SCHOOLING WITHOUT LEARNING: FAMILY BACKGROUND AND EDUCATIONAL PERFORMANCE IN FRANCOPHONE AFRICA

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Abstract

An increasing number of children in Sub-Saharan Africa are enrolled in school, but many of them learn very little. Despite increasing interest in learning outcomes in Africa, little is known about the prevalence and determinants of inequalities in learning. In this study, we explore the association between family socio-economic status (SES) and primary school learning outcomes in 10 Francophone African countries using data from PASEC, a standardized assessment of mathematics and reading competence. We find that learning outcomes are both poor and highly stratified. We develop and test a conceptual framework that highlights three mechanisms through which family SES might contribute to learning: educational resources at home, material deprivation, and sorting into schools of different quality. We find that most of the effect of SES on learning outcomes operates through sorting into schools, which results from a combination of the unequal distribution of resources (such as teachers and textbooks) across schools and high socio-economic segregation between schools. We suggest that most countries in the region can improve equity as well as overall performance by redistributing resources across schools.

Key words: learning crisis, Sub-Saharan Africa, PASEC, school effects, educational inequality

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Introduction

African countries have made impressive progress in expanding access to education over the last few decades. Partially driven by the Millennium Development Goals (MDGs) and the Education For All (EFA) initiative, many countries in the region have abolished fees for basic education, and enrolment rates have increased substantially, particularly at the primary level (Lewin, 2009). The main value of education, however, lies not in the number of years spent at school but in the skills and knowledge acquired during this time (Behrman & Birdsall, 1983; Pritchett, 2013).

Available evidence suggests that learning outcomes in Sub-Saharan Africa are often disturbingly poor, leading many observers to speak of a 'learning crisis' (Kremer, Brannen, & Glennerster, 2013; The Education Commission, 2017; World Bank, 2018). In a widely reported study, the Education for All Initiative estimated that there are currently 130 million children enrolled in primary school who do not learn even the most basic literacy and numeracy skills, 52 million of whom are located in Sub-Saharan Africa (UNESCO, 2014, p. 191). World Bank President Jim Yong Kim called the lack of learning in the global South a "moral and economic crisis that must be addressed immediately" (World Bank, 2018, p. xi).

Poor learning outcomes are not universal, however, and tend to be concentrated among the most disadvantaged segments of society (Crouch & Gustafsson, 2018). Most of the global discourse around the 'learning crisis' focuses on raising overall levels of learning, rather than addressing inequalities in learning and creating equal learning opportunities for all children. It is imperative to study inequality in learning outcomes because of the well-known associations between learning and a range of important life outcomes, including health (Glewwe, 1999), child mortality (Smith-Greenaway, 2013) and earnings (Hanushek, Schwerdt, Wiederhold, & Woessmann, 2015). Inequality in learning thus lays the foundation for future social stratification (Heckman, 2006). Moreover, there are indications that equality in learning outcomes is associated with higher overall levels of achievement on the national level (Freeman, Machin, & Viarengo, 2011; PISA, 2012). Finally, learning outcomes are an important indicator of the quality of education provided. By studying the role of schools and educational policies in structuring learning outcomes for different social groups, we can design more effective interventions to reduce inequality and raise overall levels of learning.

In this study, we focus on a classic measure of educational inequality: the relationship between family socio-economic status (SES) and learning outcomes. We use the PASEC 2014 dataset, which is based on a highly detailed survey of pupils and schools in 10 Francophone African countries. The surveyed countries have relatively similar curricula and share a language of instruction (with one exception), which facilitates the standardized assessment of educational performance. Our first objective is to assess the overall level of socio-economic inequality in learning. We find that learning outcomes in Sub-Saharan Africa are not only poor, but also highly unequally distributed. Second, we develop a conceptual framework that highlights three pathways through which family SES might contribute to learning in Sub-Saharan Africa: (1) educational resources at home, (2) material deprivation, and (3) sorting into schools. We use a simple mediation model to assess the relative importance of each of these three pathways, and find that most socio-economic inequality operates through sorting into schools of different quality. Third, we analyze to what extent the effect of schools on learning inequality can be explained by the unequal distribution of resources (such as teachers and textbooks) across schools. Finally, we provide evidence for large cross-national differences in learning inequality, and discuss ways to improve equity as well as overall performance based on the experiences of better performing countries.

Background: Schooling and Learning in Francophone Africa

Our study covers 10 predominantly Francophone countries, located in western and central Africa[3]. Although they are all located at the lower end of the global income ranking, they display some variation in economic development, ranging from extremely poor countries such as Burundi and Niger—with per capita incomes of $782 and $851 respectively—to lower middle income countries such as Congo Brazzaville and Cameroon (see Table 1). Moreover, their national incomes tend to be highly unequally distributed, as indicated by the GINI coefficients. The skewed income distribution reflects a class structure that is broadly characterized by a small, very wealthy elite, an emerging (urban) middle class and a large, mainly rural population living around or just above the poverty line. Absolute poverty and deprivation remain widespread in each of the sampled countries, which are all ranked as "very low" on the United Nations Development Program's Human Development Index (2015). As a result, levels of malnutrition and disease prevalence are

[3] Seven of the countries are former French colonies (Benin, Burkina Faso, Congo Brazzaville, Ivory Coast, Niger, Senegal, Tchad); one of the countries is a former Belgian colony (Burundi); and two of the countries were German colonies that were divided between the French and British following World War One (Cameroon and Togo). Different colonial powers left differential educational legacies in the post-colonial period, with the French system being more centralized and the British system being more de-centralized and reliant on local power structures (Garnier & Schafer, 2006).

generally high, particularly among children. For example, in Chad and Niger over 40% of children under five are considered stunted (The World Bank, 2015).

Despite these socio-economic challenges, each of the countries in our study has made substantial gains in primary school enrollment in recent years. For example, between 2000 and 2010 net primary enrollment increased from 27% to 64% in Niger, and from 40% to 94% in Burundi (UNESCO, 2015). Five of the countries in the study (Benin, Burundi, Congo, Cameroon, and Togo) had achieved near universal primary education by 2014, with net enrollment rates over 90%, while the other five countries ranged from 60% to 72% (Table 1) [4]. The drive to expand primary education partially reflects global commitments such as the Millennium Development Goals, which were primarily focused on enrollment metrics (Filmer, Hasan, & Pritchett, 2006). Some of the countries in the study—including Benin, Burundi, Cameroon, Senegal, and Togo—have also eliminated primary school fees, which has been linked to increased enrollment in other parts of Africa (Lucas & Mbiti, 2012; The World Bank, 2009). Educational expansion has closed or substantially reduced gender gaps, rural-urban gaps as well as wealth gaps in primary school enrolment (Lewin, 2009; Lewin & Sabates, 2012; The World Bank, 2009).

However, there is increasing recognition that the impressive gains in (primary) school enrolment in Africa mask major deficiencies in learning (Kremer et al., 2013; UNESCO, 2014; World Bank, 2018). Comparative studies show that average learning outcomes in Sub-Saharan Africa are poor, even compared to other low-income regions (Kremer et al., 2013; Pritchett, 2013). Regional assessments such as PASEC concluded

[4] Following the World Bank's definition: "Net enrollment rate is the ratio of children of official school age who are enrolled in school to the population of the corresponding official school age".

that more than half of sampled children did not meet the minimum threshold for mathematics and reading proficiency, in spite of spending several years in school (PASEC, 2015). As an illustration, a recent report found that only one in twelve Nigerian girls that had completed fifth grade was able to read a single sentence (Sandefur, 2016).

Previous research has highlighted several explanations for the 'learning crisis' in Sub-Saharan Africa. First, the rapid expansion of primary enrolments has caused a shortage of teachers in many African countries, resulting in the hiring of underqualified and poorly trained teachers who often lack understanding of their subject matter (Verspoor, 2008). For example, in an assessment of primary school instruction in seven African countries, Bold et al. (2017) found that 32% of teachers failed a grade 4 mathematics test. The same study found that less than 11% of teachers had a minimum knowledge of pedagogy and that most teachers were unable to critically assess student learning; instead, many teachers relied upon outdated rote learning methods. Furthermore, teachers and schools are rarely held accountable for learning outcomes, and have limited incentives to improve performance (Michaelowa, 2001; Yu & Thomas, 2008). These factors often manifest themselves in high rates of teacher absenteeism; for example, in the aforementioned study of seven African countries Bold et al. found teachers were absent from class 44% of the time, so that students were taught for less than 3 hours a day on average (2017, p. 188). Poor learning outcomes in sub-Saharan Africa have also been attributed to a lack of basic resources (such as textbooks and latrines, or even classrooms) and very high student-to-teacher ratios (Michaelowa, 2001; Piper, Simmons, Dubeck, Jepkemei, & King, 2018; World Bank, 2018; Yu & Thomas, 2008).

