Research Brief: Student Engagement in Online Learning During COVID School Closures Predicts Lower Learning Loss in Fall 2020

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Introduction

Following the emergence of the virus SARS-CoV-2 and the ensuing global pandemic of COVID-19, in March 2020 school districts across the country were shut-down as part of an effort to mitigate the spread of the virus. With schools closed, student learning transitioned to the home with students participating in school online, creating an unusual situation for students, parents, and teachers. News reports showed that many students simply stopped participating altogether (Goldstein, Popescu, & Hannah-Jones, 2020). Moreover, participation in online learning is likely to be impacted by student socio-economic status (Esquivel, Blume, Poston, & Barajas, 2020).

Among the issues highlighted by Esquivel, et al. (2020), is the lack of access to stable internet or computers among low-income houses, the inability of some working-class parents to simply stay at home and not work, and the lack of other tools and skills necessary to assist children in successful learning from home. A study by the Economic Policy Institute (Garcia & Weiss, 2020) pointed out that home-schooling works well for students who have access to "intentional, personalized, and sufficient resources" (p. 2). These conditions are more difficult to meet in lower income households. This is demonstrated by Garcia & Weiss' (2020) finding that the pandemic has worsened already existing opportunity gaps. The authors point out that uneven access to devices and internet access is one of the most critical disparities between low socioeconomic status (SES) and high SES households.

A study by Curriculum Associates showed that the interruption in instruction had created historical shortfalls in reading, with 25% of 2nd graders at least 2 grades behind in reading at the beginning of the year, compared with a historical average of just 19%

(Huff, 2020). This is supported by research from the Center for Research on Education Outcomes at Stanford University (CREDO, 2020) which demonstrated that students lost on average between 57 and 183 days of learning in reading. These findings demonstrate a clear loss in learning performance in reading and suggest that losses will be felt more so by lower SES households. It remains unclear if student losses in reading are greater among students who did not participate in online learning during the last two months of the 2019-2020 school year, and how much those losses may vary by SES.

ISIP and At-Home Learning

The Istation™ suite of tools is uniquely positioned to help fill some of the gaps created by the COVID-19 pandemic. Istation offers progress monitoring and assessment via the Istation's Indicators of Progress (ISIP™) Reading and Math assessments and offers interactive online curriculum that is tailored to a student's performance on these assessments. In this way, Istation may help to offer the kind of individualized instruction that Garcia & Weiss (2020) point out is crucial to student success. Additionally, ISIP assessments give information regarding a students' relative strengths and weaknesses, they give parents and teachers critical information about how best to help a student. Istation can thus be a powerful tool to help students be successful in learning at home.

After the school closures in March of 2020, Istation made the ISIP available for at-home administration, and also made the Istation curriculum and Ipractice, the at-home curriculum, available for all customers. This research is focused on whether or not engagement in online learning helped stem the learning loss for students that used Istation. We compare the Fall 2020 performance of those students who did or did not

engage in online learning using Istation, and if the differences varied by school level socioeconomic status (SES). Using whether or not a student had an ISIP™ score in April or May as a proxy for student engagement in online learning using Istation, and free-or-reduced price lunch information from the National Center for Education Statistics (NCES) as a measure of school level socioeconomic status, we are able to compare performance directly and determine how SES and engagement in online learning using Istation combine to determine how students are faring amid the challenges of the pandemic.

Data and Methods

For this study, we obtained data from the extensive Istation database. We limited the data to Texas schools that had used Istation assessments in both the 2019-2020 and 2020-2021 school years. The beginning of the school closures and the extent of restrictions varied by state and selecting only Texas schools allowed us to control for these differences. Schools with scores from only one year were excluded as we would either be unable to determine student engagement in 2019 or we would not have scores from the Fall of 2020. A total of 1,688 schools was included in the sample. A description of these data are provided in Table 1. Using the percent of students at the school who were Hispanic or Latino based on data from the National Center for Education Statistics (NCES), we created two categories: schools that had 40% or more of students who were Hispanic or Latino, and those that had less than 40%. Similar categories were created for the percentage of students who were African American. Four categories were created for percent of students who were white, and these categories follow quartiles for the national student body. Socioeconomic status at the school level was categorized using

the NCES categories of <25% of students who receive free or reduced priced lunch (FRPL), 25%-50%, 50.1%-75%, and greater than 75% of students receiving free or reduced priced lunch. We also used the NCES categories for rural, urban, and suburban schools.

