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Sakaue, Katsuki

Wokadala, James

Ogawa, Keiichi

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(URL)

Effect of parental engagement on children's home-based continued learning during COVID-19–induced school closures: Evidence from Uganda

Katsuki Sakaue [a],[*], James Wokadala [b], Keiichi Ogawa [a]

[a] *Graduate School of International Cooperation Studies, Kobe University, 2-1 Rokkodai-cho, Nada-ku, Kobe 657-8501, Japan*
[b] *College of Business and Management Sciences, Makerere University, Plot 51, Pool Road, Kampala P.O. Box 7062, Uganda*

A B S T R A C T

This study examines the effect of parental engagement on children's continued learning amid COVID-19–induced school closures in Uganda, where the government's distance learning program had limited coverage. The results show that children from households with more parental engagement are more likely to engage in learning activities at home when primary schools are closed. A significant effect of parental engagement is found in rural areas as well. Furthermore, we found that, in rural areas, the level of parental engagement is significantly more correlated with home-based learning among children from government schools than those from private schools.

1. Introduction

School closures have been introduced worldwide as part of the common non-pharmaceutical interventions for reducing the spread of COVID-19. To mitigate the negative impact of learning loss caused by school closures, significant efforts have been made across countries to set up distance learning platforms for ensuring equitable access to quality learning. However, considering the limited capacity of information and communications technologies (ICT), concerns about the effectiveness of this strategy, particularly in low-income countries, have been raised (United Nations Educational, Scientific and Cultural Organization [UNESCO] et al., 2020).

A growing number of studies have explored the inequalities in home-based learning amid school closures. Studies from low- and middle-income countries (LMICs) have primarily focused on access to distance learning platforms and highlighted the digital divide as the main source of learning inequality amid school closures (Avanesian et al., 2021; Azubuike et al., 2021; Hossain, 2021; Van Cappelle et al., 2021). However, research has revealed that majority of the children, especially those in LMICs in sub-Saharan Africa (SSA), are engaged in home-based learning without reliance on digital learning platforms (Dang et al., 2021; Uwezo, 2020). Despite this, few studies have explored the determinants of home-based learning in a situation where the public distance learning system is inadequate. Although its potential has been emphasised and its effects on home-based learning during school

closures have been assessed in some LMICs (e.g., Annual Status of Education Report Centre [ASER], 2021; Brossard et al., 2020; Heyneman, 2022; Yu et al., 2021), studies directly examining the influence of parental engagement using nationally representative data collected during school closures remain limited, particularly in low-income countries.

Uganda, a low-income country in East Africa, is a case in point to fill this empirical research gap. Uganda is among the countries that closed primary schools for a long period.[1] While its Ministry of Education and Sports (MoES) distributed home learning materials for free and broadcasted lessons through radio and television during the school closures (MoES, 2020a), a study revealed that such interventions have limited coverage (Uwezo Uganda, 2021). Besides, without relying on the ICT-based distance learning platforms, some case studies documented that home-based learning efforts by parents/guardians expanded, especially during the period of prolonged school closures (Atuhurra et al., 2022). Against this background, this study applies a community fixed effects approach to address the challenges in identifying the effect of parental engagement on children's continued learning at the primary education level during the COVID-19–induced school closures in Uganda. We used nationally representative sample data from the Uganda High-Frequency Phone Survey (UHFS) and the Uganda National Panel Survey (UNPS) 2019/20.

The remainder of the paper is organised as follows. Section 2 reviews prior literature on the determinants of learning engagement during the

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COVID-19 pandemic and the influence of parental engagement on children's learning. Section 3 describes Uganda's policies on COVID-induced school closures. Section 4 explains the methodology. Section 5 presents the results and discussion and Section 6 provides the conclusion.

2. Literature review

2.1. Determinants of children's learning during the COVID-19 pandemic

Several observational studies have explored the determinants of home-based learning using large-scale datasets collected during the pandemic. These studies assessed the extent to which socioeconomic status (SES), namely the social and economic position of a household typically measured by wealth, income, occupation and education, is associated with children's learning engagement at home (Azevedo et al., 2021). Although high-income countries have generally succeeded in establishing a distance learning system to ensure that students have access to schooling during the pandemic, evidence repeatedly shows that learning inequalities have widened due to differences in the type of method used and how it is used (Bacher-Hicks et al., 2021; Champeaux et al., 2022; Jæger and Blaabæk, 2020; Mangiavacchi et al., 2021).

Studies have also explored the roles of parents, neighbourhoods, and schools in high-income countries, in widening or mitigating inequalities during the pandemic. These studies have shown the positive effect of the involvement of the abovementioned actors on children's home-based learning (Agostinelli et al., 2022; Andrew et al., 2020; Dietrich et al., 2021; Grewenig et al., 2021). While these studies have also shown that learning inequalities persist or are even worsened by channels operating through these actors during school closures, there are studies that assessed the effectiveness of interventions which are designed to mitigate inequalities during the pandemic. For instance, Carlana and La Ferrara (2021) found a stronger effect of the provision of free online tutoring by volunteering university students on learning outcomes of secondary school students from lower SES households in Italy.

In LMICs, where the overall infrastructure capacity is weaker than that in high-income countries, learning inequality primarily stems from the differences in access to distance learning systems across various socioeconomic and vulnerability status groups (Avanesian et al., 2021; Nicola et al., 2021; Nicola et al., 2022; Wolf et al., 2022).[2] For instance, a study conducted in Ethiopia, two states of India, Peru, and Vietnam, found that students from wealthy and highly educated households in urban areas with Internet access are more likely to engage in online learning or use alternative platforms provided by schools (Hossain, 2021). Another study from India found that the digital divide is not only determined by access to technology but also by the effective use of learning technology among adolescents in LMICs (Van Cappelle et al., 2021). Additionally, a study using nationally representative data of primary and secondary school children in Bangladesh found no evidence that shows ensuring technology access can boost children's learning time at home during school closures (Asadullah and Bhattacharjee, 2022). This finding implies the importance of promoting digital competence of parents as the country provides a distance learning system, which is also emphasised to some degree in a high-income country context (Seabra et al., 2022).

Moreover, it is worth noting that mitigating the digital divide may not be the realistic solution in countries whose supporting infrastructure for ICT use in education is considerably limited. Descriptive analyses based on the household-level learning assessment conducted by Uwezo

in Kenya and Uganda have revealed that distance learning systems using ICT, including ones that use radio or television, reached only a fraction of school-aged children and were ineffective (Uwezo, 2020; Uwezo Uganda, 2021). Despite this, limited efforts have been made to investigate the unique determinants of home-based learning among children who do not particularly rely on ICT-based distance learning systems, even though they comprise much of the population particulary in low-income countries.

2.2. Influence of parental engagement on children's learning

The importance of parental engagement in children's educational outcomes has been well recognised in previous literature in various fields (Avvisati et al., 2010; Boonk et al., 2018). In Economics, parental time is considered one of the essential family inputs in the commonly used education production function (Todd and Wolpin, 2003). While less focus is given to the identification of the effect of family inputs, compared with school inputs, among empirical literature applying education production function, rigorous studies in the United States have identified a significant impact of family inputs on both children's cognitive and non-cognitive skill development (Cunha and Heckman, 2009; Todd and Wolpin, 2007).

In addition, a group of observational studies in high-income countries have typically applied the instrumental-variable (IV) approach, which is one of the empirical strategies designed for identifying causal effects of a certain policy or practice in the absence of experimental data, to explore the causal link between parental engagement and children's learning achievement and/or behavioural outcomes (Aizer, 2004; Cabus and Ariës, 2017; Houtenville and Conway, 2008; Neymotin, 2014). For instance, Houtenville and Conway (2008) found that parental effort had a strong positive effect on learning achievement, particularly for reading and math test scores, in case of public school children in the United States. Using the same dataset, Neymotin (2014) identified the positive effect of parental involvement on high school children's behavioural outcomes. A recent study from the Netherlands found that parental involvement in homework had a positive effect on the academic achievement of secondary school students (Cabus and Ariës, 2017).

Using large-scale household survey data from LMICs, a growing number of empirical studies have examined the effect of various types of parental engagement on different outcomes related to early child development (e.g., Ong'ayi et al., 2020; Sun et al., 2018). At the primary education level, Mahuro and Hungi (2016) found that parental participation through parenting and communication types of involvement is positively correlated with students' learning achievement using data collected from sixth-grade students from two rural districts in Uganda. A study was also conducted in rural districts of one state of India, finding that wealthier parents are more likely to get involved in the education of low-achieving children (Cashman et al., 2021). Another study from Bangladesh identified the lack of parental support as one of the key predictors of dropout among primary-school-age children (Sabates et al., 2010).

2.3. Parental engagement and children's home-based learning during school closures

During COVID-19–induced school closures, the role of parents in education has been reinforced in several studies as the parents became primarily responsible for children's continued learning (Khalid and Singal, 2022; Ribeiro et al., 2021; World Bank et al., 2021). Many studies, which investigated the effect of school closures on children's development outcomes, including their psychosocial functioning, identified the mediating effect of parental practices (Penna et al., 2023). While most of these studies have identified a negative effect (Panda et al., 2020), a study from New Zealand highlighted its finding on the mixed positive and negative effects (McNeill and Gillon, 2022).