There is ongoing debate about which factors are most important in explaining learning outcomes. Some scholars argue that the fundamental issue is lack of school resources (see Bennell, 2002) and classroom overcrowding as evidenced by high student-to-teacher ratios, while others maintain that increases in school resources (such as textbooks and teachers) will have limited impact without institutional reforms, including improvements in teacher's education, incentives and accountability (Hanushek & Luque, 2003; Kremer et al., 2013). In recent years, low-cost private schools have emerged as competitors for underperforming public schools in many African countries. There is some debate about whether these schools indeed deliver better quality education, and about the implications for inequality (Grant, 2017; Nishimura & Yamano, 2013).

Although these studies provide insightful evidence regarding the causes of low levels of performance, they tend to ignore the distribution of learning outcomes among different socio-economic groups. Indeed, it is often believed that family background is of limited importance to learning outcomes in the global South, either because there is little variation in socio-economic status, or because the effect of families is dwarfed by that of schools. This idea can be traced back to two influential studies by Heyneman and Loxley (1982, 1983), who showed that school characteristics were far more important than family background in explaining learning outcomes throughout Latin America, Africa and Asia. This runs counter to what is typically observed in high income countries—including by the influential Coleman report—where family background is generally found to be the main determinant of educational performance. Moreover, Heyneman and Loxley found that the effect of families on learning decreases with GDP, while the effect of school and teacher quality increases, a finding that later became known as the 'Heyneman-Loxley Effect'.

Their explanation for these findings, which were confirmed in more recent research (Chiu, 2010), is that in a context of scarce resources, the marginal effect of an additional unit of school quality is higher. They also suggest that in low-income countries "the desire for a place in school and the pressure on students to do well on examinations does not appear to vary as markedly on the basis of parental socioeconomic status" (Heyneman & Loxley, 1983, p. 1183). Although more recent studies on low-income countries have re-emphasized the role of socio-economic disadvantage in the learning process (e.g. Alcott & Rose, 2017; Baker, Goesling, & LeTendre, 2002; Jones & Schipper, 2015; Smith, 2011), they fall short of elucidating the mechanisms behind socio-economic inequality in learning.

Our study addresses these research gaps, firstly by documenting the overall degree of socio-economic inequality in learning in a region that has received scant attention in the literature, and secondly by developing and testing a conceptual framework to explore the relative importance of different pathways through which family background may affect learning outcomes in Africa and other low-income contexts.

Conceptual framework

Existing theories on inequality in educational performance are generally based on the experience of rich industrialized nations, and thus are of less relevance to the low-income countries in our sample. As described in the previous section, education in Sub-Saharan Africa is faced with numerous challenges, including inadequate physical infrastructure, a lack of educational materials and resources, teachers who are underqualified and poorly trained, and high levels of poverty and physical deprivation among pupils. In this section, we develop a conceptual framework that takes these challenges into account and considers the unique realities of the educational landscape in Africa other low-income contexts.

Throughout the framework (depicted in Figure 1), we define learning inequality as the extent to which learning outcomes depend on a pupil's socio-economic background (following e.g. PISA, 2012). We are thus talking about inequality of opportunity, rather than inequality as dispersion (Van de Werfhorst & Mijs, 2010).

We start by estimating the overall degree of socio-economic inequality in learning, proxied by the bivariate association between SES and learning (line **c** in Figure 1). We argue that this effect of family SES on learning outcomes operates through three distinct pathways.

First, there is a direct effect of family SES (line **c'** in Figure 1). This unmediated effect is generally assumed to reflect unobserved 'educational resources' available in a household, which relate to a supportive home learning environment as well as parents' ability to help their children with homework (Bukodi & Goldthorpe, 2013). The direct effect also includes any other unmeasured effects of SES, however, such as differences in the frequency of attendance or effects of family background on motivation and self-confidence.

Second, particularly in this low-income context, family SES affects learning outcomes through material deprivation. A range of studies show that prolonged exposure to poverty and its associated risks can impair the development of important cognitive functions in children (Black et al., 2013; Grantham-McGregor et al., 2007). Malnutrition, poor health and physical impairments are more common among pupils from low-SES backgrounds (path **a)**, and can have a profound impact on children's physical and mental ability to learn (path **b**) (Glewwe & Miguel, 2007; Walker et al., 2016). Moreover, child labor remains highly common in the countries we study, and has been shown to lower educational performance (Heady, 2003). For example, a study in Brazil found working while attending school led to a loss of between one quarter and three fifths of an average year of learning (Emerson, Ponczek, & Souza, 2017).

Third, family SES likely affects children's learning via direct and indirect parental decisions about which school children attend. Internal migration is high in Sub-Saharan Africa (Abel & Sander, 2014), and comparatively wealthier families are more likely to live in or move to the (urban) areas that have the best schools (Glick & Sahn, 2009). The rise of private education in Africa has provided better-off families with another option to provide their children with potentially higher-quality schooling (Grant 2017). Even in the public system, however, direct and indirect costs (such as textbooks and school uniforms) may create barriers to access for poor children. As a result, high-SES children tend to sort into schools with better facilities and resources. In our conceptual framework, the sorting pathway can be interpreted as the combined effect of socio-economic segregation between schools (**d**) and the effect of school quality on learning outcomes (**e**). The literature on school effectiveness in low-income countries has identified several school characteristics that are associated with positive learning outcomes, including physical resources as well as teaching practices and school governance. Much less is known, however, about how measures of school quality are associated with family background and the ways in which schools might inadvertently reinforce pre-existing inequalities.

Method

Data

We use data from the Programme for the Analysis of Education Systems (PASEC) survey, which was commissioned by the Francophone Ministerial Conference for Education (CONFEMEN). Data were collected in 2014 and made publicly available in July 2017. The PASEC 2014 survey collected data on pupils and primary schools in 10 Francophone countries in Western and Central Africa: Benin, Burkina Faso, Burundi, Cameroon, Chad, Congo, Côte d'Ivoire, Niger, Senegal and Togo. In each country between 160 and 266 schools were sampled, and in each school one 6th grade class was randomly selected, from which 20 pupils were randomly drawn. In total, this provides us with a sample of 31,213 6th graders in 1,808 schools from across the ten countries.

The sampled pupils were asked to complete a standardized reading and math assessment, and provided basic information about themselves and their families. Moreover, detailed questionnaires on various aspects of teaching and school resources were completed by the teacher and the school's headmaster. A key advantage of the PASEC methodology is that it is able to distinguish differences in learning even at the lower end of the distribution. Performance scores can be compared in absolute terms or relative to minimum learning thresholds defined by PASEC.

One limitation of our analysis is that primary school attendance is not universal in the countries we study (see Table 1), and PASEC only covers children who are currently in school. This might be particularly a concern for countries like Burkina Faso, Niger and Senegal where more than a quarter of all children are excluded from primary school (see

Table 1). Because we would expect the poorest students to have higher dropout rates and lower levels of performance (Lewin, 2009), our estimates of the association between SES and learning may be conservative because we focus on pupils in schools[5]. As a supplement we plan to use data from other sources (UNESCO and DHS) to explore how differential exclusion from schooling may have affected our results.

Analytical approach

Following the conceptual framework outlined in Figure 1, we assume the following mediation model for socio-economic inequality in learning outcomes:

$$c = a * b + d * e + c'$$

Where c is the total association between SES and learning outcomes, a is the association between SES and material deprivation, b is the association between material deprivation and learning outcomes, d is the association between SES and school quality, and e is the effect of school quality on learning outcomes. The total indirect effect of SES through material deprivation and differential access to quality schooling is $a * b + d * e$, while c' constitutes the direct or residual effect of family SES, which we interpret as the effect of educational resources in the household.