Table 1. Description of Sample at the School Level

Total Number of Schools	**1,688**	
Race/Ethnicity at the School		
Greater than 40% Hispanic Origin	1006	60%
Less than 40% Hispanic Origin	682	40%
Greater than 40% African American	92	6%
Less than 40% African American	1596	94%
Greater than 82% White	40	2%
55%-82% White	253	15%
15%-54.9% White	624	37%
Less than 15% White	771	46%
Urbanicity of the School		
Urban (including small cities)	563	33%
Suburban	663	39%
Rural	462	27%
SES of the School		
Less than 24.9% FRP Lunch	212	13%
25% - 49.9% FRP Lunch	266	16%
50% - 74.9% FRP Lunch	501	30%
Greater than 75% FRP Lunch	709	42%

To address our research questions, we focused on differences in ISIP Reading scores. We first collected all ISIP Reading Scores from January or February of the 2019-20 school year to control for previous academic achievement. By using the Istation unique identifier, we also obtained their score in September of 2020. We then looked at whether or not the student had participated in online learning using Istation after

schools were closed in March. We created a dummy variable based on whether a student had an ISIP Reading Score in any month for the 2019 school year after the school closures started in Texas (i.e., a score in April, May, or June). If they had a score in these months, they were assigned a "1", if not, they were given a "0". After flagging student engagement and obtaining student scores, we then used the SES quartile to compare differences in ISIP Reading outcomes from the Fall of 2020, separating by both engagement at the student level and SES at the school level.

The ISIP Reading is split into an Early Reading assessment and an Advanced Reading assessment. For both assessments, there is not a minimum or maximum score. However, for the ISIP early reading, a score of 134 or below is in the 1st percentile for Fall of prekindergarten and a score of 290 or above is in the 99th percentile for Spring of third grade. For the ISIP advanced reading, a score of 1463 or below is in the 1st percentile for Fall of fourth grade, and a score of 2796 or above is in the 99th percentile in Spring of eighth grade.

We split the dataset by grade and used an analysis of covariance (ANCOVA) to assess mean differences in September 2020 scores by grade, student engagement and SES categories. January 2020 is the middle of the year benchmarking month, and we used these student scores as a continuous covariate in the model to control for prior achievement. Students who engaged in online learning using Istation may have differed in achievement level at baseline, creating a selection bias. Using January 2020 prior scores as a continuous covariate allowed us to control for this difference by covarying out these prior differences. Some students did not have a January 2020 score. For these students we used February 2020 scores where possible. Students who had no score in

either month were excluded from the analysis, as we did not have a baseline measurement for those students. Istation had allowed progress monitoring at home in September of 2020 in addition to the previous spring. Since progress monitoring at home scores tended to be higher than scores obtained at school, we excluded students who were using progress monitoring at home in Fall of 2020 to compare similar testing conditions with the January scores.

Results

We limited this study to the elementary grades K-5. The number of students in each SES Quartile according to NCES data is broken down by grade in Table 2. The total number of students in grades K-5 was 188,398. Kindergarten students had the lowest number of students in the study, as it was confined to those students who had used Istation in pre-kindergarten in the 2019-2020 school year.

