Book Chapter

From Closure to Recovery: Tracing the Educational Impact of COVID-19 in Chile

Álvaro Hofflinger* Rony Rodríguez-Ramírez† Emiliana Vegas‡

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Abstract

This chapter analyzes the effects of school closures in Chile, the nation with the longest period of school closures among OECD countries. Using data from PISA (national level) and SIMCE (student level) in 2022, we examine the association between school closures and students' GPA, attendance rates, and math and reading scores. Our findings show that, on average, students' attendance rates and math and reading scores experienced a decline, while their annual GPA increased after 2020. The results also show that school closures affect students differently depending on their demographic and socioeconomic backgrounds.

*Arizona State University, DR Center for Latin American Studies, Harvard University
†Harvard University
‡Harvard Graduate School of Education and Harvard Center for International Development

1 Introduction

Between 2020 and 2022, Chile maintained its schools fully closed for 259 days as a measure to slow the spread of COVID-19. During the school shutdown, some students had access to remote learning, while other students, for example those in rural areas, had no class at all but were expected to independently complete tasks at home. This is the longest period of school closures among Latin American and OECD countries (Organisation for Economic Co-operation and Development, 2022). This chapter aims to provide a comprehensive analysis of the COVID-19-related school closures, examining the multifaceted aspects of how the pandemic affected student learning and overall educational outcomes in Chile. The disruption led to a critical juncture in education and calls for an in-depth evaluation of the strategies employed during this period and their effectiveness.

The assessment of learning losses and student outcomes, including grades, attendance, and dropout rates, during the COVID-19 pandemic is crucial for understanding the full impact of prolonged school closures and remote learning (Patrinos et al., 2022). Moreover, these consequences will be worse for non-white students, ethnic minorities, rural dwellers (due to connectivity issues), and students with disabilities (Azevedo et al., 2021; Lichand et al., 2021; Monge et al., 2020; Pérez-Mora and Moreno Arellano, 2021). The pervasive learning losses reflect a significant educational setback, especially in core subjects like reading and mathematics (Hammerstein et al., 2021). This is not just a short-term academic crisis but a long-term challenge with potential lifelong implications for the affected students. For example, research indicates substantial deficits globally, with an average learning loss representing 35% of a normal school year's learning (Betthäuser et al., 2023). These educational setbacks are not just numerical figures; they translate into diminished capabilities in literacy and numeracy, which are foundational skills essential for future learning and success in the job market.[1] Therefore, assessing these losses is vital to quantify the extent of the impact and to tailor recovery strategies that address these specific areas of deficit.

Additionally, the pandemic has underscored disparities in educational access, with a

[1] Attendance and dropout rates are equally critical indicators of the pandemic's impact on education. The shift to remote learning, while necessary, exacerbated existing inequalities, particularly affecting students from lower socio-economic backgrounds, rural areas, and indigenous communities. These groups often lacked access to essential learning resources, including internet connectivity and support materials, leading to higher absenteeism and increased risk of dropping out. The alarming rise in dropout rates, as reported in various countries, not only disrupts the educational trajectory of individual students but also poses a broader societal concern. Increased dropout rates have been linked to a range of negative outcomes, including lower future earning potential, poor physical and mental health, and higher likelihood of engagement in risky behaviors. Therefore, monitoring these rates is imperative to identify at-risk populations and implement targeted interventions, such as re-engagement programs and infrastructure improvements, to bring these students back into the educational fold and mitigate the long-term effects of educational disruption (Organisation for Economic Co-operation and Development, 2023).

marked increase in absenteeism and dropout rates among students from lower socio-economic statuses, rural areas, and indigenous communities. These trends threaten not only individual educational progress but also have wider societal implications, including reduced future earning potential and increased health and behavioral risks. The broader socio-economic implications of these educational disruptions are profound, potentially leading to decreased future income and heightened poverty levels, especially among vulnerable groups. Studies predict a reduction in relative income for students affected by the pandemic, with a more pronounced effect on vulnerable groups (Azevedo et al., 2021; Hanushek and Woessmann, 2020; Bracco et al., 2022). Policymakers and educators must use assessments of learning losses and attendance rates to inform a comprehensive response, ensuring educational recovery and socio-economic stability in the post-pandemic era. This information is essential because, as researchers have shown, the most consequential effects of the pandemic will be experienced in the long run, during the student's lifetime. Consequently, academics and policymakers must better understand these effects.

Our exploration starts with a brief review of the global repercussions on student learning resulting from the COVID-19-related school closures. Then, we focus on the post-pandemic educational landscape in Chile. First, we investigate the immediate effects of school closures on student academic achievement, attendance records, and overall grade point averages. Second, we delve into the factors that fueled educational disparities, highlighting the intensified inequities faced by diverse student populations. Finally, we draw broader policy implications and propose viable strategies for the recovery and advancement of Chile's education system in the wake of the pandemic's enduring legacy.

2 Brief overview of the impact of COVID-19 globally

The consequences of school closures can be categorized into two distinct effects: the more immediate and visible ones (transversal) and those that follow a cumulative pattern over time (longitudinal). In the short term, notable impacts include learning loss, increased dropout rates, and school absenteeism. In the long term, the repercussions of school closures manifest in an increase in poverty and a reduction in the future earnings of students schooled during the pandemic.

