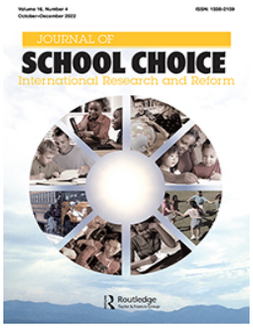

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The Longer Students Were Out of School, the Less They Learned

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ABSTRACT

COVID-19 led to school closures and emergency remote learning. This paper analyzes school closures during the pandemic using a unique data base. The determinants of the duration of school closures estimates were used to instrument school closures – stringency of lockdown and vaccination – and causally estimate the impact of duration on learning. It is estimated that for every week that schools were closed, learning levels declined by almost 1% of a standard deviation. This means that a 20 week closure, for example, would reduce learning outcomes by 0.20 standard deviation, almost one year of schooling.

KEYWORDS

COVID-19 pandemic; learning loss; school closures

Introduction

COVID-19 school closures led to emergency remote-learning systems almost immediately. At its peak, nearly 1.6 billion learners in more than 190 countries, or 94% of the world's student population, were impacted by school closures (UNESCO, 2020). Students learned less when they were remote and attending high-poverty schools, which were hit hardest (Engzell, Frey, & Verhagen, 2021). Learning losses could cost this generation of students close to $15 trillion in lifetime earnings (Psacharopoulos, Collis, Patrinos, & Vegas, 2021). Worldwide, learning losses on average amount to 0.17 of a standard deviation (Patrinos, Vegas, & Carter-Rau, 2023), equivalent to roughly a one-half year's worth of learning[1].

I estimate the impact of the duration of school closures on learning. The longer the duration of the closures, then the greater the losses. For countries with robust learning loss data, average school closures were 21 weeks, leading to average losses of 0.23 standard deviation, almost a whole year's worth of learning. Each week of closures increases learning loss by 1% of a standard deviation. This will increase the education gaps between high and low socio-economic status students (Agostinelli, Doepke, Sorrenti, & Zilibotti, 2022), especially in lower-income countries (Kaffenberger, 2021). The main lesson learned is that if COVID continues as a low-intensity pandemic, or if a similar situation arises, keeping schools open should be a priority, as the evidence

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shows that the health benefits of school closures seemed to have been lower than the cost of learning losses (Allen, 2022; Davies et al., 2020, 2021; Gandini et al., 2021; Lee & Raszka, 2020; Ludvigsson, 2020; Raffetti & Di Baldassarre, 2022). The priority now should be to minimize the long-term impacts of school closures.

This paper contributes to several strands of the literature. First, it adds to the growing research on the impact of school closures on learning outcomes (Agostinelli, Doepke, Sorrenti, & Zilibotti, 2022; Belot & Webbink, 2010; Haelermans, Jacobs, van der Velden, van Vugt, & van Wetten, 2022), especially on the impact of duration on learning loss (Goldhaber et al., 2022; Jack, Halloran, Okun, & Oster, 2022). It also adds to the literature on the determinants of school closure duration (Kurmann & Lalé, 2021; Nitsche & Hudde, 2022). This paper uses unique data to estimate the precise impact per week of closures on learning loss across a variety of countries. From a human capital perspective, it makes sense that school closures would lead to learning loss since schooling is a productive endeavor (Becker, 1994); therefore, extending the time away from in-person instruction should lead to a reduction in learning outcomes. Programs to support learning loss mitigation have been explored.

Data

We supplement the robust data on learning losses compiled by Patrinos, Vegas, and Carter-Rau (2023) with a few more recent studies (see Annex 1 and https://microdata.worldbank.org/index.php/catalog/5367). Most refer to primary schooling. The number of weeks of school closure is compiled from the same studies. Not all surveys are nationally representative. In the United States, the learning loss surveys are representative, but school closure duration varied state to state, and our figure represents an average. In Nepal, the data come from a study that only includes adolescent girls from one disadvantaged district. Besides school closure and duration, other possible correlates of learning loss are included. One of those controls is the pandemic itself. We include the COVID-19 death rate per 100,000 population; the lockdown stringency index; and the vaccination rate.

