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Relationships between ICTs and primary & secondary education during the COVID-19 pandemic in Sri Lanka[1]

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Abstract

Education is considered to be one of the basic services/infrastructures that the state ought to provide for its citizens as indicated in the conceptual framework and the literature linking it to minimum thresholds of a social contract that the state should in terms of its obligations to its citizens (Trivelli et al, 2020).)

The COVID-19 pandemic saw a complete halt in traditional school-based (in-person) education due to movement and gathering restrictions. This was therefore an opportunity to see how successfully (or otherwise) education delivery over digital technology filled the gap — after all, years of investment by multilateral funders, charitable foundations, and nation states in various ICT technologies in schools, along with the commercially-driven increase in ICT access, would lead one to think that countries would have made the transition to remote education and used digital assets inside schools and homes. However, the reality is somewhat different.

Using data from survey data nationally representative of all households and persons over the age of 15 in India and Sri Lanka that that educational needs indeed drove increased demand for general Internet access in India and Sri Lanka, with many (previous nonusers) coming online for the first time during the pandemic.

Data from Sri Lanka show 85% of enrolled children got some form of access to education, majority using some kind of digital technology or a mix of digital and non-digital channels. In fact, having digital connectivity made a significant difference, with households with connectivity being more likely to have access to some form of education compared to households without. For example, in Sri Lanka, 90% of the children who lived in a household that was connected to the internet had access to some form of education while only 67% of the children in unconnected households did so. This makes the case for the correlation between digital access and education during technology. However, the households that were excluded were the already marginalized – the rural, the poor, for example. So, it calls into question the ability of ICTs to include the already excluded.

The research also shows that children and families were let down by digital technology itself (e.g., poor quality, lack of devices, digital literacy, data package pricing) as well as analogue complements (schools not being ready), and socio-cultural factors (such as parents not trusting the children to be online by themselves.

Furthermore, is also unclear if this is “education” (a two-way process involving different ways of teaching and learning) or a set of instructions the schools assigned, and the children completed. Long-term education outcomes are yet to be seen, and by third party estimates are expected to be high.

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1. Investments in digital tech in education

1.1 Investments in education

Education is considered to be one of the basic services/infrastructures that the state ought to provide for its citizens as indicated in the conceptual framework and the literature linking it to minimum thresholds of a social contract that the state should in terms of its obligations to its citizens (Trivelli et al, 2020).) Most countries recognise this, having adopted or ratified multiple international instruments of international human rights law. Examples include the Convention on the Rights of the Child (OHCHR, n.d.), the International Covenant on Economic, Social and Cultural Rights, the UNESCO Convention against Discrimination in Education (Right to Education, 2014), and other instruments that mandate that states provide free primary education (and provide secondary and tertiary education, "progressively free of charge") (Right to Education). Around 182 countries mandate a set number of years (with the lowest being five; average, 10) of free, compulsory education guaranteed in legal frameworks (World Bank, n.d.). Other countries provide tertiary education for free as well. Of course, despite international obligations, some states still impose fees on access to primary education. Furthermore, attendance often involves certain indirect costs like books, uniform, and travel that impede access for low-income families.

Sri Lanka's policy on free education dates back to 1945. In 1944, the Minister of Education (at the time) Dr. C.W.W Kannangara introduced the Education Bill that contained the "Free Education" scheme. In October 1945, the "free education policy" came into effect upon being approved by the State Council (Alawattegama, 2020). Although other reforms were proposed by the Special Committee of Education, the "free education policy" aimed at all primary and secondary students was the most significant. Following the implementation of the free education scheme, 400 new schools were built during the years 1944-48 and student enrolment reached 1.2 million (Sedere, 2016). In 1947, free education was extended to all undergraduates studying in state universities (Sedere, 2016).

We know that when it comes to education indicators, the emerging economies in Africa, Asia and Latin America (many of who are lower income countries) lag behind the more developed countries in the region and of the global north. Within the global South, in general Sub Saharan African has poorer education related indicators when compared to South Asia, and both are behind Latin America (Table 1, Table 2, Table 3). We see that Sri Lanka outperforms its South Asian neighbours for many education performance indicators, and often is on par with significantly more developed regions of the world. This is at least in part as a results of the long term investment in education, not just providing free education, but also providing free text books to school children (grades 1-11) since 1980. Since 1993, many school going children have received free school uniforms and meals.

Table 1: Education indicators by country grouping

Group	Gross enrolment ratio in primary & secondary education (%)			Government expenditure on education as % of GDP	Pupil to qualified teacher ratio in primary education	Pupil to qualified teacher ratio in secondary education
	Total	Female	Male			
Low-income countries	73	69	77	3.5	46	25
Middle- income countries	88	88	88	4.5	27	20
High-income countries	104	103	104	5.0	-	-
Sri Lanka	100	101	99	1.9	27	22

South Asia	89	88	90	3.9	32	25

Source: World Bank DataBank: Education Statistics (World Bank, n.d.) ; Note the gross enrolment ratio is for the year 2018, while government expenditure and pupil to qualified teacher ratio are for the year 2019.
Note Unavailable data indicated by a "-"

Table 2: Education indicators: LDC vs. OECD comparison

Group	Gross enrolment ratio in primary & secondary education (%)			Government expenditure on education as % of GDP	Pupil to qualified teacher ratio in primary education	Pupil to qualified teacher ratio in secondary education
	Total	Female	Male			
Least- Developed Countries	77	75	79	3.3	42	28
OECD countries	104	104	104	5.3	-	-
Sri Lanka	100	101	99	1.9	27	22
South Asia	89	88	90	3.9	32	25

Source: World Bank DataBank: Education Statistics (World Bank, n.d.)
Note Unavailable data indicated by a "-"

Table 3: Education indicators by geography

SDG Region	Primary completion rate (%)			Upper secondary completion rate (%)		
	Total	Female	Male	Total	Female	Male
Sub-Saharan Africa	63	65	60	26	25	29
Central and Southern Asia	87	88	86	52	50	55
Western Asia and Northern Africa	89	88	89	56	58	55
Latin America and the Caribbean	92	94	91	61	65	58
Eastern and South-eastern Asia	97	97	95	70	76.1	64
Sri Lanka	98	97	99	65	66	64
South Asia	91	95	87	50	44	56

Source: World Bank DataBank: Education Statistics (World Bank, n.d.)

