COVID-19 learning losses: early grade reading in South Africa

Abstract

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Using three different studies on early grade reading from no-fee schools across in South Africa, this paper establishes short-term learning losses in reading for grade 2 and 4 students from under-resourced school contexts. We find that in 2020 grade 2 students lost between 57% and 70% of a year of learning relative to their pre-pandemic peers. Among a grade 4 sample, learning losses are estimated at between 62% and 81% of a year of learning. Considering that in 2020 students in the samples lost between 56% to 60% of contact teaching days due to school closures and rotational timetabling schedules compared to a pre-pandemic year, this implies learning to schooling loss ratios in the region of 1 to 1.4. There is some evidence from the grade 4 sample that the reading trajectories of children benefiting more from attending school pre-pandemic – namely girls and children with stronger reading trajectories - are more negatively impacted. Mitigating the long-run implications of these learning losses will require a significant pivoting of the education system to ensure that instructional practices are appropriately levelled to optimise learning.

1. Introduction

A year after the World Health Organization declared the outbreak of the COVID-19 pandemic, around half the world's students were still experiencing complete or partial school closures (UNESCO 2021). The length of school closures varies by development level with children from poorer countries missing substantially more classroom instruction time than children from high income countries (United Nations 2020). Every day that children are out of school, they risk falling further behind with potential long-term consequences for their future well-being (Kaffenberger 2020, Angrist et al 2021). With prolonged closure, learning losses can be expected to exceed what is suggested by actual days of school lost as children forget skills acquired before the closure (Gustafsson and Nuga 2020). School closures may also increase the risk of dropout for vulnerable children (Smith 2020).

Among developing countries, the average number of schooling days lost has been high (Angrist et al 2021, UNESCO 2021) yet the ability of their education systems to respond to school closures and support remote learning has been limited. Education responses to the crisis depend crucially on home learning environments, parental ability to support learning, digital connectivity and skills; all attributes along which there is a great divide between richer and poorer countries (Avanesian et al 2021 and Hossain, 2021). Moreover, developing countries were facing a learning crisis prior to the pandemic with children already battling to keep up with curricula demands and classes characterised by high variability in learning levels (World Bank 2018, Kaffenberger 2020). School closures will likely amplify that variation and schools that are able to provide effective remediation and pivot to more targeted individualised learning will be in a better position to mitigate the impact. Disparities along all these dimensions are expected to exacerbate learning inequality between high- and low-income countries (Jones et al 2021, Azevedo et al, 2021).

Governments, international organisations and education policy researchers urgently need accurate information on the costs of school closure if they are to optimally manage responses to the ongoing pandemic and design recovery strategies. Evidence on actual learning losses due to COVID-19 is only starting to emerge and comes almost exclusively from high-income countries where school closures

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were fairly short and schooling systems are highly effective (see for example Engzell et al 2021, Maldonado and De Witte 2020 and Schult et al 2021).

This paper contributes to the literature on COVID-19 learning losses by providing one of the first pieces of evidence on the impact of COVID-19 disruptions on learning from a developing country. Our study draws on three different studies on early grade reading from no-fee schools located in three South African provinces. Following Angrist et al (2021) and Azevedo (2020), we conceptualize learning losses as the combination of a "deterioration" of knowledge that is forgotten over time, and the "opportunity cost" of lost learning which is the learning students would have gained over a typical year of schooling if schools were not disrupted. For a given level of remediation efforts, the larger the extent of these combined losses in early grades, the larger the detrimental impacts not only for later learning but for future life outcomes, human capital and ultimately economic growth (Azevedo et al 2021; Hanushek and Woessmann 2020).

Using a difference-in-difference strategy, we estimate short-term learning losses in reading for grade 2 and 4 students from under-resourced school contexts. Our results highlight significant short-term losses in learning in 2020 due to COVID-19 disruptions of between 57% and 81% of a normal school year. South Africa simply has no option but to engage in significant remediation efforts in the coming years and to avoid future school disruptions as much as possible.

This paper is organised as follows. The next section summarises earlier literature on school closures, related simulations and the emerging evidence on COVID-19 school closures. Section 3 presents the data and schooling losses are described in Section 4. The methodology is discussed in Section 5. Results on learning loss are presented in Section 6. The final section concludes.

2. Background

While educational disruptions due to COVID-19 are unprecedented in length and global scope, previous empirical evidence on the impact of planned and unplanned school closures can provide some indication of the impacts we might expect.

Evidence on the impact of unplanned closures comes from teacher strikes in Belgium (Belot and Webbink 2010), Argentina (Jaume and Willen 2019), Canada (Baker 2011) and South Africa (Wills 2020); shortened school years in Germany (Cygan-Rehm 2018 and Hampf 2019), children who missed school during World War II (Ichino and Winter-Ebmer 2004) the 2005 earthquake in Pakistan (Andrabi et al 2020), the 2014-2015 Ebola epidemic in West Africa (Bandiera et al 2020 and Smith 2021) and Hurricane Katrina in the US (Sacerdote 2012).

Several of these studies document long-term effects of school closures with affected children having lower educational attainment, lower earnings, higher unemployment and being more likely to be in lower skilled occupations in adulthood (Jaume and Willén 2019, Belot and Webbink 2010, Cygan-Rehm, 2018, Ichino and Winter-Ebmer 2004).

There is a sizeable literature on learning losses over the planned long summer break in the US (see Cooper et al 1996 for an early meta-analysis and Kuhfeld 2020 for a summary of more recent research). Similar losses have been documented in Canada (Davies and Aurini 2013) and there is some evidence of the phenomenon in Europe (Lindahl 2001, Meyer et al 2017, Verachtert et al 2009). In the same vein, researchers have documented learning losses associated with transitions between schooling systems in Ghana (Sabates et al 2021) and the break between grade transitions in Malawi (Slade et al 2017).

Learning losses tend to exacerbate existing inequalities as they disproportionately affect the most disadvantaged students. The gap between low-income and middle- to high-income children that accumulates over the summer vacations is well documented (Cooper et al 1996, Allington et al 2010)[4]. Post Ebola increases in high school dropout rates were highest amongst youth from the poorest households in Sierra Leone and Guinea (Smith 2020). In Pakistan, mothers' education fully mitigated the impact of the disruption of the 2005 earthquake on learning losses (Andrabi et al 2020).