We also control for national income. Since there are some reports that students in private schools lost less learning than others (Arenas & Gortázar, 2022; Jack, Halloran, Okun, & Oster, 2022; Wolf et al., 2021), we include the proportion of private schools as a control. To gauge to what extent connectivity helped, we include individuals using the internet (percent of the population). To measure preexisting school quality, we include the score from the World Bank's Harmonized Learning Outcomes (HLO). To measure the

Table 1. Means and Standard Deviations.

Variable	Mean	Std. Dev.	Source
Learning loss (SD)	0.23	0.16	see Annex 1 (Learning Loss COVID-19 2020–2022)
Weeks closed	20.78	18.21	see Annex 1
Death rate/100k	152.36	125.56	Johns Hopkins Coronavirus Resource Center
GDP p/c $US	21709	22717	World Bank
Private school (%)	14.84	14.10	World Bank
Internet (%)	69.44	25.12	International Telecommunication Union
School quality	462.08	89.97	Angrist et al. 2021
Vaccination rate	59.77	32.17	Oxford Coronavirus Government Response Tracker
Stringency index	56.29	8.90	Hale et al 2021
Union density	22.38	16.05	International Labour Organization
Democracy	7.02	4.76	Polity 5

strength of trade unions, we include the trade union density rate. We use the Polity5 dataset as the measure of democracy. See Table 1 for means, standard deviations, and sources.

School closures and learning losses

The literature suggests that school closures are an efficient strategy to reduce the overall duration of a pandemic (Bin Nafisah, Alamery, Al NafesaA, Aleid, & Brazanji, 2018). The decision to close down schools was primarily aimed at mitigating the spread of COVID-19 during the beginning of the pandemic (Raffetti & Di Baldassarre, 2022). Models from previous epidemics such as influenza suggested the role of schools as places that facilitate the spreading and the possible benefit from closure (Cauchemez, Valleron, Boëlle, Flahault, & Ferguson, 2008; Jackson, Mangtani, Hawker, Olowokure, & Vynnycky, 2014). It was estimated that since school holidays could lead to a 20–29% reduction in the rate at which influenza is transmitted to children, then this might work for COVID-19. School closures delay the epidemic peak if implemented earlier but do not eliminate it. Imperfect knowledge led to no guidance on how long the duration of closures should be. Democratic countries tended to implement closures more quickly from the start of the pandemic than those with a more authoritarian regime (Cronert, 2020).

Researchers using national data – for example, the United States national achievement test, NAEP – have shown that there is a significant correlation between the length of school closures and learning loss, confirming earlier research (Barnum, 2022; Goldhaber et al., 2022; Jack, Halloran, Okun, & Oster, 2022; Lehrer-Small, 2022; West, 2022). In the United States, public schools averaged less in-person teaching than private schools. These results are explained in large part by political preferences, vaccination rates, teacher unionization rates, and local labor conditions (Kurmann & Lalé, 2021). (Teacher) unionization

