
Math	2018–2019	8	Hispanic	218.7	228.3	9.5
Math	2020–2021	8	Hispanic	225.4	228.5	3.1
Math	2021–2022	8	Hispanic	212.5	219.7	7.1
Math	2018–2019	8	White	233.1	242.7	9.6
Math	2020–2021	8	White	236.4	240.0	3.6
Math	2021–2022	8	White	228.2	236.7	8.5
Reading	2018–2019	3	Black/Afri Am	176.2	187.9	11.7
Reading	2020–2021	3	Black/Afri Am	180.0	182.8	2.8

Table A2 (continued)

Subject	Year	Grade	Race/ethnicity	Fall	Spring	Achievement gain
Reading	2021–2022	3	Black/Afri Am	170.8	182.7	11.9
Reading	2018–2019	3	Hispanic	182.4	194.0	11.6
Reading	2020–2021	3	Hispanic	182.2	185.4	3.2
Reading	2021–2022	3	Hispanic	175.2	188.3	13.1
Reading	2018–2019	3	White	193.7	205.7	12.0
Reading	2020–2021	3	White	195.5	200.7	5.2
Reading	2021–2022	3	White	190.0	203.7	13.7
Reading	2018–2019	4	Black/Afri Am	186.8	195.1	8.3
Reading	2020–2021	4	Black/Afri Am	185.9	189.2	3.3
Reading	2021–2022	4	Black/Afri Am	180.5	190.3	9.8
Reading	2018–2019	4	Hispanic	191.0	200.2	9.2
Reading	2020–2021	4	Hispanic	190.1	193.0	2.9
Reading	2021–2022	4	Hispanic	184.3	194.8	10.5
Reading	2018–2019	4	White	201.5	211.1	9.6
Reading	2020–2021	4	White	206.7	211.3	4.6
Reading	2021–2022	4	White	199.7	208.6	8.9
Reading	2018–2019	5	Black/Afri Am	193.9	202.1	8.2
Reading	2020–2021	5	Black/Afri Am	194.7	197.2	2.5
Reading	2021–2022	5	Black/Afri Am	188.3	194.5	6.2
Reading	2018–2019	5	Hispanic	200.1	207.3	7.2
Reading	2020–2021	5	Hispanic	198.3	202.5	4.2
Reading	2021–2022	5	Hispanic	192.8	200.4	7.6
Reading	2018–2019	5	White	212.0	218.4	6.4
Reading	2020–2021	5	White	213.5	216.7	3.2
Reading	2021–2022	5	White	210.5	216.9	6.4
Reading	2018–2019	6	Black/Afri Am	199.4	203.1	3.7
Reading	2020–2021	6	Black/Afri Am	198.7	201.2	2.5
Reading	2021–2022	6	Black/Afri Am	194.6	200.7	6.1
Reading	2018–2019	6	Hispanic	209.0	212.1	3.1
Reading	2020–2021	6	Hispanic	202.4	205.4	3.0
Reading	2021–2022	6	Hispanic	202.3	206.9	4.6
Reading	2018–2019	6	White	215.1	219.7	4.6
Reading	2020–2021	6	White	215.9	217.4	1.5
Reading	2021–2022	6	White	215.6	220.7	5.1
Reading	2018–2019	7	Black/Afri Am	203.7	209.6	5.9
Reading	2020–2021	7	Black/Afri Am	205.3	208.0	2.7
Reading	2021–2022	7	Black/Afri Am	199.2	205.0	5.8
Reading	2018–2019	7	Hispanic	209.7	214.2	4.5
Reading	2020–2021	7	Hispanic	210.1	213.5	3.4
Reading	2021–2022	7	Hispanic	205.9	211.4	5.5
Reading	2018–2019	7	White	219.7	225.4	5.7
Reading	2020–2021	7	White	222.0	224.5	2.5
Reading	2021–2022	7	White	217.5	222.0	4.5
Reading	2018–2019	8	Black/Afri Am	206.8	212.8	6.0
Reading	2020–2021	8	Black/Afri Am	207.3	210.9	3.6
Reading	2021–2022	8	Black/Afri Am	205.2	209.3	4.1
Reading	2018–2019	8	Hispanic	213.5	219.2	5.7
Reading	2020–2021	8	Hispanic	215.6	218.6	3.0
Reading	2021–2022	8	Hispanic	211.6	215.1	3.5
Reading	2018–2019	8	White	223.1	229.6	6.5
Reading	2020–2021	8	White	226.6	228.0	1.4
Reading	2021–2022	8	White	223.1	226.8	3.7

SOURCE: Author's calculations of the Community Data System.

