UNIVERSITY OF CAMBRIDGE
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Using educational transitions to estimate learning loss due to Covid-19 school closures: The case of Complementary Basic Education in Ghana

Research and Policy Paper 20/8

June 2020

RTI INTERNATIONAL

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Acknowledgements:

The Complementary Basic Education Programme was funded by DFID and USAID and managed by the Management Unit at Crown Agents, in partnership with the Ghanaian Ministry of Education and Ghana Education Service. Data collection for this project was commissioned and funded by DFID, Ghana. We are grateful for the comments received by Dr Rob Gruijters, Professor Anna Vignoles and Professor Pauline Rose on earlier drafts of this paper.

All errors in this report are the responsibility of the authors.

Suggested citation:

Sabates. R., Carter., E., Stern. J (2020) Using educational transitions to estimate learning loss due to Covid-19 school closures: the case of Complementary Basic Education in Ghana. REAL Centre, University of Cambridge. DOI: 10.5281/zenodo.3888219.

Introduction

Across the world, countries are facing unprecedented and challenging times in trying to support the education of millions of children outside of school. Various methods for reaching children at distance have been implemented in diverse countries, ranging from the use of radio and television in locations of limited internet penetration to full online provision for better resourced schools and systems. Many countries including Afghanistan, Ethiopia, Ghana, India, and Pakistan are using off-line educational resources to provide education to many of the world's most marginalised students who cannot be reached with technology. How much children will learn during this time remains unknown, although it is expected that the poorest will be hit the hardest.

Providing a deeper understanding of the inequalities in learning which are expected as a result of school closures is central to the debate around educational provision in the post-COVID-19 era. As governments ease restrictions on school closures, and as children return to school under new social distancing rules, it is expected that not all children will return to education. Those who do return will have a learning loss resulting from school closures. For the most marginalised children, the magnitude of their expected learning loss and the factors expected to protect children from such loss, remain empirical questions.

A number of recent blogs have indicated that forms of marginalisation experienced by children are likely to be connected to increased learning losses due to school closures. For example, Parsitau et al. (2020) blog for the case of Kenya described girls and refugee children as learners likely to face devastating consequences as a result of COVID-19 due to their lack of educational resources at home and the potential risk of sexual exploitation for girls. Similarly, Tibebu (2020) highlighted girls from the poorest rural households in Ethiopia being particularly at risk of learning loss due to higher likelihood of sexual exploitation, but also early marriage and labour, all of which will impact their future learning possibilities. Additionally, parents of many children in Ethiopia (as well as in many other countries in the Global South) are not literate and so they are less likely to support their learning (Iyer, et al., 2020; Kim and Rose, 2020). Children living in stressful home environments, as well as the stress experienced by children themselves, are likely to impact children's emotional stability as well as the learning support received at home while schools are closed (Moroni, et al., 2020). Children with disabilities are also expected to be at a high risk, not just of having limited learning opportunities through inclusive online platforms, but also reduced support from health professionals currently at the frontline of the COVID-19 crisis (McClain-Nhlapo, 2020).

Recognising the potential higher risks that might be faced by marginalised populations and the potential consequences on their learning, it is important to establish how much learning is likely to be lost as a result of school closures, and the extent to which these populations are disproportionately

affected. We are also unsure whether having support at home for learning, or the availability of learning materials, activities and resources, will matter. These issues remain unknown during the current pandemic which has caused many schools to close for a significant period of time. Furthermore, empirical evidence on the impact of unintended school closures on learning is currently extremely limited. Yet, there are two ways in which researchers have engaged with estimating the impact of school closures on learning loss.

First, some researchers have used the impact of natural disasters which has caused children to spend time away from schools. Using the case of Pakistan, recent research by Andrabi, Daniels and Das (2020) trace the impact of school closures for children who were affected by the 2005 earthquake, which left many children out of school for a significant period of time. The authors estimated a learning loss equivalent to 1.5 years of education in the areas most affected by the earthquake. The authors indicated that educated mothers were able to mitigate learning losses, but not losses in other factors of human capital accumulation such as nutrition. The authors also highlighted there was a greater loss in learning when children return to school, perhaps because the curriculum had not adjusted to the level they were at when they re-joined school. These findings also resonate with Sacerdote (2012), who found that students impacted by school closures and displacement resulting from Hurricane Katrina (in the United States) suffered sharp declines in test scores in the year following the disaster (approximately 0.10 standard deviations).

Another way to estimate time out of school is using what is known as long holidays or transition time. Many school systems provide a break somewhere between 6 to 9 weeks between the end of a school year and the beginning of the next academic year. Most schools remain closed during this time, although some offer holiday clubs, cultural, artistic or sport activities for children. Several studies from the Global North have estimated the learning loss as a result of the time away from school. In the UK, for example, Shinwell Jackie and Defeyter (2017) estimated loss in spelling for children between the ages of 5 and 10 years, in areas of low socioeconomic affluence, when they returned to school immediately after the 7-week summer holiday. In particular, the authors found a small but statistically significant change in mean scores for spelling, changing from 26.6 to 25.4 from the beginning to the end of the summer (although no significant effects were found for their performance in reading words). In the USA, summer learning loss has been studied extensively. One of the earliest reviews of the issue found that summer losses equated to approximately one month of schooling, on average (Cooper et al, 1996). A more recent study found that students from low socioeconomic background were more likely to fall behind in mathematics, roughly between 4 to 5 points in the maths test per month away from school relative to children from higher socioeconomic backgrounds (McAlister, 2014). Other studies conducted in the USA have suggested that the impacts of extended school breaks without learning increase over time, and that children from disadvantaged

backgrounds fall further and further behind their more affluent peers who have the opportunity to engage in learning activities throughout these periods (Terzian et al. 2009; Blazer, 2011).

Empirical evidence from the Global South on learning loss as a result of grade transition has not been as well documented. Slade, et al., (2017) used literacy assessments in Malawi to estimate learning loss during long breaks in the academic year. Their results show that across grade transitions from primary 1 to 2 and 2 to 3, children performed lower on all literacy subtasks. For example, children who transitioned from grade 2 to grade 3 in 2015 lost "12.7 letters per minute, 10.2 syllables per minute, 5.7 words per minute and 5.4 words per minute in connected text during the transition" (Slade, et al., 2017, p 469). They found no differences by gender in learning loss for their sample. Using the learning trajectories of out of school children in Ghana, who completed a complementary educational programme between October 2016 and June 2017 and then transitioned into government schools in October 2017, Akyeampong et al. (2018) also found significant learning losses during the three months transition period. For example, the authors found a 20 percentage point drop in number identification and 23 percentage point decline in reading comprehension, on average during this transition period. Akyeampong et al. (2018) did not find relative gender differences in learning loss, on average, during this period.

Further empirical evidence from the same case of out of school children in Ghana has shown wide inequalities in learning loss by language and prior academic performance by gender during the transition period (Carter, et al., 2020a; Carter, et al., 2020b). Girls who were low performers (i.e. with results in the lowest quartile of scores) at the beginning of the Complementary Basic Education (CBE) programme in 2016-17 were more likely to remain low performers throughout the 2 academic years than their low performing male counterparts, who managed to shift from their initial weak position overtime (Carter, et al., 2020b). With respect to language, Carter et al. (2020a) found that children who changed language of instruction from mother tongue during the CBE programme to one of the official languages of the Ghanaian Education Service in public schools significantly lost language gains achieved during the CBE programme. The average learning loss for children who moved into government schools with a different language of instruction was 33 percentage points in letter sound identification and 37 percentage points in reading comprehension relative to children for whom the language of instruction remained the same. Carter et al. (2020a) further found that these differences varied by grade of transition, as this was related to language of instruction in Ghana, but no gender differences were found according to losses during the transition period based on language of instruction.