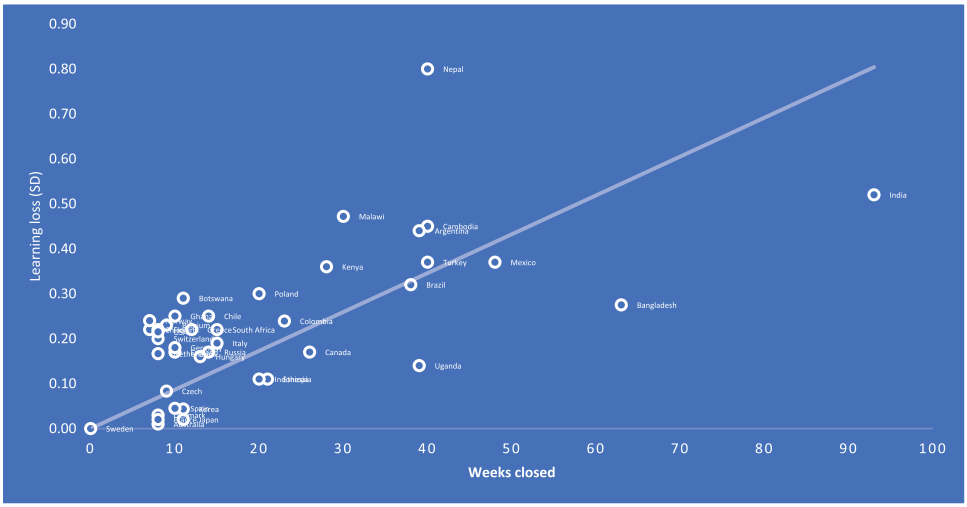

Figure 1. Learning Loss and Duration.

did not necessarily always favor school closures. For example, in Greece, teachers went on strike opposing the government's distance education plan (Lambropoulos, Vathi-Sarava, & Karatzia-Stavlioti, 2022). Nitsche and Hudde (2022) show that societal gender ideology has likely influenced school reopening policies – that is, countries with more supportive attitudes toward maternal employment reopened schools significantly sooner than those with less supportive attitudes toward maternal employment.

There is a clear link between weeks of school closures and learning loss (Figure 1). School closures were an exogenous event, brought about by the pandemic and the need to control the infection rates. Closures as part of national lockdowns were imposed. It turns out that an average learning loss of 0.23 standard deviation occurred on average with a school closure duration of 21 weeks in a sample of 41 countries (which represent 2/3 of the world's population).

We estimate learning loss, *LL*, in terms of standard deviations, as a result of weeks closed, *W*, and several control variables, X_n:

$$LL = \beta_1 W + \beta_n X_n + \varepsilon \quad (1)$$

In terms of learning loss, it makes little difference if the controls are included; all are insignificant, and they do not change the coefficient on school closures much (see Table 2). With or without controls, every week of school closures increases learning loss by almost 0.01 of a standard deviation; or 1% of a standard deviation. This means that a 20-week closure will reduce learning outcomes by the equivalent of almost ¾ of a year's worth of schooling. No other observed variable has an impact, so it is merely duration that counts.

Table 2. Determinants of Learning Loss.

Variable	1	2
Weeks	0.006***	0.007***
	(0.001)	(0.002)
Death rate		0.000
		(0.000)
Private		−0.0025
		(0.002)
Internet		0.0012
		(0.003)
School quality		−0.001
		(0.001)
Vaccination		0.001
		(0.001)
Stringency		0.000
		(0.003)
Union		0.002
		(0.002)
Democracy		0.005
		(0.006)
Log GDP p/c		−0.0499
		(0.048)
Constant	0.110*	0.568*
	(0.029)	(0.295)
Observations	41	41
R-squared	0.415	0.542

Note: Standard errors in parentheses.
*** $p<.01$, ** $p<.05$, * $p<.1$.

Given that there is little evidence that school closures reduced infection rates, then it is a high cost to pay, especially after it was deemed secure to open schools safely.

The determinants of duration of school closures

While closures were exogenous, the decision to remain closed longer was a conscious choice, especially after the American Academy of Pediatrics (2020) released, on June 24, 2020 , the first school guidance for safe in-person learning and the European Centre for Disease Prevention and Control (2020) released its recommendation on August 6, 2020 . By the time of the 2020–21 school year, it had become clear that it was possible to safely open schools (de Hoyos & Saavedra, 2021). By August 2020 evidence supported a marginal role of children as drivers of the first wave of infections (Munday et al., 2021). School reopening did not play a causal role in the increased number of new cases and hospitalizations in Italy during the period of September – October 2020 (Gandini et al., 2021), and it was not the main driver of the increased spreading of the COVID-19 UK variant in England at the beginning of 2021 (Davies et al., 2021). Moreover, school closures have no detectable effect on the contact patterns of adults (Cauchemez, Valleron, Boëlle, Flahault, & Ferguson, 2008). Other studies suggested that school closure during the 2009 H1N1 influenza epidemic in Pennsylvania would