In the absence of available data, several organisations and researchers have used prior research on school closures or extrapolations based of loss of share of a year of schooling to model and predict the likely impact of COVID-19 school closures on learning. Kaffenberger (2020) simulates learning losses using data from seven low- and middle-income countries. As a conservative estimate, they project that school closure lasting one-third of a normal year during grade 3 will result in a one-year deficit by grade 10. In their model, the initial learning loss is exacerbated as students return to school behind the curriculum and therefore continue to fall further behind as they move through school. Kuhfeld et al (2020) provide projections for the US based on the analysis of summer learning patterns of five million students together with estimates from the absenteeism literature. They predict that grade 3 to 8 students would enter school in the fall of 2020 with losses of around 32% to 37% of a normal year in reading and around 50% to 63% in mathematics. These losses would be disproportionately experienced by weaker students, with the top third potentially making learning gains in reading. Azevedo et al (2020) simulate scenarios for varying lengths of school closures and effectiveness of remote learning based on assumptions from the World Banks Learning Adjusted Year of Schooling (LAYS) data for 157 countries together with data from the Programme for International Student Assessment (PISA). Their simulations consider the effect of household income loss on school dropout in addition to the impact of school closures. They predict COVID-19 impacts of between 0.3 and 0.9 quality-adjusted years of schooling.

Gustafsson and Nuga (2020) model learning losses for South Africa under various scenarios of how effective the schooling system is in catching up lost learning. If students catch up to pre-pandemic trajectories after three years, they predict below-expected grade 12 outcomes up to 2022. Without successful catch-up, they predict below-expected grade 12 outcomes to last 11 years.

Since these initial modelling exercises, it has become evident that school disruptions have been longer than initially expected, extending well beyond 2020. Angrist et al (2021) model contemporaneous impacts of COVID-19 related school closures on grade 2 and 3 reading fluency by the end of 2020 accounting for actual school closure periods (ranging between 13 to 45 weeks) but using pre-pandemic early grade reading assessment data from Ethiopia, Kenya, Liberia, Tanzania, and Uganda. They predict a cumulative 46% increase in grade 1 to 3 students being unable to read a single word of grade-level text and as much as a 51% decline in oral reading fluency at the mean across these countries overall. Projected forwarded, these losses could lead to 2.8 years of lost learning by grade 10. They note however that country specific impacts on early grade reading depend on the length of school closures, when lockdowns were imposed relative to school calendar cycles and the number of days of school that had taken place before the onset of school closures. Furthermore, their model predicts that the magnitudes of school closure impacts are particularly large for struggling readers (Angrist et al 2021).

Previous evidence on school closures and the related simulations and projections can tell us something, but the world has never experienced disruptions on this scale. Not only are there concurrent shocks of a widespread global economic downturn but these shocks are being experienced simultaneously

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[4] See Kuhfeld et al 2020 for discussion on mixed findings on losses and disadvantage in the more recent literature on summer learning losses in the US.

across the globe. School closures are happening at a time of heightened economic uncertainty, falling household incomes, rising unemployment and psychological costs associated with increased health and mortality risks. The unique challenges presented by COVID-19 underscore the need for empirical evidence of actual COVID-19 related school losses to inform policy responses to the crisis.

Evidence of actual learning losses due to COVID-19 school closures is starting to emerge from some of the highest income countries in Europe. Using standardized tests in the last year of primary school in Belgium, Maldonado and De Witte (2020) find that the 2020 cohort have mathematics scores that are 0.19 standard deviations lower than the previous cohort. Losses in Dutch were larger at 0.28 standard deviations. The also find that inequality within and between schools increased and that schools with a more disadvantaged student population experience larger learning losses. In a sample of Dutch primary schools, Engzell et al (2021) find learning losses for reading, mathematics and spelling that are equivalent to the period of time that schools remained closed. Over the relatively short eight-week lockdown, learning losses were around 0.08 standard deviations with losses up to 60 percent larger for students with less-educated parents. Tomasik et al (2020) compare learning progress in mathematics during the eight-week school closures in Switzerland to gains in the previous eight weeks. For primary school pupils, they find significant decreases in learning gains and significant increases in heterogeneity in learning during the school closures. They find no significant effects on secondary school pupils. Schult et al (2021) compare reading and mathematics scores from mandatory tests conducted in Germany in September each year. Compared to the previous three years, grade 5 students in 2020 have scores that are lower by 0.07 standard deviations in reading comprehension, 0.09 in operations, and 0.03 in numbers.

As Engzell et al (2021) points out, these findings surely represent a "best case" scenario from countries with highly effective schooling systems and relatively short school closure durations (between 8 and 9 weeks). The ability to respond to and recover from school closures depends on the length of closure and the capacity to support remote learning and remediate any gaps on return to school.

To the best of our knowledge, there is no published empirical evidence on the impact of COVID-19 on short-term learning in developing countries. Although we acknowledge a small grey literature from low-to-middle income countries pointing to evidence of learning losses in samples from Kenya, Ethiopia, Pakistan and Sao Paulo, Brazil.[5] These findings highlight the negative impacts of school closures on numeracy and literacy skills, and how remote learning, where possible, is a poor substitute for in-school instruction (Lichand et al 2021). This paper contributes to the evidence base on learning losses in developing countries. We exploit longitudinal data collected on early grade reading from four

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[5] In Kenya, a small and non-representative study of students with high usage of an online maths tutoring programme exhibited declines in maths age from 9.28 to 8.98 when assessed again between October 2020 and March 2021 (Whizz Education, 2021). This implies a learning loss in excess of 3.5 months. In Pakistan, children enrolled in both private and public-private partnership schools were asked a simple two-item student mathematics assessment over the phone in September 2020 and again in February 2021 (Crawfurd et al 2021). From this limited data, they identify that boys experienced learning losses while girls remain roughly on track as girls spent more time studying over the period than boys. The two-item assessment also suggests that poorer students are more likely to experience learning losses. In Ethiopia, emerging evidence suggests lower mathematics scores among grade 6 students at the start of the school year of about 30% to 40% as much as a normal year (Kim et al 2021). The study by Lichand et al (2021) in Sao Paulo, Brazil, estimates the effects of remote learning on secondary education. Using difference-in-difference estimation, they contrast variation in dropout risk and standardized test scores between the first and the last school quarters in 2020 to that in 2019, when all classes were in-person. They find that drop-out risk increased 365% under remote learning, and average standardized test scores decreased by 0.32 standard deviations.

different provinces in South Africa to estimate learning losses in grade 2 and 4 due to COVID-19 related disruptions to schooling in 2020.

