Learning Loss in the Covid-19 Pandemic Era: Evidence from the 2016-2021 Grade Six National Learning Assessment in Cambodia

Supplementary Technical Report for the 2021 Grade Six National Learning Assessment

April 2022

EUROPEAN UNION
Sverige
Transforming Education
USAID
for every child
មូលនិធិភាពជាដៃគូសម្រាប់អភិវឌ្ឍសមត្ថភាពវិស័យអប់រំ (CDPF III)

Published in 2022 by
United Nations Children's Fund (UNICEF)
Cambodia Country Office

Cover Photo: © UNICEF/2021/Chansereypich Seng

Preface

On 11th March 2020, life as we know it changed, when the World Health Organization confirmed that the COVID-19 virus had become a pandemic. It caused millions of deaths and tens of millions of hospitalisations, but also led to unprecedented global socio-economic upheaval. Across the world, education was one of the most affected sectors and children's lives among the worst impacted.

Five days after the pandemic was declared, the Royal Government of Cambodia closed all educational institutions as a preventative measure to combat the spread of the virus. Across the 2019-20 and 2020-21 school years, Cambodian schools were closed for more than half of the days they should have been open. These closures disrupted children's lives and learning and put extra pressure on families who were already suffering due to the restrictions caused by the pandemic.

In response, the Ministry of Education, Youth and Sport (MoEYS), together with development partners, made enormous efforts to provide continuous distance learning opportunities for Cambodian children. However, the quality and quantity of home-based and distance learning varied significantly among children.

In November 2021, MoEYS, through the Education Quality Assurance Department (EQAD) conducted a national learning assessment for grade six students to better understand the impact of COVID-19 and the subsequent school closures on students' learning outcomes. Technical support was provided by UNICEF through the Capacity Development Partnership Fund (CDPF). The objective of the assessment was to establish learning outcomes in the post-school closure period and confirm the magnitude of learning loss among grade six students.

A nationally representative sample of more than 6,000 grade 6 students in 230 schools across Cambodia participated in the assessment. The results found that many children have fallen behind in their learning during the pandemic, in both Mathematics and Khmer. While learning loss has occurred across the board, children in rural areas, those in public schools and those from poorer households continue to show significantly lower learning achievements compared to their urban, private and wealthier counterparts. Cambodia is one of the few countries that have proved the extent of learning loss with hard data. The findings will inform and guide the required policy and action to reverse this trend.

MoEYS, UNICEF and partners encourage stakeholders to act based on the findings of this assessment and further build on its recommendations. This includes stepping up the provision, duration, and effectiveness of remedial education and increasing the level of targeted, tailored support to particularly disadvantaged children to help them catch up on lost learning.

Phnom Penh, 1 April 2022

H.E. Dr. Hang Chuon Naron
Minister
Ministry of Education, Youth and Sport

Ms. Foroogh Foyouzat
Representative
UNICEF Cambodia

Acknowledgements

This technical report was prepared by Jeffery H. Marshall using the grade six learning assessment raw data sets from 2016 and 2021. Hiroyuki Hattori, Chief of Education, UNICEF Cambodia, provided technical direction and editing. Ung Chinna, Director of EQAD/MoEYS and his team, Channra Chum and Philip Finell of UNICEF Cambodia provided technical inputs and support. Financial support through the Capacity Development Partnership Fund (CDPF) contributed by the European Union (EU), the Swedish International Development Cooperation Agency (SIDA), the United States Agency for International Development (USAID), the Global Partnership for Education (GPE) and UNICEF is gratefully acknowledged.

Acronyms

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
CDPF	Capacity Development Partnership Fund
EMIS	Education Management Information System
EQAD	Education Quality Assurance Department
ESP	Education Strategic Plan
EU	European Union
GPE	Global Partnership for Education
HLM	Hierarchical Linear Modeling
IRT	Item Response Theory
MoEYS	Ministry of Education, Youth and Sports
NLA	National Learning Assessment
OECD	Organisation for Economic Co-operation and Development
PPS	Probability Proportional to Size
SD	Standard Deviation
SEAMEO	Southeast Asian Ministers of Education Organization
SEA-PLM	The Southeast Asia Primary Learning Metrics
SES	Socioeconomic Status
SESQ	Socioeconomic Status Quintile
Sida	Swedish International Development Cooperation Agency
SOP	Standard Operating Procedure
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WFP	World Food Programme

Table of Contents

List of Tables and Figures

Tables

Figures

Executive Summary

During the 2020-2021 Covid-19 pandemic period Cambodian primary schools were closed for more than half of the official school calendar across two school years, and face-to-face instruction was replaced with remote teaching and learning activities. Concerns about "learning loss"—defined as post-pandemic achievement levels that are below the expected level based on pre-pandemic trends—are paramount given both the length of the school closure period and the inherent challenges in transitioning an entire education system into remote teaching. These concerns are especially present in countries like Cambodia where previous results from national (EQAD, 2017), regional (UNICEF & SEAMEO, 2020) and international (OECD & MoEYS, 2018) assessments have consistently demonstrated low levels of student achievement in language and mathematics.

This study uses data from the 2016 and 2021 grade six national learning assessments (NLA) carried out by the Education Quality Assurance Department (EQAD) of the Ministry of Education Youth and Sports (MoEYS) to analyze the Covid-19 pandemic impact on students' learning in Cambodia. From a diverse set of research questions covering the systemic response to the crisis and the ultimate impact on student learning achievement, two core questions stand out. First, to what extent did overall grade six student achievement change between 2016 and 2021 based on nationally representative samples of schools and students? And second, what kinds of remote learning strategies appear to be relatively effective in mitigating learning loss during the extended closure period?

The 2021 grade six national learning assessment data were collected during a two-week period in November 2021 in 200 public schools and 30 private schools. To facilitate the estimation of learning loss via a comparison with the 2016 grade six NLA the identical student test booklets from 2016 were used in the 2021 NLA. Students and teachers also completed questionnaires covering a range of areas, including extensive blocks of questions related to the teaching and learning (and home) environments during the 2020-21 Covid-19 pandemic school closure period.

Grade six learning loss 2016-2021: Main findings

The main findings from the detailed comparisons of 2016 and 2021 grade six achievement levels include:

- There is evidence of substantial learning loss for grade six students, as average achievement levels in 2021 are 0.30-0.75 standard deviations lower than the 2016 averages.
- The estimated learning loss is more pronounced in Maths than in Khmer. Student scores in Khmer reading were only marginally lower in 2021 compared with 2016, but in dictation and some aspects of writing there appears to be much more learning loss.
- The students and schools that experienced the largest declines tend to be those with relatively higher (expected) scores: urban school scores declined more than rural schools, private schools had substantially more learning loss than public schools, and higher SES students generally lost more than lower SES students. Although this does depend to some extent on the learning outcome that is analyzed.

- The apparent trend towards equalization in grade 6 achievement—meaning smaller learning gaps between key strata—is not due to equity-enhancing improvements among rural and poor students, but rather is a result of a troubling combination of substantial learning loss among higher performing cohorts and a concentration of students in the lower performance levels in the pre-pandemic period.

Remote teaching implementation, support and effectiveness: Main findings

Based on student and teacher responses to the extensive set of questions about remote teaching and learning activities, home support and school support processes, in addition to statistical analysis of how different kinds of remote learning activities are associated with student test score results, a number of key findings stand out:

- Students report very different rates of access to technology (internet, computers etc.) across the main strata, although most students report having some kind of access to the internet.
- Emergency teaching activities (teacher sends assignments home, prepares worksheets, etc.) are more frequently reported by students (and teachers) than technology-based remote teaching (virtual classes, recorded lessons, use of social media etc.).
- There are very large gaps in access to both the emergency/reinforcement and technology based remote teaching activities. Students in urban areas, private schools and higher SES families report more access to these activities, especially the technology-based activities.
- Urban, private school and higher SES students report more support at home, but there is no evidence that home support for remote learning is associated with test score results.
- Student test scores are significantly higher in schools where students reported more frequent use of emergency teaching/reinforcement and technology-based remote learning activities during the Covid-19 pandemic school closure period.
- Specific remote learning activities that appear to have been most effective include teachers checking in with students to verify completion of assignments and teachers posting schoolwork on social media. However, these kinds of activities were more frequently employed in urban (versus rural) and private (versus public) schools, and among higher SES children.

Policy recommendations

The policy recommendations drawn from the key findings of the learning loss analysis are divided into two categories.

First, how will the Cambodian education system address learning loss which is likely to be present in all grades at the primary level (and above)? The direct takeaway from the grade 6 NLA is that students are significantly behind the expected learning level, but the challenge with implementing remediation and curriculum adjustments is that there was already a need for this type of support given the very low overall levels of student achievement in the pre-pandemic period. The more specific ideas that are considered include:

- Expansion of the early grade learning programmes
- Systematic learning assessments for all grades

- Continuing and strengthening remedial teaching and learning
- Further strengthening school-based management
- Continued teacher development

Concerns about how a system that was already struggling to produce student achievement can now pivot to address a major shock to student learning provide a good segue into the second main question going forward: what kinds of remote education processes merit attention for systemic integration (i.e. mainstreaming into regular education as part of a "build back better" process)? The underlying challenge with this set of ideas is twofold. First there are the needs of upgrading teacher skills, which is already a priority along multiple dimensions (including content knowledge). And second there is the access issue. The goal of expanding technology-based remote teaching and learning activities is not to just improve the overall levels of student achievement (on average), but to reach the students who are most vulnerable and farthest behind but who may also have the least amount of access to internet and online learning tools.

Additional policy recommendations in this area include:

- Strengthening teacher skills
- Expanding and enhancing digital learning platforms and content
- Enhancing education system and schools' preparedness for future emergencies

1 Introduction

Cambodia's results in national (EQAD, 2017), regional (UNICEF & SEAMEO, 2020) and international (OECD & MoEYS, 2018) student assessments have consistently demonstrated low levels of overall student achievement in language and mathematics. Standing out are the high shares of students that are classified in the lowest learning levels, and are unable to correctly answer basic questions for their grade level (or earlier grades). This situation is not unusual in developing countries that have rapidly expanded primary and secondary school participation, and highlights the global imperative of addressing the learning crisis in resource-constrained countries (World Bank et al., 2021).

The Covid-19 pandemic and resulting school closures have the potential to exacerbate the learning crisis in countries like Cambodia. **Across the 2019-20 and 2020-21 school years Cambodian schools were closed for more than half of the official school calendar period.** The 2019-20 school year was interrupted at mid-term and during the school closure period organized remote learning activities were progressively introduced, and features like end-of-year exams were canceled. The 2020-21 school was then delayed and began with a three month period of regular (face-to-face) instruction, only to be interrupted again for 6 months before reopening for a 10 week face-to-face instruction period in October 2021. As the system transitioned into remote learning there was a steady increase in the numbers and kinds of remote learning measures that were implemented from the 2019-20 to 2020-21 school years. But given both the length of the school closure period and the inherent challenges in transitioning an entire education system into remote teaching it is likely that most students spent significantly less time in learning during school closures compared to when schools were open.

The combination of lost days with insufficient engagement in learning during an extended period of remote teaching and learning leaves little question that the education system—and students—were subjected to a tremendous pandemic-related shock, with potentially far-reaching implications for outcomes like student achievement that were already quite low at the onset of the pandemic period. This study uses data from the 2016 and 2021 grade six national learning assessments (NLA) carried out by the Education Quality Assurance Department (EQAD) of the Ministry of Education Youth and Sports (MoEYS) to analyze the Covid-19 pandemic impact on schooling in Cambodia. From a diverse set of research questions covering the systemic response to the crisis and the ultimate impact on student achievement, two core questions stand out. First, to what extent did overall grade six student achievement change between 2016 and 2021 based on nationally representative samples of schools and students, and how did learning change vary between different groups of students and school types? And second, what kinds of remote learning strategies appear to be relatively effective in mitigating learning loss during the extended closure period, and how did access to these strategies vary between student and school sub-samples?

The results related to learning loss and remote education effectiveness are useful for two general areas of education programming in Cambodia. First there is the necessity of establishing learning loss specifics to anticipate remediation and other activities that will be necessary to help students catch up. The data in this study provide very specific guidance in grade 6, but the results also provide more general guidance for the entire system. It is also important to identify relatively

effective remote learning strategies that have potential to be mainstreamed into the system (i.e. "build back better"), albeit with caution given unequal access to some of these features. The remote education period has been a form of forced experimentation, and it is possible that lessons learned during this phase can be leveraged to improve "regular" schooling in the post-pandemic period.

This report provides a technical supplement to the regular national assessment reporting function that is carried out by EQAD. The full report for the 2021 grade six assessment incorporates the main findings from this study (EQAD, 2022). However, the technically-demanding work of establishing learning loss between different time periods (and samples), and assessing effectiveness of different remote education modalities, requires a level of detail that is not appropriate for a national report targeting a general audience.

2 Analytical Framework

2.1 The Covid-19 pandemic and learning loss

Figure 2.1 provides a very basic conceptual overview of Covid-19 pandemic-related shocks and their potential effects on child outcomes. **The focus of this study is on the sequence highlighted in red, which begins with pandemic-induced school closures and a discontinuation of face-to-face instruction, with mitigation efforts via remote education activities and home support, and a student achievement outcome at the end of this period.** This focus on the closures-mitigation-achievement sequence is largely dictated by the available data from the grade 6 national learning assessment. But there are other important impact channels in Figure 2.1. For example, the combined effects of school closings and home lockdown policies can impact the child's emotional and psychological well-being, which may be mitigated by psychological support that is embedded in the remote education regime, or provided through other channels. There is also the economic impact on families that can increase school dropout by generating more demand for child labour and/or reducing household income and the ability to pay for schooling.

Focusing on the student learning sequence, the severity of the learning loss that results from the school closure shock will depend on the effectiveness of the mitigation measures that are in place. If schools are unable to deliver effective content and support during an extended school closure period, then the pace of student learning will be largely determined by home support features and the child's own initiative.

Figure 2.1 Pandemic period shocks, mitigation strategies and outcomes

1. Pandemic period shocks		2. Mitigation strategies		3. Child outcomes
School closures and discontinuation of face-to-face instruction	→	Remote learning measures Home/parental support	→	Student achievement ("learning loss")
Lockdown measures (separation from friends, activities, etc.)		Psychological support for children and families		Psychological-emotional well-being and adaptation
Economic impact on family		Economic support to families		School continuation

One final consideration overlays Figure 2.1: "pre-existing" systemic deficiencies. Developing country education systems with limited resources and capacity are already struggling to effectively deliver content to students on a daily basis. This situation is compounded by the weak support system in place in many homes. **This in turn creates a situation where an already vulnerable school population is impacted by an extended school closure shock, and the system's ability to cope with that shock is likely to be limited if the factors that determine mitigation effectiveness (resources, teacher capacity, etc.) are already in short supply.** This sequence of added demands on top of an existing crisis helps explain the disturbing evidence from poor countries impacted by natural disasters like earthquakes and tsunamis, where large

impacts on outcomes like student achievement were remarkably durable, and effectively became permanent (Save the Children, 2016).

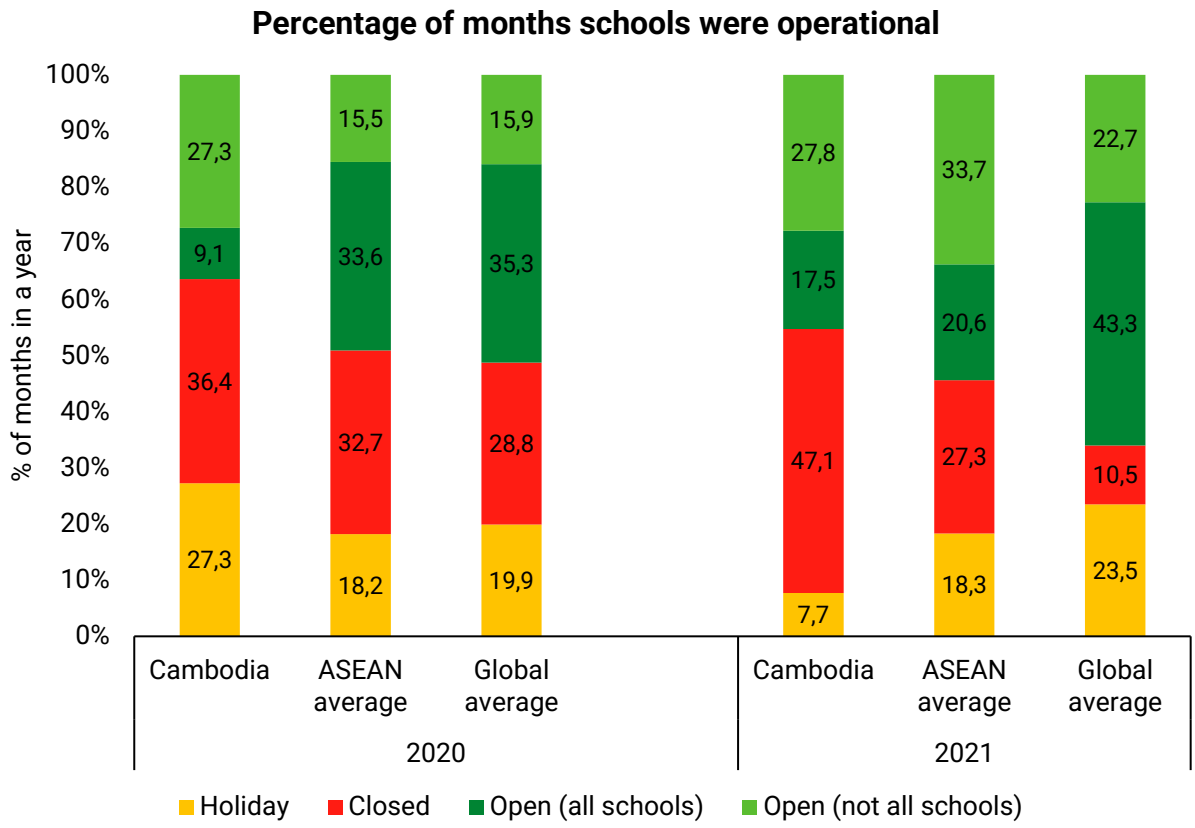
2.2 The Covid-19 pandemic impact on Cambodia's education system

During the Covid-19 pandemic period both the official calendar and number of "regular" school days (i.e. days when schools were open normally) were significantly impacted. The 2019-20 school year began in November 2019 and, following the official school calendar, was supposed to finish in August 2020, with an intended total of roughly 200 instruction days. However, with the onset of Covid-19 pandemic related measures, all schools were instructed to close and go on an early school break at the end of March 2020. In April the MoEYS issued a directive (MoEYS, 2020a) for all schools to implement remote, home-based learning during school closure. While schools were allowed to reopen and start face-to-face teaching in September 2020, many schools continued to experience temporary closure due to community outbreaks of Covid-19 till the end of the 2019-20 school year in November 2020. This resulted in a loss of roughly 100 days of face-to-face instruction in the majority of schools.

The official school calendar was then adjusted to adapt to the pandemic situation, and the 2020-21 school year actually began in early January 2021. Schools operated normally for nearly three months before again closing at the end of March 2021 for just over 6 months before re-opening for a 10 week period of regular operation between October and mid December 2021. As a result, roughly 150 days (or 75 percent of the official calendar) of normal, face-to-face instruction were lost during the 2020-21 school year. The 2021-22 school year began in mid-January 2022 and at this time (March 2022) has proceeded normally without interruption.

The school closure periods in Cambodia affected public and private schools equally, with very little variation across provinces (although schools in Phnom Penh and Kandal provinces did close somewhat earlier in March 2021). The data in Figure 2.2 largely confirm the extended school holiday period in 2020 and the extensive loss of face-to-face instruction time in 2021 based on UNESCO monitoring data during the pandemic period. **Cambodia also reported higher rates of school closures in both years compared with ASEAN and global averages.**

Figure 2.2 Percentage of months schools were in holiday period, closed, and fully and partially open by year, Cambodia versus ASEAN and global averages



Data source: UNESCO school closing monitoring data (2020-2021)

From the outset of school closure, the MoEYS, with support from development partners, implemented a number of remote education support measures. New materials and modalities were continuously developed and rolled out for growing numbers of students as school closures were extended from the 2019-20 to 2020-21 school years. These measures can be categorized into three general groups: 1) internet-based remote learning where students access learning content online through various platforms; 2) "traditional" remote learning platforms through television and radio; and 3) "emergency teaching" and reinforcement-type activities where schools send materials home to children to maintain student engagement. More specifically, the remote learning activities included:

- Recording and live streaming of lessons on the MoEYS website, Facebook page, Kru (Teachers) website and e-learning platforms, taught by "outstanding" teachers selected from various schools in the country. These lessons focused on Khmer and mathematics instruction for primary grades 1-6.
- A TV channel (TVK2) was established and dedicated to learning, with 24/7 broadcasting of e-lessons for pre-school, primary and secondary school students.
- Worksheets for Khmer, mathematics and science for both primary and secondary school students were developed by MoEYS, and electronically shared with schools.

- A paper-based home learning package was developed by MoEYS and distributed for grade 1 and 2 students nationwide.
- Six remedial learning packages developed and circulated to teachers nationwide, with a focus on Khmer and math for primary grades 2-6.

Based on the directive issued in April 2020, the MoEYS developed an operational guideline (MoEYS, 2020b) in June 2020 that elaborated practical implementation measures of distance education at all levels including roles and responsibilities of different stakeholders. At first, the MoEYS started with online lessons for students in Grades 9 and 12 to prepare them for the annual national examinations. As the school closures were prolonged, the MoEYS expanded distance learning content to cover all students from pre-school to Grade 12, including ethnic minority children and children with disabilities. Remote learning for students was implemented through a variety of means and platforms. Initial programs were delivered online through digital platforms such as the MoEYS e-learning portal and Facebook and YouTube pages. Then other means and channels were added to cater for a greater number of students including TV and radio programs at both national and sub-national levels. With support from development partners, paper-based home learning packages were also developed and distributed nationwide to students, particularly those in early grades of primary education. Individual schools and teachers also initiated various continuous teaching and learning measures including synchronous instruction using online classrooms, provision of homework and feedbacks to students through phone or social media, home visits and physical small group teaching sessions.

In the Joint Education Sector Needs Assessment (MoEYS et al., 2020) [1] conducted by MoEYS and development partners, students were asked about their awareness and use of alternative learning measures, which included the "traditional" remote learning options provided through television and radio together with digital learning options. The top four measures used by students were: worksheets and other paper-based learning materials; online free e-learning videos posted on the official MoEYS e-learning portal; online learning modules prepared by the school they attend; and National TV education broadcasts in this order (MoEYS et al., 2020).

The assessment (MoEYS et al., 2020) further suggests that a majority of teachers across different grade levels and geographical locations conducted and facilitated some form of small group learning of varying frequency, and were in touch with their students at least twice a week through some form of communication channels. Only around 30% of students had access to online learning materials and approximately 70% of students reported access to at least one of the distance learning programs of MoEYS during the early stages of the school closure in 2020. Around 70% of students studied less 3 hours per week, which is much less than the time children would have spent on learning if they had attended school. Another survey (ADB et al., 2021)[2] indicates continuous efforts and interventions by MoEYS and schools eventually enabled more than 95% of students to access alternative learning measures during the later stages of the school closure. However the quality and quantity of home-based learning continued to vary among children.

[1] Data collection took place between 17 August and 14 September 2020.
[2] Data collection took place in August 2021.

2.3 Research objectives

As countries like Cambodia recover from the Covid-19 pandemic and restart regular schooling there is a need to answer two, closely related questions: how much has student achievement been impacted, and how effective was the remote learning regime? **These two questions are essentially two sides of the same coin, and recognize the potentially critical role played by the systemic response to the pandemic school closures in determining the degree of learning loss.**

These two core questions are central to the research objectives of this report, which are summarized in five general areas.

1. How did the Covid-19 pandemic school closure period impact grade six student achievement levels? The combination of a shortened 2019-20 school year and a reliance on remote learning during the 2020-21 school year predicts a decline in student achievement against expected levels. The 2016 grade 6 national assessment provides a reference point for measuring this learning loss. More specific follow-up questions include:

- How does the learning loss vary between Khmer language and Mathematics?
- Within each subject which sub-content areas (e.g. geometry, dictation, etc.) appear to be most impacted?

2. How did the pandemic impact on student achievement vary between sub-populations of students and schools? Among the key strata are gender, location (urban-rural), student SES and school type (public-private). Previous NLAs have demonstrated large learning gaps between these categories (EQAD, 2016), and a critical question is therefore whether the pandemic shock has increased these gaps and left poor and rural students even farther behind their more affluent and urban counterparts.

3. What did the teaching and learning environment look like during the pandemic school closure period, especially in 2020-21 when the remote learning activities were fully implemented? More specifically:

- What kinds of remote learning activities were implemented according to students and teachers? And to what extent do their responses agree about the provision of these activities?
- What kinds of students and teachers had access to technological resources (internet, computers) that are critical for the internet-based remote learning activities?
- How did the remote learning experience vary across school and student categories?
- What kinds of support did students receive at home from caregivers?
- What kinds of remote learning (and other) supports were provided to teachers during the school closure period?
- How did the school closures and pandemic measures affect the emotional well-being of students and teachers?

4. What factors are associated with grade 6 student achievement levels at the end of the 2020-21 school year? The EQAD data make it possible to consider differences in student achievement related to student-family background, school resources, teacher characteristics and

capacity, classroom conditions and teaching and learning processes. Given the extensive school closure period in 2020-21 it is also important to examine differences in student learning outcomes related to different school- and teacher-initiated remote learning activities as well as home support processes. Finally, what kinds of students had access to the remote learning activities that appear to have been most effective for mitigating learning loss?

5. What are the main policy implications from the remote learning period in Cambodia? First, what do the results mean for remediation and other activities—including targeted measures—that may be necessary to counteract learning loss? Second, what are the main lessons from the systemic response to extended school closings, and how can the remote education system be strengthened in preparation of possible future closings? And finally, how can lessons learned from this forced experimentation period be leveraged to improve teaching and learning in "regular" primary education in Cambodia? Focusing on the remote learning experience and the activities that appear to be most potentially impactful: how much potential do these strategies have for mainstreaming into regular education? And how can these measures be implemented with equity to overcome access constraints to technology and lower levels of engagement and support at home?

2.4 Data collection and sampling

The 2021 grade six national learning assessment (NLA) data were collected during a two week period in November 2021. Enumerators were trained centrally (in Phnom Penh) and then visited schools to complete the data collection in a two day period. EQAD provided supervision during the data collection period, and was then responsible for the data cleaning, data entry and final data file provision. Additional details on the data collection process are provided in the EQAD Grade 6 NLA report (EQAD, 2022).

To facilitate the estimation of learning loss via a comparison with the 2016 grade six NLA the identical student test booklets from 2016 were used in the 2021 NLA. EQAD has extensive experience (since 2005) with creating student assessment item banks and final test booklets to measure implementation of the official curriculum. Student assessment results in Khmer language and Maths are measured on the basis of percentage correct, proficiency levels and scale scores constructed using item response theory (IRT) methods. Details on the grade six national learning assessment test development and scoring process are provided in the earlier 2016 NLA report (EQAD, 2016).

Grade six students were administered a student questionnaire covering home and family characteristics (parental education, home possessions, etc.), schooling experiences (pre school, grade repetition, etc.), school climate, classroom learning activities and extra class (or "private tutoring") participation. Student absences and performance marks for the 2020-21 school year were obtained from the teacher marking/assessment book. Grade six teachers also completed a background questionnaire as well as a short test of content knowledge based on a block of identical test questions drawn from the grade six student assessment. School data were obtained through the EMIS system, including school enrolment as well as school type (public-private), location (urban-rural) and region.

Students and teachers were also asked to answer an extensive block of questions related to the teaching and learning (and home) environments during the 2020-21 Covid-19 pandemic school closure period. Both teachers and students were asked questions about teacher actions (sending assignments, checking in, etc.), remote learning activities (online classes, use of social media, etc.), familiarity/use of different remote learning platforms (MoEYS webpage, tv channel, etc.) and access to internet and other technological resources (computers, tablets, smart phones, etc.). Teachers were asked to provide some additional details on teaching methods during the closure period, and the support they received for implementing remote education. Students were asked about the support they received at home from caregivers. And finally, students and teachers were asked questions about their emotional well-being and engagement during the school closure period.

The 2021 grade 6 NLA was implemented using the same two stage cluster sampling method as the 2016 assessment (with different schools). In the first stage separate samples of public (200) and private (30) schools were chosen using probability proportional to size (PPS) sampling methods that ensure equal selection chances for all enrolled students. In the second stage EQAD staff obtained lists of enrolled students from each school and randomly chose 30 students across all grade 6 classes (e.g. A, B, C, etc.). Data collection enumerators then arrived at each school with these lists of students as well as replacements for absent students.

Grade 6 teachers were also randomly chosen, although in roughly half of the sampled schools there was only one grade six class section (and one responsible teacher). In schools with multiple grade six classrooms most of the grade 6 teachers were included in the data collection. However, it is not possible to match individual students with their specific class section teacher in schools with more than one grade six section.

PPS methods are often referred to as "self-weighting" since schools (and provinces) with the largest population have higher probabilities of inclusion. Nevertheless, given the oversampling of private schools—which make up 30/230 (13 percent) of the sample but less than 5 percent of the grade six population—it is necessary to weight the data to correct the proportion of public and private. The final sampling weight corrects for the public-private imbalance and also provides minor adjustments to the sample based on the final actual total of students by urban/rural and regional strata.

2.5 Study design and methods

In previous EQAD national learning assessment reporting cycles the focus of the analysis has been on current student achievement levels, with some additional comparisons against earlier assessments in the same grade to track systemic progress. **In the post-pandemic period the focus is somewhat different, with more emphasis given to the comparisons with previous cycles in order to estimate the degree of learning loss.** The 2021 grade six NLA provides the first opportunity to consider student achievement levels in the post-pandemic period in Cambodia; future EQAD NLAs will likely revisit this topic in other grades.

The use of the 2016 grade six NLA as a reference point for establishing learning loss rests on several assumptions. This includes the assumption that the grade six samples in 2016 and 2021 are nationally representative, which is supported by the large samples of schools and PPS

methods (with weighting). However the issue of representation goes beyond sampling design and school selection, and also references the composition of the samples (and respective populations) during the end of the year data collections. One concern is that the extended school closures in the 2019-20 and 2020-21 school years may have increased student dropout. This is examined in detail in Annex A using EMIS data on enrolments from the 2013-14 through 2021-22 school years. Based on this analysis there is some evidence that grade six enrolments (especially for girls) declined in the 2021-22 school year, which began in January 2022 after the grade six data were collected for this study (in November 2021). But the patterns of derived dropout rates and cohort completion rates between the two grade 6 NLA periods (2013-2017 and 2018-2022) are very similar. **On the basis of this review there is no evidence of a major exodus of students from the system during the pandemic period.**

An additional concern is that students may have been officially enrolled in the 2020-21 school year but did not actually attend during the face-to-face instruction period when the grade 6 NLA was conducted due to parental concerns about Covid-19. This issue cannot be addressed with the available data, although the enrolment figures for the 2021-22 school year could potentially capture this form of dropout since the 2020-21 and 2021-22 school years ran nearly continuously. More specifically, if children were held out of face-to-face instruction in November and December of 2021 (which included the end of year exam period that determines passing to the next grade) it seems unlikely that they would then go to the school to enroll in the new school year in January 2022.