not have been worth the cost (Brown et al., 2011). Costs such as productivity losses of education professionals and parental wages outweigh the benefits in terms of decreased infection. Simulations showed that closing schools resulted in substantially higher net costs than not closing schools (Brown et al., 2011). Therefore, during the 2009 H1N1 epidemic, school closures could have resulted in substantial costs to society as the potential costs of lost productivity and childcare could have far outweighed the cost savings in preventing influenza cases. In other words, the likely beneficial impact of school closures is limited. At most, studies suggested that school closure can be a useful control measure during an influenza pandemic, particularly for reducing peak demand on health services, but they were not precise on the quantifiable benefits (Jackson, Mangtani, Hawker, Olowokure, & Vynnycky, 2014). It turned out that the actual benefits of school closure during the COVID-19 pandemic were less than expected (Raffetti & Di Baldassarre, 2022). Children have been less contagious than adults (Davies et al., 2020; Lee & Raszka, 2020; Ludvigsson, 2020). Allen (2022) calculates a number of cost/benefit ratios of lockdowns in terms of life-years saved in Canada. Using a mid-point estimate for costs and benefits of lives saved the reasonable estimate for Canada is a ratio of lost life due to lockdowns over lives saved of just 141 out of a population approaching 40 million.

We estimate the determinants of weeks closed using the same control variables. This is observational data used to estimate duration of closures by a set of independent variables. In our analysis, the only significant variables are GDP, private schooling, school quality, the stringency of lockdowns, and the vaccination rate (Table 3). Higher-income countries have a shorter duration of school closure. A low vaccination rate is associated with longer school closures. Similarly, more stringent lockdowns also increase the length of closures. Higher test scores before COVID-19 are correlated with longer school closures. This might suggest that when authorities believe their education system and therefore its distance education version is of high quality, then they tend to prolong school closures.[2] A higher proportion of private schools in a country leads to a longer duration of school closures. Interestingly, the death rate is not a factor, suggesting that school closures were not based on incidence of COVID-related fatalities.

While the unplanned closures were imposed on schools due to an external event, the duration of the closures was a choice, to some extent at least. To properly estimate the determinants of the duration and its impact on learning outcomes, then one needs to address potential endogeneity issues. Table 3 suggests that national income, private schooling, school quality, the stringency of lockdowns, and the vaccination rate are associated with the duration of school closures. Since stringency is related to closures, and quality and private schooling are related to learning outcomes, then we experiment with the vaccination rate as a possible

Table 3. Determinants of Duration of School Closures.

Variable	Coefficient
Death rate	−0.009
	(0.021)
Private	0.409**
	(0.166)
Internet	−0.0243
	(0.267)
School quality	0.139***
	(0.039)
Vaccination	−0.255**
	(0.098)
Stringency	0.486*
	(0.280)
Union	0.112
	(0.150)
Democracy	−0.355
	(0.552)
Log GDP p/c	−8.742*
	(4.566)
Constant	21.800
	(29.15)
Observations	41
R-squared	0.639

Note: Standard errors in parentheses.
*** $p<.01$, ** $p<.05$, * $p<.1$.

instrument. It could be argued that a high vaccination rate may lead to shorter school closures. A study shows that school closures can be minimized by regular testing and vaccination against COVID-19 (Colosi et al., 2022). The stringency index, a composite measure based on the strength of lockdown measures, can be used to measure how restrictive the measures were (Gros, Ounnas, & Yeung, 2021). Instrumental variables (IVs) are used to control for confounding and measurement error in observational studies. They allow for the possibility of making causal inferences with observational data. They adjust for both observed and unobserved confounding effects. We believe that the vaccination rate and the stringency index instrument for closures well and are unlikely to determine learning losses on their own. We instrument the duration of school closures using the vaccination rate and the stringency index using 2SLS. The first stage and IV results are presented in Table 4.