As already mentioned, some studies in high-income countries have

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[2] Inequalities in access to distance learning systems is also observed in high-income countries where distance learning system is underdeveloped such as Japan (Akabayashi et al., 2023). Blaskó et al. (2022) also pointed out that there is a significant variation in the share of children who have no access to important distance learning resources across countries in Europe.

found that parental support was one of the key non-SES predictors of children's learning during the pandemic (Agostinelli et al., 2022; Grewenig et al., 2021). A study from China also highlighted the central roles of parental involvement and children's learning engagement during school closures (Yu et al., 2021). In addition, there are studies especially from high-income countries, that investigated how the changes in intrahousehold parental divisions during the pandemic affected children's home-based learning. For instance, a detailed study from Italy identified the positive effect of fathers' increased involvement on their children's home-based learning during school closures (Mangiavacchi, 2021).

Based on descriptive analysis using pre-pandemic data, Brossard et al. (2020) argued for the potentially important role of parental engagement in ensuring children's continued learning at home in LMICs, particularly where access to ICT-based distance learning platforms is lacking. Recent studies have also explored this topic in LMICs using data collected during the pandemic. For instance, ASER Centre (2021) highlighted their findings that more than three-quarters of children in rural primary schools in India received help from their family members. They also found that children receive more support when their parents are more highly educated and when they are in non-government schools instead of in government schools (ASER Centre, 2021). A descriptive analysis using phone survey data collected in rural areas in one district in India found that parental involvement during school closures could reduce the probability of their children dropping out (Sarkar et al., 2022). Besides, a study from Nigeria revealed a significant correlation between the parents' educational level and their ability to support their children's home-based learning (Azubuike et al., 2021).

Related to this research, a group of studies assessed the impact of interventions that facilitate parental engagement or the effect of facilitated parental engagement on children's learning during school closures.[3] Heyneman et al. (2022) revealed a positive correlation between inspired parental engagement and children's learning achievement amongst the participants of a nationwide non-formal primary education programme during school closures. In Botswana, Angrist et al. (2022) conducted a randomised control trial to assess the impact of interventions using short message service and phone calls during school closures. Although the findings ignored heterogeneity in the effect of different SES groups, the intervention was shown to have a significantly positive effect on parental engagement in education at home and the children's learning achievement.

3. Context of the study

In Uganda, school closures were first ordered on 18 March, 2020 and went into effect on 20 March. The academic year (AY) 2020, which started on 3 February, was cut short by the immediate school closures. Although the duration was set for one month in the initial order, it was extended to five more months. From September 2020, the government made efforts to reopen schools in a phased manner. For primary education, seventh-grade classes first resumed on 15 October, 2020.[4] Originally slated for 7 June, efforts to resume classes for the remaining grades were interrupted by the second wave of the pandemic. The total lockdown imposed in June 2021 called for the full closure of all schools in Uganda. Consequently, face-to-face classes for first- to third-grade pupils in AY 2020 had been stalled for around two years. Schools reopened only on 10 January, 2022. Fig. 1 shows a timeline of school closures/reopening for primary education in Uganda.

Uganda's MoES immediately developed a response plan for the COVID-19 pandemic, focused on ensuring children's continued learning at home (MoES, 2020b). Under the framework for implementing this plan, the MoES made efforts to distribute printed home learning materials for free and to broadcast lessons by model teachers selected from districts through radio and television (MoES, 2020a).[5]

The roles of parents/guardians specified in the framework include the following: 1) monitor and guide children's learning process; 2) provide materials; and 3) provide support as needed, including making time for the children and facilitating access to the radios and TVs (MoES 2020a, p. 5). A quick assessment was made to investigate the coverage of these interventions during the first phase of full school closures. According to Uwezo Uganda (2021), the proportion of students who had been enrolled in formal education in AY 2020 and engaged in home-based learning was the highest for seventh-graders (71%) and decreased with the lower grades: 56% for sixth-graders and 28% for first-graders. Radio and television lessons were used 29% and 12% of those who engaged in home-based learning, respectively. Printed materials from the government were used by 22% of the students.

Apart from the government's main distance learning measures, some efforts were initiated at the community level to facilitate continued home-based learning. These efforts typically mobilised volunteer teaching assistants and/or teachers to interact with children in a small group, receiving support from non-state actors such as NGOs (Datzberger et al., 2022; Uwezo Uganda, 2021). Although few studies have explored whether these community-led efforts enhanced continued learning at the national level, some investigated the community's coping strategies during the prolonged school closures in Uganda. For instance, Atuhurra et al. (2022) documented the home-based learning efforts in rural areas in six districts in the Busoga sub-region of Eastern Uganda. According to findings from their qualitative case study, parents/guardians became more responsible for their children's learning after they realised the limited coverage of the government's distance learning program. This study also documented cases where some government primary schools ensured teacher availability in response to parents'/guardians' requests for additional support for home-based learning.

While imposed on government schools during the period of closure, the same regulation generally applied to private schools, to whom printed home learning materials were also distributed (MoES, 2022).[6] Although the government continued to pay government school teachers during school closures, private schools, whose major source of income is fees charged from parents, struggled not only to pay teachers' salaries but also to maintain the schools' operation with limited support from the government. While private schools could collect tuition fees from students' families and continue teaching using their own distance learning platforms utilising ICT, some—especially those categorised as low-fee private schools—still suffered from serious financial distress and indebtedness as school closures were extended (Alam and Tiwari, 2021; Ehwi and Ehwi, 2021; Kahunde et al., 2022).

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[3] Before the pandemic, a growing number of experimental studies had provided precise estimates on the impact of interventions that promote parental engagement on children's outcomes (Avvisati et al., 2014; Barrera-Osorio et al., 2022).

[4] Within the national curriculum of Uganda, children start with seven years of primary education (from first- to seventh-grade), from six to twelve years of age.

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[5] Although the MoES's framework to implement a response plan for the COVID-19 pandemic targets both primary and secondary education level, the policy context for primary education is mainly reviewed since the study focuses on continued learning of children who enrolled in primary schools before the school closures.

[6] Uganda abolished fees in the target primary schools when the Universal Primary Education (UPE) policy was introduced in 1997 (Byamugisha and Nishimura, 2015). All schools that receive a capitation grant from the government under the UPE policy are referred to as government schools in this study. Following the terms used in government documents, all schools that are run by non-state actors, including non-government organizations, private entrepreneurs, and investors, and do not receive a grant from the UPE policy are referred to as private schools in this study (MoES, 2017, p. 27; Kabay, 2021, p. 78).
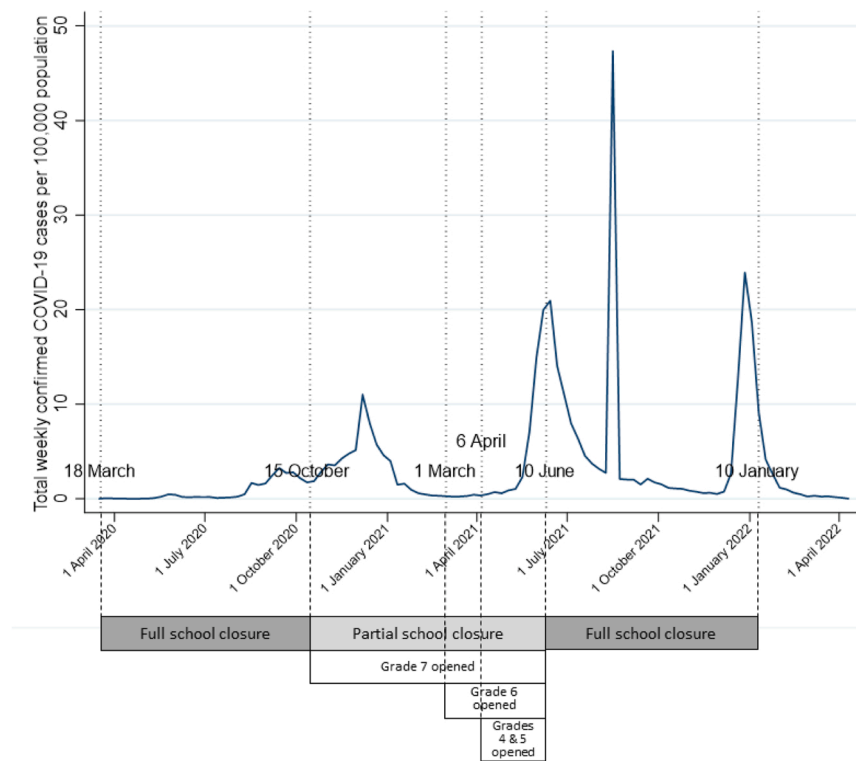
Fig. 1. Timeline of COVID-19 and school closings/reopening for primary education in Uganda.
Source: Elaborated by the authors based on World Health Organization (2022).