Table A3 Achievement Gains of KPS Students by Poverty Status for Selected Years

Subject	Year	Grade	Race/ethnicity	Fall	Spring	Achievement gain
Math	2018–2019	3	No Poverty	197.8	212.7	14.9
Math	2020–2021	3	No Poverty	194.4	203.7	9.3
Math	2021–2022	3	No Poverty	190.6	206.6	16.0
Math	2018–2019	3	Poverty	182.3	197.2	14.9
Math	2020–2021	3	Poverty	182.3	188.5	6.2
Math	2021–2022	3	Poverty	173.2	188.2	15.0
Math	2018–2019	4	No Poverty	207.7	222.9	15.3
Math	2020–2021	4	No Poverty	208.2	215.9	7.7
Math	2021–2022	4	No Poverty	201.1	214.9	13.8
Math	2018–2019	4	Poverty	191.7	203.7	15.0
Math	2020–2021	4	Poverty	190.5	195.7	5.3
Math	2021–2022	4	Poverty	184.3	195.8	11.5
Math	2018–2019	5	No Poverty	221.8	232.2	10.4
Math	2020–2021	5	No Poverty	215.6	222.8	7.2
Math	2021–2022	5	No Poverty	212.6	226.3	13.8
Math	2018–2019	5	Poverty	201.4	211.5	10.1
Math	2020–2021	5	Poverty	200.8	204.2	3.4
Math	2021–2022	5	Poverty	192.6	202.1	9.4
Math	2018–2019	6	No Poverty	222.6	234.7	12.1
Math	2020–2021	6	No Poverty	221.3	227.7	6.4
Math	2021–2022	6	No Poverty	217.0	228.0	11.0
Math	2018–2019	6	Poverty	205.1	214.2	9.0
Math	2020–2021	6	Poverty	205.8	209.3	3.4
Math	2021–2022	6	Poverty	199.2	207.5	8.3
Math	2018–2019	7	No Poverty	232.6	243.7	11.1
Math	2020–2021	7	No Poverty	230.1	235.8	5.7
Math	2021–2022	7	No Poverty	224.5	234.6	10.1
Math	2018–2019	7	Poverty	211.4	220.9	9.4
Math	2020–2021	7	Poverty	213.6	217.6	4.0
Math	2021–2022	7	Poverty	204.2	212.1	7.9
Math	2018–2019	8	No Poverty	239.0	249.0	10.0
Math	2020–2021	8	No Poverty	240.0	243.8	3.7
Math	2021–2022	8	No Poverty	233.3	242.8	9.5
Math	2018–2019	8	Poverty	216.7	225.5	8.8
Math	2020–2021	8	Poverty	221.9	224.7	2.8
Math	2021–2022	8	Poverty	211.7	219.3	7.6
Reading	2018–2019	3	No Poverty	197.8	209.6	11.8
Reading	2020–2021	3	No Poverty	198.3	204.7	6.4
Reading	2021–2022	3	No Poverty	195.1	206.7	11.6
Reading	2018–2019	3	Poverty	180.5	192.3	11.8
Reading	2020–2021	3	Poverty	184.8	187.9	3.1
Reading	2021–2022	3	Poverty	174.5	188.1	13.6
Reading	2018–2019	4	No Poverty	208.2	216.8	8.6
Reading	2020–2021	4	No Poverty	210.8	215.4	4.6
Reading	2021–2022	4	No Poverty	203.5	212.4	8.9
Reading	2018–2019	4	Poverty	189.5	198.5	9.0
Reading	2020–2021	4	Poverty	190.3	194.0	3.7
Reading	2021–2022	4	Poverty	185.4	195.3	9.9
Reading	2018–2019	5	No Poverty	218.8	224.6	5.8
Reading	2020–2021	5	No Poverty	215.6	218.9	3.3
Reading	2021–2022	5	No Poverty	214.7	220.7	6.0
Reading	2018–2019	5	Poverty	198.7	206.0	7.3
Reading	2020–2021	5	Poverty	198.8	201.7	2.9
Reading	2021–2022	5	Poverty	193.1	199.6	6.5
Reading	2018–2019	6	No poverty	220.7	225.7	5.0
Reading	2020–2021	6	No poverty	220.3	223.4	3.1