A review of over 40 studies conducted in 15 nations, including Spain, Italy, Sweden, the United Kingdom, and Australia, reveals significant learning losses due to the COVID-19 pandemic-related school closures. Betthäuser et al. (2023) report these deficits to be more severe among students from lower socio-economic backgrounds, averaging a loss of 35% of the

learning acquired in a typical school year. In countries like Cambodia, Ecuador, Guatemala, Honduras, Paraguay, Senegal, and Zambia, estimates suggest that a significant share of students could have lost about 1.5 years in terms of expected learning (Kaffenberger, 2021). In Pakistan, the anticipated loss ranges from 0.3 to 0.8 years of schooling (Geven and Hasan, 2020). Singh et al. (2022) found that students in rural Tamil Nadu in India exhibited learning deficits of approximately 0.7 standard deviations in math and 0.34 standard deviations in language compared to peers from 2019, after 18 months of COVID-19-induced school closures. Remarkably, two-thirds of this loss was recovered within six months of schools reopening. Regarding Mexico, despite the government's implementation of a remote education policy, the projected short-term learning loss would still amount to a third of an academic year, escalating to a whole year over the long term (Monroy-Gómez-Franco et al., 2022). This broader context within Mexico aligns with findings from Guanajuato, where despite partial recovery, students still exhibited learning deficits post-reopening (Alasino et al., 2024).

Furthermore, Hevia et al. (2022) estimated considerable learning losses in reading and mathematics during the 2019-2021 period, which would increase learning poverty in both subjects (a 25.7% increase in reading and 29.9% in mathematics). Colombia experienced learning losses across all subjects (Vegas, 2022), while Chile faced losses equivalent to 51% of learning, with a 56-percentage-point gap between students enrolled in low socio-economic level institutions and those from higher-income backgrounds (España, 2022). In Brazil, remote teaching accounted for only 27.5% of the learning achieved in a normal classroom setting (Lichand et al., 2021). Similarly, European countries and the United States showed comparable trends; for example, the Netherlands reported losses up to 60% greater among students from families with lower levels of education (Engzell et al., 2021); Germany saw reduced time dedicated to school activities (Grewenig et al., 2021; WöSSmann et al., 2020), with a similar phenomenon expected in Austria and Switzerland (Di Pietro et al., 2020); the United States faced learning losses (Chetty et al., 2020) and a sustained decline in school performance in math and reading tests (Kogan and Lavertu, 2021; Kuhfeld et al., 2020; Kuhfeld, Megan et al., 2022; Kennedy and Strietholt, 2023), both phenomena disproportionately affecting students from low-income families or ethnic/racial minorities. While the United States marked a significant educational recovery last year, with progress outpacing historical averages (Fahle et al., 2024); yet this rebound did not translate into narrowed achievement gaps in higher-poverty districts which continued to struggle, with some states seeing these gaps widen further (Fahle et al., 2024).

School closures required a redistribution of students' time at home to accommodate learning-related activities. Research indicates significant differences in time use and engagement in

study-related activities among students and families of different socio-economic levels, further exacerbating existing disparities. Students from lower socio-economic backgrounds spent far less time learning at home compared to their middle and high-income peers, whose time spent learning at home was two to three times that of their peers from poorer households. Due to the socioeconomic conditions of their families or schools, these students faced greater difficulty accessing active support and adequate educational resources and tools, such as consistent teacher support, computers, online classes, or digital learning materials (Andrew et al., 2020; Dietrich et al., 2020; Jæger and Blaabæk, 2020).

Research also suggests a relationship between (limited) access to remote education and increased school dropout rates (Acurio Hidalgo et al., 2021; Lichand et al., 2021; Gelber et al., 2021). Using simulated data from 174 countries, Azevedo et al. (2021) found that future enrollment rates may substantially decline; approximately 11 million students could leave the educational system. Actual data confirms similar results; for instance, Ethiopia experienced an 11.3% increase in school dropouts in 2021 compared to 2019, with the majority of dropouts being girls, older students, and low-achieving students (Bayley et al., 2023; Belay, 2020). In Pakistan, Khan and Ahmed (2021) estimated that up to 7.2 million primary education students might drop out due to a reduction of up to 50% in the family budget, and another 15.5 million could do so due to worker layoffs. In Indonesia, Halid (2022) found that the rate of school dropouts in basic education rose by 36.4%. In Chile, the dropout rate increased by 0.2 percentage points, interrupting the sustained decline of previous years (Ministerio de Educación, Chile, División de la Educación General, 2020). Various studies suggest that dropping out of school is linked to poorer labor conditions in terms of employment type and salary (Koc et al., 2020), deterioration in physical/mental health, and higher probabilities of substance abuse such as tobacco, drugs, and/or alcohol (Maclean, 2013, 2014; Reingle Gonzalez et al., 2016; Townsend et al., 2007), as well as a higher likelihood of having legal troubles (Bäckman, 2017).

In terms of long-term effects, Hanushek and Woessmann (2020) point out that, on average, a student might experience a 3% reduction in relative income, a figure that is expected to be higher among vulnerable students. Meanwhile, Bracco et al. (2022) estimate that school closures will lead to an increase of 8.4 to 20.7% in poverty levels in Latin America. In Indonesia, Yarrow et al. (2020) predict that the future earnings of affected students could decrease annually by up to US $484. In Poland, the projection is even grimmer, with students' future wages potentially decreasing by more than US $15,000 per year (Gajderowicz et al., 2022).

3 The Chilean Case

3.1 Efforts and policy decisions during the pandemic

In an effort to curb the spread of COVID-19, educational institutions worldwide were closed. Latin America and the Caribbean was among the regions with the longest duration of school closures, averaging a total of 146 days (UNICEF, 2021). For instance, from March 2020 to February 2021, schools in Panama were closed for 211 days, El Salvador for 205 days, Bolivia for 192 days, Brazil for 191 days, Costa Rica for 189 days, Mexico for 180 days, Venezuela for 170 days, Ecuador for 169 days, Guatemala for 165 days, Paraguay for 158 days, and Honduras for 147 days (UNICEF, 2021). In contrast, Uruguay experienced school closures for only five weeks during 2020 (Gottlieb, 2022).