We started with a pooled model that looks at the total impact of family SES on mathematics performance, controlling for cross-national differences in learning[6]:

$$Math_{ijc} = \beta_0 + \beta_1 * SES_{ijc} + X_{ijc} + u_c + e_{ijc} \qquad \text{(Model 1)}$$

[5] When exclusion rates differ between countries, this may also affect their average performance ranking. Even though our study is not predominantly about cross-national differences, this should be taken into account when interpreting subsequent results.

[6] In further analyses, we replicate these models for each individual country; results are discussed in text.

where X_{ijc} refers to a set of basic child-level demographic control variables (sex and age of pupil i in school j in country c)[7] and u_c are dummy variables for the 10 countries participating in the survey[8]. The coefficient β_1 in this model can be interpreted as the overall degree of socio-economic inequality in learning outcomes in the region, which includes any effects that operate through material deprivation, sorting into schools of different quality, and educational resources at home. Next, we added a number of proxies for physical and mental deprivation (D_i), such as being hungry in school or engaging in child labor:

$$Math_{ijc} = \beta_0 + \beta_1 * SES_{ijc} + X_{ijc} + D_{ijc} + u_c + e_{ijc} \qquad \text{(Model 2)}$$

The change in the SES coefficient relative to (1) can be interpreted as the indirect effect of SES through material deprivation. It is important to note that we are not primarily interested in the effect of these covariates themselves, but in the extent to which they explain the relationship between SES and learning. A covariate contributes to learning inequality when it is both positively correlated with SES and has a substantial positive effect on test scores.

In a second specification, we introduce a set of school fixed effects (SFE_j). In this model we exclude the country fixed effects which are implicitly controlled for by the school fixed effects.

$$Math_{ijc} = \beta_1 * SES_{ijc} + X_{ijc} + D_{ijc} + SFE_{jc} + e_{ijc} \qquad \text{(Model 3)}$$

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[7] We refrained from including further control variables, such as the language spoken at home, attending preschool, and repeating a grade, because they can be assumed to be endogenous to family SES. Supplementary analysis showed that including these variables would not substantively affect our findings.
[8] Standard errors were adjusted to account for clustering of pupils in schools.

The extent to which the introduction of school fixed effect explains the SES-learning gradient reflects the extent to which learning inequality is due to sorting into schools of different quality: the $d * e$ pathway in Figure 1 (Freeman & Viarengo, 2014)[9]. The school fixed effects incorporate any school characteristics that may contribute to learning. This is important because previous research shows that many important aspects of school quality, especially intangible assets such as teacher motivation and academic climate, generally remain unobserved in school surveys (McEwan & Trowbridge, 2007). The school fixed effects also incorporate the influence of the broader school environment, including peer effects, characteristics of the school's location or unobserved characteristics of pupils and parents. They can thus can be interpreted as 'Type A' school effects: "the difference between a child's actual performance and the performance that would have been expected had the child attended a 'typical school'" (Raudenbush & Willms, 1995, p. 209). Learning inequality emerges when high-SES parents are able to send their children to schools with the largest Type A effects "regardless of whether that school's effectiveness derives from the superb practice of its staff, from its favorable student composition, or from the beneficial influence of the social and economic context of the community in which the school is located" (Raudenbush & Willms, 1995, p. 210). From a policy perspective, however, it is relevant to know how the allocation of resources to schools might affect learning inequality. In further analyses, we therefore look at the association between family background and specific school resources.

[9] Because we are looking at primary school pupils, we assume that our results are not affected by tracking.

Measures

Learning outcomes: Our measure of learning outcomes are the math test scores provided by PASEC. Performance scores are standardized to have a mean of 500 and a standard deviation of 100 across all pupils in the 10 countries. Results are averaged across five plausible values.

Family socio-economic status: Our main independent variable is family socio-economic status (SES). Following standard practice in educational research (Martinez, Naudeau, & Pereira, 2017), we define SES as a composite indicator of a family's social, economic and cultural resources. Each of these may have distinct and independent effects of children's educational outcomes, although they tend to be strongly correlated. The components of SES that are considered here are an index of household assets—such as a television and a fridge—which is provided by PASEC, father's and mother's literacy and the number of books at home. Each of these variables was reported by the pupils: their distribution can be observed in Appendix Table 1. For analytical purposes, we obtained a composite indicator of SES for each pupil using principal component analysis[10]. We then divided the composite family SES into country-specific quintiles to account for potential non-linearity in the SES-learning gradient. There is substantial variation in SES both between and within countries. Congo Brazzaville and Cameroon score highest on each of the four indicators, which is in line with overall higher GDP per capita (Table 1).

Material deprivation: We measure material deprivation using three different indicators, each of which are reported by the pupil's themselves. The first indicator,

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[10] The results obtained using principal component analysis were substantively similar to those using other commonly established methods, such as sheaf variables (Whitt, 1986), or including each background characteristic as a separate variable.

seeing/hearing disability equals 1 when the child has a hearing impairment or has a visual impairment that is not corrected by eyeglasses. The second indicator, *hungry*, equals 1 when the child is often hungry in school. The third indicator, *child labor*, equals 1 when the child frequently engages in non-domestic work outside school (farming, commerce or physical labor). Descriptive statistics are presented in Table 1. All measures are self-reported by the child and thus may be subject to reporting bias.

School quality: In our main models we include school fixed effects to control for unobserved time invariant school-characteristics (e.g. quality measures). In supplementary models, we also looked at the role of specific school resources related to quality, including the teacher's education level, gender, experience and degree of absenteeism, the pupil-teacher ratio, and composite indices for classroom resources (such as textbooks) and school facilities (such as latrines) (see Appendix Table 2 for summary statistics). We also include two binary variables indicating whether the sampled classroom was composed of multiple grades and taught in shifts. Finally, we include an indicator for private schools. There is considerable variation in the share of private schools, ranging from 5% in Niger to 49% in Congo Brazzaville.

Child demographic characteristics: All models control for the pupil's gender and age. Overage enrollment and grade repetition are highly common in Sub-Saharan Africa, so that the sampled Grade 6 pupils encompass a wide age range.

Results

Descriptive findings

Descriptive statistics for key pupil-level variables are provided in Table 2. There was substantial variation in learning between as well as within countries, as evidenced by the means and standard deviations for mathematics performance. Niger had the lowest average math score (406 points, almost one standard deviation below the mean) while Burundi had the highest (593 points). The figure also highlights the magnitude of the learning crisis in the region: in seven out of the ten countries the average performance lies below PASEC's Grade 6 minimum proficiency threshold of 521, suggesting that most pupils do not master even the most basic elements of the curriculum.

In addition to means and standard deviations, we provide the intra-school correlation of mathematics performance, which can be interpreted as the degree of between-school inequality in learning. This correlation averaged .55 across countries, which is high compared to what is typically observed in the OECD (PISA, 2012). There may be various reasons for the clustering of students of similar skill levels in the same schools, which we will discuss in more detail in the upcoming sections.

We also calculated the intra-school correlation of socio-economic status, which is a common measure of school segregation. Table 2 shows that school segregation was very high in the countries we study. For example, the average correlation in SES between two pupils who attended the same school was more than .6 in Niger, Cameroon and Chad, compared to an average of .23 in the OECD (PISA, 2012) (need to change to TIMMS). When children from disadvantaged backgrounds are clustered in the same schools, this is likely to reinforce social background effects on learning, especially when school resources are unequally distributed.

Figure 2 plots the average mathematics score of pupils in each socio-economic quintile. In each of the ten countries a positive SES-learning gradient can be observed, although its magnitude differs considerably. The difference in mathematics performance between the bottom and the top quintile varied from 122 points (1.2 standard deviations) in Cameroon to 22 points in Burundi. The association between SES and learning appears to be non-linear in several countries, with larger gaps between the top and the middle quintile than between the bottom and the middle quintile. In Niger, Chad and Ivory Coast even the top SES quintile performed below the minimum threshold. In Burundi, on the other hand, performance was high regardless of socio-economic origin: even the bottom SES quintile in Burundi scored higher than the top quintile in any of the other countries.