The vaccination rate and the stringency index turn out to be useful instruments. Since we do not have many degrees of freedom, we estimate a very parsimonious equation, explaining weeks closed with the vaccination rate. It turns out that a lower (higher) vaccination rate leads to a longer (shorter) duration of school closures, while a higher stringency index prolongs school closures. Therefore, we can tentatively conclude that the duration of school closures leads to a higher level of learning loss. In the IV estimates, a week of school closures leads to a 0.006 standard deviation increase in learning loss, just slightly higher than the OLS estimate.

Table 4. Determinants of Learning Loss.

Variable	First stage weeks closed	IV learning loss
Vaccination	−0.301**	
	(0.073)	
Stringency	1.021*	
	(0.262)	
Weeks		0.006***
		(0.002)
Constant	−18.723	0.111
	(14.567)	(0.034)
N	41	41
R-square	0.409	0.415
F-test	13.13	10.98
[*p*-value]	0.000	0.002
Sargan (overidentification) statistic		0.409
[*p*-value]		[0.5223]

Implications

In terms of learning loss, it makes little difference if the controls are included; all are insignificant. This suggests that school closures themselves were responsible for learning loss and the severity of that loss was primarily due to how long schools were kept closed. What matters is time spent in school. While pre-COVID learning levels varied considerably across countries, depending on many factors, learning happens if children go to school. Keeping schools open reduces learning losses, even in the poorest countries and in countries with low pre-COVID learning levels. This is especially important because research has found little evidence showing that school closures reduced infection rates.

Students learn less when they are not being taught in school buildings. Duration played a key role. The long-term impact may be increased education gaps, especially between students from high and low socioeconomic status.

The main lesson learned here is that if COVID continues as a low-intensity pandemic, or if a new, similar situation arises, keeping schools open should be a priority, as the evidence shows that the benefits of school closures seemed to have been lower than the cost of learning losses. However, the task at hand is to figure out how to accelerate learning and make up for the lost time. Fortunately, there are several things that work in terms of mitigating learning losses. These include online tutoring programs, which were shown to reduce learning loss significantly in several randomized controlled trials (see, for example, Carlana & La Ferrara, 2021; Gortazar, Hupkau, & Roldán, 2022; Kraft, List, Livingston, & Sadoff, 2022). A large-scale randomized trial testing low-technology interventions – SMS messages and phone calls – with parents to support their child in Botswana improved learning by 0.12 standard deviation (Angrist, Bergman, & Matsheng, 2022). Compensatory education works as well. In Tamil Nadu, India, two-thirds of the school

closure learning deficit was made up within 6 months after school reopening, with a government-run after-school remediation program contributing one-quarter of the recovery (Singh, Romero, & Muralidharan, 2022). In Nigeria, a program designed to make up missed lessons during school closures led to a rebound within 2 months, and a recovery of all learning losses among students in low-cost schools (Adeniran, Okoye, Yedomiffi, & Wantchekon, 2022).

Conclusion

COVID-19 led to school closures and emergency remote-learning systems. The analysis investigated the impact of school closures using a unique data base. The determinants of the duration of school closures estimates were used to instrument school closures – stringency of lockdown and vaccination – and causally estimate the impact of duration on learning. It is concluded that for every week that schools were closed, learning levels declined by almost 1% of a standard deviation. This means that a 20 week closure, for example, would reduce learning outcomes by 0.20 standard deviation, almost one year of schooling.

The findings here could influence education policy decision-making. It would be wise for policy makers to be aware of the linkages between public health decisions – such as vaccinations – and the spillover effects on class time and learning. Such linkages have clear implications for the development of learning technologies (such as different applications for distance learning) and the resilience of learning outcomes.

Notes

1. This paper represents the opinions of the author and should not be attributed to the World Bank Group. Any errors are the fault of the author. I benefited from discussions at seminars at Wesleyan University, University of Mississippi, University of Maryland, Carleton University, University of Arkansas, GLO conference, ICFES, Global Schools Forum and FHi360. I received excellent comments from George Psacharopoulos, Robert Maranto, Xiaoxue Zhao, Chris Sakellariou, Vicente Garcia Moreno, Kevin Macdonald, Gustavo Arcia, David Marshall, Karthika Radhakrishnan-Nair, and Noah Yarrow.
2. Since we do not control for family size, then the relationship between higher test scores and longer duration school closures could be caused by smaller families. But since family size may be a proxy for development, it might be captured by GDP per capita.