In Chile, the Ministry of Education (Mineduc) launched various initiatives to support teachers and families during the pandemic. Notable among these was the Aprendo en Línea digital platform, which provided content and materials for students, teachers, and guardians across different educational levels and modalities. Other initiatives included the creation of the TV Educa Chile educational television channel, the distribution of printed educational materials to students, assistance to institutions for the effective use of digital tools, and the provision of technological devices to students and educational establishments (Centro de Estudios, Ministerio de Educación, 2020a,b; Ministerio de Educación, Chile, 2020).

In response to concerns raised by international organizations such as the United Nations, UNESCO, and UNICEF about the negative consequences of prolonged school closures, the Mineduc encouraged the return to in-person schooling at the start of the 2021 academic year. This included prioritizing the vaccination of education workers, providing students with COVID-19 school insurance which covered medical care for the Coronavirus, distributing health care kits, setting a budget of 186 billion for infrastructure, and creating funds such as the "Yo Confío en mi Escuela Fund" for public schools needing infrastructure improvements and the "Apoyo para el Retorno Seguro" Fund for public and private subsidized institutions requiring sanitary protection resources. From the second semester of the 2021 academic year, educational establishments gradually returned to in-person teaching (Ministerio de Educación, Chile, 2022a).

Following the 2021 reopening, the government developed plans and programs focused on addressing the negative impacts of school closures. During 2022, the Mineduc initiated the Comprehensive Educational Reactivation Policy "Seamos Comunidad," comprising a series of measures aimed at addressing issues like school coexistence and mental health, learning

recovery, improvement of educational infrastructure, connectivity, and student retention. Various programs were implemented, including the, "Territorial de Convivencia Escolar, el Plan Nacional de Tutorías, la Estrategia de Fortalecimiento de Lectura, Escritura y Comunicación Creativa," and workshops on coexistence and well-being for teachers. To tackle the issues of dropout and absenteeism caused by the pandemic, attendance reports were sent to public and private subsidized private schools, along with guidelines for re-engaging students (Ministerio de Educación, Chile, 2022b,d). In 2023, the Ministry of Education announced an expansion of the educational reactivation plan, allocating additional resources. The plans included setting up re-entry classrooms, extending the tutoring program, and increasing coverage of the Connectivity 2030 program (Ministerio de Educación, Chile, 2022c,d).

Particularly in the first phase of the pandemic (2020-2021), several of the measures developed by the Mineduc required, for their proper implementation, that students had access to the internet or that schools reopened. However, neither option was viable in rural areas. Rural zones typically have low levels of connectivity; for example, while an average of 45% of urban non-indigenous families have broadband internet access, only 3% of indigenous households in rural areas have this service (Ministerio de Desarrollo Social y Familia, Chile, 2017). Additionally, despite lower levels of contagion, rural areas kept their schools closed (Hofflinger, 2020). For instance, by March 2021, nearly 80% of rural schools remained closed (Centro de Estudios, Ministerio de Educación, 2023).

Furthermore, adapting to the virtual learning environment was more complex in rural areas due to the low digital literacy of parents in these sectors, complicating educational support for their children (Cáceres-Muñoz et al., 2020; Kuzmanic et al., 2023; Monge et al., 2020). In summary, low connectivity and school closures placed vulnerable students at greater risk of the negative consequences arising from remote education.

3.2 PISA assessments in Chile

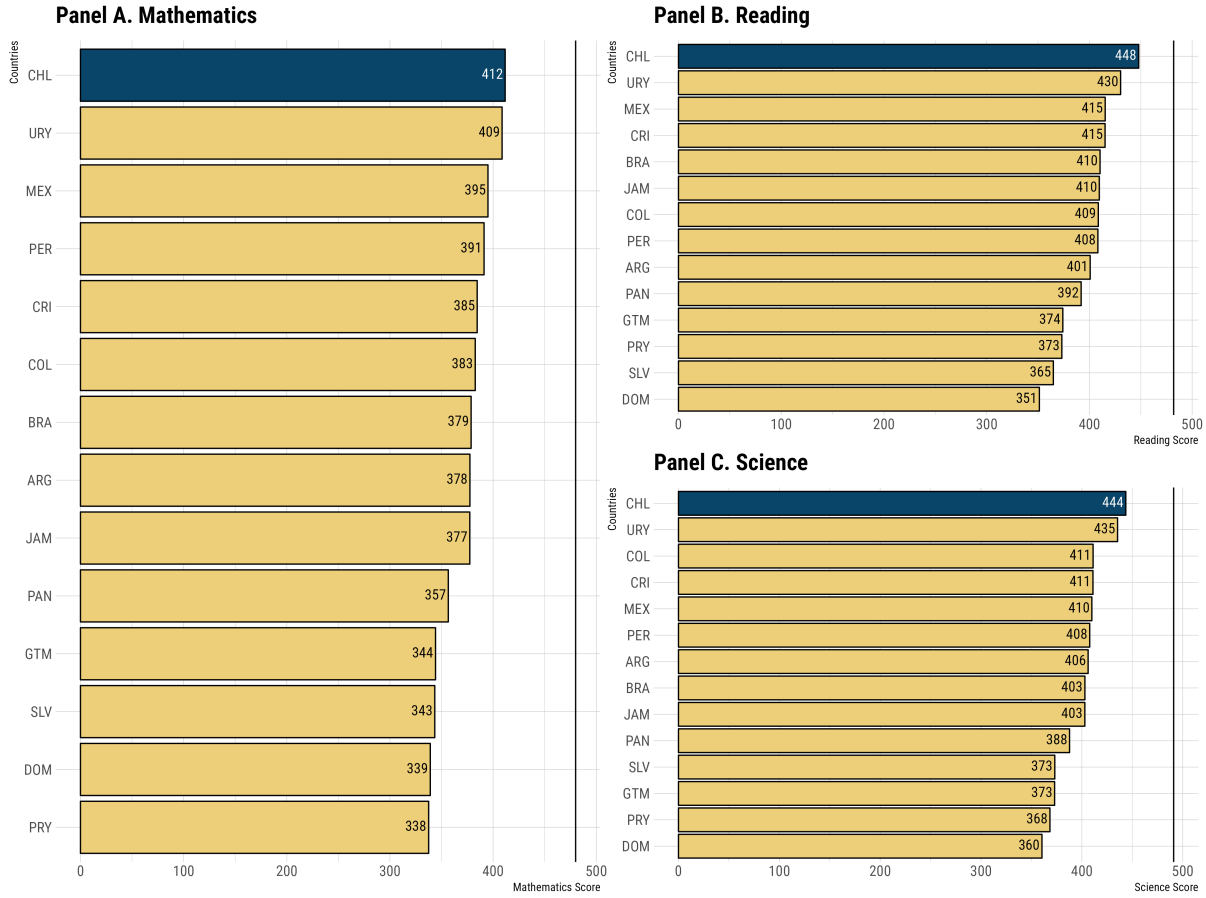
The 2022 PISA report highlights significant challenges in Chile's education system, particularly in mathematics. Chilean 15-year-olds scored an average of 412 points in mathematics, substantially lower than the Organization for Economic Co-operation and Development (OECD) average of 472 points. Figure 1 depicts the score in mathematics, reading, and science for all the Latin American and the Caribbeen countries that were part of 2022 PISA. Compared to 2018, Chile scored 5 points lower in 2022 in mathematics, 4 points lower in reading, and scored the same in science. However, this decline in performance is notable, as the 2022 scores are among the lowest ever observed in Chile since the PISA assessments began.