Table 2. Number of Students in Each SES Quartile by Grade

	SES Quartile				
GRADE in Fall 2020	1	2	3	4	Total
K	228	264	185	147	824
	27.7%	32.0%	22.5%	17.8%	
1	13,800	13,824	9,006	9,162	45,792
	30.1%	30.2%	19.67%	20.0%	
2	13,481	13,531	8,492	7,665	43,169
	31.2%	31.3%	19.7%	17.8%	
3	13,607	11,569	8,026	6,743	39,945
	34.1%	28.9%	20.1%	16.9%	
4	11,488	8,632	5,962	4,063	30,145
	38.1%	28.6%	19.8%	13.5%	
5	10,102	8,354	5,737	4,330	28,523
	35.4%	29.3%	20.1%	15.2%	

Descriptive statistics broken down by grade and SES quartile are reported in Table 3 for students who did and did not engage with Istation content following the school closures. This table shows that the group mean for students with engagement is consistently higher than the group mean for students without. Means also increase as poverty decreases as shown by the consistently higher means for students in SES quartiles 3 and 4.

Seeing the pattern of increased means by student engagement and SES quartile, we conducted ANCOVAs to determine if the differences between students who had engaged with Istation content in the Spring of 2020 following the school closures in Texas were statistically significant. Again, students who had ISIP scores in April, May, or June of 2020 were flagged as having engaged, and students who did not have scores were flagged as having not engaged. We then compared differences in benchmark Reading scores from September 2020. The results are summarized in Table 3 below, followed by results from the ANCOVA models in Table 4.

Tables 3 and 4 show that there are clear, statistically significant differences in Fall 2020 reading scores by both SES quartile and student engagement. Students who engaged with Istation in the months following the school closures in the 2019-2020 school year suffered less learning loss in Reading in the Fall of 2020 even after controlling for prior year ISIP reading scores. This effect varied by school SES as the marginal means plots below indicate. Since the sample size is large, we also computed effect sizes using Hedges' *g*. This statistic is typically used when sample sizes for the different groups are not equal, and will give results similar to Cohen's *d*. The effect sizes are predominately over .20 with a few exceptions, mostly in grades 4 and 5. The highest

effect sizes are in first grade, where they range from .33 to .42. We plotted percentile ranks in the marginal means plot to better demonstrate the real differences between students. Error bars in all plots represent +/- 1 standard error.

Table 3. Descriptive Statistics by Grade and SES Quartile

		Students without Online Engagement			Students with Online Engagement				
Grade	SES Quartile	Mean	N	Std. Dev.	Mean	N	Std. Dev.	Hedges's g Effect Size	Hedges's g Effect Size by Grade
K	1	177.71	184	14.23	181.05	44	16.49	0.23	0.53
K	2	180.26	196	17.25	182.65	68	13.88	0.14	
K	3	182.25	103	13.48	189.01	82	13.85	0.49	
K	4	180.81	72	14.13	195.80	75	17.04	0.95	
1	1	194.47	8,068	14.52	199.49	5,732	16.46	0.33	0.37
1	2	196.21	7,668	14.38	201.38	6,156	14.68	0.36	
1	3	199.17	3,960	13.19	204.31	5,046	14.64	0.37	
1	4	203.10	3,828	14.18	209.19	5,334	14.55	0.42	
2	1	215.58	8,409	19.79	219.61	5,072	19.41	0.21	0.23
2	2	219.16	8,346	18.31	223.52	5,185	17.86	0.24	
2	3	223.01	4,513	17.54	225.77	3,979	16.90	0.16	
2	4	227.69	3,608	17.00	231.16	4,057	16.81	0.21	
3	1	228.64	8,328	19.82	234.28	5,279	19.25	0.29	0.29
3	2	232.96	6,994	18.38	238.33	4,575	17.26	0.30	
3	3	237.49	3,974	18.17	241.45	4,052	17.79	0.22	
3	4	242.26	2,877	18.45	245.66	3,866	17.16	0.19	
4	1	1738.18	7,099	188.19	1776.07	4,389	183.40	0.20	0.19
4	2	1789.62	5,456	185.05	1817.77	3,176	172.18	0.16	
4	3	1832.54	3,199	184.15	1857.17	2,763	175.14	0.14	
4	4	1868.56	1,618	182.21	1901.81	2,445	162.85	0.19	
5	1	1845.63	6,532	190.97	1883.91	3,570	193.35	0.20	0.18
5	2	1900.01	5,759	187.70	1929.15	2,595	183.32	0.16	
5	3	1939.92	3,550	182.63	1972.80	2,187	178.55	0.18	
5	4	2000.84	2,191	177.11	2028.40	2,139	183.67	0.15	

