COVID-19 Learning Loss in Texas

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Executive Summary

This study investigates students' achievement loss in reading and math due to COVID-19 pandemic school closures. Data from the extensive Istation database across two academic years (2019-2020 and 2020-2021) were analyzed to determine if there had been a learning loss due to COVID-19 school closures in March 2020.

Learning Loss varied by grade in reading and math.

In reading, COVID-19 school closures contributed approximately 2 months' learning loss. Students entering kindergarten did not demonstrate significant learning loss. However, students in grades 1-8 showed that they started the school year where they had left off the previous March. Remote learning may have helped students maintain the gains they had achieved from the beginning of the school year through March, but the students did not maintain these gains when school started in the fall. This represents 1-2 months additional learning loss.

In math, COVID-19 school closure contributes approximately 1-2 months learning loss for students in early elementary grades, and the learning losses were more substantial in the upper elementary grades.

Students lost their Math ability more rapidly than their reading ability.

Students had approximately 2 months of learning loss in reading and in early elementary grades in math. Students in fifth, sixth, and seventh grade in math, on the other hand, had learning losses that were substantially greater than would be expected over the summer.

Learning loss varied by type of school

While it varied by grade and subject, we evaluated the learning losses by the poverty level of each school, categories as low, mid-low, mid-high, or high. Students in low-poverty schools had steeper losses in reading than students in mid-high or high-poverty schools. Kindergarten and first grade students in high-poverty schools made some gains in reading as compared to previous cohorts, and students in first grade in low-poverty schools had greater learning losses. In grades 2 to 6 all types of schools had learning losses, and typically low-poverty schools had greater learning losses. In seventh grade, students in high-poverty schools had higher learning losses.

In math, students in kindergarten and first grade made some gains in math, while students in low-poverty schools had the greatest learning losses. In second and third grade, students in mid low-poverty schools had the greatest learning losses, and in fourth and fifth grade, students in low-poverty schools had the greatest learning losses. Students in seventh grade in mid-high poverty schools had some slight gains, and students in low-poverty schools had the greatest losses.

Conclusion

- Learning losses were greater in math than they were in reading.
- Learning losses varied by grade, with kindergarten students having less learning loss than students in other grades.
- Learning losses were typically steeper in low poverty schools than in high poverty schools.

Introduction

In March and April of 2020, school closures across the US were implemented to slow the spread of the COVID-19 pandemic. Students across the country tried to complete their academic year using educational technology from home. Some of these programs were put together quickly as teachers, school administrators, students, and parents adapted to the new learning model.

In March of 2020, Istation, an educational technology company based in Dallas, Texas, made their formative assessment and adaptive curriculum available to teachers and students at home to help them adjust to remote learning. Istation also offered the teacher directed lessons available to parents and expanded the parent portal to help parents assist their students.

There were immediate concerns that students would be impacted by school closures and remote learning. Researchers from the Northwest Educational Association (NWEA) (Kuhfeld, Soland, et al., 2020; Kuhfeld, Tarasawa, et.al., 2020), projected the potential impact of COVID-19 school closures on the academic achievement of 5 million students. They projected students would begin the 2020-2021 school year with 63% to 68% of the learning gains in reading and 37% to 50% of the learning gains in mathematics. They also found that a student who scored in the 50th percentile in the fall 2019 Measures of Academic Progress (MAP) assessment in math could be expected to score between the 30th and 40th percentile in fall 2020 (Kuhfeld et al., 2020). Other research using fall 2020 data showed that students had lost 13% of their gains in reading, and 33% of the gains in math. Learning loss was greater in schools that served students of color (Dorn, et al., 2020).

These projections are useful for educators in assessing the impact, and this research will expand on these efforts to explore the actual learning loss for students specifically in the state of Texas who used Istation in the 2019-2020 and 2020-2021 school years. It is important to understand whether students experienced learning loss over and above what may have naturally occurred in the summer.

Summer Learning Loss

Research on summer learning loss is mixed. Some research indicates that students' achievement scores decline over summer by 1 months' worth of school-year learning, while other research indicates that there is minimal learning loss and in some instances learning gains (Campbell, et al., 2019). Students lose their math ability more rapidly than their reading ability, and students in higher grades experience larger losses than students in lower grades (Quinn & Polikoff, 2017). Other research demonstrates that students from all socioeconomic backgrounds forget more of what they learned in math over the summer than the amount they lose in reading skills (Shafer, 2016). In addition, students who are lower achieving may experience less loss, and may even experience some gains, as compared to students who are higher achieving (Campbell et al., 2019). Many school districts, especially those that serve students living in higher-poverty households, offer summer learning or enrichment programs to stave off summer learning loss, making it less predictable as to who will experience the loss and who will not. In this research, we expect that there may be differences in the amount of learning loss experienced by students of lower or higher socioeconomic status.

Because the COVID-19 pandemic occurred around mid-March in the US, students may have experienced learning loss from the COVID-19 school closures as well

as summer learning loss. Students experienced the school closures differently depending on their individual circumstances. Some students transitioned into a home environment where there was access to technology and dependable internet service. Other students had home environments where there may have been other students in the home that shared a computer or tablet, and internet service was unreliable. Others still disappeared from the classroom, and teachers were not able to make contact with them. Therefore, while summer learning loss is typical across grades and subject matter, we expect that students will have additional learning loss due to the school closures.

This study investigates students' learning loss from COVID-19 school closures using Istation's Indicators of Progress (ISIP™) assessments in reading and math. Istation is an integrated learning system that provides a formative assessment that can be used for either progress monitoring or benchmarking. Over 4 million students have been assessed using the ISIP Early Reading (ISIP ER), ISIP Advanced Reading (ISIP AR) and ISIP Math.

We used two research questions to guide us. First, we wanted to know if the learning losses experienced during the pandemic were greater than what would be expected from normal summer loss. Next, we wanted to know if these differences varied by socioeconomic status at the school level, specifically if students in high-poverty schools had more or less learning loss than students in low-poverty schools.

Methodology

Measures

ISIP assessments are web-delivered, computer-adaptive testing (CAT) assessments. They are built using two-parameter item response theory and driven by a fully CAT algorithm. ISIP gathers and reports frequent information about student progress in the critical domains throughout and across academic years (Mathes, 2011; Patarapichayatham et al., 2013).

The purpose of ISIP Reading is to measure students' reading ability and identify deficits in critical areas to provide continuous differentiated instruction. ISIP ER is available for prekindergarten through third grade, and ISIP AR is available for fourth through eighth grade. ISIP Math is designed for students in prekindergarten through eighth grade (Istation, 2018).

Data

This study focused on students enrolled in public schools in Texas. Each student had two years of ISIP data: 2019-2020 school year data and 2020-2021 school year data. Students with one-year data in either the 2019-2020 school year or 2020-2021 school year were excluded from this analysis. This helped to control for missing data in key time periods and also helped ensure that the sample was equivalent for both academic years.

In the 2019-2020 school year data, students had scores from the September assessment month through March of the 2019-2020 school year. Istation made the assessment and the curriculum available for students at home, and some students

continued using the Istation program in April and May of 2020 during the pandemic. Most students had ISIP scores up to the March assessment month, some students had scores up to April, and some students had scores up to May 2020. Because of the vast amounts of missing data in April and May and the potential sample bias due to access to technology or a conducive home environment, April and May scores are dropped from this study. Using information from the students' growth trajectories, we projected the expected growth for April and May, which will be described in the methods section.

In the 2020-2021 school year data, students had scores from the September assessment month. Because the COVID-19 pandemic was not under control at the beginning of the school year, many schools in Texas allowed students to take classes from either a virtual platform from home or in school in September 2020. Some students took ISIP assessments at home, and others took them at school. Preliminary research indicated that there were significant differences in scores when the students were assessed at home or school, and therefore we kept the test event from September 2020 for tests that were administered in school. Students who assessed at home were dropped from the analysis. This also helped to control for the variability in the home environment. After the two years' data are combined, there are eight test events in total.

We used the students' grade level in the 2020-2021 school year to compute the longitudinal growth. For example, a seventh-grade student means that the student was in the sixth grade in the 2019-2020 school year, and they are now in seventh grade in the 2020-2021 school year. In reading, fourth grade students were excluded from this study because of a scaling issue in ISIP ER and ISIP AR. ISIP ER has a different scale from ISIP AR, and fourth grade students who took ISIP ER in the 2019-2020 school

year when they were in third grade and also took ISIP AR in the 2020-2021 school year had scores from two different scales.

For the math assessment, we had the additional step of converting scale scores. ISIP Math was renormed for the 2020-2021 school year with a new vertical scale. We converted the old scale scores to the new scale scores for this analysis. For math, we encountered convergence issues in eighth-grade assessment; therefore, that grade was eliminated from this analysis.