If large numbers of poor and low achieving students have dropped out during the pandemic period then the learning loss estimations based on the 2016-2021 comparisons will be understated. Conversely, if relatively high scoring students were being kept at home by parents then the learning loss estimates will be overstated. It should be restated that the analysis in Annex A does not suggest a significant increase in dropout for the grade 6 cohort during the pandemic period. Furthermore, the results from multivariate analyses of student achievement show that student achievement levels tend to be marginally higher in schools with more dropout in both grade 6 NLA periods, which is consistent with relatively low scoring students being more likely to drop out (see Annex A).

In sum, the evidence from the available data does not suggest major alterations to the grade 6 cohort during the period when the 2021 grade 6 NLA was conducted that would substantially complicate comparisons with the earlier grade 6 NLA conducted at the end of the 2015-16 school year. [3] Nevertheless, it should be clearly stated that the national impact of the Covid-19 pandemic on school in Cambodia makes it impossible to definitively establish learning loss, and the estimations based on comparisons with earlier rounds of surveys require some amount of caution.

[3]An additional assumption that underlies the 2016-2021 analysis is borrowed from the program evaluation literature: the "equality of trends" assumption. This assumption is somewhat modified for the NLA work, but it essentially requires that grade six student achievement was not on a significant downward trend in the period leading up to the 2021 NLA. This topic is briefly addressed in Section 3.1 using equated test scores for the 2007, 2013, 2016 and 2021 grade six national learning assessments.

In terms of data analysis methods there are two general sets of activities. First there are comparisons of student achievement results between years (e.g. 2016 versus 2021) for the overall samples as well as by sub-samples, in addition to comparisons across sub-samples within each survey (i.e. boys versus girls, public versus private, etc.). All descriptive statistics summaries and comparisons between NLA surveys and categories rely on weighted data and robust standard errors that correct for the clustered nature of the sample. Tests of significance are used to flag significant differences in these comparisons.

The other main statistical activity is multivariate analysis of the 2021 grade six data to identify significant predictors of student achievement. The statistical equation is based on a mixed model (or "HLM") specification:

$$Y_{ni} = \alpha + \beta_X' X_i + \beta_n' S_n + \delta_n + \varepsilon_i \quad (1)$$

where achievement Y for student i studying in school n is analyzed as a function of a block (vector) of student and family background characteristics (X) and a block of school and teacher characteristics (S) from school n. The random effect (δ) captures additional variation between schools.

The multivariate modeling is divided into two parts. In the first part the focus is on student, school and teacher characteristics that are associated with student achievement variation, divided into a "Model 1" that focuses on student characteristics (plus some basic school controls) and "Model 2" that includes the full set of student, school and teacher variables. The independent variables for Models 1 and 2 were chosen in order to cover the main areas of education inputs and school, teacher and student characteristics.[4]

In the second part of the analysis the extensive set of remote learning indicators were added to models 1 and 2 (separately). Given the research interest in identifying specific remote learning practices that are associated with higher student achievement outcomes, this approach is preferred to creating an overall index (or factor) for the remote learning measures. This aspect of the work generated an enormous amount of output since there are over 50 individual measures of remote learning between the student and teacher questionnaires. Also, these variables can be analyzed in categorical form, as a linear measure and, in the case of student responses, as school averages rather than individual responses. Additional details of this aspect of the work are provided in Section 5.

The statistical modeling is based on standard econometric techniques for cross-sectional data, but it is important to note that these relationships are statistical "associations" rather than causal effects (or "determinants"). This is especially important for the remote learning indicators given the research and policy interest in identifying strategies that can possibly be

[4] The main categories of variables were determined on the basis of previous research in Cambodia and beyond, with an intention to capture key features of schools, classrooms and student background. Final variable selection did require some exploration within these blocks of variables to determine which individual indicators were the best fit and had the fewest missing values. The final variables were not chosen exclusively on the basis of their significance in the model, they were instead chosen in order to cover multiple features of schools and households, with particular attention to measures of process and capacity that are plausibly impacted by education policy (i.e. "policy levers").

mainstreamed into regular school practice (see research objectives in section 2.3). The main findings from this work are subjected to a series of robustness checks to help ensure validity, but again some caution is required in interpretation since it is not possible to rule out omitted variable bias and an observed correlation that is not strictly causal (this issue is returned to in Section 5).

3 Detailed summary of grade six learning loss 2016-2021

Key findings

- There is evidence of substantial learning loss for grade 6 students, as average achievement levels in 2021 are 0.30-0.75 standard deviations lower than the 2016 averages.
- The estimated learning loss is more pronounced in Maths than in Khmer. Student scores in Khmer reading were only marginally lower in 2021 compared with 2016, but in dictation and some aspects of writing there appears to be much more learning loss.
- The students and schools that experienced the largest declines tend to be those with relatively higher (expected) scores: urban school scores declined more than rural schools, private schools had substantially more learning loss than public schools, and higher SES students generally lost more than lower SES students. Although this does depend to some extent on the learning outcome that is analyzed.
- The apparent trend towards equalization in grade 6 achievement—meaning smaller learning gaps between key strata—is not due to equity-enhancing improvements among rural and poor students, but rather is a result of a troubling combination of substantial learning loss among higher performing cohorts and a concentration of students in the lower performance levels in the pre-pandemic period

By applying identical student tests in Khmer language and Maths it is possible to use differences between 2016 and 2021 averages as estimates of grade six learning loss in the Covid-19 pandemic period. This section provides a detailed overview of these differences based on overall test scores and distributions (3.1), content areas within each test subject (3.2), and differences between student and school strata (3.3).

3.1 Estimates of overall Khmer and Maths learning loss

Table 3.1 provides basic summaries of overall Khmer and Maths scores in the 2016 and 2021 national learning assessments for all schools and the public only samples based on two measures of achievement. The "weighted" measures are constructed by EQAD subject specialists who assign each content area within the test subject a specific percentage (or weight) of the overall score. The IRT-generated scale scores are based on a statistical model that generates a comparable score for all students from the 2016 and 2021 samples, with the baseline average (2016) set at 500 points (with standard deviations of 100).[5]

The results in Table 3.1 demonstrate significant differences between the 2016 and 2021 averages, regardless of the dependent variable or sample. Overall Khmer scores declined from 52.7 percent correct in 2016 to 46.5 percent in 2021, or roughly 0.30 standard deviations. In Maths the weighted percentage decline was even larger, from 49.4 percent to 38.3 percent (or nearly 0.60 standard deviations). **With the IRT-based measures—which generate a more**

[5] The 2016 averages in Table 3.1 are not exactly at 500 points due to the use of weights in the final comparisons.

complete picture of student performance taking into account all of the test information—the learning loss estimates are even larger: almost 0.45 standard deviations in Khmer, and roughly 0.75 SD in Maths. The learning loss estimates are very similar in the overall and public-only samples.

Table 3.1 Comparison of overall scores 2016-2021, by test subject and sample

Overall measure/Content area:	All schools: 2016	All schools: 2021	Sig.	Public only: 2016	Public only: 2021	Sig.
Khmer percentage (weighted)	52.7	46.5	**	51.9	45.7	**
	(21.3)	(21.2)		(21.2)	(21.1)	
Khmer scale (IRT)	497.4	454.6	**	493.9	451.1	**
	(100.7)	(94.1)		(100.1)	(93.2)	
Maths percentage (weighted)	49.4	38.3	**	48.6	37.6	**
	(21.7)	(18.0)		(21.3)	(17.5)	
Maths scale (IRT)	497.8	421.9	**	494.3	418.5	**
	(100.9)	(82.4)		(99.3)	(80.0)	

**Difference between 2016 and 2021 average is significant at p<=0.01 level
*Difference between 2016 and 2021 average is significant at p<=0.05 level
+Difference between 2016 and 2021 average is significant at p<=0.10 level

Figure 3.1 summarizes student performance in public schools based on proficiency levels that are determined with cut points set by EQAD subject-matter experts. The results confirm the decline in student achievement on the basis of actual skills. At the time of the 2016 grade 6 NLA 34.2 percent of students were unable to meet the Basic level threshold in Khmer language, meaning they could not answer at least 50 percent of a set of items covering basic elements of the curriculum. **In 2021 this share had increased to 45.4 percent, while the share of students performing in the Basic level increased and the shares performing in the Proficient and Advanced categories declined.**

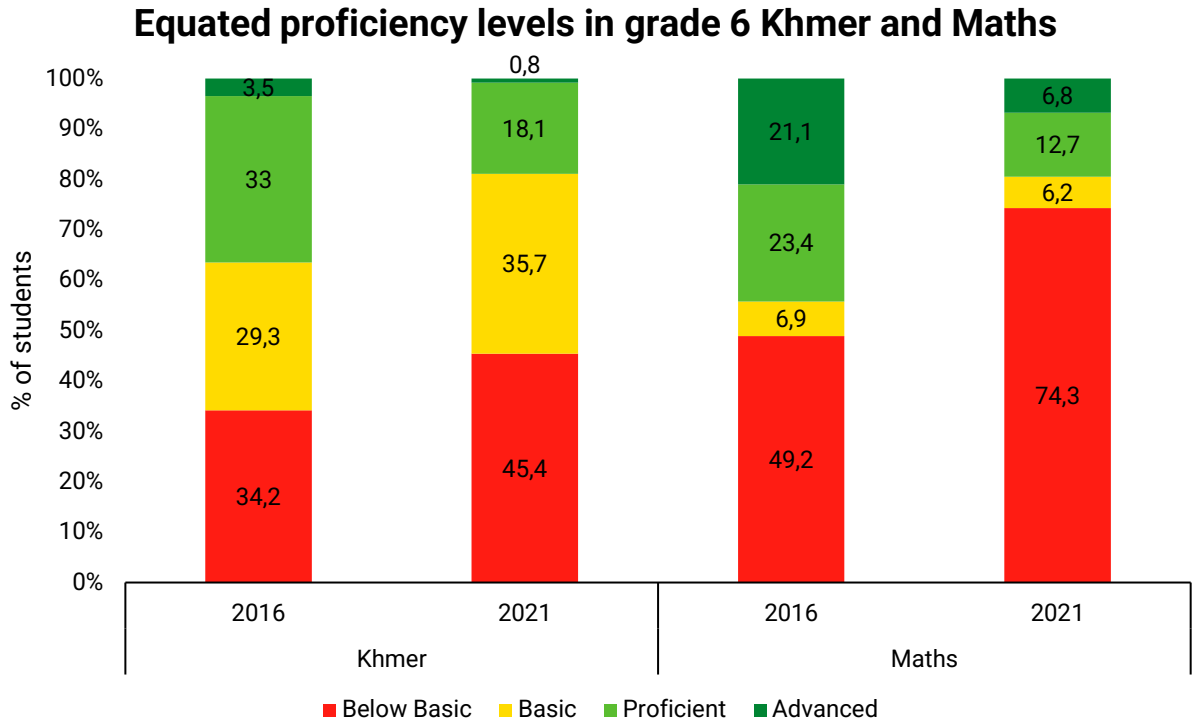
In Maths the deterioration in Figure 3.1 is even more pronounced: almost half of the students were in the Below Basic category in 2016, and that increased to nearly 75 percent in 2021. This was accompanied by a substantial reduction in the proportions of students performing in the Proficient and Advanced categories.

The various measures of student performance strongly suggest a significant decline in student achievement during the pandemic period. However it is important to rule out a pre-pandemic declining trend that would complicate interpretation of the 2016-2021 comparisons. Figure B1 in Annex B provides a summary of equated scores in Khmer and Maths over the last four grade 6 national learning assessment cycles (2007-2013-2016-2021). The results show somewhat mixed performance between 2007 and 2016, and it should be noted that the equating work is based on a somewhat small number of common test items across the four test rounds.[6] **But importantly**

[6] Equating refers to the statistical process of generating a comparable score across two or more tests that do not have identical content, but share at least some common test questions (also called "anchor" or "link" items). For the grade six assessments the equating work was carried out sequentially. First the 2007 and 2013 tests were equated by

there is no evidence that achievement levels were on a downward trend, and the drop in 2021 averages in both subjects clearly stands out.

Figure 3.1 Equated proficiency levels in grade 6 Khmer (overall) and Maths in 2016 and 2021, public schools only

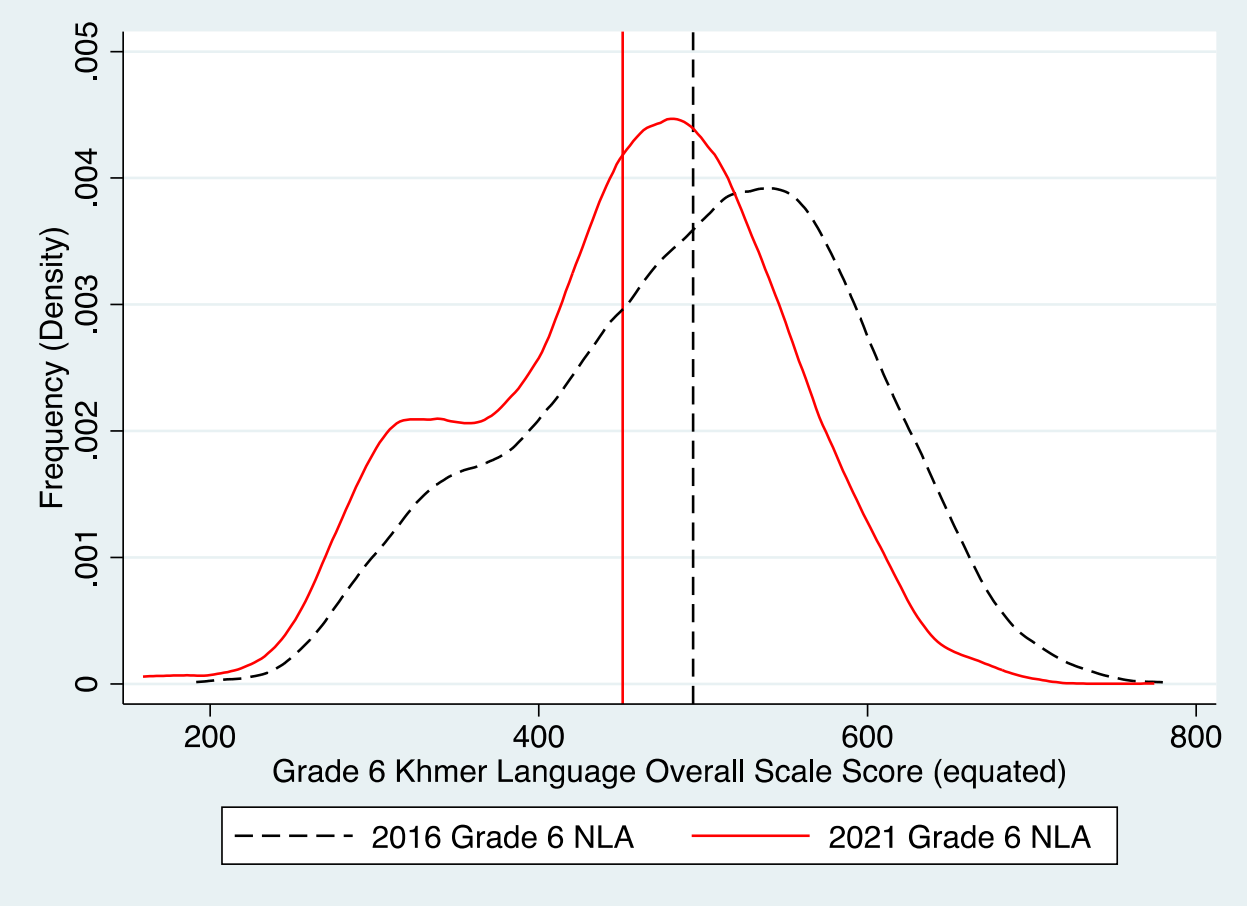


Data source: EQAD grade 6 NLA (2016, 2021)

Figures 3.2 and 3.3 provide additional summaries of the 2016 and 2021 learning assessment comparisons based on histogram distributions of IRT-generated scores in each year (by subject). For Khmer (Figure 3.2) the 2021 distribution (solid red line) has clearly moved to the left of the 2016 distribution (black dotted line), which is consistent with learning loss. The size of the gap is measured by the difference between where the respective vertical lines cross the x axis at the bottom (about 45 points or 0.45 standard deviations).

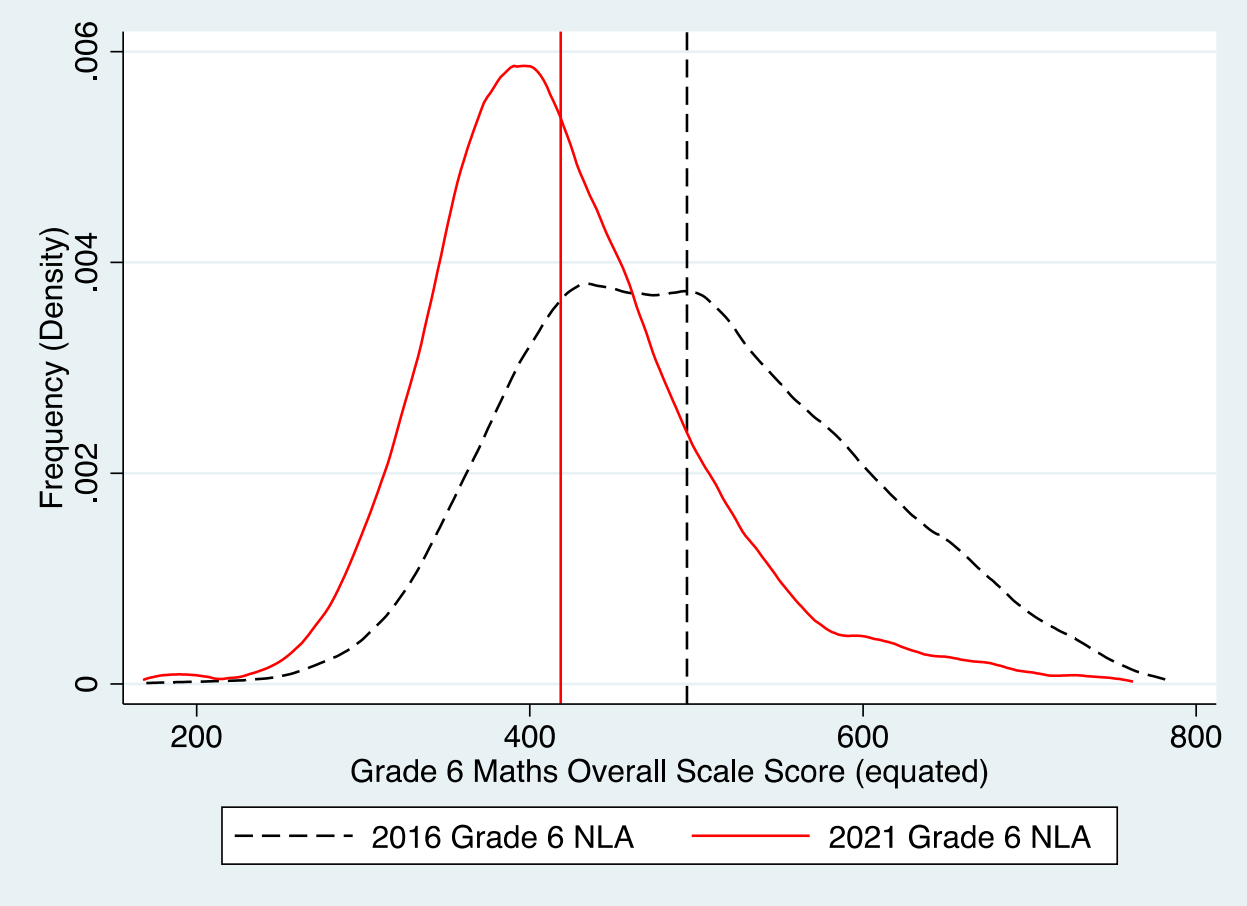
incorporating the 2007 item data into the IRT analysis of 2013, and setting the baseline (2007) mean to 500. Then the 2013 and 2016 tests were equated using the same procedure, but with a baseline (2013) mean set at the level obtained from the 2007-2013 equating. And then finally the 2016 and 2021 data were equated, which actually does not rely on standard equating procedures since the tests are identical, but again uses the 2016 baseline mean (from the 2013-2016 equating) as the reference point. The results in Figure B1 show the results from this sequential process with the 2007 averages set at 500, and the subsequent assessment averages interpreted in relation to the 2007 baseline. It should be noted that there are only 5 common test questions that are on the 2007, 2013, 2016 and 2021 grade six student tests in Khmer and Maths (5 for each subject). For the 2013-2016-2021 equating there are six common items in Khmer and nine common items in Maths. These are somewhat limited numbers of common items for carrying out equating work, so the results in Figure B1 should be interpreted with some caution since the common test items may not have sufficient coverage across the various difficulty levels of the tests to accurately generate comparable measures.

Figure 3.2 Histogram summaries of IRT equated grade 6 Khmer test scores 2016-2021, public schools only



Data source: EQAD grade 6 NLA (2016, 2021)

Figure 3.3 Histogram summaries of IRT equated grade 6 Maths test scores 2016-2021, public schools only



Data source: EQAD grade 6 NLA (2016, 2021)

In mathematics (Figure 3.3) the shift to the left is even more pronounced, as demonstrated by a roughly 75 point (or 0.75 SD) change in the overall mean. **The most striking part of the learning loss for mathematics is the large decline in the number of students scoring above 500 points on the test;** the gap between the red and black dotted line in the right side of the graph represents the decline in the numbers of students scoring in the upper range of the test. This is consistent with the substantial decline in green shaded students in the proficiency scale summary in Figure 3.1 above.

Figures B2 (gender), B3 (urban-rural) and B4 (private schools) in Annex B provide additional histogram summaries that provide a visual depiction of how student test scores have declined in this period.

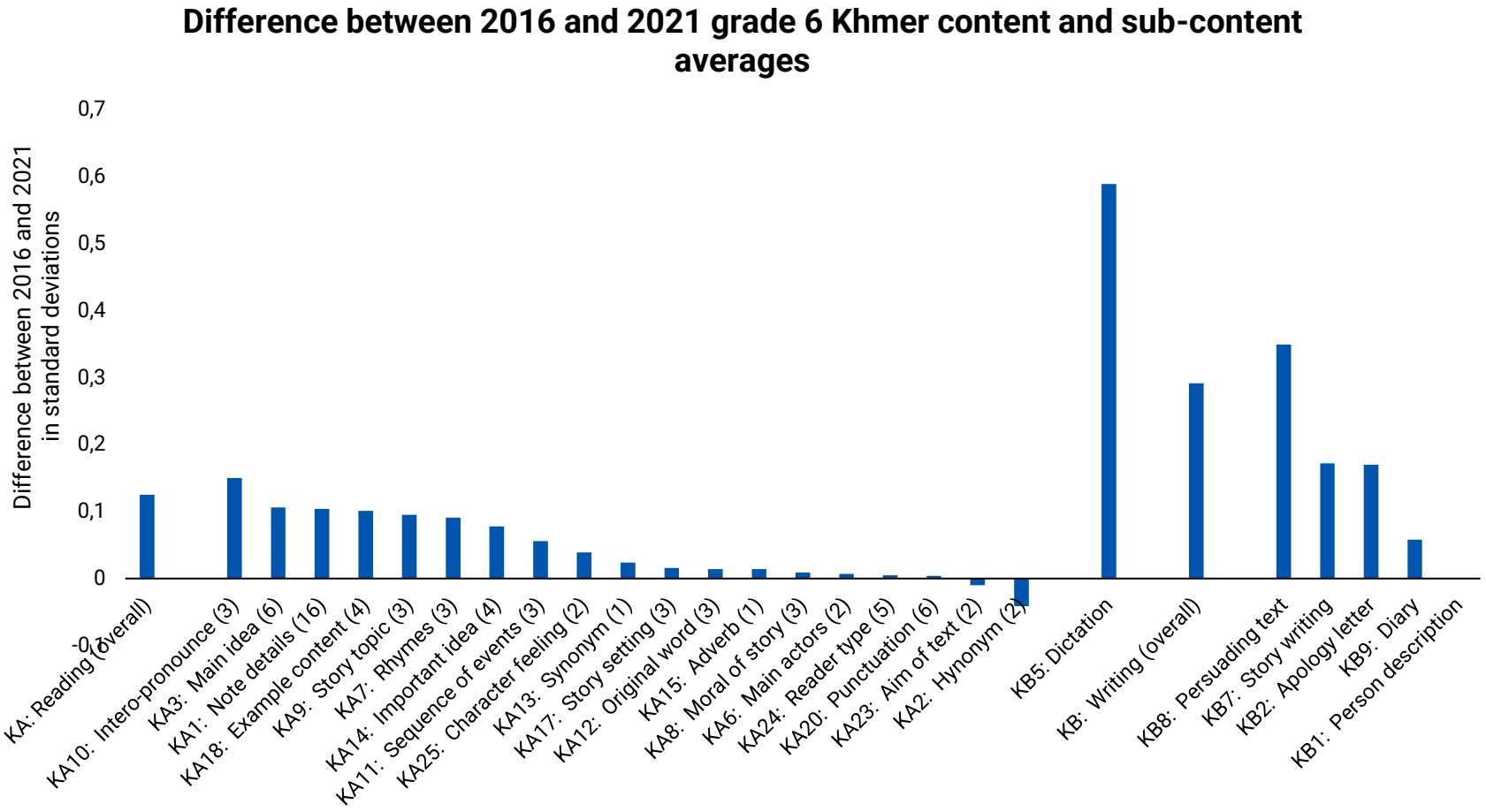
3.2 2016-2021 comparisons by content areas

The overall score comparisons in Section 3.1 provide a sense of how student achievement levels have declined in Khmer and Maths between the 2016 and 2021 national assessments. But a more detailed review is necessary in order to understand more about the specific content areas where student learning loss is most pronounced. It was already shown that Maths scores have declined more than Khmer scores, but within each subject there is additional variation in results.

Figures 3.4 and 3.5 provide graphical summaries of learning loss by content area in Khmer (Figure 3.4) and Maths (3.5). The bars represent the gap between the 2016 and 2021 content area average, measured in standard deviations. Taller bars represent larger declines in student achievement in 2021 versus 2016. Tables B1 (Khmer) and B2 (Maths) in Annex B provide the actual numbers (based on percent correct) with tests of significance to highlight declines that are statistically significant.

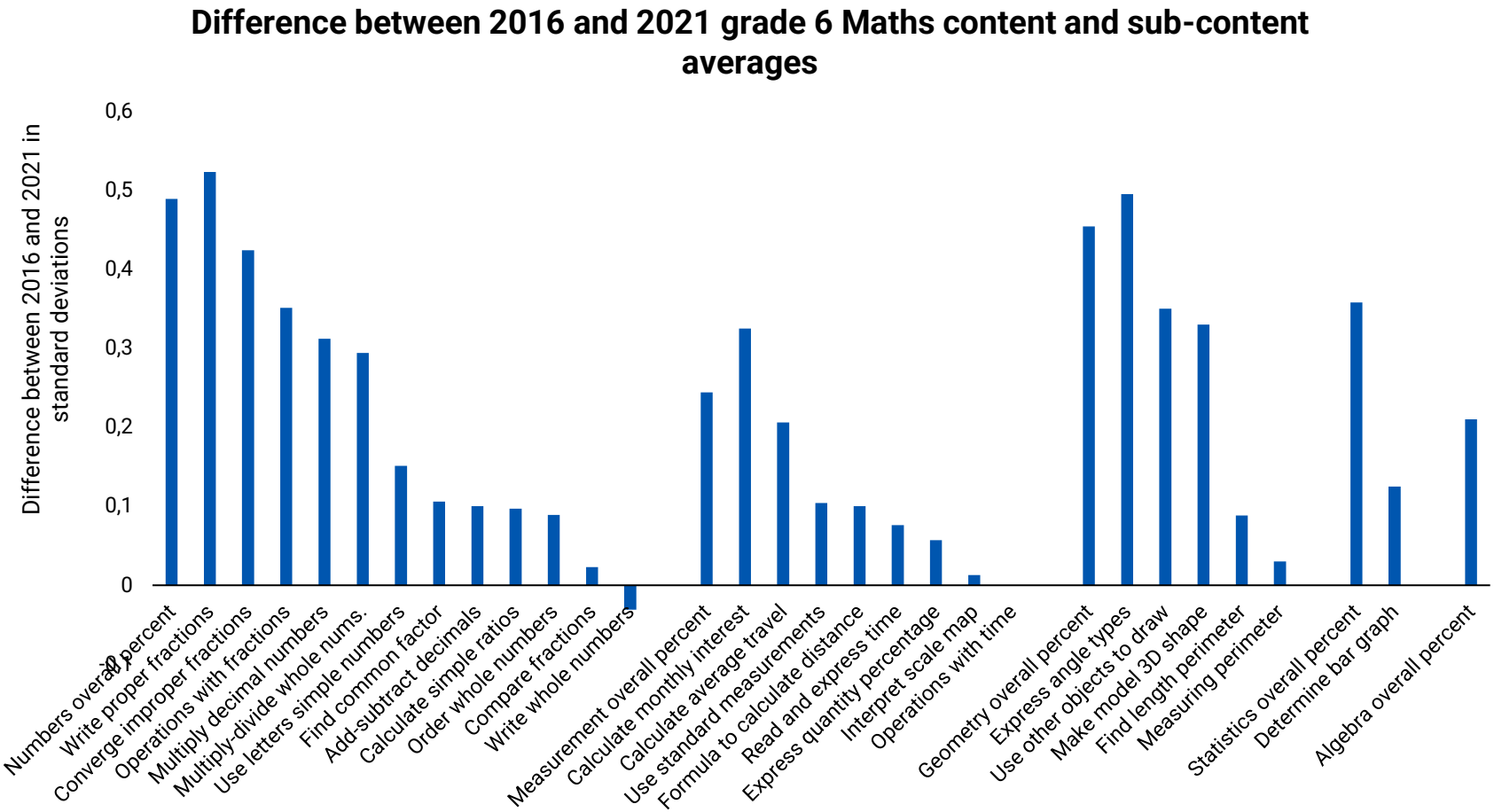
The content area-specific comparisons show very different results by test subject. In Khmer the estimated learning loss in the Reading content areas—which are measured mainly through multiple choice test questions—is relatively low (left half of Figure 3.4). The overall difference is roughly 0.12 standard deviations, and the differences between 2016 and 2021 are statistically significant in about half of the specific areas (gaps of 0.05 SD and above are significant).

Figure 3.4 Difference between 2016 and 2021 grade 6 Khmer content and sub-content averages in standard deviations, public schools only



Data source: EQAD grade 6 NLA (2016, 2021)

Figure 3.5 Difference between 2016 and 2021 grade 6 Maths content and sub-content averages in standard deviations, public schools only



Data source: EQAD grade 6 NLA (2016, 2021)

The learning loss in Khmer is instead concentrated in the writing activities which are divided into dictation and open writing tasks. Students were read aloud 20 words and asked to write out each individual word. The 2016 grade six sample averaged 7.8 correct words, compared with just 4.8 words in 2021 (a roughly 0.60 standard deviation difference). The standardized differences in the open writing activities in Figure 3.4 are also notably larger than the reading activities, although not as large as the estimated learning loss in dictation.