3. Data

To identify learning losses in grade 2 and 4, we draw on three longitudinal studies of early grade reading in Nguni home languages (isiXhosa, Siswati and isiZulu) and English across no-fee schools in different South Africa provinces.

To estimate learning losses at the grade 2 level, we use data collected in three waves from an evaluation of the Funda Wande (FW) reading programme. This study was set in the three urban and peri-urban districts in the Eastern Cape province. At the beginning of 2019 (wave 1), 10 grade 1 (FW cohort 1) and 10 grade 2 (FW cohort 2) students were randomly selected for assessment from 57 isiXhosa quintile[6] 1-3, or commonly referred to as a no-fee, schools. These same students were re-assessed in the final term of 2019 (wave 2) and in the first term of 2021 (wave 3).

The second Early Grade Reading Study (EGRSII) was conducted between 2017 and 2019 in 180 no-fee schools in two districts in the Mpumalanga province. Reading outcomes were tracked for a single cohort of students from 180 schools over five data collection periods from the start of grade 1. Comparable assessment tasks in Nguni home languages (Siswati or isiZulu) and English First Additional Language (EFAL) are only available from the end of the grade 2 year in 2018 (wave 3), followed by the end of grade 3 in 2019 (wave 4) and the end of grade 4 in 2020 (wave 5).

EGRSII allow us to calculate learning gains over a period of COVID-19 disruptions, but identifying what learning trajectories would have looked like in a normal year requires a counterfactual sample. For this we draw on assessment data from the Story Powered Schools (SPS) study. Using similar assessments to EGRSII, 10,233 grade 2 to 4 students were assessed in isiZulu, isiXhosa and EFAL from 354 no-fee schools in predominately rural KwaZulu-Natal and Eastern Cape province schools at the beginning of 2018 (wave 1) and term 3 of 2019 (wave 2).

Sample sizes

Table 1 summarises the student samples used from these studies in this paper. We will compare the reading gains of students who were in grade 2 in 2020 (FW COVID group) against students who were in grade 2 in 2019 (FW counterfactual group) in the same schools. We will also compare the performance of students who were in grade 4 in 2020 (EGRS II COVID group)[7] against that of students who completed grade 4 between 2018 and 2019 (SPS counterfactual group). It is noted that across the three studies, assessment data from treatment and control schools are pooled together as treatment effects were modest, and there is no reason to expect differential COVID-19 disruptions by treatment.

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[6] Quintiles refer to Department of Basic Education proxies for the socio-economic status of a school. Quintile 1 to 3 schools do not charge fees and thus serve the poorest three quarters of students, while Quintiles 4 and 5 schools are typically fee charging.

[7] EGRSII followed grade 1 students from 2017 and by 2019, 19% of students were still in grade 1 or 2. We exclude these students and restrict the sample to students who were in grade 3 in 2019.

Table 1: Sample comparisons

	Grade 2	Grade 4
COVID group	FW cohort 1 Grade 1 Term 4 (2019) ➡ Grade 3 Term 1 (2021) schools=57, students=435	EGRS II Grade 3 Term 4 (2019) ➡ Grade 4 Term 4 (2020) schools=180, students=1899
Counterfactual	FW cohort 2 Grade 2 Term 1 (2019) ➡ Grade 2 Term 4 (2019) schools=57, students=566	SPS Grade 3 Term 1 (2018) ➡ Grade 4 Term 3 (2019) schools = 354, students=2910

Appendix Table A1 summarises characteristics of the four groups of students making up the COVID and counterfactual groups in this study. While none of these samples is representative of a grade population nationally or provincially, these are relevant samples from which to examine learning losses in schools serving the poor in South Africa. All the samples are drawn from quintile 1 to 3 schools. Nationally, three-quarters of South African children attend these no-fee charging schools. Additionally, the Nguni home languages assessed among these sample students are spoken widely in South Africa.[8] Consistent with limited access to remote learning opportunities in no-fee schools, computer access among the student samples is also low (13-34%).

The table reflects how similar the COVID and counterfactual groups are to each other with respect to school quintile and asset indicators of socio-economic status. It also confirms an equal mix of girls and boys across the groups. Finally, attrition rates across assessment waves are shown. Attrition rates are very similar across the grade 4 COVID and counterfactual groups at around 12% to 14%. Among the grade 2 sample, attrition is notably higher among the COVID group at 20.6% than among the counterfactual group (3.6%). This is due to the longer period between the assessment waves (5 terms versus 4), and significant reports of children changing schools or not returning to school at all during the pandemic period. Compared to the sample reassessed in 2021, the grade 2 2020 sample that were not reassessed in 2021 had weaker reading outcomes in a previous assessment.

Assessments

The early grade reading studies used in this paper share common or very similar assessments in Nguni home language or English First Additional language (EFAL)[9]. In each study, fieldworkers administered a one-on-one Early Grade Reading Assessment (EGRA) with each student[10]. Supporting the grade 2 learning comparison using FW data, the COVID-group and counterfactual group of students completed equivalent letter-sound knowledge tasks and equivalent text reading tasks in isiXhosa across assessment waves. Supporting a comparison of learning gains at the grade 4 level, the same home language (isiZulu/Siswati) text reading task was administered to the COVID cohort from EGRSII in grade 2 (2018), grade 3 (2019) and grade 4 (end of 2020).[11] Similarly, the same home language

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[8] These three Nguni languages are classified as Southern Bantu languages. As the most widely spoken of South Africa's 11 official languages, isiZulu and isiXhosa comprise the first language for about 23% and 16% of the population respectively (Statistics South Africa, 2012).

[9] In South Africa the language of learning and teaching switches from home language in the first three grades to either English or Afrikaans in grade 4.

[10] Similar software platforms were used for administering one-on-one assessments and consequently standardised timing protocols were applied to timed tasks across the studies.

[11] There are strong grounds for pooling together Nguni language samples (specifically isiZulu and Siswati) for this study. A detailed examination of text passages used in these assessments reveal very strong similarities (see Ardington et al (2021)).