The proportion of students achieving at least Level 2 proficiency in mathematics was only 44%, compared to the OECD average of 69%. Moreover, only 1% of Chilean students were top performers in mathematics, significantly below the OECD average of 9%. This decline in mathematics performance is coupled with a performance gap based on socio-economic status, where advantaged students outperformed their disadvantaged peers by 69 score points, slightly less than the OECD average gap of 93 points (Organisation for Economic Co-operation and Development, 2023). Despite this, there has been a narrowing of the performance gap between the top and bottom socio-economic quartiles in Chile from 2012 to 2022, contrary to the stable average gap observed across OECD countries (Organisation for Economic Co-operation and Development, 2023).

Additionally, the PISA 2022 report reveals gender disparities and the impact of immigration and the COVID-19 pandemic on student learning outcomes in Chile. Boys outperformed girls in mathematics by 16 points, aligning with a global trend where boys outperformed girls in 40 countries in mathematics. In contrast, girls scored higher than boys in reading in almost all participating countries. The proportion of immigrant students in Chilean schools increased to 7% in 2022, in comparison to 2018, with a substantial performance gap of 29 points in mathematics favoring non-immigrant students (Organisation for Economic Co-operation and Development, 2023). The COVID-19 pandemic had a significant impact, with 53% of Chilean students experiencing school closures for more than three months, and nearly half reported difficulties in understanding assignments during remote learning. These challenges underscore the need for targeted interventions to address educational disparities and support vulnerable student groups in Chile (Organisation for Economic Co-operation and Development, 2023).

Figure 2 panel A plots the PISA math scores against the duration of full and partial school closures across various countries using the UNESCO (2022) school closure dataset for all the countries that took part in PISA 2022. We use duration of full and partial school closures (in weeks). The figure shows a downward trend, suggesting a negative correlation between the length of school closures and math scores. The longer the duration of school disruptions, the lower the PISA math scores. The implication is clear: extended periods away from traditional classroom environments and face-to-face instruction have hindered students' ability to learn and perform in mathematics.

Figure 1: PISA 2022 scores in Latin American and the Caribbean.