Table 4. ANCOVA comparisons of FRPL Quartile & Engagement

Grade	Variable	df	SS	MS	*F*	p	Partial η^2
K	Prior ISIP	1	206915478.77	206915478.77	8267.54	<.001	0.637
	SES Quartile	3	170736.05	56912.02	2.27	*ns.*	0.001
	Online Engagement	1	502101.81	502101.81	20.06	<.001	0.004
	Interaction	3	181091.65	60363.88	2.41	*ns.*	0.002
1	Prior ISIP	1	70471.46	70471.46	400.49	<.001	0.346
	SES Quartile	3	5186.31	1728.77	9.82	<.001	0.038
	Online Engagement	1	2623.76	2623.76	14.91	<.001	0.019
	Interaction	3	1047.23	349.08	1.98	*ns.*	0.008
2	Prior ISIP	1	5036462.23	5036462.23	27618.94	<.001	0.354
	SES Quartile	3	114125.87	38041.96	208.61	<.001	0.012
	Online Engagement	1	51820.97	51820.97	284.18	<.001	0.006
	Interaction	3	1660.32	553.44	3.03	<.05	0.000
3	Prior ISIP	1	6419945	6419945	23402.04	<.001	0.294
	SES Quartile	3	309021.4	103007.1	375.4825	<.001	0.020
	Online Engagement	1	53745.06	53745.06	195.912	<.001	0.003
	Interaction	3	7101.675	2367.225	8.629031	<.001	0.001
4	Prior ISIP	1	11235914.67	11235914.67	63718.25	<.001	0.541
	SES Quartile	3	104476.50	34825.50	197.49	<.001	0.011
	Online Engagement	1	14038.26	14038.26	79.61	<.001	0.001
	Interaction	3	1430.27	476.76	2.70	<.05	0.000
5	Prior ISIP	1	60856080.21	60856080.21	1899.77	<.001	0.039
	SES Quartile	3	124878322.02	41626107.34	1299.46	<.001	0.076
	Online Engagement	1	10472866.71	10472866.71	326.94	<.001	0.007
	Interaction	3	774170.40	258056.80	8.06	<.001	0.001