(isiZulu/isiXhosa) reading passage was used to assess the counterfactual group from SPS. Across both SPS and EGRSII the English familiar word reading tasks were almost identical across grades and assessment waves.

4. School days lost

On 15 March 2020, the president of South Africa announced a range of measures to limit the spread of the COVID-19 pandemic including the closure of schools from 18 March to 14 April 2020. In the end, schools only gradually started re-opening from 1 June 2020 and were closed again from 27 July to 24 August 2020. During June and July 2020 there was a staggered return of students by grade starting with grades 7 and 12. Grade 2 and 4 students were some of the last grades to be allowed to return to school. Once schools opened again on 24 August 2020, compliance with health, safety and social distancing requirements meant that most schools could not operate at full capacity. Thus in addition to contact teaching days lost due to official school closures and the phased-in grade approach to school reopening, school days were lost due to platooning or rotational timetabling. Additional days of schooling were also lost due to individual school decisions to reopen late or close earlier than scheduled for the year.

Table 2. School days in 2020 for grade 2 and 4 students in the majority of study schools

Term	Dates	Eastern Cape (FW): Grade 2			Mpumulanga (EGRS): Grade 4	
		Maximum possible school days per DBE regulations	School days for majority of sample schools	School days taking rotational timetabling into account	Maximum possible school days per DBE regulations	School days taking rotational timetabling into account, assuming official school timetable followed*
Term 1	15 Jan – 18 Mar	46	46	46	46	46
Term 2	8 Jun – 24 Jul	5	0	0	0	0
Term 3	24 Aug – 23 Oct	44	44	22	53	26
Term 4	2 Nov -15 Dec	32	25	12	32	16
Total		**127**	**115**	**80**	**131**	88
% of 2019 days (199 days)		64%	58%	40%	66%	44%

*Actual school days for the majority of EGRSII grade 4 students in 2020 is unknown.

In both the FW and EGRSII study, teachers were asked about the timetabling implemented in their school due to social distancing requirements when students returned to school in term 3 or 4 of 2020. The vast majority of the FW school sample (86%) were implementing rotational timetabling in term 3 of 2020, with equal numbers either alternating classes within grades or alternating students within a class. For these schools with rotational timetabling, students were scheduled to be at school on 50%

We also do not find appreciably different results in the analyses that follow in disaggregating across isiZulu and Siswati speaking students.

of the teaching days. In term 4 of 2020, around 80% of the EGRSII study schools were implementing some form of rotational scheduling.[12]

The first and fourth column of Table 2 shows the maximum possible days that schools could be open for grade 2 and 4 students in 2020. Schools were meant to teach up to 15 December 2020. In the FW sample, most of the schools had stopped teaching for grade 2s by 4 December 2020. Accounting for fewer school days than officially scheduled and rotational schedules, grade 2 students would have had 80 school days which is only 40% of the 199 school days in the 2019 school calendar. We don't know how many days the EGRSII study schools were open, but assuming a maximum number of scheduled days and rotational schedules, then at best grade 4 students could have attended school for 44% of a normal school year.

Absenteeism

In addition to fewer scheduled days, data from the FW schools suggests that a significant portion of students never returned to school in 2020 after the initial school closure in March 2020. Between the end of 2019 and the beginning of 2021, 15% of sampled students left the school. Of these students, the school reports that 29% have dropped out and are not attending school at all. On average teachers from the 57 FW schools, report that 9% of grade 2 students never returned in the 2020 school year and two teachers reported that over 30% of their students never returned. The same teachers were also asked how many of their grade 2 students were absent on the days they were meant to be at school (see Table 3). In the third term, one in five teachers report that more than half their students were absent. This improved by the fourth term with only 7% of teachers reporting such high levels of absenteeism.

There is less available information on absenteeism in the EGRSII study. As one available indicator of absenteeism, 75% and 79% of grade 2 and 3 teachers in term 4 2020 indicated that the number of students attending lessons in their grade was smaller than normal.

Table 3. Percentage of grade 2 students absent on days they were meant to attend school after schools reopened from COVID-19 school closures, FW schools

	Term 3, 2020	Term 4, 2020
None	4%	9%
Just a few (1 to 4)	53%	63%
Quite a few (5-10 students) but less than half	23%	21%
About half	12%	4%
More than half	4%	4%
Most were absent	5%	-
Total teacher responses = schools in study	**100%**	**100%**

Source: FW, Eastern Cape sample. Teacher responses from 57 schools.

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[12] Grade 2 teacher responses from EGRSII indicate that 77% of these schools followed rotational schedules, while grade 3 teacher responses from these schools suggest 84% used rotational timetables.

5. Method

To measure the impact of the pandemic on learning we need a plausible counterfactual against which to compare student outcomes. We employ difference-in-differences (DD), a quasi-experimental approach, and compare learning gains for grade 2 and 4 students during the pandemic against gains of their peers prior to the pandemic. Our DD strategy relies on the assumption that, in the absence of COVID-19, the pandemic cohort would have experienced a counterfactual achievement gain identical to the observed achievement gain in the pre-pandemic cohort. DD allows for the groups to be observationally different but assumes that this difference is constant over time and can be differenced out. The plausibility of this assumption depends on the particular setting to which DD estimation is applied.

Although DD does allow for imbalance in the level of the outcome of interest and other covariates between the treatment group and the counterfactual, the more similar the two groups are pre-treatment, the more plausible the assumption that the groups are inherently similar. For our estimates of grade 2 learning losses, there is no reason to believe that there would be systematic differences between the COVID group and the counterfactual group drawn from the same school. However, significantly higher attrition for the COVID group may have introduced some imbalance between the two groups although we find no evidence of this in student reports of household possessions at baseline (Table A1). In our grade 2 DD estimates we include school fixed effects which will absorb any time invariant between-school variation. We are therefore comparing pandemic learning trajectories against pre-pandemic trajectories within the same school.

For grade 4, while there are some differences in student reports on household possessions (Table A1), it appears the COVID group from EGRSII schools and the counterfactual group from SPS schools are fairly similar along these dimensions. Nevertheless, to minimise potential selection bias in the comparison between EGRSII and SPS we use coarsened exact matching[13] to match student characteristics pre-pandemic. We use the previous wave (wave 3) of EGRS II data to match students' reading performance at the end of grade 2 with performance at the beginning of grade 3 for SPS. In addition to reading fluency, we match on school quintile, gender and baseline household possessions (computer, television, refrigerator, car and flush toilet inside the household). DD models are then applied to the matched samples.