1.2 Investments in ICTs – global trends

The use of ICTs in education has been viewed as a way for emerging economies to not just improve but to also leapfrog and catch up with developed countries on education related indicators – in access to education, quality of education and education management. Investing in ICTS within education systems was seen as a way for teachers to access teaching content that could be centrally developed and distributed. Connected devices were seen as a way for students to acquire new knowledge through newer ways of learning. Education management and information systems were seen as a way for school administration systems to have efficient and up-to-date information. There have been not only top-down government policies and national-level programmes, but also bottom-up initiatives with non-governmental/community-based organisations and demand stimulation strategies that were funded and implemented in many countries.
For example, multilateral initiatives started in the early 2000s, and many continue today in various forms. The UN ICT Task Force (UN Press, 2001) was established in 2001 and aimed to promote the use of ICTs for economic and social development, including in the education sector. The UNESCO ICTs in Education Programme (UNESCO Bangkok, 2007) was established in 2002 to support the integration of ICTs in education systems worldwide. The World Summit on the Information Society (WSIS) (UNESCO, n.d.) as far back as 2003 recognised the importance of using ICTs to improve

education and promote digital literacy. The UNDP's Global e-Schools and Communities Initiative (GeSCI, n.d.) was launched in 2004 and aimed to promote the use of ICTs in education in developing countries, with a particular focus on teacher training and curriculum development. The UN's Global Alliance for ICT and Development (GAID), established in 2006, aimed to promote the use of ICTs for sustainable development, including in the education sector.
Such global initiatives have often been supported by and supportive of numerous national-level initiatives in developing and developed countries. The SchoolNet Namibia Project (EDC, n.d.), launched in Namibia in 1999, aimed to use ICTs to improve teaching and learning in Namibian schools. The National Education Technology Plan (NETP) (Arafeh, 2004) in the United States was first released in 2004 and has been updated multiple times since then to provide a framework for using technology to improve teaching and learning in US schools. The Digital Education Revolution (DER) (Australian National Audit Office, 2011) in Australia, launched in 2008, aimed to provide all Australian students in years 9-12 with access to a computer for learning. The National Strategy for Information and Communications Technology in Education (NSICTE) (UNESCO, 2017) of the Philippines, launched in 2007, aimed to improve the quality of education in the Philippines through the integration of ICTs. The South Korean Government's Smart Education Initiative (Lim & Kye, 2019), launched in 2011, aimed to promote the use of ICTs in education, with a focus on digital textbooks and online learning. The Singaporean Government's Masterplan for ICT in Education (Ministry of Education, Singapore, n.d.), launched in 1997, aimed to integrate ICTs into all aspects of education, from curriculum development to teacher training.

The impact of such initiatives has been mixed at best, with some literature pointing to failure or low impact of ICT investments in education, while others cite positive results. Many studies that are available come from the developed world, and a “comprehensive and rigorous body of evidence of the educational impacts of ICT interventions in developing countries does not yet exist and is needed to better understand if and how particular interventions will prove effective” (Tolani-Brown, McCormac, & Zimmermann, 2011, p.232) .
For example, a study on the use of mobile phones to improve educational outcomes (Valk, Rashid, & Elder, 2010) that drew from six case studies Philippines, Mongolia, Bangladesh, Thailand, and India found clear benefits, like enhanced learning, increased student interest/engagement, a rise in grades of those at the tail end, and more flexible learning (schedule-wise). On the other hand, issues identified were technological issues/technical difficulties, language barriers and a lack of familiarity with advanced smartphones, and at times higher costs (than traditional learning). Additionally, results were mixed regarding the benefits to students who have been unsuccessful in traditional learning: while one project indicated that mobile-assisted distance learning provided more opportunities for students, another project found that students with weaker academic performance prior to the study found it more difficult to leverage the mobile system, concluding that those students might benefit more from a “teacher-centric” approach. This indicates that ICTs would be useful insofar as students have basic tech literacy and a basic academic foundation.
A 2015 study of ICT intervention in Malaysia (Ghavifekr & Rosdy, 2015) yielded similar results: overall, ICTs were found to have a positive impact on education, in a number of ways: students were more engaged in lessons, were able to broaden their knowledge, were assisted in improving their language learning skills (reading, writing, listening and speaking), saw improvements in ability to be creative/imaginative and better express their thoughts and ideas teachers found it easier to teach. However, it was also found that a lack of support from school administrations and training and development for teachers in ICT use, and sufficient time to learn to use ICTs in teaching, can hinder benefits. Therefore, the results here indicate that ICTs work to the extent that teachers are sufficiently trained and competent and confident in their ability to handle systems.
A study in Kenya on the utility of low-cost ICT materials – DVD-based content – in the classroom (Tabira & Otieno, 2017) yielded similarly mixed results. The test mean scores from science classes where ICTs were used were higher than for the classes where ICTs were not used (in the two schools involved in the study). However, the test mean scores from maths class in one of the schools yielded

the opposite result. This indicated certain insights on teacher/instructor use of ICTs: findings and interviews indicated that teachers with prior experience using ICTs were cognisant of its limitations, and therefore used DVD materials in an interactive approach that involved discussion, while teachers with no prior experience with ICTs used the DVD material entirely as substitutes. The latter group were found in the maths class and school in which test results in the non-ICT class were higher. The takeaway here is that positive impacts of ICTs can depend on the teacher's competency with the technology.

A 2017 Asian Development Bank (ADB) report on the adoption of ICTs in education in Bangladesh, Nepal and Sri Lanka corroborates this emerging pattern of administrative and development support for ICTs as an instrumental factor in successful implementation, with its findings of "significant gap[s] between development goals and the outcomes of implementation of ICT in education" (p. xi), identifying "fragmented efforts with redundancies and lack of sustainability and scalability of ICT in education efforts".

ICTs were expected to transform education from teacher-centred, lecture-based instruction to student-centred, interactive learning environments (Jones, n.d.). A 2015 systematic review (Gamage & Tanwar, 2017) looked at all English-language reports published between 1990 – 2014 that addressed the use of technology in the classroom. The study examined 63 studies in-depth and quantitatively synthesised a subset of them, finding that teacher training, one laptop per child, and on-site coaches contributed to positive effects. It also found that perception of teachers regarding the use of technology was twice as important as their perception of the ease of use of that technology.