Fig 1. Estimated Marginal Means Plot for Kindergarten

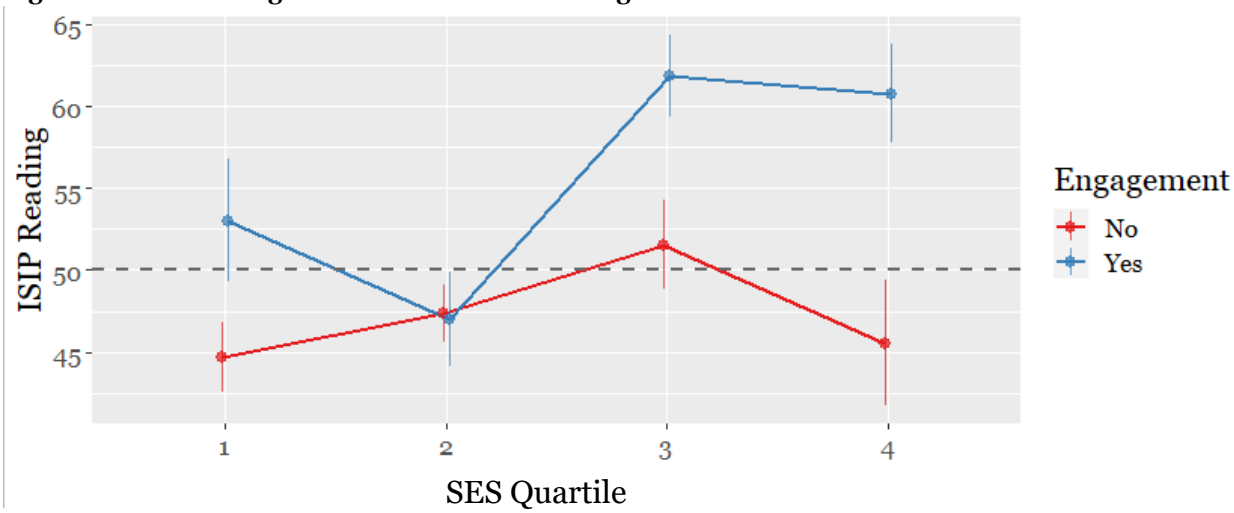


Fig 2. Estimated Marginal Means Plot for 1st Grade

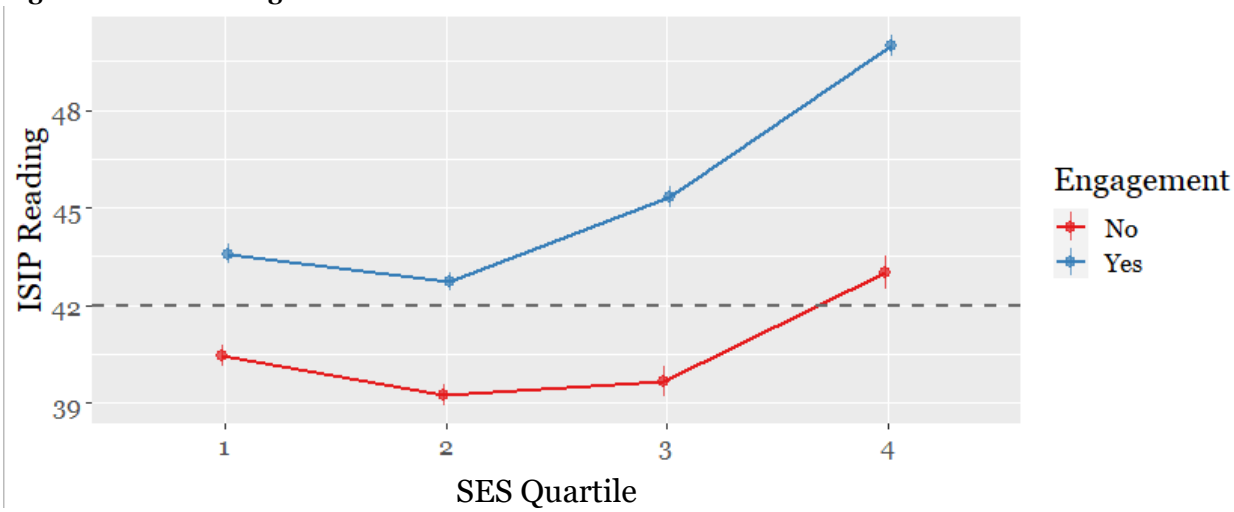