4. Methodology

4.1. Analytical framework and empirical strategies

Before explaining the framework used for analysing the determinants of children's learning engagement, the study needs to clarify the definition of the key concept: parental engagement.[7] The previous studies have made several definitions of this concept. Although there are also several ways in categorising considerably diverse forms of parental engagement, related literature generally makes a broad distinction between the one based at school and the one based at home (Boonk et al., 2018; Pomerantz et al., 2007). In line with other studies that investigate the effect of parental engagement during school closures, this study focuses on the parental engagement at home (Ribeiro et al., 2021; Yu et al., 2021). While, among the studies in a normal setting, parents' home-based engagement is often defined as parents' practices that assist their children with tasks directly related to schools, including homework, communication about school matters (e.g., Barnard, 2004), this may not be applicable in exploring the cases during school closures in low-income countries where schools provided limited access to curriculum-based online learning opportunities. Thus, to directly capture the level parental engagement activities inside the house during school closures, this study defines parental engagement as parents' commitment in two of the most important dimensions of caregiving practices at home in early childhood and primary education: (1) cognitive; and (2) socioemotional caregiving (Bornstein and Putnick, 2012; Cosso et al., 2022; Ma et al., 2016).

For our empirical application, the study primarily followed Hossain (2021), which explores the learning inequality by SES during COVID-19

school closures in LMICs. Although the amount of learning time is typically used as a proxy for students' educational outcomes during school closures in high-income countries, a binominal variable that indicates whether a student engages in learning was used due to the common limitations of the data from LMICs. In addition to the SES variables and other standard controls included in Hossain's (2021) model, this study focused on assessing the effect of parental engagement besides accounting for more factors.

The study used the framework developed by Werner and Woessmann (2021) to adjust a standard educational production function outlined by Hanushek (2020) to the context of COVID-19 school closures. Within the education production function, in which the skill development of children is modeled as a function of the student, family, and school inputs, school closures mean the reduction of school inputs. In essence, an increased learning gap is expected by theory because high-SES parents can compensate for lost inputs from the school more than low-SES families (Werner and Woessmann, 2021, p. 6).

Specifically, the following model was used:

$$Y_{ijk} = \beta_0 + \beta_1 P_{jk} + \beta_2 X_{ijk} + \varepsilon_{ijk} \qquad (1)$$

where Y_{ijk} is a binary variable that represents the learning engagement of the individual i in household j at community k. P_{jk} represents the level of parental engagement, X_{ijk} is a matrix of individual-, household-, and community-level covariates, and ε_{ijk} is the error term. The main coefficient of interest is β_1. One of the identification problems stems from the fact that limited community-level variables are available in the dataset. Besides, even though sufficient community-level variables are available, it makes sense to assume that there are important community-level unobservable confounding factors, such as enthusiasm for education, which affect both children's home-based learning and the level of parental engagement during school closures. To address this issue, the following equation was preferred where C_k represents community fixed effects:

$$Y_{ijk} = \beta_0 + \beta_1 P_{jk} + \beta_2 X_{ijk} + \beta_3 C_k + \varepsilon_{ijk} \qquad (2)$$

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[7] The term 'parental involvement' is also used to describe parents' investment in the education of their children (Cosso et al., 2022). This study uses the term, 'parental engagement,' following the terminology adopted by Sun et al. (2018), using the proxy variable that is identical to the one used in this study.

Although this study used the dependent variable with a dichotomous nature, a linear probability model (LPM), which uses ordinary least squares (OLS) as an estimation method, was preferred because its out-performance over maximum likelihood estimation methods, such as a probit model, has been argued by several studies, particularly when group dummy variables are included in the model (e.g., Angrist and Pischke, 2009; Timoneda, 2021). As a robustness check, the study also presents the average marginal effects for the key explanatory variable, which are calculated based on the estimates from probit regression analyses. Considering the sampling strategy described in the next subsection, standard errors were clustered at the community level to control for correlation within the community (primary sampling unit) in estimating all models following the suggestion by Abadie et al. (2022).

Although the study can utilise a relatively rich set of individual and household characteristics, household-level unobservable confounders may remain. Since the parental engagement variable is only available at the household-level, this study cannot include household fixed effects in the equation, unlike other studies (e.g., Aizer, 2004) that used an individual-level variable on whether a child receives parental support or not. Moreover, β_1 estimated by Eq. (2) may be biased since the relationship may run from children's learning engagement to parental engagement; whether a child in primary school engages in learning activities at home or not may determine the parents'/guardians' interaction with their children. To address the aforementioned issue, previous studies, which use the individual-level parental engagement variable, often applied IV approach.[8] However, under the condition that limited community-level variables are available and the parental engagement variable is only available at the household level, it was difficult to find the suitable IVs that affect the child's learning engagement only through parental engagement.

4.2. Data

The data were obtained from the fifth round of the UHFS conducted by the Uganda Bureau of Statistics (UBOS) in collaboration with the World Bank (UBOS, 2022a). As described in UBOS (2021), the sample for the first round of UHFS consisted of 2257 households, each having at least one member or reference individual with a phone number, which were selected from the UNPS 2019/20. The UHFS attempted to reach all the households unless they explicitly refused to participate in the subsequent rounds. In the fifth round, 2122 households were interviewed for 16 days starting from 2 February, 2021. This study mainly used the fifth round of the UHFS since data on the key explanatory variable of interest—parental engagement—was only collected in this round.

The UNPS, where the sample of UHFS came, started interviewing households in 2009/10. Out of 783 Enumeration Areas (EAs) that were targeted during the Uganda National Household Survey (UNHS) 2005/06, 322 were selected.[9] The UNHS 2005/06 adopted a stratified two-stage sampling design. At the first stage, EAs were selected via stratification in a way that the sample could generate estimates for urban and rural areas in the whole nation and each of the four regions. In the second stage, ten households were randomly selected from each EA in

principle (UBOS, 2006a, 2006b). According to UBOS (2010), EAs of UNPS 2009/10 were basically selected from EAs of UNHS 2005/06 with equal probability in each region, which was first stratified by urban/-rural and then by the district. Although the sample of the UNPS 2019/20 contained households added in the subsequent rounds of UNPS 2009/10 to replace the dropped households, sample refreshment was done to ensure the sample was still comparable to a nationally representative cross-section. This can generate reliable estimates for urban and rural areas in the whole nation using the updated census frame (UBOS, 2020).

The outcome variable used in this study was obtained from individual-level data on learning collected from the UHFS. After the fourth round, UHFS asked if each child aged between 3 and 18 in the household had been engaged in any education or learning activities in the past seven days. The study created a binary variable from the response to this question and used it as an outcome variable. Related to a key explanatory variable of interest, namely parental engagement, the fifth round of UHFS asked respondents if any household member aged 15 or over engaged in the following activities: (1) played, (2) read books or looked at picture books, (3) told stories, (4) sang songs, (5) went outside, and (6) named, counted, or drew things for or with randomly selected children aged between 2 and 10 in the last 17 days. With regard to the linkage of these activities with the definition of parental engagement of this study, the second and the third activity corresponds to the cognitive caregiving and the other activities correspond to the socioemotional caregiving. Based on Datar and Mason (2008), this study summed up the dichotomous variables created based on the responses to create a proxy variable for parental engagement.[10] In addition, the study presents the estimate using the alternative index created by principal component analysis (PCA) and multiple correspondence analysis (MCA) for checking the robustness of our main findings.[11] Not all households responded to all six items. Following Datar and Mason (2008), two missing responses were allowed in creating the composite variable on the parental engagement index applying the above measures.

Unlike traditional face-to-face surveys, UHFS only asked questions about the selected topics in each round, considering any more to be burdensome for the respondents. Like other high-frequency phone surveys, UHFS collected limited data on essential SES variables. The missing data in the UHFS were complemented by the baseline SES of households collected in the UNPS 2019/20 (UBOS, 2022b). Specifically, a variable for years of schooling was created based on the responses from UNPS 2019/20 about the highest education level attained.[12] This study used a variable on monthly per capita expenditure (MPCE) constructed by UBOS as a proxy for wealth.[13] Regarding the ICT asset, UHFS collected household-level data on television ownership and Internet

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[8] The key to success of IV approach in identifying the effect of parental engagement is to find a convincing IV, that is strongly correlated with parental engagement, but is not associated with the children's outcome apart from the possible indirect effect running through the parental engagement (Schwerdt and Woessmann, 2020). In the previous studies, whether the family had rules on chores (Houtenville and Conway, 2008), whether a parent is engaged in general volunteer work for helping child (Neymotin, 2014), and birth order of each child (Cabus and Ariës, 2017) were used as the IV for parental engagement.

[9] In this study, the term, 'community' is also used to indicate an EA. In Uganda's census, EA is not necessary a complete Local Council One (LC1), which is the smallest administrative unit in Uganda. EA can be part of LC1 or more than one LC1 (UBOS, 2005, p. 118).

[10] This simple strategy has been applied in previous studies that used comparable items to make a proxy for the level of parental engagement (e.g., Bornstein and Putnick, 2012; Sun et al., 2018). The Cronbach's alpha is 0.7636.

[11] In this study, the original variables for each parental engagement activity are categorical. Considering the fact that PCA was originally designed for summarizing a set of continuous variables, the study also uses MCA, which is more appropriate for categorical variables (Blasius and Greenacre, 2006). The study referred to the discussion by the previous studies which question the use of PCA in creating asset index (Booysen et al., 2008; Kolenikov and Angeles, 2009).

[12] UHFS asked a question about the highest level of education in the first round. However, the question was only given to one respondent in each household. Therefore, it is not possible to create a variable on the schooling of the household head based on UHFS data. Those who completed Junior 1, Junior 2, and Junior 3 levels were coded as having attended schooling for 7, 8, and 9 years, respectively. Those who completed post primary specialised training or certificate, completed post-secondary specialised training or diploma, and completed degree and above were coded as having attended schooling for 10, 16, and 17 years, respectively.