Given the richness of the data and the timely importance of this research due to school closures, we use the learning trajectories utilised by Carter et al. 2020a and 2020b to gain further insights in the

factors that predict disparities in learning loss resulting from the transition period. In particular, we focus on children's motivation to learn and study hard, whether children receive support to study at home or if they ask for help from family members with their school work, whether they have access to educational materials or activities at home, as well as availability of television, radio and mobile phones, which are currently considered as central to supporting children's learning during school closures. Our aim is to understand which factors are associated with greater disparities in learning loss during the transition period. Empirically, we assess learning losses relative to learning gains achieved during the previous academic year, i.e. when children were enrolled in the CBE programme.

To our knowledge, this is one of the first analyses to estimate expected learning losses due to school closures for a population of disadvantaged and previously out of school students, who through complementary education managed to improve foundational skills (building on the work of Carter et al. 2020a and Carter et al. 2020b). The work of Slade et al. (2017) is important for motivating our paper, but their estimates are nationally representative of Malawi's learners in grades 1 to 3 on average, not the most marginalised. Furthermore, our paper highlights the extent of learning loss and whether this is associated with key factors related to the individual and their home learning environment, which has not been explored before. Moreover, children who participated in the CBE programme are unlikely to have had access to educational programmes between school years, as could have been the case for children in more economically affluent areas. Therefore, we assume that what was learned during the CBE programme may have not been reinforced through extra-curricular educational programmes. Of course, we do expect that other forms of learning took place, and this is acknowledged as a limitation of our measurement of learning via foundational numeracy test scores.

Objective and research questions

The overall aim of this study is to estimate learning loss as a result of time out of school, measured by the time children spent without access to formal education after graduating from the CBE programme in June 2017 and before enrolling in government school in October 2017. We extend previous work in Ghana and Malawi which focused on learning loss by gender and language of instruction to include differences according to: (1) student perceptions regarding the difficulty of lessons, student effort and their self-concept of mathematic ability; (2) having support at home for learning; (3) availability of reading materials, learning activities at home as well as television, radio and mobile phones in the home. The overall research question is: *what is the learning loss experienced by marginalised children during the transition between CBE and formal schooling?* The following sub-questions are also addressed:

a. To what extent do learning losses in the transition period depend on effort, self-concept of mathematic ability or perceptions of difficulty of lessons at school?
b. To what extent do learning losses in the transition period depend on the willingness of students to ask for support from adult members when they found learning challenging or whether children were given enough time to study at home?
c. To what extent do learning losses in the transition period depend on the availability of materials and activities in the home environment, including radio, television and mobile phones?

For all these questions, we are interested in examining the size of the learning loss between groups. To do this, we estimate learning loss relative to learning gains throughout CBE as children had different starting points with their learning.

Methodology

Description of the sample

Data used for this paper were collected as part of an evaluation of the CBE programme and then used by Carter et al. to investigate learning trajectories by language (2020a), as well as prior academic performance and gender (2020b). The evaluation of the CBE programme collected data on children who took part on the programme in the 2016-17 academic year and were tracked longitudinally over two years. Four rounds of data collected included baseline and endline assessments on foundational literacy and numeracy during the CBE programme and the first year after transition into government schools, background socioeconomic characteristics of children as well as their opinion about learning support received at home. Data on learning loss refers to the period between the end of the CBE in June 2017 and the beginning of the government school year in October 2017.

The original sampling took place in September 2016, when 2,360 students were selected from over 40,000 students enrolled in the CBE programme using a stratified random sampling approach intended to provide proportional representation by gender, language, region, district and provision by implementing partners. The original sample consisted of 53% boys. 66% were located in the Northern region, 12% in Upper West, 11% in Upper East, 9% in Brong Ahafo and 2% in Ashanti. From the original sample, 29% of the children responded they had access to a light bulb during the night, whereas 55% used a torch light. Similarly, little over half of the children in the original sample indicated they go hungry some days, whereas the rest indicated that they did not. Finally, 79% of these children had never been to school prior to enrolling in the CBE programme in September 2016 and 21% had some school experience but had already dropped out.

As demonstrated by Carter et al. (2020a), there was attrition between the original sample of 2,360 children and the estimated sample which contains children with full information over the 4 time periods of data collection (1,166 children). Their overall conclusion was that the “estimation sample contains a larger proportion of children who are high performers, missed fewer school days, and engage more with learning activities at home compared with the full sample" (Carter et al. 2020a, p. 4). The implication of sample attrition for our paper is that our estimates of the learning loss are likely to be lower-bound estimates for the CBE student population overall (i.e. including those with lower performance and who missed more school days).

Assessment of numeracy skills

We use foundational numeracy skills over time to measure learning loss during the transition from CBE into government schools. The learning assessment used for the four rounds of data collection were based on the Early Grade Mathematics Assessment (EGMA) for numeracy. EGMA was designed to provide information about basic reading, writing and mathematics competencies — those competencies which should typically be mastered in the very early grades of primary school, without which pupils are likely to struggle to continue to achieve higher academic competencies.

The assessments administered during the CBE programme (rounds 1 and 2 of data collection) were different from the standard EGMA instruments, which were used during transition into government schools (rounds 3 and 4 of data collection). The assessments administered during the CBE programme were modified by the Directorate of Research Innovation and Consultancy (DRIC) of the University of Cape Coast in Ghana, to reflect the specific literacy and numeracy competencies learners were expected to acquire in the CBE programme.[i] Due to these adaptations, the assessments used during CBE phase of data collection contained a few key differences from the EGMA used in the latter phase of data collection. These included differences in the numbers of items in each task as well as the subtask constitution of the instrument. These differences including the number of assessment items (in brackets) are shown in Table 1.

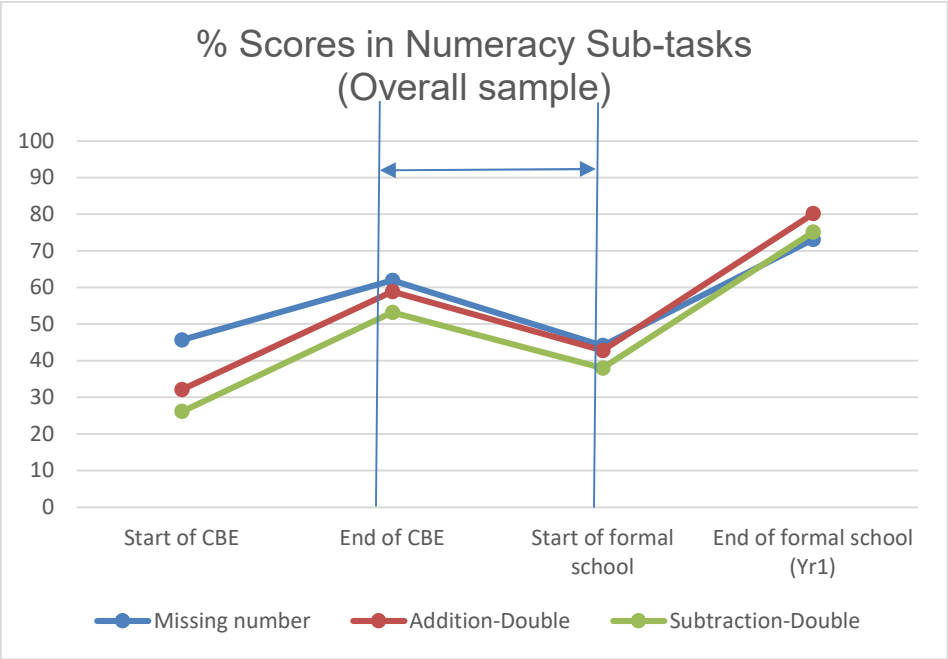
Table 1: Differences in test instruments between modified and standard EGMA

Modified EGMA Instrument (Start and end of CBE)	**Standard EGMA Instrument** (Start and end of first year of formal school)
Number identification: One-digit (50)	Number identification: One and two-digit (20)
Number identification: Two-digit (40)	Number discrimination (10)
Missing number (5)	Missing number (10)
One-digit addition (2 mechanical; 1 word problem)	One-digit addition (20 mechanical)
One-digit subtraction (2 mechanical; 1 word problem)	One-digit subtraction (20 mechanical)
Two-digit addition (4 mechanical)	Two-digit addition (5 mechanical)
Two-digit subtraction (4 mechanical)	Two-digit addition (5 mechanical)
Problem solving: Multiplication (3)	Word problems (6)
Problem solving: Division (3)	

Notes: Numbers in parenthesis indicates the number of items for each subtask.