Socio-economic inequality in learning

We assessed the overall degree of learning inequality in the region (line **c** in Figure 1) by regressing mathematics performance on SES quintiles in a pooled model, controlling for the gender and age of the pupil as well as country fixed effects (Model 1). In line with Figure 2, we observed the strongest effect for the top quintile. On average, pupils in the highest SES quintile scored 60 points (0.6 standard deviations) above those at the bottom ($p<0.001$), while those in the middle quintile scored 18 points higher ($p<0.001$). It is thus not the poorest pupils 'falling behind' but rather the relatively better-off pupils outperforming the others, including those in the middle of the SES distribution. Moreover, girls performed slightly worse than boys on average (-3.8, $p<0.001$), and performance decreased with age. The latter observation is common in studies of this kind, since overage enrollment is generally a sign of low ability and/or irregular attendance (Lewin, 2009).

Material deprivation

In a second step we added a number of indicators for material deprivation (Model 2). Because of the well-established association between poverty-related stressors and cognitive development, we expect these indicators to partially mediate the association between SES and learning (the $a * b$ path in Figure 1). Our indicators for child labor and untreated visual or hearing impairment had a substantial negative effect on learning, which in line with previous research. The effect of being hungry in class (controlling for other background variables) was small and not significant, which may result from the misinterpretation of this question by the child respondents, 'hunger' being a rather subjective concept. Contrary to our expectations, however, including these indicators explained very little of the association between SES and learning: the difference between the bottom and the top quintile decreased by 3.9 points, and between the bottom and the fourth quintile by 1.4 points. Further analysis shows that the link between our indicators for material deprivation and family SES (path a in Figure 3) was rather weak in most countries (results not shown).

School quality

In a further specification, we include the school fixed effects (SFE_j), which incorporate all observed as well as unobserved school level-factors that may explain learning differences between schools (Model 3). Assuming the initial allocation to schools was not based on ability, the difference between the SES coefficients in Model 2 and Model 3 reflects the extent to which learning inequality is due to sorting into schools of different quality (the $d * e$ path in Figure 1). Table 3 clearly shows that school quality, broadly defined, explains most of the association between SES and mathematics performance. The differences between the first, second, third and fourth SES quintiles become insubstantial when controlling for school effects, while the difference between the top and the bottom quintile is reduced from 56 to 5 points, a 91% decrease. This is a striking result, which demonstrates that differences in the quality of schools attended by 'poor' and 'rich' children explain most of the gap in their learning outcomes. Our findings thus suggest that schools are the major driver of learning inequality in this low-income context: we discuss this observation in more detail in the following sections.

The direct effect of SES (c' in Figure 1) has a particular interpretation in the school fixed effect model: it is the average difference between two pupils of different backgrounds who attend the same school. Table 4 shows that this difference is small or negligible in our sample. Again, these results stand in stark contrast to findings from the OECD, where substantial learning gaps can generally be observed remain between low and high-SES pupils even when they attend the same school (Marks, Cresswell, & Ainley, 2006).

Differences based on gender, age and visual impairment remain largely unchanged, however, when comparing children within the same school. In the next section, we examine whether the effects observed thus far differ between countries.

Cross-national differences

The previous sections looked at overall trends across the ten countries, which may mask cross-national variation in the direct and indirect effects of SES on learning. We therefore ran models M1, M2 and M3, which test our key hypotheses, separately for each country. Figure 3 provides a concise summary of the findings by plotting the difference in mathematics performance between the bottom and the top quintile under different model specifications. The full results are presented in Appendix Table 3.

Our findings show that the key conclusion from the previous section—that school fixed effects explain almost the entire association between SES and learning—holds in each of the 10 countries, although there is substantial variation between countries in the overall level of learning inequality. Figure 3 shows that SES is a positive and significant predictor of mathematics performance in each of the countries under study. The total effect of SES is largest in Togo and Cameroon, where the difference in learning between the top and the bottom SES quintile is equivalent to a standard deviation, and smallest in Burundi, followed by Burkina Faso, Ivory Coast and Chad. Like in the pooled model, material deprivation explains very little of the association between family SES and learning. In each country, however, the SES-learning gradient largely disappears when comparing pupils in the same school. Only in Chad, Cameroon and Niger can we observe a significant effect of family background after controlling for school fixed effects, but it amounts to a fraction its total value.

Our findings thus suggest that differences in the quality of schools attended by poor and wealthier children drive cross-national variation in learning inequality. Inequality is high when poor children are clustered in low-quality schools. This point is further illustrated in Figure 4, which plots the average school fixed effect of pupils in the bottom and the top SES quintile. Schools with a positive fixed effect perform better than what would be expected based on the composition of their student body, while those with a negative fixed effect perform worse. In the absence of prior selection on ability, the school fixed effects can thus be interpreted as an omnibus measure of school quality (Freeman & Viarengo, 2014). In all countries, pupils with low-SES parents attend lower-quality schools than their high-SES peers. The difference is particularly large in countries such as Togo and Cameroon, which have a highly segregated school system and high levels of learning inequality. School quality is more equally distributed in Burundi, Chad and Burkina Faso, where learning inequalities are consequently lower. Not surprisingly, Burundi and Burkina Faso also have the lowest levels of school segregation (see Table 2).

It is also noteworthy that gender differences vary considerably between countries. In Benin and Burundi girls outperform boys in math, but the opposite is true in countries like Chad, Congo and Niger. In the next section, we explore the role of schools in more detail by examining differences in school resources between pupils from different social backgrounds.

The role of schools in learning inequality

In the previous sections, we have shown that school effects explain most of the association between SES and learning outcomes in each of the countries under study. However, we still do not know what makes the schools that high-SES children attend more effective. We therefore turn our attention to the specific school characteristics that may contribute to socio-economic inequality in learning, using the school-level variables collected by PASEC. First, we replace the school fixed effects in Model 3 by random effects, which we then predict using a set of variables related to teacher characteristics (education level, absenteeism, experience, gender, contract type, and use of local language in class), school resources and practices (double shift teaching, multigrade classes, pupil-teacher ratio, index of classroom resources, index of school assets) and school type (public or private). In combination, these variables explain about 30% of the between-school variation in learning (see Table 4).

Table 4 shows that private schools outperform public schools by almost half a standard deviation, even when controlling for pupil background and school resources. School resources also play an important role: a standard deviation increase in the classroom resource index and the school infrastructure index are associated with 11 and 14 points higher math scores, respectively. Consistent with expectations, performance is better when the teacher is more educated and worse when classes combine pupils from multiple grades. Other school characteristics such as double shift teaching, the pupil/teacher ratio and teacher experience appear to play a comparatively less important role.

Now that we have established which school-level factors are important for learning, we can assess their distribution across poor and rich pupils (defined here as the bottom and the top SES quintiles). In Figure 5, we plot socio-economic inequality in three selected school quality indicators: attending a private school, having access to math textbooks and attending a school without latrines. The latter two have been selected because they exemplify the classroom resources and school infrastructure indices described above, and their effect on school performance has been well-established (Adukia, 2017; Frölich & Michaelowa, 2011).

Inequality in access to private schooling is particularly striking. In Chad, 40% of the top SES pupils attend a private school, compared to 3% of the bottom SES pupils. The corresponding figures for Congo Brazzaville are 86% and 8%. These findings challenge claims that private schooling in Sub-Saharan Africa pro-poor, as is sometimes suggested (Tooley & Dixon, 2005), and suggests that these schools primarily cater to the better-off. Access to textbooks is slightly less stratified, although noticeable gaps between poorer and richer students can be observed, particularly in countries where many pupils do not have textbooks. Finally, it can be observed that most high SES pupils attend schools with latrines, but this is often not the case for their poorer counterparts.

Discussion

Creating equal learning opportunities for all children is a core objective of educational policy. The academic discourse around on the 'learning crisis' in the global South has largely overlooked socio-economic inequalities in learning, however. In part, the focus on school characteristics—rather than family background—can be retraced to classic work by Heyneman and Loxley (1982, 1983), who argued that social origin is comparatively less important for learning outcomes in low-income countries. We argued, however, that there are important reasons to believe family socio-economic status will affect school performance, not only directly but also indirectly through material deprivation and differential access to quality schooling.