[13] Details of how UBOS constructed the MPCE variable in UNPS are described in Ssewanyana and Kasirye (2012).

access in the sixth round, which was undertaken around one month after the fifth round.[14]

Considering the non-negligible impact of the pandemic on household income, which was explored in previous research (e.g., Agamile, 2022; Kansiime et al., 2021), this study included additional SES variables, taken from the UHFS data, to account for the possible income losses experienced by households during the pandemic. Applying the same strategy used by Agamile (2022), this study used all the available dummy variables representing income reduction from each occupation type (wage work, agricultural production, and non-farm business) together with those representing income received by a household from each occupation type. We also created variables on other individual-, household-, and community-level cofounders, making the most of the available data from the UHFS. The definitions and data sources of all variables used in this study are listed in Appendix Table A1.

Previous studies that examined the relationship between parental engagement and children's learning had typically focused on younger children, believing that parental effort is the most influential the younger the child (e.g., Houtenville and Conway, 2008). Following this custom, the sample was restricted to children who had attended primary school before the beginning of the COVID-induced school closures, to explore the determinants of continued learning. It was further restricted to first- to sixth-graders because classes for seventh-graders were resumed in February 2021 when the fifth round of the UHFS was conducted (see Fig. 1 in Section 3). The final sample consisted of 2122 children from 976 households.

4.3. Descriptive statistics

Table 1 shows the descriptive statistics for the study's variables. Considering the substantially different development contexts between rural and urban populations, and the relatively small sample size for the urban population, regression was run for full and rural samples of children in the next section. Table 1 also reports the descriptive statistics by location to sense the rural-urban disparities in the sample characteristics.

As expected, urban children are more likely to engage in continued learning (49.5% of children continued learning in urban areas vs. 33.9% in rural areas). There is no statistically significant difference in the parental engagement index between rural and urban areas. However, a significant difference was found in the availability of children's books. While half of children in urban areas are from households with at least one children's book, only 37% of children in rural areas have access to a children's book at home.

Although the schooling (years) of the household head was used as one of the SES variables, the summary statistics of its categorical variables are also presented to unveil the rural-urban disparity in a more tangible manner. As shown in Table 1, 50.4% of the children in rural areas belonged to households whose heads had not completed primary education, and 30% belonged to households whose heads had completed post-primary education. The majority of children in the urban areas were from households whose heads had completed post-primary education. In addition to the rural–urban gap in wealth, Table 1 confirms the significant gap in ICT assets; urban children are significantly more likely to have television and Internet access. In rural areas, only 14.5% and 8.6% of children are from households with television and the Internet, respectively.

This study also descriptively checked the disparity in continued learning and the home learning environment by SES group and school type. As shown in Appendix Table A2, the independent-means *t*-test result shows that children from richer households with a more educated household head who attended a private school before school closures are

more likely to engage in learning, receive more parental engagement, and have access to children's books than their counterpart. This overall trend is consistent with the one observed in rural areas in India by research that descriptively analysed the proportion of children who receive help from parents by parents' education and school type (ASER Centre, 2021) as well as studies that primarily assessed the correlation between SES and parental support (Azubuike et al., 2021; Cashman et al., 2021).

5. Results and discussion

5.1. Determinants of children's home-based continued learning

This study first conducted analyses using LPM to examine the individual-, household-, and community-level determinants of children's continued learning during school closures. Table 2 shows the results for the full and rural samples. Table 2 only presents the results from the selected models. How the main coefficient of interest changed as more covariates were added is presented in Tables A3 and A4 in the Appendix for full and rural samples, respectively.

This study first explored how the key factors identified in the previous literature on LMICs (e.g., Azubuike et al., 2021; Hossain, 2021) determine continued learning amid prolonged school closures. Unlike mentioned in previous studies which emphasised the digital divide as the main source of learning inequality amid school closures (Avanesian et al., 2021; Azubuike et al., 2021; Hossain, 2021; Van Cappelle et al., 2021), access to ICT tools is not a key predictor, which is consistent with the finding from Asadullah and Bhattacharjee (2022). In the full sample, television ownership showed a significant effect in the model controlling for community dummies only at the 10% level (Column 3 in Table 2). While television ownership has a significant effect in rural areas at the 10% level in baseline models, it turns insignificant after controlling for community dummies (Columns 5 and 6 in Table 2).

Regarding the SES variables, the significantly positive effect of welfare is not found in all models through an OLS regression analysis. While that of household head's schooling is found at the 10% level (Columns 1 and 4 in Table 2), it loses its significance after controlling for home learning environment factors. Although these results somewhat contradict the ones commonly found in previous studies that applied a similar model (Andrew et al., 2020; Azubuike et al., 2021; Dietrich et al., 2021; Grewenig et al., 2021; Hossain, 2021), it should be highlighted that inequality due to income losses brought by the pandemic was persistent across different specifications. This suggests that the role of home learning environment factors has been limited in mediating learning inequalities brought by income losses during the pandemic. Both the full and rural samples analyses showed that children in households that experienced a reduction in income from agricultural production are around 17 percentage points less likely to engage in learning even after controlling for community dummies (Columns 3 and 6 in Table 2).

Children who attended private schools before the pandemic are significantly more likely to continue learning in the baseline models, which hold SES and other individual/household characteristics except home learning environment factors constant. Although the effect is significant in both the full and rural samples at the 5% level (Columns 1 and 4 in Table 2), it gets insignificant when home learning environment factors are controlled (Columns 2 and 5 in Table 2). In the rural model, a significant difference by school type is observed in the model with community dummies, however, the significance level was 10% (Column 6 in Table 2). Although the result suggests that the home learning environment is a more dominant factor than school type in determining continued learning, heterogeneity in the effect of parental engagement by school type may exist.

The study included control variables related to household composition, which were not included in previous studies on LMICs. According to the full sample analysis, there seems to be an overall trend that

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[14] The sixth round of data collection was conducted for 18 days from 22 March, 2021 (UBOS, 2021).

Table 1

Summary statistics for full, rural and urban samples.

Variables	Full ($n = 2122$)		Rural ($n = 1734$)		Urban ($n = 388$)		Difference
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	
Individual characteristics							
Learning engagement (%)	36.7		33.9		49.5		−15.6***
Female (%)	50.6		51.5		46.6		4.85*
Age	10.2	3.0	10.3	3.0	9.9	3.1	0.424**
Grade							
Grade 1 (%)	20.6		21.9		14.7		7.22***
Grade 2 (%)	16.6		16.2		18.6		−2.35
Grade 3 (%)	19.1		19.1		19.1		0.02
Grade 4 (%)	16.9		17.1		16.0		1.15
Grade 5 (%)	13.9		13.3		16.2		−2.92
Grade 6 (%)	12.9		12.3		15.5		−3.12*
Attended private school (%)	37.0		33.3		53.6		−20.3***
Relationship to the household head and birth order							
First born	16.1		15.6		18.3		−2.73
Middle born (households with more than 2 own children)	52.6		54.8		42.5		12.3***
Last born (households with more than 1 own child)	11.7		10.9		15.2		−4.31**
Grandchild (%)	15.7		14.8		19.8		−5.02**
Others (other relatives or non-relatives) (%)	3.9		3.9		4.1		−0.26
Household characteristics							
Number of children	5.0	2.2	5.2	2.2	4.4	1.8	0.814***
Number of adults	2.6	1.2	2.6	1.2	2.8	1.5	−0.163**
Age group of household head							
Under 30 years (%)	4.1		4.3		3.4		0.975
30–39 years (%)	24.4		22.8		31.2		−8.35***
40–49 years (%)	36.4		38.1		28.6		9.51***
50–59 years (%)	20.0		19.6		22.2		−2.61
Over 60 years (%)	15.1		15.2		14.7		0.477
Female household head (%)	24.0		22.0		33.0		−11.0***
Schooling (years) of household head	7.1	3.6	6.7	3.4	8.9	4.0	−2.14***
Schooling of household head (categorical)							
No schooling or some primary	46.3		50.4		27.8		22.6***
Completed primary	19.8		20.1		18.6		1.57
Some or completed secondary	27.1		24.4		39.2		−14.8***
Completed post-secondary	6.8		5.1		14.4		−9.36***
Log (MPCE)	11.2	0.6	11.1	0.6	11.6	0.7	−0.44***
Wage work (%)	29.4		27.7		36.9		−9.12***
Agricultural production (%)	91.3		96.8		67.0		29.8***
Non-farm business (%)	50.0		46.9		63.4		−16.5***
Reduction in income from wage work (%)	12.8		12.9		12.6		0.232
Reduction in income from agricultural production (%)	37.2		40.1		24.0		16.2***
Reduction in income from non-farm business (%)	26.2		25.1		31.2		−6.04**
Television	21.2		14.5		51.0		−36.6***
Internet (%)	13.0		8.6		32.5		−23.9***
Attendance of social gatherings per week							
None	19.2		18.3		23.2		−4.86**
Once	39.7		39.2		42.0		−2.85
Twice or three times	34.3		34.8		32.2		2.56
Four or five times	6.8		7.7		2.6		5.15***
Parental engagement index	2.8	2.0	2.7	2.0	2.8	1.9	−0.0673
Having children's books (%)	39.3		37.0		49.5		−12.5***
Community characteristics							
Log (Mean MPCE)	11.4	0.5	11.3	0.4	11.8	0.6	−0.468***
Mean schooling (years) of household head	6.9	2.4	6.6	2.2	8.4	3.0	−1.850***
Urban	18.3						
Region							
Central (%)	20.6		17.4		34.8		−17.4***
Eastern (%)	30.4		34.0		14.4		19.6***
Western (%)	23.7		24.0		22.2		1.83
Northern (%)	25.3		24.6		28.6		−4.04*

