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Do remote learning tools reduce learning loss during school closure? Experience from Central Asia and the Caucasus during the COVID-19 pandemic

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ADB Working Paper Series

**DO REMOTE LEARNING TOOLS REDUCE
LEARNING LOSS DURING SCHOOL
CLOSURE? EXPERIENCE FROM
CENTRAL ASIA AND THE CAUCASUS
DURING THE COVID-19 PANDEMIC**

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Abstract

School closures have a negative impact on children's educational outcomes. During the COVID-19 pandemic, Central Asia and the Caucasus introduced online classes and TV programs with a view to preventing learning loss. Based on a household survey in nine countries (Afghanistan, Azerbaijan, Georgia, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, and Uzbekistan), this is one of the first regional studies to document learning loss and the efficacy of remote learning tools in Central Asia and the Caucasus. Some 79% of households felt that their children's learning progress was slower than in in-person schooling, including 39% who perceived either "very little progress" or "no progress." Our econometric analysis finds that online classes reduced perceived learning loss during school closures, but this does not hold for TV programs. In addition, traditional paper lessons were also effective in reducing perceived learning loss but only for shorter school closure durations. The usage of online classes is strongly correlated with household income and location (urban vs. rural) as well as internet connectivity. Combined usage of TV programs and paper lessons may be an effective alternative to online lessons during longer closure periods.

Keywords: remote learning, learning loss, online class, COVID-19 pandemic, Central Asia

JEL Classification: I20, I21, I25

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1. INTRODUCTION

School closures have a negative impact on children's educational outcomes, which could eventually lead to a reduction in the future productivity and income of both individuals and countries (Hanushek and Woessmann 2020). During the COVID-19 pandemic, large and unequal effects of school closure on learning progress were found (Agostinelli et al. 2022; Engzell, Frey, and Verhagen 2021; Haelermans et al. 2022; Lichand et al. 2022; Moscoviz and Evans 2022). Patrinos (2023) find that one additional week of school closure increases the degree of learning loss by 1% of a standard deviation (SD). Alasino et al. (2024) find that student performance is 0.2–0.3 SD lower after school closures in Mexico, equivalent to 0.66–1.05 years of schooling. During school closures, the transition to online classes/learning was observed worldwide because in-person classes were not available. In addition to online classes, many Asian countries introduced TV and/or radio programs as an additional remote learning tool because internet connections were not necessarily available in some areas (UNESCO, UNICEF, and World Bank 2021). Due to efforts to ensure continuity in learning with remote learning tools in Uzbekistan, one study suggests that there were no learning losses during school closures (Iqbal and Patrinos 2023). However, evidence from other Asian countries suggests there were delays in learning progress during the school closure period (ADB 2022; Maddawin et al. 2024).

Experiences of school closures in Central Asia and the Caucasus provide important lessons for building resilient education systems. The region experienced perhaps the largest effect of school closures on students' learning progress due to relatively longer periods of closure (UNESCO 2021). At the same time, to prevent learning losses, the governments and international partners provided not only online classes but also other remote learning tools such as TV, paper lessons, and radio programs. Assessing the learning losses during the school closure periods and the efficacy of these remote learning tools in reducing such losses may help prevent them during future school closures, which could be due not only to pandemics but also to other shocks, including air pollution and natural disasters. It is important to learn from the experience of the COVID-19 pandemic to provide evidence-based policy recommendations. Thus far, however, the evidence is very limited in Central Asia and the Caucasus, and this is one of the first regional studies to document learning losses and the efficacy of remote learning tools during the pandemic.

We collected household survey data from 10 member countries of the Central Asia Regional Economic Cooperation Program (CAREC), excluding the People's Republic of China (PRC). Since there were no school closures in Turkmenistan, for this study we use data from nine countries, namely Afghanistan, Azerbaijan, Georgia, Kazakhstan, the Kyrgyz Republic, Mongolia, Pakistan, Tajikistan, and Uzbekistan. Our survey data include parents' perceived progress of their children's studies ("perceived learning progress or loss") and children's actual usage of remote learning tools. The results suggest that 79% of the households felt that their children's learning progress was slower than in in-person schooling, including 39% who perceived either "very little progress" or "no progress," despite the governments' efforts to minimize learning loss with remote learning tools. Our econometric analysis suggests that online classes, whose usage strongly correlates with household income and location (urban vs. rural), were effective in reducing perceived learning loss during school closures, but this does not hold for TV programs. Traditional paper lessons were also commonly used, but they were effective in reducing learning losses only for shorter school closure periods. We also find that a combined usage of TV programs and paper lessons seemed effective under longer closure periods.

This study contributes to the literature in two ways. First, it investigates the effectiveness of remote learning, including tools like online classes, paper lessons, and TV programs. Previous studies suggest that, if used properly, online classes may be as effective as traditional in-person classes in terms of learning outcomes (Swan 2003). Some recent studies suggest that online classes were to some extent effective for learning progress during school closures (Awal 2023; Roman and Plopeanu 2021). However online classes in Central Asia and the Caucasus (particularly in rural areas) were challenged by the lack of access to a good-quality internet connection, as well as access to devices (e.g., computers, tablets, smartphones). Instead, offline tools such as TV programs and paper lessons were provided for children who could not access online classes, which could help to mitigate the negative impact. Our results suggest that, when combined with paper lessons, TV programs may mitigate the negative effects of school closure on learning progress, although the effects are smaller than those of online classes.

Second, this is one of the first regional studies to document learning losses in Central Asia and the Caucasus during the pandemic. Previous studies on learning losses mainly focus on high-income countries such as the United States, the Netherlands, and Germany, while some focus on middle- and low-income countries like Bangladesh, Brazil, Indonesia, and Kenya (cf., Patrinos, Vegas, and Carter-Rau 2023). Maddawin et al. (2024) recently reports learning losses in Southeast Asian countries, yet evidence from Central Asia and the Caucasus is thus far limited despite the longer duration of school closures in the region. Although we were not able to implement objective measures of learning losses like test scores, our survey data reflect respondents' actual responses to governments' policies on school closures and remote learning. We add unique evidence on parents' perceived learning progress in Central Asia and the Caucasus to the literature.

The remainder of this paper is organized as follows. Section 2 describes the data and context of this study. Section 3 presents descriptive evidence. Section 4 investigates the effectiveness of remote learning tools and presents the results of econometric analysis. Section 5 concludes and provides policy recommendations.

2. DATA AND CONTEXT

2.1 Data

Following the COVID-19 pandemic and school closures in 2020 and 2021, we conducted household surveys in nine CAREC member countries (excluding the PRC and Turkmenistan) from September to October 2022 with a view to understanding the impacts of the pandemic on households and children's educational progress.¹ Computer-assisted telephone interviews (CATIs) were carried out on randomly selected representative samples of more than 1,000 households from each country, as face-to-face interviews were not practical under the pandemic conditions. For each country, we confirm that the regional and household income (quantile) distributions are in line with the national statistics. The questionnaire covered socioeconomic status, employment, gender and education of the household head, household income and expenditure, and children's education (if any) during the time of the pandemic. Azhgaliyeva et al. (2022) and Kodama et al. (forthcoming) for further details.