The final data file had 292,349 students for reading, and 34,104 students for math. The sample is disaggregated by the socioeconomic status at the school level. To obtain this category, we used information on the percentage of students receiving free or reduced priced lunch at the school. Schools that have 75% or more students receiving FRPL are considered high poverty (SES 1). Schools that are mid-high poverty have between 50% and 74.9% of students receiving FRPL (SES 2). Mid-low poverty schools (SES 3) have between 25% and 49.9% of students receiving FRPL, and schools that have less than 25% of students receiving FRPL are low-poverty schools (SES 4). In both reading and math, there was more representation in high and mid-high poverty schools than in low or mid-low poverty schools. Less than 1% of the sample came from private or parochial schools.

Model

To answer the first research question of whether learning losses experienced during the pandemic were greater than what would be expected from normal summer loss, a piecewise growth model is used to estimate students' COVID-19 learning loss. It is a type of time series analysis for nonlinear growth with longitudinal data. A growth

model examines the development of individuals on one or more outcome variables over time. The outcome variables can be observed or continuous latent variables. A model was fit by grade level using Mplus software. Mplus handles the relationship between the outcome and time by allowing time scores to be parameters in the model so that the growth function can be estimated. This is the approach used in structural equation modeling (Muthén & Muthén, 1998-2017).

Table 1: Number of Students by Grade Level

Assessment	Grade 2019-2020	Grade 2020-2021	Sample Size	SES 1	SES 2	SES 3	SES 4
Reading	Pre-K	K	40,426	33%	31%	20%	17%
	K	1	47,448	31%	31%	21%	18%
	1	2	48,911	31%	30%	21%	18%
	2	3	42,242	33%	30%	20%	18%
	3	4	37,942	33%	29%	21%	18%
	4	5	36,485	33%	30%	19%	19%
	5	6	16,052	37%	30%	21%	12%
	6	7	15,584	37%	30%	21%	12%
Math	Pre-K	K	1,716	43%	44%	13%	0%
	K	1	6,502	30%	41%	20%	8%
	1	2	6,631	24%	42%	25%	8%
	2	3	6,461	25%	41%	20%	13%
	3	4	5,611	26%	41%	18%	15%
	4	5	4,398	24%	40%	18%	17%
	5	6	1,414	25%	44%	4%	26%
	6	7	1,371	20%	42%	12%	24%

Note: Percentages may not add up to 100 due to rounding; or private/parochial schools that do not have SES information.

In a piecewise growth model, different phases of development are captured by more than one slope growth factor (Muthén & Muthén, 1998-2017). It is suitable in many educational situations because a student's growth trajectory is not always linear. The piecewise growth model is suitable for this study because it allows multiple slope factors in the model. COVID-19 school closures happened in mid-March, so we could expect students had a linear growth trajectory from the beginning of the year until the

pandemic arrived in March. Students' growth trajectories may be different specifically in April and May as students tried to finish their academic year virtually at home. Over the summer students may or may not have improved their reading and math skills depending on their home environment. Therefore, students may have encountered summer learning loss as indicated by many studies such as Shafer (2016) and Quinn & Polikoff (2017). Once students headed back to school in fall of 2020, they started their school year with growth trajectories that varied from the school closures in the spring, through the end of the school year, to the beginning of the fall semester.

Kamata et al., (2013) demonstrated ways to model nonlinear growth using three testing occasions. They demonstrated the growth models in the context of curriculum-based measurement with the fall, winter, and spring reading fluency benchmark assessments using a linear growth model, a piecewise growth mixture model, a growth mixture model, and a growth model with an estimated time score model. They concluded that a piecewise growth mixture model performed well with three test events. Therefore, we applied a piecewise growth model with our longitudinal data with eight test events to estimate an effect of learning loss due to the COVID-19 pandemic on students' achievement in reading and math.

Piecewise models typically require larger sample sizes, and there were convergence issues when we tried to run them separately by grade and SES at the school level. Therefore, to answer the second research question of whether differences in learning loss varied by socioeconomic status at the school level, we used a cohort analysis and compared the means from September 2019 and September 2020 by grade

and SES to determine how far students were behind similar students in the same schools in the previous academic year.

Analysis

The piecewise analyses were completed by grade level for ISIP ER, ISIP AR, and ISIP Math. Figure 1 shows a model in this study. There are eight test events. The "i" is an intercept of the growth factors, and "s1" is the slope for the first phase of development, which includes the first seven test events (SEP2019, OCT2019, NOV2019, DEC2019, JAN2020, FEB2020, and MAR2020). This first phase covers students' growth trajectories before COVID-19 pandemic school closures. The "s2" is the slope for the second phase of development, which has only the last test event (SEP2020), when students headed back to school to start their new academic year in fall of 2020 during the COVID-19 pandemic. In other words, slope 1 represents students' growth trajectories in the 2019-2020 school year, whereas slope 2 represents students' growth trajectories in the 2020-2021 school year.

As mentioned earlier, approximately 80% of students did not remain in the program in April and May, and most students did not use Istation assessments over summer especially in June, July, and August. September is considered the beginning-of-the-year assessment month, and May is the end-of-the-year assessment month. April, May, June, July, and August were not included in the analysis. Again, the students' grade level in the 2020-2021 school year is used. In reading, we do not have results for students in fourth grade because of the differences in scale scores, and eighth grade is eliminated due to the convergence issue.
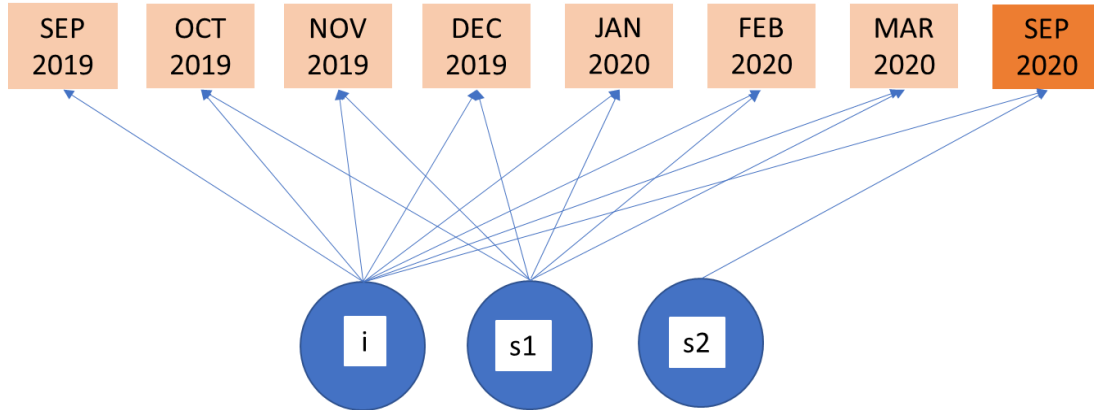
Figure 1: Piecewise growth model

Results

Piecewise Model

Table 2 shows the observed mean score by month. Table 3 shows the estimated intercepts, estimated slope 1, and estimated slope 2. The estimated intercept is a cut point on the y-axis, with the ISIP scores by month on the x-axis. The intercept shows the estimated scale scores at the beginning of the year, which is September of the 2019-2020 school year. Estimated slopes are the students' growth trajectories in each segment in a growth model. The estimated intercepts and estimated slopes 1 and 2 in Table 3 are used to the derive estimated mean score for each assessment month using the formula $\hat{y}_i = i + s_1 * (time1)_i + s_2 * (time2)_i$ and results are shown in Table 4. Observed mean scores and estimated mean scores were comparable across grades in both reading and math, indicating reasonable results from a piecewise growth model.