Fig 3. Estimated Marginal Means Plot for 2nd Grade

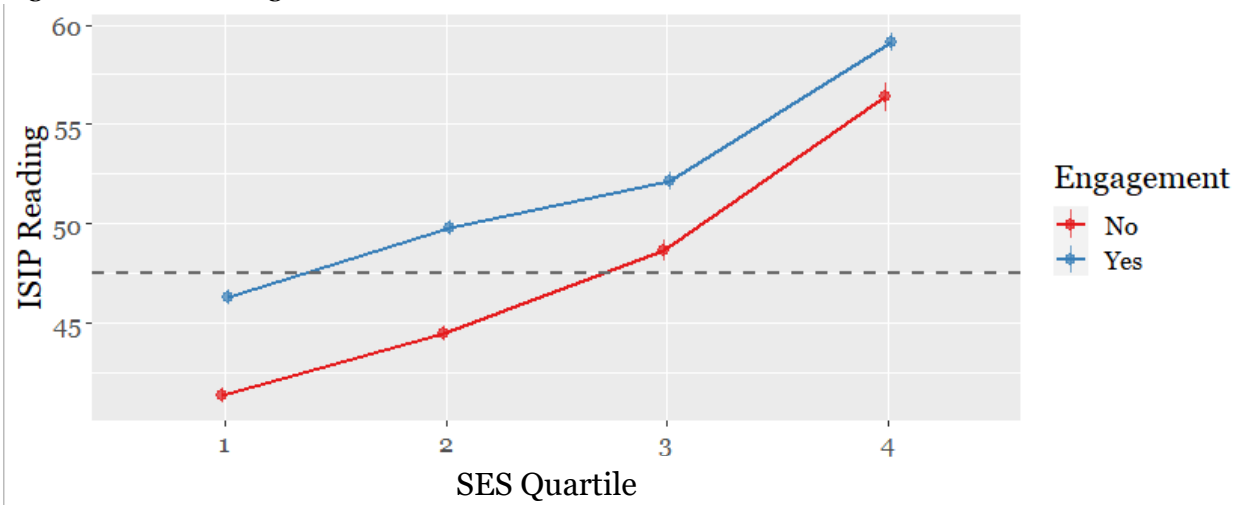


Fig 4. Estimated Marginal Means Plot for 3rd Grade