Note: Mean and standard deviations are reported for continuous variables, while percentage of individuals that have a value one for that variable is reported for dummy variables. MPCE = monthly per capita expenditure.

children who are neither the child nor the grandchild of the household head are less likely to engage in learning (Column 3 in Table 2). Besides, OLS estimates for birth order variables show that, compared to being a first born, being a last born increases the probability of engaging in learning in rural areas, although it becomes insignificant after controlling for community dummies (Columns 4–6 in Table 2). Although it is out of scope for this study to delve into the robustness of this effect, this may partly capture the cases wherein older children's continued learning, especially in a rural setting, was inhibited by increased child labour, which is reported in previous studies (e.g., Sserwanja et al., 2021). Literature, which assesses the effects of sibling composition on children's school attendance, commonly found that earlier-born children are likely to be disadvantaged as they are more likely to work as child labourers than their younger siblings when households are forced by poverty (Emerson and Souza, 2008).

Table 2

OLS regression result for exploring the determinants of continued learning using full and rural samples.

Dependent variable: Learning engagement	Full (n = 2122)			Rural (n = 1734)		
	(1)	(2)	(3)	(4)	(5)	(6)
Parental engagement index		0.058***	0.054***		0.058***	0.047***
		(0.008)	(0.015)		(0.009)	(0.016)
Individual characteristics						
Female	0.015	0.019	0.018	–0.003	0.008	0.004
	(0.020)	(0.019)	(0.021)	(0.022)	(0.021)	(0.023)
Age	0.070***	0.065***	0.048**	0.068***	0.067***	0.054**
	(0.021)	(0.019)	(0.022)	(0.023)	(0.021)	(0.024)
Age-squared	–0.003**	–0.003***	–0.002*	–0.002**	–0.002**	–0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Attended private school	0.076**	0.040	0.048	0.086**	0.044	0.075*
(Base: Attended government school)	(0.030)	(0.029)	(0.041)	(0.034)	(0.032)	(0.044)
Relationship to the household head and birth order						
(Base: First born)						
Middle born (among households with more than 2 own children)	0.024	0.011	–0.003	0.021	0.011	0.007
	(0.030)	(0.028)	(0.030)	(0.032)	(0.030)	(0.031)
Last born (among households with more than 1 own child)	0.082*	0.055	0.032	0.114**	0.092**	0.071
	(0.042)	(0.040)	(0.045)	(0.046)	(0.043)	(0.047)
Grand child	0.052	0.046	0.035	0.061	0.052	0.076
	(0.058)	(0.055)	(0.076)	(0.060)	(0.057)	(0.077)
Others (other relative or non-relative)	–0.119**	–0.151**	–0.159**	–0.089	–0.116*	–0.121
	(0.058)	(0.059)	(0.078)	(0.061)	(0.063)	(0.074)
Household characteristics						
Number of children	–0.011	–0.009	–0.007	–0.010	–0.008	–0.006
	(0.009)	(0.008)	(0.013)	(0.009)	(0.008)	(0.013)
Number of adults	–0.001	–0.010	0.007	–0.001	–0.007	–0.005
	(0.018)	(0.016)	(0.029)	(0.021)	(0.019)	(0.030)
Age group of household head						
30–39 years	–0.091	–0.083	0.051	–0.094	–0.088	0.025
	(0.073)	(0.066)	(0.118)	(0.081)	(0.072)	(0.121)
40–49 years	–0.071	–0.050	0.070	–0.081	–0.058	0.029
	(0.077)	(0.070)	(0.121)	(0.086)	(0.077)	(0.124)
50–59 years	–0.044	–0.026	0.073	–0.089	–0.059	0.009
	(0.082)	(0.075)	(0.129)	(0.091)	(0.082)	(0.130)
Over 60 years	–0.108	–0.104	–0.005	–0.138	–0.129	–0.070
(Base: Under 30 years)	(0.089)	(0.084)	(0.138)	(0.098)	(0.090)	(0.141)
Female household head	–0.003	–0.016	0.044	0.017	0.005	0.001
(Base: Male household head)	(0.039)	(0.036)	(0.065)	(0.044)	(0.041)	(0.068)
Schooling (years) of household head	0.009*	–0.006	0.0002	0.010*	–0.007	–0.004
	(0.005)	(0.005)	(0.008)	(0.006)	(0.006)	(0.008)
Log (MPCE)	0.022	0.021	–0.013	–0.001	0.022	–0.019
	(0.032)	(0.035)	(0.046)	(0.036)	(0.039)	(0.047)
Wage work	0.127***	0.108***	0.096	0.130**	0.104**	0.176**
	(0.046)	(0.041)	(0.060)	(0.055)	(0.048)	(0.072)
Agricultural production	0.072	0.068	0.041	–0.005	0.041	0.053
	(0.060)	(0.058)	(0.123)	(0.098)	(0.089)	(0.179)
Non-farm business	0.099**	0.101**	0.013	0.114**	0.106**	0.005
	(0.044)	(0.041)	(0.073)	(0.049)	(0.047)	(0.079)
Reduction in income from wage work	–0.140***	–0.109**	–0.106	–0.143**	–0.105*	–0.138
	(0.054)	(0.048)	(0.085)	(0.064)	(0.058)	(0.098)
Reduction in income from agricultural production	–0.126***	–0.140***	–0.168***	–0.106***	–0.124***	–0.171***
	(0.038)	(0.034)	(0.061)	(0.041)	(0.037)	(0.060)
Reduction in income from non-farm business	–0.024	–0.045	0.054	–0.037	–0.052	–0.039
	(0.048)	(0.045)	(0.083)	(0.054)	(0.051)	(0.088)
Television	0.066	0.055	0.144*	0.104*	0.093*	0.098
	(0.051)	(0.046)	(0.075)	(0.061)	(0.055)	(0.084)
Internet	0.035	0.019	–0.079	–0.004	–0.025	–0.084
	(0.055)	(0.049)	(0.088)	(0.068)	(0.061)	(0.104)
Attendance of social gatherings per week (Base: None)						
Once	–0.028	–0.039	0.093	–0.033	–0.050	0.129*
	(0.043)	(0.038)	(0.067)	(0.049)	(0.043)	(0.070)
Twice or three times	–0.015	–0.077*	0.041	–0.017	–0.083*	0.073
	(0.044)	(0.041)	(0.074)	(0.051)	(0.047)	(0.079)
Four or five times	–0.036	–0.080	–0.018	–0.055	–0.101	0.024
	(0.068)	(0.065)	(0.108)	(0.073)	(0.069)	(0.111)
Having children's books		0.135***	0.085		0.126***	0.082
		(0.035)	(0.057)		(0.038)	(0.057)
Community characteristics						
Log (Mean MPCE)		0.010			–0.032	
		(0.044)			(0.049)	
Mean schooling (years) of household head		0.012			0.021**	
		(0.008)			(0.009)	
Urban	0.004	0.003				
(Base: Rural)	(0.048)	(0.045)				

(continued on next page)

Table 2 (*continued*)

Dependent variable: Learning engagement	Full (*n* = 2122)			Rural (*n* = 1734)		
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	−0.224	−0.399	0.322	0.099	0.043	0.147
	(0.378)	(0.438)	(0.560)	(0.416)	(0.494)	(0.592)
Regional dummies	Yes	Yes	No	Yes	Yes	No
Community dummies	No	No	Yes	No	No	Yes
R-squared	0.1609	0.2494	0.6223	0.1512	0.2410	0.6165

Notes: Numbers in parentheses are robust standard errors clustered at the community level. Grade dummies are included in all models. MPCE = monthly per capita expenditure. ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

5.2. The effect of parental engagement on children's home-based continued learning

Focusing on the effect of the parental engagement index, the OLS and community fixed effects estimates obtained from the full sample suggest its positive significant effect on learning engagement. Similar estimates were obtained after restricting the sample to rural children. As shown in Column 6 in Table 2, children in rural households with one more parental engagement activity are 4.7 percentage points more likely to engage in learning even after controlling for community dummies. These findings are generally consistent with the ones from existing research that conducted OLS regression analysis to examine the correlation between parental involvement and learning engagement in more developed countries (Agostinelli et al., 2022; Grewenig et al., 2021; Yu et al., 2021). The results presented in Tables A3 and A4 in the Appendix generally confirm that the inclusion of SES variables in the model does not substantially alter the coefficient on the parental engagement variable. However, the coefficient of our interest was reduced when controlling for a dummy variable on whether a household has children's books or not, in both full and rural samples.

Considering the substantial difference in the learning context by the type of school attended, we further split the sample into children who were attending government and private schools before the school closures. Table 3 shows that the significant effects disappear once the sample is restricted to children in private schools in rural sample, while significant positive effects are enhanced for those in government schools in both full and rural samples. The estimated OLS coefficient, obtained by controlling for community dummies, increases slightly from 5 to 6 percentage points both in full and rural samples (see Columns 3 and 6 in Table 2, and Columns 1 and 3 in Table 3).