The DD estimate of the impact of COVID is defined as

$$\left(\bar{y}_{c=COVID,t=2} - \bar{y}_{c=COVID,t=1}\right) - \left(\bar{y}_{c=Counterfactual,t=2} - \bar{y}_{c=Counterfactual,t=1}\right)$$

where $\bar{y}_{ct}$ is the average reading skill for group c at assessment point t. We estimate the DD using Ordinary Least Squares regressions of the form

$$y_{ijct} = \alpha + \beta_1 C + \beta_2 T + \beta_3 (C * T) + \epsilon_{ij}$$

where y_{ijct} is the measured reading skill for student i in school j in group c at assessment point t. C is a dummy variable indicating whether the student is in the COVID group and T is another dummy variable that takes the value one for the second assessment point. The term ϵ_{ij} is an independent and identically distributed error term clustered at the school level to allow for correlation in the unobservables between students within the same school. The DD estimate is obtained as the β_3 coefficient on the interaction between C and T.

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[13] Coarsened exact matching (CEM) establishes balance between two groups by coarsening the matching variables into bins and exact matching units in the two groups on all coarsened variables simultaneously.

In the next section, we present a visual inspection of pre-pandemic parallel trends to support the DD analysis.


6. Results

Descriptive results

Before we provide estimation results, we visually examine the performance of students during the 2020 school year and compare their learning gains against a relevant counterfactual group. We also visually inspect to what extent pre-pandemic learning trajectories of the COVID and counterfactual groups display parallel trends to support a DD analysis.

We start with the COVID group who were in grade 2 in 2020, comparing their gains in letter sound knowledge (left panel of Figure 1) relative to a counterfactual group of grade 2s in 2019 in the same schools. First, we observe pre-pandemic trajectories in letter sound knowledge across the two groups that display almost parallel trends. This is seen by comparing the solid line from point G1T1 to G1T4 against the dashed line from G2T1 to G2T4. Pre-pandemic, the average student in the COVID-group is also performing at a very similar level in term 4 of grade 1 (G1T4) as the average student in the counterfactual group at term 1 of grade 2 (G2T1) (27 versus 29 correct lettersounds per minute). However, almost a year after COVID-19 related school closures, the COVID group is only correctly sounding 37 letters per minute on average at the beginning of grade 3 (2021) in contrast to the counterfactual group who averaged 46 correct letters per minute in grade 2, term 4 (2019).

The right panel of Figure 1 then shows the performance of these two groups on the oral reading fluency (ORF) task. No pre-pandemic trends in ORF can be observed for the COVID group as an ORF assessment could not be administered at the start of grade 1 when most students were unable to read one word. But pre-pandemic performance is similar across the two groups. This is seen when comparing average ORF of the COVID group at the end of grade 1 (G1T4) with that of the counterfactual group at the start of grade 2 (G2T1). A year after the onset of the pandemic, however, substantially worse average ORF outcomes are observed for the COVID group at the start of grade 3 (G3T1) in 2021, compared with the counterfactual group at the end of grade 2 (G2T4) in 2019.

Figure 1. Grade 2 learning gains – FW COVID group versus counterfactual
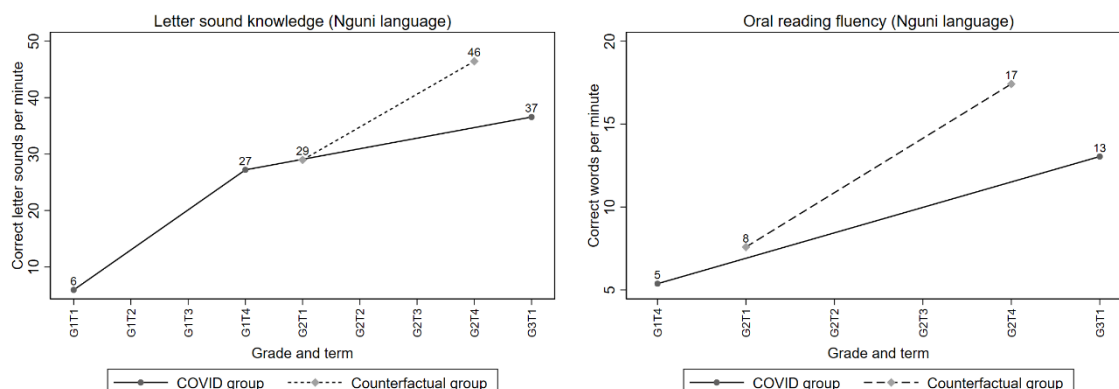
Notes: Sample is restricted to students who are assessed in all three waves. G=grade and T=term.

In a similar vein, Figure 2 compares learning gains for EGRSII students who were in Grade 4 in 2020 against those of SPS students. The left panel summarises trajectories of correct words per minute in a Nguni home language (isiZulu/Siswati) while the right panel focuses on correct words per minute in English (the language of learning and teaching from grade 4). Starting with home language and focusing on the SPS counterfactual group together with the SPS grade 2 and 4 cohorts, we see roughly linear growth in correct words per minute from the first term of grade 2 to the third term of grade 5. The pre-pandemic trend for EGRSII is parallel but we observe a sharp break from the trend over 2020. For English, we do not have pre-pandemic trends for EGRSII but given what we observe for home language, it is reasonable to assume in the absence of the pandemic that learning gains would be similar to those for SPS. However, the gradient for the EGRSII group during the pandemic is substantially flatter relative to their peers in the SPS study over a pre-pandemic period.