Developing countries face additional barriers in adopting ICTs in education. Snoeyink and Ertmer (2001) identify a series of barriers including lack of equipment, unreliability of equipment, lack of technical support, and resource related issues, organisational (school) culture, teacher factors, beliefs about teaching and technology, and openness to change. For example, Table 4 shows that lower-income countries have fewer individuals who use the Internet and own mobile phones.

Table 4: Internet and phone usage by national income level

Unavailable data indicated by a "-"

Group	Individuals using the Internet (% of population)	Individuals owning a mobile phone (per 100 inhabitants)
Low-income countries	20.6	49.1
Lower-middle income countries	-	65.5
Middle-income countries	57.3	-
Upper-middle income countries	-	76.3
High-income countries	89.6	95.4

Sources: Individuals using the Internet (2020 data): World Bank DataBank: SDG Statistics (n.d.); Individuals owning a mobile phone (2022 data): International Telecommunication Union (n.d.)

All these translate into lower levels of ICT use in education in the lower income countries. Furthermore, within developing countries, there are significant gaps in access to the Internet, suitable devices, as already highlighted in other chapters.

1.3 Investments in ICTs – Sri Lanka

Sri Lanka too has looked to ICTs to bridge various gaps in education delivery and management. On the deliver of education and learning outcomes, investments in connecting schools were made, and computer labs were set up.

For example, since the start of the e-Sri Lanka initiative (the large, cross cutting digitally enabled development project that started in 2003), the governments apex ICT body, the ICT Agency of Sri Lanka along with the Ministry of Education (MOE), focused on installing computer labs in schools across the country. The Asian Development Bank was one of the main funders, among others, and computer-aided intelligent learning (e-learning) systems were set up between 2011-14 (Asian Development Bank, 2017).

In parallel, investments were made in attempts to improve education related information flows to aid the management of the education system. The Ministry of Education (MOE) in Sri Lanka has made several concerted efforts to implement its Education Management Information System (EMIS) since 2012, focusing around students and school principals. In in 2014, the Asian Development Bank (ADB) attempted to assist the MOE in collecting and managing data related to teachers in public schools. Despite these efforts, the envisioned Management Information System (MIS) failed to materialize as it faced challenges in incorporating crucial data regarding principals and students. The attempt to integrate certain specific software into the Human Resource Management system also encountered setbacks, ultimately rendering it unsuccessful in achieving its intended objectives. Later, the UNESCO Open EMIS initiative in Sri Lanka made progress in collecting data from an extensive pool of education stakeholders, encompassing both students and teachers (over 4 million individuals). This comprehensive data collection effort aimed to provide a holistic understanding of the education landscape. The Ministry of Education (MOE) gathered information from nearly the entire student and teacher population. This data collection effort encompassed over 50 variables, including intricate aspects of student profiles such as Body-Mass-Index (BMI) calculations and family details linked to unique student IDs. The MOE planned to introduce variables related to academic achievements and extracurricular activities. Unfortunately, the completion of data cleansing and validation was interrupted by the emergence of the COVID-19 pandemic, leading to the system's isolation and a subsequent lack of updates. The initiative faced challenges due to frequent school closures triggered by events like the Easter Sunday bombing in 2019, Sri Lanka's formal declaration of COVID-19 as a pandemic in March 2020, and the onset of the fuel crisis in March 2022.

Deploying education management systems has proven to be a challenge for Sri Lanka. The Committee on Public Accounts (COPA) in the Parliament of Sri Lanka that met on June 23, 2023, revealed that the Ministry of Education had spent over LKR 60 million for a National Education Management Information System (NEMIS) in 2013/2014, but the data is incomplete. Officials are yet to respond formally to COPA, but preliminary discussions with them by LIRNEasia shows that despite all the training and support provided to school for data submission, the data submitted remain spotty and inaccurate. This could be attributed to the lack of incentives for teachers and principals when referring to data entry and cleansing.

2. Education during the pandemic

2.1 Trends in Asia

The spread of COVID-19 resulted in many countries going into various stages of reduced mobility in Asia, similar to most parts of the world. For primary and secondary schools, this meant shutting them down to in-person learning. Attempts were made to engage in learning/teaching using various methods, including using ICTs, distribution of printed teaching material and so on. The length of closures and impacts of lack of in-person learning varied by region, country, and age group. In many (larger) countries, the length of closures varied by state or area, depending on the spread of the disease.

While different countries/regions saw different closure lengths and effects of distance education, students across the globe have incurred considerable costs due to these closures: losses in numeracy, literacy, and other skills they would have gained through in-person schooling. As expected, lower-income countries in Asia, Africa and Latin America have borne the brunt: during the peak of the pandemic, more than half of the roughly 1.6 billion students worldwide left out of school were from LICs (International Development Research Centre, 2022).

Additionally, policy responses vis-à-vis remote delivery were implemented "due to popularity in the global context rather than suitability to the specific context" (Sayed, Singh, Pesambili, Bulgrin, & Mindano, 2021, p. 35) i.e., despite the fact that students and teachers in developing countries (particularly sub-Saharan African, and South Asia, and Latin America and the Caribbean) lacked access to remote learning technologies, and training to use/competency in using them, these regions were quick to adopt distance learning along with the rest of the world. School closures exacerbated existing social problems in these poorer regions like food poverty, gender inequality, technological divides, and inequitable access to good education.

According to UNICEF (2021), 800 million children across Asia were at risk because their education was impacted by COVID-19-related shutdowns since early 2020. Schools in Asia were closed for an average of 50% of teaching days. In some countries, the number was much higher – the Philippines and Bangladesh closed schools to in-person learning the entire period from 2020 until the second half of 2021. Some countries had almost two years of school closure. Others had more than one round of closures, with open schools in between – for example, Fiji had two school closures between 2020 and 2021 (ADB, 2022). Apart from the Maldives, schools throughout South Asia were fully closed for longer than the global average. Re-opening schools was a challenge because many schools lacked water, sanitation, and health facilities.

Of course, educational activities did not stop completely for everyone. Many countries moved to remote delivery of education. Emphasis was placed on distance learning, using ICTs. While all countries in the region implemented measures to allow students to continue their studies remotely –TV, radio and the Internet were the most common methods – many children were unable to access these provisions (UNICEF, 2021). Most countries struggled with the lack of resources, lack of readiness, lack of skill, lack of access to and/or affordability of quality connectivity. Consequently, by 2021 at least 28% (around 220 million) students from pre-primary to upper secondary in the region had not been reached by remote learning measures (UNICEF). World Bank simulations predict a cost of around 0.3 to 0.9 schooling years due to the pandemic, with the possibility of around seven million students dropping out of school (UNICEF).