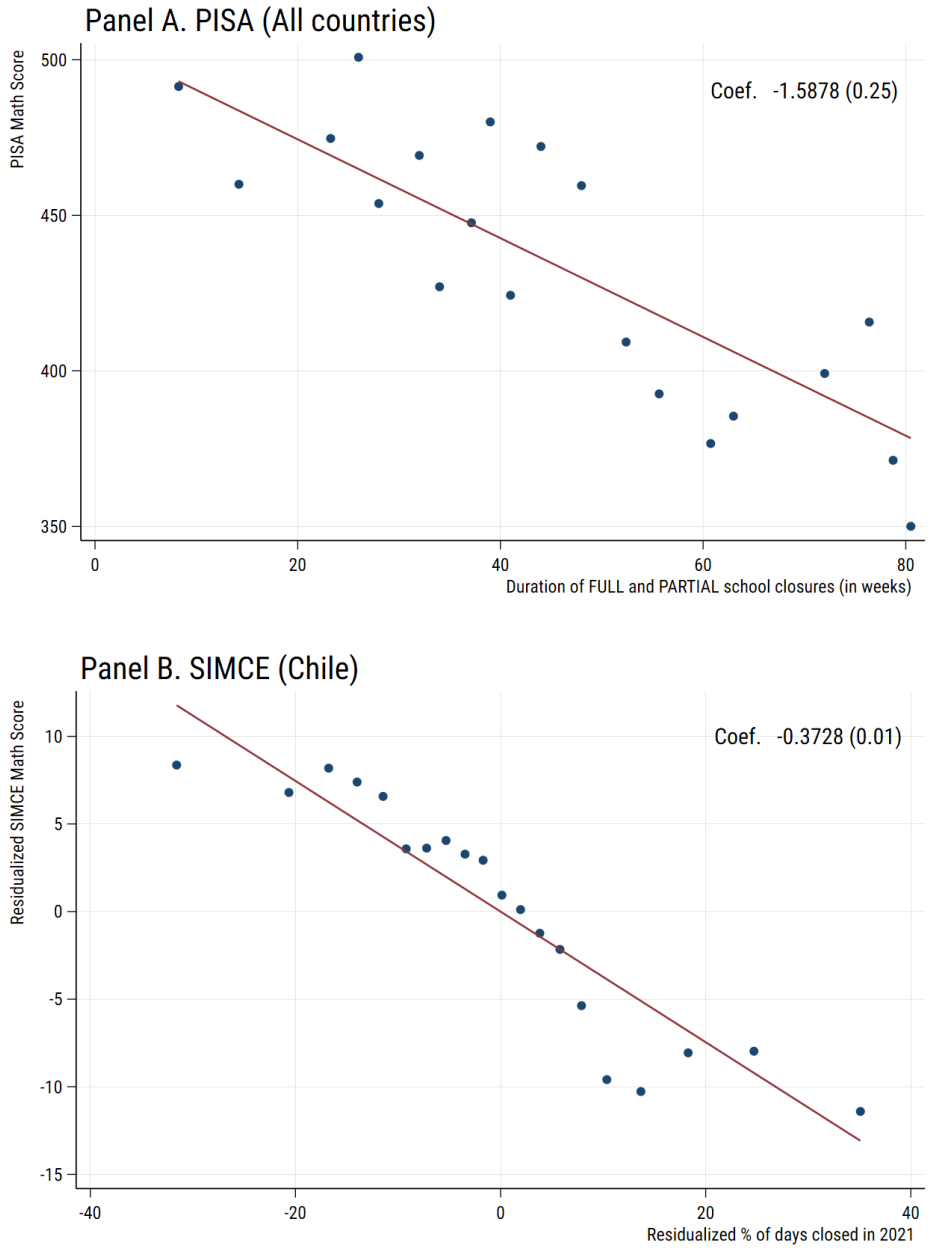


Source: Organisation for Economic Co-operation and Development (2023).
Notes: Vertical line represents OECD average for mathematics (480), reading (482), and science (491).

Panel B focuses specifically on Chile and uses the national assessment, SIMCE, math scores plotted against the percentage of days schools were closed in 2022 for schools. Like the PISA data, there is a visible negative trend line, showing that as the percentage of school closure days increased, the average SIMCE math scores in Chile decreased. This localized insight complements the global data provided by PISA, underscoring the challenges faced by Chilean students. The SIMCE scores are essential for understanding the country-specific impact of the pandemic on education which reveals the extent to which school closures have affected Chilean students' learning outcomes in mathematics. Reading scores also follow the same trend.

Both figures allow us to understand the scale and specifics of the educational challenges posed by the pandemic. Globally, as the PISA data shows, student mathematics learning suffered due to school closures. In Chile, the SIMCE data provides a more detailed picture of these challenges, showing how local students' math performance was affected by the number of days schools were closed. This consistent pattern across both international and national assessments indicates a broad and serious impact of the pandemic on educational outcomes.

Figure 2: Relationship between school closures and mathematics score for PISA and SIMCE.



Source: OECD (2023) for Panel A, and SIMCE 2022 for Chile.

Notes: In Panel B, we plot residualized SIMCE math scores and residualized % of days closed in 2021 on the following controls: Mother's and father's education, family income deciles, and whether the mother and father are indigenous or not. Standard errors are shown in parenthesis.

4 Data and Methods

We assembled data on students' test scores and socio-demographic characteristics from Chile's national assessment, SIMCE. Our analysis specifically focused on secondary school students so that we could compare the results with PISA. In Chile, it is mandatory for all students to take SIMCE; however, the scores of students with developmental disabilities ("estudiantes con

necesidades educativas especiales permanente") are not reported (Agencia de Calidad de la Educación, 2023).

We obtained data on student attendance and grade point average (GPA) from "Rendimiento del Estudiante" (Centro de Estudios, Ministerio de Educación) in 2022. In Chile, GPA ranges from 1 to 7, with 5 corresponding roughly to a B in the United States. We gathered data on school closures from "Estado apertura de establecimientos" (Centro de Estudios, Ministerio de Educación, 2023). Each school self-reported this data during the pandemic and provided daily information about whether schools were opened or closed in 2021. We created the variable "% of days closed 2021" by dividing the number of days that each school was closed by the total number of days during the school year (from March to December 2021). Finally, we merged these records (school closures) with the student -level data using a unique school ID number in both datasets.

To examine the impact between the duration of school closures and secondary school student scores in Chile, we analyze SIMCE 2022, and follow a similar strategy to Kennedy and Strietholt (2023) and Patrinos (2023). We standardized reading and mathematics scores and estimate the following specification:

$$Y_{is} = \alpha + \beta_1 \text{Duration}_s + \mathbf{X}_i'\delta_i + \mu_d + \varepsilon_{isd} \tag{1}$$

where Y_{is} is the standardized score for reading or mathematics for student i in school s; Duration_s is a variable that equal to the percent of days closed for school s in year 2021; $\mathbf{X}_i$ is a vector of characteristics of student i such as whether the mother (father) has a secondary education, college education, family income,[2] and whether the mother (father) is indigenous; μ_d are district fixed effects, and ε_{isd} is the error term.