Figure 2. Grade 4 learning gains by grade – EGRSII COVID group versus SPS counterfactual
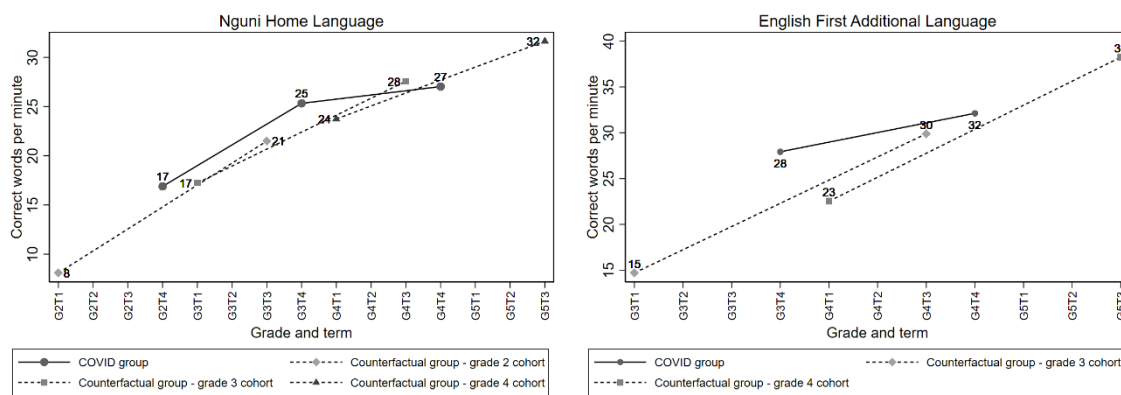
Estimation results

We now turn to the DD estimations of learning gains. The learning gain outcome measures divide the gain for each learner by the number of days between the first and second assessments to take into account the different time periods between assessments. Gains are then scaled up to one year and coefficients are therefore expressed as differences in learning over a year. This scaling assumes linearity in learning over time. No available evidence in South Africa currently exists that points to non-linearity in learning over a school year. Additionally, South Africa's longest school holiday in a normal school year is only around four to five weeks so holiday losses are likely to be less of an issue than in settings with extended summer breaks[14]. Figures 1 and 2 also support the assumption of a linear trend.

Table 4 presents DD estimates of the effect of the pandemic on students' reading trajectories in grade 2 and grade 4. The constant term indicates the learning gains of the counterfactual group and the coefficient on the COVID-19 indicator quantifies the extent to which gains were diminished for the COVID group. For the grade 2 comparison only, the DD estimates include school fixed effects and therefore identify learning losses within the same school. Starting with the first column, gains in letter sound knowledge in grade 2 were 16 letters per minute lower in 2020 than 2019. This represents 70% of a year of learning lost. Grade 2 students in the counterfactual group improved their ORF by 13 words while those in the COVID group only improved by 5 words over the year.

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[14] The 2018/2019 year-end holiday was three weeks and four days and the 2019/2020 year-end holiday was five weeks and four days. In 2019 there was a two week break after term one, a three week break after term two and a one week break after term three.

There are reasons to believe that these learning losses are under-estimated (in absolute terms). Firstly, school closures only came into effect from the second term in 2020 and we would expect students to have made progress along the same trajectory of the counterfactual group up to that point. Second, attrition was considerably higher for the COVID group and attrition is correlated with poorer initial reading proficiency. This means that a greater proportion of weaker students will be missing from the COVID sample than the counterfactual sample. The schools also report that a substantial portion of the students who have left the school have dropped out, suggesting that the attritors' outcomes would be even worse than their previous performance would predict.

Table 4. Estimating learning losses

	Grade 2		Grade 4	
	Correct letter sounds per minute	**Home Language correct words per minute**	**Home Language correct words per minute**	**English correct words per minute**
COVID-19 indicator	-16.00***	-7.339***	-6.900***	-6.537***
	(1.367)	(0.716)	(0.321)	(0.652)
Constant	22.73***	12.80***	8.557***	10.56***
	(0.594)	(0.311)	(0.198)	(0.558)
Observations (students)	1,001	1,001	4,761	4,736
R-squared	0.245	0.184	0.153	0.098
School fixed effects	YES	YES	NO	NO
Matching	NO	NO	YES	YES
% of year of learning lost	70%	57%	81%	62%

Notes: *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. Robust standard errors that allow for correlation in the unobservables between students in the same school in parentheses.

The DD estimates for grade 4 do not include school fixed effects as the COVID and counterfactual groups are from different schools. Instead, we use coarsened exact matching to match students' initial reading performance, gender and school quintile. Appendix Figure A1 presents the raw and matched initial oral reading fluency distributions of the two groups. Unmatched estimates and estimates with matching models that additionally include baseline household possessions (computer, television, refrigerator, car and flush toilet inside the household) are shown in appendix Table A2. Results are substantively similar across all three models. We see a significant negative impact of the pandemic on reading in grade 4. Learning losses for grade 4 are around 7 words per minute for both home language and English. These reading fluency gains are between 19% to 38% of the gains of the counterfactual

group[15]. Expressed differently, the estimated learning losses in grade 4 are between 62% to 81% of a year of learning.

Heterogeneous effects

The DD estimates in Table 4 and the appendix tables quantify the average impact of the pandemic across all students. We now consider whether the pandemic had differential impacts on specific sub-groups of students. Two learner level characteristics are investigated for any differential effects i) initial reading proficiency and ii) gender.

There are reasons to believe that the pandemic would have differential impact by initial reading proficiency but it is not immediately obvious in which direction. More proficient students may have been in a better position to continue learning outside of school than their weaker performing peers. Alternatively, schooling losses may have translated into greater learning loss for this group if their pre-pandemic learning was more effective. Table 5 shows the coefficients for DD models that include interaction terms between initial reading proficiency and the COVID-19 indicator[16]. Starting with letter sound knowledge for grade 2, we see that students in the top tercile have significantly lower gains in correct letter sounds per minute than students in the bottom quartile. This is not unexpected with a constrained skill such as letter sounds and diminishing improvements once students reach a level of around 20 correct letter sounds per minute have been documented in various isiXhosa reading studies (Ardington et al 2020). For the three word reading fluency tasks, we see that initial reading proficiency is positively related to learning gains. For example, students in the top tercile in grade 2 see increases in their reading fluency that are around five words per minute higher than students in the lowest tercile.

The COVID-19 indicator remains substantial and highly significant across both grades and all tasks. Findings on the impact by initial reading proficiency are mixed. For grade 2 letter sound knowledge, the coefficient on the interaction term between the COVID-19 indicator and the top tercile is positive and statistically significant. This suggests that the pandemic had the most severe impact on the least proficient students and more muted effects on those with higher initial reading proficiency. We don't see such protective effects for grade 2 ORF where statistically insignificant interaction terms suggest all students were equally disadvantaged by school closures. In contrast, the grade 4 students with higher initial reading proficiency seem to have been most severely impacted by school closures. Students in the middle of the distribution of initial reading proficiency suffered greater home language reading losses than their peers at the bottom and top end. For English reading, compared to students in the lowest tercile, learning losses were 62% and 80% higher for the students in the second and third tercile respectively.