¹ Turkmenistan was excluded from this study because it reported no school closures during the COVID-19 pandemic.

For those respondents who have any school-age children (aged six to 18), we asked questions related to school closures and the perceived learning progress of the school-age child who most recently had a birthday. In addition to basic information on this child such as grade level as of now and before the school closures (December 2019), we asked about the duration of school closures since February 2020, modes of remote learning (class instruction) they used during the closures, the parents' perceptions of the child's learning progress during the closures, and whether the child was enrolled in school after reopening.

In this study, we restrict the samples to households who had any school-age children and experienced school closures. This leaves a subsample of 3,600 households, equivalent to around 40% of the original dataset. Table 1 shows the distribution of our sample. The sample mainly consists of households with elementary school and middle school children: 36% in Grades 1 to 3, 25% in Grades 4 to 6, and 24% in middle school. Nearly half of the households reside in urban areas and the remaining half live in rural areas.

Table 1: Sample Distribution: Grade Level, Area (Rural vs. Urban), and Country

	Share, % (restricted sample)	Share, % (original sample)
Grade level (December 2019)		
Preschool/kindergarten	5.20	
Elementary P1-P3	36.25	
Elementary P4-P6	25.14	
Middle school	23.83	
High/vocational school	9.58	
Location (rural vs. urban)		
Rural	53.05	53.06
Urban	46.95	46.94
Country		
Afghanistan	6.75	11.21
Azerbaijan	10.33	10.86
Georgia	8.25	10.86
Kazakhstan	10.33	11.00
Kyrgyz Republic	13.12	11.44
Mongolia	12.44	10.97
Pakistan	18.07	11.12
Tajikistan	10.95	10.96
Uzbekistan	9.77	11.58
Observations	3,600	10,207

Source: Authors' estimates from the survey.

2.2 Context

During the time of the COVID-19 pandemic, CAREC countries implemented various measures, including lockdown and school closures. Table 2 shows the duration of school closures in CAREC countries based on UNESCO's database. In Afghanistan and Pakistan, on average, schools were fully closed for more than 35 weeks and partially closed for around 25 weeks. These closures may have led to learning losses of 0.35 to 0.60 SDs (based on the estimates by Patrinos (2023)). Azerbaijan and

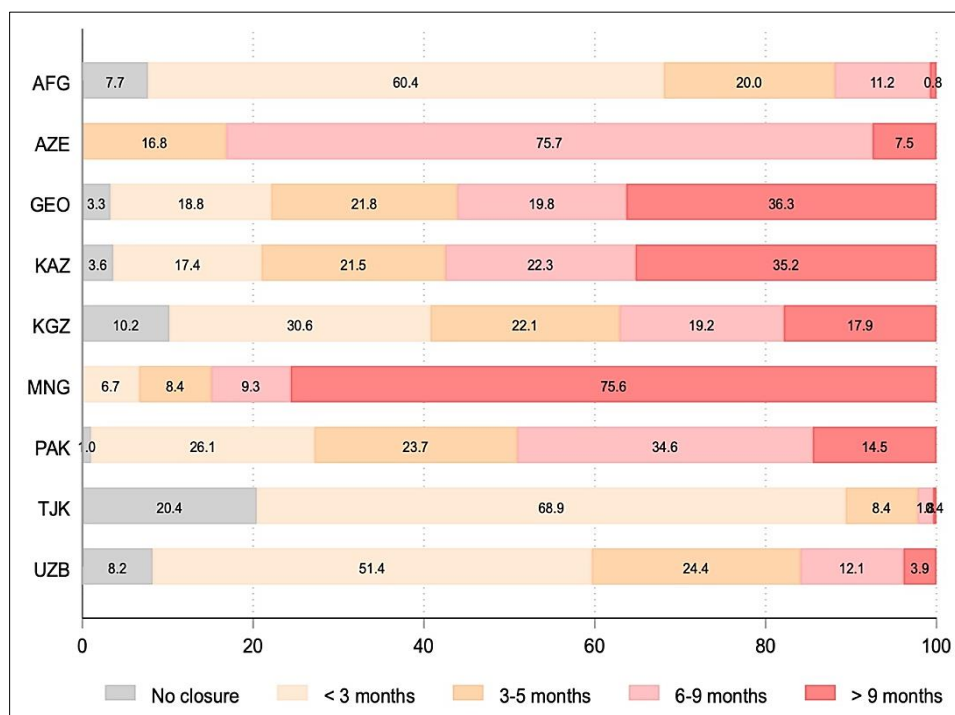
Mongolia also had long closure periods with 29 and 24 weeks of full closure and 20 and 34 weeks of partial closure, respectively. In Kazakhstan, schools were partially closed for 43 weeks. In contrast, Tajikistan had no full school closure but had four weeks of partial closure.

Table 2: Duration of School Closures and Types of Distance Learning (Feb 2020 – March 2022)

	Duration (week)		Modes of Remote Learning			
	Fully Closed	Partially Closed	Online Classes	TV Programs	Radio Programs	Take-home Packages (paper)
Afghanistan	35	26	✓	✓	✓	
Azerbaijan	29	20	✓	✓		
Georgia	19	16	✓	✓		
Kazakhstan	9	43	✓	✓	✓	
Kyrgyz Rep.	14	13	✓	✓	✓	✓
Mongolia	24	34	✓	✓		
Pakistan	37	24	✓	✓	✓	✓
PRC	9	21	✓	✓	✓	
Tajikistan	0	4				
Uzbekistan	13	1	✓	✓	✓	

Sources: UNESCO, UNICEF, and World Bank (2021); UNESCO’s COVID-19 Global Monitoring Database, COVID-19 Education Response. <https://covid19.uis.unesco.org/global-monitoring-school-closures-covid19/country-dashboard/>.

Figure 1: Reported Duration of School Closures, % Households



Notes: The abbreviations (iso3) of the countries are as follows: Afghanistan (AFG), Azerbaijan (AZE), Georgia (GEO), Kazakhstan (KAZ), Kyrgyz Republic (KGZ), Mongolia (MNG), Pakistan (PAK), Tajikistan (TAJ), and Uzbekistan (UZB).
 Source: Authors’ estimates from the survey.

Figure 1 shows the distribution of the reported school closure durations based on our survey. From February 2020 to September–November 2022 (time of the survey), a very large share of households in Mongolia (78%) experienced school closures of longer than nine months, followed by Georgia (36%) and Kazakhstan (35%). In Azerbaijan, Tajikistan, and Uzbekistan, the majority of households had only up to three months of school closure. There are some variations in the school closure durations within the countries, which enables us to examine the linkage between the closure duration and learning progress during the pandemic in a more granular way.