This may be attributed to the fact that the children in private schools

Table 3
The effect of parental engagement on continued learning by school type attended before the school closures using full and rural samples.

Dependent variable: Learning engagement	Full		Rural	
	Attended government school (*n* = 1337)	Attended private school (*n* = 785)	Attended government school (*n* = 1157)	Attended private school (*n* = 577)
	(1)	(2)	(3)	(4)
Parental engagement index	0.058***	0.054**	0.059***	0.026
	(0.019)	(0.025)	(0.019)	(0.026)
Constant	0.216	0.751	0.524	−0.123
	(0.722)	(1.259)	(0.719)	(1.559)
Other covariates	Yes	Yes	Yes	Yes
Regional dummies	No	No	No	No
Community dummies	Yes	Yes	Yes	Yes
R-squared	0.6675	0.7368	0.6783	0.7211

Notes: Numbers in parentheses are robust standard errors clustered at the community level. Grade dummies are included in all models. ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

were from households with more parental engagement and could generally receive more support for learning from schools than their counterparts. The effect of parental engagement was more significant among children in government schools who had almost been cut off from schooling in many cases especially in rural areas.[15] Although the study sheds light on this overall trend, it could not account for the type of private school and the level of support children could receive from the school at the time of the survey due to data limitations. As described in Section 3, it should be noted that there was a significant variation in how both government and private schools could provide support while coping with the impact of school closures in Uganda.

5.3. Robustness checks

To verify the main findings on the effect of parental engagement on children's continued learning derived from the estimation results using full and rural samples, as well as the ones restricting the sample to the children attending government schools and private schools (Table 4), a series of robustness checks were employed. Column 1 presents the primary results obtained in the previous analyses for comparison purposes.

First, average marginal effect of parental engagement was calculated for each group based on the probit model estimates to check the robustness of our key findings obtained from the analyses using LPM. The number of observations was reduced in all specifications because the samples from the communities where all children engaged in learning and all children did not engage in learning during the survey period were dropped in using maximum likelihood estimation methods (see Column 2 in Table 4). The results basically show a similar direction of effect, but the magnitude of the coefficient slightly increases, and the significance level of the positive effect among children from private school changes from 5% to 1% in the full sample. This could be attributed to the fact that the role of parental engagement in facilitating children's home-based learning is generally more critical among communities where there is variation in whether a child engages in learning at home during school closures than those where there is no variation.

Second, the study checked how the coefficients for our main findings can change when the households with relatively old children are excluded from the sample. Specifically, the study conducted analyses

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[15] The studies, which had been conducted before the pandemic, revealed chronic teacher absenteeism among government primary schools in Uganda, which is often attributed to the lack of public supervision as well as parental engagement (Bold et al., 2017; Wilke et al., 2022). According to another case study conducted primarily in rural areas in the Busoga sub-region of Eastern Uganda, parents generally recognise that a difference between government and private schools lies in support for learning by teachers (Kabay, 2021). As depicted in Kabay (2021), teachers in private primary schools work hard to teach as their salaries come from their pupils' parents, while teachers in government primary schools are not motivated to teach due to the inadequate amount and frequent delays of the salary payment.

Table 4

Robustness checks for the effect of parental engagement by school type using full and rural samples.

Dependent variable: Learning engagement	Primary model	Probit	Using the sample from which the households with children aged 12–14 are excluded	Using alternative parental engagement index	
				PCA	MCA
	(1)	(2)	(3)	(4)	(5)
A: Full					
Parental engagement index	0.054***	0.069***	0.080**	0.065***	0.108***
	(0.015)	(0.015)	(0.033)	(0.017)	(0.029)
Regional dummies	No	No	No	No	No
Community dummies	Yes	Yes	Yes	Yes	Yes
Observations	2122	1103	689	2122	2122
B: Full / attended government school					
Parental engagement index	0.058***	0.083***	0.103**	0.069***	0.115***
	(0.019)	(0.023)	(0.045)	(0.022)	(0.037)
Regional dummies	No	No	No	No	No
Community dummies	Yes	Yes	Yes	Yes	Yes
Observations	1337	563	388	1337	1337
C: Full / attended private school					
Parental engagement index	0.054**	0.086***	0.046	0.066**	0.109**
	(0.025)	(0.027)	(0.053)	(0.030)	(0.050)
Regional dummies	No	No	No	No	No
Community dummies	Yes	Yes	Yes	Yes	Yes
Observations	785	349	301	785	785
D: Rural					
Parental engagement index	0.047***	0.058***	0.071**	0.058***	0.096***
	(0.016)	(0.017)	(0.034)	(0.018)	(0.030)
Regional dummies	No	No	No	No	No
Community dummies	Yes	Yes	Yes	Yes	Yes
Observations	1734	894	541	1734	1734
E: Rural / attended government school					
Parental engagement index	0.059***	0.080***	0.102**	0.070***	0.116***
	(0.019)	(0.024)	(0.040)	(0.022)	(0.037)
Regional dummies	No	No	No	No	No
Community dummies	Yes	Yes	Yes	Yes	Yes
Observations	1157	469	322	1157	1157
F: Rural / attended private school					
Parental engagement index	0.026	0.044	–0.013	0.033	0.055
	(0.026)	(0.033)	(0.058)	(0.032)	(0.053)
Regional dummies	No	No	No	No	No
Community dummies	Yes	Yes	Yes	Yes	Yes
Observations	577	275	219	577	577

Notes: Numbers in parentheses are robust standard errors clustered at the community level. In Columns 2, coefficients are average marginal effects and standard errors are obtained with the delta-method using the maximum likelihood estimator from the probit model. Grade dummies are included in all models. PCA = principal component analysis. MCA = multiple correspondence analysis. ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

using LPM for the sample from which the households with children aged 12–14 years were excluded.[16] As shown in Column 3 in Table 4, the results indicate a larger effect of parental engagement for all groups except the children from private schools where the effect size gets smaller and its significance level turns to beyond 10% in the full sample. The results suggest that, as a trend, relatively old children may potentially take up the role of parents/guardians in providing educational support for the younger children, leading to a larger effect of parental engagement when the sample is restricted to households with no relatively old children.

Third, instead of using the index simply summing up the dichotomous variable, the study examined the effect of parental engagement using the alternative index, which is a weighted sum of the original dichotomous variable. PCA and MCA are conducted to calculate the weight assigned for each activity variable. Summary statistics for each

activity variable and weights calculated by undertaking PCA and MCA are reported in Table A5 in the Appendix. As shown in Columns 4 and 5 in Table 4, the results confirm the robustness of our key findings.

6. Conclusion

This study examined the effect of parental engagement on children's continued learning at the primary level amid the COVID-19–induced school closures. Unlike previous literature, which highlighted learning inequality due to the gaps in access to ICT tools, household education/ income level, and school type, this study found that income losses brought by the pandemic and household learning environment are prevailing predictors of continued learning. Moreover, the main results show that a child from households with more parental engagement is more likely to engage in learning activity at home when primary schools are closed even after controlling for unobservable community characteristics. A statistically significant effect of parental engagement is found in rural areas as well. We also found that, especially in rural areas, parental engagement level is more significantly correlated with home-based learning among children from government school than those from private school.

The findings have implications for policies that can effectively promote continued learning during school closures caused by public health crises or other natural/man-made disasters. This study provides

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[16] The lower end of this age group (12 years) is selected considering the fact that official school age for grade six is 11 years and the sample is restricted to first- to sixth-graders as mentioned in the Subsection 4.2. The upper end of this age group (14 years) is selected because a household member aged 15 is regarded as a person who can become a parent or a guardian in the questionnaire used in the UHFS based on the fact that reproductive age group ranges between 15 and 49.

evidence that suggests policymakers, particularly in low-income countries, should prioritise facilitation of parental engagement to ensure continued learning among children from households with relatively fewer options, to compensate for the loss of school inputs. Compared to developing a costly online learning platform, harnessing parents' local efforts to compensate for children's lost schooling years could be a realistic and cost-effective policy option for mitigating learning inequality in low-income countries.

There are rigorous evidences supporting the use of low technology for promoting parental engagement, which can lead to continued learning (Angrist et al., 2022; Wolf et al., 2021). By directly assessing the influence of parental engagement using nationally representative data collected in a low-income country, this study also provides evidence that promoting parental engagement among households could increase the probability of continued learning. However, it also suggests that promoting parental engagement may not mitigate the learning inequality caused by income losses. This evidence implies that government efforts to promote parental engagement should be combined with targeted school-/community-based actions that support children from vulnerable groups.

The results should be interpreted with caution mainly because the study relied on cross-sectional data with limited variables collected during the pandemic. This study could not account for the variation in actions taken by schools during school closures, although this has been partially addressed by controlling community fixed effects. In addition to the unobservable household characteristics, it should be noted that both children's learning achievement and innate ability were not accounted for. Additionally, this study did not address the simultaneous relationship between children's learning engagement and parental engagement. It should also be noted that the study could not investigate

how the effect of parental engagement varies according to its different types, including the ones that involve the connection between parents and teachers in school. By addressing the aforementioned limitations, future studies can explore how parental engagement during school closures affects children's dropout rates and learning achievement in low-income country context as well.