For mathematics the learning loss pattern is very different, with large gaps (0.30-0.50 SD) across numerous content areas. The largest decline is in Numbers (0.48 SD), followed by Geometry (0.45 SD), Statistics (0.36 SD), Measurement (0.24 SD) and Algebra (0.22 SD). There are some individual content strands that do not show much decline in 2021 compared with 2016, but overall the results suggest a more general decline in mathematics knowledge across the curriculum.

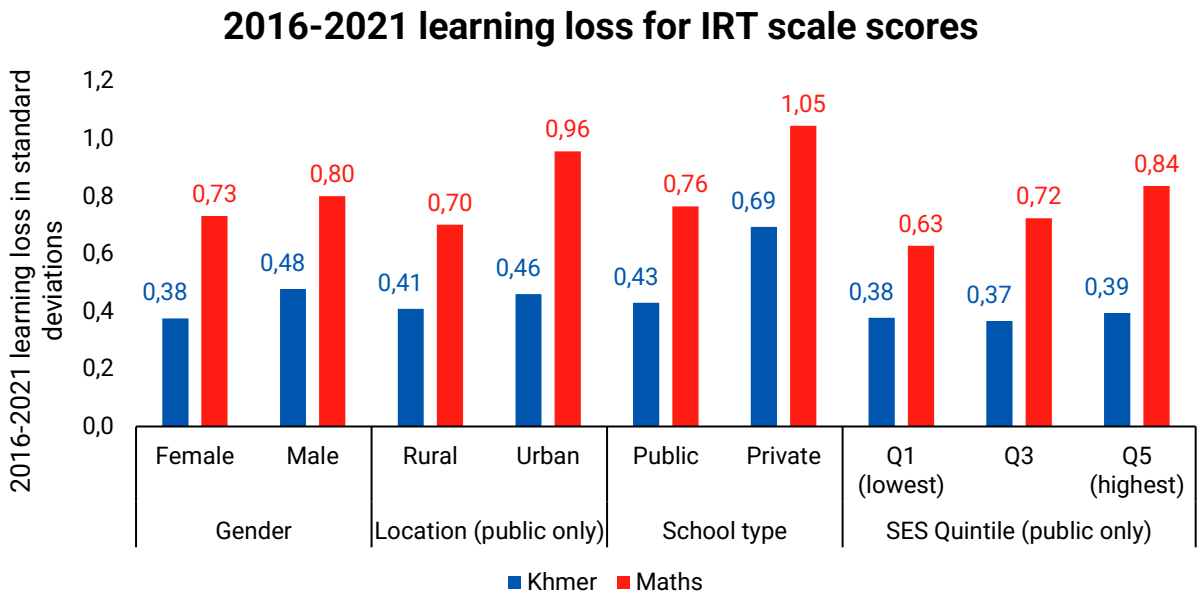
3.3 2016-2021 comparisons by sample strata

One of the key questions for grade six learning loss is whether or not the Covid-19 pandemic has led to an increase in achievement gaps between students and schools. Equity is a major concern in global discussions about the pandemic given the likelihood that poor children have been disproportionately impacted through some combination of increased economic pressure on the family (and more child labor), fewer resources at home to support remote learning, and less support provided by schools during the school closure period (Acevedo et al. 2021). By contrast, there is an expectation that children from wealthier families—especially those with access to private schools—will be able to better adapt during this period, and perhaps even avoid learning loss altogether.

Figure 3.6 summarizes estimated learning loss in Khmer and Maths across the main survey strata based on the IRT-generated scale scores, with the bars representing the difference (in standard deviations) between the 2016 and 2021 averages (or 2016 average minus 2021 average). Figures B5 and B6 in Annex B provide the actual scale score results by subject and strata.

The results in Figure 3.6 do not show larger achievement gaps in the post-pandemic assessment, and instead show that urban schools had more learning loss than rural schools, private schools had more learning loss than public schools, and higher SES student scores declined more than lower SES students. For example, the urban school mathematics achievement average in 2021 was nearly one standard deviation lower than the 2016 average, while in rural schools the average declined by 0.70 standard deviations. The private-public difference is even larger: private school student averages declined by 1.05 standard deviations in Maths, and 0.69 SD in Khmer, compared with 0.76 and 0.43 standard deviations for public schools in Maths and Khmer, respectively. Furthermore, the declines in urban and private schools are larger than in rural and public schools when real percentage changes are used (i.e. 2016-2021 decline divided by 2016 average) instead of simple change measures.

Figure 3.6 2016-2021 learning loss (in standard deviations) for IRT scale scores by main strata and subject

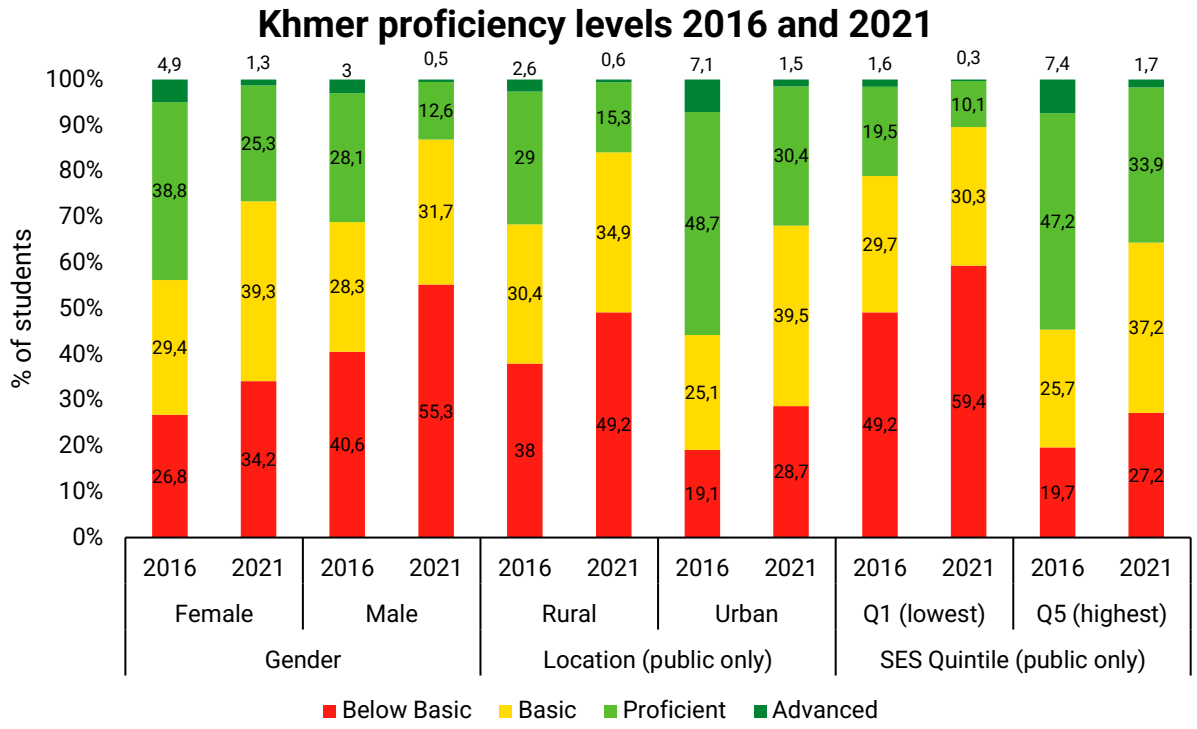


Data source: EQAD grade 6 NLA (2016, 2021)

Figures 3.7 (Khmer) and 3.8 (Maths) summarize the proficiency level measures of performance in 2016 and 2021 by sample strata; Figure B7 in Annex B provides a comparisons of public and private school proficiency levels. The results are generally consistent with the results in Figure 3.6 for the overall scale scores. **Proficiency levels deteriorated in 2021 in all sub-samples, but it is the higher performing urban and private school categories that experienced the biggest changes.** In Khmer the pattern is not quite as pronounced, but the percentage increase in Below Basic students is substantially larger among urban and SES quintile 5 (highest) children in comparison with their rural and quintile 1 counterparts. However in Maths and private schools the trends are more notable. **In 2016 54.1 percent of grade six students in rural schools were classified in the Below Basic proficiency level, and this proportion increased to 76.9 percent in 2021. But in urban schools the proportion more than doubled from 30.3 to 62.3 percent (Figure 3.8).** Only 20.5 percent of private school students were classified as Below Basic in mathematics in 2016, but in 2021 this proportion increased to 50.4 percent (Figure B7). These deteriorations in mathematics performance represent massive declines in real skills and knowledge.

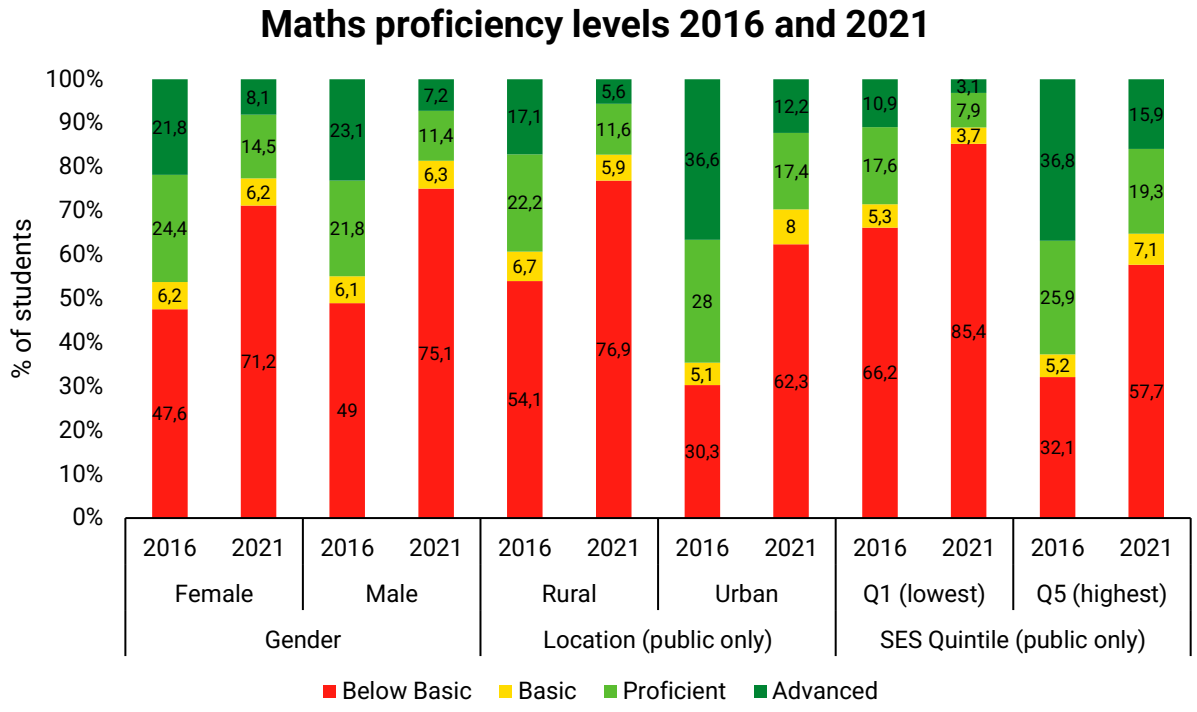
The results in Figures 3.6-3.8 suggest that achievement gaps have actually declined in grade six as a result of pandemic-related learning loss. But the full picture for equity dynamics requires some additional explication. One complication is the potential for multiple choice-based tests to underestimate the true learning loss by imposing an artificial minimum range of scores since children can guess at the answers. The mathematics test included one open-ended question, and the remaining items were multiple choice. However for Khmer the test included multiple choice reading items together with open questions for dictation (writing in correct word) and writing activities.

Figure 3.7 Comparison of Khmer proficiency levels by main strata 2016 and 2021



Data source: EQAD grade 6 NLA (2016, 2021)

Figure 3.8 Comparison of Maths proficiency levels by main strata 2016 and 2021

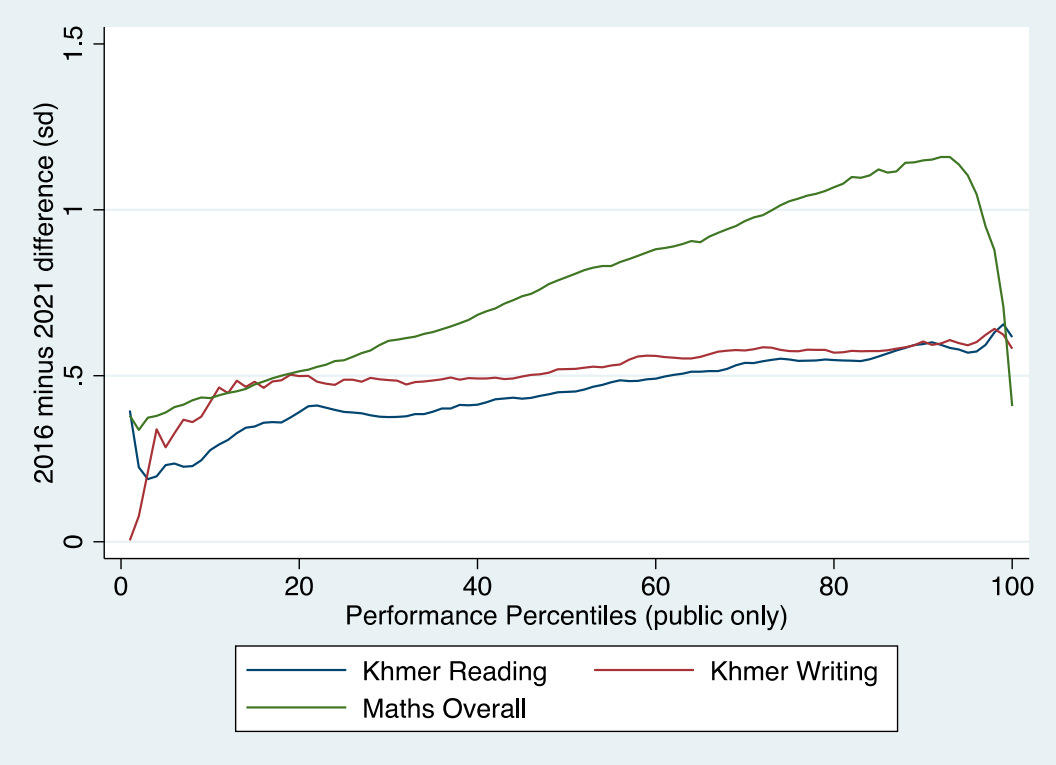


Data source: EQAD grade 6 NLA (2016, 2021)

The availability of open questions (in Khmer) makes it possible to estimate achievement gaps that are not affected by guessing at multiple choice questions. Figure B8 in Annex B compares achievement gaps in Khmer reading, writing and dictation by gender, location, school type and SES. The results show a substantial reduction in achievement gaps between public and private schools in all three content areas. But for location (urban versus rural) and SES (Q5 versus Q1) the achievement gaps have only been reduced in dictation, and have not changed much in reading or writing.

The results in Figure 3.9 conclude the analysis with a summary of estimated learning loss by IRT scale score percentiles and subject in the public school samples. The percentiles refer to the ranked scores for the entire sample in each survey year, from lowest scores (first percentile) to the highest scores (100th percentile). **For mathematics there is a very pronounced upward trend, which is consistent with higher performing students experiencing the most learning loss;** although this does trail off at the far right of the distribution where a small percentage of high performers in 2021 closed the gap on their 2016 counterparts. In Khmer reading and writing (which includes dictation) the learning loss trends are also getting larger in higher performance percentiles, but the slopes of the lines are much less positive than in mathematics. The results for Khmer are also somewhat affected by the choice of dependent variable, as the overall Khmer score based on the weighted percent correct (see Table 3.1) shows a more inverse-U pattern where learning loss is relatively low in the lower and higher performance ranges and more pronounced in the middle (Figure B9 in Annex B).

Figure 3.9 Estimated learning loss (in standard deviations) by IRT scale score percentile, public schools only



Data source: EQAD grade 6 NLA (2016, 2021)

Based on a very detailed summary of equity dynamics across the 2016-2021 grade six national learning assessments there is substantial evidence that higher performing categories of students and schools experienced the most learning loss. As a result there has been a general reduction in achievement gaps between urban-rural, low-high SES and (especially) public-private, although this does depend to some degree on the outcome and measure used. **This trend towards greater equity—meaning smaller achievement gaps in 2021 compared with 2016—is not the product of equity-enhancing measures that have brought up scores among the lower strata. It is instead the result of a troubling combination of substantial learning loss among higher performing cohorts and a concentration of students in lower performance levels in the pre-pandemic period.**

4 Remote learning environments during the pandemic school closure period

Key findings

- Students report very different rates of access to technology (internet, computers) across the main strata, although most students report having some kind of access to the internet.
- Students and teachers were asked about remote teaching and learning activities that can be divided into two general categories: emergency teaching (or reinforcement) and technology-based teaching.
- Emergency teaching activities (send assignments home, prepare worksheets, etc.) are more frequently reported than technology-based remote teaching (virtual classes, recorded lessons, use of social media).
- There are very large gaps in access to both the emergency/reinforcement and technology based remote teaching activities. Students in urban areas, private schools and higher SES families report more access to these activities, especially the technology-based activities.
- Students report a fairly limited amount of support in the home during the school closure period.
- Urban, private school and higher SES students report more support at home, but there is no evidence that home support for remote learning is associated with test score results.

Previous sections have demonstrated substantial learning loss between the 2016 and 2021 grade six national assessments. There are potentially many reasons for learning loss during an extended pandemic period (see Section 2.1), and it should be restated that while access to remote learning measures gradually increased among Cambodian primary school students during the pandemic period, the quality and quantity of home-based learning continued to vary significantly among students. **Nevertheless, the clear implication from the previous section is that the remote education responses to the pandemic were not fully effective.**

Despite these concerns about overall effectiveness of remote teaching, there is likely to be meaningful variation in school responses to the pandemic-induced school closures, and also variation in the effectiveness of different strategies. This section addresses the first part of this topic—variation in remote learning environments during the 2020-21 school year—while leaving the question of relative effectiveness for Section 5. Across the student and teacher questionnaires there are more than 50 variables that are related to remote teaching practices, use of materials and various platforms, and home (and school) support and work environments. The descriptive summary in the following sections provides a comprehensive overview of these various aspects in order to address a wide of range of research questions about the remote learning experience (see Section 2.3). Then in Section 5 the focus will be on a reduced set of these indicators that appear to be most strongly associated with student achievement outcomes.
The results are presented in four sections. Section 4.1 summarizes student and teacher technology access. Section 4.2 includes student- and teacher-reported features of remote education grouped into emergency teaching/reinforcement and technology-based categories.

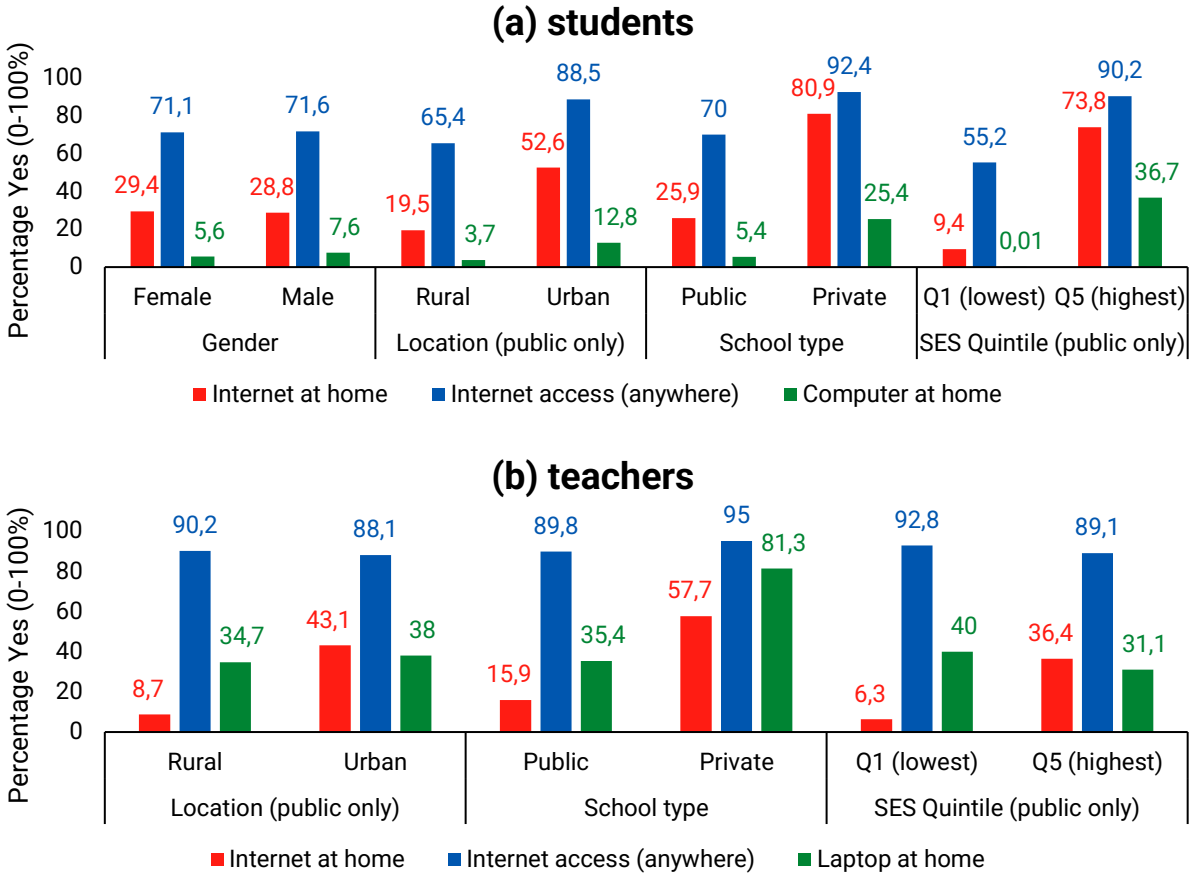
Section 4.3 examines the home support environment reported by students (including child labor measures), and the school and system support environment reported by teachers. Section 4.4 focuses on the use of different learning platforms by students and teachers.

4.1 Teacher and student access to technology

Figure 4.1 summarizes internet and computer access for students (a) and teachers (b). Relatively few students and teachers report having internet connections at home, but most report having access in some way (via phone, café, etc.). Home computers are also fairly rare among students (about 6 percent on average), but more common in teacher homes.

There is substantial variation in technology access across the main strata. **As expected, urban, private and higher SES students report significantly higher rates of home internet connections, access to internet and home computers.** For teachers the differences are less pronounced since most have access to internet somewhere, and computer ownership rates are actually lower in teachers who work with quintile 5 students compared with quintile 1.

Figure 4.1 Internet and computer access by main strata (2021) (a) students and (b) teachers



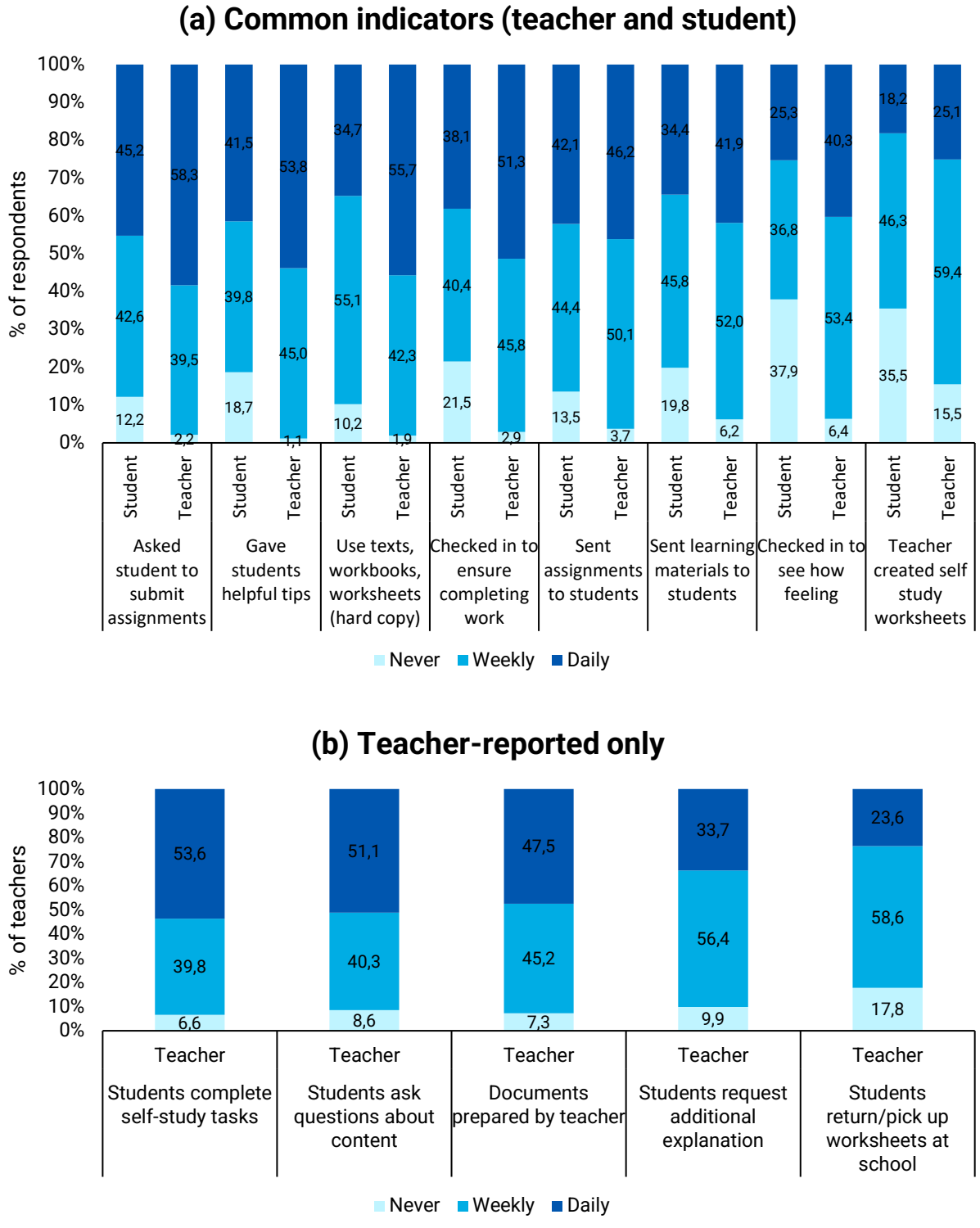
Technology access is potentially important in the remote learning phase since it facilitates the use of real time teaching and other connection and interaction strategies.

4.2 Student-teacher interaction and materials during school closure period

Figures 4.2 and 4.3 summarize various features of remote education as reported by students and teachers, divided into emergency teaching/reinforcement (Figure 4.2) and technology-based (Figure 4.3) activities (and materials); the third category for "traditional" remote education (tv, radio) is considered separately in Section 4.3. **The most commonly reported activities in the emergency teaching/reinforcement category include asking students to submit assignments, giving helpful tips, using textbooks and other core materials, and checking in to ensure students are completing the work (Figure 4.2).** Less commonly reported activities include teachers creating self-study worksheets, checking in to see how students are feeling, and students coming to school to pick up/drop off materials (Figure 4.2).

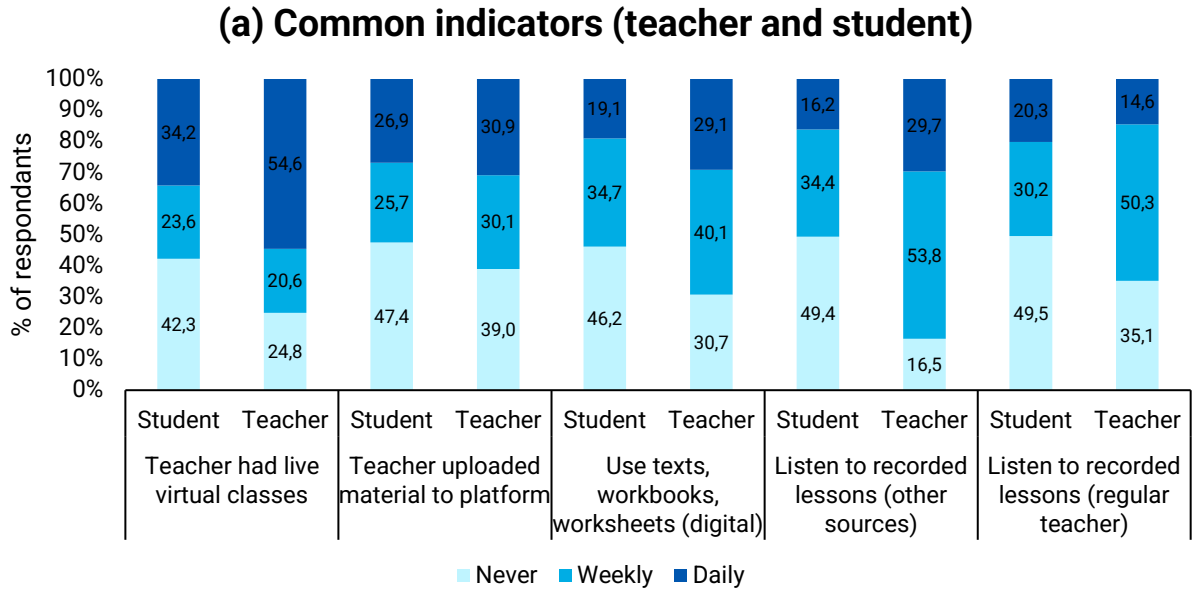
The students and teachers report significantly less frequent interaction via the technology-based activities. The most frequently reported activities include the use of virtual classes, uploading material to social media, and using digital learning resources (Figure 4.3). These activities are reported on a daily basis by students in only about 25-35 percent of the schools, and sizeable proportions of students report never accessing these activities. This gap in technology-based remote learning opportunities is returned to below.