Overall, the loss in learning is expected to be significant for Asia's school-aged children. It was not just the loss of learning, but also the mental distress, missed school meals and routine vaccinations, heightened risk of dropping out of school, increased child labour and increased child marriage. Entry into the school system may be another fatality – for example, according to the ADB (2021), in the Philippines, participation rate in organised learning (i.e., the enrolment rate) dropped from 86% in

2019 to 65% in 2020. For much of these negative impacts, the already most vulnerable children were the hardest hit (UNICEF, 2021).
A recent Asian Development Bank estimate (2021) suggests a present value of USD 1.25 trillion in future earnings losses in Asia and the Pacific.
It is not just students who were impacted. Teachers were impacted with increased workload, heightened anxiety about losing their job, future pay cuts and job losses due to digitalisation. About 50% of teachers also did not think they were able to work efficiently due to increased time on devices. The lack of adequate resources in digital form was a worry for many, and self-reported digital tech skill levels were low among many teachers in Asia (Chandran, Sharma, & Kannamma, 2021).

2.2 The Pandemic and education in Sri Lanka

Sri Lanka too broadly followed this trend. All schools were shut down and remote education attempts were made using a mix of methods. There were school closures and re-openings at various junctures. All schools were initially closed on the 12th of March 2020. There were further closures on the 13th July 2020, 5th October 2020 and 27th April 2021 in lieu of the multiple waves of COVID-19. In order to facilitate revision classes and exam windows, there were a few instances of selective re-opening of schools (focused on higher grades). For instance, on the 27th of July 2020, students in grades 11,12 and 13 returned to school in selected areas and on the 23rd of November 2020, following all schools being closed on the 5th of October, students in grades 6-13 returned to school in a few areas. In parallel to this, the government launched curriculum-based TV programs for school-aged children such as the "Guru Gedara" TV Channel and e-Thaksalawa online learning platform.
The e-Thaksalawa platform was launched on March 25, 2020 and was made accessible to students without any data charges being applied. "Guru Gedara" TV was launched on April 16, 2020.
Following recognizing the fact that students faced multiple challenges during the pandemic, an abbreviated school curriculum was introduced by the National Institute of Education on 8th November 2021.

3. Methodology

This paper draws on data from LIRNEasia's 2,500 sample nationally representative survey conducted between March 2021 and October 2021, which allows for national level estimates to be made within a 95% confidence interval with ±2.8% margin of error. The target populations for the survey included all households and population aged 15 and above in Sri Lanka. National representation at the desired levels of precision was achieved by using a comprehensive national sample frame at the most granular level possible (most granular administrative division level data) and ensuring random selection at every level of sample selection.

Table *5*: Coverage and sample frame related information of the survey

Coverage	Sample frame used	Level of representation
125 GNDs covering all 25 districts and provinces	GND-level data from the National Census of Population and Housing 2012	National, Urban-rural level, Men vs. women, Western province vs rest Sri Lanka

Note: GND = Grama Niladhaari Division (lowest unit of governance)

The sampling methodology in steps is as follows.

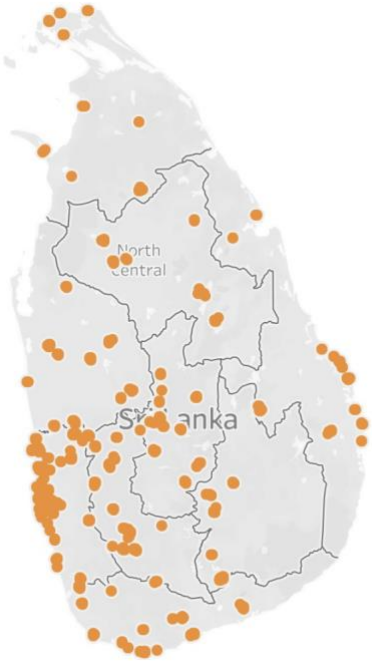
- Separation of national sample frame into urban and rural primary sample locations (PSUs)

- Sampling the required number of PSUs from each stratum (urban and rural) using probability proportionate to size (PPS)
- Segmentation of the PSUs where the number of households exceeds a certain threshold (about 200 to 250 households)
- Mapping, listing, and marking all households in the selected PSU or a randomly selected segment of the PSU.
- The lists serve as the sample frame for simple random selection of households. This was done with the assistance of key informants (e.g.: Grama Niladhari officer, Samurdhi officer etc.)
- Systematic random selection of the required number of households (20-25) from each selected PSU or the PSU segment
- Listing all household members or visitors aged 15-65 staying the night at the selected household.
- Simple random selection (using the CAPI programme) of one household member for individual survey from household list compiled in the previous step.

The lowest administrative level sampling frames available to the public in Sri Lanka were Grama Niladhari Divisions (GNDs). Therefore, GNDs were considered as Primary Sampling Units for sampling for the Sri Lanka survey.

GNDs were divided into smaller areas for listing and enumeration. These administrative units typically have a larger number of households. For instance, some GNDs (specifically in Colombo) can have as many as 6,000 households, making the listing all households impossible if selected into the sample. Therefore, such large administrative units were segmented while in the field, according to pre-defined methodology, and one or more smaller segments then randomly selected for listing and enumeration. It is important to note that the core principle of random selection was incorporated at every stage of sample selection to ensure national representation. There was no purposive, convenience or quota selection of any kind.

Figure 1: 2021 COVID impact survey sample locations based on GPS coordinates recorded during fieldwork.



Sample size determination

The desired level of accuracy was set to a confidence level of 95% and an absolute precision (relative margin of error) of 2.8%. The population proportion (p) was set conservatively to 0.5, which yields the largest sample size. The minimum sample size (n) was determined by the following equation:

$$n = \left(\frac{Z_a \sqrt{p(1-p)}}{C_p} \right)^2$$

Where,
n = Minimum sample size
Za= Z-value for 0.05 level of significance
Cp = Margin of error
p = Population proportion

Inserting the parameters for the survey yields the minimum sample size for simple random sampling; therefore, for our sample design (stratified with multiple levels in some cases) the minimum sample size was multiplied by the design effect variable.