Table 2: Observed Scale Scores of Each Assessment Month

Assessment	Grade as of September 2020	SEP 2019	OCT 2019	NOV 2019	DEC 2019	JAN 2020	FEB 2020	MAR 2020	SEP 2020
Reading	K	165	169	175	177	179	181	182	180
	1	180	185	189	192	194	196	199	199
	2	202	205	208	210	212	214	217	221
	3	223	225	227	229	230	232	234	235
	5	1,830	1,849	1,871	1,892	1,903	1,880	1,908	1,915
	6	1,926	1,939	1,959	1,975	1,982	1,947	1,983	1,986
	7	2,008	2,006	2,034	2,021	2,051	2,002	2,023	2,044
	8	2,056	2,044	2,059	2,086	2,097	2,062	2,072	2,112
Math	K	210	214	224	233	240	244	258	321
	1	308	323	340	353	361	369	380	396
	2	395	411	426	437	442	453	463	453
	3	453	461	469	474	476	479	481	476
	4	478	483	490	496	498	505	509	496
	5	506	508	513	518	522	525	531	508
	6	517	513	519	522	537	538	540	527
	7	542	542	550	557	562	556	557	541

Table 3: Estimated Intercept, Estimated Slope 1, and Estimated Slope 2

Assessment	Grade as of September 2020	Estimated Intercept	Estimated Slope 1	Estimated Slope 2
Reading	K	164.879	2.762	-10.793
	1	180.371	3.053	-5.309
	2	201.262	2.435	-1.845
	3	221.828	1.800	-3.292
	5	1,831.960	12.158	-31.602
	6	1,927.053	8.557	-40.929
	7	2,010.222	5.038	-35.069
	8	2,053.472	7.266	-92.433

Assessment	Grade as of September 2020	Estimated Intercept	Estimated Slope 1	Estimated Slope 2
Math	K	209.796	7.805	28.826
	1	312.913	11.302	-8.293
	2	397.996	10.719	-26.404
	3	457.100	4.281	-12.169
	4	478.193	5.153	-16.963
	5	503.634	4.409	-25.260
	6	515.002	5.304	-21.027
	7	542.075	3.384	-21.021

Table 4. Piecewise Scaled Scores for Each Assessment Month

Assessment	Grade as of September 2020	SEP 2019	OCT 2019	NOV 2019	DEC 2019	JAN 2020	FEB 2020	MAR 2020	SEP 2020
Reading	K	165	168	170	173	176	179	181	180
	1	180	183	186	190	193	196	199	199
	2	201	204	206	209	211	213	216	220
	3	222	224	225	227	229	231	233	235
	5	1,832	1,844	1,856	1,868	1,881	1,893	1,905	1,910
	6	1,927	1,936	1,944	1,953	1,961	1,970	1,978	1,984
	7	2,010	2,015	2,020	2,025	2,030	2,035	2,040	2,044
	8	2,053	2,061	2,068	2,075	2,083	2,090	2,097	2,108
Math	K	210	218	225	233	241	249	257	321
	1	313	324	336	347	358	369	381	396
	2	398	409	419	430	441	452	462	453
	3	457	461	466	470	474	479	483	476
	4	478	483	488	494	499	504	509	496
	5	504	508	512	517	521	526	530	508
	6	515	520	526	531	536	542	547	527
	7	542	545	549	552	556	559	562	541

Reading

In reading, students encountered COVID-19 learning loss across grades. ISIP ER students (kindergarten to third grade) kept improving their reading ability until March. To better understand the impact of the school closures, we also projected scores for April and May. We evaluated the scores at each month and the associated percentile rank for each month. Most months varied by only a few percentile points. Therefore, we took the average of the percentiles across the months and used that percentile to project what growth would have been in April and May. We also projected the typical learning loss in the summer by using the incoming scores in September of the 2019-2020 school year. This method may not completely capture the full learning loss, as typically in Texas students take their May assessment in the beginning of the month and school lets out two to four weeks later. Students also begin school in August, and therefore there may be two months of instruction that the method described here does not fully capture.

Across grades, most of the growth trajectories were simply flat from March 2020 until they headed back to school in September 2020. In kindergarten, the estimated score for March in prekindergarten was 181, and the estimated September score in kindergarten was 180.

Their projected April 2020 score was 183, and the projected May score was 185. Kindergarten students experienced an estimated 5-point loss on the ISIP scale. In first grade, the estimated March 2020 score of their kindergarten was 199 and the estimated September score was 199. Their projected May score was 201. They experienced an estimated ISIP scale 2-point loss from the previous year and were 3 points behind last year's counterparts. This represents 2-3 months' learning loss.

In second grade, the estimated March 2020 score of first grade was 216 and the projected May score was 220. Students' estimated September score was 220. Typically they would score 222 in September and were therefore behind previous cohorts. This represents 1-2 months' learning loss. In third grade, the estimated March score of their second grade was 233 and their projected May score was 235. The estimated September score was 235, however the previous cohort had a score of 240, which indicates some normal reading growth from May to June when school closes, and from August to September when school opens. This 5- point difference represents about 2-3 months of learning loss.

ISIP AR students (fifth to eighth grade) had more pronounced learning loss. They also experienced a flat growth rate similar to early reading students. Based on the projections described above, students typically do not lose much in the summer when comparing the May and September scores, likely due to summer reading programs, and growth during May and August when school is in session. However, all three grades had flat learning trajectories, meaning that their March scores in a previous grade and their September scores were flat, indicating that they lost approximately 2-3 months of instruction time.

Cohort comparisons show that September 2020 observed mean scores are less than September 2019 scores, indicating that incoming students performed lower when compared to similar students in the previous year. The means students in first and second grade were 2 points behind the previous cohort, which is approximately 1-2 months' worth of additional learning loss.

There are differences in growth in upper elementary school, where students' typically do not lose as much learning in reading over the summer. Fifth to seventh grade students experienced 17, 26, and 11 observed ISIP scale point loss in the 2021 school year compared to the same grade level a year before. Students' scores in September 2020 were lower than their cohort in September 2019 across grade levels. Results from estimated mean scores also confirm the observed mean scores results. These losses demonstrated 2 months' loss of growth.

We found that students' September mean scores in 2020 were approximately equivalent to their mean scores around March or April in their prior year. This indicates that once students are pulled from schools in March, their learning trajectory was from them until September of 2020. Although some students may have been able to maintain their reading ability until the end of the school year, the majority of students did not maintain learning growth achieved after schools closed, but they did not experience additional loss. Previous research shows that students' growth trajectories are flat or decline slightly from May 2020, which is the end of the school year, to September, which is the beginning of next school year.

Typical summer learning loss in reading is either flat growth between May and September, or one month when using the ISIP reading scores. This research demonstrates that in reading, the COVID-19 school closure contributes approximately one to 2 months' loss in reading in addition to the typical summer loss. If there were gains during remote learning in the spring, they helped students to maintain the level they were already at, but students did not retain any of the gains that may have occurred. These results are consistent with many studies on COVID-19 learning loss as