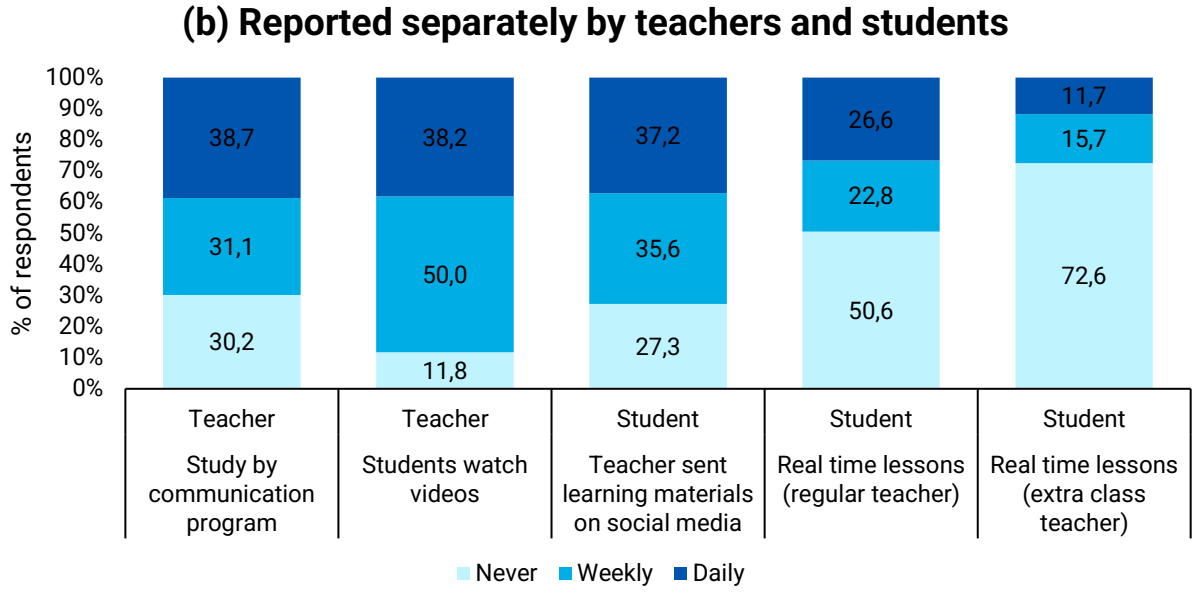
Figure 4.2 Student and teacher reported frequency of emergency teaching/reinforcement remote teaching activities, 2021 Grade 6 NLA (a) Common indicators (teacher and student) (b) Teacher-reported only



Data source: EQAD grade 6 NLA (2021)

Figure 4.3 Student- and teacher-reported frequency of technology-based remote teaching activities, 2021 Grade 6 NLA (a) Common indicators (teacher and student) (b) Reported separately by teachers and students

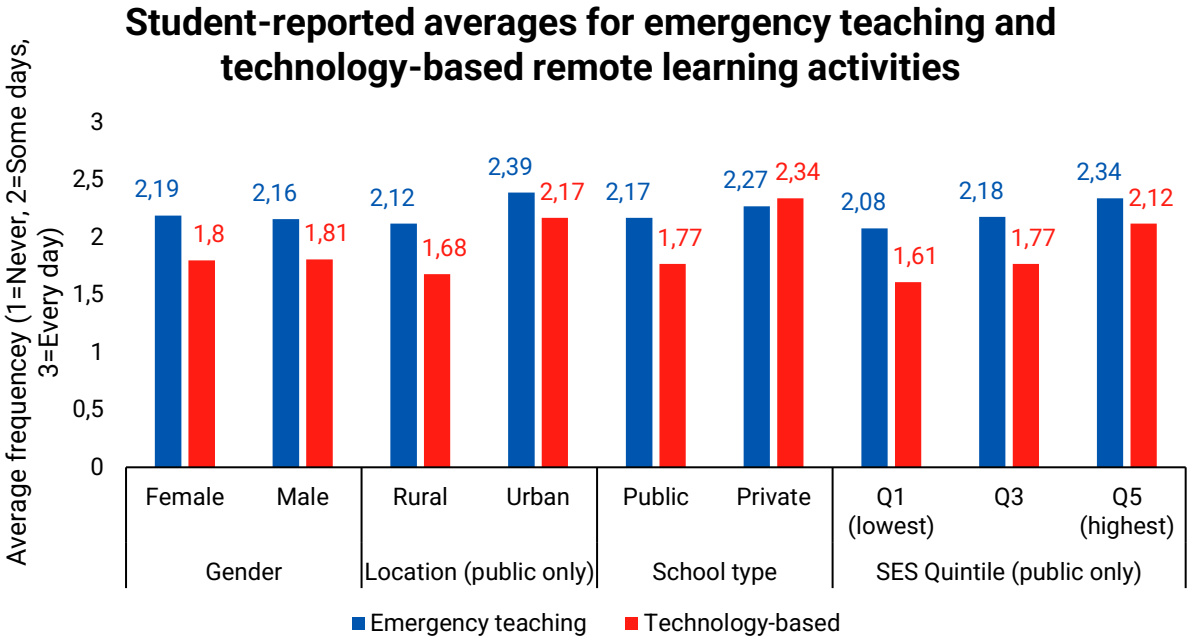




Data source: EQAD grade 6 NLA (2021)

Overall averages for the frequency that students report engaging in emergency-teaching (send assignments home, prepare worksheets, check in with student, etc.) and technology-based (virtual classes, social media, etc.) remote learning activities are reported in Figure 4.4. Between female and male students there are no differences. But for the other category comparisons there are significant differences. **The pattern is the same for both constructs: urban, private and higher SES students report more frequent engagement in both the emergency teaching and technology based remote activities.** The differences are much larger for the technology-related activities. For example, public school students report an average frequency of 2.17 (1=never, 2=some days, 3=every day) for the emergency teaching activities, compared with 2.27 for private school students. But for technology-based interaction the public average is just 1.77 compared with 2.34 for private school students.

Figure 4.4 Student-reported averages for emergency teaching and technology-based remote learning activities (scale 1-3) by main strata, 2021 Grade 6 NLA



Data source: EQAD grade 6 NLA (2021)

Three findings stand out from the student- and teacher-reported remote learning activities in this section. **First, there is more of an emphasis on emergency teaching activities—where teachers find various ways to interact with students "offline"—than in technology-based remote learning.** This is not surprising given the level of technology access, especially since roughly 30 percent of students reported not having any access to the internet (Figure 4.1a).

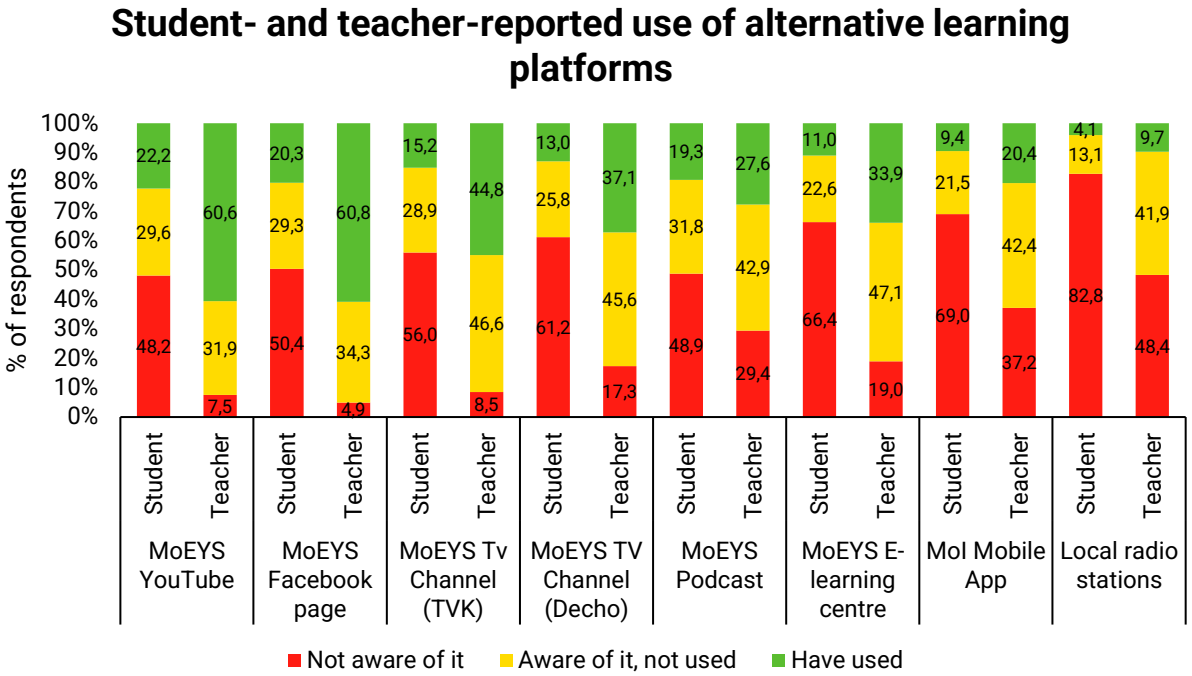
Second, even focusing on the emergency teaching outreach there are students who are reporting virtually no engagement with these activities. **For example, 22 percent of students reported that their teacher never checked in with them to see if they are completing schoolwork and assignments (Figure 4.2a).** This may reflect poorly engaged students who are not taking advantage of existing resources, or teachers and schools that are not offering much in the way of support.

The third finding follows the second, and highlights the inequality in student access to these different remote learning features. Urban, private and high SES students report significantly higher participation in both categories of remote learning, with especially large differences in the technology-based activities (compared with emergency teaching-reinforcement).

4.3 Alternative learning platform access and use

Students and teachers were asked about their awareness and use of alternative learning platforms, which include the "traditional" remote learning options provided through television and radio together with internet-based platforms. Figure 4.5 summarizes the proportions of students and teachers who are not aware of these platforms, are aware but have not used, and have actually used them. **For students there is a very high rate of non-awareness (50 percent and above) for the traditional and technology-based platforms.** In terms of actual student use the most frequently cited are the MoEYS YouTube page (22.2%), the MoEYS Facebook page (20.3%) and the MoEYS Podcast (19.3%). For teachers the patterns are again very similar, although in general teachers are much more aware of these platforms, and also report substantially more usage, mainly in the same categories that were most frequently mentioned by students.

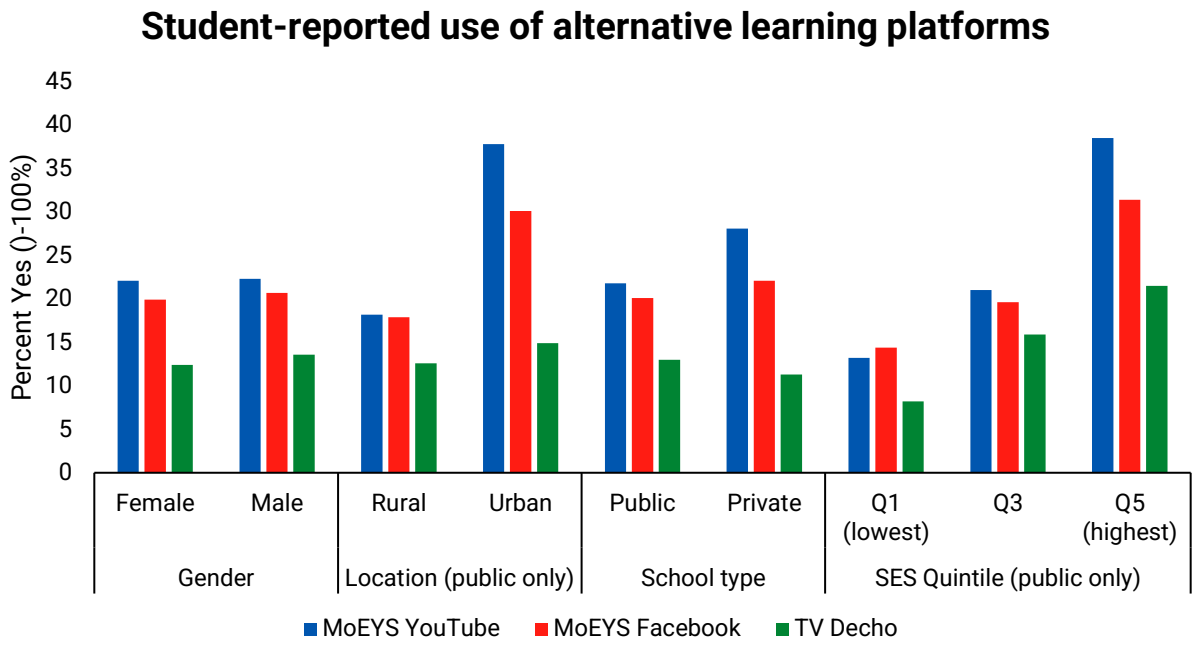
Figure 4.5 Student- and teacher-reported use of alternative learning platforms, 2021 Grade 6 NLA



Data source: EQAD grade 6 NLA (2021)

Figure 4.6 compares the percentage of students who reported using the MoEYS Facebook, Youtube and TV Decho platforms by the main strata. **Urban and higher-SES children are more likely to report using all platforms than their rural and low-SES counterparts, although the differences are larger for the internet-based platforms.** Public and private school students report very similar usage patterns.

Figure 4.6 . Student-reported use of alternative learning platforms by main strata, 2021 Grade 6 NLA



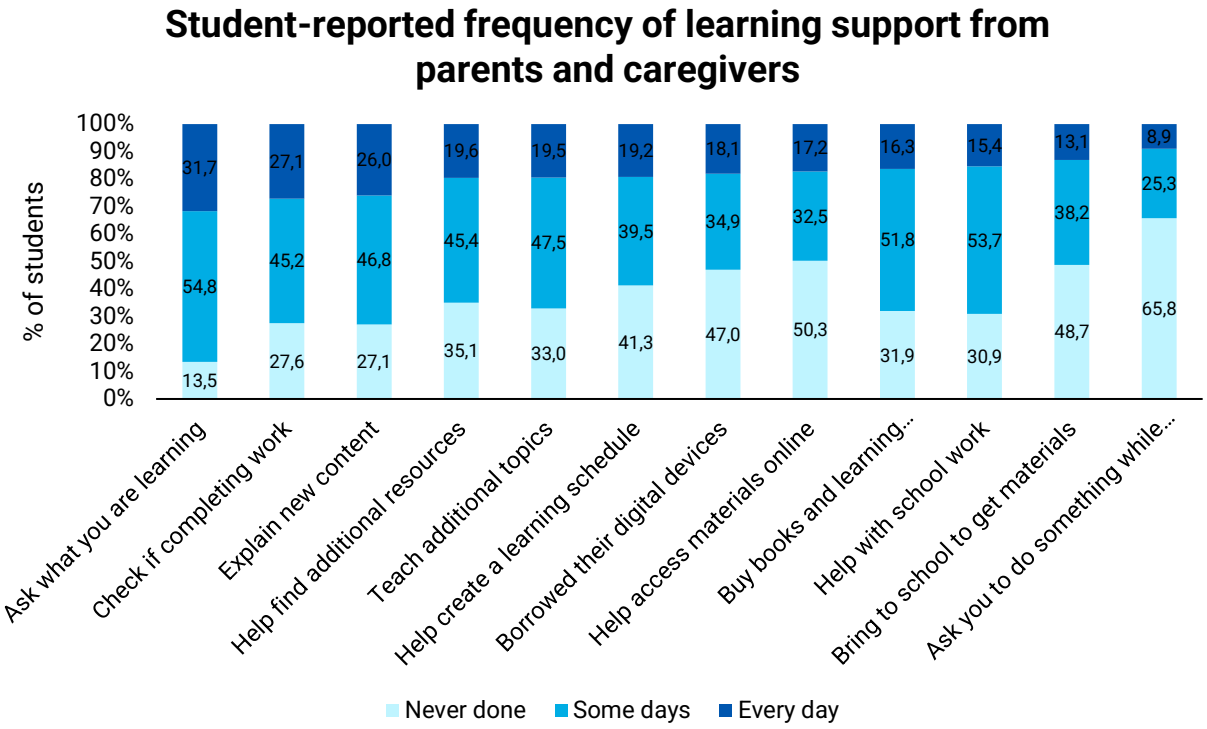
Data source: EQAD grade 6 NLA (2021)

4.4 Student and teacher support

Students were asked a series of questions about how frequently they received different kinds of learning support in the home from parents and caregivers. **Overall, students report receiving somewhat limited help at home.** Figure 4.7 shows that the most common form of help from parents (or caregivers) was asking what they were learning, checking to see if they completed their work and explaining new content: these three activities occurred on a daily basis in 25-30 percent of the households, and in some days in roughly half of the sample. The most infrequent activities were bringing the child to school to get materials and helping access new materials online. But across all of the activities there are significant proportions of students (at least 20 or 30 percent) that reported they never received this kind of support.

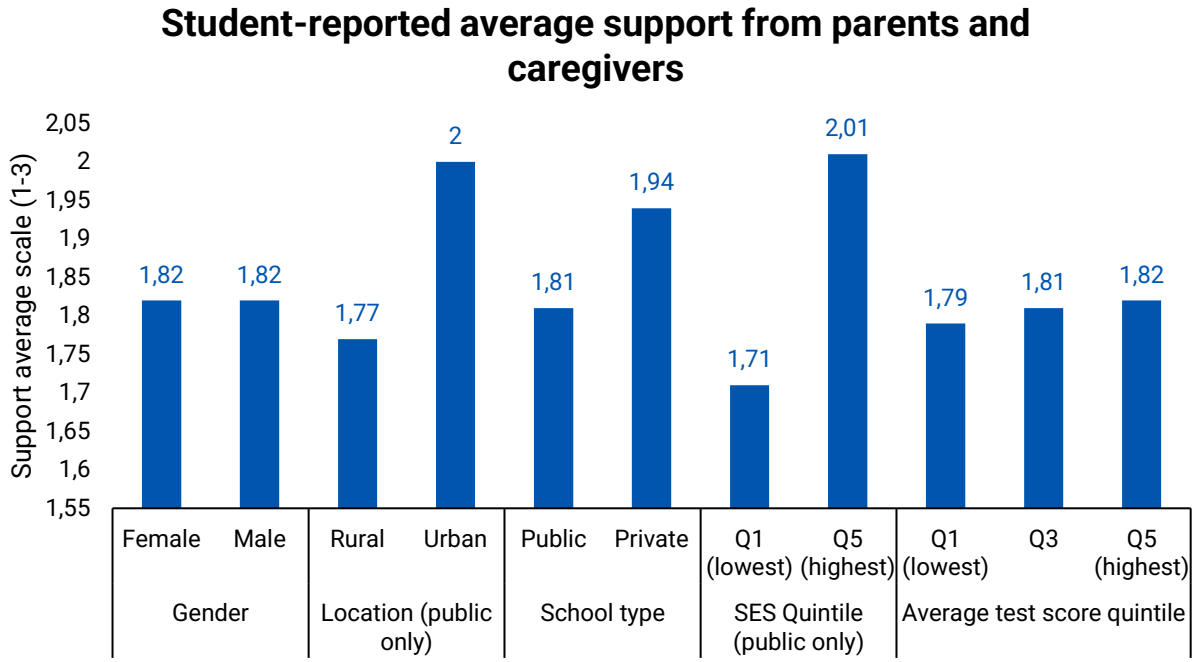
Figure 4.8 follows up with a comparison of an overall support index across the main strata as well as among five quintiles of students based on their average achievement in Khmer and Maths. Not surprisingly, urban, private and higher SES students report receiving more help at home than their rural, public and lower SES counterparts. But the comparisons by student test scores do not show a pattern**: the lowest performing students report nearly the same level of support from caregivers as the highest scoring students.** This suggests that home support is not positively associated with student test results, which may be a reflection of parental capacity. Furthermore, there are clearly cases of children who are not seeking out this kind of help who are performing quite well.

Figure 4.7 Student-reported frequency of learning support from parents and caregivers , 2021 Grade 6 NLA



Data source: EQAD grade 6 NLA (2021)

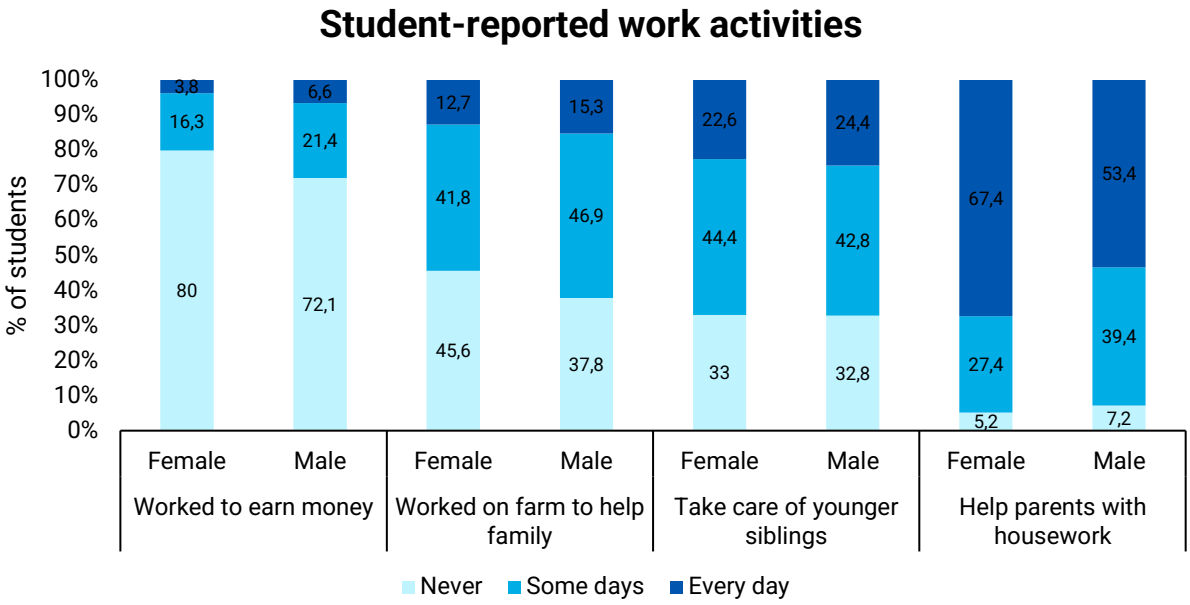
Figure 4.8 Student-reported average support from parents and caregivers by main strata, 2021 Grade 6 NLA



Data source: EQAD grade 6 NLA (2021)

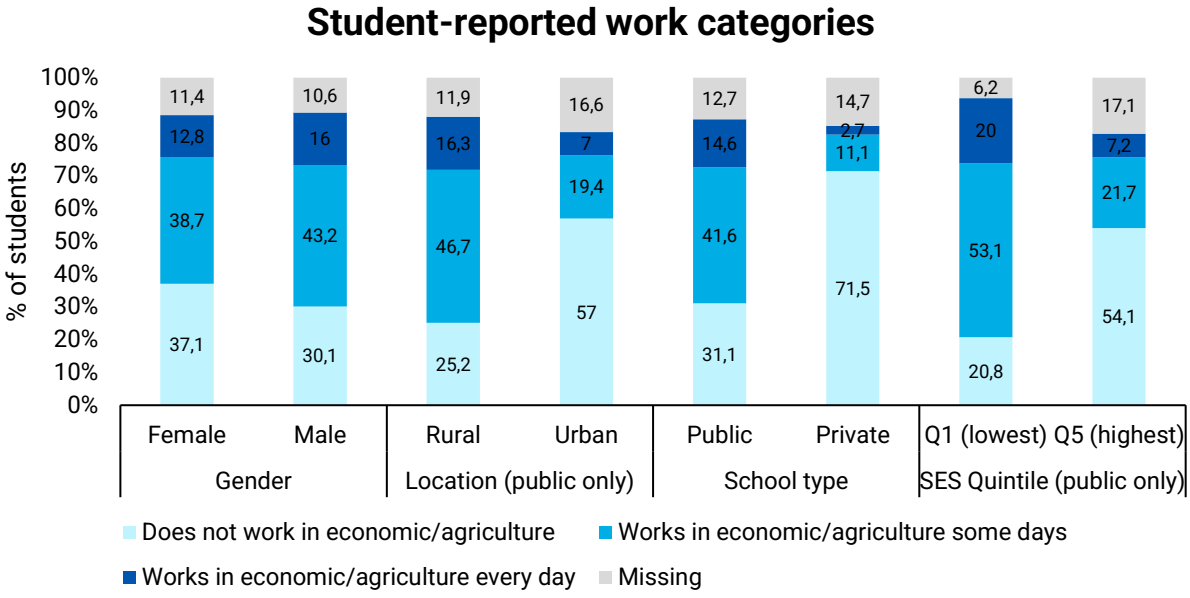
The analysis of home support concludes with a summary of child-reported work activities during the school closure period. The overall sample averages in Figure 4.9 show that relatively few boys and girls reported being regularly engaged in economic labor outside of the home. Over half of the sample reported being engaged in agriculture work and taking care of siblings at least in some days. The most common activities are helping with housework, especially for girls, which nearly every student in the sample reported doing at least some days per week.

Figure 4.9 Student-reported work activities by gender, 2021 Grade 6 NLA



Data source: EQAD grade 6 NLA (2021)

Figure 4.10 Student-reported work categories by main strata, 2021 Grade 6 NLA

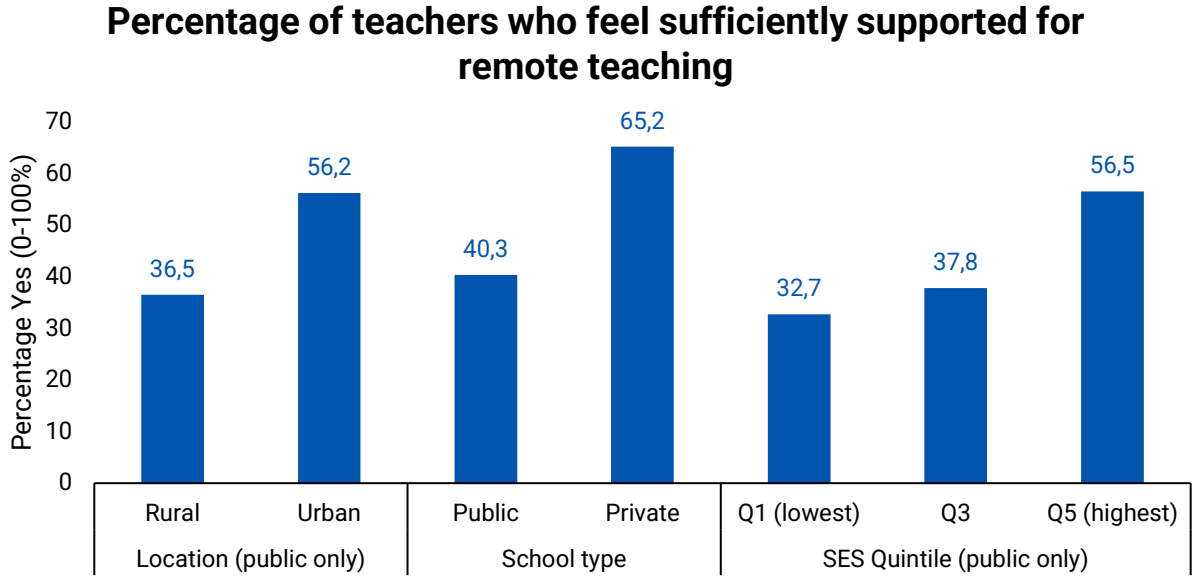


Data source: EQAD grade 6 NLA (2021)

Figure 4.10 then provides a more focused summary of child work activities by strata, with a focus on the economic and agricultural work categories. Not surprisingly, the results show rural, public school and lower SES children are significantly more likely to report being engaged in this kind of work during the school closure period than their urban, private school and higher SES counterparts.

Teacher support dynamics were covered in several questions in the teacher questionnaire. **Only about half of the grade six teachers felt they were sufficiently supported for conducting remote teaching (Figure 4.11).** These averages are substantially higher in urban schools, private schools and among teachers of higher SES students.

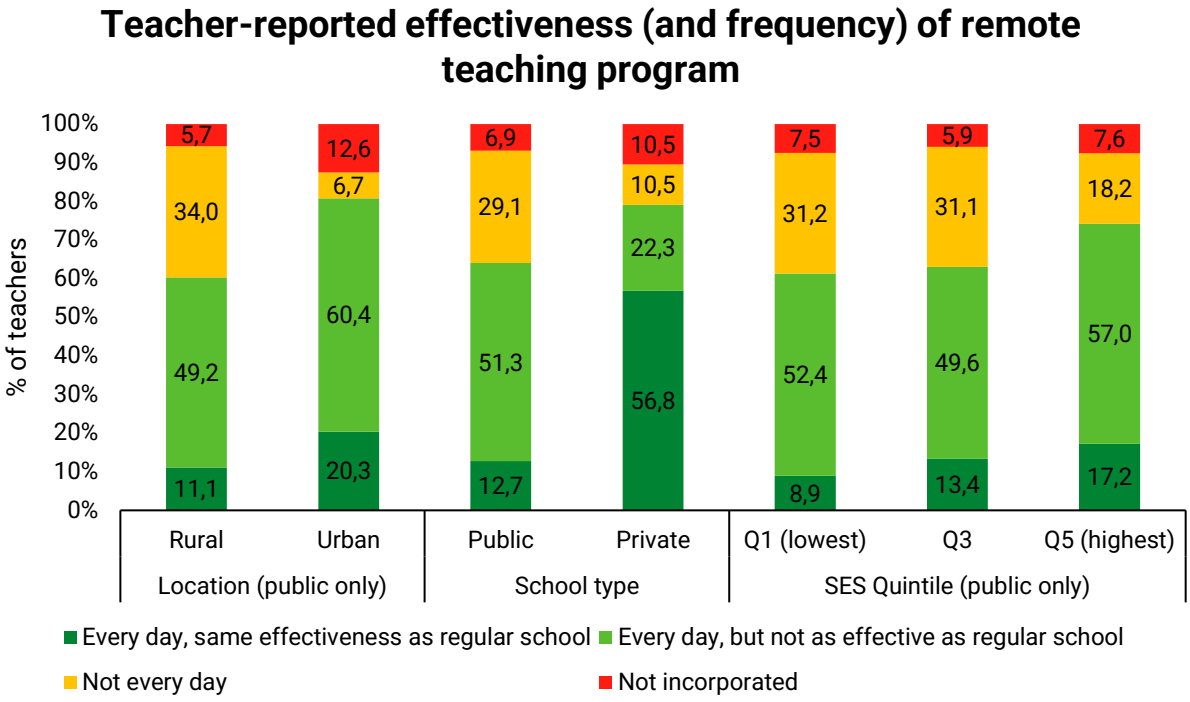
Figure 4.11 Percentage of teachers who feel sufficiently supported for remote teaching by school type and student SES categories, 2021 Grade 6 NLA



Data source: EQAD grade 6 NLA (2021)

Teachers were also asked to describe the overall effectiveness of the remote teaching program in their schools. Figure 4.12 presents the results based on a four category summary: remote teaching was implemented every day and had same effectiveness as regular (face-to-face) teaching, remote teaching was implemented every day but not as effective as regular teaching, remote teaching was implemented but not every day, and remote teaching not implemented. **Only 13 percent of grade six teachers felt that the remote teaching program in their school was as effective as regular face-to-face instruction, although this was much higher in private schools (56.8%).** The most common response was that remote teaching was used on a daily basis, but was less effective than regular teaching (5l.3 percent of public schools). Relatively small shares of teachers indicated that remote teaching was not incorporated. But there is substantial variation in the frequency: **for example 34 percent of rural school teachers indicated that remote teaching was incorporated "some days" compared with just 6.7 percent of urban teachers.**

Figure 4.12 Teacher-reported effectiveness (and frequency) of remote teaching program by school type and student SES categories, 2021 Grade 6 NLA



Data source: EQAD grade 6 NLA (2021)

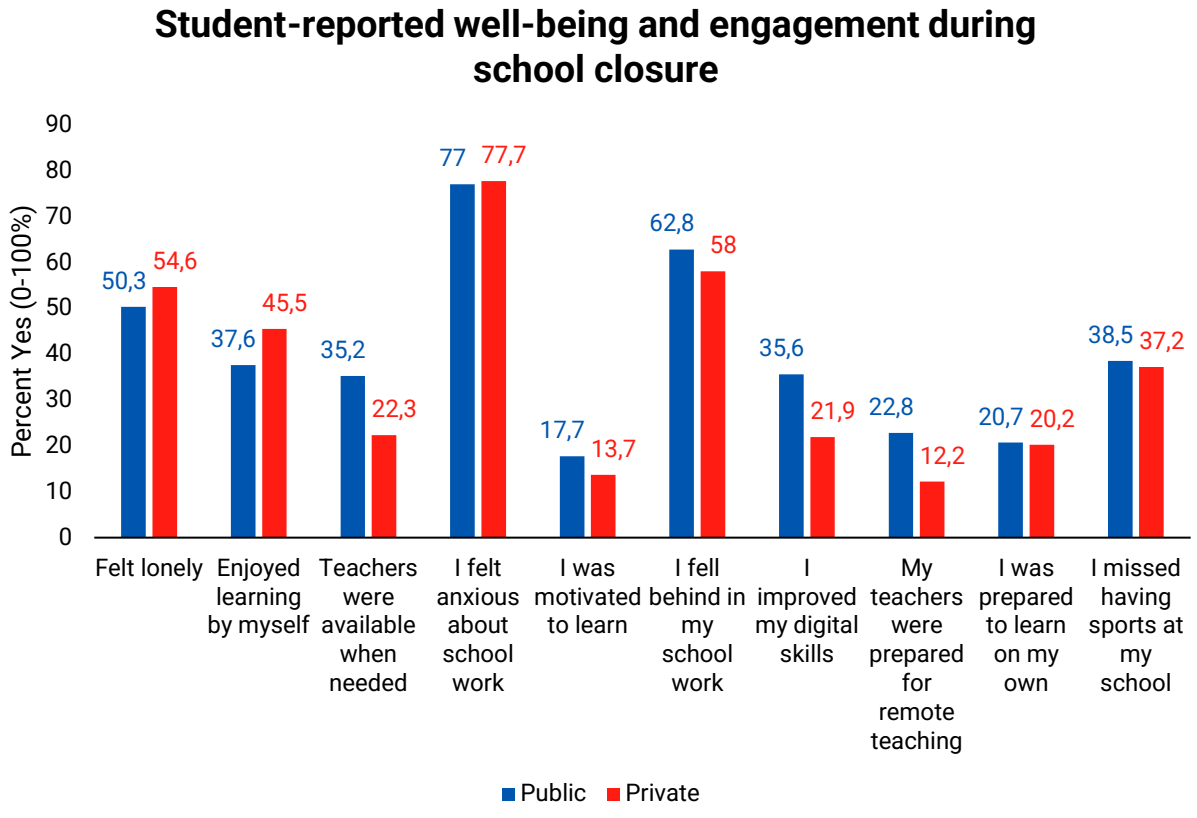
The results in Figure 4.12 provide an interesting perspective on effectiveness of remote teaching during the school closure period. But it should be noted that these teacher responses are not significantly associated with actual student learning levels. In other words, student test scores are not significantly higher in schools where teachers report having an effective, daily remote teaching regime compared with schools where teachers report less frequent remote teaching.