Due to minor differences between the subtask constitution of instruments used in the first and second year of data collection, only some items could be selected for comparison over time. The analysis that follows therefore includes only missing number identification, two-digit addition, two-digit subtraction and a combined measure of numeracy from these three subtasks. We include here all three subtasks as well as the overall measure of numeracy as we want to explore if learning loss is more pronounces for the most basic numeracy skills than for slightly more advanced skills. The hypothesis is that as children build numeracy competencies, there is less learning loss due to time out of school. Figure 1 presents the percent score in each of these subtasks over time, and during the transition period.

Figure 1: Percent score achieved in numeracy subtasks over time



The learning loss during the transition period shown in Figure 1 is substantial, particularly for missing number identification. Gains in missing number identification during the CBE programme constituted 16 percentage points. However, the loss during the transition was nearly 18 percentage points. This implies that more than 100% of the learning gains during the CBE programme were lost during the transition period in missing number identification. For the other subtasks, the learning loss relative to gains was smaller in magnitude. For double-digit addition, the learning gain during the CBE programme was equivalent to 27 percentage points whereas the loss during the transition was 16 percentage points. Therefore, 60% of learning gains in double-digit addition were lost as a result of the transition. Finally, for double-digit subtraction, learning gains during the CBE programme were also 27 percentage points, and the learning loss 15 percentage points, with an estimate of 56% loss from the previous learning gains. On average, the learning loss across all subtasks is about two-thirds of the previous learning gains during the CBE programme.

The magnitude of the learning loss per month out of school is sizeable. For missing number identification, every month out of school had a learning loss equivalent to one third of what was learned during the previous school year. For the other numeracy subtasks, the learning loss per month was around 19 to 20% of what was learned during the previous schooling experience. For the combined numeracy score, the learning loss is around 20% of what was learned during the previous

school experience. Considering that many children will spend somewhere between 4 to 6 months not in school as a result of the COVID-19 school closures, the learning gains obtained from foundational numeracy skills before the pandemic could be completely lost if no actions are taken to continue to support learning at home.

Key factors related to learning loss

We extend previous work by Carter et al. (2020a and 2020b) to measure learning loss according to individual factors of the learner, the support at home received from other adults, and the materials, activities and assets available in the home which could foster learning during school closures due to COVID-19. Our aim is to provide a deeper understanding of the expected impact of the pandemic on learning losses and for this reason we are including motivational factors, support from home as well as availability of learning materials and activities at home (see Table 2 for descriptive statistics on these factors).

Self-rated opinions on learning were obtained by questions given to children and assessed on a 4 point Likert scale (from all the time to never). These questions were administered at the end of the CBE to account for their opinion about learning during the programme. An indicator that the child was able to follow the lessons was given from the question "*I found most of my lessons easy when I was at school*". An indicator of effort was given from the statement "*I tried hard to learn my lessons*" and an indicator for self-rated concept of mathematical ability came from the statement "*I was very good at mathematics at school*". We dichotomise all these indicators to differentiate between those who indicated 'never' and 'sometimes' from those who indicated 'most of the time' and 'always' for each of these statements (see Table 2).

Support at home from an adult for school work was also measured from child reports by combining the following statements: "*when I did not understand things at school I asked my mother or female adult*" and "*when I did not understand things at school I asked my father or male adult*". Here we differentiate between those who never asked an adult (35.7% of the sample), from those who asked most of the times or always at least one of the adults, male or female in the household (21.5% of the sample). Our middle category is for children who sometimes ask one adult (male or female), but never asked the other (42.9% of the sample). Another indicator was related to whether the child was given enough time to study at home (measured as binary to differentiate 'not at all' from the rest). We do not have information on parental education as this was not included in the survey, but it would be another important variable to include for support at home.

Table 2: Descriptive statistic of key factors related to learning loss

Variable	Description	% within estimation sample
Lessons easy	Sometimes/never found lessons easy	64.2
	Most of the times/always found lessons easy	35.8
Effort	Sometimes/never tried hard	46.6
	Most of the times/always tried hard	53.4
Self-concept ability	Sometimes/never good at maths	70.6
	Most of the times/always good at maths	29.4
Time study	Time at home to study	68.7
	No time at home to study	31.3
Asking for support	Never ask adult	35.7
	Sometimes ask adult	42.9
	Most of times/always ask adult	21.5
Activities at home	Access to reading or counting activities at home	73.1
Reading Materials	Access to books or reading materials at home	72.6
TV	Access to television	15.6
Radio	Access to radio	52.2
Mobile Phone	Access to mobile phone	72.5
Sample size	**Number of observations**	**1,166**

Finally, indicators related to learning activities or learning materials available in the home environment included whether children had access to activities involving reading, writing or counting as well as the availability of books or other reading materials. Interestingly, nearly three-quarters of children had access to reading materials or activities related to reading, writing or counting (Table 2). Access to television, radio and mobile phones are explored as potential devices to bring schooling into children's homes. As shown in Table 2, only 15.6% of children in the sample had access to a television in the home, and little over half to a radio. 72.4% of children indicated they had a mobile phone in their homes.

Children who work hard at school, find their lessons easy or believe they are good at maths are likely to differ in their attainment before and after their transition period relative to other children. Similarly, children who receive support at home with their school work and are able to find time to study at home are also likely to differ from other children who do not have the same sources of support at home. Appendix Table A1 shows the average learning assessments at the end of the CBE programme and at the beginning of government school according to all the factors which are

analysed in this paper. As shown, there are significant differences in terms of the learning loss during this period. For example, children who ask for help from adults in the household have only 5 percentage points learning loss in double-digit subtraction during the transition whereas those who never ask for help have 21 percentage points learning loss in the same numeracy subtask. But also, children who have reading materials at home have 13 percentage points learning loss in double-digit subtraction whereas children who did not have these materials have 21 percentage points learning loss in the same subtask. It is likely that these variables are correlated, and that children who have reading materials are also likely to have learning activities at home and receive support from adults. Therefore, we will verify the correlation between these factors and implications for analysis in the results section.

Estimation method

In order to estimate the relative learning loss during the transition we use difference-in-difference (DID) estimation techniques. DID compares the numeracy attainment in each of the subtasks, as well as a combined measure of numeracy, before and after the transition, for children who have diverse opinions about learning in school as well as different levels of support at home, whether from adults or through availability of materials and activities. In all our estimations, we also include other controls which are important for learning trajectories (and potentially learning loss). These control variables include gender and age of the child, school grade of transition, whether the child had to change language of instruction from the language in which they learned during the CBE programme, school attendance in the 5 days prior to the survey in each time period, household size, whether the household has access to electricity and relative poverty (whether the child ranked their household among the poorest in the community or not).