To understand the differential impact of the pandemic, we use SIMCE scores from 2018 and 2022, and evaluate the impact on pre-pandemic and post-pandemic cohorts.[3] We estimate the following model which interact baseline characteristics with our pandemic indicator as follows:

$$Y_{is} = \alpha + \beta_1 \text{Group}_i + \beta_2 \text{Pandemic}_{ic} + \beta_3(\text{Group}_i \times \text{Pandemic}_{ic}) + \mathbf{X}_i'\delta_1 + \mu_s + \varepsilon_{is} \tag{2}$$

where Group_i denotes one of the baseline variable for heterogeneity analysis (e.g., girl, ethnicity, rural residency, and whether student's family falls within the lowest income quartile

[2] We converted family income to the midpoint of each category using the robust Pareto midpoint estimator (von Hippel et al., 2017).

[3] We standardized math and reading tests scores to the year 2018 as our baseline to have a mean of 0 and a standard deviation of 1.

of the distribution); Pandemic_{ic} is an indicator variable that equals 1 if student i was in 10th grade post-pandemic and 0, otherwise; c denotes cohort; $\mathbf{X}_i$ is a vector of characteristics of student i such as whether the mother (father) has a secondary education, college education, family income, and whether the mother (father) is indigenous; μ_s are school fixed effects; and ε_{is} represents the error term.

5 Results

We begin by presenting in Table 1 the relationship between percent of days closed in 2021 with SIMCE 2022 scores. Columns (1) to (3) present the results for mathematics, and columns (4) to (6) the results for reading. In all cases, the relationship between days closed and test scores is negative, and the point estimates range between 0.007 to 0.012 standard deviations (SD). This means that a 1 percentage point increase in the days that a school remained during 2021 is associated with a reduction of 0.007 SD in math scores and 0.003 SD in reading scores.

Table 1: Relationship between percent days closed in 2021 with SIMCE 2022 scores.

	Dependent Variable:					
	Math Scores			Reading Scores		
	(1)	(2)	(3)	(4)	(5)	(6)
% days closed in 2021	-0.0111***	-0.0119***	-0.0072***	-0.0067***	-0.0076***	-0.0034***
	(0.0008)	(0.0009)	(0.0007)	(0.0007)	(0.0008)	(0.0006)
Observations	154,526	154,526	127,355	152,748	152,748	125,907
Mean % Days Closed	43.476	43.476	43.061	43.466	43.466	43.052
R^2	0.033	0.094	0.186	0.012	0.045	0.109
District Fixed Effects	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes
Extrapolated Estimates from half a year of school closure	-0.553	-0.597	-0.360	-0.335	-0.382	-0.171

Notes: Standard errors clustered at the school level are shown in parenthesis. Controls include dummies for mother education and father education (high-school and/or college attainment), family income deciles, and whether the mother (father) is indigenous or not. *, ** and *** denote significance at the 10%, 5% and 1% levels.

Given that the mean percent of days closed in 2021 is 43%, we can use the coefficients to estimate the impact on test scores. For instance, a 50% closure would be associated with a decrease of approximately 0.36-0.58 SD in mathematics test scores and 0.15-0.35 in reading test scores.

Table 2 presents the same identification strategy as the one presented in Table 1 but for student attendance and GPA scores. For attendance, all three models show a negative relationship with the percentage of days closed, indicating that more days of school closure are associated with lower attendance rates, as expected. The coefficients range from -0.003 to -0.005 SD, and all are statistically significant. When examining GPA, columns (4) and (5) in-

dicate a significant negative impact of school closures on GPA, with coefficients of -0.003 and -0.004 SD, respectively. However, when we include district fixed effects and student characteristics in column (6), the relationship between school closures and GPA becomes statistically insignificant, with a coefficient very close to zero. This suggests that once students are compared with their peers within the same district, the percentage of days schools closed in 2021 did not affect students' annual GPA. However, other variables such as mother's and father's educational attainment, family income, and student's ethnicity are associated with a student's GPA. The change in statistical significance from models (4) and (5) to model (6) for GPA suggests that factors controlled for in model (6) like family background and socio-economic status may play a critical role in mediating the impact of school closures on GPA. In other words, these factors could be more influential in determining GPA outcomes than the mere fact of school closure.

Table 2: Relationship between percent days closed in 2021 with attendance and GPA.

	Dependent Variable:					
	Attendance			GPA		
	(1)	(2)	(3)	(4)	(5)	(6)
% days closed in 2021	-0.0034***	-0.0057***	-0.0038***	-0.0036***	-0.0038***	-0.0002
	(0.0007)	(0.0008)	(0.0008)	(0.0006)	(0.0007)	(0.0006)
Observations	155,410	155,410	128,036	155,410	155,410	128,036
Mean % Days Closed	43.487	43.487	43.067	43.487	43.487	43.067
R^2	0.003	0.043	0.057	0.003	0.036	0.083
District Fixed Effects	No	Yes	Yes	No	Yes	Yes
Controls	No	No	Yes	No	No	Yes
Extrapolated Estimates from half a year of school closure	-0.171	-0.286	-0.188	-0.180	-0.191	-0.012

Notes: Standard errors clustered at the school level are shown in parenthesis. Controls include dummies for mother education and father education (high-school and/or college attainment), family income deciles, and whether the mother (father) is indigenous or not. *, ** and *** denote significance at the 10%, 5% and 1% levels.

Overall, the analysis underscores the importance of considering a variety of factors when assessing the impact of school closures on educational outcomes. The findings indicate a clear negative association between school closures and attendance, which holds even after controlling for other factors. For GPA, the initial negative association disappears once student characteristics are included, suggesting that students' academic performance as measured by GPA may have been buffered by other factors during the pandemic. These results highlight the complexity of the educational disruptions caused by COVID-19.