4.5 Student well-being and engagement

Students were asked a series of questions about their well-being and engagement during the school closure period. The basic conceptual framework in Section 2.1 highlighted the potential for long-term impacts from extended school closures on children's emotional well-being. The questions in the EQAD survey touch on some of these aspects, but overall the block of questions is more general and touches on multiple features of the school closure period experience, including teacher readiness and engagement.

Figure 4.13 summarizes the results for these questions with comparisons between public and private school students. Significant percentages of students indicated they felt lonely during the school closure period, although roughly 40 percent did note that they enjoyed learning by themselves. **A very high percentage indicated feeling anxious about schoolwork, roughly 60 percent acknowledged that they fell behind during the school closure period, and only 20 percent reported being prepared to learn on their own; these results are certainly consistent with the learning loss shown above.** The students also reported somewhat low levels of teacher preparation and engagement, and somewhat surprisingly this was true in both public and private schools.

Figure 4.13 Student-reported well-being and engagement during school closure period by school type, 2021 Grade 6 NLA



Data source: EQAD grade 6 NLA (2021)

5 Statistical analysis

Key findings

- Multivariate analysis is used to identify significant predictors of student achievement, and the results are consistent with previous work in Cambodia (and beyond) and show that student and family background measures (family SES, number of siblings, rural location, etc.) are significantly related to test scores.
- Some of the strongest predictors of student performance are related to student engagement, including student absences, the number of repetition episodes and homework completion.
- Student test scores, especially in mathematics, are significantly higher in schools where teachers have higher levels of content knowledge.
- Student test scores are significantly higher in schools where students reported more frequent use of emergency teaching/reinforcement and technology-based remote learning activities during the Covid-19 pandemic school closure period.
- Specific remote learning activities that appear to have been most effective include teachers checking in with students to verify completion of assignments and teachers posting schoolwork on social media. However, these kinds of activities were more frequently employed in urban (versus rural) and private (versus public) schools, and among higher SES children.

There are two sets of analyses that incorporate the multivariate modeling that was introduced in the methods discussion in Section 2.3. The first includes a comprehensive set of student, family, teacher and school characteristics as predictors of student achievement in Khmer and Maths. This kind of "factors associated" work is fairly standard in national (and international) assessment reporting, and the purpose is to provide policymakers and stakeholders with information about the kinds of factors that are most significantly associated with student achievement. These statistical models also include some aggregated measures of remote learning strategies used by schools to get a sense of how student achievement was impacted by the school's (and family's) response to the pandemic-related school closures.

The second part of the statistical modeling analysis then dives deeper into the remote learning experience to identify specific strategies that are associated with higher test scores; put differently, these are strategies that reduced (or mitigated) learning loss during the closure period.

There are two challenges for both sections of the statistical analysis. **First, there are many variables in the EQAD dataset and it is not possible to analyze everything at once.** For the factors associated modeling the variables have been selected to cover the main aspects of the educational experience, including student and family background characteristics, student engagement, teacher background and capacity, and school features. And as noted above this also includes some overall measures of remote learning activities.

For the more detailed remote learning analysis the student and teacher responses cover more than 50 specific activities. The statistical modeling analysis in this section builds on the factors associated modeling by adding in the individual remote learning indicators one by one, and comparing the statistical significance and impact (or coefficient) of the various activities. The goal of this section is to identify individual remote learning strategies that appear to have been especially effective.

The second challenge affects all cross-sectional data analyses of this type: the inability to establish direct causation between specific features of schools and student learning outcomes. More specifically, a problem that is often referred to as omitted variable bias can produce an observed association (i.e. correlation) between two variables that may not be a result of a direct relationship between those two variables, but may instead be caused by a correlation between both variables and some other, unmeasured variable. So, for example, in the case of remote learning it may be observed that student test scores are higher in schools where students report more engagement with teachers during the school closure period. But that does not automatically mean that the increased engagement itself is responsible for higher scores, even when controlling for other variables in the model (including student engagement indicators). It may instead simply reflect that the kinds of schools that are more engaged with students during lockdowns also do other things better, and as a result their students perform better.

The results that are presented in this section cannot be treated as strictly causal findings, they are instead statistical associations. This is useful evidence for government counterparts and other stakeholders, but it should be emphasized that these kinds of statistical results are simply one input into a larger policy discussion about effectiveness, and other sources of information should be consulted as well.

5.1 Statistical analysis: Factors associated with Khmer and Maths test scores

Table 5.1 summarizes the results from the multivariate statistical analysis for the Khmer student achievement outcome; Table B3 in the Data Annex provides the counterpart results for Maths. The dependent variable is the Khmer scale score obtained from the IRT analysis of the test score data. The independent variables are grouped into a series of main categories. The first column provides the overall sample average for each independent variable (standard deviation in parentheses). The statistical analysis results are based on two models. Model 1 only includes the student and family background measures, the student engagement measures, and the main school category controls, but does not include the teacher and classroom indicators. Model 2 is the "full" model that includes all of the variables.

The use of models 1 and 2 make it possible to assess coefficient stability across different specifications; for example the changes in the private school coefficient between models 1 and 2 give some insight into the factors that explain higher test scores in private schools. But the model 1-2 demarcation is also useful in the next section when testing for remote education features that are significantly associated with student achievement.

A summary of the main findings in Tables 5.1 and B3 includes the following:

- **Consistent with research in other countries (and previous analyses in Cambodia), the student and family background characteristics are significantly associated with test scores.** Girls score much higher than boys in Khmer, but there is no significant difference in Maths. Older children and children with more siblings have lower scores, while children from higher SES households have higher scores.
- **Children from households that have internet connection (home wi-fi) score significantly higher, even when controlling household SES and parental education, etc.** This is a potentially important mechanism during the pandemic period given the importance of connectivity for remote learning.
- **Children who reported working in economic and agricultural activities during the school closure period have much lower levels of achievement.** For example, children who reported working "some days" in these activities (which does not include work around the household) scored about 0.20 standard deviations (SD) lower than children who reported they did not do any work of this kind. And students who reported working every day scored nearly 0.40 SD lower (in Khmer). These are very large effects.
- **As expected, the student engagement indicators are strong predictors of student test scores.** Students who are more frequently absent (according to the teacher marking guide) during the regular school period (e.g. face-to-face instruction) have significantly lower scores. Students who report they never complete homework have much lower scores.
- The results for remedial and extra classes ("private tutoring") are mixed. **Table B3 shows that students who are spending more on extra Maths classes have significantly higher Maths scores.** But in a separate summary there is actually a negative association between extra class participation and Khmer achievement, and a positive one for Mathematics (see Table B7 in Annex B). Higher SES children are more likely to report participating in extra classes, which is not surprising since they are fee-based. But the evidence suggests that in Khmer language the students that join these classes are engaged in remediation (i.e. they are somewhat behind), while in mathematics the results are consistent with "enrichment" where more engaged students are getting farther ahead (see Marshall and Fukao 2019 for more general discussion on this topic in Cambodia).
- **The teacher characteristics are less significant predictors of student achievement in comparison with student background and engagement.** This is not an unusual finding in statistical analysis of this type, and reflects in part the difficulty of capturing features of effective teaching in quantitative research. Student scores are marginally higher in schools with teachers with higher levels of education, but they are actually significantly lower (in Khmer) in schools with more experienced (older) teachers.
- **Students have significantly higher mathematics scores in schools where teachers scored higher on the mathematics test.** The effect size is modest but still important: a standard deviation increase in teacher maths score is associated with 0.11 standard deviation higher student score (Table B3). In Khmer the association is positive but not statistically significant.

- **The overall averages for the frequency of emergency teaching/reinforcement and technology-based remote learning activities are positive and significant predictors of Khmer and Maths test scores.** Of the two general constructs the technology based average is a stronger predictor of student achievement, but when included in the full model (Model 2) it is only significant in the Khmer language estimation (Table 5.1, estimation 5). The frequency that students report receiving support in the home is actually negatively associated with test scores, which suggests that higher scoring students are somewhat independent.
- **Private and urban schools have significantly higher scores than their public and rural counterparts, but these advantages are reduced when controlling teacher characteristics and remote learning activities.** For example, in the basic Model 1 estimation the residual advantage for private school students is 0.37 standard deviations above their public school counterparts in Khmer (estimation 1). But when controlling for technology-based remote learning this advantage is reduced to 0.22 SD (estimation 3). And when controlling for teacher characteristics the private school advantage is no longer significant (estimation 5).

The multivariate analyses that are summarized in Table 5.1 were also implemented in a sample that was restricted to public school students. These results (summarized in Table B5 in Annex B) are nearly identical to the results presented in Figure 5.1, although only the Model 2 estimations are presented (by subject) with separate results for each of the overall remote learning averages.

Table 5.1 Predictors of grade six overall Khmer student achievement IRT score, whole sample 2021 NLA

Independent variable:	Sample mean (SD)	Model 1 (1)	(2)	(3)	(4)	Model 2 (5)
Student-family characteristics:						
Child if female	49.7	0.31**	0.31**	0.31**	0.31**	0.31**
		(13.36)	(13.39)	(13.41)	(13.39)	(13.39)
Child age	12.4	-0.08**	-0.08**	-0.08**	-0.07**	-0.08**
	(1.05)	(-5.32)	(-5.32)	(-5.32)	(-5.25)	(-5.43)
Number of siblings	2.7	-0.06**	-0.06**	-0.06**	-0.06**	0.06**
	(1.9)	(-5.16)	(-5.16)	(-5.10)	(-5.09)	(-5.01)
Mother ed: University[a]	2.6	0.08	0.07	0.07	0.08	0.07
		(1.11)	(1.10)	(1.08)	(1.20)	(1.12)
Family SES factor	-0.37	0.04*	0.04*	0.03*	0.04*	0.03*
	(1.9)	(2.07)	(2.06)	(1.97)	(2.31)	(1.97)
Family has internet at home	28.7	0.07*	0.07*	0.07*	0.07*	0.07*
		(2.25)	(2.24)	(2.21)	(2.42)	(2.19)
Child is hungry (scale)	1.24	-0.09**	-0.09**	-0.09**	-0.09**	-0.09**
	(0.52)	(-3.78)	(-3.76)	(-3.79)	(-3.90)	(-3.86)
Learning materials index	90.3	0.01	0.01	0.01	0.01	0.01
	(18.1)	(0.70)	(0.69)	(0.73)	(0.93)	(0.75)
Child work during school closure period (reference=no work):						
Worked some days in economic/agriculture work	39.9	-0.22*	-0.21*	-0.21*	-0.21*	-0.21**
		(-7.05)	(-7.04)	(-7.01)	(-6.89)	(-7.02)
Worked every day in economic/agriculture work	13.9	-0.39**	-0.39**	-0.39**	-0.36**	-0.39**
		(-9.62)	(-9.66)	(-9.67)	(-8.89)	(-9.66)
Student engagement:						
Child has never repeated a grade	75.1	0.09**	0.09**	0.09**	0.09**	0.09**
		(3.46)	(3.45)	(3.49)	(3.58)	(3.52)
Private tutor spending (Khmer)	685	-0.006	-0.006	-0.006	-0.005	-0.006
	(3,531)	(-0.76)	(-0.75)	(-0.76)	(-0.61)	(-0.76)
Student absences (total)	3.5	-0.20**	-0.20**	-0.20**	-0.20**	-0.20**
	(5.1)	(-8.59)	(-8.59)	(-8.68)	(-8.52)	(-8.86)
Student homework completion (reference =very often):						
Never	4.2	-0.28**	-0.27**	-0.27**	-0.29**	-0.27**
		(-4.34)	(-4.31)	(-4.29)	(-4.66)	(-4.31)
Sometimes	32.4	-0.10**	-0.10**	-0.09**	-0.11**	-0.10**
		(-4.05)	(-3.93)	(-3.91)	(-4.41)	(-3.95)
Teacher and classroom characteristics:[b]						
Teacher is female	34.6	----	----	----	----	-0.05
	(40.9)					(-1.41)
Teacher experience in years	14.7	----	----	----	----	-0.11*
	(8.9)					(-2.30)
Teacher certification (ref.: primary teacher):						
Lower secondary teacher	11.0	----	----	----	----	0.06
	(27.1)					(1.38)
Upper sec./higher teacher	1.5	----	----	----	----	0.03**
	(9.3)					(2.86)

Teacher test score (Khmer)	684.1	----	----	----	----	0.03
	(47.3)					(0.72)
Number of students in class	37.9	----	----	----	----	-0.02
	(19.5)					(-0.70)
Teaching materials index	43.7	----	----	----	----	0.02
	(35.0)					(0.57)
Teacher-reported climate	2.5	----	----	----	----	0.01
index	(0.35)					(0.27)
Student-reported climate	-0.03	----	----	----	----	-0.05
factor (class average)	(0.36)					(-0.97)
Student-reported class	2.60	----	----	----	----	0.12**
participation (class avg.)	(0.27)					(2.88)
School characteristics:						
School enrolment	518.1	0.13+	0.13*	0.06	0.14*	0.06
	(555.3)	(1.92)	(1.98)	(0.96)	(2.02)	(0.99)
Rural location	77.5	-0.20**	-0.11	-0.08	-0.22**	-0.22+
		(-2.73)	(-1.17)	(-0.90)	(-3.00)	(-1.75)
Private school	5.4	0.37**	0.41**	0.22*	0.37**	0.03
		(3.96)	(3.80)	(2.00)	(3.92)	(0.19)
Remote learning indicators:						
Average emergency teaching/	2.17	----	0.09**	----	----	----
reinforcement	(0.28)		(2.46)			
Average technology-based	1.80	----	----	0.19**	----	0.14**
	(0.41)			(3.33)		(2.58)
Home support average	1.82	----	----	----	-0.05**	----
	(0.40)				(-3.73)	
Sample size	5,437	5,437	5,437	5,437	5,437	5,437

Data source: EQAD 2021 Grade 6 NLA

Notes: All dependent and continuous independent variables are standardized (e.g. presented in standard deviations). Estimations include a random effect at the school level ("mixed" model/HLM), with robust standard errors adjusted for clustering to calculate t-statistics (in parentheses). Sampling weights are included at the student and school levels. Additional controls (in Models 1 and 2) are included for geographic zone (not presented). [a]Mother's education reference category is 4-6 years, other controls are included in estimations (not presented). [b]Teacher variables are matched with students in single grade 6 class schools only, in remaining schools teacher data refer to school averages.

**Parameter is significant at the p<0.01 level

*Parameter is significant at the p<0.05 level

+Parameter is significant at the p<0.10 level

Based on the initial set of multivariate statistical analysis results in Tables 5.1 and B3 there are three main findings that stand out. **First there is the strong association between student and family background and student achievement.** This is especially true for the student engagement factors related to homework completion and attendance. These findings simply reinforce the message that home resources matter, and students who are less engaged in school are going to perform poorly on standardized tests.

Second, student achievement levels are not solely determined by their household and their level of engagement: school and teacher features are also important. Standing out are things like teacher content knowledge which can be impacted through better training.

And finally, there is some evidence in this section that some schools were more successful in mitigating learning less during the pandemic period through their remote teaching regime. These initial results focus on overall averages for emergency teaching/reinforcement and technology-based remote teaching, and a more detailed review of individual practices is the focus of the next section. Nevertheless, it is encouraging to note that test scores are higher in schools where the students reported (on average) more engagement in remote learning.

5.2 Statistical analysis: Remote teaching features and student achievement

The statistical methodology for analyzing the extensive set of remote learning indicators has already been introduced: incorporate the same models from the factors associated analysis and add individual remote learning measures to these multivariate analyses to identify significant remote education features. This generates a very large amount of output because there are actually three sets of remote education measures: the individual measures as reported by students, the school average for the student-reported measures, and the teacher-reported measures. Furthermore, all of these different indicators are analyzed based on Models 1 (see estimation 1 in Table 5.1) and 2 (estimation 5 in Table 5.1) separately for Khmer and Maths. In total this produces over 200 individual sets of regression results.

This very large amount of output is summarized in different ways, beginning with Figures B12, B13 and B14 in Annex B that provide the coefficients for various remote teaching measures based on their addition to Models 1 and 2. An additional summary was prepared for all of the remote learning indicators that included model 1 and 2 coefficients from Figures B12-B14 with additional coefficients for the individual student-reported measure (e.g. not school average) and the teacher-reported measure (when available). This very detailed summary made it possible to "triangulate" the main findings across multiple measures to identify individual remote teaching features that consistently stand out as significant predictors of student achievement.

From this background analysis eight remote teaching strategies stand out as being potentially effective. These are divided into the emergency teaching/reinforcement and technology-based categories used in previous sections.

Emergency teaching/reinforcement effective strategies:

- Teacher sent assignments home
- Teacher checked in to ensure completion
- Teacher asked student to submit assignments
- Students used texts, workbooks and worksheets

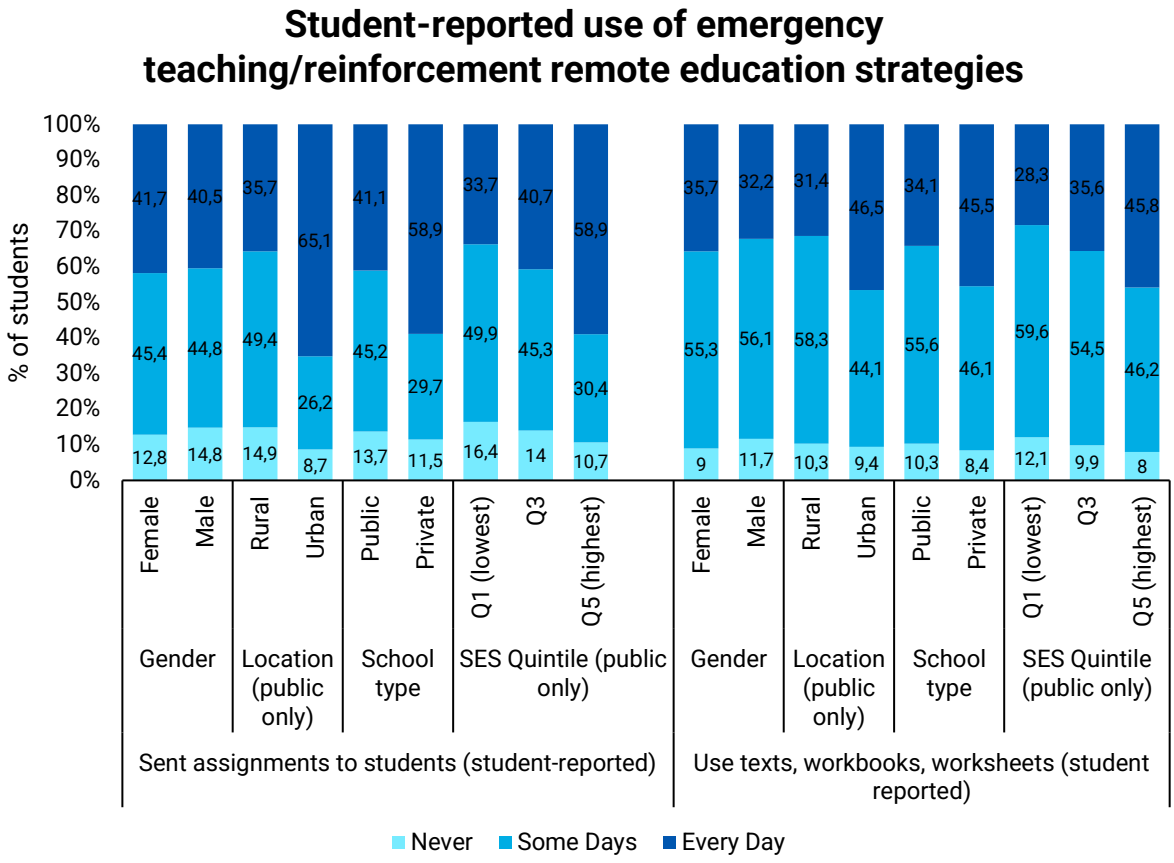
Technology-based strategies:

- Teacher provided live virtual classes
- Teacher posted material social media
- Teacher provided real-time lessons
- Student accessed MoEYS YouTube page

The more detailed analysis of this sub-set of remote teaching features is provided in Tables B5 (Khmer) and B6 (Maths) in Annex B. For each indicator the coefficient is presented for models 1 and 2 based on student-reported school averages. **The findings show that this subset of distance education strategies are consistently associated with better student scores, although this is more true for Khmer than Maths.** The effect sizes generally measure 0.10-0.15 standard deviations, which is moderate but still notable given the large number of variables that are being controlled (especially in Model 2).

Now that a group of eight remote teaching practices have been identified as potentially effective, the key question is what kinds of student have the most access to these features? Figures 5.1 and 5.2 address this question with detailed comparisons across the main strata for remote teaching access two of the emergency teaching/reinforcement activities (Figure 5.1) and two technology-related activities (Figure 5.2). **The main takeaway from both figures is that students report very different levels of usage of these activities between rural and urban schools, public and private schools, and by SES background. In other words, not all students were equally exposed to these potentially effective remote education strategies.**

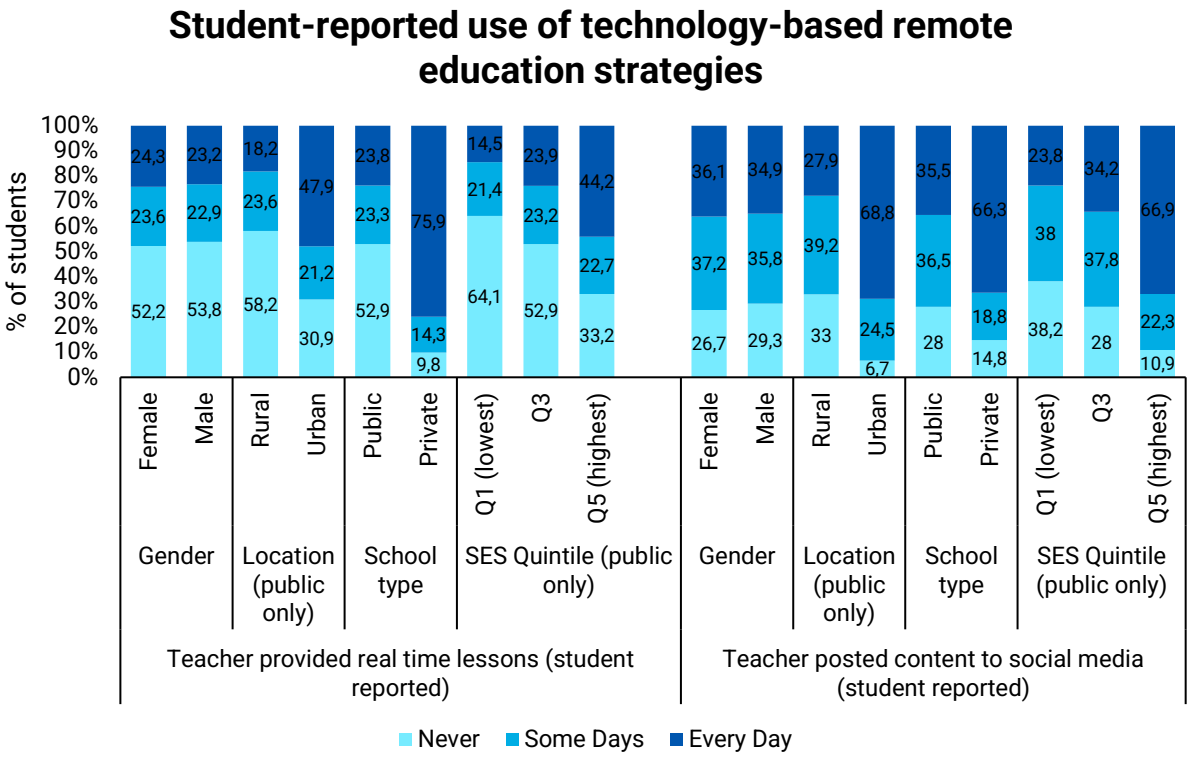
Figure 5.1 Student-reported use of emergency teaching/reinforcement remote education strategies by main strata, 2021 Grade 6 NLA



Data source: EQAD 2021 Grade 6 NLA

For example, 58.9 percent of SES quintile 5 students (from public schools) reported that their teacher sent them assignments every day, compared with just 33.7 percent of quintile 1 students (Figure 5.1, left hand side). 46.5 percent of urban students reported using textbooks, workbooks and worksheets every day, compared with 31.4 percent of rural students (Figure 5.1, right hand side).

Figure 5.2 Student-reported use of technology-based remote education strategies by main strata, 2021 Grade 6 NLA



Data source: EQAD 2021 Grade 6 NLA

The reported access gaps are even larger in the technology-based remote education indicators. 76 percent of private school students reported that their teacher provided real-time lessons every day, compared with just 24 percent of public school students (Figure 5.2, left hand side). 68.8 percent of urban school students reported that their teacher posted activities on social media, compared with only 28 percent of rural students. These are very large gaps in access to what appear to be relatively effective remote teaching strategies, which in turn helps explain the student achievement gaps based on the 2021 national learning assessment.

6 Main findings and policy recommendations

This report summarizes the results from a comprehensive analysis of the 2021 grade six national learning assessment (NLA) in Cambodia, with a focus on estimating learning loss during the Covid-19 pandemic period based on comparisons with the 2016 grade six NLA that used the exact same test questions. Primary school students in Cambodia were subjected to a two-stage pandemic shock that began with the irregular school calendar and school closure of the 2019-20 school year and was followed by an extended school closure period in the 2020-21 school year. **The 2021 student achievement levels are substantially lower than the 2016 reference point averages in both Khmer and Maths.** The estimated learning loss—meaning the difference between the 2021 averages and what would be expected based on the 2016 NLA results—is between 0.30-0.45 standard deviations (SD) in Khmer, and 0.50-0.80 SD in Maths (estimates vary by choice of test score measure).
The estimates for learning loss using overall scores translate into very large declines in student proficiency levels. **For example, in grade six mathematics the percentage of children classified in the lowest proficiency level ("Below Basic") increased from roughly 50 percent in 2016 to nearly 75 percent in 2021.** Conversely, the percentage of students in the highest proficiency level ("Advanced") declined in Maths from over 20 percent in 2016 to just six percent in 2021.

In Khmer language the learning loss is concentrated in the writing activities, especially in dictation where students performed nearly 0.60 standard deviations lower in 2021 (compared with just over 0.10 SD in the Khmer reading content). In mathematics the learning loss is more general and is apparent in each of the main content areas (e.g. numbers, geometry, etc.), albeit with some individual strands of content where the student averages are similar to those from 2016.

The learning loss estimates are generally larger in the higher performing categories of schools. Urban student test scores declined more than rural student scores, private school student averages declined by more than public school student averages, and higher SES children experienced marginally more learning loss than their lower SES counterparts. The exception is for gender, where the gap between boys and girls increased in both subjects in 2021 compared with 2016. These equity dynamics do vary somewhat by choice of test score measure, but the main message is clear: **learning gaps did not increase in grade six during the pandemic period due to the substantial learning loss among the middle and higher scoring students combined with the large number of students who were already in the lowest performance levels in the pre-pandemic period.** In other words, concerns that the pandemic would increase learning inequality are not borne out, but this nominal equalization trend is misleading and is simply a feature of a larger learning crisis that predates the pandemic.

Consistent with previous research in Cambodia and beyond, there are a number of school and teacher factors that are associated with higher scores in the 2021 sample. **Standing out is the significant association between teacher content knowledge and student performance on the grade six tests, especially in mathematics.** Additional teaching and learning process indicators were also significant, including classroom inclusiveness and the use of homework.

A comprehensive review of remote learning process variables during the school shutdown period highlights three core findings. **First, relatively few of the student and teacher reported activities are significantly associated with student learning outcomes.** This is especially true for mathematics student achievement, and also when controlling student and family background and school-teacher characteristics in the statistical modeling. This result may be indicative of the challenges of measuring remote teaching practices, but it may also reflect implementation deficiencies in these activities.

The statistical analysis did identify a group of remote learning activities that are consistently associated with better student achievement. These activities are divided into "emergency teaching"-reinforcement and technology-based categories. Examples of possibly effective strategies include checking on students to ensure they have completed assignments and using social media to post assignments and provide feedback.
However student access to this core group of significant remote teaching strategies is very unequal: rural students, public schools and lower SES students report significantly lower rates of use of these tools. This is especially true for the technology-based activities, which in turn highlights the underlying challenges of reaching all students via these platforms.

If students in private schools and urban locations had more access to these critical remote learning activities than their public school and rural counterparts, then why did learning gaps apparently decrease between these groups during the pandemic period? The answer reflects in part the peculiar features of learning loss dynamics in learning crisis countries where large numbers of students are in the lowest performance categories. Low performing students almost certainly did not fare well during the pandemic, but their scores were already quite low. By contrast, more engaged students with more resources were better able to access activities that helped mitigate learning loss, but these activities were not effective (or frequent) enough to overcome what was a major shock to their normal learning routines. These results clearly raise concerns about the overall effectiveness and limitations of the education system's remote teaching response. While growing numbers of materials, channels and activities were introduced to support remote learning during school closure in the 2019-20 and 2020-21 school years, their use varied from student to student and in general they spent much less time in learning at home compared to when schools were open.