A generic equation for the DID estimation we utilise in this paper to estimate the relative magnitude of learning loss for each of the factors is:

$$N_{it} = \beta_0 + \beta_1 F_i + \beta_2 Time + \beta_3 F_i|Time + \gamma X_{it} + e_{it} \qquad (1)$$

where *N* is a measure of numeracy (each of the 3 subtasks plus a combined average performance) for child *i* in time *t*; *F* is a vector containing the factors which were are interested to measure relative differences (in some cases it is a dummy variable and in others a categorical variable); *Time* is a dummy variable to indicate the pre-transition and post-transition; and *F*|*Time* is the interaction term which denotes the relative difference in learning loss between children who have benefitted (or not) from such factors before and after the transition. The matrix X contains control variables.

We propose to undertake the following empirical strategy in order to respond to our research questions. First, we estimate the model described by equation (1) for the individual factors of finding lessons hard, effort with schoolwork and mathematics ability. These factors are entered in the model with the time interaction to estimate the DID parameters. For the other factors related to home support and home resources, we include them in the model as controls. Second, we estimate the DID for factors related to home support and include as controls individual factors plus home resources. Third, we estimate the DID for factors related to home resources and include as controls individual factors plus home support. Finally, a model which includes all the DID parameters for all factors is presented.

In order to estimate the relative learning loss of the transition, we use the magnitude of the estimated parameters and adjust to the relative gains during the CBE programme. In other words, we consider the relative loss as a function of the relative gains prior to the transition. This is an estimate of the percentage loss relative to gains.

Results

In this section, we present results on the relative learning loss due to time out of school for children according to individual factors, home support and home resources. We include all numeracy subtasks as well as the combined measure for numeracy. In order to ease interpretation of results, whenever possible we will focus on the overall numeracy result, particularly if this is consistent with results being significant also for at least 2 other subtasks. If results are significant for one subtask, but not for the other two and not for the overall numeracy score, we also point this out as a relevant finding, potentially on the nature of the level of foundational numeracy skill being assessed.

To what extent do learning losses in the transition period depend on effort, self-concept of mathematic ability or perceptions of difficulty of lessons at school?

Before including individual factors in our empirical models, we estimate the correlation between effort, finding lessons easy and perceptions of mathematic ability. The tetrachoric correlation (or correlation estimates when variables are dichotomous, 0/1) between effort and ability was 0.64, between ability and finding lessons easy 0.67 and between effort and finding lessons easy was 0.69. These correlations indicate that these factors tend to move in the same direction, whereby children who work hard for their lessons also tend to find them easy and further report being good at mathematics.

What is also important, for our empirical models, is to find whether we have enough children (at least 30) for each of the different combinations of these individual factors (e.g. children who have low effort but high mathematics ability and who found their lessons hard). Of all possible combinations, the

smallest number of observations was 42 children. This was for students who did not try hard in lessons, found lessons easy and felt they were good at mathematics. The next smallest number was 62 children (i.e. those who did not try hard in lessons, found lessons hard but felt they were good at mathematics). For all other combinations, the number of children ranged from 80 to 373. Therefore, we are confident that we can include these factors in the model, in terms of satisfying the cell size for estimation.
Table 3 shows results for the child level factors that relate to whether students found lessons easy at school, effort, and self-perception of mathematics ability. The first finding shows the average learning loss for those who indicated that lessons were hard, they did not try hard in school and they did not think they were good in maths, was 21.4 percentage points for missing numbers, 24 percentage points for double-digit addition, and 21.7 percentage points for double-digit subtraction. The average learning loss across these subtasks for this group is 22.4 percentage points.

Then, for each of the individual factors we show the relative difference in performance at the end of the CBE programme (indicated by estimated parameters on lessons, effort and ability) and the DID estimator, which is whether the learning loss over time as a result of the transition period is greater or smaller between two groups of children (for example those who found their lessons easy relative to those who found their lessons hard). For children who perceived lessons easy while at school, their average attainment at the end of the CBE programme was slightly higher than for children who perceived lessons difficult (this is shown by the significant parameter of approximately 8-9 percentage points for all outcomes in Table 3). However, the relative learning loss between children who found lessons easy and difficult is the same, as the estimated DID parameter for lessons easy relative to hard was not statistically significant. It is important to highlight that this measure is more linked to perceptions or confidence, rather than actual attainment.

For children who reported that they tried hard with most of their lessons, we found that they achieved on average lower scores at the end of the CBE programme relative to those children who indicated otherwise. However, we found that the relative learning loss during the transition period was smaller for children who tried hard compared with children who did not. That is, the DID estimator for effort for the combined numeracy score was 8.9 percentage points, which means that children who worked hard had a lower learning loss during the transition relative to children who did not work hard (recall, there is already an estimated learning loss, so the positive parameter is an estimate of a smaller learning loss).

Finally, for maths ability, we find that children who perceive they were good at maths achieved higher scores across all subtasks at the end of the CBE programme relative to children who did not feel they

were good at maths. This average difference was nearly 11 percentage points using the combined numeracy score. However, we did not find a relative learning loss between children who felt they were good at maths and those who did not as a result of the transition period.

Table 3: Learning loss during transition time: difference-in-difference estimator for child-factors related to effort, difficulty with lessons and perceptions of maths ability

	Missing number	Addition	Subtraction	Numeracy Combined
VARIABLES	(1)	(2)	(3)	(4)
Average learning loss (L=0; E=0; A=0)	-21.400***	-24.041***	-21.724***	-22.388***
(lessons hard, no effort, low ability)	(1.994)	(2.239)	(2.261)	(1.854)
Lessons easy	7.723***	8.529***	7.824***	8.026***
	(2.031)	(2.339)	(2.444)	(1.936)
DID: Lessons easy relative to hard	-0.612	0.588	0.670	0.215
	(2.667)	(3.166)	(3.259)	(2.601)
Effort: tried hard	-7.596***	-7.175***	-6.163***	-6.978***
	(1.956)	(2.213)	(2.317)	(1.839)
DID: Effort tried hard relative to not	6.817***	9.300***	10.712***	8.943***
	(2.557)	(2.971)	(3.068)	(2.468)
Maths ability: mostly good	13.232***	8.015***	11.528***	10.925***
	(2.043)	(2.311)	(2.521)	(1.967)
DID: Mostly good maths relative to not	-4.892*	2.954	-3.401	-1.779
	(2.803)	(3.260)	(3.423)	(2.740)
Other controls	Yes	Yes	Yes	Yes
Constant	33.201***	22.920***	13.012*	23.044***
	(5.892)	(6.866)	(7.201)	(5.744)
Observations	1,995	1,995	1,995	1,995
R-squared	0.325	0.261	0.234	0.327

Note: Robust standard errors in parentheses. DID (difference-in-difference parameters) indicates the *relative loss* within factors. Each model is estimated conditioning on the remaining factors and control variables (results not shown here). Asterisks *, **, *** indicate statistical significance at 10, 5, 1 and 0.1% level. Source: CBE Monitoring and Evaluation 2016-2018.

To what extent do learning losses in the transition period depend on the willingness of students to ask for support from adult members when they found learning challenging and whether children were given enough time to study at home?

For this section we focus on what we defined as support at home, namely 1) whether children asked adults in the home for help with school work, and 2) whether children were given enough time to study at home. The correlation between these variables is 0.18 and the smallest cell count was 44 children who reported not having enough time to study, but who regularly asked adults in the household for help with school work. We are therefore able to introduce these factors into the model.

shows results for the relative learning loss due to the transition period according to home support factors. The average learning loss in Table 4 refers to children who never asked for support and who were not given enough time to study at home. For these children, the average learning loss was 20.8 percentage points for missing number identification, 18.1 percentage points for double-digit addition, 22.6 percentage points for double-digit subtraction and 20.5 percentage points for the average across these subtasks.