well as summer learning loss in reading (Kuhfeld, Soland, et al., 2020; Kuhfeld, Tarasawa, et al., 2020; Quinn and Polikoff, 2017). Figures 2 – 3 show the difference between the expected summer learning loss and the actual COVID-19 learning loss by grade for ISIP ER, and Figure 4 shows the learning loss for students assessed with ISIP AR. These graphs show that the biggest loss was that student learning did not progress in April and May, and that for the most part students picked up in September where they left off in March of 2020.
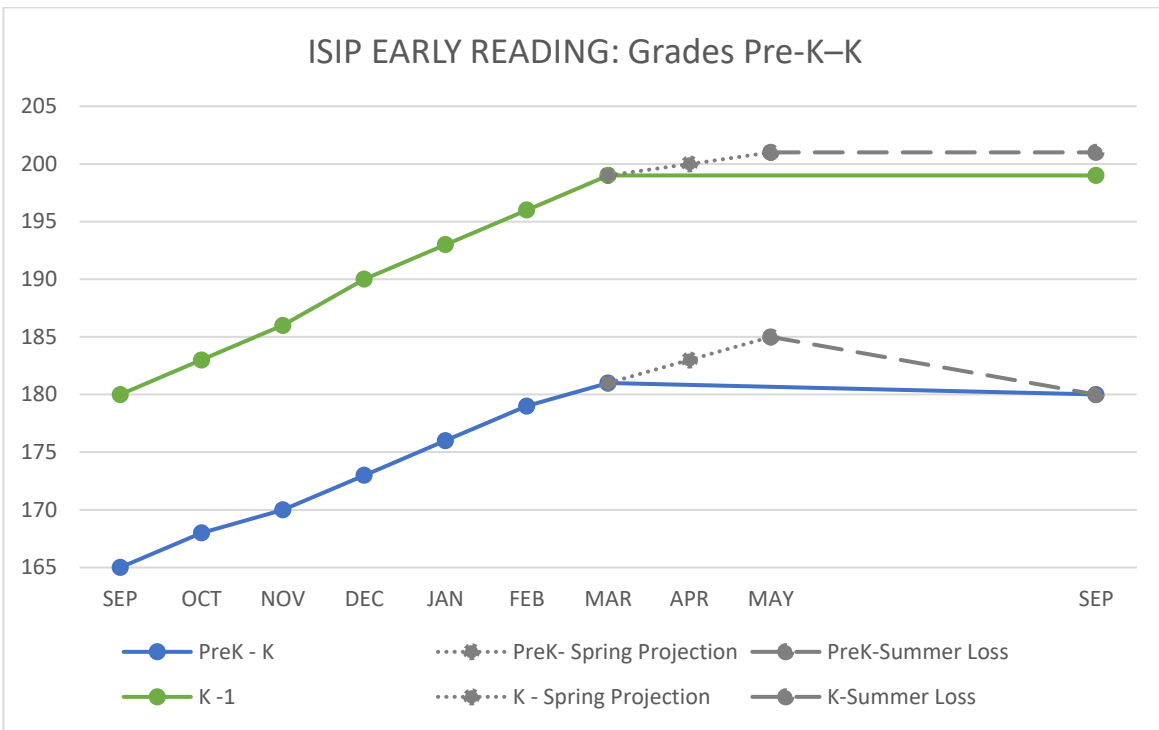
Figure 2. Typical summer loss and COVID-19 learning loss in reading: grades PreK-K.
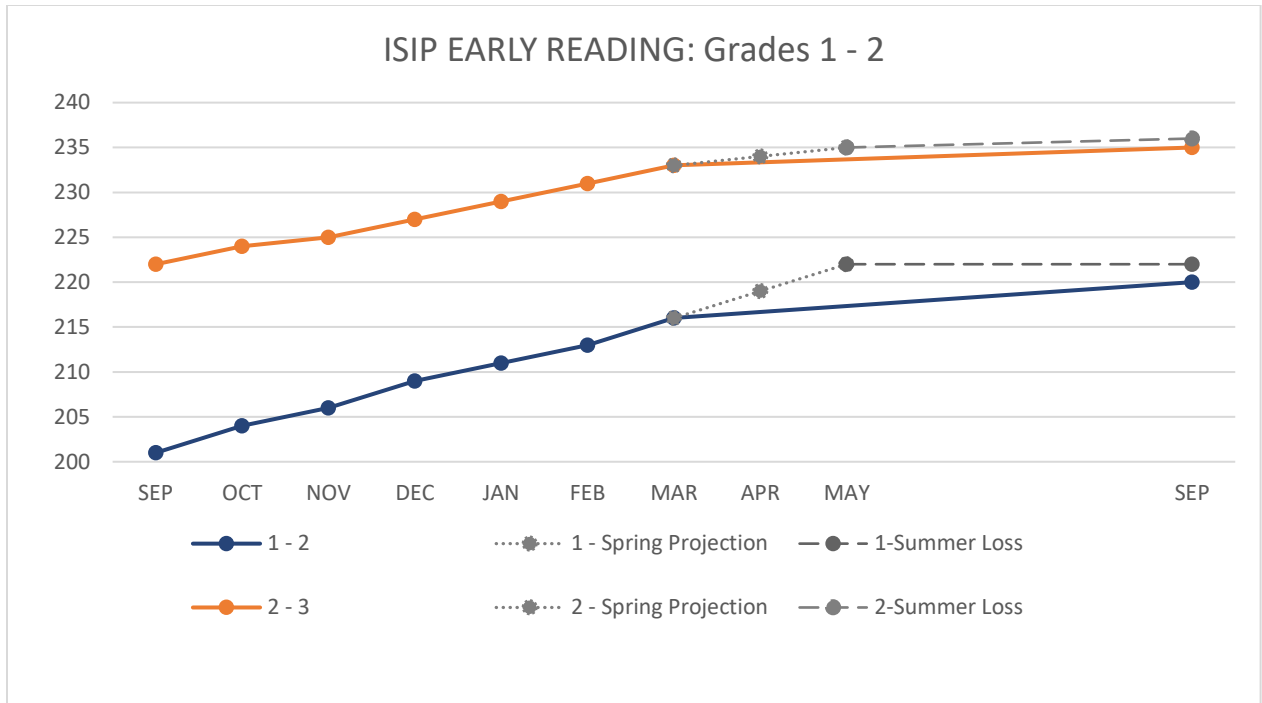
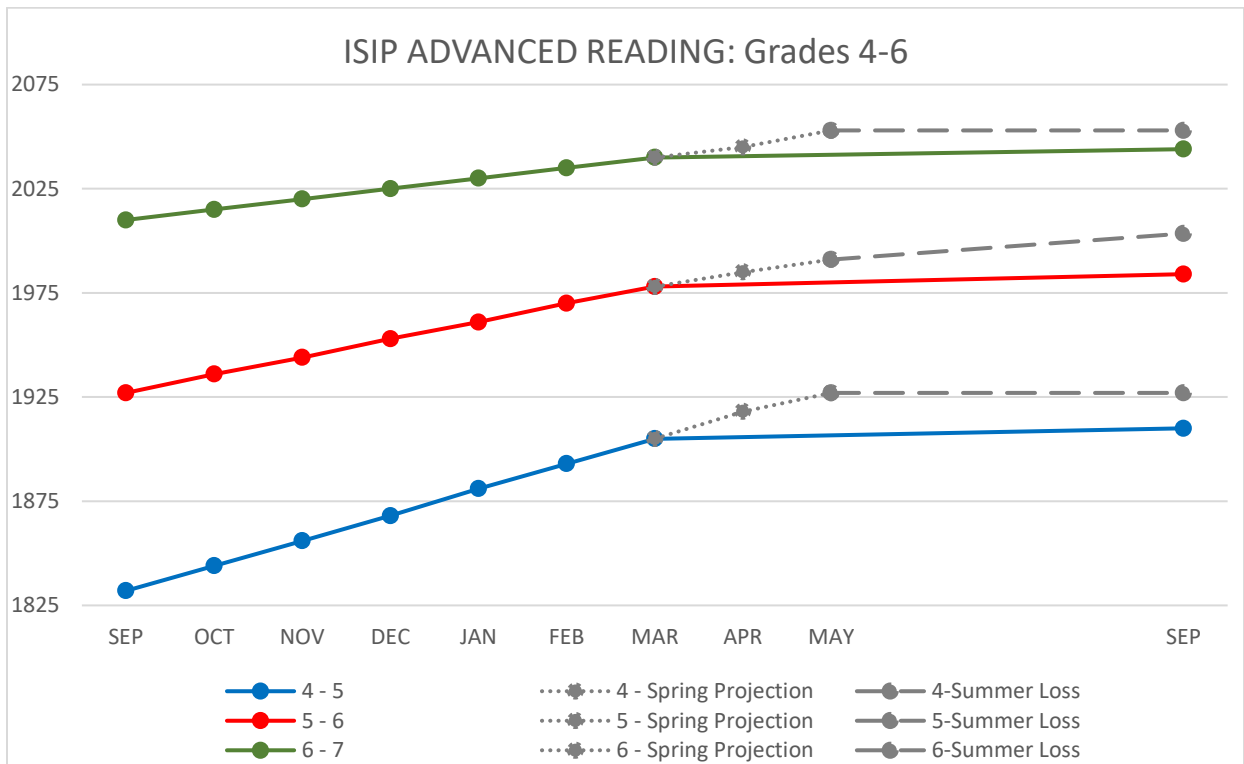Figure 3. Typical summer loss and COVID-19 learning loss in reading: grades 1-2.

Figure 4. Typical summer loss and COVID-19 learning loss in reading: grades 4-6.

Math

ISIP Math students encountered COVID-19 learning loss across grades in addition to the normal summer loss, although this varied by grade. The youngest students, those in kindergarten in the 2019-2020 school year who entered first grade in 2020-2021, scored slightly lower than students in the previous cohort and did not have a large loss. Starting in second and third grade, students experienced a higher loss. Students who were in third grade in the 2020-2021 school year were slightly behind, but students who were in fourth grade experienced a steeper learning loss, losing eight ISIP Math points as compared to the previous cohort. Students in higher grades have steeper declines in the summer as the math content gets more difficult and there are fewer opportunities to practice their skills over the summer. However, the loss due to COVID-19 was greater than the loss in reading, with students losing an additional 2 months in fifth grade, an additional 2 months in sixth grade, and an additional 2 months in seventh grade.

The cohort comparison shows that first and third grade students experienced a 2-point loss on the observed ISIP scale in 2020-2021 school year (396 in September 2020 vs. 398 in September 2019 for first grade and 476 in September 2020 vs. 478 in September 2019 for third grade). Second grade students experienced 4 points' loss on the observed ISIP scale in the 2020-2021 school year (453 in September 2020 vs. 457 in September 2019). Fourth to sixth grade students experienced 8-, 7-, and 15 points' loss on the observed ISIP scale in the 2020-2021 school year, respectively. Results from estimated mean scores also confirm these piecewise mean scores results.

Similar to ISIP ER and ISIP AR students, ISIP Math students showed COVID-19 learning loss when comparing their September 2020 performance scores to their previous assessment performance scores. Figure 5 shows the results for kindergarten and first grade. In first grade, students' September 2020 scores were approximately equivalent to their mean scores in April. Figure 6 shows the results for students in second and third grade, and these students' September 2020 scores were approximately equivalent to their mean scores around January and February of their prior grade level. In fourth and sixth grades, students' September 2020 scores were approximately the same as their December mean scores of their prior grade level. Moreover, in fifth and seventh grades, students' September 2020 scores were approximately the same as their mean scores around September or October of their previous grade level. These results are available in Figure 7.