CRediT authorship contribution statement

Katsuki Sakaue: Conceptualization, Methodology, Software, Formal analysis, Writing – original draft, Funding acquisition. **James Wokadala:** Conceptualization, Methodology, Resources, Writing – original draft, Writing – review & editing. **Keiichi Ogawa:** Writing – review & editing, Funding acquisition.

Conflicts of interest statement

None.

Appendix

See Tables A1-A5.

Table A1
Definition of variables.

Variable	Data	Definition
Individual characteristics		
Learning engagement	UHFS Round 5	Dummy variable indicating whether the child has been engaged in any education or learning activities for a seven-day period prior to the interview
Female	UHFS Round 5	Dummy variable for child's gender (base category = male)
Age	UHFS Round 5	Child's age at the time of the interview
Grade	UHFS Round 4	Dummy variables for grade the child attended before schools were closed due to COVID-19 pandemic
Attended private school	UHFS Round 4	Dummy variable indicating whether the child attended private school, which is managed by private entities, NGOs, or religious organization, before school closure or attended government school (base category)
Relationship to the household head and birth order	UHFS Round 5	Dummy variables for the child's relationship to the household head and birth order, indicating whether he or she is first born (base category), middle born child, last born, grandchild, or others (other relatives such as brothers/sisters, nieces/nephews, and brothers/sisters-in-law or non-relative such as domestic helpers)
Household characteristics		
Number of children	UHFS Round 5	Number of children aged 18 or below in the household
Number of adults	UHFS Round 5	Number of adults aged 19 or above in the household
Age group of household head	UHFS Round 5	Dummy variables for a household head aged under 30 years (base category), 30–39 years, 40–49 years, 50–59 years, and over 60 years
Female household head	UHFS Round 5	Dummy variable for household head's gender (base category = male)
Schooling (years) of household head	UNPS 2019/20	Schooling (years) of the household head in 2019/20
Log (MPCE)	UNPS 2019/20	Natural logarithm of monthly household consumption expenditures per adult equivalent in 2019/20
Wage work	UHFS Round 5	Dummy variable indicating whether wage work was one of the sources of household's livelihood during COVID-19 pandemic
Agricultural production	UHFS Round 5	Dummy variable indicating whether family farming, livestock or fishing was one of the sources of household's livelihood during COVID-19 pandemic
Non-farm business	UHFS Round 5	Dummy variable indicating whether non-farm family business was one of the sources for household's livelihood during COVID-19 pandemic
Reduction in income from wage work	UHFS Round 5	Dummy variable indicating whether the household suffered a reduction in the income from its wage work COVID-19 pandemic
Reduction in income from agricultural production	UHFS Round 5	Dummy variable indicating whether the household suffered a reduction in the income from its agricultural production during COVID-19 pandemic

(continued on next page)

Table A1 (*continued*)

Variable	Data	Definition
Reduction in income from non-farm business	UHFS Round 5	Dummy variable indicating whether the household suffered a reduction in the income from its non-farm business during COVID-19 pandemic
Television	UNHS Round 6	Dummy variable for the ownership of television during COVID-19 pandemic
Internet	UNHS Round 6	Dummy variable for the access to the Internet during COVID-19 pandemic
Attendance of social gatherings per week	UNHS Round 5	Dummy variables for the number of times the respondent attended religious or social gatherings for a seven-day period prior to the interview, indicating none (base category), once, twice/three times, or four/five times.
Parental engagement index	UNHS Round 5	Total number of activities any household member aged 15 or over engage in for a child aged between 2 and 10 in the household
Having children's books	UHFS Round 5	Dummy variable indicating whether the household has children's books for a child
Community characteristics		
Log (Mean MPCE)	UNPS 2019/20	Natural logarithm of community average of monthly household consumption expenditures per adult equivalent among the sampled households in 2019/20
Mean schooling (years) of household head	UNPS 2019/20	Community average of schooling (years of household head) of household head among the sampled households in 2019/20
Urban	UNPS 2019/20	Dummy variable if the community is located in urban area (base category = rural area)
Region	UNPS 2019/20	Dummy variables indicating whether the community is located in the Central (base category), Eastern, Western, or Northern region

Notes: MPCE = monthly per capita expenditure.

Table A2

Comparison of summary statistics of selected variables by household welfare, schooling of household head, and school type.

Variables	Mean	Standard Deviation	Mean	Standard Deviation	Difference
A: Household welfare	Quintiles 1 and 2 ($n = 1000$)		Quintiles 3, 4, and 5 ($n = 1122$)		
Learning engagement (%)	28.7		43.9		–15.2***
Parental engagement index	2.6	1.9	2.9	2.0	–0.323***
Having children's books (%)	30.2		47.3		–17.1***
B: Schooling of household head	No schooling or some primary ($n = 982$)		At least completed primary ($n = 1140$)		
Learning engagement (%)	31.3		41.4		–10.1***
Parental engagement index	2.4	1.9	3.1	2.0	–0.647***
Having children's books (%)	27.9		49.0		–21.1***
C: School type	Attended government school ($n = 1337$)		Attended private school ($n = 785$)		
Learning engagement (%)	30.1		48.0		–18.0***
Parental engagement index	2.6	2.0	3.1	2.0	–0.525***
Having children's books (%)	32.9		50.1		–17.2***

Notes: Mean and standard deviations are reported for continuous variables, while percentage of individuals that have a value one for that variable is reported for dummy variables. The significance of the difference is reported based on the results of independent-means *t*-test. ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

Table A3

OLS regression result for examining the effect of parental engagement on continued learning using full sample.

Dependent variable: Learning engagement	Full ($n = 2122$)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Parental engagement index	0.067***	0.069***	0.072***	0.073***	0.071***	0.071***	0.072***	0.072***	0.071***	0.060***
	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.009)
Individual characteristics										
Female		0.01	0.013	0.02	0.019	0.021	0.022	0.02	0.021	0.019
		(0.021)	(0.021)	(0.02)	(0.02)	(0.02)	(0.02)	(0.019)	(0.02)	(0.02)
Age		0.047**	0.049**	0.062***	0.063***	0.061***	0.063***	0.066***	0.071***	0.057***
		(0.022)	(0.022)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Age-squared		–0.003***	–0.003***	–0.003***	–0.003***	–0.003***	–0.003***	–0.003***	–0.003***	–0.002***
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Attended private school (Base: Attended government school)					0.064**					
					(0.031)					
Relationship to the household head and birth order (Base: First born)										
Middle born (among households with more than 2 own children)		–0.026	0.005	0.009	0.014	0.012	0.013	0.005	0.011	0.012
		(0.026)	(0.032)	(0.029)	(0.029)	(0.028)	(0.029)	(0.028)	(0.029)	(0.028)
Last born (among households with more than 1 own child)		0.058	0.065	0.055	0.059	0.058	0.057	0.055	0.059	0.05
		(0.041)	(0.044)	(0.041)	(0.041)	(0.041)	(0.041)	(0.04)	(0.041)	(0.041)

Table A3 (*continued*)

Dependent variable: Learning engagement	Full (*n* = 2122)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Grand child		0.016	0.07	0.027	0.028	0.034	0.033	0.026	0.043	0.045
		(0.046)	(0.061)	(0.056)	(0.057)	(0.057)	(0.058)	(0.057)	(0.056)	(0.056)
Others (other relative or non-relative)		−0.127**	−0.119**	−0.129**	−0.124**	−0.133**	−0.145**	−0.159***	−0.133**	−0.127**
		(0.058)	(0.059)	(0.061)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.060)
Household characteristics										
Number of children			−0.016*	−0.015**	−0.015**	−0.015*	−0.014*	−0.012	−0.014*	−0.012
			(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Number of adults			−0.007	0.001	−0.001	−0.001	−0.003	−0.006	−0.005	−0.003
			(0.017)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.015)
Age group of household head										
30–39 years			−0.012	−0.061	−0.064	−0.070	−0.074	−0.071	−0.077	−0.068
			(0.067)	(0.066)	(0.065)	(0.066)	(0.066)	(0.064)	(0.066)	(0.069)
40–49 years			−0.004	−0.044	−0.045	−0.046	−0.054	−0.039	−0.054	−0.048
			(0.069)	(0.069)	(0.068)	(0.069)	(0.069)	(0.068)	(0.069)	(0.072)
50–59 years			0.029	−0.029	−0.029	−0.029	−0.041	−0.020	−0.033	−0.031
			(0.075)	(0.075)	(0.074)	(0.075)	(0.075)	(0.074)	(0.074)	(0.077)
Over 60 years (Base: Under 30 years)			−0.063	−0.096	−0.092	−0.101	−0.110	−0.073	−0.117	−0.123
			(0.087)	(0.084)	(0.083)	(0.084)	(0.086)	(0.084)	(0.083)	(0.086)
Female household head (Base: Male household head)			0.011	−0.017	−0.017	−0.006	−0.015	−0.012	−0.014	−0.018
			(0.038)	(0.035)	(0.035)	(0.035)	(0.035)	(0.034)	(0.035)	(0.035)
Schooling (years) of household head						0.008*				
						(0.004)				
Log (MPCE)							0.065**	0.053**		
							(0.026)	(0.026)		
Wage work							0.119***			
							(0.04)			
Agricultural production							0.049			
							(0.057)			
Non-farm business							0.111***			
							(0.042)			
Reduction in income from wage work							−0.128**			
							(0.05)			
Reduction in income from agricultural production							−0.134***			
							(0.035)			
Reduction in income from non-farm business							−0.049			
							(0.045)			
Television								0.082*		
								(0.047)		
Internet								0.079		
								(0.049)		
Attendance of social gatherings per week (Base: None)										
Once			−0.051	−0.023	−0.022	−0.025	−0.016	−0.015	−0.030	−0.041
			(0.042)	(0.04)	(0.041)	(0.041)	(0.039)	(0.04)	(0.04)	(0.04)
Twice or three times			−0.080*	−0.088**	−0.089**	−0.090**	−0.080*	−0.064*	−0.091**	−0.099**
			(0.045)	(0.043)	(0.043)	(0.043)	(0.042)	(0.041)	(0.043)	(0.042)
Four or five times			−0.066	−0.060	−0.063	−0.065	−0.062	−0.057	−0.072	−0.079
			(0.066)	(0.071)	(0.07)	(0.07)	(0.072)	(0.069)	(0.068)	(0.067)
Having children's books										0.146***
										(0.034)
Community characteristics										
Urban (Base: Rural)				0.072*	0.063	0.056	0.054	0.036	0.031	0.062
				(0.041)	(0.042)	(0.043)	(0.042)	(0.045)	(0.043)	(0.041)
Constant	0.182***	−0.037	0.063	0.19	0.146	0.143	−0.567*	−0.532	0.13	0.177
	(0.025)	(0.116)	(0.142)	(0.126)	(0.126)	(0.13)	(0.324)	(0.326)	(0.128)	(0.125)
Regional dummies	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Community dummies	No	No	No	No	No	No	No	No	No	No
R-squared	0.077	0.099	0.111	0.190	0.193	0.193	0.196	0.228	0.198	0.207