Table 2 also shows the modes of remote learning introduced during the school closures. To reduce the negative effects of school closures, governments in CAREC countries implemented multiple modes of remote learning, mainly online classes and TV programs. Radio programs were also introduced in some countries. Take-home packages were not commonly used remote learning modes, unlike in Southeast Asian countries (UNESCO, UNICEF, and World Bank 2021). According to UNESCO's dataset, the use of remote learning methods was not reported in Tajikistan, presumably reflecting the relatively short school closure period.

During the school closure periods, governments and international partners made great efforts to provide remote learning opportunities to all students. For example, in Azerbaijan, the government launched the Microsoft Teams-based "Virtual School," where students and teachers can access educational content (e.g., e-books, video lessons) and online classes (Ministry of Science and Education of Azerbaijan 2020). In Kazakhstan, the government provided the online platform "Kundelik," where students can access video lessons, online personal consultations with teachers, and online courses. Video lessons were also broadcasted on nationwide TV channels such as "Balapan" (in Kazakh), "El arna" (in Russian), regional TV channels, and Qazaq Radio (United Nations 2020). In Georgia, the government provided various kinds of remote learning, including the development of a new educational TV channel, "First Channel Education," and Microsoft Teams-based virtual classrooms (Ministry of Education, Science, Culture, and Sports of Georgia 2020). In Uzbekistan, the government broadcasted video lessons on national TV channels. These lessons were also made available on video-sharing platforms like YouTube, Mover.uz, and learning management platforms (Meliboeva, Patrinos, and Teixeira 2020).

3. STYLIZED FACTS

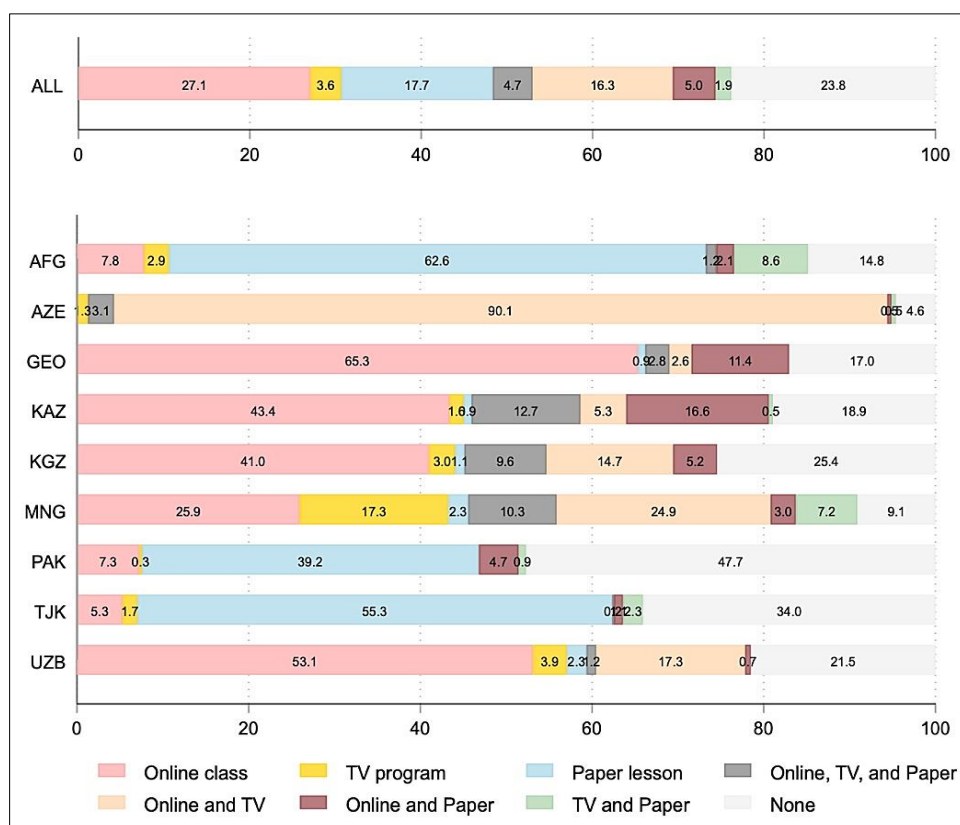
This section presents descriptive statistics of our variables of interest: modes of remote learning actually used by children (Figure 2) and parents' perceived progress of learning during school closures (Figure 3).

Despite government efforts to implement remote learning modes like online classes and TV programs, our household survey suggests that many children did not necessarily use these remote learning modes (Figure 2). Overall, 65% and 30% of children used online classes and TV programs, respectively, while only 2.8% used radio programs (results not shown). The use of radio programs was very rare (around 1%) and they were thus added to "TV programs." Some 24% of children did not use any remote learning tools. Online classes were not common in countries like Afghanistan, Pakistan, and Tajikistan, where internet connections are typically poor in rural areas. The usage of TV programs was not as common as that of online classes but was popular in Azerbaijan and Mongolia. A significant share of households reported that their child used paper (take-home package) lessons during school closures. These shares are higher in those countries where online class and TV program participation

rates were lower, such as Afghanistan, Pakistan, and Tajikistan. Presumably, in these countries, households substituted online classes and TV programs with traditional paper lessons.

Figure 2 also indicates that some children took multiple modes of distance learning. The share of those who took online classes together with TV classes was particularly high in Azerbaijan (90.1%), followed by Mongolia (24.9%), Uzbekistan (17.3%), and the Kyrgyz Republic (14.7%). In Azerbaijan, most students perhaps used the “Virtual School” launched by the government, where they could access both online classes and TV or video lessons (cf., Ministry of Science and Education of Azerbaijan 2020). The combination of online and paper lessons was also common in some countries like the Kyrgyz Republic (16.6%) and Georgia (11.4%). Some households used all possible means of distance learning, e.g., Kazakhstan (12.7%), Mongolia (10.3%), and the Kyrgyz Republic (9.6%).