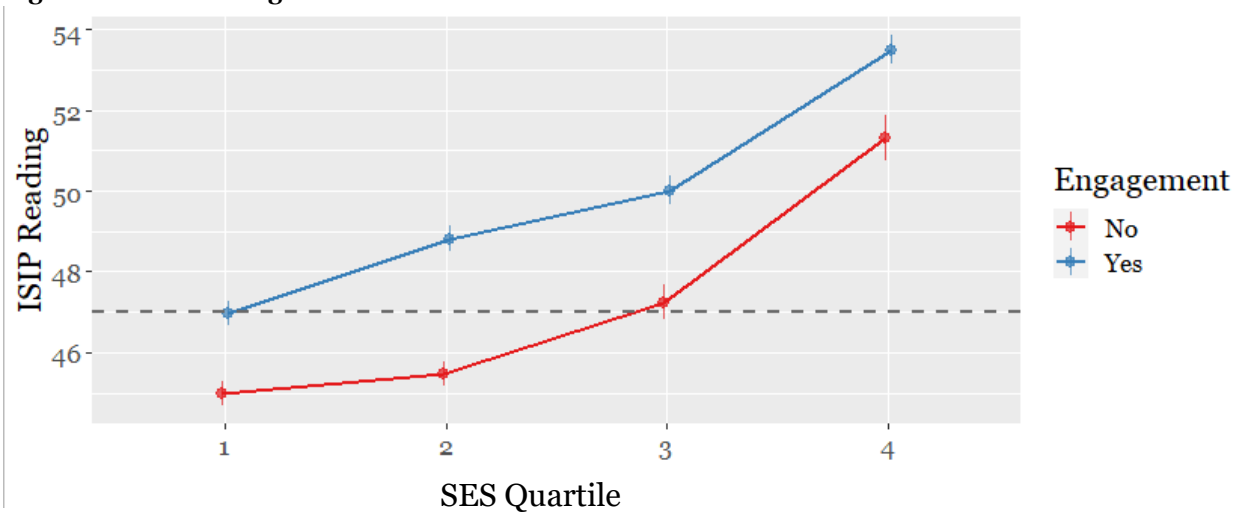


Fig 5. Estimated Marginal Means Plot for 4th Grade

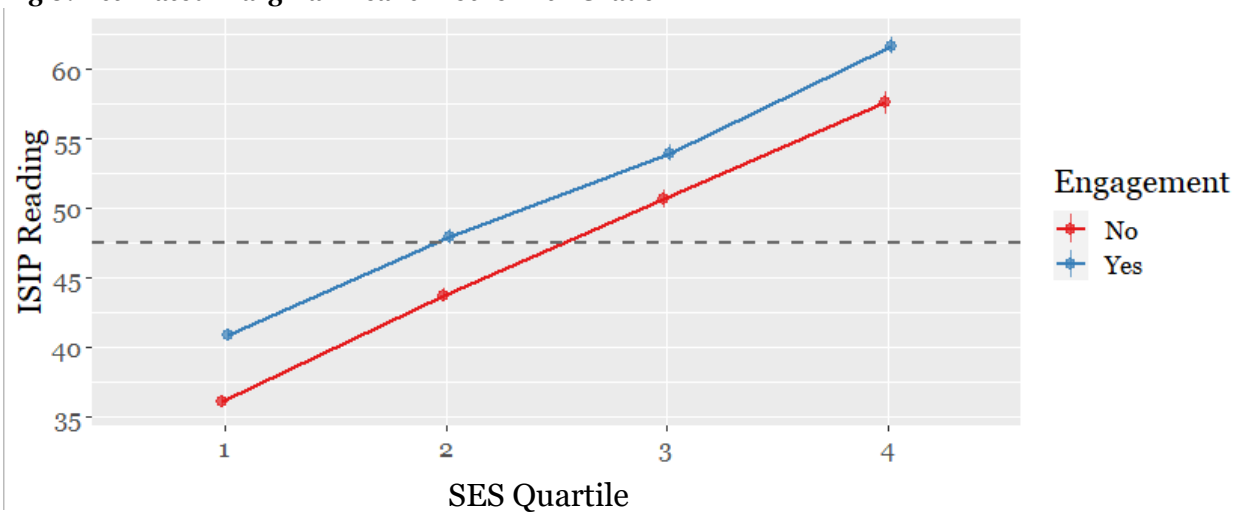
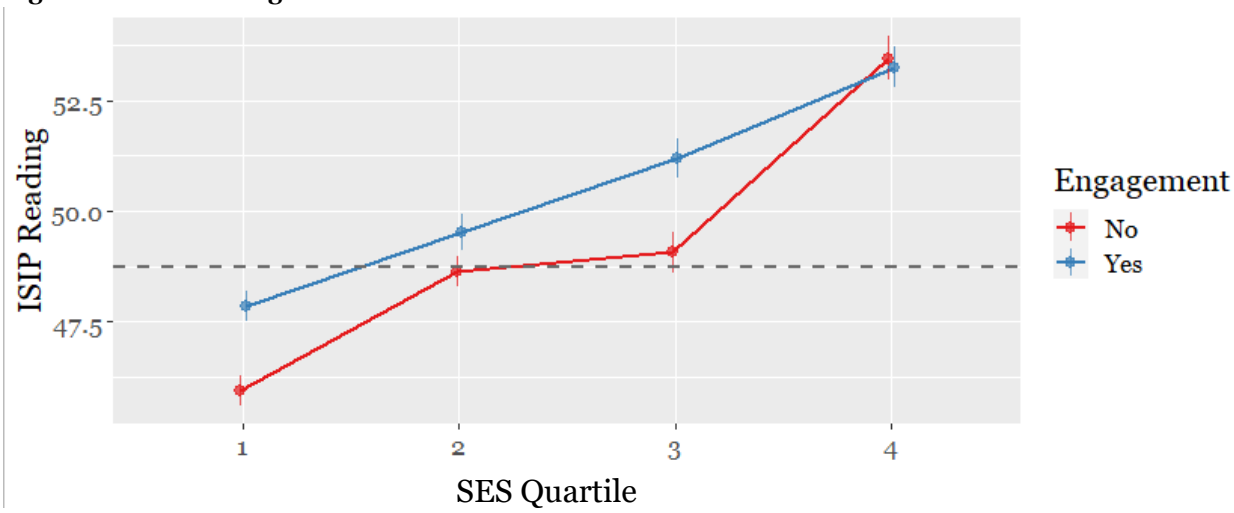