In terms of the relative learning loss, most of the evidence indicates no differences between children who were given time to study relative to those who were not given time. The only parameter which was significant was for double-digit addition, where children who were given more time to study achieved, on average, 4.7 percentage points higher scores at the end of the CBE programme relative to children who were not given time to study.

The most relevant result, however, relates to receiving support from adults when children did not understand lessons at school. Children who reported always asking for support from adults had a learning loss 14.4 percentage points lower than for children who never asked for help using the overall numeracy score. This result is even more important if we consider that at the end of the CBE programme, children who reported asking for support and those who never asked for support did not differ in their numeracy scores. Therefore, the relative learning loss is mostly through the transition period and not measured from initial differences in attainment.

Table 4: Learning loss during transition time: difference-in-difference estimator for home support

	Missing number	Addition	Subtraction	Numeracy Combined
VARIABLES	(1)	(2)	(3)	(4)
Average learning loss (no time; no help)	-20.849***	-18.089***	-22.614***	-20.517***
	(2.219)	(2.510)	(2.610)	(2.147)
Time to study at home	3.436	4.695**	1.278	3.136
	(2.114)	(2.326)	(2.496)	(2.012)
DID: time to study relative to no time	-2.906	-3.978	3.881	-1.001
	(2.668)	(3.071)	(3.177)	(2.598)
Sometimes ask adult help	-3.618*	1.508	-1.198	-1.103
	(2.197)	(2.485)	(2.607)	(2.126)
Most times ask adult help	-6.518***	0.053	0.314	-2.050
	(2.193)	(2.546)	(2.667)	(2.049)
DID: sometimes ask relative to never ask	4.420	-0.102	5.095	3.138
	(2.824)	(3.244)	(3.324)	(2.737)
DID: most times ask relative to never ask	15.566***	12.953***	14.638***	14.386***
	(2.878)	(3.461)	(3.537)	(2.798)
Other controls	Yes	Yes	Yes	Yes
Constant	24.821***	12.394*	4.635	13.950**
	(5.958)	(6.930)	(7.222)	(5.808)
Observations	1,995	1,995	1,995	1,995
R-squared	0.331	0.262	0.237	0.331

Note: Robust standard errors in parentheses. DID (difference-in-difference parameters) indicates the *relative loss* within factors. Each model is estimated conditioning on the remaining factors and control variables (results not shown here). Asterisks *, **, *** indicate statistical significance at 10, 5, 1 and 0.1% level. Source: CBE Monitoring and Evaluation 2016-2018.

To what extent do learning losses in the transition period depend on the availability of materials and activities in the home environment, including radio, television and mobile phones?

For this final section we focus on home resources. Firstly, we obtain the tetrachoric correlations between all these indicator variables for home resources. The variables with the highest correlation were having reading materials at home and involvement with reading, writing or counting activities at home (correlation 0.76). The second largest correlation was for mobile phones and radios at home (correlation of 0.56) and mobile phones and television (correlation 0.47). Other correlations are in the order of 0.3, for example for mobile phones and reading materials, as well as for reading materials and radios, and television

The main issue with the availability of resources was the cell count for estimation purposes. For activities at home and availability of resources we have enough in the cell count, i.e. around 125 for children living in households where there are learning activities and no reading resources or *vice versa*. However, the cell count for living in households with no mobile phone and a television was 15. More importantly, we only have 6 children living in households with radios and a television but no mobile phone and only 9 children living in households with a television, but no radio or mobile phone. Given the potential of these three factors for bringing learning resources into homes as a result of school closures, and the issues with cell counts, we combine these three factors into one. In other words, for estimation purposes we differentiate between children living in households with access to either a television, radio or mobile phone (79.4% of the sample) from those without any of these resources (20.6% of the sample).[ii]

Table 5 shows results for the model estimating relative learning loss due to home resources. The average learning loss for children who had no learning activities at home or reading resources as well as no television, radio or mobile phone (83 children) was 26.7 percentage points for missing number identification, 36.5 percentage points for addition double, 29.3 percentage points for subtraction double and 30.8 percentage points for the average across these subtasks. It is important to highlight that this is the largest average learning loss for any of the groups previously explored, i.e. children who did not have the individual attributes or did not have access to home support.

With respect to the relative learning loss, our results show that children who had access to reading, writing or counting activities in the home had a smaller learning loss compared with children who did not have access to these activities (see Table 5). For the overall numeracy score, children who had access to learning activities at home had 11.7 percentage points lower learning loss relative to children who did not have access to these activities. Importantly, at the end of the CBE programme, the average score across all numeracy subtasks was similar for children who had access to learning materials and for those who did not.[iii]

Table 5: Learning loss during transition time: difference-in-difference estimator for home resources

	Missing number	Addition	Subtraction	Numeracy Combined
VARIABLES	(1)	(2)	(3)	(4)
Average learning loss (no act or resources)	-26.687***	-36.514***	-29.282***	-30.827***
	(3.198)	(3.503)	(3.707)	(2.941)
Literacy/numeracy activities	3.392	-5.511*	-3.696	-1.938
	(2.845)	(3.004)	(3.270)	(2.671)
DID: Learning activities relative to none	6.085*	16.371***	12.601***	11.686***
	(3.538)	(3.811)	(4.003)	(3.313)
Reading materials	-0.936	-0.660	-0.045	-0.547
	(2.547)	(2.878)	(3.067)	(2.466)
DID: Reading materials relative to none	7.349**	4.251	3.847	5.149
	(3.339)	(3.829)	(3.974)	(3.238)
TV/Radio/Mobile	1.785	-1.087	1.577	0.758
	(2.309)	(2.654)	(2.832)	(2.216)
DID: TV, Radio or Mobile at home relative to none	-3.168	4.632	0.687	0.717
	(2.992)	(3.465)	(3.630)	(2.887)
Controls	Yes	Yes	Yes	Yes
Constant	32.306***	22.652***	11.361	22.106***
	(6.084)	(7.010)	(7.345)	(5.853)
Observations	2,027	2,027	2,027	2,027
R-squared	0.322	0.269	0.233	0.328

Note: Robust standard errors in parentheses. DID (difference-in-difference parameters) indicates the *relative loss* within factors. Each model is estimated conditioning on the remaining factors and control variables (results not shown here). Asterisks *, **, *** indicate statistical significance at 10, 5, 1 and 0.1% level. Source: CBE Monitoring and Evaluation 2016-2018.

For reading materials at home, we found that children who live in households which had reading materials had a lower learning loss due to the transition period in missing number identification relative to children who did not have access to reading materials. The relative learning loss was 7.3 percentage points lower. For all other numeracy subtasks, we did not find statistical evidence of a relative learning loss due to the transition period by having reading resources at home.

Finally, with respect to having access to a television, radio or mobile phone at home, we did not find statistical differences in relative learning loss for children who had access to at least one of these assets at home and those who did not (Table 5).[iv]

Combining Factors: learning loss due to effort, support from adults at home, availability of learning activities at home and availability of reading resources at home

In combining factors, it is important to obtain the number of children that we have for comparison purposes, i.e. ones that we are using for the average loss. For the model with all factors, we only have 6 children who did not have access to any of the 8 previously modelled factors. While this group may be extremely marginalised in terms of learning support, it is not possible to estimate the model empirically.

Hence, we decided to only use factors that were previously estimated as statistically significant for relative loss in a combined model, as shown in Table 6. The average learning loss during the transition is considered for children who did not work hard in lessons, never asked for help from adults at home when they did not understand lessons at school, were not involved in learning activities and did not have reading materials at home (78 children). For these children, the average learning loss during the transition was 33.4 percentage points for overall numeracy (with similar magnitude coefficients for all of the individual subtasks). For most subtasks, the average learning loss is the highest from all previously estimated models. We can conclude that these 78 children attained the greatest learning loss as a result of the time out of school than any other children in the sample.