A key feature of remote education is support. For students the evidence is not encouraging: **not only do students generally report receiving limited help at home from caregivers, but very few student-reported support activities in the home are associated with higher levels of learning.** Overall, the data actually suggest that the highest scoring students are very independent and did not often receive help in the home. For teachers the support system questions are focused on the pandemic response, and the results are more mixed. More than half report being adequately supported, but a substantial number of teachers did not feel they were prepared to effectively deliver remote teaching content. Teachers communicated this on the basis of self-assessment of their preparation, but following from above the substantial decline in student test scores likely reflects limitations with implementation and support as well.

There are two main areas for policy recommendations. **First, how will the system address learning loss which is likely to be present in all grades at the primary level, and probably at**

higher levels as well? The direct takeaway from the grade 6 NLA is that students are significantly behind the expected learning level, which in turn has implications for teaching processes in all grades. For example, an extended remedial learning phase may be required at the beginning of each grade, combined with adjustments to curricula to facilitate the transitions that students are making with each successive grade.

The challenge with implementing remediation and curriculum adjustments is that there was already a need for this type of support given the very low overall levels of student achievement in the pre-pandemic period. In other words, the pandemic impact on student learning cannot be treated as an exogenous shock that can be addressed with some amount of extra resources in order to get students "back on track." Most students were already substantially behind the expected learning level for their grade, and the various human and other resources in place to address the pandemic-induced learning loss are the same resources that were available before the shock. Key policy recommendations include:

- **Expansion of the early grade learning programmes:** Learning is a cumulative process and students cannot gain access to new and more complex curriculum without foundational knowledge and skills such as literacy and numeracy. Ensuring early graders acquire fundamental literacy and numeracy skills is the necessary and most efficient strategy to improve overall learning outcomes in the long run.
- **Systematic learning assessments for all grades:** Understanding the current level of student learning is the first step to identify suitable and effective strategies to tackle the problem of learning loss. Formative assessments focused on core foundational skills need to be conducted at the classroom level in the early part of the first semester and on an ongoing basis.
- **Continuing and strengthening remedial teaching and learning:** In conjunction with the beginning of the 2021-22 school year when all schools reopened in January 2022, MoEYS instructed all schools to focus on remedial teaching learning at least for the first two months of the new semester. Considering the magnitude of learning loss, remedial learning will be required for much longer periods. Remedial programmes should continue not only to respond to learning loss but also to regularly provide individualized, differentiated support based on the specific needs of each student.
- **Further strengthening school-based management:** Student engagement (e.g. regular attendance and homework completion) is key for learning success. Strict, systematic monitoring and follow-up of student school attendance and learning behavior is critical in each school through effective school-based management.
- **Continued teacher development**: Teacher quality affects student learning performance. Upgrading teacher qualifications and competencies through continuous professional development of teachers is one of the policy priorities of MoEYS's Education Strategic Plan (ESP) 2019-2023. Both pre-service and in-service teacher training should expand its focus beyond content knowledge and basic pedagogies to respond to emerging needs such as effective distance education, digital education, early grade learning and remedial learning.

Concerns about how a system that was already struggling to produce student achievement can now pivot to address a major shock to student learning provide a good segue into the second

main question going forward: **what kinds of remote education processes merit attention for systemic integration (i.e. mainstreaming into regular education as part of a "build back better" process)?**

For the emergency teaching-basic reinforcement type strategies the results simply highlight the importance of teacher engagement with student learners. Things like regular assignments (homework), checking in with students and reviewing student work are basic features of engaged teaching, and it is not surprising that student scores are higher when they report that their teachers more frequently employed these strategies. **The goal therefore is to strengthen this form of interaction during "regular" schooling through effective school-based management.**

For technology-based processes the results are a little different, and point to potentially specific strategies and measures that may be worth pursuing. Once again the causal limitations of the statistical analysis need to be recognized, as we simply cannot conclusively state that these measures are directly related to student achievement. With this caveat it is still possible to think about mainstreaming, which means supporting teachers and students to make use of things like social media for additional teaching engagement, using the MoEYS e-learning portal for extra instruction and practice, and even using synchronous learning activities like online classes.

The underlying challenge with this set of ideas is twofold. **First there are the needs of upgrading teacher skills, which is already a priority along multiple dimensions (including content knowledge). And second there is the access issue.** The goal of expanding technology-based remote teaching and learning activities is not to just improve the overall levels of student achievement (on average), but to reach the students who are most vulnerable and farthest behind. Improving accessibility and affordability of digital learning particularly among the most marginalized areas and populations will require significant effort and investment beyond the education sector. Additional policy recommendations in this area include:

- **Strengthening teacher skills**: In order for teachers to conduct effective distance learning including regular assignments and monitoring of student progress, they need to be equipped with relevant skills including digital skills. As recommended above, continuous, systematic development of teacher skills will be critical.
- **Expanding and enhancing digital learning platforms and content:** Over the past two years, a growing number of digital learning platforms and content have become available in Cambodia to respond to the needs of distance education during school closure. The MoEYS e-learning platform has been significantly enhanced now with a rich set of free multimedia materials available for students, teachers and parents. These materials are useful not only for distance learning but also for remedial learning as well as regular learning. Continued upgrading and expansion of digital learning platforms and content is expected including the availability of options that do not require internet access in rural, remote schools.
- **Enhancing education system and schools' preparedness for future emergencies:** Based on the lessons learned from the school closure and distance education caused by the Covid-19 pandemic, a general standard operating procedure (SOP) should be developed which provides practical guidance on how to pivot to remote learning in times

of pandemics, natural disasters and any other emergencies that require schools to close for extended periods. Based on this SOP, each school is expected to develop an emergency preparedness plan so that swift actions will be taken in case of emergencies to avoid unnecessary learning loss.

7 References

ADB, UNICEF and WFP (2021). COVID-19 Socio-economic Impact Assessment in Cambodia – Round 7. Phnom Penh: Asian Development Bank (ADB), United Nations Children's Fund (UNICEF) & World Food Programme (WFP).

Azevedo, J.P., A. Hasan, D. Goldemberg, Diana; S.A. Iqbal and K. Geven (2020). Simulating the Potential Impacts of COVID-19 School Closures on Schooling and Learning Outcomes: A Set of Global Estimates (English). Policy Research working paper; no. WPS 9284; COVID-19 (Coronavirus). Washington, DC: World Bank Group. http://hdl.handle. net/10986/33945

Education Quality Assurance Department (EQAD) (2017). 2016 Grade 6 National Learning Assessment Summary. Phnom Penh: MoEYS.

Education Quality Assurance Department (EQAD) (2022). 2021 Grade 6 National Learning Assessment Summary. Phnom Penh: MoEYS.

Marshall, J.H. and T. Fukao (2019). Shadow education and inequality in lower secondary schooling in Cambodia: Understanding the dynamics of private tutoring participation and provision. *Comparative Education Review,* 63(1), 98-120.

MoEYS (2020a). No.23. Directive on Distance Learning and E-learning Programme for Students from Pre-Primary, Primary and Secondary Education. Phnom Penh: MoEYS.

MoEYS (2020b). No. 29. Operational Guideline for Distance Learning Implementation. Phnom Penh: MoEYS.

MoEYS, Save the Children and UNICEF (2020). Cambodia COVID-19: Joint Education Needs Assessment. Phnom Penh: MoEYS.

OECD and MoEYS (2018). Education in Cambodia: Findings from Cambodia's experience in PISA for Development (PISA-D). Phnom Penh: MoEYS.

Save the Children (2016). Education Disrupted: Disaster Impacts on Education in the Asia Pacific Region in 2015. Singapore: Save the Children.

UNICEF and SEAMEO (2020). SEA-PLM 2019 Main Regional Report, Children's learning in 6 Southeast Asian countries. Bangkok, Thailand: United Nations Children's Fund (UNICEF) & Southeast Asian Ministers of Education Organization (SEAMEO).

World Bank, UNESCO and UNICEF (2021). The State of the Global Education Crisis: A Path to Recovery. Washington D.C., Paris, New York: World Bank, UNESCO, and UNICEF.

Annex A: EMIS data estimations of student dropout in the Covid-19 pandemic period

The learning loss estimations that are central to the analysis in this report are based on several assumptions, including the expectation that the grade six samples in 2016 and 2021 effectively capture the overall populations of students. As noted in the main text, the use of large samples (200+ schools) drawn through random selection with probability proportional to size (PPS) methods likely ensures adequate representation of the defined grade six populations in each survey year. But there is still the concern that the Covid-19 pandemic period has led to alterations in the makeup of the sample. More specifically, there are two general scenarios that are potentially problematic for the grade 6 learning loss estimations.

1. The Covid-19 pandemic has led to an increase in dropout among more vulnerable students, which would result in a 2020-21 grade six sample that is skewed towards less vulnerable students. In this scenario the learning loss estimations would *under*-estimate the amount of learning loss.
2. More engaged parents and households hold their children back from school participation during the face-to-face instruction period at the end of the 2020-21 school year (when the grade 6 NLA was conducted) due to Covid-19 concerns, and choose instead to focus on at home learning. If these are relatively high performing students, then the learning loss estimations in 2021 will likely *over*-estimate the amount of learning loss.

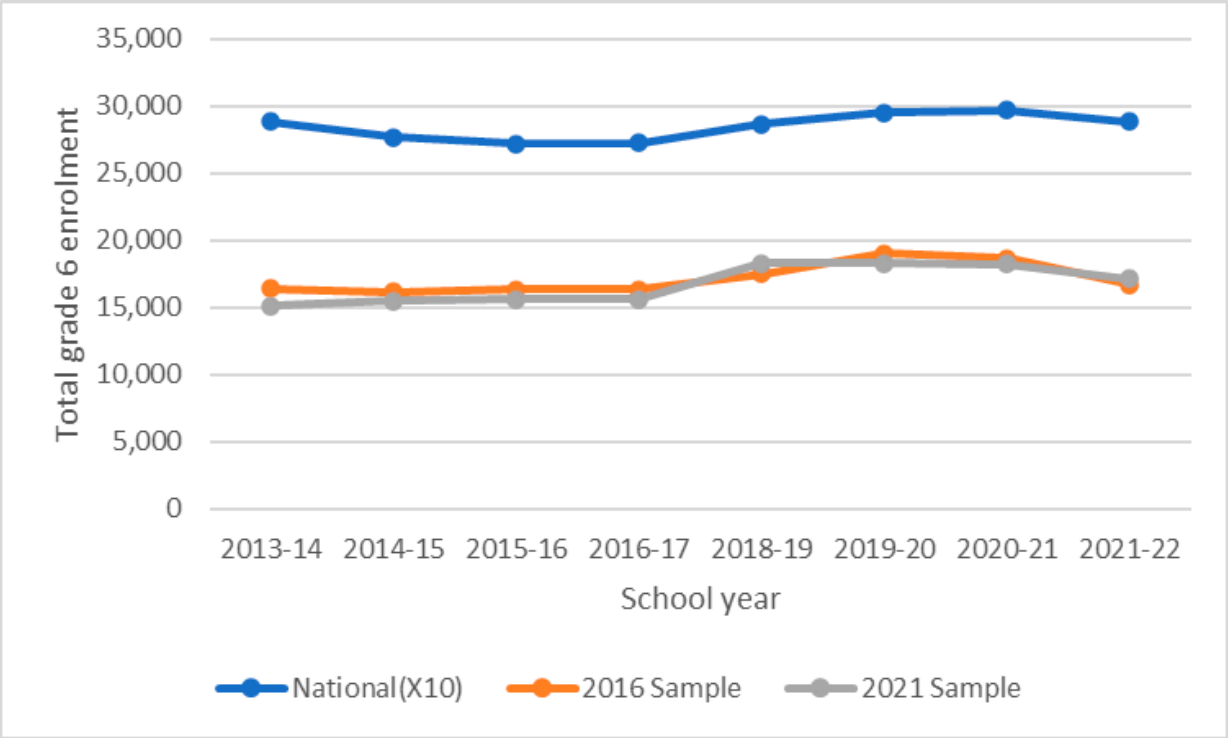
In both scenarios the problem is not an inaccurate sample because the samples are correctly drawing students from the grade 6 population that is attending school at the time of the grade assessment in 2021 (using the same sampling approach as in 2016). The problem instead is that the population itself has been altered due to the pandemic in such a way that complicates comparisons with earlier grade six study populations (e.g. 2016 and before). This issue of sample comparability is not specific to the Covid-19 pandemic shock, as there are already changes that are likely taking place between 2016 and 2021, such as families having fewer children. This is one of the inherent complications in comparing results across samples: there are no two populations that are identical, especially across a four year period.

Nevertheless, there is still the possibility that the Covid-19 pandemic has led to a large amount of attrition that is not random, and that as a result the 2021 sample is missing a component of the grade 6 population that was not missing in 2016. With EMIS data it is possible to examine trends across the 2016 and 2021 study periods to get a sense of the comparability between the samples and, if there is variation, take stock of how differences in the populations may impact the learning loss estimations. This is only possible for public schools because private schools in Cambodia do not report the same EMIS indicators.

Figure A1 begins with a summary of the grade 6 student population nationally and within the 2016 and 2021 grade six NLA samples. It should be noted that the 2016 and 2021 sampled schools do not all have data across this entire nine year period, but most of the 200+ schools are included in the sub-samples. The result that stands out is the noticeable decline in grade enrolment at the beginning of the 2021-22 school year, which is the year following the 2020-21

school year when the 2021 NLA was conducted. Furthermore, a more detailed analysis of the 2020-21 to 2021-22 grade 6 population decline finds that the grade 6 population for girls declined by about 4 percent between these years, compared with 1.5 percent for boys.

Figure A1. Grade 6 population 2013-2022 nationally and by grade 6 NLA sample

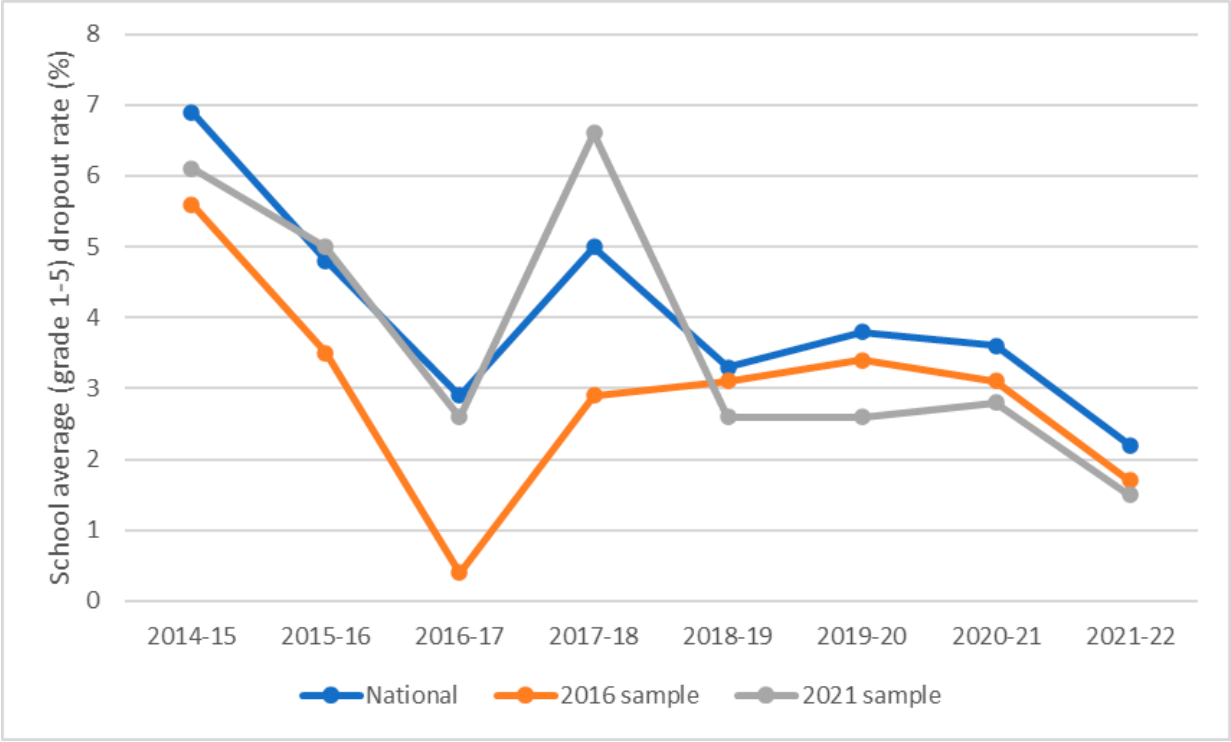


Data source: EMIS, various years
Notes: The national population totals should be multiplied by 10, the scaled total is presented in order to facilitate comparisons with sub-samples of schools.

Figure A2 summarizes the trends in average grade 1-5 dropout rates for the national population of schools as well as by the 2016 and 2021 samples of NLA schools. This is calculated using a cohort reconstruction method with EMIS data that looks at the number of students who are still enrolled in year t+1 (as repeaters and new entrants into the following grade) in comparison with the total for the grade in year t. The overall dropout rate measure moves around a bit, but there is no clear evidence that dropout increased in the pandemic period, and it actually declined based on data from the beginning of the 2021-22 school year.

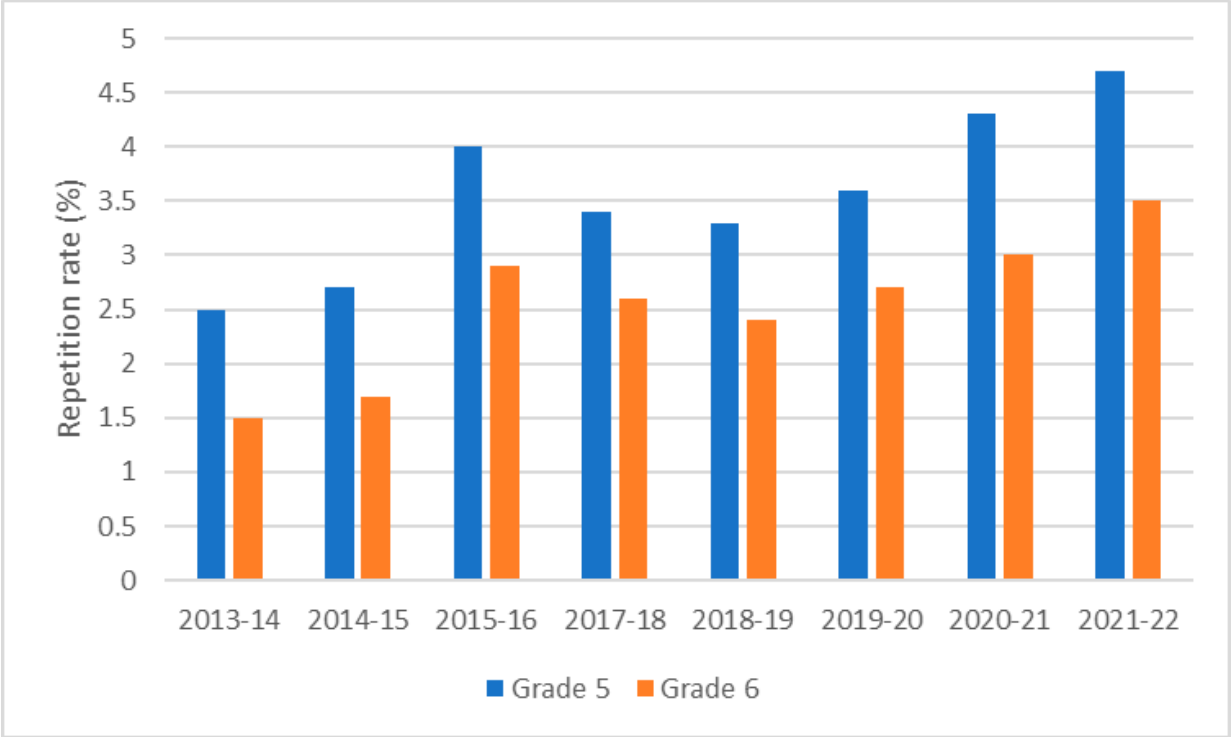
One trend that is apparent is that grade repetition rates in grades 5 and 6 have increased marginally during the pandemic period (Figure A3 below). This is true for the national population of schools as well as the grade 6 NLA sample schools from 2016 and 2021. But the repetition rates at the time of the 2020-21 NLA are very similar to those at the time of the 2015-16 NLA.

Figure A2. School average year-on-year dropout rate by school year



Data source: EMIS, various years

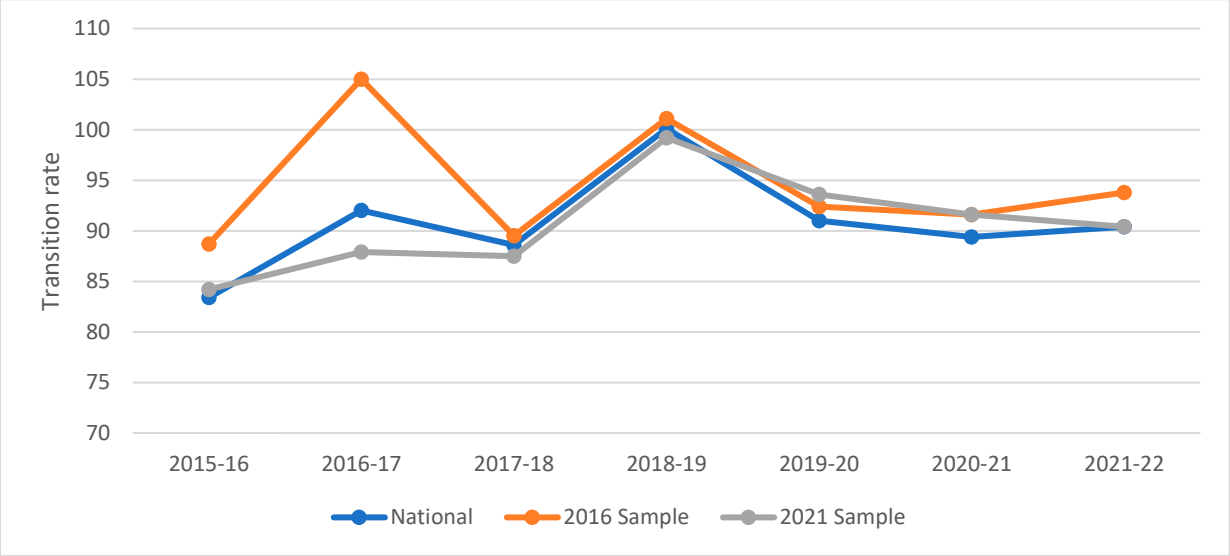
Figure A3. Grade repetition rates in grades 5 and 6 by school year (national averages)



Data source: EMIS, various years

Figure A4 concludes the EMIS analysis with a comparison of transition rates between grade 4 and 6, which are estimated by taking the number of new entrants into grade 6 in year t+2 and dividing this by the total number of students in grade 4 in year t. This is a derived transition rate and is not as accurate as actually following cohorts of students over time. The results again show a high degree of agreement between the overall national trend and the grade 6 NLA sample schools. The transition rates again move around some, but there is no clear evidence that the grade 6 populations in the Covid-19 pandemic period were much notably smaller (relative to the grade 4 total from two years earlier) than in the 2015-16 data collection period (in fact transition rates have increased on this measure).

Figure A4. Derived grade 4-6 transition rates by school year



Data source: EMIS, various years

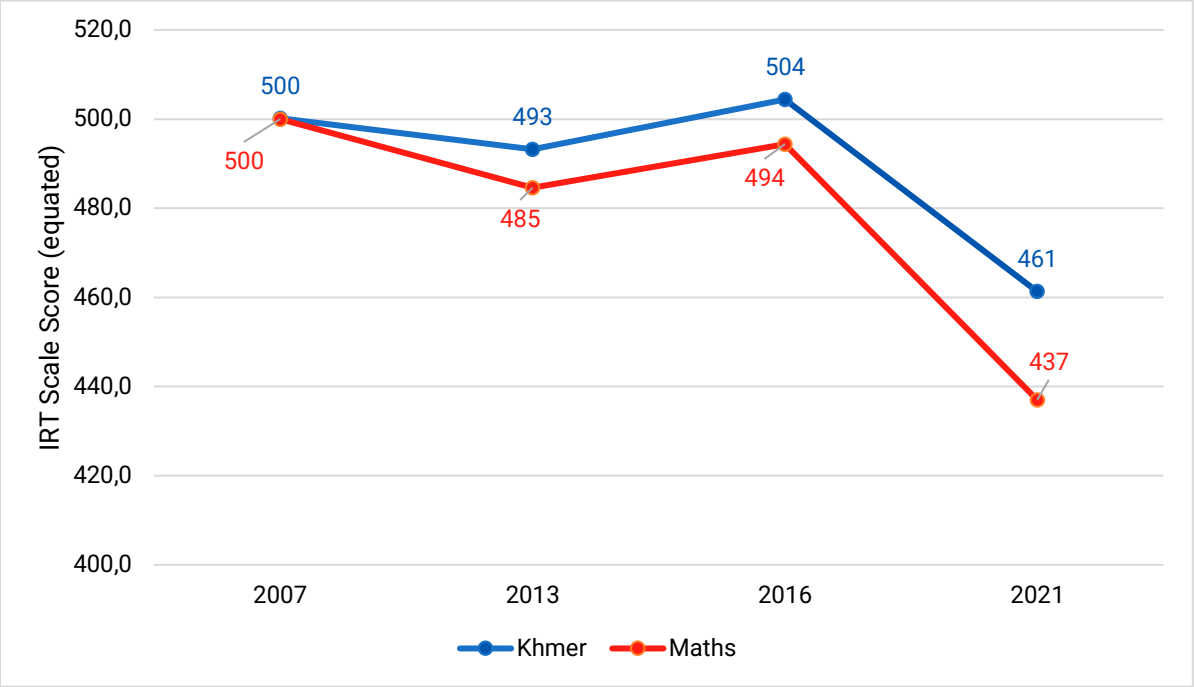
The results from Figures A1-A4 are not conclusive, and the underlying question of sample comparability across survey years is inherently complicated and dynamic. Nevertheless, there is no evidence of major changes in the grade 6 enrolled population at the time of the 2021 grade six national learning assessment (using 2016 as a reference point). Furthermore, as noted in the main text, the 2020-21 and 2021-22 school years were in effect continuous since the 2020-21 school year ended in December 2021 and the 2021-22 school year began in January 2022. So if children were being held out of school (after enrolling in 2020-21) during the face-to-face teaching period from October-December 2021 it does not seem likely that they would have gone to school to enroll at the beginning of the 2021-22 school year. In other words, the 2021-22 school year enrolments may provide some additional clues about enrolment patterns at the end of the 2020-21 school year, and again there is no evidence of major changes.

Finally, different measures of dropout and transitions were included in the public-only statistical analyses of student achievement that are summarized below in Table B4. The results consistently show that schools with higher cohort transition rates, and lower rates of dropout, have marginally lower test scores in the multivariate modeling. This is mainly true for the test scores in Khmer language (maths parameters are not significant). Also, a similar pattern is found in the 2016 multivariate analyses (results not presented). What this suggests is that when controlling other

factors the schools that retain the most children have marginally lower achievement, which is another way of saying that the children that drop out of school appear to be lower scoring on average. The consistency of this pattern across 2016-2021, combined with the lack of evidence of major change in dropout rates (or students being held out), again suggests that the 2016 and 2021 NLA results can be used to estimate learning loss in the pandemic school closure period.