Figure 2: Actual Usage of Distance Learning Modes, % Households

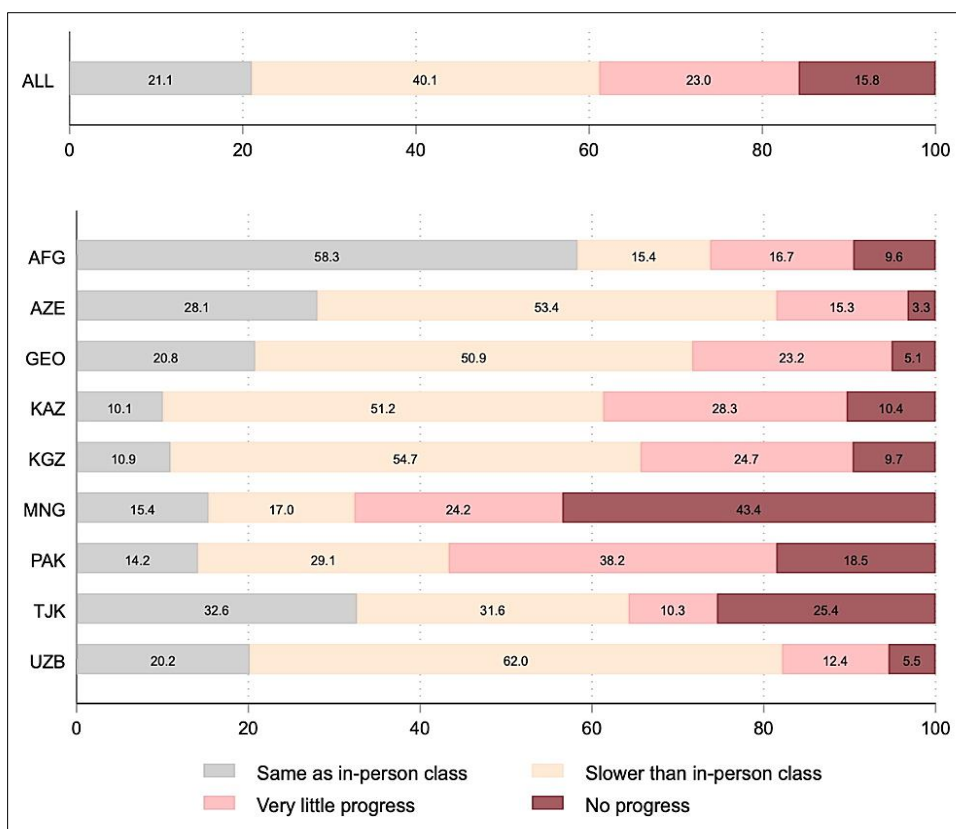


Note: % of households with children who experienced school closure. “TV program” includes radio program.
 Source: Authors’ estimates from the survey.

Our measure of learning loss is parents’ perceived learning progress during school closures. For those households (parents) whose children experienced school closures, we asked for their subjective evaluations of their children’s study progress compared to in-person classes according to four possible responses: “same as in-person class,” “slower than in-person class,” “very little progress,” or “no progress.” The latter three may be viewed as evidence of perceived learning loss, and the last two as severe learning loss.

Figure 3 shows the survey results. Overall, about 79% of households felt that their child’s learning progress was slower during school closures than in in-person classes. Of these, 15% of households saw “no progress” and 23% saw “very little progress.” Thus, despite the provision of remote learning tools such as online classes and TV programs, the vast majority of households perceived mild or severe learning loss during school closures.

Figure 3: Perceived Learning Progress during School Closures, % Households



Note: % of households with children who experienced school closure.

Source: Authors’ estimates from the survey.

The perceived learning loss was severe particularly in Mongolia, where more than 40% of households reported “no progress.” This was perhaps due to the longer duration of school closures: 76% experienced more than nine months of closure. In addition, 56.7% reported either “no progress” or “very little progress” in Pakistan. The perceived learning loss was relatively mild in Afghanistan, yet 42% of parents perceived delayed progress.

4. ECONOMETRIC ANALYSIS

4.1 Determinants of the Usage of Distance Learning Tools

To investigate the determinants of the use of different remote learning modes, we estimate the following equation:

$$\Pr(RL_i^m = 1) = f(\alpha^m + Duration_i\beta^m + X_i\delta^m + \varepsilon_i^m), \tag{1}$$

where RL_i^m is a dummy variable that takes the value of one if child i used remote learning mode m during school closure. Given the small share of those who used radio programs, we only consider the usage of online classes, TV programs, and traditional paper lessons as remote learning modes. $Duration_i$ is the duration of school closure, and X_i includes the child's grade level in December 2019 (before the school closure) and a set of household characteristics. ε_i is the mean zero error term and f is a known function that represents the logit model.

Table 3 presents the estimation results. The duration of school closure appears to be an important driver of the usage of remote learning modes (i.e., online and TV classes). A longer duration of school closure leads to a higher likelihood of using these two remote learning modes. Children in higher grades are more likely to use online classes: Compared to children in elementary Grades 1–3, children in elementary Grades 4–6, middle school, and high school are more likely to use online classes by 3.8%, 2.8%, and 8.2%, respectively. In contrast, TV classes and paper lessons are used more by children in lower grades.

Table 3: Determinants of Usage of Distance Learning Tools, Marginal Effects of Logit Model

	(1)		(2)		(3)	
	Online Classes		TV Classes		Paper Lessons	
School closure duration (< 3 months)						
3 to 5 months	0.063***	(0.016)	0.052***	(0.017)	-0.034*	(0.021)
6 to 9 months	0.028*	(0.017)	0.041**	(0.019)	-0.001	(0.021)
More than 9 months	0.012	(0.017)	0.051***	(0.019)	-0.018	(0.023)
Grade in 2019 (Primary 1–3)						
Preschool	-0.001	(0.024)	0.010	(0.027)	-0.140***	(0.032)
Primary 4–6	0.038***	(0.013)	-0.023	(0.014)	0.004	(0.018)
Middle school	0.028*	(0.014)	-0.038**	(0.016)	-0.045**	(0.019)
High school	0.082***	(0.019)	-0.104***	(0.023)	-0.082***	(0.024)
Internet (no connection)						
Available but not used	0.015	(0.030)	-0.047	(0.031)	-0.020	(0.034)
Poor connection	0.040**	(0.017)	-0.014	(0.018)	0.053**	(0.021)
Good connection	0.056***	(0.015)	0.004	(0.016)	0.054***	(0.019)
Household/head characteristics						
Location (rural = 1)	-0.050***	(0.012)	0.051***	(0.012)	0.029*	(0.015)
Gender (female = 1)	-0.032**	(0.014)	-0.003	(0.014)	-0.000	(0.017)
(Primary school = 1) Middle school	0.049**	(0.023)	-0.015	(0.033)	0.031	(0.029)
High school	0.090***	(0.019)	0.026	(0.028)	0.059**	(0.023)
Vocational school	0.035	(0.034)	0.054	(0.044)	-0.019	(0.051)
College	0.087***	(0.020)	0.015	(0.028)	0.061**	(0.025)
Household income (class = 4; highest)						
Income class = 1	-0.026*	(0.016)	0.017	(0.018)	0.049**	(0.023)
Income class = 2	-0.025*	(0.015)	0.009	(0.015)	0.016	(0.020)
Income class = 3	-0.030**	(0.015)	0.012	(0.016)	0.017	(0.018)
Country fixed effects	✓		✓		✓	
Observations	3,600		3,600		3,600	

Notes: Asterisks (*, **, and ***) denote significance at 10, 5, and 1 % levels, respectively. Standard errors are reported in parenthesis. The variable value in parentheses shows the reference group, e.g., less than three months of school closure. See Appendix Table A1 for household income class categories.

Source: Authors' estimates from the survey.

As expected, internet connectivity is an important correlate of the usage of online classes. Due to better connectivity, children in urban areas are more likely to use online classes, while children in rural areas tend to use TV classes and paper lessons. Interestingly, better internet connections and rural area correlate with paper lessons, presumably because they complement online and TV classes. The household head's gender and educational background and household income are also key correlates of online class usage. These findings suggest that children in better-off and urban households had a higher chance of using online classes, which could have increased learning gaps (Marteau 2020). It seems that TV classes to some extent substitute for online classes, and one important policy question is whether TV classes are as effective as online classes in reducing learning loss during school closure.