Fig 6. Estimated Marginal Means Plot for 5th Grade



The results clearly show that scores for students who showed engagement in online learning using Istation in April or May of 2020 after the school closures performed better in September 2020. As expected, scores are consistently higher for lower SES groups for students who engaged in online learning using Istation. For grades 2-4, the marginal means plots indicate that there is greater separation between students with and without engagement at the lowest SES quartile. This suggests that students from schools with the highest rates of poverty suffer the greatest negative impact of reduced learning and engagement for these grades. These effects persist even when controlling for prior achievement, which helped to eliminate the possibility of differences between students at the outset.

In figure 2, the differences between first graders with online engagement and without online engagement ranges from 3.5-6 percentile rank points. Moreover, students in SES quartile 1 with online engagement scored higher than students in SES quartile 3 in grade 1. In grades 2 and 3, the difference between SES quartile 4 and SES quartile 1 students was lower for students with online engagement. Collectively, these results show that ISIP narrowed the gap in achievement between students in high poverty versus low poverty schools, and further bolsters the assertion that low SES students received the most benefit from Istation usage.

Discussion

The effect of COVID-19 on student learning outcomes is of great concern to educators, parents, and students across the country. It is likely that the significant disruption in usual learning settings will have an adverse impact on many students.

Researchers are predicting that the learning loss will be extensive for students, but that may vary by grade and exacerbate summer learning loss (Kuhfeld, et. al. 2020). Additionally, this disruption is expected to widen existing disparities in educational outcomes as a function of SES. Our findings add evidence to reinforce these concerns and quantify the effect of this disruption on student scores. Specifically, we show that students who did not engage in online learning using Istation in the Spring of 2020 following the school closures had significantly lower scores on the ISIP Reading in the Fall of 2020. This effect varied as a function of SES, especially in grades 1-4, where students in lower SES quartiles who did not engage showed a greater disadvantage compared to students who did engage. This supports the concern that COVID-19 has disproportionately disadvantaged students from lower SES households.

Given that student engagement is such a powerful predictor of future performance, parents must strive to keep students engaged in learning. This may be especially challenging for lower SES households, where parents may not be able to work from home, may not have the flexibility in their work schedules to assist students who may be struggling, and who may not have the same access to the internet and other resources critical to successful at home learning. Istation may be able to ameliorate some of these gaps by providing students with online curriculum and assessments and providing detailed information to parents and teachers about a student's strengths and weaknesses. What is very clear from these results is that educators, parents, and policymakers must work together to make certain students are engaged in some form of learning, especially lower SES students. Students may need assistance with devices, access to the internet, and closer monitoring from their teachers. All students must have

access to the tools and resources needed to make at home learning as successful as possible now and for possible future pandemics.

Limitations and Future Directions

It is not yet clear what may be the cause of these disparities. It could be that students from higher SES categories are engaging in at home learning using resources other than Istation. Additionally, it is not clear why students who did not engage performed poorly compared to students who did. It may be that high-performing students are more likely to engage in learning, so that there is a selection bias in comparing students on this basis. We attempted to control for this by using prior scores as a covariate in the analysis, but other artifacts of a selection bias between the groups may persist. Future research might be able to parse out these causes by examining the relationship between high or low levels of Istation curriculum usage and ISIP Reading test scores, which could in turn show that Istation curriculum per se is associated with higher test scores, as opposed to other learning resources.

We used the presence of an assessment score as a proxy for online engagement in learning using Istation. Schools and districts may have been using online tools other than Istation during the spring of 2020. This may also have biased some of these results.

Finally, the sample for this study was limited to students in the state of Texas. Future research should examine these effects in other parts of the United States, that had different models for returning to school, including all remote learning, or all in-person.

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