In the absence of empirical data from previous surveys that would have suggested a different value, a value of 2 was used as the design effect for each country. The actual sample size increased beyond the minimum requirement to compensate for clustering effects, and allow for urban/rural disaggregation of data, as well as gender-based disaggregation and more importantly to have representative data at more granular levels in the sample.

Statistical methods

Logistic regression:

Logistic regression modelling was employed to understand the relationships between enrolled student receiving any form of remote education and receiving education via online means during the COVID-19 lockdowns in March to July in 2021.

Table 6: Variable coding for logistic regression models

Variable	Value	Interpretation
Receiving any form of remote education	1	Received education
	0	Did not received education
Receiving remote education via online means	1	Received education
	0	Did not received education

Logistic regression models were utilized as a binary regression technique suited for scenarios in which the variable of interest is binary.

The logistic models established connections between determining and mediating factors and the outcome variable in Table 6. These models contributed to the estimation of the probability of the outcome variable being above or below a particular threshold, thus leading to the observed outcome.

The probability of the outcome variable (Yi) was calculated using the logistic function:

$$Probability\ (Yi) = \frac{1}{1 + \exp\ (-\alpha - \sum_{t=1}^{n} \beta_i X_i)}$$

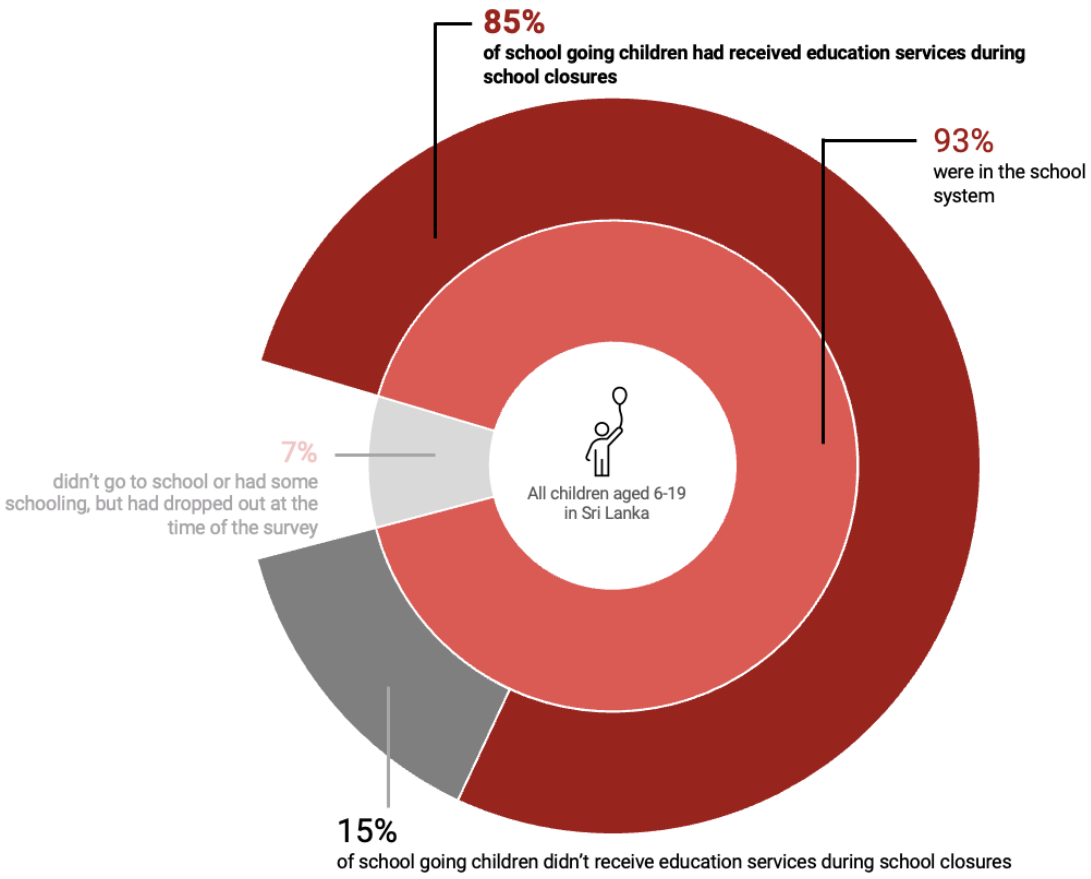
In this equation, Yi represented the dichotomous outcome of interest, as defined in Table 4, while Xi referred to the influential factors (also known as determining and mediating factors) that influenced this outcome. The values of βi indicated the sensitivities of each influential factor Xi. These influential factors corresponded to the series of factors which are related to receiving remote education during the COVID-19 lockdowns. The use of the exponential function in modelling the dependent variable ensured that its predicted value fell within the range of 0 and 1.

4. Findings

4.1 Access to education

First, we examine the extent to which education continued during the lockdowns. We note here that we mean access to some kind of education, irrespective of the quality, quantity or intensity of the content. All respondents who had at least one child in school (in kindergarten up until grade 13/year 13) before the lockdown were asked the question "Did you receive any of the following education services for your school age-child during March - July (in 2020) period when schools were closed?" Among households that had children already enrolled in school prior to the pandemic, 85% received educational services (Figure 2).

Figure 2: Access to education during COVID-19 lockdowns in Sri Lanka



Source: LIRNEasia survey, 2021

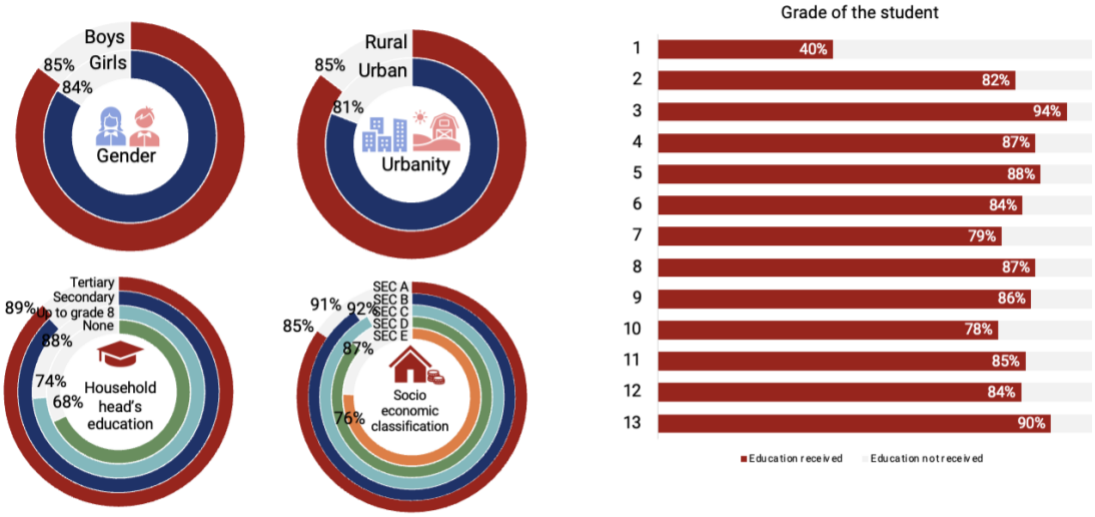
Characteristics of students receiving education