We used a unique dataset on educational performance, family background and school characteristics and in 10 Francophone African countries—including some of the poorest countries in the world—to study socio-economic inequality in learning. We found that the near-universal levels of primary school enrolment in these countries mask substantial differences in the actual skills obtained by children from poor and wealthier backgrounds. A mediation analysis showed that most of the effect of family background on learning outcomes could be explained by sorting into schools of differential quality. Schools in Sub-Saharan Africa reinforce inequality because they are highly socially segregated, and resource differences between schools are large (see Smith, 2011 for similar observations in South Africa). In contrast, indicators of material deprivation explain relatively little of the SES-learning association, even though they are important determinants of learning outcomes in their own right. Our findings also suggest that the direct effect of SES is limited: we found little or no differences between children from different social origins who attended the same school. The fact that rich and poor children who attend the same school have similar test scores strengthen our argument that learning inequality results from the unequal distribution of school quality, rather than from pre-school differences in ability. In further analyses, we assessed which school characteristics are particularly important for learning inequality, and showed that access to better-resourced and private schools was highly socially stratified.

Our findings confirm Heyneman and Loxley's observation on the importance of school quality as a determinant of learning outcomes in low-income contexts. However, we qualify this perspective in an important way: although the effect of family background is limited once the effect of schools has been accounted for, family background largely determines which school a child attends. Ignoring the association between family background and school quality omits an essential pathway through which socio-economic (dis)advantage affects children's learning, and therewith their life chances.

These findings have clear implications for educational policy. Improvements in school enrolment remain elusive when pupils do not learn, and our findings show that it is often the most disadvantaged students who learn the least. It is encouraging, however, that SES-based learning gaps are generally negligible when comparing pupils who attend the same school, because it suggests that these gaps are neither biologically nor socially determined, and may be amenable to policy intervention. An obvious way to improve equality would be to ensure a more equitable distribution of resources across schools. Moreover, national initiatives to 'raise the floor' in learning can be particularly effective ways to improve overall learning outcomes and reduce inequality (Wagner, 2018).

The experience of Burundi could serve as an example in this regard: even though it is the poorest country in our dataset, it has the overall mathematics score, and the lowest degree of socio-economic inequality (see Figure 3). Not surprisingly, school segregation and quality disparities between schools are much less pronounced in Burundi than in the other countries in the study. Moreover, Burundi has implemented curriculum reform in accordance with EFA guidelines and shifted to teaching primary education in local languages—as opposed to French—which has been shown to be associated with improved learning outcomes in other contexts (PASEC, 2016)[11].

The main limitation of the analyses presented here lies in the cross-sectional nature of the PASEC survey. Learning results from the gradual accumulation of skills over the early life course, and starts well before the age of school entry (Heckman, 2006). Moreover, our measures of material deprivation did not always have the expected association with

[11] It should be noted that Burundi pupils are on average almost two years older than the sample average (see Table 1). Although this might be part of the reason for Burundi's exceptional test performance, it does not explain its high levels of equity.

SES and learning, which may be due to errors in self-reports by children. More objective measures of deprivation, such as stunting, might have a stronger association with SES.

These limitations notwithstanding, our findings contribute to a growing literature on the 'learning crisis' in the global South (Bold et al., 2017; Glewwe & Muralidharan, 2016; Kremer et al., 2013), by showing how family background and school quality interact to produce unequal learning outcomes. Future research on educational performance in Africa and other low-income contexts could further develop this perspective by analyzing how learning inequality develops over the primary school career and beyond. The conceptual framework developed in this paper should be applicable to other low-income regions as well, and it would be fruitful to explore whether the role of families and schools in shaping learning inequality is different in other parts of the world.

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Figures

Figure 1: Conceptual framework

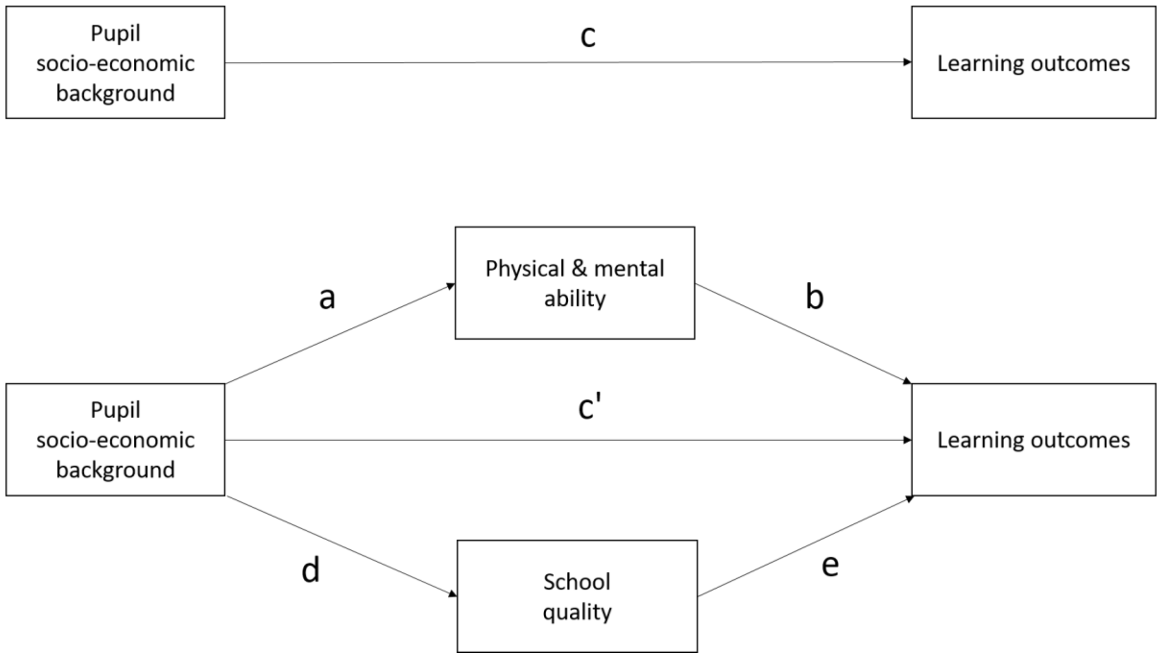
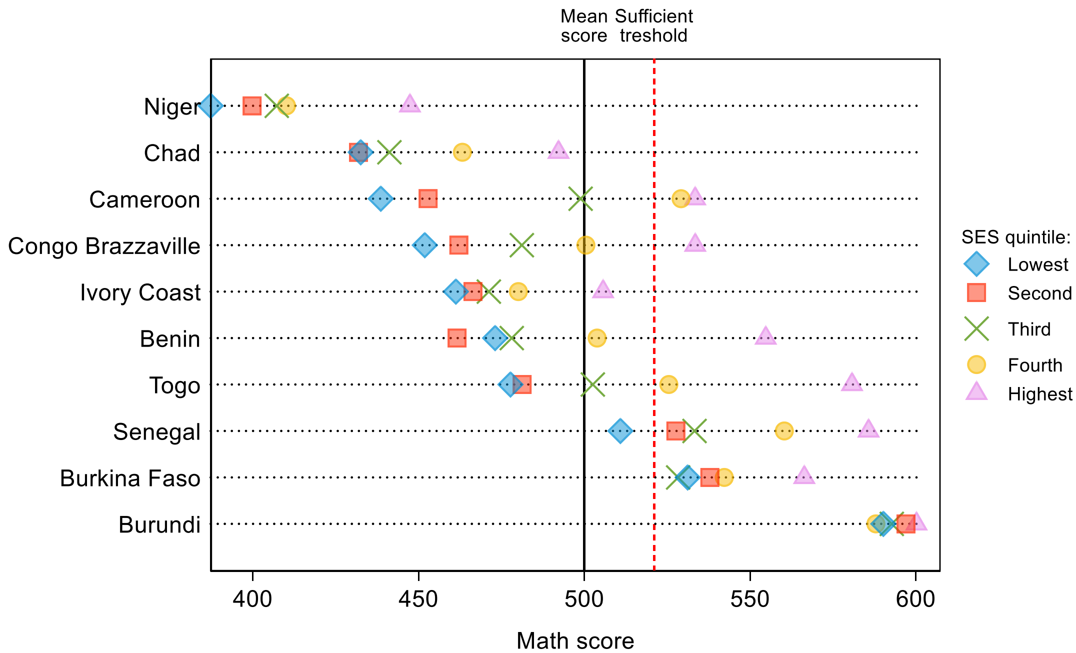
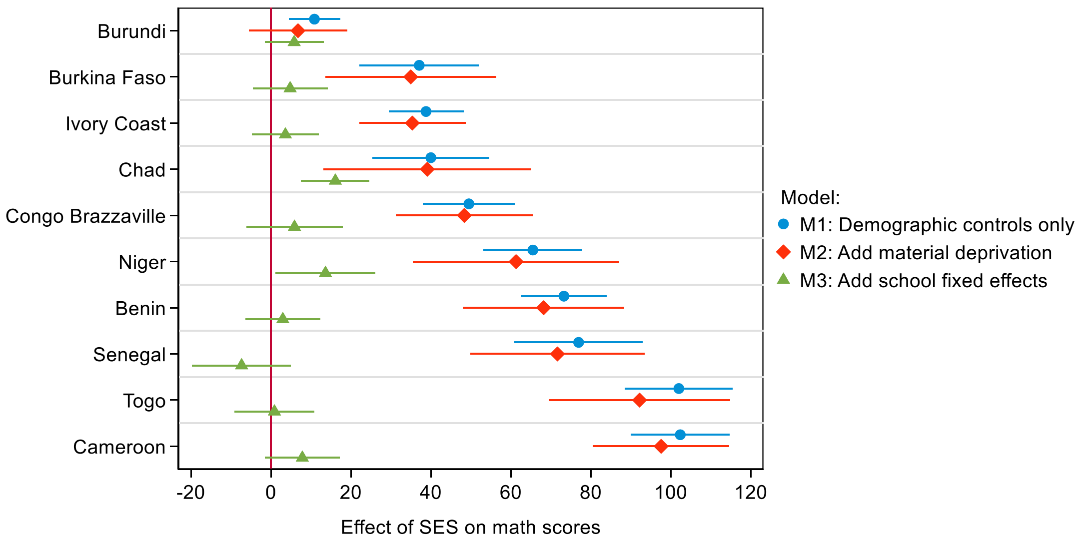