It is evident that students lost their math ability more rapidly than reading ability, and students in higher grades experienced larger loss than students in lower grades. There are two reasons for the differences. First, understanding the ISIP Math norms helps to better put these results in context. The norms were developed using a parabola norming method that better fit the observed learning trajectory. For math, students have greater gains in the fall and winter months, and though growth continues through the spring, the gains are less pronounced. Students also lose their math ability over the summer even in a typical year.
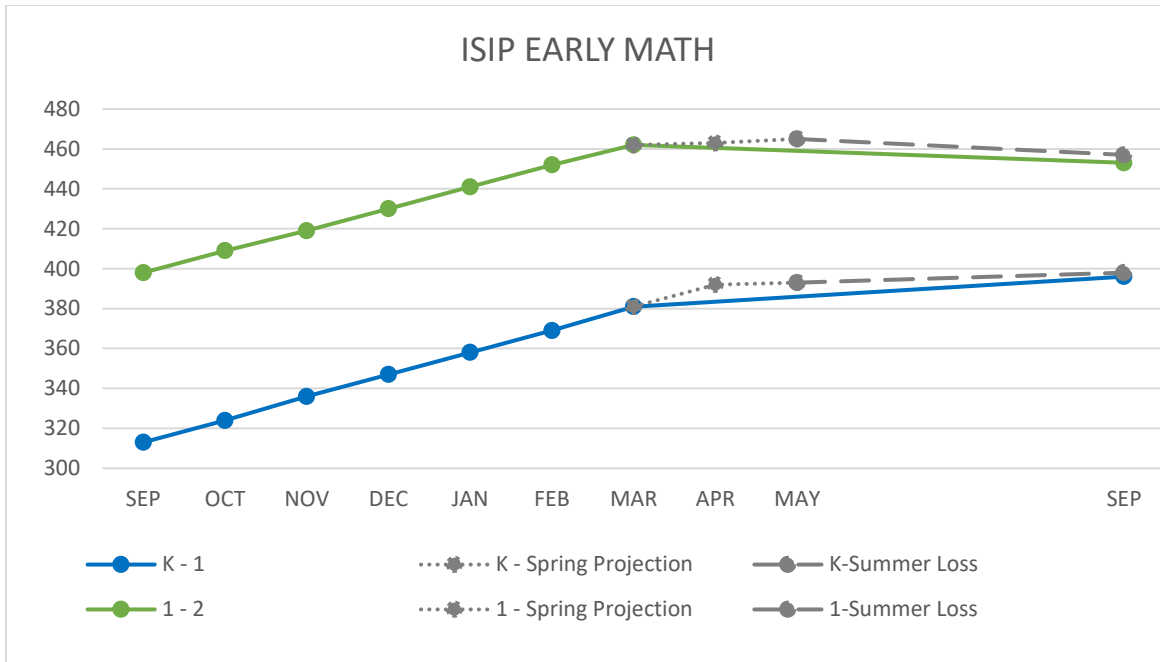
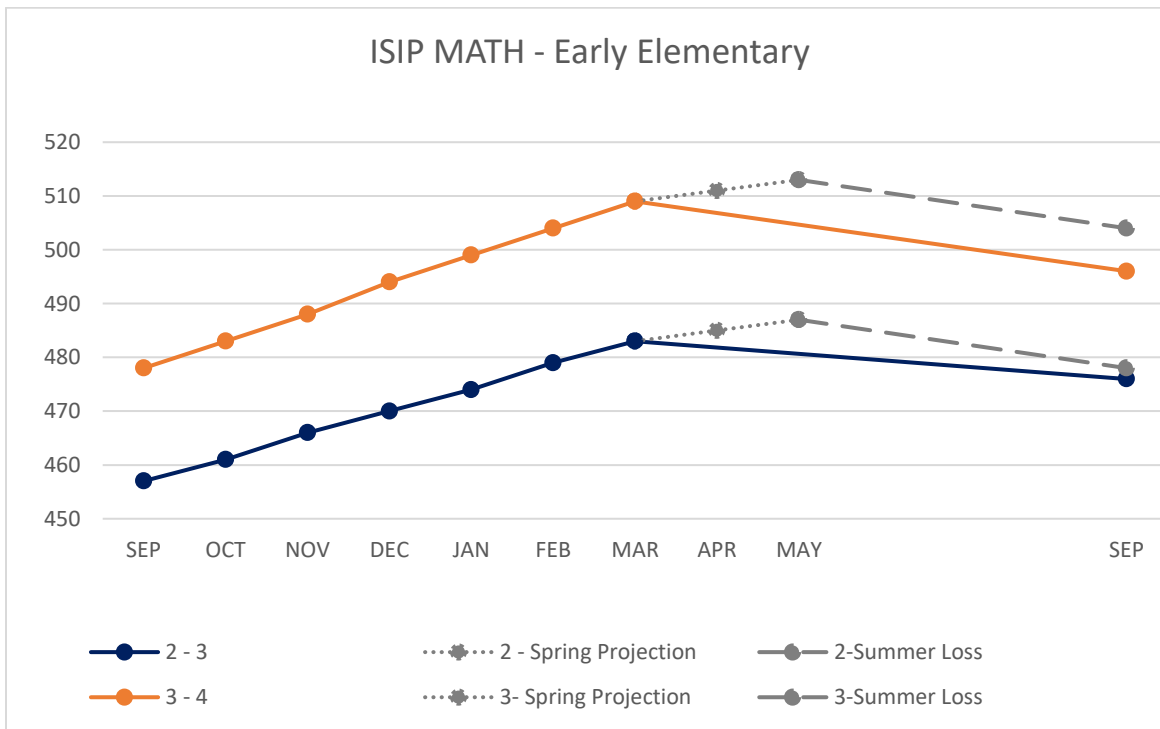Figure 5. Typical summer loss and COVID-19 learning loss in math: grades K-1.

Figure 6. Typical summer loss and COVID-19 learning loss in math: grades 2-3.
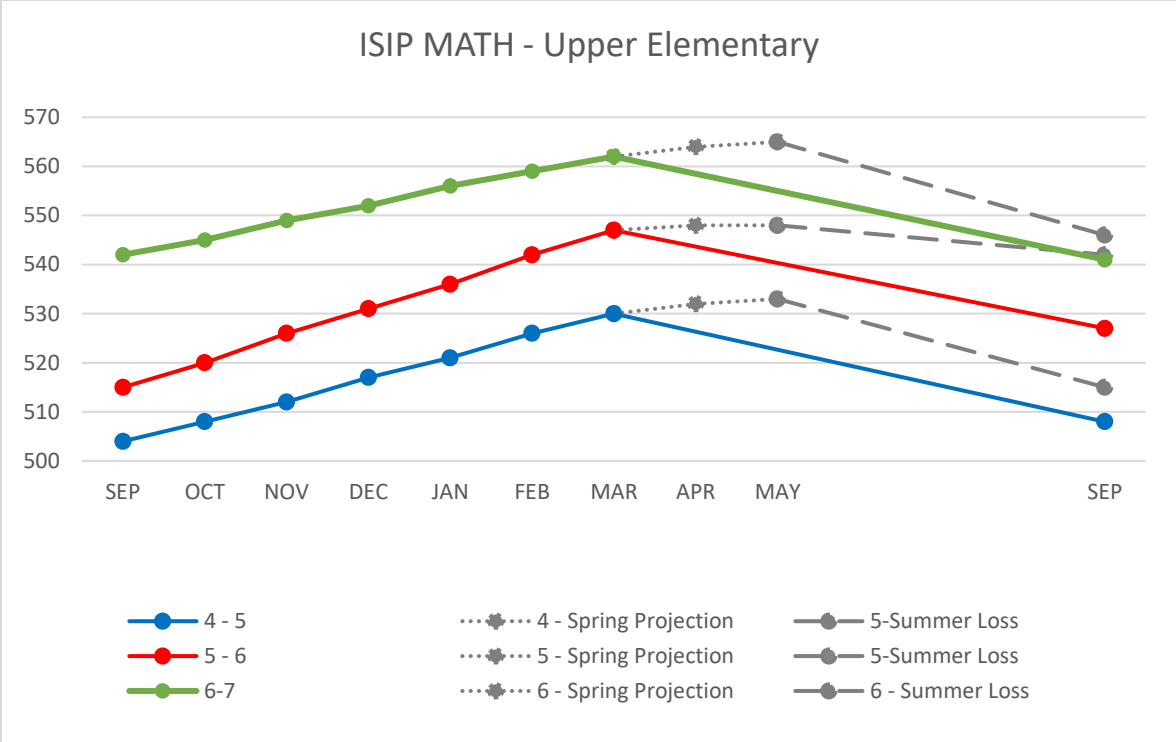
ISIP MATH - Upper Elementary

Figure 7. Typical summer loss and COVID-19 learning loss in math: grades 4-6.