Table A3 (continued)

Subject	Year	Grade	Race/ethnicity	Fall	Spring	Achievement gain
Reading	2021–2022	6	No poverty	218.5	223.5	5.0
Reading	2018–2019	6	Poverty	204.1	208.0	3.9
Reading	2020–2021	6	Poverty	202.9	204.2	1.3
Reading	2021–2022	6	Poverty	199.8	205.2	5.4
Reading	2018–2019	7	No poverty	225.6	231.2	5.6
Reading	2020–2021	7	No poverty	227.1	228.8	1.7
Reading	2021–2022	7	No poverty	222.0	227.2	5.2
Reading	2018–2019	7	Poverty	207.5	213.0	5.5
Reading	2020–2021	7	Poverty	208.7	212.1	3.4
Reading	2021–2022	7	Poverty	203.5	208.4	4.9
Reading	2018–2019	8	No poverty	228.4	233.2	4.8
Reading	2020–2021	8	No poverty	229.6	231.1	1.5
Reading	2021–2022	8	No poverty	227.5	231.3	3.8
Reading	2018–2019	8	Poverty	210.8	216.9	6.1
Reading	2020–2021	8	Poverty	214.1	216.3	2.2
Reading	2021–2022	8	Poverty	209.7	213.4	3.7

SOURCE: Author's calculations of the Community Data System.

Table A4 Achievement Gains of KPS Students by Gender for Selected Years

Subject	Year	Grade	Race/ethnicity	Fall	Spring	Achievement gain
Math	2018–2019	3	Female	186.1	200.7	14.6
Math	2020–2021	3	Female	184.2	191.3	7.1
Math	2021–2022	3	Female	177.4	192.4	15.0
Math	2018–2019	3	Male	184.6	199.8	15.2
Math	2020–2021	3	Male	186.1	192.9	6.8
Math	2021–2022	3	Male	177.9	193.5	15.6
Math	2018–2019	4	Female	195.6	207.9	12.3
Math	2020–2021	4	Female	194.0	199.5	5.5
Math	2021–2022	4	Female	187.0	198.9	11.9
Math	2018–2019	4	Male	195.2	208.2	13.0
Math	2020–2021	4	Male	195.9	202.2	6.3
Math	2021–2022	4	Male	188.9	201.0	12.1
Math	2018–2019	5	Female	204.7	214.3	9.6
Math	2020–2021	5	Female	204.7	208.7	4.0
Math	2021–2022	5	Female	196.4	206.8	10.4
Math	2018–2019	5	Male	205.5	216.5	11.0
Math	2020–2021	5	Male	204.0	208.6	4.6
Math	2021–2022	5	Male	198.2	208.8	10.6
Math	2018–2019	6	Female	209.5	219.3	9.8
Math	2020–2021	6	Female	211.5	215.9	4.4
Math	2021–2022	6	Female	204.1	212.9	8.8
Math	2018–2019	6	Male	208.2	217.6	9.4
Math	2020–2021	6	Male	210.5	214.9	4.4
Math	2021–2022	6	Male	203.1	212.2	9.1
Math	2018–2019	7	Female	216.3	225.6	9.3
Math	2020–2021	7	Female	217.9	221.6	3.7
Math	2021–2022	7	Female	209.2	217.9	8.7
Math	2018–2019	7	Male	214.8	225.4	10.6
Math	2020–2021	7	Male	218.9	224.2	5.3
Math	2021–2022	7	Male	210.4	218.5	8.1
Math	2018–2019	8	Female	222.5	231.3	8.8
Math	2020–2021	8	Female	227.8	230.6	2.8
Math	2021–2022	8	Female	215.6	223.5	7.9
Math	2018–2019	8	Male	220.4	229.8	9.4
Math	2020–2021	8	Male	226.2	229.7	3.5
Math	2021–2022	8	Male	217.9	226.0	8.1
Reading	2018–2019	3	Female	186.3	197.8	11.5
Reading	2020–2021	3	Female	188.3	192.0	3.7
Reading	2021–2022	3	Female	180.8	193.9	13.1
Reading	2018–2019	3	Male	181.8	193.8	12.0
Reading	2020–2021	3	Male	187.7	191.6	3.9
Reading	2021–2022	3	Male	178.9	191.8	12.9
Reading	2018–2019	4	Female	195.7	204.4	8.7
Reading	2020–2021	4	Female	196.7	200.6	3.9
Reading	2021–2022	4	Female	190.0	199.8	9.8
Reading	2018–2019	4	Male	192.1	201.3	9.2
Reading	2020–2021	4	Male	194.7	198.8	4.1
Reading	2021–2022	4	Male	188.7	198.2	9.5
Reading	2018–2019	5	Female	203.5	210.7	7.2
Reading	2020–2021	5	Female	204.5	207.9	3.4
Reading	2021–2022	5	Female	199.2	205.7	6.5
Reading	2018–2019	5	Male	201.4	208.2	6.8
Reading	2020–2021	5	Male	201.4	204.0	2.6
Reading	2021–2022	5	Male	197.2	203.6	6.4
Reading	2018–2019	6	Female	209.7	213.9	4.2
Reading	2020–2021	6	Female	211.7	213.7	2.0