4.2 Remote Learning Tools and Perceived Learning Loss

To investigate the effectiveness of remote learning modes in reducing perceived learning loss, we estimate the following equation:

$$\Pr(LL_i) = f(\alpha + Duration_i\beta + RL_i^m\gamma + (Duration_i \times RL_i^m)\lambda + X_i\delta + \varepsilon_i), \quad (2)$$

where LL_i is a variable that represents the perceived learning loss outcome of child i . We consider two outcomes: (i) severe learning loss (= 1 if “very little progress” or “no progress” and = 0 if otherwise) and (ii) severity of learning loss (= 1 if “same as in-person class”, = 2 if “slower progress,” = 3 if “very little progress,” and = 4 if “no progress”). $Duration_i$ is the duration of school closure (categorical variable) and RL_i^m is a remote learning mode used during school closure (dummy variables). We include interaction terms between duration and mode to elicit the effects of remote learning modes on reducing the negative effects of longer school closure. We use a binary logit model and ordered logit models, respectively, to estimate the equations.

Table 4 shows the estimation results. A longer duration of school closure is found to significantly increase the probability of “severe learning loss” (Column 1) and “higher severity of learning loss” (Column 2). Compared to a less than three-month closure, a six- to nine-month closure and more than nine-month closure increase the former probability by 14 percentage points (p.p.) and 26 p.p., respectively. Under the shorter school closure duration (less than three months), paper lessons are found to decrease the probabilities by 16.1 p.p. and 6.9 p.p., respectively.

When the remote learning mode is interacted with duration (**Duration # Mode in Table 4**), online classes are found to mitigate the negative effects of longer school closures on learning progress. However, this does not hold for TV programs. To demonstrate such mitigation effects, Figure 4 depicts the predicted probabilities of “severe learning loss” with respect to the duration of school closure, conditioned on with and without usage of remote learning mode. It shows that the probabilities of severe learning loss increase as the school closure duration gets longer, but the probabilities do not increase when online classes are used. However, TV programs do not bring about such a mitigating effect. The probability of learning loss increases as the duration becomes longer irrespective of the use of TV programs. Interestingly, although the probability of learning loss is lower with the use of paper lessons, this effect diminishes significantly as the school closure duration becomes longer. This finding suggests that paper lessons were not effective when the school closure duration was relatively long. Overall, only online classes were found to be an effective measure for reducing learning loss during longer school closure durations.

Table 4: Remote Learning Modes and Perceived Learning Loss

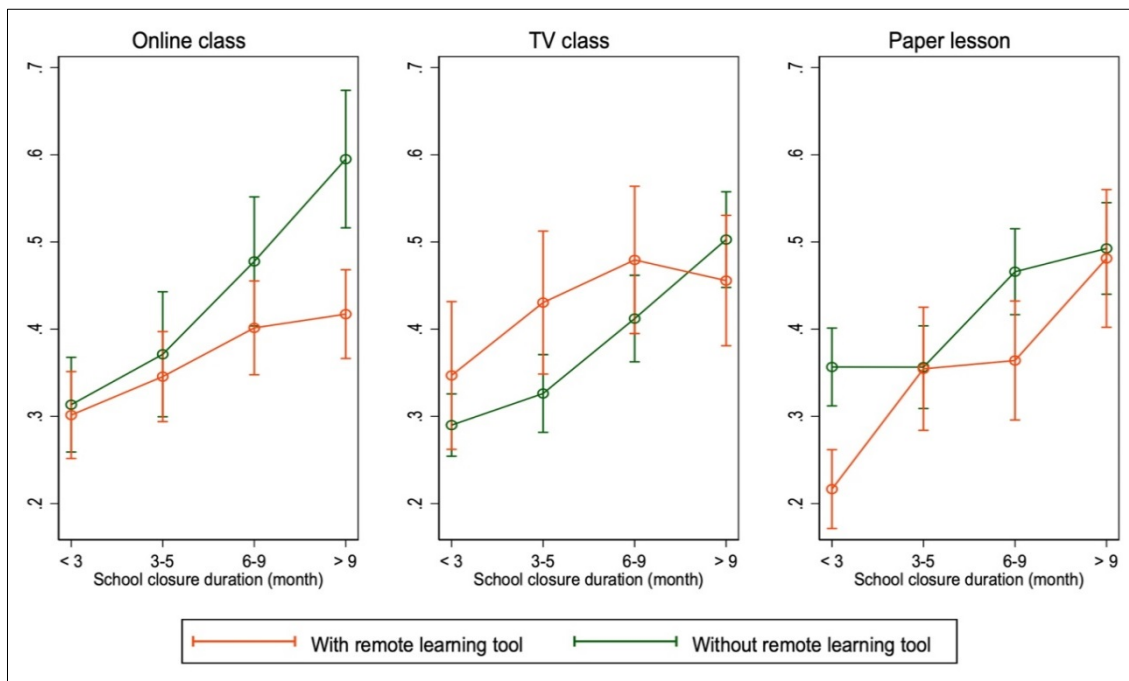
	(1) Logit Model				(2) Ordered Logit Model			
	(= 1 if Very Little or No Progress; = 0 Otherwise)				(= 1 if Same, = 2 if Slower, = 3 if Very Little, = 4 if No Progress)			
	Coefficient		Marginal Effect		Coefficient		Marginal Effect	
Duration (< 3 months)								
3 to 5 months	-0.013	(0.210)	-0.003	(0.043)	-0.087	(0.192)	-0.008	(0.017)
6 to 9 months	0.599***	(0.212)	0.136***	(0.048)	0.548***	(0.186)	0.062***	(0.022)
> 9 months	1.101***	(0.232)	0.260***	(0.054)	0.801***	(0.192)	0.100***	(0.026)
Mode of remote learning (none)								
Online classes	-0.051	(0.183)	-0.012	(0.043)	-0.057	(0.155)	-0.007	(0.018)
TV programs	0.265	(0.208)	0.062	(0.049)	0.204	(0.166)	0.023	(0.019)
Paper lessons	-0.688***	(0.156)	-0.161***	(0.037)	-0.601***	(0.137)	-0.069***	(0.016)
Duration # Mode								
3 to 5 months # Online	-0.061	(0.247)	-0.014	(0.058)	-0.013	(0.213)	-0.002	(0.025)
6 to 9 months # Online	-0.251	(0.246)	-0.059	(0.058)	-0.274	(0.208)	-0.032	(0.024)
> 9 months # Online	-0.667***	(0.247)	-0.156***	(0.058)	-0.588***	(0.204)	-0.068***	(0.023)
3 to 5 months # TV	0.173	(0.287)	0.040	(0.067)	0.356	(0.232)	0.041	(0.027)
6 to 9 months # TV	0.021	(0.294)	0.005	(0.069)	-0.083	(0.238)	-0.010	(0.027)
> 9 months # TV	-0.441*	(0.267)	-0.103*	(0.062)	-0.256	(0.219)	-0.029	(0.025)
3 to 5 months # Paper	0.681***	(0.244)	0.159***	(0.057)	0.610***	(0.214)	0.070***	(0.025)
6 to 9 months # Paper	0.282	(0.239)	0.066	(0.056)	0.124	(0.202)	0.014	(0.023)
> 9 months # Paper	0.644***	(0.235)	0.151***	(0.055)	0.413**	(0.200)	0.048**	(0.023)
Grade in 2019 (Primary 1–3)								
Preschool	0.945***	(0.178)	0.221***	(0.042)	0.969***	(0.157)	0.111***	(0.018)
Primary 4–6	0.129	(0.099)	0.030	(0.023)	0.113	(0.082)	0.013	(0.009)
Middle school	0.300***	(0.105)	0.070***	(0.025)	0.228***	(0.086)	0.026***	(0.010)
High school	0.166	(0.135)	0.039	(0.032)	0.070	(0.116)	0.008	(0.013)
Household income (class = 4; highest)								
Income class = 1	0.205	(0.131)	0.048	(0.030)	0.209*	(0.108)	0.023**	(0.012)
Income class = 2	0.240*	(0.133)	0.056*	(0.031)	0.298***	(0.109)	0.034***	(0.012)
Income class = 3	0.073	(0.123)	0.017	(0.028)	0.134	(0.100)	0.014	(0.010)
Constant	-1.248***	(0.226)						
Country fixed effects	✓				✓			
Observations	3,553				3,553			