Table 6: Learning loss during transition time: difference-in-difference estimator for main factors (individual, home support and home resources)

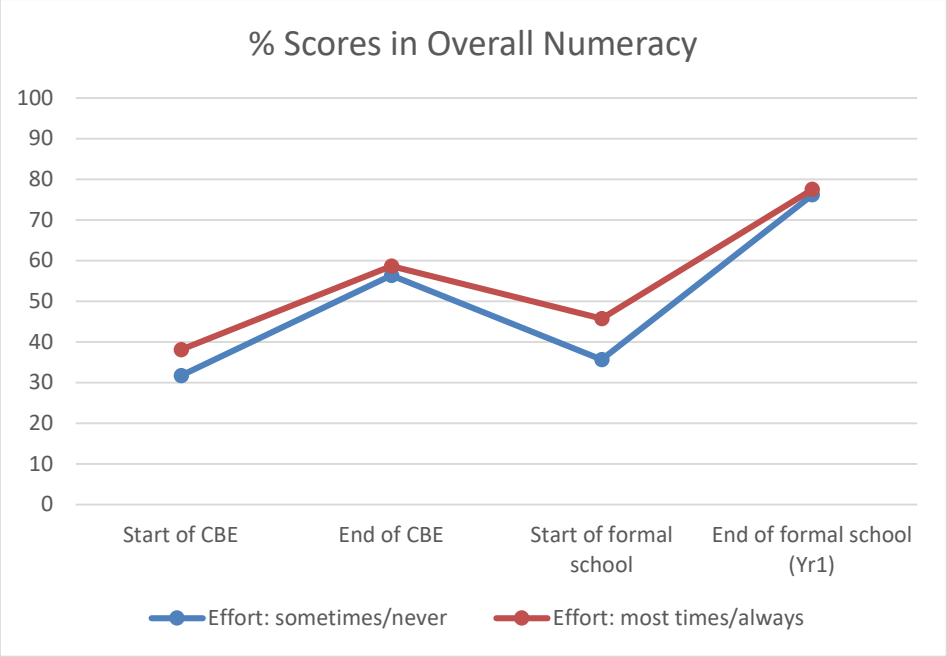
	Missing number	Addition	Subtraction	Numeracy Combined
VARIABLES	(1)	(2)	(3)	(4)
Average learning loss	-31.797***	-34.988***	-33.518***	-33.434***
(no effort, no help, no activities or resources)	(3.065)	(3.182)	(3.342)	(2.757)
Effort: tried hard	-5.276***	-5.823***	-3.877*	-4.992***
	(1.944)	(2.191)	(2.305)	(1.835)
DID: Lessons easy relative to hard	2.525	6.976**	6.647**	5.383**
	(2.497)	(2.928)	(3.001)	(2.427)
Sometimes ask adult help	-2.420	4.544*	0.151	0.758
	(2.224)	(2.529)	(2.677)	(2.169)
Most times ask adult help	-6.081**	6.158**	2.759	0.945
	(2.696)	(3.077)	(3.226)	(2.566)
DID: sometimes ask relative to never ask	2.031	-5.902*	2.189	-0.561
	(2.902)	(3.378)	(3.470)	(2.843)
DID: most times ask relative to never ask	14.135***	4.245	12.763***	10.381***
	(3.448)	(4.114)	(4.184)	(3.378)
Literacy/numeracy activities	5.083*	-5.145*	-1.830	-0.631
	(2.862)	(3.067)	(3.316)	(2.697)
DID: Learning activities relative to none	2.976	15.980***	9.199**	9.385***
	(3.635)	(4.017)	(4.162)	(3.436)
Reading materials	-0.653	-0.867	-0.038	-0.519
	(2.518)	(2.812)	(3.011)	(2.414)
DID: Reading materials relative to none	6.692**	4.436	3.654	4.927
	(3.278)	(3.745)	(3.892)	(3.165)
Lessons easy	7.010***	8.510***	7.560***	7.693***
	(1.361)	(1.622)	(1.667)	(1.337)
Maths ability: mostly good	11.834***	10.300***	10.707***	10.947***
	(1.449)	(1.674)	(1.772)	(1.420)
Time to study at home	1.938	2.229	2.870*	2.346*
	(1.371)	(1.573)	(1.608)	(1.320)
TV/Radio/Mobile	0.214	1.228	1.957	1.133
	(1.570)	(1.844)	(1.906)	(1.529)
Other Controls	Yes	Yes	Yes	Yes
Constant	41.899***	31.012***	22.314***	31.742***
	(6.022)	(6.924)	(7.261)	(5.800)
Observations	2,027	2,027	2,027	2,027
R-squared	0.329	0.274	0.240	0.336

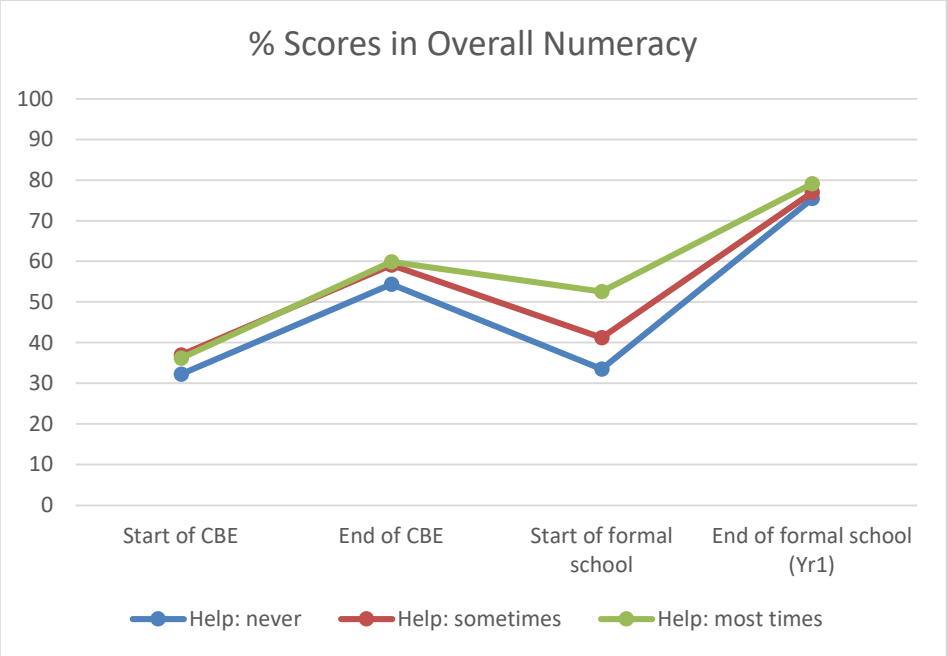
Note: Robust standard errors in parentheses. DID (difference-in-difference parameters) indicates the *relative loss* within factors. Each model is estimated conditioning on the control variables (results not shown here). Asterisks *, **, *** indicate statistical significance at 10, 5, 1 and 0.1% level. Source: CBE Monitoring and Evaluation 2016-2018.