Table 3: Gaps in Test Scores and Academic Performance

	Group Indicator:			
	Girl	Indigenous	Rural	Lowest Quartile
	(1)	(2)	(3)	(4)
Panel A. Math Scores				
Group Indicator	-0.111***	0.042***	-0.103***	-0.030***
	(0.007)	(0.015)	(0.011)	(0.007)
Pandemic Cohort	-0.217***	-0.234***	-0.240***	-0.247***
	(0.011)	(0.008)	(0.009)	(0.009)
Group Indicator × Pandemic Cohort	-0.024**	0.032***	0.095***	0.058***
	(0.010)	(0.012)	(0.017)	(0.009)
Observations	251,586	251,632	245,442	251,632
Mean Dep. Variable in 2018	0.057	0.057	0.069	0.057
Panel B. Reading Scores				
Group Indicator	0.271***	0.070***	-0.049***	0.023***
	(0.006)	(0.017)	(0.012)	(0.007)
Pandemic Cohort	-0.158***	-0.141***	-0.141***	-0.122***
	(0.010)	(0.007)	(0.007)	(0.008)
Group Indicator × Pandemic Cohort	0.030***	-0.009	-0.014	-0.063***
	(0.010)	(0.012)	(0.018)	(0.010)
Observations	249,153	249,198	243,084	249,198
Mean Dep. Variable in 2018	0.044	0.044	0.052	0.044
Panel C. GPA				
Group Indicator	0.171***	0.010	-0.033***	0.001
	(0.004)	(0.010)	(0.009)	(0.005)
Pandemic Cohort	0.229***	0.236***	0.233***	0.234***
	(0.006)	(0.005)	(0.005)	(0.005)
Group Indicator × Pandemic Cohort	0.018***	0.008	0.010	0.008
	(0.006)	(0.008)	(0.013)	(0.006)
Observations	255,299	255,363	248,991	255,363
Mean Dep. Variable in 2018	5.716	5.716	5.721	5.716
Panel D. Attendance				
Group Indicator	-0.897***	-0.394***	0.374***	-0.270***
	(0.057)	(0.142)	(0.106)	(0.060)
Pandemic Cohort	-2.709***	-2.551***	-2.588***	-2.419***
	(0.102)	(0.083)	(0.084)	(0.085)
Group Indicator × Pandemic Cohort	0.402***	0.093	0.109	-0.248***
	(0.094)	(0.111)	(0.164)	(0.088)
Observations	255,299	255,363	248,991	255,363
Mean Dep. Variable in 2018	92.952	92.952	93.004	92.952
School Fixed Effects	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes

Notes: Standard errors clustered at the school level are shown in parenthesis. All regressions control for mother education and father education (high-school and/or college attainment), family income deciles, whether the mother (father) is indigenous or not, and school fixed effects. Each column is a separate regression of the given outcome where we use as the group indicator variable the respective column label. *, ** and *** denote significance at the 10%, 5% and 1% levels.

We analyze the impact of school closure in our sample across different baseline characteristics using equation (2). In Table 3, we present our comparative analysis of academic outcomes and attendance rates across various demographic segments. We examine the following characteristics: the student's gender (girl), indigenous background, rural residency, and belonging to the lowest income quartile. For each panel, the group indicator variable is substituted by the characteristic denoted in the respective column number. We focus on the main specification that uses school fixed effects and demographics controls.

Panel A shows that, overall, the gap in math scores between the pandemic and non-pandemic cohorts was marked, with the pandemic cohort registering a significant decline in scores, ranging from 0.22 to 0.25 SD (about 14 to 16 points across all demographics). Notably, the most adversely impacted group during the pandemic were girls, facing the largest differential at nearly 0.02 SD decrease. This represents an increase in the gap between boys and girls after the pandemic of about 11 percent. Despite variations in the magnitude of decrease, none of the groups succeeded in bridging the pandemic-induced performance gap in the year 2022.

Panel B presents the results for the reading. The reading proficiency gap, when comparing pandemic and non-pandemic cohorts, was slightly narrower to the math gap, with a decrease of 6 to 7 points from pre-pandemic levels or 0.12 to 0.16 SD decrease. Nonetheless, students within the lower income quartile witnessed a more pronounced decline in reading scores, with a reduction of up to 0.06 SD compared to their counterparts in higher income quartiles in the post-pandemic period. Similarly to the results presented in Panel A, none of the sub-groups was able to close the gap after two years into the pandemic.

Panel C and Panel D present the results for GPA and attendance. There is an overall positive trend in GPA across all groups post-pandemic, with the interaction effect showing a significant positive impact exclusively for girls. However, it's important to note that the method for calculating GPA may have been adjusted during the school closures; for example, schools may have revised the GPA calculation criteria post-pandemic, incorporated new assessment methods or adjusted grading scales to reflect the unique challenges and learning environments during the post-period (Al-Jarf, 2022; Bulman and Fairlie, 2022; Karadag, 2021). These changes could influence the interpretation of GPA trends. Similar trends have been observed in other countries, where researchers have found an increase in the GPA in higher education and high school after 2020.

Finally, in our analysis, we observe a significant decline in attendance post-pandemic across all subgroups. Notably, students in the lowest income quartile experienced a dis-

proportionately negative impact, exacerbating the attendance disparity relative to their peers in higher income brackets. This trend is evident when examining the combined effects of the pandemic and its interaction with income levels, indicating a widening gap in attendance rates among different socioeconomic groups.

Overall, school closures adversely affected math and reading scores across diverse subgroups, as shown in Table 3. When analysis within school variations, the impact, particularly on pandemic cohorts, reveals a significant increase in the disparities between groups, affecting not only test scores but also attendance rates. While there was a general decline in test scores for math and reading, GPAs did not uniformly suffer, suggesting that there may have been compensatory strategies or alterations in assessment methodologies during the pandemic period. This indicates a nuanced landscape of academic impacts, where different evaluation metrics reflected varying levels of resilience or vulnerability.