Table 6 presents estimates of the impact of the pandemic by gender. At each assessment point across grades and studies, girls outperform boys. We therefore include initial reading proficiency terciles and the female coefficient then identifies the additional learning gains for girls over boys in the same initial tercile. Similarly, the interaction term measures the differential impact of COVID by gender within the same initial proficiency tercile. For letter sound knowledge, we do not see a differential impact by gender. Across all three reading fluency tasks, female students were substantially more impacted by the pandemic. In grade 2, girls had learning losses of around nine words per minute in contrast to

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[15] We can also compare EGRS II learning gains against the SPS grade 4 cohort for whom we have assessment data from grade 4 term 1 and grade 5 term 3. Findings are substantively similar with estimates of learning losses of 73% in home language and 62% in English (appendix Table A3).

[16] For Funda Wande, we used principal components analysis to create a composite reading proficiency score and grouped students by tercile of this aggregate measure. For EGRS II and SPS, we grouped students by tercile of the outcome measures of interest at baseline.

losses of six words per minute for boys. Learning losses in grade 4 were 20% and 27% higher for girls than boys in home language and English reading respectively.

Table 5. Learning losses by initial reading proficiency

	Grade 2		Grade 4	
	Correct letter sounds per minute	**Home Language correct words per minute**	**Home Language correct words per minute**	**English correct words per minute**
Initial reading proficiency - tercile 2	1.576	3.156**	1.073***	4.604***
	(2.762)	(1.386)	(0.364)	(0.456)
Initial reading proficiency - tercile 3	-12.90***	5.686***	1.035**	6.728***
	(3.161)	(1.362)	(0.432)	(0.493)
COVID-19 indicator	-19.54***	-7.299***	-6.483***	-4.129***
	(2.060)	(0.953)	(0.508)	(0.638)
COVID-19 x tercile 2	0.515	-0.267	-1.673***	-2.566***
	(2.857)	(1.680)	(0.622)	(0.872)
COVID-19 x tercile 3	10.23***	-0.0169	-0.0179	-3.289***
	(3.243)	(1.597)	(0.696)	(0.853)
Constant	26.47***	9.804***	7.890***	6.314***
	(1.862)	(0.722)	(0.316)	(0.334)
Observations (students)	991	991	4,682	4,656
R-squared	0.303	0.169	0.159	0.140
School fixed effects	YES	YES	NO	NO
Matching	NO	NO	YES	YES

Notes: *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. Robust standard errors that allow for correlation in the unobservables between students in the same school are shown in parentheses.

Table 6. Learning losses by gender

	Grade 2		Grade 4	
	Correct letter sounds per minute	**Home Language correct words per minute**	**Home Language correct words per minute**	**English correct words per minute**
Initial reading proficiency - tercile 2	1.475	2.800***	0.158	3.334***
	(1.729)	(0.858)	(0.299)	(0.410)
Initial reading proficiency - tercile 3	-9.087***	4.823***	0.344	4.715***
	(1.953)	(0.846)	(0.359)	(0.428)
COVID-19 indicator	-17.08***	-5.540***	-6.292***	-5.285***
	(1.614)	(0.759)	(0.387)	(0.495)
Female	1.618	5.687***	3.142***	3.091***
	(1.721)	(0.984)	(0.321)	(0.333)
COVID-19 x female	2.662	-3.449***	-1.245**	-1.446**
	(2.066)	(1.042)	(0.514)	(0.640)
Constant	24.37***	7.272***	6.790***	5.815***
	(1.660)	(0.706)	(0.283)	(0.330)
Observations (students)	991	991	4,682	4,656
R-squared	0.295	0.265	0.181	0.151
School fixed effects	YES	YES	NO	NO
Matching	NO	NO	YES	YES

Notes: *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. Robust standard errors that allow for correlation in the unobservables between students in the same school are in parentheses.

7. Conclusion

This paper contributes some of the first evidence on the impact of COVID-19 school closures on learning in developing countries. Using three different studies on early grade reading in no-fee schools in South Africa across multiple provinces, this paper establishes learning losses in reading for grade 2

and 4 students. We use the performance of a 2019 grade 2 cohort in the same Eastern Cape schools as a credible counterfactual for the learning gains of grade 2s in 2020. To estimate grade 4 learning losses, we drew on two sets of studies from three provinces to establish a COVID group and suitable counterfactual sample from equally under-resourced school contexts.

We find that grade 2 students lost between 57% and 70% of a year of learning when measured in terms of reading outcomes relative to their pre-pandemic peers. Among the grade 4 sample, we estimate learning losses of between 62% and 81% of a year of learning. As a point of comparison, students in the school samples lost about 56% to 60% of the number of contact teaching days they normally would have received in a pre-pandemic school year due to a combination of school closures and rotational timetabling schedules. This implies learning to schooling loss ratios in the region of 1 to 1.4. We find however, that there is evidence to suggest that our grade 2 results likely underestimate learning losses. The grade 2 students who are not included in the estimations due to attrition, for reasons of having dropped out or higher absenteeism, have weaker pre-pandemic reading outcomes than those who were reassessed in a COVID period.

Interesting distributional impacts emerge among the student samples. Although girls in South Africa typically perform better than boys, both in terms of their reading levels and trajectories within a normal school year, we find some evidence from both the grade 2 and 4 samples that girls' word reading is disproportionately negatively affected relative to boys. This pattern emerges even after controlling for student's baseline reading performance. One possible explanation for this result is that those who were benefiting more from being at school pre-pandemic are those that lose out the most. The grade 4 results show that the reading trajectories of children doing better before the pandemic (in reading terciles 2 and 3) are more negatively affected than those students with weaker pre-pandemic reading performance (tercile 1).

Larger national assessments, testing a wider range of skills, would be required to explore distributional impacts in more depth. Nevertheless, while our samples are neither representative nationally nor at a provincial level, they present the only available data to assess early grade learning losses in South Africa in the absence of any systemic national testing. The results are instructive for understanding how learning trajectories have been impacted in under-resourced schooling contexts where most children have had no access to remote learning opportunities. The results highlight the vital importance of ensuring schools remain open and that children attend school daily. However, a limitation of this study is that we are unable to apportion these learning losses to factors beyond schooling disruptions, such as shocks to household incomes, rising hunger and impacts of pandemic-related events on children's socio-emotional well-being (Wills et al 2020, Favara et al 2021).