Disclosure statement

No potential conflict of interest was reported by the author.

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Annex 1: Learning loss database

Country	Average learning losses (SD)	Weeks closed	Sources
Nepal	0.80	40	Tech (2022)
India	0.52	93	Singh, Romero, and Muralidharan (2022)
Malawi	0.47	30	Asim, Gera, and Singhal (2022)
Cambodia	0.45	40	UNICEF (2022)
Argentina	0.44	39	Argentina, Ministerio de Educación de la Nación (2022)
Mexico	0.37	48	Hevia, Vergara-Lope Tristan, Velásquez-Durán, and Calderón Martín Del Campo (2021)
Türkiye	0.37	40	Coskun and Kara (2022)
Kenya	0.36	28	Education (2021)
Brazil	0.32	38	Lichand, Doria, and Leal-Neto (2022)
Poland	0.30	20	Gajderowicz, Jakubowski, Patrinos, and Wrona (2022)
Botswana	0.29	11	Angrist, Bergman, and Matsheng (2022)
Bangladesh	0.28	63	Hassan, Islam, Siddique, and Choon Wang (2021)
Chile	0.25	14	Abufhele, Bravo, López Bóo, and Soto-Ramirez (2022)
Ghana	0.25	10	Wolf et al. (2021)
Colombia	0.24	23	Vegas (2022)
Norway	0.24	7	Skar, Graham, and Huebner (2021)
Belgium	0.23	9	Gambi and de Witte (2021)
China	0.22	7	Clark, Nong, Zhu, and Zhu (2021)
Finland	0.22	8	Lerkkanen, Pakarinen, Salminen, and Torppa (2022)
Greece	0.22	12	Lambropoulos, Vathi-Sarava, and Karatzia-Stavlioti (2022)
South Africa	0.22	15	Ardington, Willis, and Kotze (2021)
United States	0.22	8	Bielinski, Brown, and Wagner (2021); Domingue, Hough, Lang, and Yeatman (2021); Kogan and Lavertu (2021); Kuhfeld, Ruzek, and McEachin (2021); Lewis, Kuhfeld, Ruzek, and McEachin (2021); Locke, Patarapichayatham, and Lewis (2021); Pier, Christian, Tymeson, and Meyer (2021)
Switzerland	0.20	8	Tomasik, Helbling, and Moser (2020)
Italy	0.19	15	Contini, Di Tommaso, Muratori, Piazzalunga, and Schiavon (2022)
Germany	0.18	10	Ludewig et al. (2022)
Canada	0.17	26	Georgiou (2021)
England	0.17	10	Education Policy Institute (2021)
Netherlands	0.17	8	Haelermans, Jacobs, van der Velden, van Vugt, and van Wetten (2022)
Russian Federation	0.17	14	Chaban, Rameeva, Denisov, Kersha, and Zvyagintsev (2022)
Hungary	0.16	13	Molnár and Hermann (2023)
Uganda	0.14	39	Uwezo (2021)
Ethiopia	0.11	21	Kim, Rose, Tirunch, Sabates, and Woldehanna (2021)
Indonesia	0.11	20	Amelia, Kadarisma, Fitriani, and Ahmadi (2020)
Czechia	0.08	9	Korbel and Prokop (2021)
Spain	0.05	10	Arenas and Gortázar (2022)
Korea, Rep.	0.04	11	Yarrow, Kim, Yoo, and Pfutze (2022)
Denmark	0.03	8	Birkelund and Karlson (2022)
France	0.02	8	Thorn and Vincent-Lancrin (2021)
Japan	0.02	11	Asakawa and Ohtake (2021)
Australia	0.01	8	Gore, Fray, Miller, Harris, and Taggart (2021)
Sweden	0.00	0	Hallin, Danielsson, Nordström, and Fälth (2022)

Note: There could be considerable regional variability in the closure figures, especially in federal countries, such as the United States. Figures reported here consider full closures only.