6 Discussion

The objective of this chapter has been to analyze the impact of school closures in Chile, the nation with the longest period of school closures among OECD countries (Organisation for Economic Co-operation and Development, 2022). Using data from PISA and SIMCE (2022), we found that, on average, high school students experienced a decrease in their academic achievement and attendance records, but an increase in GPA after the pandemic. The results also show that the impact of school closures varied by student gender, ethnicity, family income, and whether they come from a rural area.

Several factors contributed to the disparities in educational outcomes observed in Chile during the COVID-19 pandemic. Students socio-economic background was as a primary factor, with students from lower-income families facing more significant challenges in accessing remote learning (Organisation for Economic Co-operation and Development, 2023). This group often lacked the necessary technological resources, such as reliable internet access and devices, which are essential for participating in online education. Additionally, these students were more likely to experience a lack of suitable learning environments at home, further hindering their ability to engage effectively in their studies (Díaz et al., 2022).

Educational disparities are notably influenced by gender and income level, particularly in the context of math performance. Students from the lower quartile of the income distribution and girls experienced more pronounced declines in math scores. This discrepancy could be attributed to factors such as differential access to educational resources or variations in home learning environments (Díaz et al., 2022; Belay, 2020). For instance, students from lower-

income households might have encountered more significant challenges in accessing digital learning tools or receiving adequate academic support at home. Another possible reason is that, according to España (2022), students in the highest income quintile were able to lose fewer classes during the pandemic, which could also have contributed to the gap in learning assessments as shown in this chapter. Similarly, the differential by gender on educational outcomes post pandemic might reflect underlying disparities in expectations, resources, or support, with these factors collectively contributing to the observed gaps in tests performance.

Bellei and Contreras (2023) found that the return to in-person classes was slow, and based on official data, the national average school attendance was 83% in 2022. Students in the lowest income quartile were particularly affected, and the gap in attendance has yet to see an improvement. Despite various efforts to boost school attendance, a substantial portion of students remained absent, with the most pronounced effects in publicly funded schools and among students from poorer regions (Centro de Estudios, Ministerio de Educación, 2022). This reflects a global trend where the most vulnerable student populations, similar to the lowest income quartile in our analysis, face heightened challenges in educational participation and achievement.

The effectiveness of remote teaching methods and the preparedness of schools and teachers to transition to online education could also have influenced educational outcomes (Bellei and Contreras, 2023). While we do not have ways of testing these hypotheses, schools with better resources and more technologically adept staff may be more able to provide effective remote learning experiences. In contrast, schools with limited resources and teachers who lacked training in digital tools struggled to maintain educational continuity. Additionally, the psychological impact of the pandemic, including stress and anxiety among students, could have further compounded learning challenges, particularly for those without access to adequate mental health support.

In contrast, our results show that students' annual GPA increased significantly after the pandemic. This finding is consistent with previous studies that show an upward trend in student grades after 2020 (Alishev et al., 2022; Cavanaugh et al., 2022; Clark et al., 2021; Doz, 2021; Rodriguez-Planas, 2021; Supriya et al., 2021; Tillinghast et al., 2023). Some research indicates that the increase in grades can be explained by a more flexible attitude adopted by schools and teachers, which may represent a compensatory measure in reaction to adverse circumstances faced by students during remote learning (Al-Jarf, 2022; Bulman and Fairlie, 2022; Karadag, 2021).

The wider implications of these educational disruptions in Chile extend beyond the imme-

diate learning outcomes. The decline in learning due to the pandemic is likely to have long-lasting effects on the future prospects of the affected students. Azevedo et al. (2022) estimate that the decrease in learning and school engagement could potentially lead to a reduction of 7 to 10% in future earnings for students impacted by the school closures. This economic impact, coupled with the increase in dropout rates, is a cause for serious concern. It highlights the need for comprehensive strategies that not only address the immediate educational challenges but also mitigate the long-term socio-economic consequences of the COVID-19 pandemic on Chile's younger generation.

The experiences and challenges brought forth by the COVID-19 pandemic have significant implications for educational policy in Chile and present opportunities for reform and improvement. First, addressing the digital divide must be a top priority. The pandemic has highlighted the urgent need for equitable access to technology and internet connectivity as essential to modern education. Policies should focus on providing consistent and reliable digital access to all students, regardless of their socio-economic status or geographical location. This includes not only the distribution of devices but also the improvement of internet infrastructure in remote and rural areas. Alongside technological access, there is a need for comprehensive digital literacy programs for both students and teachers to ensure the effective use of these resources.

Second, teacher training and support systems must be strengthened. The transition to online education during the pandemic revealed gaps in digital competencies among educators. Future policies should include ongoing professional development opportunities for teachers, focusing on digital skills and innovative teaching methods suited for both online and blended learning environments. Additionally, there should be an emphasis on emotional and psychological support for teachers, who have faced significant stress and adaptation challenges during the pandemic. Providing educators with the necessary tools and support is crucial for improving the overall quality of education.

Third, the mental health and well-being of students must be integrated into educational policies. The isolation and stress caused by the pandemic have had a profound impact on students' mental health, affecting their ability to engage and succeed in their studies (Blanchflower and Bryson, 2022). Implementing mental health programs, counseling services, and social-emotional learning curricula in schools can provide students with the necessary support to navigate these challenges. Such initiatives should be designed to be inclusive, addressing the needs of students from diverse backgrounds and with varying levels of need.

Last, there is a need for flexible and resilient educational frameworks that can adapt to

unforeseen challenges like those presented by the pandemic. This includes developing and implementing policies that allow for a seamless transition between in-person, remote, and hybrid learning models as circumstances require. Creating contingency plans and resources for emergency education situations will ensure that learning can continue uninterrupted in any future crises. In conclusion, the lessons learned from the pandemic provide a roadmap for strengthening Chile's educational system, making it more inclusive, adaptive, and resilient to future challenges.

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