We can further analyse the 85% of school going children who received some kind of education during school closures to understand their individual and household characteristics.

We see from Figure 3 that the children who received education services were more likely to be in households with educated parents (e.g. with tertiary and secondary education), from middle class or

upper middle class households. Interestingly, we see there is not a significant gender gap between boys and girls, both being equally likely to be educated during this period. Children is Year/Grade 1 were much less likely to be receiving education compared to older children, but beyond that, we can discern meaningful patterns in who got educated vs who didn't based on Grade.

Figure *3*: Percentage of children who received education services, by location, household head's education, and socio-economic classification.



Source: LIRNEasia survey, 2021

4.2 Channels for reaching students

Children in Sri Lanka received education through a multitude of means or channels. While many of the channels included the internet/data connectivity via a device (e.g. assignments sent to a smartphone/computer, life online-line lessons, information/instructions sent via text message etc), information and assignments physically delivered to the home played a significant part (Table 7). Anecdotally we know that in rural areas in particular, where connectivity was poor or households (of both students and teachers) were less likely to have high speed internet access, the teachers printed assignments and used networks of students to deliver assignments to others.
What is measured is simple delivery of some kind of instructions related to various topics. There is no way to judge from the questionnaire (or the responses if these methods of sending instructions were successful in achieving learning objectives. It is likely that a two-way interaction between teachers and students was better than students simply receiving instructions from the teacher (one way) without any feedback or discussion. Some channels may have been better suited for delivering content in new and interesting way due to the use of multimedia (e.g. video) which is not possible on other channels (e.g. voice calls).

Table 7: Modes of delivery of education during the pandemic in Sri Lanka (as % of students who received education)

Channel	Sri Lanka
Live online lessons	58%
Info/work delivered over a phone call	67%
Info/work delivered via text messages	56%
Info/work delivered (physically) home	71%

Instructions to listen to radio programmes	33%
Instructions to watch TV programmes	62%
Recorded audio or video lessons	50%
Learning management systems like Google Classroom	43%

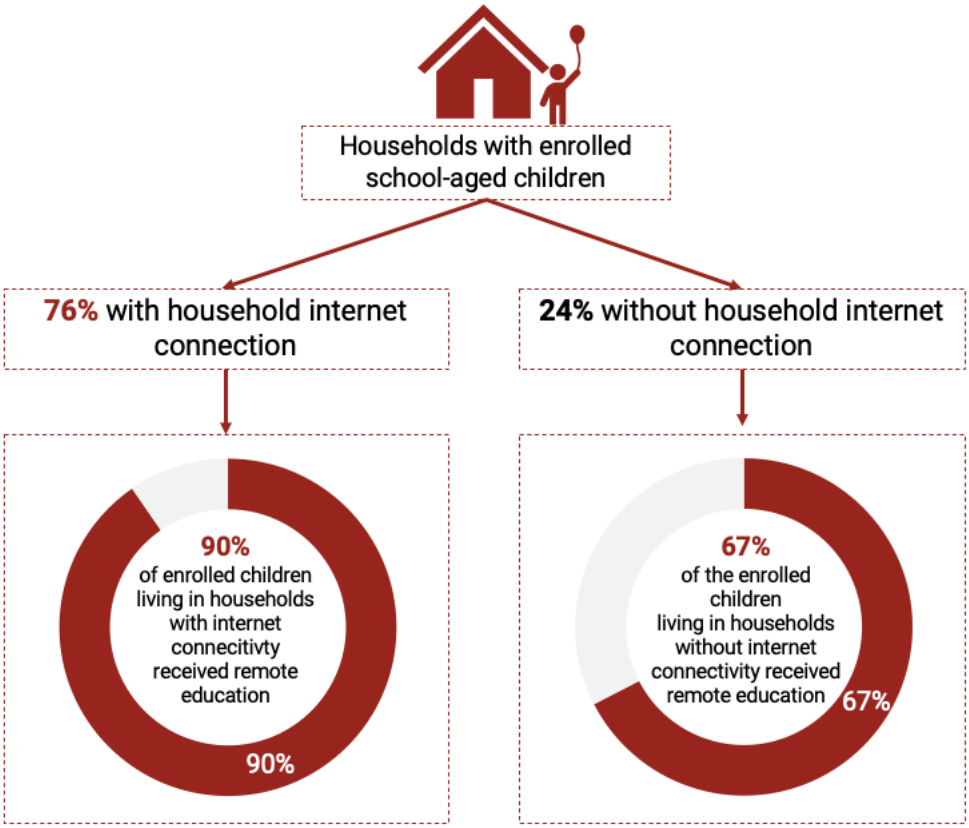
Source: LIRNEasia survey, 2021

4.3 Correlation between internet connectivity and getting educational services

We know that education was a key driver of Internet adoption. In 2020-2021, around 1.1 million Sri Lankans came online for the first time. Among them, 61% said "needs that arose during COVID-19" were the reason they came online"– needs such as working and education.

We also see that having Internet access strongly correlates to accessing education. In Sri Lanka, of households that had children of school going age going into the pandemic, 76% had a working connection and 90% of the children in these households had access to educational services. On the other hand, in the 24% of households that had no Internet connectivity only 67% had access to educational services. (Figure 4)

Figure 4: Access to education services by connected versus unconnected households during the lockdowns.