Table A4 (continued)

Subject	Year	Grade	Race/ethnicity	Fall	Spring	Achievement gain
Reading	2021–2022	6	Female	207.3	212.7	5.4
Reading	2018–2019	6	Male	205.5	209.5	4.0
Reading	2020–2021	6	Male	206.9	208.8	1.9
Reading	2021–2022	6	Male	201.8	207.1	5.3
Reading	2018–2019	7	Female	214.1	218.5	4.4
Reading	2020–2021	7	Female	215.2	219.4	4.2
Reading	2021–2022	7	Female	210.7	215.3	4.6
Reading	2018–2019	7	Male	208.4	214.9	6.5
Reading	2020–2021	7	Male	213.4	214.8	1.4
Reading	2021–2022	7	Male	206.7	211.9	5.2
Reading	2018–2019	8	Female	217.4	222.6	5.2
Reading	2020–2021	8	Female	221.0	223.0	2.0
Reading	2021–2022	8	Female	215.0	218.9	3.9
Reading	2018–2019	8	Male	212.1	218.7	6.6
Reading	2020–2021	8	Male	216.1	218.1	2.0
Reading	2021–2022	8	Male	212.6	216.3	3.7

SOURCE: Author's calculations of the Community Data System.

Table A5 Average Math and Reading NWEA Spring Test Scores for KPS Students by Percentile, between Spring 2019 and Spring 2022 for Grades 3–8

	Math			Reading		
	2018–2019	2021–2022	Difference	2018–2019	2021–2022	Difference
3rd grade						
Percentiles						
10	179	167	–12	171	165	–6
25	190	180	–10	185	178	–7
50	201	195	–6	197	195	–2
75	211	207	–4	209	207	–2
90	219	215	–4	218	217	–1
Std. dev.	15.87	18.36	2.49	17.44	19.54	2.10
4th grade						
Percentiles						
10	185	176	–9	178	170	–8
25	197	187	–10	192	187	–5
50	210	202	–8	205	201.5	–3.5
75	219	214	–5	216	214	–2
90	230	223	–7	223	222	–1
Std. dev.	17.81	18.75	0.94	17.79	19.21	1.42
5th grade						
Percentiles						
10	192	180	–12	188	177	–11
25	202	194	–8	199	190	–9
50	216	208	–8	211	207	–4
75	228	223	–5	222	220	–2
90	239	236	–3	230	229	–1
Std. dev.	19.10	21.19	2.09	16.97	20.31	3.34
6th grade						
Percentiles						
10	193	188	–5	188	185	–3
25	205	200	–5	201	197	–4
50	219	212	–7	214	212	–2
75	233	226	–7	225	224	–1
90	244	237	–7	233	231	–2
Std. dev.	19.36	18.79	–0.57	17.69	17.70	0.01
7th grade						
Percentiles						
10	198	193	–5	191	188	–3
25	212	205	–7	206	204	–2
50	225	218	–7	219	215	–4
75	240.5	231	–9.5	229	226	–3
90	253	244	–9	237	236	–1
Std. dev.	21.08	20.55	–0.53	17.90	18.65	0.75
8th grade						
Percentiles						
10	202	198	–4	198	193	–5
25	217	210	–7	210	206	–4
50	231	224	–7	222	219	–3
75	246	239	–7	233	232	–1
90	258	253	–5	243	240	–3
Std. dev.	21.56	21.89	0.33	17.66	19.15	1.49

NOTE: The "Difference" column subtracts the 2018–2019 test score and standard deviation (second column) from the 2021–2022 test score and standard deviation (third column). NWEA math and reading test scores are included in the table.
SOURCE: Author's computations of the Community Data System.