Figure 2: Mean mathematics performance, by country and SES quintile



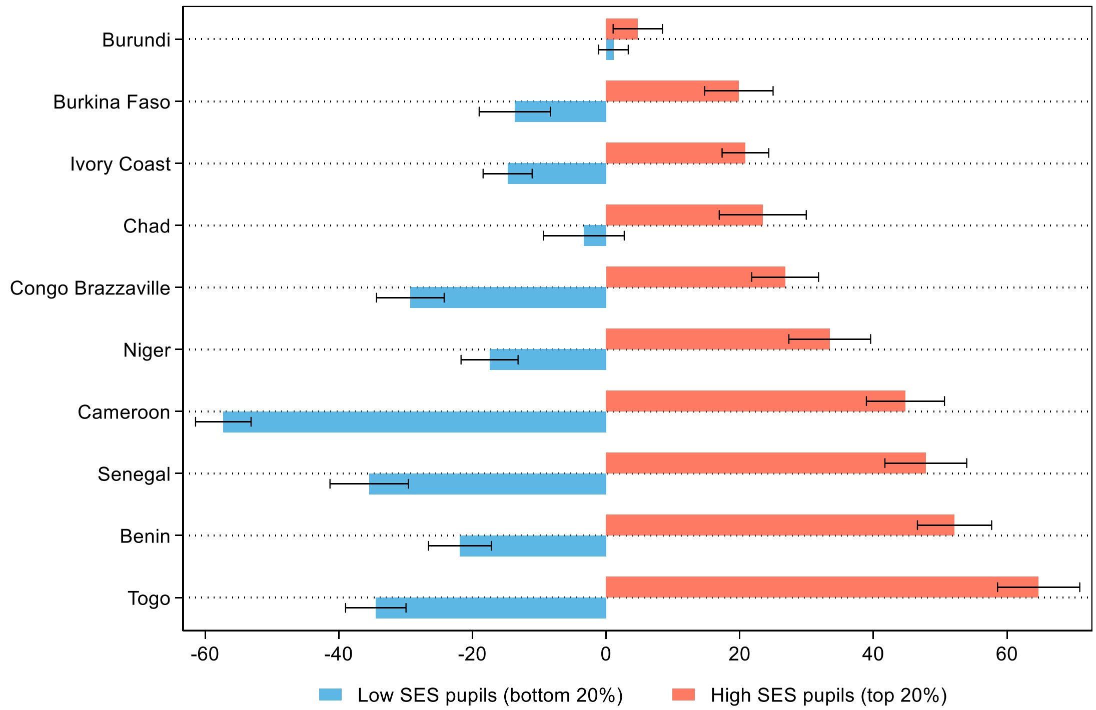
Note: Weighted. Countries are ordered by performance of the bottom quintile

Figure 3: The effect of SES on mathematics performance, by country



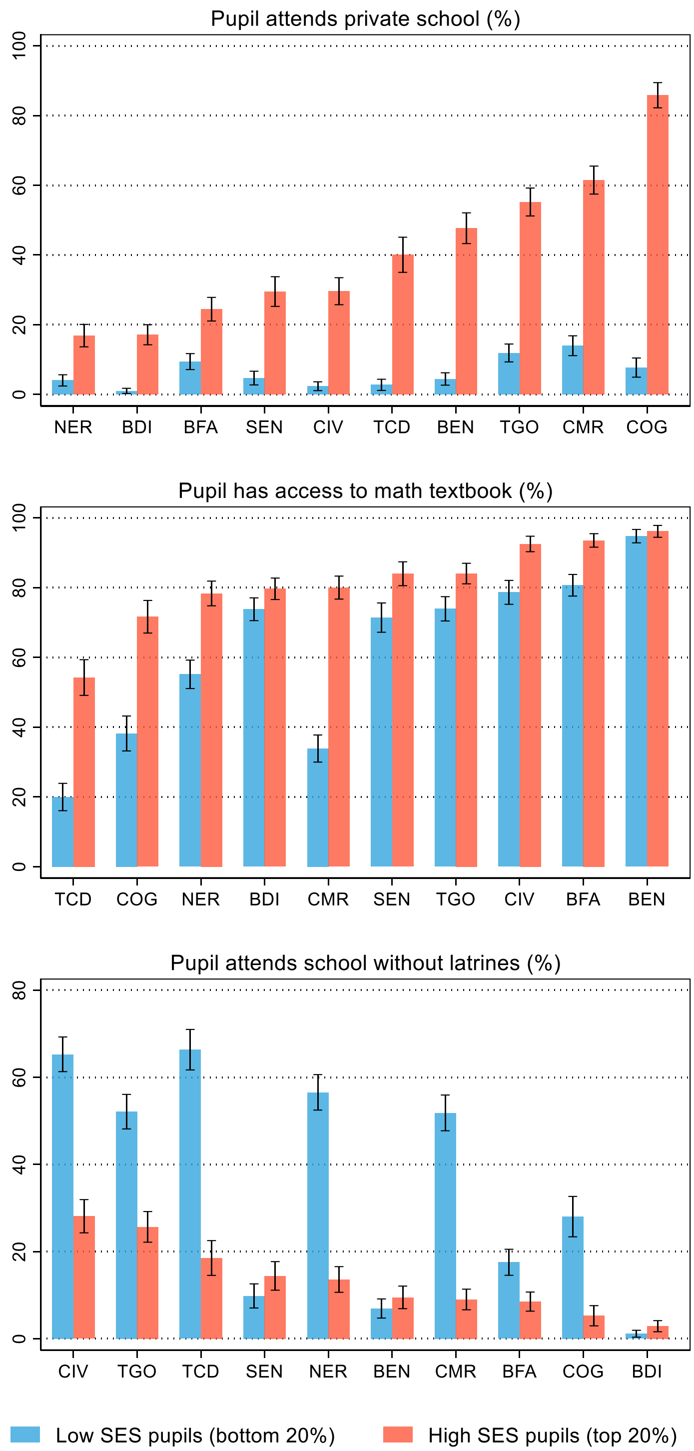
Note: Lines represent 95% confidence intervals. Full models presented in Appendix Table 4.

Figure 4: Average school fixed effect, by SES quintile



Note: fixed effects derived from regression models M3 presented in Appendix Table 4.