Notes: Numbers in parentheses are robust standard errors clustered at the community level. Grade dummies are included in all models expect the one presented in Column 1. MPCE = monthly per capita expenditure. ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

Table A4

OLS regression result for examining the effect of parental engagement on continued learning using rural sample.

Dependent variable: Learning engagement	Rural (*n* = 1734)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Parental engagement index	0.065***	0.066***	0.069***	0.072***	0.070***	0.070***	0.072***	0.071***	0.071***	0.060***
	(0.009)	(0.009)	(0.01)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)
Individual characteristics										
Female			0.008	0.009	0.012	0.009	0.011	0.013	0.009	0.01	0.011
			(0.023)	(0.023)	(0.022)	(0.022)	(0.022)	(0.022)	(0.021)	(0.022)	(0.022)

Table A4 (*continued*)

Dependent variable: Learning engagement	Rural (n = 1734)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Age		0.062***	0.064***	0.065***	0.066***	0.064***	0.064***	0.066***	0.073***	0.061***
		(0.023)	(0.023)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
Age-squared		−0.003***	−0.003***	−0.002**	−0.002**	−0.002**	−0.002**	−0.002**	−0.003***	−0.002**
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Attended private school (Base: Attended government school)					0.065*					
					(0.035)					
Relationship to the household head and birth order (Base: First born)										
Middle born (among households with more than 2 own children)		−0.012	0.011	0.019	0.022	0.021	0.022	0.008	0.016	0.022
		(0.03)	(0.036)	(0.031)	(0.031)	(0.031)	(0.031)	(0.03)	(0.031)	(0.031)
Last born (among households with more than 1 own child)		0.104**	0.116**	0.105**	0.110**	0.106**	0.107**	0.096**	0.101**	0.103**
		(0.046)	(0.048)	(0.044)	(0.043)	(0.044)	(0.043)	(0.043)	(0.044)	(0.044)
Grand child		0.011	0.069	0.032	0.035	0.037	0.036	0.034	0.046	0.044
		(0.052)	(0.062)	(0.058)	(0.058)	(0.059)	(0.06)	(0.059)	(0.058)	(0.057)
Others (other relative or non-relative)		−0.077	−0.067	−0.087	−0.083	−0.091	−0.096	−0.111*	−0.095	−0.088
		(0.063)	(0.063)	(0.064)	(0.063)	(0.062)	(0.063)	(0.063)	(0.063)	(0.063)
Household characteristics										
Number of children			−0.012	−0.014*	−0.014*	−0.013*	−0.013	−0.010	−0.013	−0.011
			(0.01)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Number of adults			−0.013	−0.0001	−0.002	−0.003	−0.003	−0.007	−0.002	−0.004
			(0.021)	(0.019)	(0.019)	(0.018)	(0.019)	(0.019)	(0.019)	(0.018)
Age group of household head										
30–39 years			−0.038	−0.074	−0.076	−0.085	−0.084	−0.082	−0.086	−0.077
			(0.073)	(0.072)	(0.071)	(0.072)	(0.072)	(0.07)	(0.071)	(0.074)
40–49 years			−0.004	−0.058	−0.058	−0.058	−0.064	−0.053	−0.070	−0.057
			(0.075)	(0.076)	(0.075)	(0.076)	(0.075)	(0.074)	(0.076)	(0.079)
50–59 years			−0.007	−0.070	−0.070	−0.067	−0.078	−0.063	−0.080	−0.062
			(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.083)
Over 60 years (Base: Under 30 years)			−0.081	−0.126	−0.123	−0.128	−0.135	−0.105	−0.150*	−0.144
			(0.091)	(0.089)	(0.089)	(0.09)	(0.091)	(0.09)	(0.089)	(0.092)
Female household head (Base: Male household head)			0.022	0.007	0.006	0.018	0.009	0.011	0.008	0.004
			(0.045)	(0.039)	(0.039)	(0.039)	(0.039)	(0.038)	(0.039)	(0.039)
Schooling (years) of household head						0.009*				
						(0.005)				
Log (MPCE)							0.052*	0.039		
							(0.031)	(0.03)		
Wage work								0.120**		
								(0.047)		
Agricultural production								0.029		
								(0.089)		
Non-farm business								0.121**		
								(0.047)		
Reduction in income from wage work								−0.132**		
								(0.059)		
Reduction in income from agricultural production								−0.116***		
								(0.038)		
Reduction in income from non-farm business								−0.054		
								(0.052)		
Television									0.124**	
									(0.057)	
Internet									0.035	
									(0.062)	
Attendance of social gatherings per week (Base: None)										
Once			−0.059	−0.029	−0.030	−0.032	−0.026	−0.021	−0.034	−0.049
			(0.048)	(0.046)	(0.046)	(0.047)	(0.046)	(0.044)	(0.046)	(0.046)
Twice or three times			−0.070	−0.089*	−0.090*	−0.092*	−0.084*	−0.064	−0.093*	−0.103**
			(0.051)	(0.049)	(0.049)	(0.049)	(0.049)	(0.047)	(0.049)	(0.048)
Four or five times			−0.068	−0.080	−0.084	−0.086	−0.084	−0.078	−0.091	−0.103
			(0.071)	(0.077)	(0.076)	(0.076)	(0.078)	(0.074)	(0.074)	(0.073)
Having children's books										0.138***
										(0.037)
Constant	0.161***	−0.165	−0.050	0.181	0.144	0.134	−0.409	−0.352	0.123	0.157
	(0.026)	(0.126)	(0.157)	(0.143)	(0.144)	(0.149)	(0.37)	(0.37)	(0.143)	(0.143)
Regional dummies	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Community dummies	No	No	No	No	No	No	No	No	No	No
R-squared	0.075	0.092	0.104	0.182	0.185	0.185	0.185	0.217	0.191	0.197

Notes: Numbers in parentheses are robust standard errors clustered at the community level. Grade dummies are included in all models expect the one presented in Column 1. MPCE = monthly per capita expenditure. ***Significant at the 1% level. **Significant at the 5% level. *Significant at the 10% level.

Table A5
Summary statistics for variables included and weights obtained from principal component analysis and multiple correspondence analysis in constructing parental engagement index.

Variables	Full (*n* = 1461)				
			PCA	MCA	
	Mean		Weights	Categories	Weights
Played (%)	63.9		0.33	Played	0.61
				Did not play	−1.09
Read books or looked at picture books (%)	34.2		0.41	Read books or looked at picture books	1.41
				Did not read books or look at picture books	−0.73
Told stories (%)	42.1		0.45	Told stories	1.29
				Did not tell stories	−0.94
Sang songs (%)	49.8		0.45	Sang songs	1.11
				Did not sing songs	−1.10
Went outside (%)	36.0		0.33	Went outside	1.09
				Did not go outside	−0.61
Named, counted or drew things (%)	38.9		0.45	Named, counted or drew things	1.38
				Did not name, count or draw things	−0.88

Notes: Percentage of individuals that have a value one for that variable is reported for dummy variables. PCA = principal component analysis. MCA = multiple correspondence analysis. PCA and MCA were conducted using data, which were collapsed to household-level before making any restrictions. In each household, two missing responses for the parental engagement activity were allowed. In the calculation using PCA, the weight assigned for each variable is from the linear combination of the variables that constitute the first principal component which accounts for 46.1% of the variation. In the calculation using MCA, the weight is from the linear combination of the coordinates for the first dimension, which accounts for 94.3% of the principal interia.

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