In addition to 2020 school closures, the opening of schools for the 2021 academic year in South Africa was delayed by a month in response to a second wave of COVID-19 infections. On return, social distancing requirements were still in force. By mid-2021, well after these learning losses were observed, the students in the study samples would still only be attending school every second day. In lieu of the detrimental long-term consequences of learning losses in the lower grades, new directives were gazetted that all primary school children are expected to return to school for daily attendance from 26 July 2021 when schools reopen after a winter break (Government of South Africa 2021)[17] The Department of Basic Education has also implemented a campaign to vaccinate all teachers and

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[17] These plans are, however, dependent on the country's risk-adjusted differentiated strategy which monitor's the level of infections at a given time.

school support staff before the end of the second term 2021, limiting infection risks for teachers and ensuring they are more comfortable with a regular teaching timetable.

While it is almost certain that the learning deficits identified will continue to increase if more school disruptions are experienced, longer-term it is unclear whether these gaps will remain static, grow or narrow over time. Andrabi et al (2020), Kaffenberger (2020) and Angrist et al (2021) warn that short-term losses are likely to be a lower bound if pedagogy continues as usual in line with curriculum demands. As children are moved up grade levels, those who are behind will continue to learn less each year. Consequently, teachers face conditions similar to multi-grade classrooms requiring an increased focus on remediation.

Recognising the need for teachers to adjust their teaching to the competency levels of children in their classrooms, the Department of Basic Education developed a three-year curriculum recovery plan which entailed trimming the curriculum in 2020 and 2021 due to the reduction in available teaching time. The revised curriculum was articulated in Recovery Annual Teaching Plans to guide teachers on its implementation. The plan also sets out a strategy to re-focus on the teaching of foundational and core content, reducing assessment requirements while improving teachers' understanding of children's competency levels with respect to curriculum requirements. Successful implementation of this plan will, however, depend on the levels of agility possible within a large public system and teachers' ability to adapt and adjust.

8. References

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9. Appendix

Table A1. Sample characteristics

	Grade 2		Grade 4	
	COVID group	**Counter-factual group**	**COVID group**	**Counter-factual group**
School quintile 1			53%	55%
School quintile 2			33%	33%
School quintile 3	100%	100%	13%	12%
Female	49%	51%	51%	50%
Computer	34%	29%	14%	13%
Television	94%	95%	74%	72%
Refrigerator	93%	93%	67%	68%
Car	52%	52%	21%	44%
Flush toilet inside house	60%	60%	12%	13%
Observations	428	546	1899	2910
Attrition between assessment one and two	20.64%	3.64%	12.12%	14.26%

Table A2. Grade 4 raw and matched DD learning losses estimates – EGRSII versus SPS

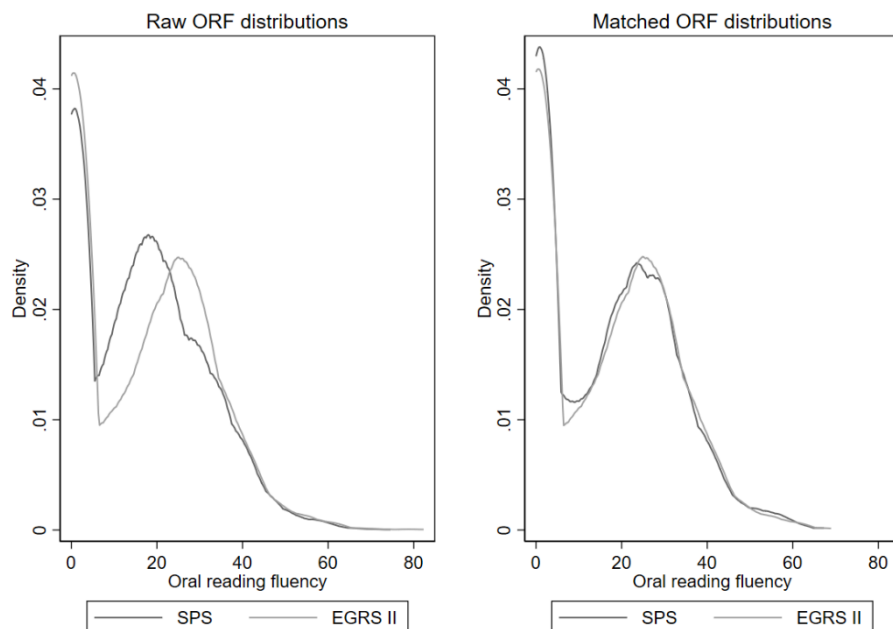|	Home Language			English First Additional Language		
	Raw	**Match 1**	**Match 2**	**Raw**	**Match 1**	**Match 2**
COVID-19 indicator	-6.917***	-6.900***	-6.834***	-6.120***	-6.537***	-5.977***
	(0.312)	-0.321	(0.349)	(0.410)	(0.652)	(0.438)
Constant	8.563***	8.557***	8.421***	10.16***	10.56***	9.975***
	(0.181)	-0.198	(0.232)	(0.237)	(0.558)	(0.277)
Observations	4,809	4,761	4,026	4,784	4,736	4,004
R-squared	0.157	0.153	0.155	0.086	0.098	0.083
% COVID group matched		98%	87%		98%	87%

Notes: Coarsened exact matching used to match EGRS II students' oral reading fluency at the end of grade 2 (wave 3) with oral reading fluency at the beginning of grade 3 for SPS. Match 1 also includes school quintile and gender. Match 2 additionally includes baseline household possessions (computer, television, refrigerator, car and flush toilet inside the household).

Table A3. Grade 4 learning losses – EGRS II versus SPS grade 4 cohort

	Grade 4	
	Home Language correct words per minute	**English correct words per minute**
COVID-19 indicator	-4.557***	-6.538***
	(0.300)	(0.403)
Constant	6.202***	10.57***
	(0.160)	(0.224)
Observations	4,777	4,751
R-squared	0.082	0.097
% of year of learning lost	73%	62%

Notes: *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. Robust standard errors that allow for correlation in the unobservables between students in the same school are in parentheses.

Figure A1. Oral reading fluency at the end of grade 2 (EGRS II) and beginning of grade 3 (SPS)

10. Funding

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