Figure 5: Distribution of educational resources, by SES quintile



Note: Capped lines represent 95 % confidence intervals. BEN=Benin, BDI=Burundi, BFA=Burkina Faso, CMR=Cameroon, COG=Congo (Brazzaville), CIV=Ivory Coast, NER=Niger, SEN=Senegal, TCD=Chad, TGO=Togo.

Tables

Table 1. Country background indicators[1]

	BEN[2]	BDI	BFA	CMR	COG	CIV	NER	SEN	TCD	TGO
Population (millions)	9	9	16	21	4	21	17	13	12	6
GDP per capita ($ PPP)	1,886	782	1,512	3,043	5,305	2,770	851	2,189	1,967	1,258
Poverty (< 2 USD) (%)	19	32	11	8	15		14	13	15	23
Urban population (%)	43	11	27	53	64	52	18	43	22	38
GINI	43	39	35	47	49		33	40	43	46
Primary spending (% GDP)	12	13	18	6	11	13	22	20	6	13
Prim. enrolment rate (gross)	122	132	83	109	112	86	68	81	92	127
Prim. enrolment rate (net)	95	93	65	90	90	72	60	71	71	91

[1] Source: World Bank Development Indicators, averages for years 2010-2014
[2] BEN=Benin, BDI=Burundi, BFA=Burkina Faso, CMR=Cameroon, COG=Congo (Brazzaville), CIV=Ivory Coast, NER=Niger SEN=Senegal, TCD=Chad, TGO=Togo.

Table 2. Descriptive statistics for pupil level variables, by country (non-standardized)

		BEN[1]	BDI	BFA	CMR	COG	CIV	NER	SEN	TCD	TGO	Total
Math score	*Mean*	496.9	593.6	539.5	489.5	481.4	475.7	405.8	546.6	450.9	520.2	503.3
	S.D.	87.4	60.1	84.7	90.9	72.3	68.4	72.7	99.8	76.9	99.7	95.1
	ICC[2]	0.58	0.30	0.52	0.62	0.59	0.39	0.48	0.54	0.63	0.60	0.55
Family SES	*Mean*	0.19	-0.34	-0.15	0.76	0.97	0.23	-0.81	0.57	-0.49	0.01	0.05
	S.D.	1.41	1.09	1.24	1.32	1.23	1.31	1.48	1.42	1.41	1.33	1.39
	ICC	0.45	0.32	0.38	0.62	0.59	0.45	0.64	0.51	0.61	0.58	0.53
Hungry in class	*%*	48.5	56.7	59.6	70.7	43.7	63.0	66.3	51.4	46.3	47.0	57.5
Child labor	*%*	54.5	62.5	65.6	72.0	48.6	63.9	72.4	43.4	66.0	61.8	62.5
Impairment	*%*	24.7	30.8	27.7	34.7	17.7	31.1	16.5	23.5	18.5	20.0	26.3
Girl	*%*	52.7	45.2	50.9	45.7	49.8	45.8	43.4	52.8	34.6	46.1	46.9
Age (years)	*Mean*	12.1	14.5	13.3	12.0	12.6	12.2	12.9	12.5	13.4	12.6	12.8
	S.D.	1.7	1.6	1.4	1.6	1.5	1.5	1.2	1.1	1.6	1.7	1.7
N		2,568	3,131	3,319	2,858	1,801	2,717	2,619	2,210	1,836	2,994	26,053

Based on the non-imputed sample. Weighted means and percentages, unweighted N.

[1] BEN=Benin, BDI=Burundi, BFA=Burkina Faso, CMR=Cameroon, COG=Congo (Brazzaville), CIV=Ivory Coast, NER=Niger SEN=Senegal, TCD=Chad, TGO=Togo. S.D.=Standard Deviation

[2] ICC refers to the intra-school correlation of the respective variable.

Table 3. Pooled models for mathematics performance

	M1 *OLS*[1]	M2 *OLS*[1]	M4 *School FE*[2]	M5 *School RE*[3]
SES quintile (*ref:* Lowest)				
Second	7.07***	7.10***	-0.02	0.13
Third	17.66***	17.02***	0.30	1.08
Fourth	31.83***	30.46***	0.82	2.25
Highest	60.21***	56.34***	4.80**	7.24***
Girl	-3.80**	-4.96***	-6.59***	-6.40***
Age	-8.11***	-7.43***	-4.65***	-4.76***
Hungry in class		2.44	-0.96	-0.49
Child labor		-22.25***	-6.14***	-7.23***
Impairment		-15.41***	-15.74***	-15.76***
Private school				43.92***
Local language teaching (*ref*: never)				
Sometimes				-9.92**
Often				-11.03*
(Almost) always				-15.08
Male teacher				-18.49***
Teacher is civil servant				-3.21
Teacher education (*ref*: < Upper sec.)				
Upper secondary				4.55
Tertiary				8.57*
Teacher experience				0.31
Teacher absence days				-1.46**
Class is double shift				2.92
Class is multigrade				-14.63***
Student / teacher ratio				0.01
Class resource index				10.65***
School infrastructure index				13.57***
Country dummies (*ref:* Benin)				
Burundi	59.09***	58.76***		63.43***
Burkina Faso	137.08***	135.85***		144.99***
Cameroon	8.63	10.26		16.26**
Congo (Brazzaville)	25.29***	19.26**		16.80**
Ivory Coast	-7.56	-6.68		5.17

Niger	-60.19***	-61.59***		-31.74***
Senegal	53.63***	49.63***		58.23***
Chad	-21.99**	-22.32***		20.58**
Togo	31.08***	30.40***		50.01***
Constant	559.54***	570.58***	575.79***	415.48***
St. Dev. (Schools)				50.02***
St. Dev. (Pupils)				55.60***
Intra-school correlation				0.447
Explained between-school var.[4] (%)				29.2
N (Schools)	1,786	1,786	1,786	1,786
N (Pupils)	26,053	26,053	26,053	26,045

[1] Standard errors adjusted for clustering in schools
[2] FE=Fixed Effect, RE=Random Effect
[3] Compared to a model excluding the school-level predictors

Appendix A: Further descriptives and models for mathematics performance

Appendix Table 1. Components of SES, by country

	BEN[2]	BDI	BFA	CMR	COG	CIV	NER	SEN	TCD	TGO	**Total**
Asset index[1]	51.65	50.09	43.61	53.02	54.18	52.34	45.81	52.25	44.12	47.53	**49.47**
No books at home	0.42	0.44	0.69	0.30	0.40	0.36	0.66	0.42	0.69	0.40	**0.48**
One bookshelf	0.46	0.45	0.25	0.44	0.39	0.49	0.25	0.43	0.24	0.50	**0.39**
Two+ bookshelves	0.12	0.11	0.06	0.26	0.20	0.15	0.09	0.15	0.08	0.09	**0.13**
Mother can read	0.35	0.33	0.60	0.75	0.85	0.41	0.31	0.38	0.29	0.37	**0.46**
Father can read	0.64	0.56	0.72	0.81	0.92	0.69	0.48	0.63	0.62	0.69	**0.67**
N	2,568	3,131	3,319	2,490	1,801	2,717	2,619	2,210	1,836	2,994	**31,213**

[1] BEN=Benin, BDI=Burundi, BFA=Burkina Faso, CMR=Cameroon, COG=Congo (Brazzaville), CIV=Ivory Coast, NER=Niger SEN=Senegal, TCD=Chad, TGO=Togo

[1] Comprises 23 common household assets and amenities (television, fridge, running water etc.), estimated using Item Response Theory (see PASEC, 2017, p. 157)

Appendix Table 2. Descriptive statistics of school-level variables, by country (non-standardized, standard deviations in brackets)