It is typical that students in the lower grades lose 1-2 months of learning in math over the summer, and students in the upper grades have 3-5 months of learning loss. COVID-19 school closure contributes an additional 1-2 months of learning loss in the lower grades, and greater loss in the upper grades. In addition, students may lose more in the upper grades due to the type of subject matter being taught. Math gets more difficult and more abstract starting in fourth grade. Our results are consistent with many studies on COVID-19 learning loss and summer learning loss in math (Dorn, 2020; Kuhfeld, Soland, et al., 2020; Kuhfeld, Tarasawa, et al., 2020; Lewis et al., 2020; Locke, et al. 2021; Quinn & Polikoff, 2017; Shafer, 2016).

In summary, our findings show that in reading, students' growth trajectory kept going up until they finished their 2019-2020 school year. Once they headed back to school in September 2020, their scores dropped significantly. Students lost about 2 months of their reading ability due to COVID-19 closures in addition to the regular 1 month's summer learning loss across grades. In math, on the other hand, students in lower grades kept improving their math ability until the semester finished. Students in higher grades had flatter growth during COVID-19 school closures in mid-March until the end of the semester. Overall, students lost approximately 2-3 months of their math ability in lower grades and 4-5 months of their math ability in upper grades due to the COVID-19 closures in addition to the regular 1-2 months' summer learning loss.

COVID-19 Learning Loss by Grade and SES

Given that the piecewise results do not fully capture student learning loss given that students often have several weeks of instruction between the May and September testing sessions, we evaluated the differences between the student cohorts in September of 2019 and September 2020. In this analysis, we also wanted to compare the differences in learning loss experienced by students in different types of schools, namely whether the school was high poverty (SES 1), mid-high (SES 2), mid-low (SES 3), or low poverty (SES 4). We calculated the means for September 2019 and September 2020 by grade and SES at the school level. Results are available in Table 5 for ISIP Reading and Table 6 for ISIP Math.

For ISIP Reading, the cohort of students in the 2020-2021 school year is behind the 2019-2020 school year cohort of students in all grades and SES levels with a few exceptions. The kindergarten cohorts appear to be comparable, indicating that students

entering kindergarten were not as severely impacted by school closures. Otherwise, students scored lower than their previous-year counterparts by an average of 5.86 percentile points in September. All mean differences were significant, likely due to statistical power; therefore we calculated effect sizes using Hedges's g. Effect sizes give a measure of how meaningful the differences are, and they can be compared to a standard deviation, where an effect size represents .1 of a standard deviation, .5 is half a standard deviation, etc. The effect sizes in this analysis range from small to moderate. These results are depicted in Figures 8 and 9 and show that students across the grades and SES levels scored lower in fall of 2020 than similar students did in the fall of 2019. Of special note is that students in low-poverty schools lost more scale score points than students in high-poverty schools. This is consistent with research that indicates that at-risk students experience lower summer learning loss than students who are not at-risk (Campbell et al., 2019).

Table 5. Cohort Comparison by Grade and School Level SES for ISIP Reading

Grade	SES	Sept. 2019	Sept. 2020	Difference in Scale Score Points	Effect Size	Difference in Percentile Points
K	SES1	175.50	177.56	-2.05	0.13	+3
	SES2	177.88	178.11	-0.23	0.02	0
	SES3	180.82	180.80	0.02	0.00	0
	SES4	185.28	186.19	-0.91	0.07	-2
1	SES1	197.04	194.92	2.12	-0.14	-7
	SES2	200.81	197.40	3.41	-0.24	-9
	SES3	204.21	200.83	3.38	-0.24	-9
	SES4	209.83	206.33	3.51	-0.24	-9

Grade	SES	Sept. 2019	Sept. 2020	Difference in Scale Score Points	Effect Size	Difference in Percentile Points
2	SES1	218.20	215.64	2.56	-0.14	-5
	SES2	222.58	219.29	3.29	-0.19	-8
	SES3	226.39	223.22	3.17	-0.19	-5
	SES4	233.49	228.64	4.84	-0.28	-7
3	SES1	232.72	229.54	3.18	-0.17	-6
	SES2	237.74	233.99	3.75	-0.21	-9
	SES3	241.37	237.49	3.89	-0.22	-9
	SES4	247.74	243.11	4.63	-0.26	-9
4	SES1	1,784.36	1,745.11	39.24	-0.22	-8
	SES2	1,834.63	1,794.79	39.84	-0.23	-9
	SES3	1,871.57	1,832.90	38.67	-0.22	-9
	SES4	1,939.24	1,891.02	48.22	-0.28	-10
5	SES1	1,893.03	1,850.34	42.69	-0.23	-11
	SES2	1,938.30	1,900.80	37.50	-0.20	-9
	SES3	1,979.11	1,944.33	34.78	-0.19	-8
	SES4	2,063.35	2,005.53	57.82	-0.33	-11
6	SES1	1,958.63	1,939.23	19.40	-0.10	-4
	SES2	2,005.44	1,985.71	19.73	-0.10	-5
	SES3	2,054.73	2,017.91	36.82	-0.20	-8
	SES4	2,135.15	2,081.79	53.35	-0.30	-10
7	SES1	1,996.27	1,988.94	7.33	-0.04	-3
	SES2	2,043.74	2,037.69	6.05	-0.03	-1
	SES3	2,096.81	2,094.82	1.99	-0.01	0
	SES4	2,125.51	2,124.38	1.13	-0.01	0

Noteworthy in these results is that students in seventh grade are fairly consistent with the previous school year, and the differences are small. While the ISIP ER results show a trajectory in grade level and SES, the results for ISIP AR are somewhat different. There is more of a sawtooth pattern, where mean scores go up by grade and SES, but the following graph shows that students in SES 1 and SES 2 schools are performing in a manner more comparable with students in the previous grade in SES 3 and SES 4 schools.
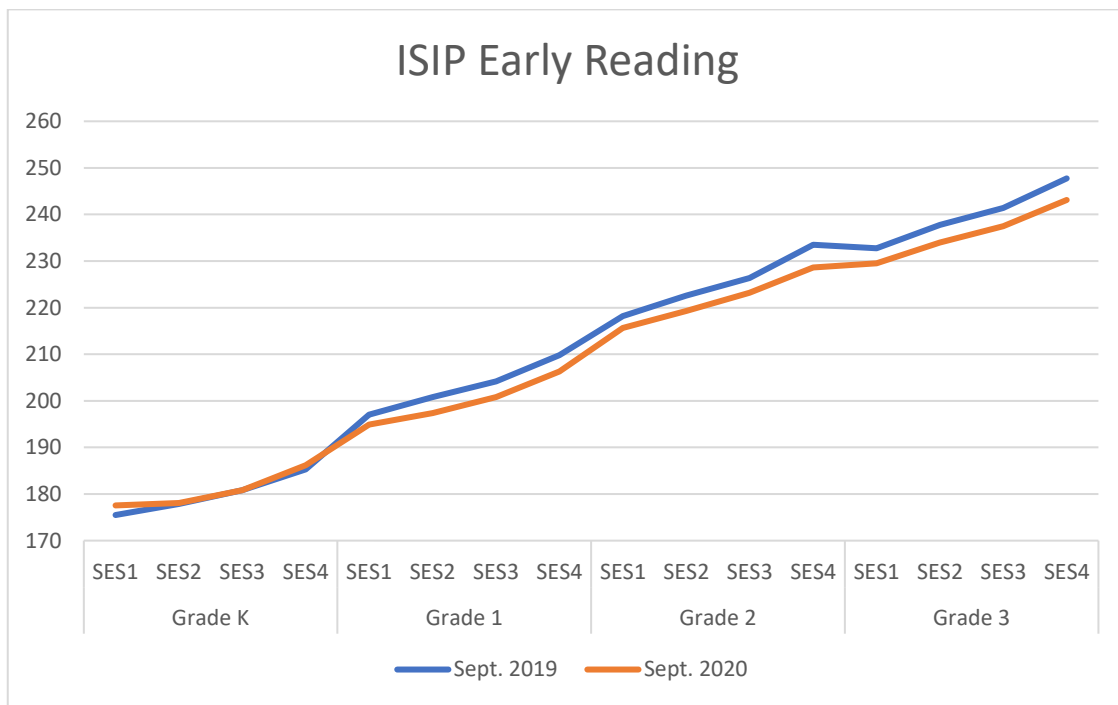