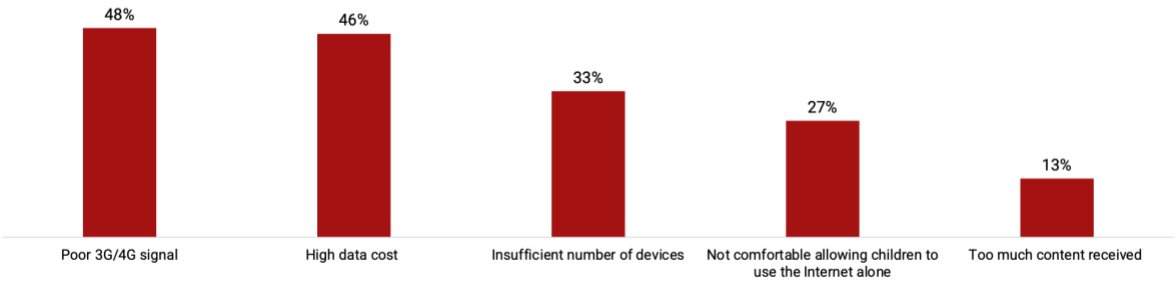


Source: LIRNEasia survey, 2021

4.4 Challenges faced

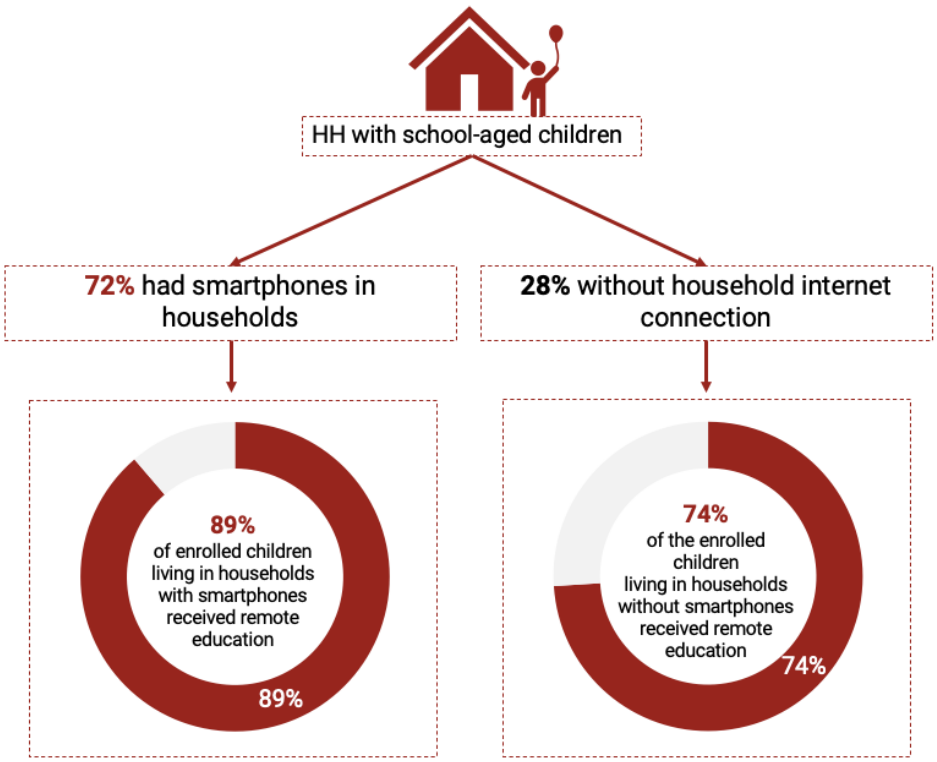
The survey also asked the respondents to identify the problems faced when accessing education. We see that the biggest challenges were related to technology – namely, poor data connectivity, affordability of data and insufficient devices. Analog challenges included parents not being comfortable with children using the internet, and feeling the schools assigned too much content (Figure 6).

Figure 5: Difficulties faced in accessing education during COVID-19 pandemic



The technology challenges specifically that of insufficient devices, can be explained by looking at Figure 7, which shows the % of households with school-aged children who received education and also had a smart phone in the household. We need to keep in mind that often the phones were used by more than one child for accessing education, and often by a parent for accessing their work.

Figure 6: Access to education services by households with and without smart phones



4.5 Explaining likelihood of getting educational services during COVID – a logistic regression model

We noted above that having intern access is correlated to the likelihood accessing education during the pandemic. However, it's not the only factor, and internet access itself is impacted by a series of factors. As mentioned earlier the data shows a substantial 85% of the enrolled students received remote education during the initial phase of the COVID-19 lockdowns. Among these students, 63% accessed education through online platforms, thereby leaving 22% of the enrolled students exclusively reliant on offline remote education methods. Two logistic regression models designated as model 1 and model 2 to examine the profiles of these student groups. The results of these models are presented in Table 8, highlighting the determinants associated with the 85% of students who participated in remote education in any form and the subgroup of individuals who specifically adopted online educational methods.

Table 8: Logistic regression models on receiving remote education by both online and offline means and online means in Sri Lanka.

Model number		1			2		
Dependent variable		Received remote education in any means			Received remote education in online means		
Nagelkerke R square		0.141			0.238		
Predictors		Sign	exp(b)	Significance	Sign	exp(b)	Significance
Location: Urban (vs Rural)		(-)	0.626	0.009	(+)	1.346	0.055
Gender: Female (vs Male)		(+)	1.038	0.790	(+)	1.120	0.298
Grade category of the child (grade 1-5 is the reference category)				0.027			0.000
Grade 6-9		(-)	0.712	0.056	(-)	0.761	0.044
Grade 10-11		(-)	0.566	0.003	(-)	0.660	0.004
Grade 12-13		(-)	0.684	0.145	(+)	1.549	0.039
Availability of computers, tabs or smartphones at households		(+)	1.082	0.279	(+)	1.284	0.000
Availability an internet connection		(+)	3.369	0.000	(+)	2.652	0.000
Socio economic classification (SEC D and E is the reference category)				0.000			0.000
SEC A and B		(+)	1.500	0.048	(+)	1.799	0.000
SEC C		(+)	2.234	0.000	(+)	2.121	0.000
Household income reduced during the lockdown		(+)	1.003	0.985	(+)	1.085	0.506
Parent's perception on education	Poor 3G/4G signal	(+)	1.265	0.104	(+)	1.406	0.003
	High data cost	(+)	1.041	0.785	(-)	0.852	0.176
	Insufficient number of devices	(+)	1.054	0.739	(-)	0.537	0.000

delivery during the lockdowns	Not comfortable allowing children to use the Internet alone	(+)	1.056	0.749	(-)	0.752	0.027
	Too much content received	(+)	1.737	0.033	(+)	2.247	0.000
Constant		(+)	2.072	0.002	(-)	0.520	0.001

As per Model 3, the variable with the most significant influence was the availability of an internet connection, which increased the odds of receiving remote education by approximately 3.4 times. Similarly, SEC categories played a vital role, particularly SEC C, which demonstrated a substantial positive relationship, increasing the odds by a factor of 2.2. Urban locations exhibited a negative association, indicating that students residing in urban areas were approximately 37% less likely to receive remote education.