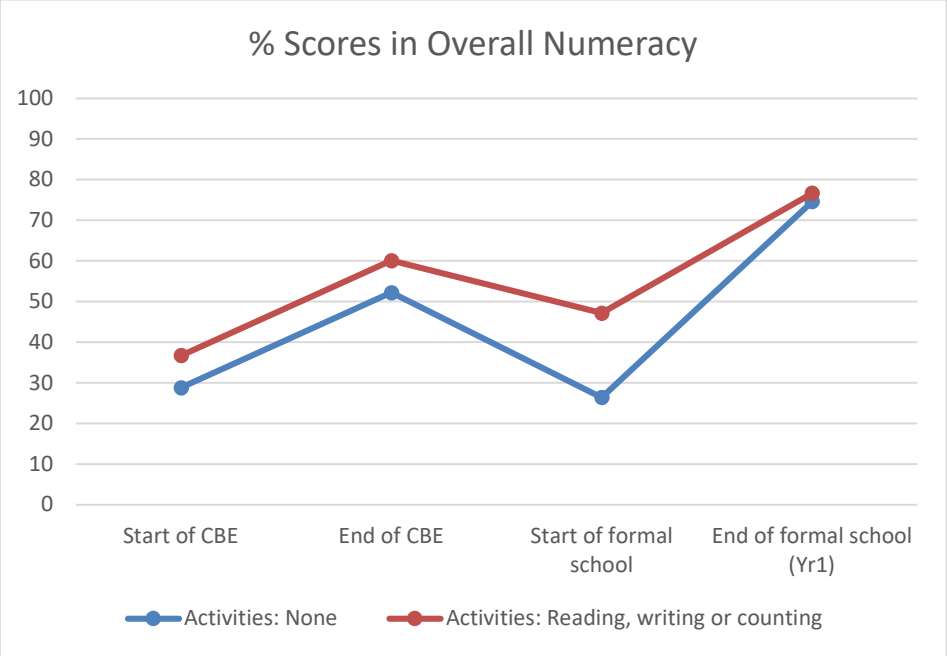
In terms of relative loss, the model that includes all previously estimated significant learning losses shows that all learning losses remain statistically significant (Table 6). What we estimate is that the size of the relative difference has reduced significantly with respect to those previously estimated. This is expected as the model includes not just more controls, but also more groups for comparison purposes. For example, if we compare the estimated learning loss for children who asked adults for help when they did not understand their lessons most of the time in Table 4 and in Table 6, we see a reduction from a 14.4 percentage point gap to a 10.4 percentage point gap relative to those who never asked for help. The main result remains. All factors previously estimating a gap remain statically significant when they are introduced in one model in Table 6.

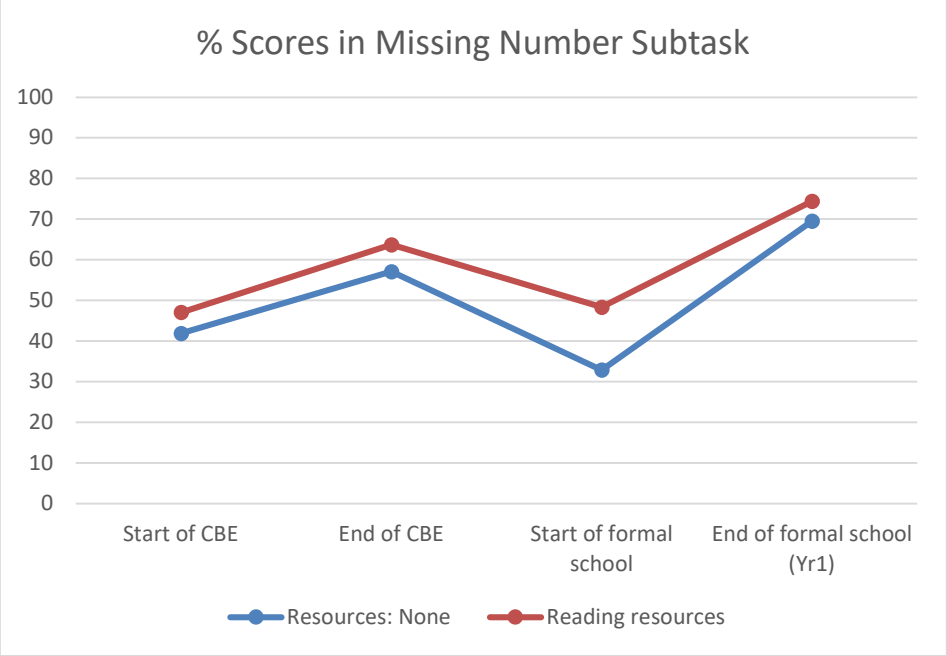
To understand more about these findings, we present the overall trajectories of children who have worked hard in lessons, asked for help, had access to learning activities and reading materials at home (see Figure 2). There are several findings to highlight from these figures. First, in all the cases presented (whether children work hard with their studies, whether they asked adults for help, whether they had learning activities or reading materials at home) the gap in numeracy achievement either remained the same or narrowed during the CBE programme. Secondly, and consistent with our analysis, these trajectories in numeracy scores show a widened gap in attainment during the transition period which then narrows again during the first year in government schools. This later finding points to the important role of schools as ‘equalisers’ of attainment; although this is only on average as previous analyses by Carter et al. (2020b) point out that low achieving girls do not have the same opportunity for equalising their attainment as low achieving boys do. Furthermore, our results also point to the importance of support at home during the transition and by implication during time off from school due to COVID-19 school closures.

Figure 2: Learning trajectories for children with access to diverse support at home and effort (different numeracy indicators).









In Table 7 we estimate that the learning loss for those who did not ask for help relative to those who asked for help most of the time is equivalent to 38.7% of the average learning gains achieved during the CBE programme. For those who did not have access to learning activities, the learning loss during the transition relative to those who did have access is equivalent to 35% of the average

learning gains previously obtained during the CBE programme. With respect to effort, the relative learning loss between those who worked hard in their lessons and those who did not is equivalent to 20% of the learning gains in the CBE programme. Since we found statistical significant results on the subtask for missing number identification for children who had access to reading materials, we used this subtask to present results in Figure 2 and Table 7. The learning loss in missing number identification for children who did not have access to reading resources relative to those who did have access was equivalent to 41.1% of the previous learning gains in missing number identification from the CBE programme (Table 7).

Table 7: Estimated relative learning loss between factors compared with learning gains during previous school experience in CBE (combined numeracy measure for all factors except reading materials)

	Estimated DID	Loss relative to previous gain	sig.
Effort	5.38	20.1%	**
Ask help (sometimes)	-0.561	-2.1%	
Ask help (most times)	10.381	38.7%	**
Literacy/numeracy activities	9.385	35.0%	**
Reading materials (*using missing number)	6.692	41.1%	**

Note: Estimates obtained from Table 6. Average gains in numeracy during CBE programme was estimated to be 26.8 percentage points for the combined numeracy score and 16.3 percentage points for missing number identification. Asterisks *, **, *** indicate statistical significance at 10, 5, 1 and 0.1% level.
Source: CBE Monitoring and Evaluation 2016-2018.

Conclusions

There is an urgent need to provide evidence on the learning loss that might be expected as a result of school closures during the COVID-19 pandemic. This study was motivated by this urgency and aims to provide evidence on the learning loss experienced by disadvantaged children from Northern Ghana who benefited from one year of accelerated complementary education and then from one year of education in government schools. During the transition, these children spent around 3 months not in formal education. We estimate that the learning loss suffered over a three-month period ranged from just over half to more than 100% of the gains attained during the prior year. The differential losses result from the difficulty of the numeracy subtasks, whereby for the easiest, namely missing number identification, the learning loss over the transition period is over 100% of the learning gains during the CBE programme. For the more advanced numeracy subtasks, the learning loss is between

56% to 60% of the previous learning gains. Ultimately, this equates to an approximately 20% to 35% loss in learning gains per month that students are out of school.