Notes: Asterisks (*, **, and ***) denote significance at 10, 5, and 1 % levels, respectively. Standard errors are reported in parenthesis. The marginal effect of the ordered logit model shows the effect on the probability of “no progress.”

Source: Authors' estimates from the survey.

With regard to children's grades in 2019, those in preschool and middle school were more likely to report learning loss than those in elementary Grades 1–3. This is perhaps because in most countries, both online classes and TV class programs were mainly provided at the elementary school level (cf., Table 3). Children from lower-income households were more likely to have perceived learning loss. This is consistent with the literature: Learning loss is particularly prevalent among children from lower socioeconomic backgrounds (Moscoviz and Evans 2022).

Figure 4: Probability of “Severe Learning Loss” by Remote Learning Modes



Notes: This figure reports the predicted probability of very little or no progress during school closure. The estimation is based on Column 1 in Table 4.

4.3 Effectiveness of Multiple Distance Learning Modes

Even though we found that only online classes were effective in mitigating severe learning loss due to longer school closures, the role of using multiple remote learning modes is not considered in our previous regression. Specifically, paper lessons may enhance the effectiveness of online classes or TV programs. To elicit the effectiveness of using multiple remote learning modes, we estimate the same equation as in Table 4 but with (i) a binary variable that represents longer school closure (= 1 if longer than six months and = 0 if otherwise) to simplify the econometric model, and (ii) interaction terms between multiple learning modes (online classes and paper lessons; TV programs and paper lessons) and the duration of school closure.

Table 5 reports the results. As in Table 4, a longer school closure duration increases the probability of severe learning loss (Column 1) or higher severity of learning loss (Column 2). The use of online classes relates to a lower probability of severe learning loss, but its combination with paper lessons does not bring about any further benefits. In contrast, even though the use of TV programs alone is not related to a lower probability, its combined usage with paper lessons mitigates the negative effects of longer school closures.

To demonstrate the role of single and multiple remote learning modes, Table 6 shows the estimated probability of severe learning loss by duration of school closure (less than vs. more than six months) and types of learning modes, based on the results from the regression reported in Column 1 of Table 5. Without taking any remote learning mode, on average the probability increases by 33% when the school closure duration is longer than six months. This probability increase is still 26% and 42% with online classes alone and TV programs alone, respectively. The usage of only paper lessons relates to the lowest probability of severe learning loss under shorter school closures

(< 6 months), but the probability increases sharply by 90% when the duration is longer (> 6 months). Under longer school closures, online classes, online and paper lessons, and TV and paper lessons relate to the lowest probabilities of severe learning loss (0.430, 0.429, and 0.426, respectively). The benefits of using multiple learning modes are seen for TV programs under longer school closure periods. Compared to online classes, TV programs are not interactive, and students tend to be less active. Paper lessons (e.g., homework) may supplement this limitation of TV programs by enhancing students' efforts with learning.

Table 5: Single and Multiple Remote Learning Modes and Perceived Learning Progress

	(1) Logit Model				(2) Ordered Logit Model			
	(= 1 if Very Little or No Progress; = 0 Otherwise)				(= 1 if Same, = 2 if Slower, = 3 if Very Little, = 4 if No Progress)			
	Coefficient		Marginal Effect		Coefficient		Marginal Effect	
Duration (> 6 months)	0.686***	(0.200)	0.160***	(0.047)	0.582***	(0.173)	0.064***	(0.019)
Mode of remote learning								
Online classes	-0.355**	(0.180)	-0.083**	(0.042)	-0.317**	(0.156)	-0.035**	(0.017)
TV programs	-0.099	(0.196)	-0.023	(0.046)	0.017	(0.147)	0.002	(0.016)
Paper lessons	-0.927***	(0.167)	-0.217***	(0.039)	-1.023***	(0.157)	-0.112***	(0.018)
Online # Paper	0.646**	(0.292)	0.151**	(0.068)	0.799***	(0.250)	0.088***	(0.028)
TV # Paper	1.210***	(0.321)	0.283***	(0.075)	1.109***	(0.267)	0.121***	(0.029)
Duration # Mode								
Duration # Online	-0.355	(0.230)	-0.083	(0.054)	-0.349*	(0.194)	-0.038*	(0.021)
Duration # TV	0.156	(0.242)	0.037	(0.057)	-0.053	(0.185)	-0.006	(0.020)
Duration # Paper	0.430	(0.271)	0.100	(0.063)	0.418*	(0.235)	0.046*	(0.026)
Duration # Online # Paper	0.028	(0.399)	0.007	(0.093)	-0.223	(0.340)	-0.024	(0.037)
Duration # TV # Paper	-1.533***	(0.422)	-0.358***	(0.098)	-1.273***	(0.354)	-0.139***	(0.039)
Country fixed effects	✓				✓			
Other control	✓				✓			
Observations	3,553				3,553			

Notes: Asterisks (*, **, and ***) denote significance at 10, 5, and 1 % levels, respectively. Standard errors are reported in parenthesis. The marginal effect of the ordered logit model shows the effect on the probability of "no progress."

Source: Authors' estimates from the survey.