Model 2 focused on the factors impacting the receipt of remote education via online means. The availability of an internet connection had the strongest positive relationship. Students who had an active internet connection at home were 2.6 times more likely to receive remote education via online means during the first COVID-19 lockdown. The access to computers, tabs, or smartphones within households displayed a strong positive effect, increasing the odds of receiving remote education vis online means by around 1.3 times. The socioeconomic classification categories SEC A and B exhibited a positive association, elevating the odds by a factor of about 1.8. Grade 12-13 students in Sri Lanka indicated a 55% higher likelihood of engaging in remote education via online means. Those who perceived that they received too much content from schools were 2.2 times more likely to receive remote education via online means. Urban students were more likely to receive remote education via online means.

Conversely, a few factors demonstrated a negative influence. Parents being uncomfortable allowing children to use the internet on their own reduced the odds of receiving remote education via online means by 25% and insufficient devices reduced the likelihood by 46%.

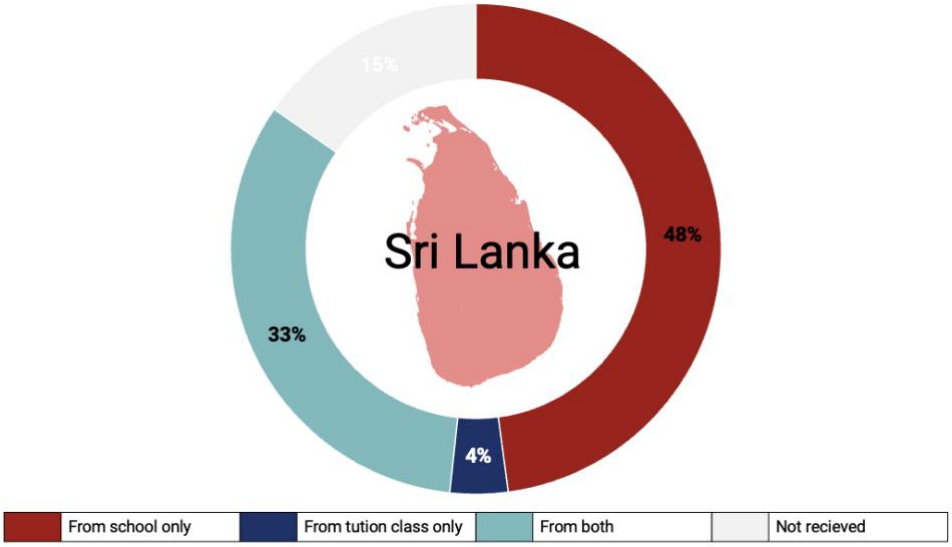
Upon comparing the two models, it is evident that the availability of devices and an internet connection significantly influenced the likelihood of both receiving remote education and receiving remote education via online means. Notably, the influence of these factors was stronger for remote education via online means, emphasizing the crucial role of technology in this mode of learning. Those students who were belong to SEC C households consistently displayed a greater likelihood of receiving remote education in both models. Students in grade 12-13 were less likely to receive remote education when considering all delivery means. However, a positive relationship emerged for students in grade 12 and 13 when it comes to remote education via online means. Furthermore, the contrasting effects of certain variables like high data cost and insufficient devices highlight the nature of determinants affecting remote education and remote education via online means. Interestingly, being an urban student had a negative relationship with overall remote education during the first COVID-19 lockdown. However, when it comes to remote education via online means, urban students were more likely to receive it. However, the urbanity variable did not significantly contribute to any of the models.

4.6 Schools vs private tuition services

In Sri Lanka, it was not just the school system that delivered education. Private tuition for various subjects is common in the country, with families paying to have their children tutored outside of school. This is especially true in the two or three years leading up to national exams (such as that of Grade 5, Grade 10 and Grade 12). Children attend these classes after school hours or during weekends. After an initial break, many tuition teachers restarted their tuition classes online. While

the majority of education services were still delivered by the school, the research shows that many students relied on both, and used tuition classes to supplement the school system.

Figure 7: Delivery of remote education from schools and tuitions



5. Conclusions

The findings of the study show that having Internet connectivity made a significant difference in the likelihood of accessing education services during the lockdown. Households with connectivity were far more likely to have children accessing education compared to households without. However, the connected households are still likely to be richer, more educated and more urban – all factors that drive the demand for more and better quality education and enable parents/adults to support children in their learning and facilitate digital access in the first place. As such, it is unclear that digital technology necessarily bridged gaps in income, age and education among households by enabling the severely marginalized to access education.

Sri Lanka relied on a range of modes or channels to deliver education – from TV, to mobile phones to physically printed paper being delivered. Some modes were interactive while others were one-way forms of communication. Parents and children faced significant technical challenges due to poor connectivity, not having sufficient devices and unaffordable connectivity prices as they attempted to access education. The challenges were not only technical – schools were not ready and children found it difficult to concentrate on remote lessons.

It is important to note that delivery of education services (which this survey measured) is not the same as positive or meaningful learning outcomes. The mere delivery of a lesson does not guarantee learning. We already know this to be true in the use of ICTs in education – the systematic evidence (from systematic reviews and other studies cited previously) show that learning outcomes change only when the educators/teachers incorporate ICTs into the teaching process and believe it to be valuable as a tool. So the lesson for education policy makers is that the benefits of ICTs don't automatically accrue. The systematic review cited earlier shows this too - the extent that curricula and teaching methods change to incorporate ICTs is what determines the extent of learning outcomes by students. The use of ICTs to deal with the shutdown of school was probably a simple holding pattern. The loss in education that accrued has to be solved with particular attention and care, and will only be felt in the coming years.

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