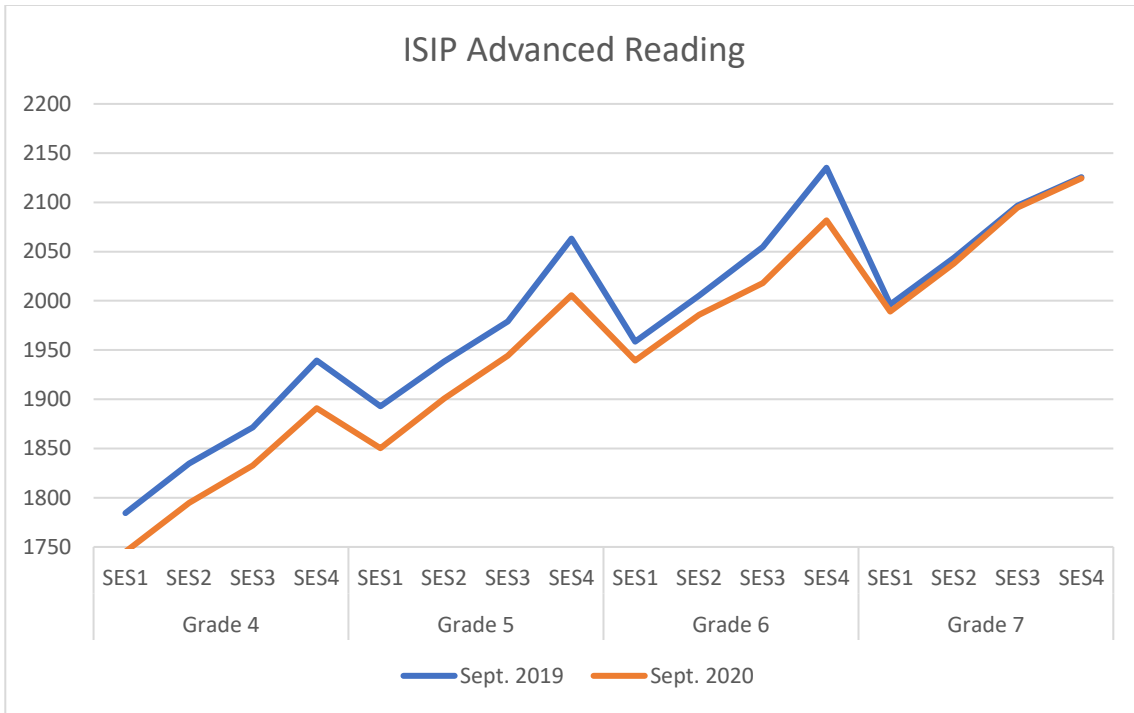Figure 8. Differences in cohort performance by school SES in reading grades K to 3.

Figure 9 . Differences in cohort performance by school SES in reading grades 4 to 7.

For ISIP Math, the cohort of students in the 2020-2021 school year score lower than students in the 2019-2020 school year cohort of students in all grades and SES levels, and the differences in the mean percentile points has a larger range. Students in kindergarten are slightly ahead of the 2019-2020 cohort in September. The mean in September is −5.55 percentile points with a range of +7 to −22. There is a greater gap in scores for students in first grade in SES 4 schools, where they fell several percentile points behind the previous year's cohort. In grades 2 and 3, students in SES 1 schools had comparable scores, but there was learning loss evident in students in SES 2 and SES 3 schools. Grades 4 to 6 have the greatest learning loss across all grades and SES categories. Figures 10 – 12 show these results. There is a sawtooth pattern in the lower grades, however in fourth and fifth grade the sawtooth pattern smooths out in the fall of 2020, showing that there was greater learning loss in the SES 4 schools.

Table 10. Mean Differences between Fall ISIP Math test scores by Grade, Month, and School Level SES

Grade	SES	Sept. 2019	Sept. 2020	Difference Scale Score Points	Effect Size	Difference Percentile Points
K	SES1	297.80	308.77	10.97	0.19	7
	SES2	305.35	307.31	1.96	0.04	1
	SES3	315.59	315.4	-0.19	0.00	0
	SES4	333.87	334.46	0.59	0.01	1
1	SES1	382.21	386.85	4.64	0.10	3
	SES2	390.60	389.88	-0.72	-0.01	-1
	SES3	399.89	399.00	-0.89	-0.02	0
	SES4	432.37	417.80	-14.57	-0.27	-11
2	SES1	447.01	447.67	0.66	0.02	0
	SES2	452.10	450.09	-2.01	-0.07	-2
	SES3	458.07	454.17	-3.90	-0.13	-5
	SES4	469.09	466.34	-2.75	-0.08	-3
3	SES1	471.33	470.91	-0.42	-0.01	-1
	SES2	477.01	473.98	-3.03	-0.10	-4
	SES3	483.40	478.87	-4.53	-0.16	-6
	SES4	489.80	488.59	-1.21	-0.29	-1
4	SES1	497.64	488.79	-8.85	-0.29	-10
	SES2	502.03	494.47	-7.56	-0.24	-9
	SES3	508.95	502.13	-6.82	-0.23	-7
	SES4	515.59	504.17	-11.42	-0.36	-13

Grade	SES	Sept. 2019	Sept. 2020	Difference Scale Score Points	Effect Size	Difference Percentile Points
5	SES1	509.66	502.15	-7.51	-0.22	-7
	SES2	512.54	506.37	-6.17	-0.17	-7
	SES3	520.34	514.26	-6.08	-0.17	-6
	SES4	537.28	516.72	-20.56	-0.52	-22
6	SES1	528.42	518.51	-9.91	-0.28	-10
	SES2	535.28	522.25	-13.03	-0.36	-14
	SES3	533.07	521.38	-11.69	-0.31	-12
	SES4	551.72	540.70	-11.02	-0.33	-10
7	SES1	532.96	526.20	-6.76	-0.17	-6
	SES2	527.57	535.56	7.99	0.19	7
	SES3	540.33	540.28	-0.05	0.00	0
	SES4	559.73	549.53	-10.20	-0.23	-9

As these results indicate, there is additional learning loss for students entering the 2020-2021 school year as compared to the previous year. Students consistently scored lower than their previous counterparts, with the exception of students in grade 7 in SES 2 and SES 3 schools. In most grades, students in SES 4 schools had larger effect sizes for mean score differences when compared to the previous cohort, indicating the loss was greater among higher performing students.
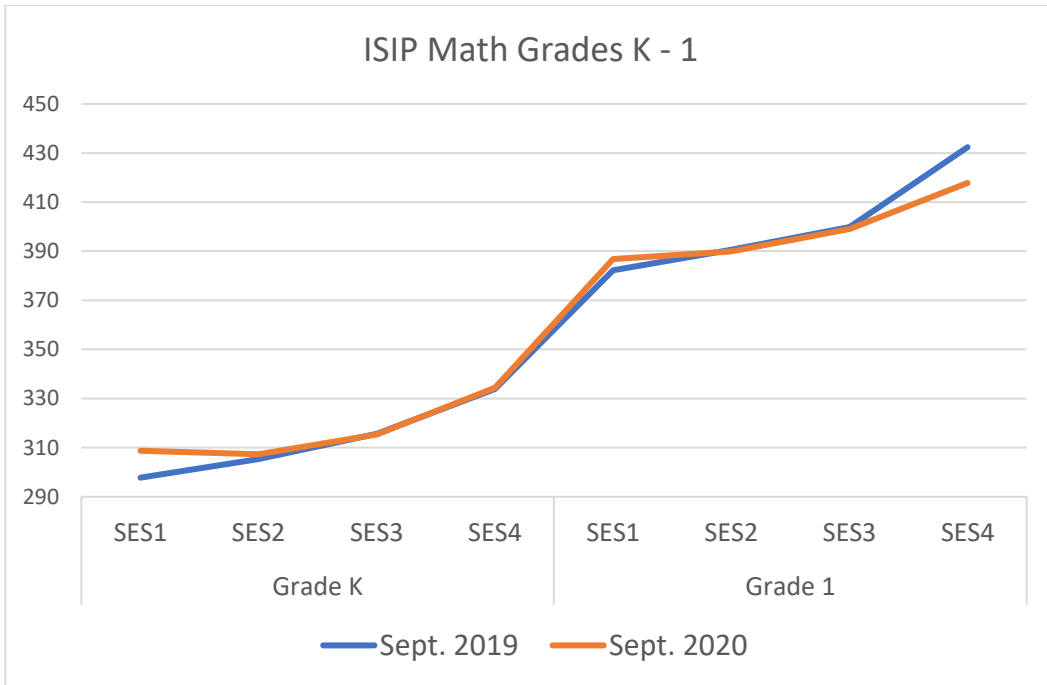
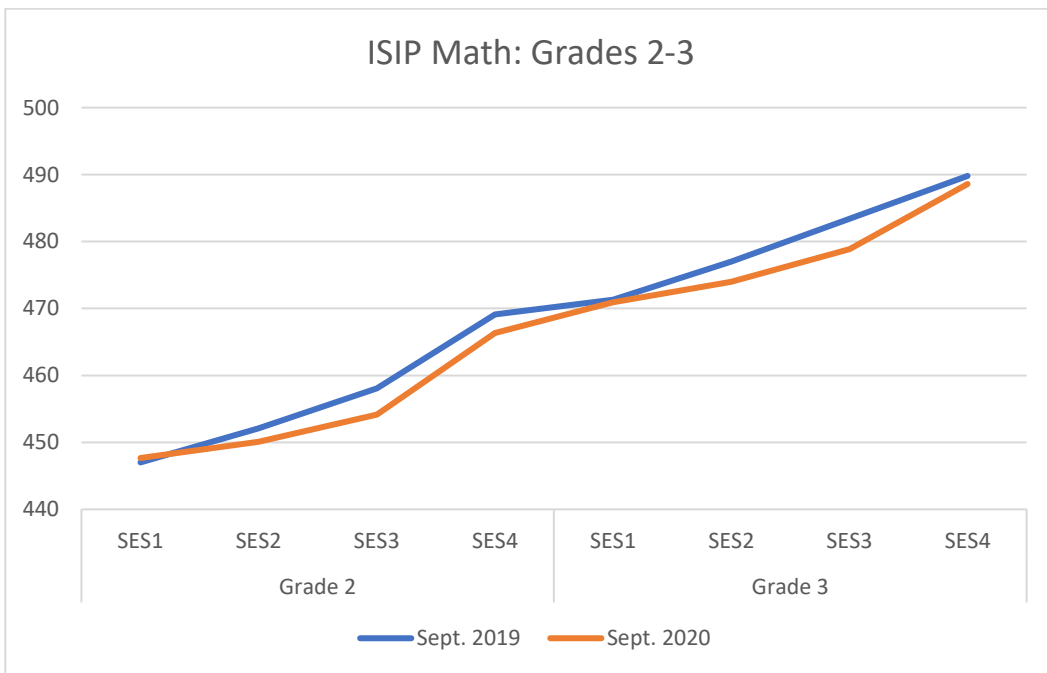Figure 10. Differences in cohort performance by school SES in reading grades K to 1.