Annex B: Additional Results

Figure B1. Comparison of IRT equated test scores 2007-2021, 2007 mean=500



Data source: EQAD grade 6 NLA (2007-2021)

Figure B2. Histogram summaries of IRT equated grade 6 test scores 2016-2021 by subject and gender, public and private schools combined

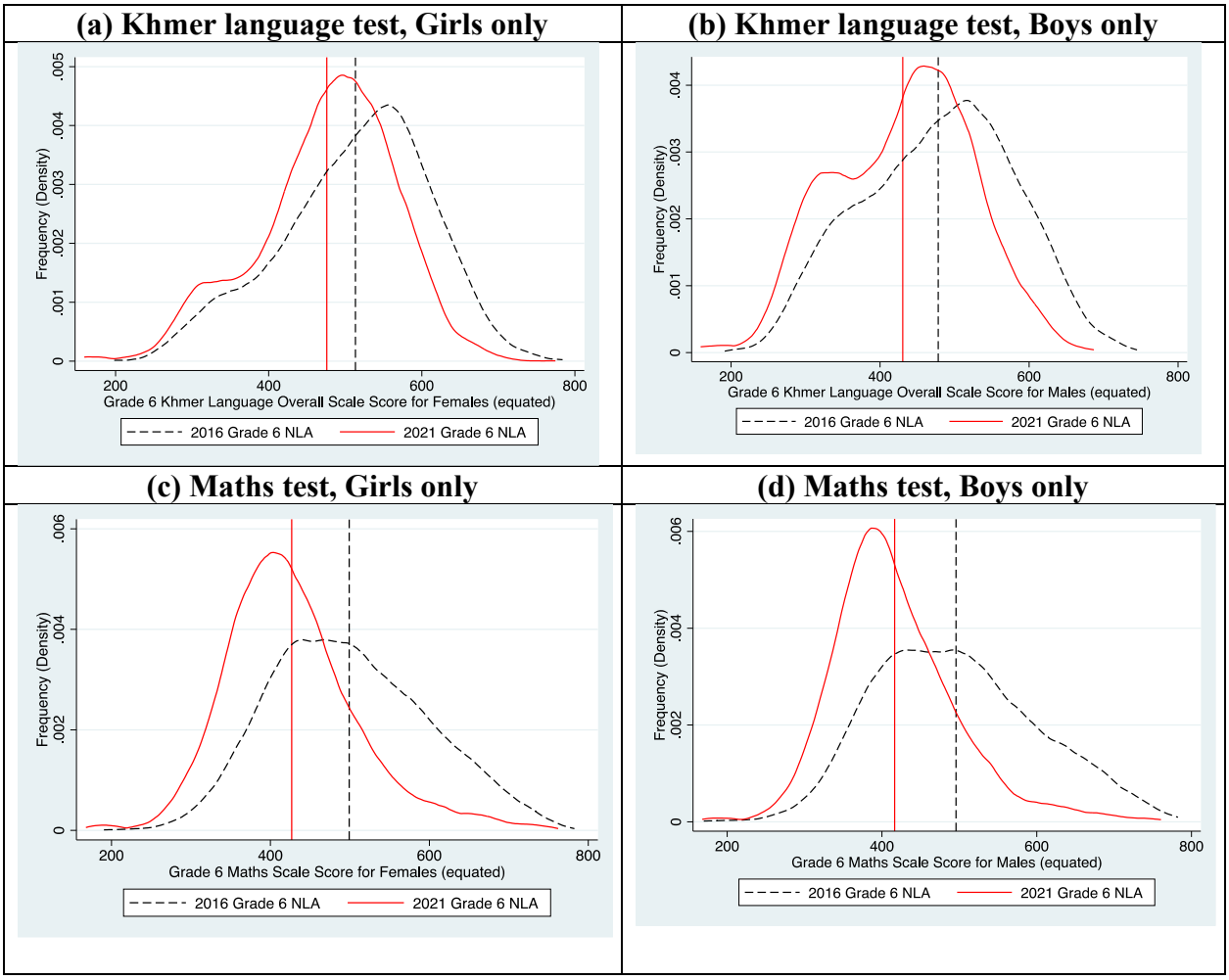


Figure B3. Histogram summaries of IRT equated test scores 2016-2021 by subject and school location, public schools only

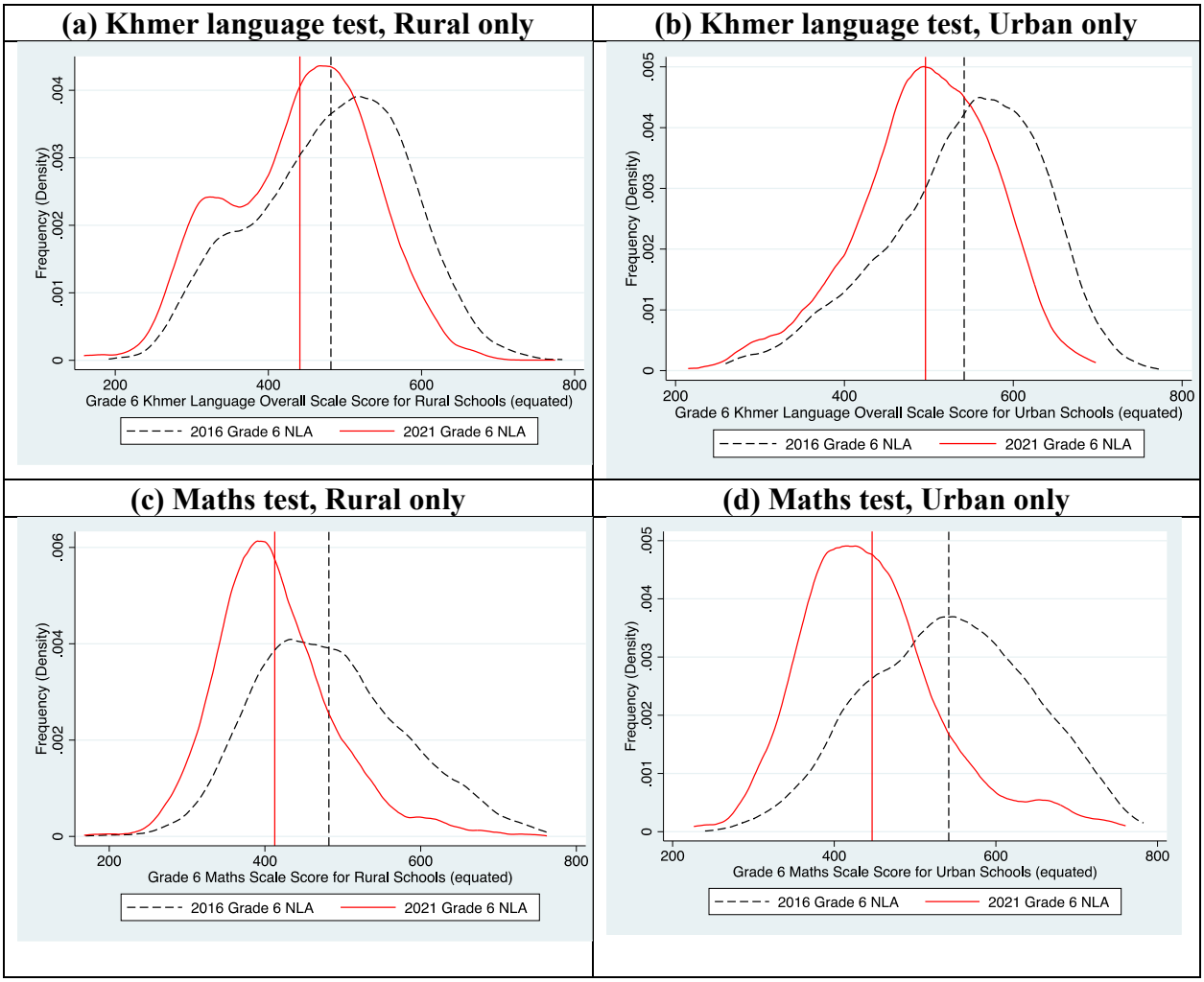


Figure B4. Histogram summaries of IRT equated grade 6 Khmer test scores 2016-2021 by subject for private schools

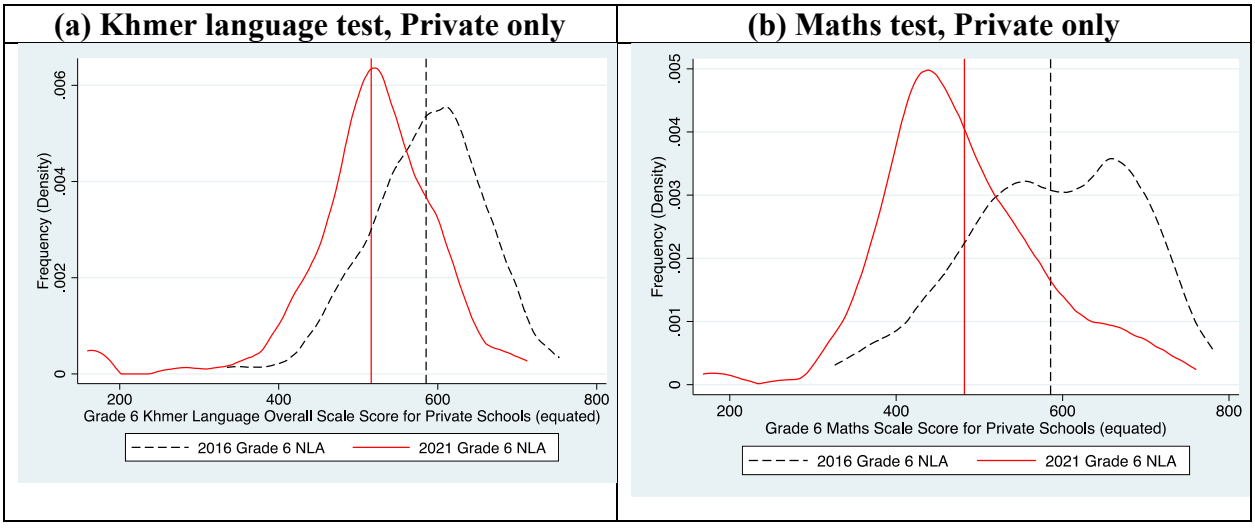


Table B1. Grade 6 Khmer content and sub-content averages in 2016 and 2021 by sample

Overall measure/Content area:	All schools:			Public only:		
	2016	2021	Sig.	2016	2021	Sig.
Overall percentage correct	57.7	52.1	**	56.8	51.2	**
Overall percentage (weighted)	52.7	46.5	**	51.9	45.7	**
Overall scale score	497.4	454.6	**	493.9	451.1	**
Reading overall (KA)	62.1	59.4	**	61.4	58.7	**
KA1: Note details (16)	65.7	62.6	**	65.1	62.0	**
KA2: Hynonym (2)	72.9	74.3		72.3	73.9	
KA3: Main idea (6)	69.7	66.2	**	69.0	65.5	**
KA6: Main actors (2)	55.9	55.6		55.3	54.9	
KA7: Rhymes (3)	57.5	53.0	**	56.5	52.0	*
KA8: Moral of story (3)	56.4	56.2		55.7	55.3	
KA9: Story topic (3)	52.9	48.3	**	52.0	47.3	**
KA10: Intero-pronounce (3)	63.9	56.8	**	63.0	55.7	**
KA11: Sequence of events (3)	61.5	58.9	+	60.7	58.0	+
KA12: Original word (3)	65.7	65.2		64.8	64.2	
KA13: Synonym (1)	24.9	23.7		23.7	22.6	
KA14: Important idea (4)	51.3	47.8	**	50.5	46.9	**
KA15: Adverb (1)	27.5	26.7		26.8	26.2	
KA17: Story setting (3)	83.9	83.4		83.5	82.9	
KA18: Example content (4)	64.6	60.4	**	63.8	59.6	**
KA20: Punctuation (6)	71.0	70.8		70.2	70.0	
KA23: Aim of text (2)	47.2	47.8		46.8	47.1	
KA24: Reader type (5)	49.9	49.7		49.0	48.7	
KA25: Character feeling (2)	70.7	69.0		70.3	68.9	
Writing overall pct. (KB)	54.2	46.9	**	53.3	45.9	**
Writing overall pct. (weighted)	46.2	37.6	**	45.3	36.6	**
Writing: Dictation (20)	38.9	24.0	**	38.0	23.2	**
Writing: Writing activities						
KB1: Describe person	78.6	78.7		77.9	78.0	
KB2: Apology letter	21.5	17.8	**	21.1	17.2	**
KB4: Absent letter						
KB7: Story writing	62.7	55.5	**	61.5	54.3	**
KB8: Persuading text	68.7	56.2	**	67.9	55.1	**
KB9: Diary	62.4	60.2		61.2	58.9	
Sample size (n)	6,380	6,013		5,939	5,238	

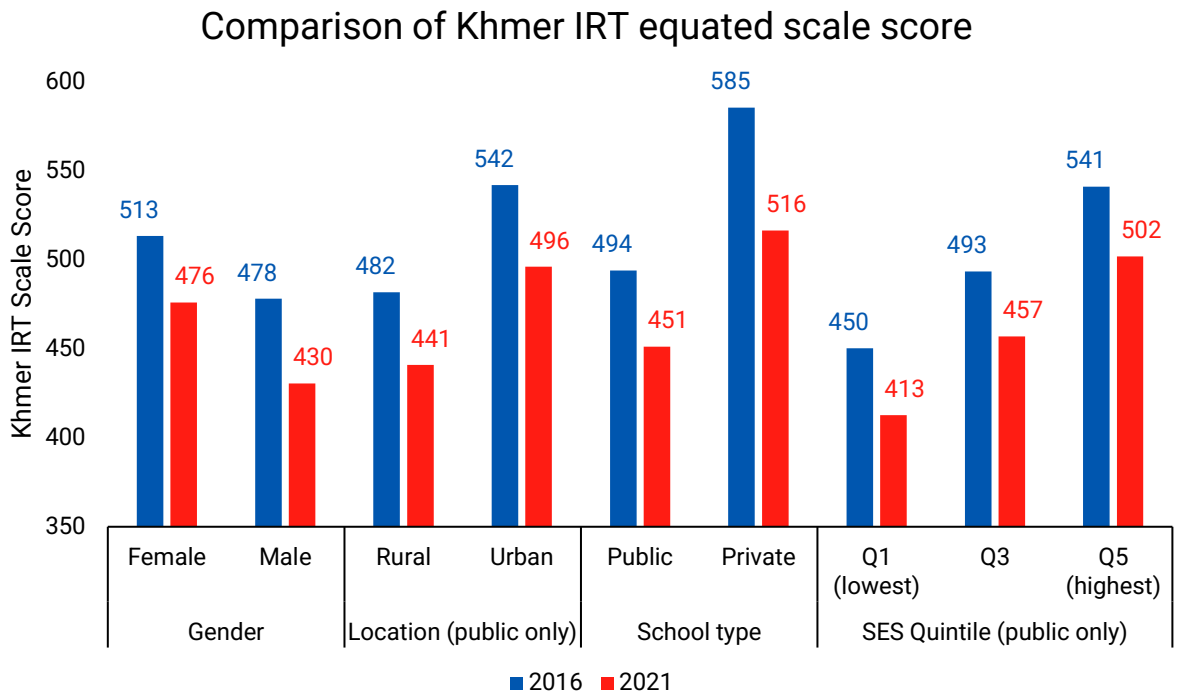
Data source: EQAD grade 6 NLA (2016, 2021)
**Difference between 2016 and 2021 average is significant at p<=0.01 level
*Difference between 2016 and 2021 average is significant at p<=0.05 level
+Difference between 2016 and 2021 average is significant at p<=0.10 level

Table B2. Grade 6 Maths content and sub-content averages in 2016 and 2021 by sample

Overall measure/Content area:	All schools:			Public only:		
	2016	2021	Sig.	2016	2021	Sig.
Overall percentage correct	49.5	38.7	**	48.7	38.0	**
Overall percentage (weighted)	49.4	38.3	**	48.6	37.6	**
Overall scale score			**			**
Numbers overall percent	48.6	37.4	**	47.9	36.7	**
Order whole numbers	44.8	40.3	**	43.9	39.5	**
Converge improper fractions	49.4	32.1	**	48.5	31.3	**
Multiply decimal numbers	59.1	46.0	**	58.5	45.4	**
Find common factor	41.3	35.9	**	40.3	35.1	**
Operations with fractions	44.1	31.9	**	43.6	31.6	**
Use letters simple numbers	54.0	46.6	**	53.1	45.6	**
Write whole numbers	47.6	49.3		46.7	48.2	
Compare fractions	15.8	14.4		14.8	14.0	
Add-subtract decimals	60.9	57.1	**	60.4	56.7	**
Multiply-divide whole nums.	53.1	42.4	**	52.3	41.6	**
Write proper fractions	43.9	26.6	**	43.0	25.9	**
Calculate simple ratios	23.1	19.2	**	22.7	18.7	**
Measurement overall percent	47.9	41.2	**	47.1	40.6	**
Express quantity percentage	57.4	54.5	+	56.6	53.8	+
Calculate monthly interest	52.9	37.1	**	52.5	36.3	**
Operations with time	46.3	45.5		45.6	45.6	
Formula to calculate distance	37.0	31.8	**	36.1	31.5	**
Use standard measurements	70.8	66.2	**	69.9	65.1	**
Read and express time	46.3	42.8	**	45.7	41.9	**
Interpret scale map	52.0	51.2		51.2	50.5	
Calculate average travel	30.2	21.2	**	29.7	20.7	**
Geometry overall percent	47.3	34.9	**	46.6	34.0	**
Find length perimeter	9.0	6.6	*	8.3	6.1	+
Express angle types	55.4	35.9	**	54.7	35.0	**
Use other objects to draw	38.0	23.8	**	36.9	22.7	**
Make model 3D shape	44.1	28.8	**	43.6	27.7	**
Measuring perimeter	34.3	32.7		33.4	31.8	
Statistics overall percent	61.1	46.6	**	60.3	45.4	**
Determine bar graph	77.1	71.5	**	76.8	71.4	**
Algebra overall percent	60.3	52.7	**	59.5	51.8	**
Sample size (n)	6,380	6,013		5,939	5,238	

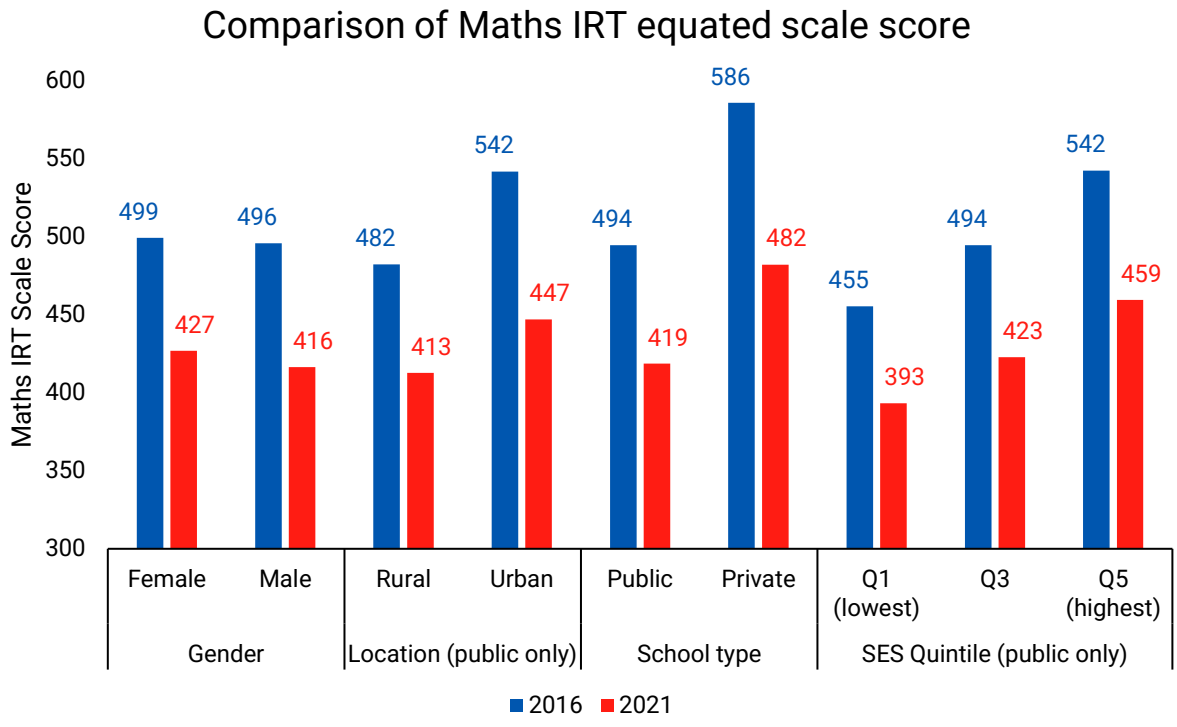
Data source: EQAD grade 6 NLA (2016, 2021)
**Difference between 2016 and 2021 average is significant at p<=0.01 level
*Difference between 2016 and 2021 average is significant at p<=0.05 level
+Difference between 2016 and 2021 average is significant at p<=0.10 level

Figure B5. Comparison of Khmer IRT equated scale score by main strata 2016 and 2021 (2016=500)



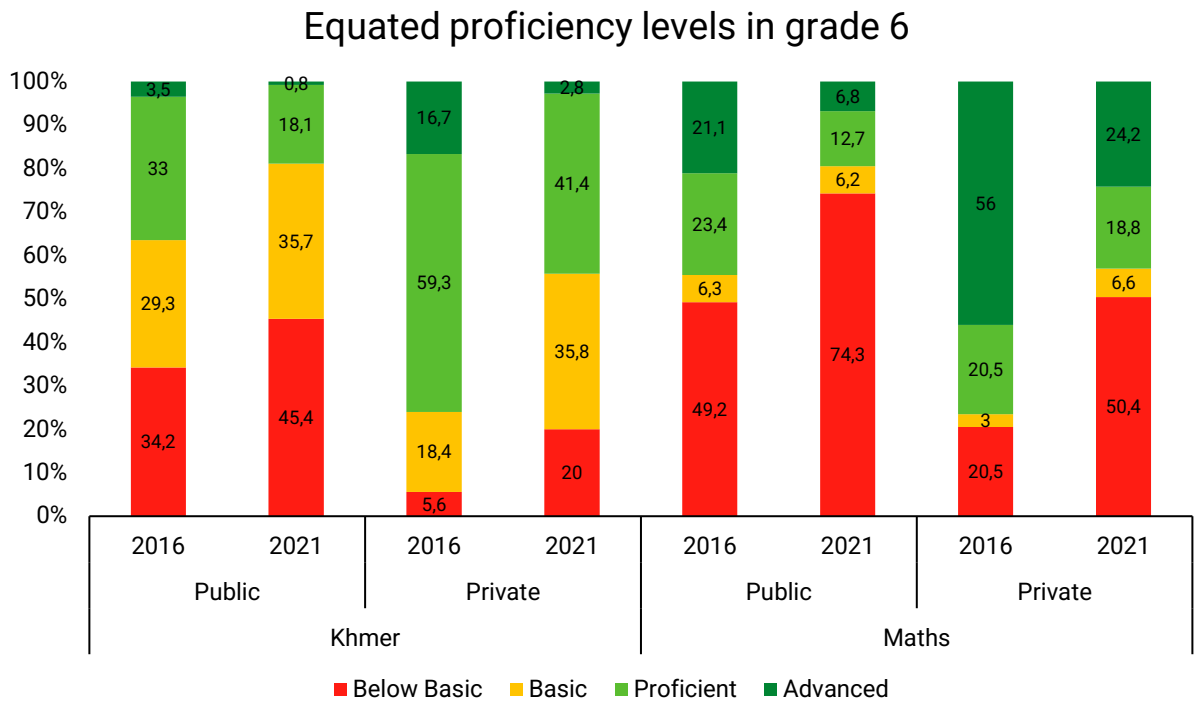
Data source: EQAD grade 6 NLA (2016, 2021)

Figure B6. Comparison of Maths IRT equated scale score by main strata 2016 and 2021 (2016=500)



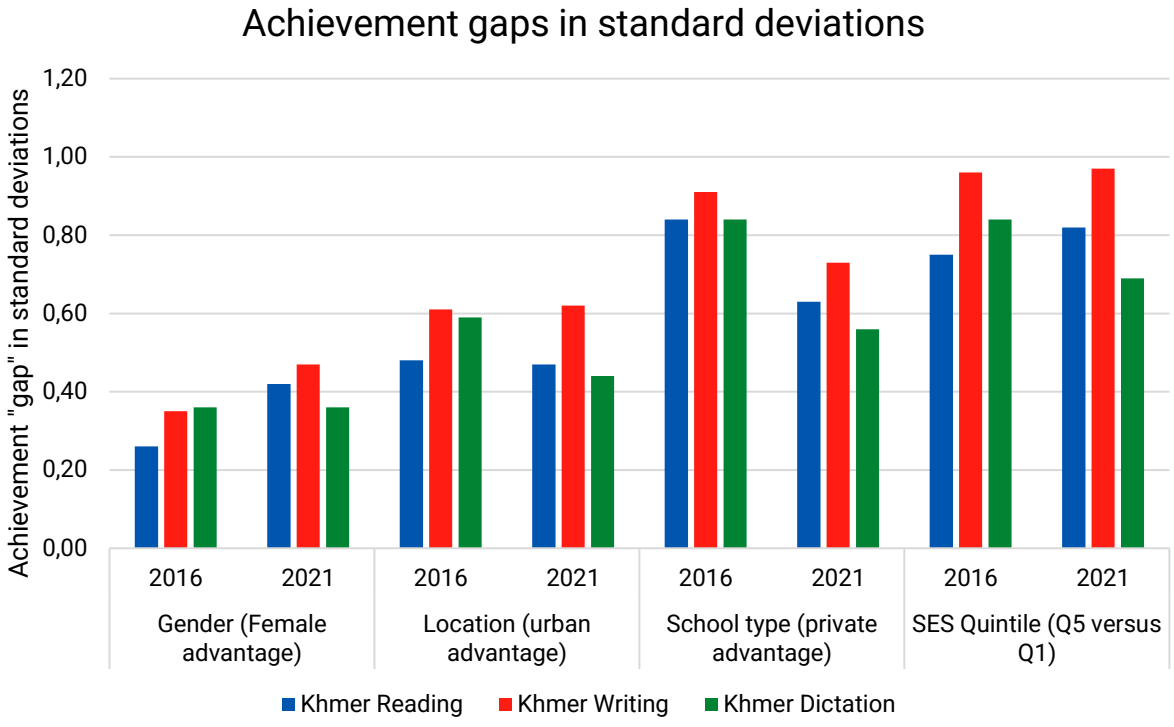
Data source: EQAD grade 6 NLA (2016, 2021)

Figure B7. Equated proficiency levels in grade 6 in 2016 and 2021 by test subject and school type



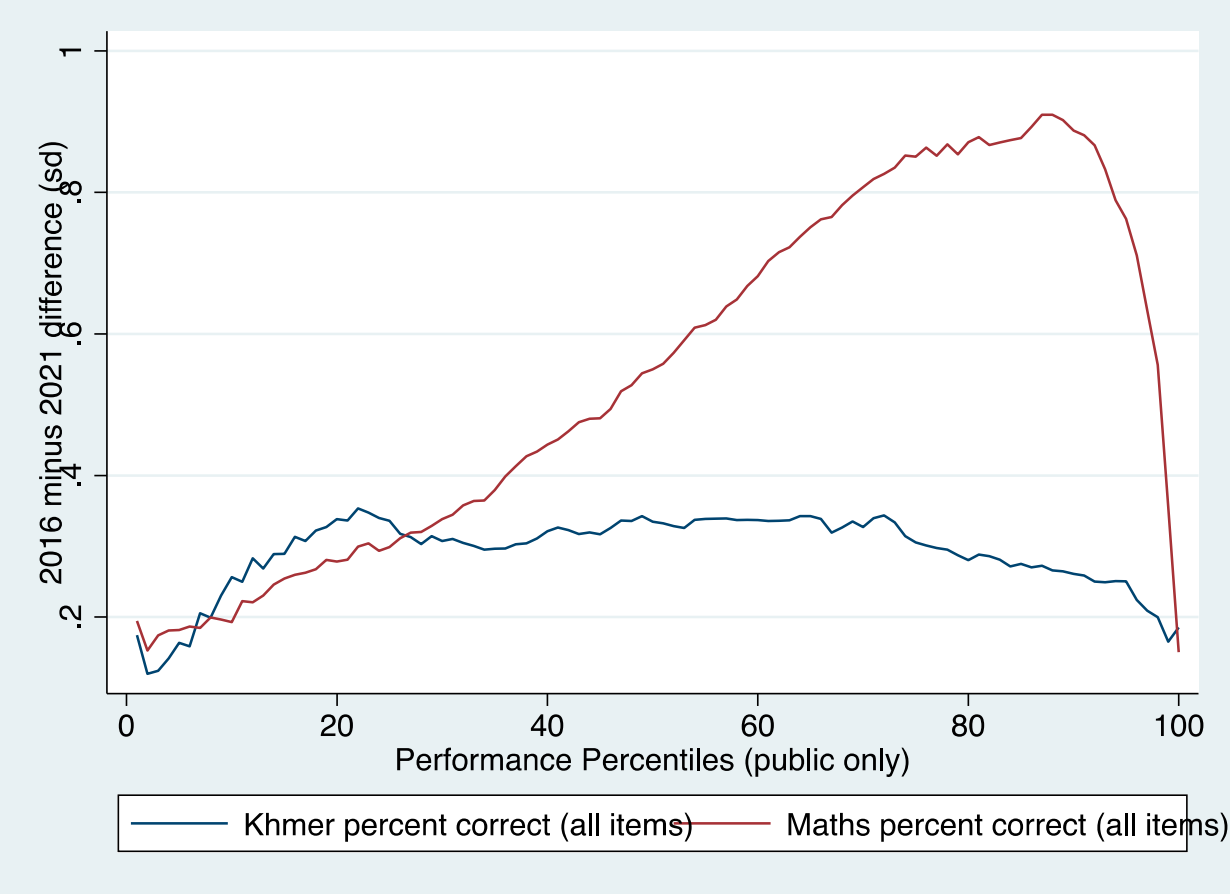
Data source: EQAD grade 6 NLA (2016, 2021)

Figure B8. Achievement gaps in standard deviations in 2016 and 2021 in Khmer content areas by main strata



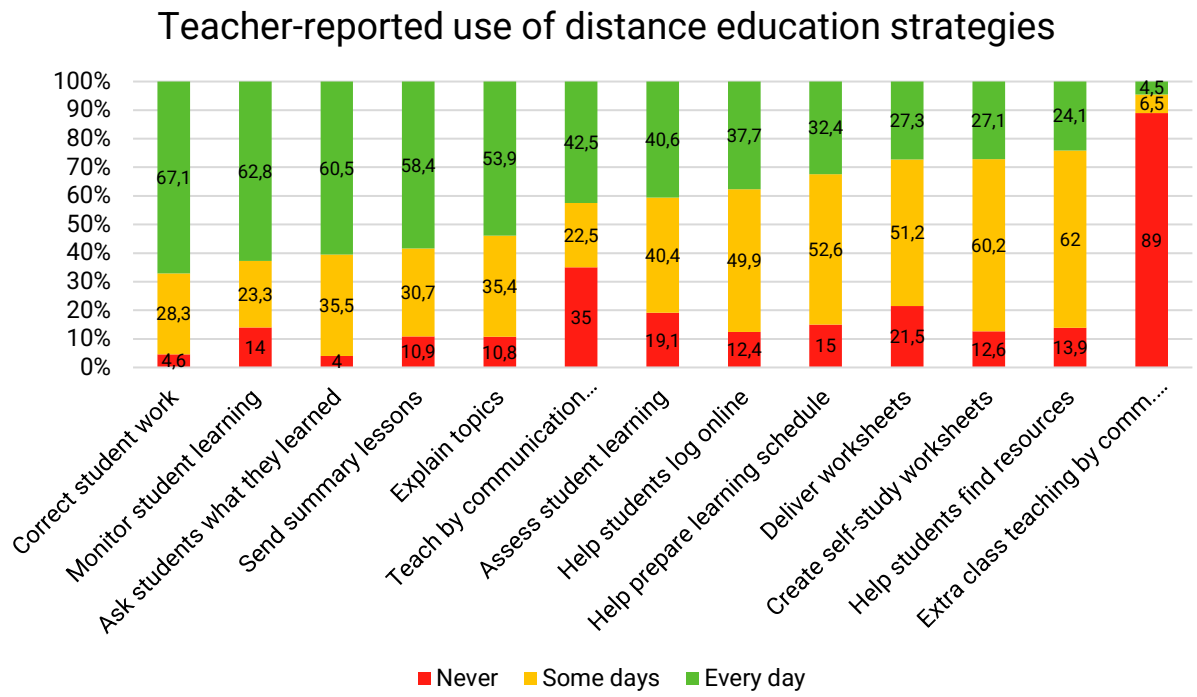
Data source: EQAD grade 6 NLA (2016, 2021)

Figure B9. Differences (in standard deviations) between 2016 and 2021 weighted percent correct scores by student percentile, public schools only



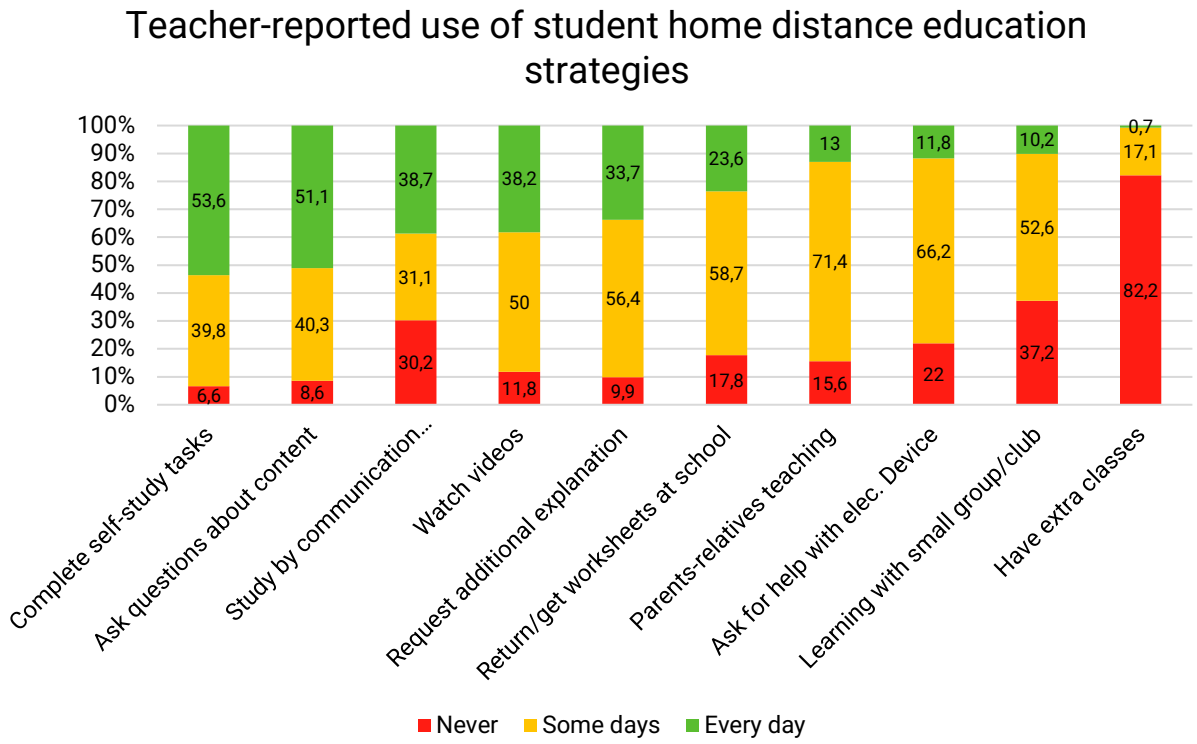
Data source: EQAD grade 6 NLA (2016, 2021)