Results from this study additionally underscore the critical role that individual and household factors play in learning loss for students from marginalised backgrounds in the Global South. As shown, not being motivated to put forth effort to study lessons learned while in school, being unable to ask for help from primary caregivers or adults in the household, as well as a lack of books and opportunities to engage in learning activity at home led to the largest relative losses for students. At a time when education is witnessing a surge in the use of digital platforms for learning, whether it is language apps, video conferencing tools or online learning software, this study reminds us that the basics matter most. This is particularly the case for students from remote and disadvantaged circumstances who struggle to gain access to books or any support at home, let alone to a computer or reliable internet. Without home-based support, these students will continue to fall further behind their peers and widen the gap that will have to be addressed by teachers once schools reopen.

A need for prioritisation of the basics for learning is also reinforced by our finding that children who did not have access to a television, radio or mobile phone at home did not have a learning loss over and above that of children who had access to these devices at home during the transition period. It is possible that these devices were not utilised for educational purposes at the time. Hence, this may explain why the lack of these resources at home was not associated with widening learning loss. It is possible that the use of these devices for educational purposes during the lockdown period will serve the purpose of supporting children's learning while at home. Still, we estimated that 20% of children in our sample did not have access to any of these devices at home. In our sample of around 40,000 learners who were enrolled in the CBE programme in the academic year 2016-17, this represents 8,000 learners. Supporting these learners with printed educational materials and learning activities has to be a priority.

Whilst this study represents an initial attempt to look at factors impacting learning loss due to school closures for marginalised students from developing countries, its findings resonate with evidence from the Global North. For example, studies have indicated that giving books to children from low-income backgrounds and encouraging them to read can be cost-effective and replicable ways to develop learning during breaks in schooling (Miller, 2007; Blazer, 2011). Studies have also revealed that positive connections with parents can have a significant impact on student achievement during transition and break periods in schooling. As such, parents should be supported to help their children's learning and development and given strategies to cope with schedules and child care issues (Blazer, 2011; Miller, 2007; Terzian et al., 2009). Although it is important to highlight that

parental literacy rates and levels of schooling are higher in the Global North and that the expectations of parental support in the Global South may take different forms.

Another main take-away from this study, is the important role that children's agency has in learning loss. A key implication of this finding is the need to pay attention to the psychosocial wellbeing of students during and following the COVID-19 crisis so they do not disengage and give up on learning. Kuhfeld et al. (2020) noted that disruptions to schooling resulting from natural disasters (in the United States and New Zealand) had long lasting effects, "with some students continuing to show psychological distress and trouble concentrating for several years afterwards" (p. 11). Related to this, is the need for the extra support for children from marginalised groups once they return to school. Compounding lower learning levels at the point of re-entry, students from disadvantaged backgrounds may face extra pressures in the aftermath of the COVID-19 crisis.

Whilst it remains to be seen what these pressures will constitute, previous research has shown that changes in classroom routines and layout following crises can disrupt learning, affect concentration and lead to a negative attitude towards learning for students from challenging backgrounds (Mudavanhu, 2015). Social-distancing measures may very well bring about such changes in the classroom environment, which could lead to similar outcomes. Reports have also shown that because of food shortages after disasters, children normally help the family to get food, missing more school in the process and eventually not performing well due to the inconsistency in schooling (Ayieko, 2006). These factors result in high failure, dropout and absenteeism. Financial constraints have also been found to cause families to withdraw students from schools (Mudavanhu, 2015). Whilst time will tell exactly what challenges will arise post COVID-19, the financial devastation already being felt will likely continue even after the crisis has passed, potentially limiting many children's opportunities to learn, even while at school.

Finally, we only focus here on certain resources and supporting activities at home which were experienced by children during their educational trajectories. We are unable to address the complex relation between children's willingness to ask for support and parents being able to offer support. We are also unable to address other complex interrelations between language and gender, which have been previously investigated for the case of the CBE. For instance, Carter et al. (2020a) have demonstrated the potential widening of the gap during transition for learners who changed language of instruction. Low performing girls were less likely than low performing boys to be able to re-gain their learning after the transition, thus widening the gender gap. This suggests that particular measures are likely to be needed to support these girls (Carter et al., 2020b). We are not certain how many children will return to schools or under which conditions. Learning in schools will have to be

only one way to continue to support children’s learning. Learning at home and in communities has to be reimagined if rapid gains are to be achieved in the post-COVID 19 era.

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Table A1: Learning loss during transition according to different factors (self, home support and home resources)

		Achievement in test scores								
Variable	Description	Missing number			Double-digit Addition			Double-digit Subtraction		
		End CBE	Start Gov.	Diff.	End CBE	Start Gov.	Diff.	End CBE	Start Gov.	Diff.
Lessons easy	Sometimes/never	57.5	39.5	-18.0	54.4	36.6	-17.8	48.2	31.9	-16.3
	Most of the times/always	68.8	50.7	-18.1	66.2	52.5	-13.7	60.1	46.8	-13.3
Effort	Sometimes/never	60.6	40.4	-20.2	57.7	36.2	-21.5	50.8	30.2	-20.6
	Most of the times/always	62.5	46.3	-16.2	59.6	47.6	-11.9	53.9	43.3	-10.6
Self-concept ability	Sometimes/never	55.2	38.0	-17.2	53.8	35.5	-18.3	46.7	31.5	-15.3
	Most of the times/always	76.4	56.3	-20.1	70.0	58.2	-11.8	65.8	50.7	-15.1
Time study	No	61.5	43.1	-18.4	57.0	40.7	-16.3	53.1	33.1	-20.1
	Yes	62.0	44.7	-17.3	59.7	43.8	-15.9	53.2	40.2	-13.0
Asking for support	Never ask	60.6	37.7	-22.9	53.1	34.7	-18.4	49.3	28.1	-21.2
	Sometimes ask	63.1	43.8	-19.4	61.0	42.4	-18.5	53.2	37.6	-15.7
	Most of times/always	60.4	52.4	-8.0	63.0	54.3	-8.8	56.1	51.0	-5.0
Activities at home	None	55.0	30.6	-24.4	54.4	25.4	-29.0	47.2	23.2	-24.0
	At least one	64.4	49.1	-15.3	60.5	49.2	-11.3	55.3	43.4	-11.9
Reading Materials	No	57.1	32.9	-24.2	55.9	31.6	-24.3	48.6	27.3	-21.3
	Yes	63.7	48.4	-15.3	60.0	47.0	-13.0	54.9	42.0	-12.9
TV	No	61.3	43.3	-18.0	59.1	41.8	-17.2	54.4	37.3	-17.1
	Yes	66.1	50.4	-15.7	59.5	49.4	-10.1	48.4	43.2	-5.2
Radio	No	57.3	39.8	-17.6	57.0	38.4	-18.6	49.2	34.2	-15.0
	Yes	66.0	48.4	-17.7	60.9	47.0	-13.9	57.0	41.6	-15.4
Mobile Phone	No	61.3	41.7	-19.6	63.1	39.2	-23.9	53.9	35.1	-18.8
	Yes	62.2	45.3	-16.9	57.5	44.4	-13.1	52.9	39.2	-13.7
Sample size	Number of observations	1,166								

Endnotes

i. DRIC held consultations with the Ghana Education Service's National Assessment Unit to ensure agreement on the proposed modifications to the standard EGRA/EGMA tools. For quality assurance purposes, the translation of the various assessment items into the different mother tongue languages was done following a test and item specification provided to translators by DRIC. See DRIC/UCC (2016), *Complementary Basic Education (CBE) Learners Assessment: Baseline Report for 2015/2016* for a full account of the process of developing the original instruments.

ii. Results remain unchanged if we combine television and radio and isolate mobile phone, as some countries are delivering learning resources via radio and television.

iii. The parameter for double-digit addition was statistically significant but only at the 10 percent level.

iv. As shown in Appendix Table A1, children who have these assets at home (television, mobile phone or radio) tend to achieve higher scores in all the numeracy subtasks relative to children living in households without these assets.

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All details correct at the time of going to print, June 2020.