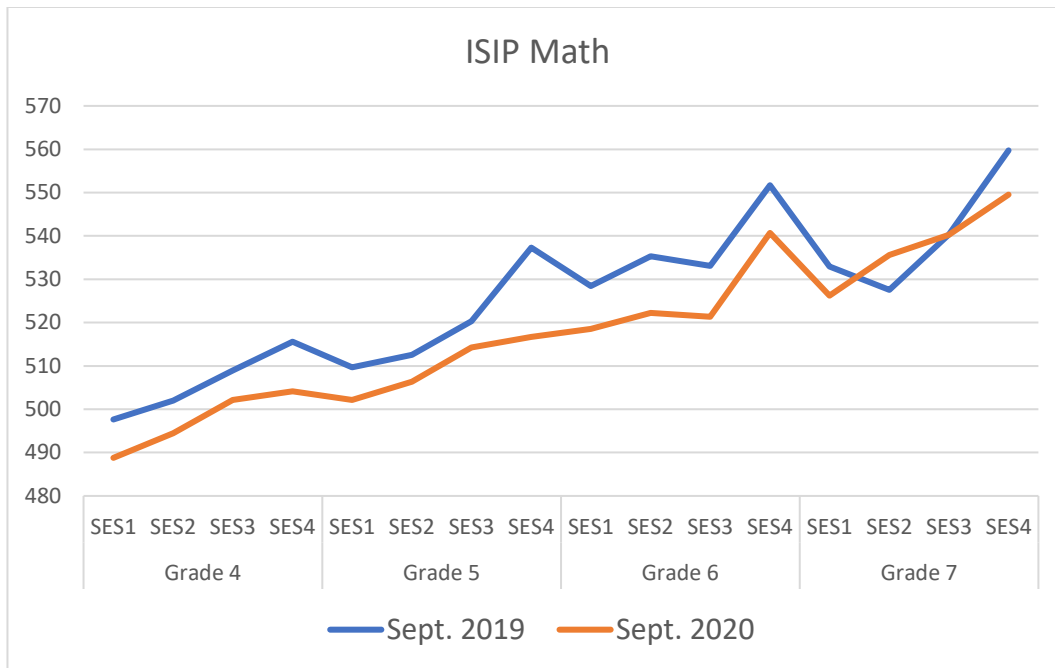Figure 11. Differences in cohort performance by school SES in reading grades 2 to 3.

Figure 12. Differences in cohort performance by school SES in reading grades 4 to 7.

Discussion

Our findings in both reading and math are consistent with previous research that found differences in learning gains and losses in reading and math (Kuhfeld, Soland et al., 2020; Dorn, et al., 2020; Huff, 2020). Students made learning gains through March in the 2019-2020 school year, but they did not make the typical gains in April and May. When they entered school in the fall, their reading ability was similar to what it had been in March when school closed, but they lost more months in math, especially in the upper grades. Research from Lewis, et al. (2020) showed that students who engaged in online learning using Istation during April and May had less learning loss than students who did not engage in online learning, and students in lower SES schools who engaged in online learning helped to narrow the achievement gap with students in higher SES schools. It is likely that online learning helped to stave off some of the anticipated

learning losses from the pandemic for those who were able to obtain the needed resources to do so.

Our findings show that learning losses were greater in math than in reading, and that it varied by school level SES. This is consistent with previous research (Dorn, et. al. 2020; Kuhfeld, Soland, et al. 2020).

The patterns of learning loss also follow what we know about summer loss in a typical school year. Shafer (2016) found that it was easier for students from all socioeconomic backgrounds to forget what they learned in math over the summer than it is for them to lose reading skills. Many parents and their children usually do not think about math as existing outside of the classroom, whereas reading activities are often part of a family's daily life. As a result, when the school year ends, students may have very few opportunities to engage in any type of mathematical thinking. Our research is also similar to Quinn & Polikoff (2017) which found that students' achievement scores declined over summer by one month's worth of school-year learning, and students in higher grades had more loss than the lower grades.

Implications and Path Forward

Our results indicate that students fell behind in reading and math during the COVID-19 pandemic. Students entering fifth, sixth, and seventh grade especially had learning losses in math that were substantially greater than would be expected over the summer. Teachers will need to take into consideration that students will need remediation of skills that they should have learned in the previous grade, and work with students to help them regain their skills. Cross-grade level teams may also help students catch up from the extended learning loss (Kuhfeld, Soland, et al., 2020).

Districts are working to assist teachers and students with the transition, but we also note in this research that the number of students in the analysis is lower in the 2020-2021 school year for the cohort analysis. Some students have seemingly disappeared from the classrooms, and districts will need to apply extra effort to locate these students and engage them in the educational process.

We currently do not know how much impact these learning losses will have, and whether or not the students will be able to catch up, especially since many schools have continued remote learning in the fall as the pandemic continued. We expect that the impact of COVID-19 extends beyond school closures in the spring of 2020 into the 2020-2021 school year. Some schools remained closed, while others opened with a hybrid model. There were also instances where schools would open for a while only to close again when there was a COVID-19 outbreak in the community. Likely there are ongoing effects of the disruption in learning in the 2020-2021 school year and tracking student progress throughout the school year and into following years is crucial for understanding the impact of the pandemic beyond the school closures in spring of 2020.

In a report from McKinsey & Company, they estimated that learning losses of five to nine months could occur by June 2021 (Dorn, et al. 2020). They recommended that districts work with teachers to make remote learning engaging, structured, and eliminate the digital divide. While further losses are expected, another approach is to look at acceleration plans using evidence-based programs to target at risk students and use formative assessments consistently to identify students that may fall through the cracks (Dorn, et al. 2020). Another approach may be to expand learning time during the day and consider summer in-person programs after the pandemic has waned.

Limitations and Future Directions

This study shows the impact of the COVID-19 pandemic on students' achievement in reading and math in Texas. While Texas is a large and diverse state, these results may not be as generalizable when comparing to other states, or to a nationwide sample.

This study focused on students who took the assessment in school in September 2020. While several studies showed that students performed differently when they took the assessment from home, the reason remains unknown. Future research needs to investigate why students who took the assessment from home scored significantly higher than students who took the assessment from school, and if there are ways to better control these differences.

Our results indicate that students lost their math ability more quickly, and while remote learning may have helped students retain their progress in reading, it was not the same for math. More research needs to investigate how remote learning is different in math than in reading, and what can be done to help students maintain their math ability as well as their reading ability. While educational technology cannot replace face-to-face teacher-student learning activities at school, virtual platforms are a powerful learning tool that can be helpful when students cannot join class in person.

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