Figure B10. Teacher-reported use of distance education strategies



Data source: 2021 EQAD grade 6 NLA

Figure B11. Teacher-reported use of student home distance education strategies



Data source: 2021 EQAD grade 6 NLA

Table B3. Predictors of grade six overall Maths student achievement IRT score, whole sample 2021 NLA

Independent variable:	Sample mean (SD)	Model 1 (1)	(2)	(3)	(4)	Model 2 (5)
Student-family characteristics:						
Child if female	49.7	0.007	0.007	0.007	0.007	0.006
		(0.31)	(0.32)	(0.32)	(0.33)	(0.24)
Child age	12.4	-0.04**	-0.04**	-0.04**	-0.04**	-0.04**
	(1.05)	(-3.29)	(-3.30)	(-3.30)	(-3.17)	(-3.40)
Number of siblings	2.7	-0.06**	-0.06**	-0.06**	-0.06**	-0.06**
	(1.9)	(-4.70)	(-4.70)	(-4.66)	(-4.56)	(-4.63)
Mother ed: University[a]	2.6	0.20*	0.20*	0.20*	0.21*	0.20*
		(2.35)	(2.34)	(2.34)	(2.41)	(2.37)
Family SES factor	-0.37	0.04*	0.04*	0.04*	0.04**	0.04**
	(1.9)	(2.15)	(2.14)	(2.09)	(2.45)	(2.08)
Family has internet at home	28.7	0.06+	0.06+	0.05+	0.06*	0.05+
		(1.78)	(1.77)	(1.76)	(2.03)	(1.70)
Child is hungry (scale)	1.24	-0.03	-0.03	-0.03	-0.03	-0.03
	(0.52)	(-1.20)	(-1.19)	(-1.20)	(-1.34)	(-1.27)
Learning materials index	90.3	0.01	0.01	0.01	0.01	0.01
	(18.1)	(0.84)	(0.84)	(0.87)	(1.16)	(0.88)
Child work during school closure period (reference=no work):						
Worked some days in economic/agriculture work	39.9	-0.15**	-0.15**	-0.15**	-0.14**	-0.15**
		(-5.24)	(-5.22)	(-5.20)	(-4.98)	(-5.19)
Worked every day in economic/agriculture work	13.9	-0.30**	-0.30**	-0.30**	-0.27**	-0.30**
		(-6.98)	(-7.01)	(-7.00)	(-6.14)	(-7.04)
Student engagement:						
Child has never repeated a grade	75.1	0.08**	0.08**	0.08**	0.08**	0.08**
		(3.39)	(3.38)	(3.41)	(3.55)	(3.42)
Private tutor spending (Maths)	854.2 (4,407)	0.03+	0.03+	0.03+	0.03*	0.03+
		(1.82)	(1.82)	(1.82)	(1.94)	(1.82)
Student absences (total)	3.5	-0.14**	-0.14**	-0.14**	-0.14**	-0.14**
	(5.1)	(-5.91)	(-5.92)	(-5.97)	(-5.89)	(-6.17)
Student homework completion (reference =very often):						
Never	4.2	-0.23**	-0.23**	-0.23**	-0.25**	-0.23**
		(-3.67)	(-3.61)	(-3.62)	(-3.91)	(-3.55)
Sometimes	32.4	-0.16**	-0.16**	-0.16**	-0.17**	-0.16**
		(-5.32)	(-5.24)	(-5.21)	(-5.56)	(-5.22)
Teacher and classroom characteristics:[b]						
Teacher is female	34.6	----	----	----	----	-0.07+
	(40.9)					(-1.67)
Teacher experience in years	14.7	----	----	----	----	-0.06
	(8.9)					(-1.19)
Teacher certification (ref.: primary teacher):						
Lower secondary teacher	11.0	----	----	----	----	-0.004
	(27.1)					(-0.09)
Upper sec./higher teacher	1.5	----	----	----	----	0.03*
	(9.3)					(2.23)

Teacher test score (Maths)		----	----	----	----	0.11*
						(2.31)
Number of students in class	37.9	----	----	----	----	0.01
	(19.5)					(0.36)
Teaching materials index	43.7	----	----	----	----	-0.04
	(35.0)					(-0.92)
Teacher-reported climate	2.5	----	----	----	----	-0.03
index	(0.35)					(-0.83)
Student-reported climate	-0.03	----	----	----	----	0.003
factor (class average)	(0.36)					(0.05)
Student-reported class	2.60	----	----	----	----	0.09*
participation (class avg.)	(0.27)					(2.13)
School characteristics:						
School enrolment	518.1	0.10	0.10	0.06	0.11	0.03
	(555.3)	(1.39)	(1.39)	(0.88)	(1.54)	(0.55)
Rural location	77.5	0.06	0.12	0.13	0.03	-0.09
		(0.47)	(0.91)	(1.01)	(0.28)	(-0.82)
Private school	5.4	0.46**	0.49**	0.38**	0.46**	0.17
		(3.11)	(3.02)	(2.48)	(3.13)	(1.14)
Remote learning indicators:						
Average emergency teaching/	2.17	----	0.07+	----	----	----
reinforcement	(0.28)		(1.64)			
Average technology-based	1.80	----	----	0.10*	----	0.06
	(0.41)			(2.01)		(1.07)
Home support average	1.82	----	----	----	-0.06**	----
	(0.40)				(-4.73)	
Sample size	5,423	5,423	5,423	5,423	5,423	5,423

Data source: EQAD 2021 Grade 6 NLA

Notes: All dependent and continuous independent variables are standardized (e.g. presented in standard deviations). Estimations include a random effect at the school level ("mixed" model/HLM), with robust standard errors adjusted for clustering to calculate t-statistics (in parentheses). Sampling weights are included at the student and school levels. Additional controls (in Models 1 and 2) are included for geographic zone (not presented). [a]Mother's education reference category is 4-6 years, other controls are included in estimations (not presented). [b]Teacher variables are matched with students in single grade 6 class schools only, in remaining schools teacher data refer to school averages.

**Parameter is significant at the p<0.01 level

*Parameter is significant at the p<0.05 level

+Parameter is significant at the p<0.10 level

Table B4. Predictors of grade six student achievement IRT scale scores by subject, public school sample 2021 NLA

	Khmer		Maths	
Independent variable:	**(1)**	**(2)**	**(3)**	**(4)**
Student-family characteristics:				
Child if female	0.31**	0.31**	0.01	0.01
	(12.76)	(12.79)	(0.40)	(0.41)
Child age	-0.08**	-0.08**	-0.04**	-0.04**
	(-5.14)	(-5.12)	(-3.26)	(-3.26)
Number of siblings	-0.06**	-0.06**	-0.06**	-0.06**
	(-4.85)	(-4.83)	(-4.58)	(-4.57)
Mother ed: University[a]	0.11	0.11	0.23*	0.23*
	(1.38)	(1.39)	(2.20)	(2.20)
Family SES factor	0.04+	0.04+	0.04*	0.04*
	(1.67)	(1.79)	(2.03)	(2.02)
Family has internet at home	0.08*	0.08*	0.06+	0.06+
	(2.40)	(2.40)	(1.76)	(1.76)
Child is hungry (scale)	-0.09**	-0.09**	-0.02	-0.02
	(-3.62)	(-3.63)	(-1.01)	(-1.01)
Learning materials index	0.01	0.01	0.01	0.01
	(0.72)	(0.74)	(0.85)	(0.85)
Child work during school closure period (reference=no work):				
Worked some days in economic/agriculture work	-0.22**	-0.22**	-0.15**	-0.15**
	(-6.92)	(-6.91)	(-4.91)	(-4.90)
Worked every day in economic/agriculture work	-0.39**	-0.39**	-0.30**	-0.30**
	(-9.45)	(-9.46)	(-6.93)	(-6.93)
Student engagement:				
Child has never repeated a grade	0.10**	0.10**	0.08**	0.08**
	(3.39)	(3.41)	(3.23)	(3.25)
Private tutor spending (by subject)	-0.003	-0.003	0.03+	0.03+
	(-0.44)	(-0.46)	(1.80)	(1.80)
Student absences (total)	-0.20**	-0.20**	-0.14**	-0.14**
	(-8.39)	(-8.36)	(-5.80)	(-5.79)
Student homework completion (reference =very often):				
Never	-0.27**	-0.27**	-0.23**	-0.23**
	(-4.17)	(-4.16)	(-3.49)	(-3.49)
Sometimes	-0.10**	-0.10**	-0.16**	-0.16**
	(-3.84)	(-3.84)	(-5.01)	(-5.00)
Teacher and classroom characteristics:[b]				
Teacher is female	-0.07	-0.07	-0.10*	-0.10*
	(-1.59)	(-1.58)	(-2.13)	(-2.12)
Teacher experience in years	-0.09	-0.09+	-0.05	-0.05
	(-1.59)	(-1.66)	(-0.84)	(-0.84)
Teacher certification (ref.: primary teacher):				
Lower secondary teacher	0.04	0.04	-0.01	-0.01
	(0.86)	(0.92)	(-0.21)	(-0.24)

Upper sec./higher teacher	0.02	0.03*	0.02	0.03*
	(1.36)	(2.23)	(1.43)	(1.97)
Teacher test score (by subject)	0.08+	0.06	0.11*	0.11*
	(1.72)	(1.17)	(2.31)	(2.27)
Number of students in class	-0.03	-0.02	0.04	0.04
	(-0.91)	(-0.63)	(1.10)	(1.14)
Teaching materials index	0.03	0.03	-0.02	-0.03
	(0.60)	(0.57)	(-0.50)	(-0.55)
Teacher-reported climate	0.01	0.01	-0.04	-0.04
index	(0.29)	(0.28)	(-0.84)	(-0.84)
Student-reported climate	-0.09	-0.06	-0.01	-0.01
factor (class average)	(-1.58)	(-1.23)	(-0.18)	(-0.02)
Student-reported class	0.12**	0.11**	0.09*	0.09*
participation (class avg.)	(2.75)	(2.72)	(2.06)	(1.96)
School characteristics:				
School enrolment	0.08	0.03	0.02	0.004
	(1.25)	(0.52)	(0.36)	(0.07)
Rural location	-0.33**	-0.30**	-0.14	-0.15
	(-2.57)	(-2.26)	(-1.17)	(-1.24)
Grade 3-6 transition rate	-0.55**	-0.53**	-0.28	-0.28
	(-2.81)	(-2.91)	(-1.45)	(-1.44)
Remote learning indicators:				
Average emergency teaching/	0.08+	----	0.03	----
reinforcement	(1.76)		(0.65)	
Average technology-based	----	0.13*	----	0.04
		(2.38)		(0.78)
Sample size	4,624	4,624	4,613	4,613

Data source: EQAD 2021 Grade 6 NLA

Notes: Samples restricted to public schools only. All dependent and continuous independent variables are standardized (e.g. presented in standard deviations). Estimations include a random effect at the school level ("mixed" model/HLM), with robust standard errors adjusted for clustering to calculate t-statistics (in parentheses). Sampling weights are included at the student and school levels. Additional controls are included for geographic zone (not presented). [a]Mother's education reference category is 4-6 years, other controls are included in estimations (not presented). [b]Teacher variables are matched with students in single grade 6 class schools only, in remaining schools teacher data refer to school averages.

**Parameter is significant at the $p<0.01$ level

*Parameter is significant at the $p<0.05$ level

+Parameter is significant at the $p<0.10$ level

Figure B12. Remote education indicator coefficients from statistical modeling (student reported teaching strategies and materials), Khmer achievement

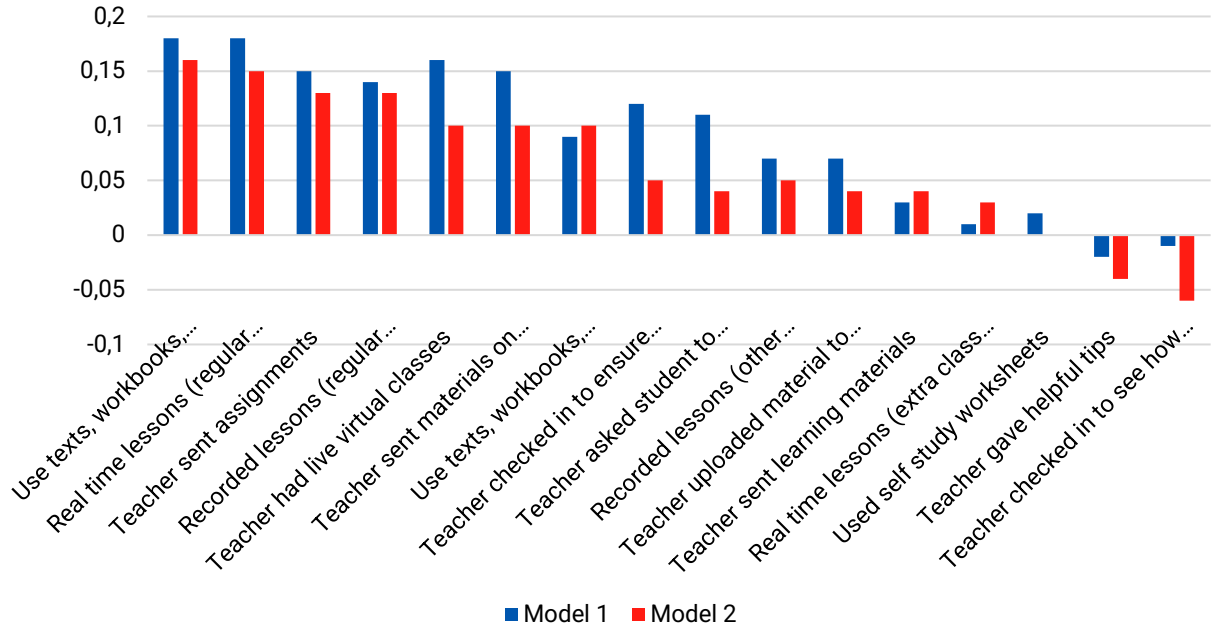


Figure B13. Remote education indicator coefficients from statistical modeling (student reported teaching strategies and materials), Maths achievement

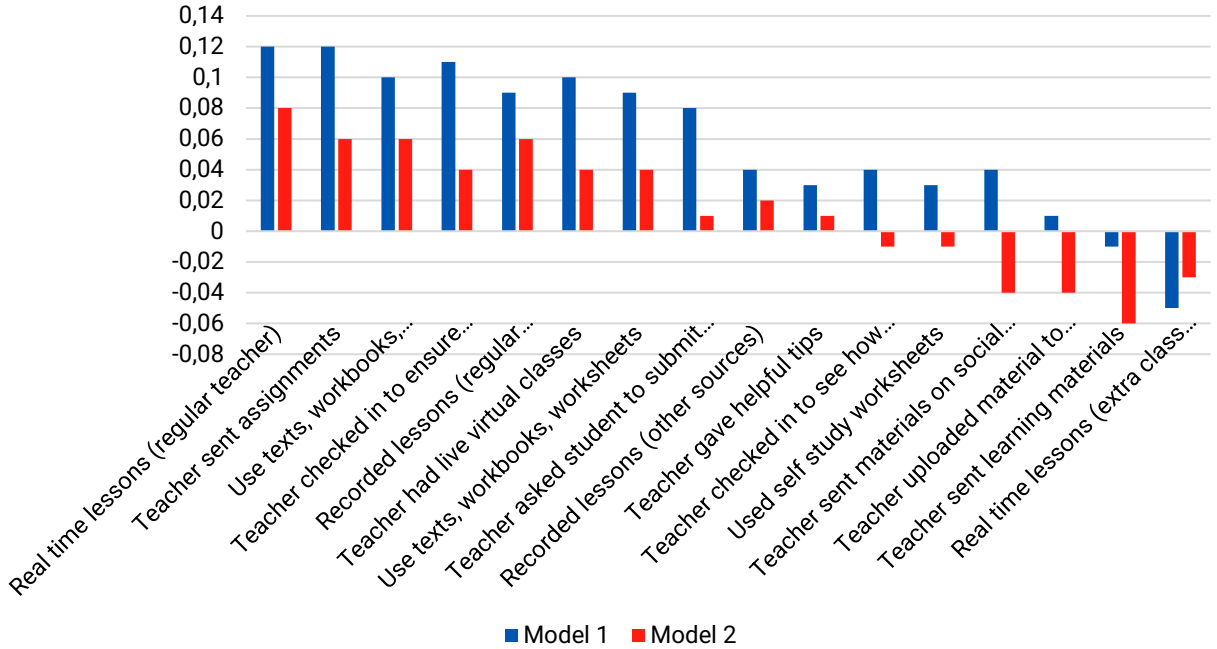


Figure B14. Remote education indicator coefficients from statistical modeling (teacher reported teaching strategies and materials), Khmer achievement

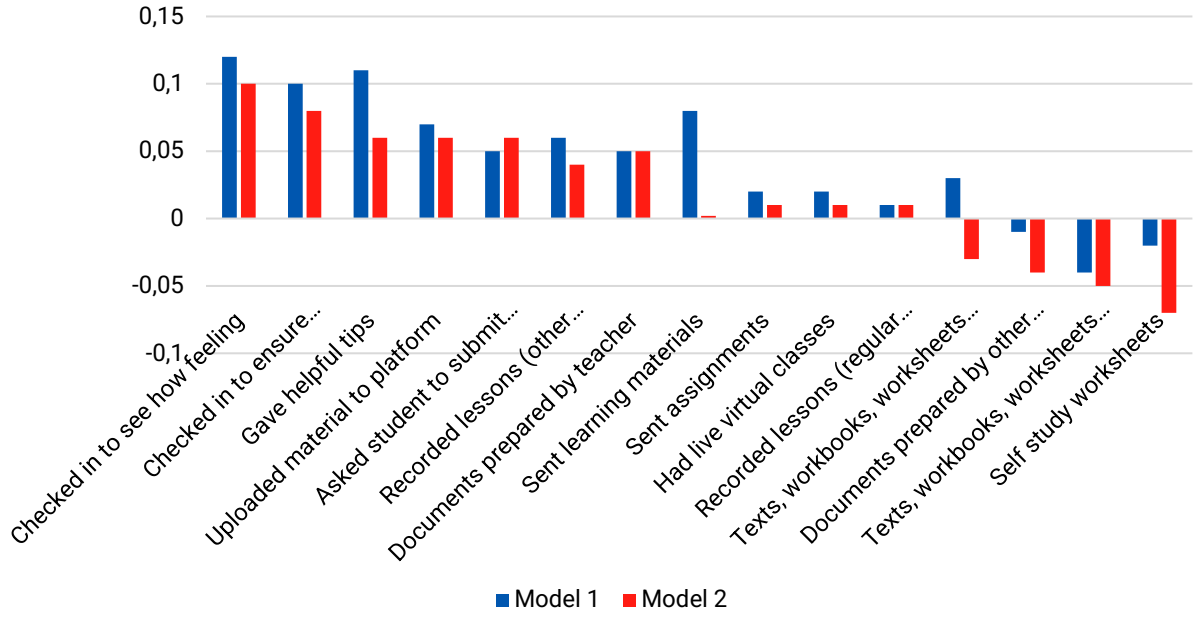


Table B5. Detailed summary of select distance learning features and association with grade 6 Khmer language test scores

Distance learning feature:	Parameters from multivariate analysis:					Comparisons by sub-samples (non-standardized):					
	Student-reported (school averages):			Student individual	Teacher measure	Location (public only):		School type		SES Quintile (public only):	
	Empty	Model 1	Model 2	Model 2	Model 2	Rural	Urban	Public	Private	Q1	Q5
Emergency teaching/reinforcement activities:											
Teacher sent assignments home	0.18**	0.13**	0.13**	-0.003	-0.01	2.21	2.56**	2.27	2.47**	2.17**	2.48**
	(4.18)	(3.14)	(3.34)	(-0.29)	(-0.15)	(0.68)	(0.65)	(0.69)	(0.69)	(0.40)	(0.31)
Teacher checked in to ensure completion	0.19**	0.10**	0.07	0.01	0.14+	2.08	2.46**	2.15	2.46**	2.12	2.35**
	(4.33)	(2.32)	(1.58)	(0.66)	(1.82)	(0.74)	(0.72)	(0.75)	(0.71)	(0.74)	(0.75)
Asked student to submit assignments	0.19**	0.09+	0.07	0.02*	0.11	2.23	2.67**	2.31	2.61**	2.23**	2.57**
	(3.84)	(1.91)	(1.60)	(1.94)	(1.24)	(0.68)	(0.55)	(0.68)	(0.63)	(0.68)	(0.61)
Used texts, workbooks and worksheets	0.23**	0.16**	0.16**	0.04**	-0.04	2.21	2.37**	2.24	2.37*	2.16**	2.38**
	(4.50)	(3.02)	(3.84)	(2.89)	(-0.41)	(0.61)	(0.65)	(0.622)	(0.63)	(0.61)	(0.63)
Technology-based activities:											
Teacher provided live virtual classes	0.24**	0.17**	0.11*	0.03*	0.008	1.78	2.27**	1.87	2.69**	1.70**	2.24**
	(4.50)	(3.32)	(2.44)	(2.07)	(0.12)	(0.84)	(0.86)	(0.86)	(0.59)	(0.82)	(0.86)
Teacher posted material social media	0.25**	0.18**	0.12*	0.05**	----	1.95	2.62**	2.08	2.52**	1.86**	2.56**
	(4.82)	(3.24)	(2.11)	(3.33)		(0.78)	(0.61)	(0.79)	(0.74)	(0.78)	(0.68)
Teacher provided real-time lessons	0.29**	0.20**	0.15**	0.01	----	1.60	2.17**	1.71	2.66**	1.50**	2.11**
	(5.28)	(3.63)	(2.97)	(0.76)		(0.78)	(0.87)	(0.83)	(0.65)	(0.74)	(0.87)
Accessed MoEYS YouTube page	0.17**	0.13**	0.07+	0.03*	-0.07	1.66	2.05**	1.73	1.89*	1.52**	2.14**
	(3.36)	(2.81)	(1.64)	(2.23)	(-1.16)	(0.77)	(0.84)	(0.80)	(0.82)	(0.71)	(0.82)

Data source: EQAD 2021 Grade 6 NLA

Notes: **Parameters from multivariate analysis** refer to individual coefficients (standardized) obtained from three different model specifications: **Empty** includes controls for student gender and age only, **Model 1** includes a set of student-family and school background measures (see Table 5.1), and **Model 2** includes the full set of student-family, school and teacher variables (see Table 5.1). For the student-reported indicators school averages are used in three of the multivariate analyses, and the individual student measure is presented for Model 2 only. All multivariate estimations include a random effect at the school level ("mixed" model/HLM), with robust standard errors used to calculate t-statistics (in parentheses). The **comparisons by sub-sample** refer to the raw indicator averages (not standardized) based on three level scales (1=Never used, 2=Used some days, 3=Used every day). The averages are presented separately by location, school type and SES quintile, with standard deviations in parentheses. Significant differences between rural-urban averages are flagged with asterisks in Urban column; for Public-Private the Private column is used. For the SES Quintile averages the school average is used for each indicator, and the tests of significance for each category average is evaluated in comparison with the overall sample mean.

**Parameter (or category average) is significant at the p<0.01 level

*Parameter (or category average) is significant at the p<0.05 level

+Parameter (or category average) is significant at the p<0.10 level

Table B6. Detailed summary of select distance learning features and association with grade 6 Maths language test scores

Distance learning feature:	Parameters from multivariate analysis:					Comparisons by sub-samples (non-standardized):					
	Student-reported (school averages):			Student individual	Teacher measure	Location (public only):		School type		SES Quintile (public only):	
	Empty	Model 1	Model 2	Model 2	Model 2	Rural	Urban	Public	Private	Q1	Q5
Emergency teaching/reinforcement activities:											
Teacher sent assignments home	0.12**	0.09**	0.08*	-0.006	0.14	2.21	2.56**	2.27	2.47**	2.17**	2.48**
	(3.42)	(2.47)	(2.00)	(-0.51)	(1.34)	(0.68)	(0.65)	(0.69)	(0.69)	(0.40)	(0.31)
Teacher checked in to ensure completion	0.13**	0.07+	0.05	-0.01	0.19*	2.08	2.46**	2.15	2.46**	2.12	2.35**
	(2.94)	(1.63)	(0.98)	(-0.05)	(2.04)	(0.74)	(0.72)	(0.75)	(0.71)	(0.74)	(0.75)
Asked student to submit assignments	0.12**	0.05	0.04	0.01	0.13	2.23	2.67**	2.31	2.61**	2.23**	2.57**
	(3.25)	(1.54)	(0.78)	(0.86)	(1.19)	(0.68)	(0.55)	(0.68)	(0.63)	(0.68)	(0.61)
Used texts, workbooks and worksheets	0.13**	0.07	0.05	0.03**	-0.004	2.21	2.37**	2.24	2.37*	2.16**	2.38**
	(3.01)	(1.59)	(1.39)	(2.87)	(-0.05)	(0.61)	(0.65)	(0.622)	(0.63)	(0.61)	(0.63)
Technology-based activities:											
Teacher provided live virtual classes	0.18**	0.11*	0.06	-0.007	-0.05	1.78	2.27**	1.87	2.69**	1.70**	2.24**
	(3.64)	(2.30)	(1.33)	(-0.43)	(-0.69)	(0.84)	(0.86)	(0.86)	(0.59)	(0.82)	(0.86)
Teacher posted material social media	0.11**	0.04	-0.02	0.03+	----	1.95	2.62**	2.08	2.52**	1.86**	2.56**
	(2.81)	(0.83)	(-0.42)	(1.78)		(0.78)	(0.61)	(0.79)	(0.74)	(0.78)	(0.68)
Teacher provided real-time lessons	0.22**	0.15**	0.11*	-0.006	----	1.60	2.17**	1.71	2.66**	1.50**	2.11**
	(4.61)	(2.71)	(1.99)	(-0.37)		(0.78)	(0.87)	(0.83)	(0.65)	(0.74)	(0.87)
Accessed MoEYS YouTube page	0.19**	0.16**	0.10*	0.04**	0.01	1.66	2.05**	1.73	1.89*	1.52**	2.14**
	(4.46)	(3.54)	(2.21)	(2.91)	(0.11)	(0.77)	(0.84)	(0.80)	(0.82)	(0.71)	(0.82)

Data source: EQAD 2021 Grade 6 NLA

Notes: **Parameters from multivariate analysis** refer to individual coefficients (standardized) obtained from three different model specifications: **Empty** includes controls for student gender and age only, **Model 1** includes a set of student-family and school background measures (see Table 5.1), and **Model 2** includes the full set of student-family, school and teacher variables (see Table 5.1). For the student-reported indicators school averages are used in three of the multivariate analyses, and the individual student measure is presented for Model 2 only. All multivariate estimations include a random effect at the school level ("mixed" model/HLM), with robust standard errors used to calculate t-statistics (in parentheses). The **comparisons by sub-sample** refer to the raw indicator averages (not standardized) based on three level scales (1=Never used, 2=Used some days, 3=Used every day). The averages are presented separately by location, school type and SES quintile, with standard deviations in parentheses. Significant differences between rural-urban averages are flagged with asterisks in Urban column; for Public-Private the Private column is used. For the SES Quintile averages the school average is used for each indicator, and the tests of significance for each category average is evaluated in comparison with the overall sample mean.

**Parameter (or category average) is significant at the p<0.01 level

*Parameter (or category average) is significant at the p<0.05 level

+Parameter (or category average) is significant at the p<0.10 level

Table B7. Detailed summary of remedial and extra classes and association with grade 6 Khmer and Maths test scores, public schools only

Remedial/Extra class measure:	Parameters from multivariate analysis:			Comparisons by sub-samples (non-standardized):						
				Gender:		Location:		SES Quintile:		
	Empty	Model 1	Model 2	Female	Male	Rural	Urban	Q1	Q3	Q5
Student Khmer test scores:										
Student taking remedial class (any subject)	-0.05	-0.05	-0.05	61.8	61.5	62.8	58.1	57.4*	61.4	66.4+
	(-1.44)	(-1.62)	(-1.54)							
Student taking Khmer extra classes	-0.07**	-0.09**	-0.08**	33.2	33.6	33.0	35.9	24.9**	33.9	47.6**
	(-2.49)	(-3.26)	(-3.20)							
Average daily spending on Khmer extra classes	0.007	0.002	0.002	636	739	611	1,001	274**	567	1,746**
	(0.75)	(0.20)	(0.21)	(3,446)	(3,714)	(3,357)	(4,371)	(1,759)	(2,638)	(6,188)
Number of extra classes per week (any subject)	0.01+	0.005	0.004	1.77	1.70	1.72	1.86	1.21**	1.86	2.46**
	(1.77)	(0.63)	(0.48)	(2.09)	(2.06)	(2.08)	(2.06)	(1.87)	(2.08)	(2.14)
Student Maths test scores:										
Student taking remedial class (any subject)	0.04	0.03	0.03	----	----	----	----	----	----	----
	(1.11)	(0.95)	(1.02)							
Student taking Maths extra classes	0.11**	0.09**	0.08**	49.1	48.2	48.7	49.4	38.9**	51.3	61.5**
	(3.86)	(2.90)	(2.77)							
Average daily spending on Maths extra classes	0.04**	0.04*	0.04*	770	904	650	1,616+	266**	670	2,511**
	(2.85)	(2.37)	(2.31)	(4,029)	(4,779)	(3,419)	(7,154)	(1,426)	(2,972)	(8,881)
Number of extra classes per week (any subject)	0.01	0.003	0.003	----	----	----	----	----	----	----
	(1.62)	(0.47)	(0.49)							

Data source: EQAD 2021 Grade 6 NLA

Notes: **Parameters from multivariate analysis** refer to individual coefficients (standardized) obtained from three different model specifications: **Empty** includes controls for student gender and age only, **Model 1** includes a set of student-family and school background measures (see Table 5.1), and **Model 2** includes the full set of student-family, school and teacher variables (see Table 5.1). All multivariate estimations include a random effect at the school level ("mixed" model/HLM), with robust standard errors used to calculate t-statistics (in parentheses). The **comparisons by sub-sample** refer to the raw indicator averages (not standardized) presented separately by location, child gender and SES quintile, with standard deviations in parentheses. Significant differences between rural-urban averages are flagged with asterisks in Urban column; for Female-Male in the Male column is used. For the SES Quintile averages the tests of significance for each category average is evaluated in comparison with the overall sample mean. All comparisons are restricted to students in public schools.

**Parameter (or category average) is significant at the $p<0.01$ level

*Parameter (or category average) is significant at the $p<0.05$ level

+Parameter (or category average) is significant at the $p<0.10$ level