Table 6: Probability of Severe Learning Loss by Single and Multiple Remote Learning Modes

	Duration of School Closure				Differences	
	Less than 6 Months		More than 6 Months		% Change	Chi-squared
None	0.424	(0.027)	0.564	(0.033)	33.02	11.97***
Online classes only	0.341	(0.021)	0.430	(0.022)	26.10	9.62***
TV programs only	0.394	(0.042)	0.561	(0.039)	42.39	8.76***
Paper lessons only	0.239	(0.217)	0.455	(0.037)	90.38	29.41***
Online and Paper	0.324	(0.043)	0.429	(0.040)	32.41	3.37*
TV and Paper	0.434	(0.057)	0.426	(0.053)	-1.84	0.01
Observations					3,553	

Notes: The estimates are based on the regression reported in Column 1 of Table 5. Asterisks (*, **, and ***) denote significance at 10, 5, and 1 % levels, respectively. Standard errors are reported in parenthesis.

Source: Authors' estimates from the survey.

4.4 Heterogeneity

We also investigate the heterogeneity across grade levels in 2019 (before the school closures) using the same specification as in Table 5 to distinguish the role of single and multiple remote learning modes. We consider the grade levels of: (i) Grades 1 to 3 in elementary school; (ii) Grades 4 to 6 in elementary school; (iii) middle school (typically Grades 6 to 9); and (iv) high and vocational school (typically Grades 10 to 12).

Table 7 shows the results. For all grade groups except for high school, a longer school closure duration is related to a higher likelihood of “severe learning loss.” When the school closure duration is shorter (less than six months), paper lessons are related to a lower probability of learning losses for all grade groups except for middle school. Online classes also relate to lower probabilities for middle and high school students. However, TV programs have no positive effects on learning progress.

Table 7: Remote Learning Modes and Perceived Learning Loss by Grade Level in 2019, Overall Marginal Effects of Logit Model

	(1)		(2)		(3)		(4)	
	Elementary 1–3		Elementary 4–6		Middle School		High School	
Duration (> 6 months)	0.220***	(0.072)	0.179*	(0.093)	0.195**	(0.090)	-0.119	(0.142)
Mode of remote learning								
Online classes	0.058	(0.066)	-0.055	(0.096)	-0.142*	(0.082)	-0.382***	(0.131)
TV programs	-0.019	(0.068)	0.163*	(0.088)	-0.152	(0.096)	-0.119	(0.233)
Paper lessons	-0.259***	(0.059)	-0.053	(0.085)	-0.297***	(0.095)	-0.269**	(0.118)
Online # Paper	0.099	(0.110)	0.263**	(0.130)	0.295**	(0.147)	0.560***	(0.209)
TV # Paper	0.408***	(0.113)	-0.183	(0.149)	0.156	(0.188)	0.128	(0.350)
Duration # Mode								
Duration # Online	-0.161**	(0.082)	-0.110	(0.111)	-0.008	(0.109)	0.278*	(0.166)
Duration # TV	0.083	(0.087)	-0.171	(0.105)	0.069	(0.112)	0.095	(0.266)
Duration # Paper	0.046	(0.096)	0.001	(0.128)	0.225	(0.151)	0.702**	(0.304)
Duration # Online # Paper	-0.038	(0.148)	-0.080	(0.175)	-0.193	(0.202)	-1.031***	(0.373)
Duration # TV # Paper	-0.330**	(0.152)	0.084	(0.185)	-0.244	(0.230)	-0.117	(0.457)
Country fixed effects	✓		✓		✓		✓	
Other control	✓		✓		✓		✓	
Observations	1,263		876		830		324	

Notes: Asterisks (*, **, and ***) denote significance at 10, 5, and 1 % levels, respectively. Standard errors are reported in parenthesis.

Source: Authors' estimates from the survey.

When the school closure duration is longer (longer than six months), for elementary Grade 1–3 students, online classes appear to be effective in mitigating severe learning loss. Combining online classes and paper lessons is also effective for high school students. Even though combined TV programs and paper lessons relate to a lower probability for elementary Grade 1–3 students, the effects are canceled out by their effect without the interaction term. Overall, these heterogeneities confirm the effectiveness of online classes and suggest the importance of providing a mode of remote learning that is appropriate for a child's grade level.

5. CONCLUSION AND POLICY RECOMMENDATIONS

School closures negatively affect children's education outcomes. During school closures caused by the COVID-19 pandemic in Central Asia and the Caucasus, online classes and TV programs were introduced as remote learning tools to reduce learning loss, along with traditional paper lessons. Based on a household survey covering nine countries, this study documents parents' perceived learning losses of children and the effectiveness of remote learning modes during school closures. Our survey data suggest that 65% and 30% of children used online classes and TV programs, respectively, and 36% relied on conventional paper lessons. Some used multiple modes, while as many as 24% of children did not use any remote learning tools. Despite the governments' efforts to minimize learning losses with remote learning tools, 79% of households with children enrolled in school felt that their children's learning progress was slower than in in-person schooling, while 39% believed that their children had shown "very little progress" or "no progress."

Our econometric analysis revealed some important findings. First, the usage of online classes is strongly correlated with advantageous household characteristics such as a good internet connection, urban residence, and a higher household income. TV programs were more commonly used by rural households. Second, online classes are found to reduce learning loss during school closures, but this does not hold for TV programs. Online classes also reduce the negative effects of a longer school closure duration on perceived learning progress. Third, on average, paper lessons are also found to be an effective mode of remote learning, but their effectiveness is limited to shorter school closure durations. Finally, combined usage of TV programs and paper lessons seems to be effective in mitigating the negative effects of longer school closure durations.

The above findings have the following policy implications. During school closures, which may also be due to natural disasters, air pollution, extreme weather, conflicts, etc., or more generally when a child is unable to go to school, online classes appear to be the best option for minimizing learning loss (as this tool provides interaction). However, in places with limited access to the internet or smart devices they are unlikely to be used by all children. In such places, paper lessons could be used as a way to reduce learning loss for a short school closure duration. Overall, building the capacity to provide children with disadvantaged backgrounds with effective access to online classes is critically important for reducing learning losses and for preventing widening gaps in terms of learning losses during future school closures. In addition, in the absence of access to online lessons during long-term school closures, the usage of TV programs together with paper lessons could be an effective alternative tool, which requires further investigation into its effectiveness.