		BEN[1]	BDI	BFA	CMR	COG	CIV	NER	SEN	TCD	TGO
Teacher uses local language											
Never	*%*	0.18	0.10	0.00	0.37	0.14	0.47	0.03	0.10	0.14	0.28
Sometimes	*%*	0.76	0.61	0.61	0.51	0.80	0.43	0.57	0.72	0.79	0.67
Often	*%*	0.06	0.26	0.28	0.09	0.05	0.09	0.31	0.17	0.06	0.05
(Almost) always	*%*	0.00	0.03	0.11	0.03	0.01	0.00	0.09	0.01	0.01	0.00
Teacher is male	*%*	0.87	0.83	0.15	0.76	0.75	0.95	0.68	0.89	1.00	0.99
Teacher is civil servant	*%*	0.59	0.29	0.96	0.08	0.34	0.86	0.57	0.50	0.39	0.46
Teacher education level											
(Less than) lower sec.	*%*	0.14	0.39	0.02	0.07	0.06	0.07	0.20	0.14	0.39	0.02
Upper secondary	*%*	0.58	0.02	0.71	0.59	0.52	0.46	0.55	0.58	0.02	0.71
Tertiary	*%*	0.27	0.59	0.27	0.34	0.42	0.46	0.25	0.27	0.59	0.27
Teacher experience	*Yrs.*	17.77	11.53	11.25	11.09	11.05	11.67	12.57	10.59	7.41	12.45
	S.D.	10.04	6.19	7.82	7.64	8.33	8.06	7.53	5.80	6.12	7.65
Teacher absence	*Days*	1.47	1.30	1.02	1.40	1.36	1.04	1.68	1.87	2.31	0.86
	S.D.	2.16	1.65	1.45	1.85	1.98	1.42	2.64	3.02	3.25	1.76
Private school	*%*	0.18	0.13	0.05	0.37	0.49	0.12	0.05	0.11	0.15	0.26
Class is double shift	*%*	0.01	0.01	0.22	0.21	0.13	0.01	0.01	0.07	0.05	0.02
Class is multigrade	*%*	0.05	0.07	0.00	0.26	0.28	0.15	0.07	0.11	0.43	0.42
Pupil-teacher ratio	*Mean*	60.12	61.64	39.84	50.53	62.26	48.92	41.35	47.00	61.40	47.53
	S.D.	28.88	21.56	13.42	28.16	51.93	20.64	16.77	41.84	27.91	26.45
Index classroom resources	*Mean*	58.62	52.69	49.20	45.63	49.94	54.07	48.23	53.46	38.18	50.17
	S.D.	8.16	10.20	6.19	9.41	6.90	8.32	8.50	10.36	8.44	9.36
Index school infrastructure	*Mean*	54.15	51.89	46.23	50.25	53.06	51.77	42.01	56.21	45.72	45.77
	S.D.	6.79	6.98	8.59	12.17	9.82	7.93	9.16	7.23	10.39	10.27
N (schools)		165	182	180	266	164	169	176	160	157	189

[1] BEN=Benin, BDI=Burundi, BFA=Burkina Faso, CMR=Cameroon, COG=Congo (Brazzaville), CIV=Ivory Coast, NER=Niger SEN=Senegal, TCD=Chad, TGO=Togo. S.D.=Standard Deviation

Appendix Table 3. Models for mathematics performance, by country

	BEN[1]	BDI	BFA	CMR	COG	CIV	NER	SEN	TCD	TGO
M1: Demographic controls only										
SES quintile (*ref:* Lowest)										
Second	-6.91	2.35	15.52*	24.87***	10.48	1.56	10.65	10.96	-5.59	0.03
Third	5.49	0.18	6.85	63.01***	27.81**	9.54	19.55**	17.44*	-2.18	20.98**
Fourth	26.67***	-6.17	20.45*	88.59***	42.74***	17.42**	25.39**	40.23***	15.22	40.14***
Highest	73.26***	10.89	37.10***	102.36***	49.51***	38.80***	65.49***	76.95***	40.01**	102.01***
Girl	18.27***	36.19***	-13.27***	-3.77	-19.61***	-15.75***	-15.17***	-13.26**	-23.41***	-15.51***
Age	-11.41***	-7.60***	-7.18***	-14.72***	-17.35***	-2.60	-5.88**	-5.55	-1.82	-6.56***
Constant	589.90***	690.79***	617.33***	613.99***	703.33***	499.24***	473.95***	579.98***	472.40***	566.27***
R^2	0.20	0.12	0.04	0.28	0.26	0.06	0.10	0.09	0.08	0.18
M2: Add material deprivation										
SES quintile (*ref:* Lowest)										
Second	-5.45	2.61	16.47*	23.38***	10.40	1.43	12.15	14.63	-5.22	-3.61
Third	6.41	0.51	6.87	59.05***	26.49**	9.77	20.06**	19.45*	-2.48	17.92*
Fourth	26.83***	-7.44	20.50*	82.96***	41.42***	16.99**	25.53**	40.42***	15.93	34.25***
Highest	68.19***	6.78	34.98**	97.58***	48.37***	35.38***	61.31***	71.66***	39.13**	92.19***
Girl	19.40***	35.16***	-14.73***	-4.35	-19.49***	-15.82***	-18.42***	-17.49***	-23.52***	-16.61***
Age	-10.38***	-7.00***	-6.61***	-13.77***	-16.59***	-2.33	-5.14*	-4.73	-1.93	-6.31***
Hungry	16.21**	-6.03	0.37	10.71*	1.38	8.55*	10.95*	-4.77	6.29	-13.23*
Child labor	-25.82***	-16.41***	-22.37***	-25.60***	-13.44**	-19.83***	-24.13***	-36.67***	-9.33	-24.29***
Impairment	-17.13**	-7.50*	-12.33	-15.54***	-3.78	-20.70***	-23.61**	-49.75***	7.18	2.87
Constant	590.49***	699.68***	628.74***	621.38***	700.54***	510.94***	479.59***	604.11***	475.75***	590.01***

R^2	0.24	0.14	0.06	0.30	0.26	0.10	0.13	0.17	0.08	0.20
M3: Add school fixed effects										
SES quintile (*ref:* Lowest)										
Second	-3.79	3.48	7.44	-6.97	1.37	-1.55	3.82	-3.65	5.26	-7.29
Third	-1.24	4.04	0.66	5.39	1.28	-0.78	7.03	-10.62*	4.58	-5.42
Fourth	-0.85	0.41	1.75	2.52	7.20	-3.05	8.15	-8.16	11.85**	-2.91
Highest	2.99	5.82	4.82	7.87	5.91	3.63	13.65**	-7.32	16.11***	0.89
Girl	19.45***	33.03***	-15.69***	-9.89***	-21.62***	-18.66***	-15.29***	-21.03***	-22.15***	-16.84***
Age	-6.78***	-5.71***	-2.84**	-9.05***	-9.48***	-3.28***	-1.45	-9.73***	1.75*	-4.78***
Hungry	1.16	-10.31***	-1.65	-3.62	1.41	6.00*	4.27	3.14	5.94*	-3.52
Child labor	-5.89*	-11.04***	-9.22***	-1.28	-6.22*	-4.77	-10.55***	-12.19***	1.29	-6.72*
Impairment	-19.96***	-4.50*	-16.30***	-15.56***	-4.18	-20.80***	-20.34***	-21.57***	0.16	-14.71***
School FE	V	V	V	V	V	V	V	V	V	V
Constant	666.01***	695.62***	415.26***	571.43***	585.33***	571.93***	525.29***	597.55***	460.32***	638.38***
R^2	0.64	0.43	0.54	0.70	0.68	0.47	0.55	0.61	0.71	0.64
N	2,568	3,131	3,319	2,858	1,801	2,717	2,619	2,210	1,836	2,994

[1] BEN=Benin, BDI=Burundi, BFA=Burkina Faso, CMR=Cameroon, COG=Congo (Brazzaville), CIV=Ivory Coast, NER=Niger SEN=Senegal, TCD=Chad, TGO=Togo. S.D.=Standard Deviation, ICC=Intra-Cluster Correlation

Appendix B. Models for reading performance

Appendix Table 5. Descriptive statistics reading performance, by country (non-standardized)

		BEN[1]	BDI	BFA	CMR	COG	CIV	NER	SEN	TCD	TGO	Total
Reading score	*Mean*	523.4	525.4	531.6	517.5	503.4	517.0	403.5	548.4	432.5	497.3	505.9
	S.D.	97.0	46.5	78.9	100.7	88.1	93.7	75.9	103.0	79.4	90.7	95.8
	ICC	0.54	0.44	0.55	0.63	0.61	0.43	0.56	0.56	0.66	0.58	0.57
N		2,568	3,131	3,319	2,858	1,801	2,717	2,619	2,210	1,836	2,994	26,053