REFERENCES

- ADB. 2022. Learning and Earning Losses from COVID-19 School Closures in Developing Asia. In *Asian Development Outlook 2022: Mobilizing Taxes for Development*. Manila: Asian Development Bank.
- Agostinelli, F., M. Doepke, G. Sorrenti, and F. Zilibotti. 2022. When the Great Equalizer Shuts Down: Schools, Peers, and Parents in Pandemic Times. *Journal of Public Economics* 206: 104574. <https://doi.org/10.1016/j.jpubeco.2021.104574>.
- Alasino, E., M. J. Ramírez, M. Romero, N. Schady, and D. Uribe. 2024. Learning Losses During the COVID-19 Pandemic: Evidence from Mexico. *Economics of Education Review* 98: 102492. <https://doi.org/10.1016/j.econedurev.2023.102492>
- Awal, R. 2023. Measuring the Effectiveness of Online Classes During the COVID-19 Pandemic: Case Study of a Government College in Bangladesh. *Journal of Management and Business Education* 6(1): 43–57. <https://doi.org/10.35564/jmbe.2023.0003>.
- Azhgaliyeva, D., R. Mishra, T. Long, P. Morgan, and W. Kodama. 2022. Impacts of COVID-19 on Households' Business, Employment and School Education: Evidence from Household Survey in CAREC Countries. ADBI Working Paper, 1335. <https://doi.org/10.56506/spwh1535>.
- Engzell, P., A. Frey, and M. D. Verhagen. 2021. Learning Loss Due to School Closures During the COVID-19 Pandemic. *Proceedings of the National Academy of Sciences* 118(17). <https://doi.org/10.1073/pnas.2022376118>.
- Haelermans, C. et al. 2022. Sharp Increase in Inequality in Education in Times of the COVID-19 Pandemic. *PLoS ONE* 17: e0261114. <https://doi.org/10.1080/00313831.2021.2006307>.
- Hanushek, E., and L. Woessmann. 2020. The Economic Impacts of Learning Losses. OECD Education Working Papers, No. 225. OECD Publishing, Paris, <https://doi.org/10.1787/21908d74-en>.
- Iqbal, S. A., and H. A. Patrinos. 2023. Learning During the Pandemic: Evidence from Uzbekistan. Policy Research Working Papers. <https://doi.org/10.1596/1813-9450-10474>.
- Kodama, W., P. Morgan, D. Azhgaliyeva, T. Long, and K. Kim. Forthcoming. Family Business during the COVID-19 Pandemic in Asia: Role of Government Financial Aid and Coping Strategies. *World Development*.
- Lichand, G., C. A. Doria, O. Leal-Neto, and J. P. Fernandes. 2022. The Impacts of Remote Learning in Secondary Education During the Pandemic in Brazil. *Nature Human Behaviour* 6(8): 1180–1180. <https://doi.org/10.1038/s41562-022-01420-9>.
- Maddawin, A., P. Morgan, A. Park, D. Suryadarma, T. Q. Long, and P. Vandenberg. 2024. Learning Disruptions during the COVID-19 Pandemic: Evidence from Household Surveys in Southeast Asia. *International Journal of Educational Development*, 107: 103053. <https://doi.org/10.1016/j.ijedudev.2024.103053>.

- Marteau, J. F. 2020. Post-COVID Education in Kazakhstan: Heavy Losses and Deepening Inequality. World Bank Blogs. <https://blogs.worldbank.org/europeandcentralasia/post-covid-education-kazakhstan-heavy-losses-and-deepening-inequality>.
- Meliboeva, N., H. Patrinos, and J. Teixeira. 2020. Uzbekistan: A Timely Response on Learning During School Closures. <https://blogs.worldbank.org/europeandcentralasia/uzbekistan-timely-response-learning-during-school-closures> (accessed 22 December 2023).
- Ministry of Education, Science, Culture, and Sports of Georgia. 2020. Pandemic and General Education in Georgia. https://mes.gov.ge/mesgifs/1609844890_2020-Annual-report-ENG.pdf (accessed 22 December 2023).
- Ministry of Science and Education of Azerbaijan. 2020. Azerbaijan: How One Ministry Found the Right Strategy, Resources, and Technology to Quickly Create Online Classrooms. <https://www.edu.gov.az/en/news-and-updates/18629> (assessed 22 December 2023).
- Moscoviz, L., and D. Evans. 2022. *Learning Loss and Student Dropouts during the COVID-19 Pandemic: A Review of the Evidence Two Years after Schools Shut Down*. Washington, DC: Center for Global Development. <https://www.cgdev.org/sites/default/files/learning-loss-and-student-dropouts-during-covid-19-pandemic-review-evidence-two-years.pdf>.
- Patrinos, H. A. 2023. The Longer Students Were Out of School, the Less They Learned. *Journal of School Choice* 17(2): 161–175. <https://doi.org/10.1080/15582159.2023.2210941>.
- Patrinos, H., Vegas, E., and Carter-Rau, R. 2023. An Analysis of COVID-19 Student Learning Loss. In *The Oxford Research Encyclopedia of Economics and Finance*, edited by Jonathan Hamilton. Oxford: Oxford University Press.
- Roman, M., and A. Plopeanu. 2021. The Effectiveness of the Emergency eLearning during COVID-19 Pandemic. The Case of Higher Education in Economics in Romania. *International Review of Economics Education* 37: 100218. <https://doi.org/10.1016/j.iree.2021.100218>.
- Swan, K. 2003. Learning Effectiveness: What the Research Tells Us. In *Elements of Quality Online Education, Practice and Direction*, edited by J. Bourne and J. C. Moore. Needham, MA: Sloan Center for Online Education, pp. 13–45.
- United Nations. 2020. Distance Learning in Kazakhstan under Quarantine. https://www.astanacivilservicehub.org/uploads/covid/files/Distance%20learning_Kazakhstan%20case.pdf (accessed 22 December 2023).
- UNESCO. 2021. *School Closures and Regional Policies to Mitigate Learning Loss Due to COVID-19: A Focus on the Asia-Pacific*. Paris: UNESCO Publishing.
- UNESCO, UNICEF, and World Bank. 2021. *The State of the Global Education Crisis: A Pathway to Recovery*. Paris: UNESCO Publishing.
- UNICEF. 2020, May. UNICEF Azerbaijan Country Office COVID-19 Situation Report No. 5. <https://reliefweb.int/report/azerbaijan/unicef-azerbaijan-country-office-covid-19-situation-report-no-5-1-may-2020>.

APPENDIX

Table A1: Income Levels in Local Currency for Each Country

Original Income Class	Revised Income Class	Afghanistan, afn	Azerbaijan, manat	Georgia, gel	Kazakhstan, tenge	Kyrgyz Republic, som	Mongolia, tugrug	Pakistan, rupee	Tajikistan, somoni	Uzbekistan, sum
1	1	≤ 5,000	≤ 820	≤ 299	≤ 60,000	≤ 6,000	≤ 500,000	≤ 5,000	≤ 800	≤ 1,200,000
2	2	5,001–15,000	820.1–1,035.0	300–599	60,001–100,000	6,001–12,000	500,001–900,000	5,001–15,000	801–1,400	1,200,001–2,000,000
3	3	15,001–30,000	1,035.1–1,240.0	600–999	100,001–150,000	12,001–20,000	900,001–1,100,000	15,001–30,000	1,401–2,400	2,000,001–3,200,000
4	4	30,001–60,000	1,240.1–1,650.0	1,000–1,499	150,001–250,000	> 20,000	1,100,001–2,100,000	30,001–60,000	< 2,400	< 3,200,000
5	5	> 60,000	> 1,650.1	> 1,500	250,001–300,000	> 2,100,001	> 2,100,001	> 60,000		
6	6				> 300,000					

Note: Since different countries have different numbers of income classes, in our empirical analyses we recategorized the income classes into four groups to make them consistent across countries. See Azhgaliyeva et al. (2022) for more details.