Enrollment Without Learning: Teacher Effort, Knowledge, and Skill in Primary Schools in Africa

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School enrollment has universally increased over the last 25 years in low-income countries. Enrolling in school, however, does not assure that children learn. A large share of children in low-income countries complete their primary education lacking even basic reading, writing, and arithmetic skills (see Hungi et al. 2010; PASEC 2015; ASER 2013)—a state of affairs that UNESCO (2013) dubbed the "global learning crisis." For example, after more than three years of compulsory language teaching, four out of five students in Mozambique and Nigeria cannot read simple words of Portuguese and English, respectively. Only one-quarter of Indian students in grade four can manage tasks—such as basic subtraction—that are part of the curriculum for the second grade. Roughly half of the students in Uganda, after three years of mathematics teaching, cannot place numbers between 0-999 in order (Bold et al. 2017a; ASER 2013).

A growing body of evidence, from both the teacher value-added literature and the experimental literature in development economics, shows that teacher quality is a key determinant of student learning, although other factors also play an important role. Little is known, however, about what specific dimensions of teacher quality matter and even less about how teachers perform along these dimensions—facts that are crucial in order to guide both research and policy design. This paper discusses an ongoing research program intended to help fill this void. Using data collected through direct observations, unannounced visits, and tests, from primary schools in seven Sub-Saharan African countries which together represent close to 40 percent of the region's total population, we answer three questions: How much do teachers teach? What do teachers know? How well do teachers teach?

The answers to these questions should be interpreted against the backdrop of a rapidly expanding, but weakly governed, primary education sector in Sub-Saharan Africa. Gross primary enrollment rates in Sub Saharan Africa have increased from around 50 percent in 1970, to 98 percent in 2014, and net enrollment rates have increased from around 40 percent

to almost 80 percent, partly in response to reduced or removed formal fees for primary schooling. Most of the increase in enrollment has taken place in the public sector, which remains the dominant actor in the sector. The increase in primary enrollment has also resulted in a huge increase in the number of teachers, which has risen from 500,000 primary school teachers in 1970 to almost 2.8 million in 2009. The salaries of these teachers make up more than 70 percent of the expenditure in education (UIS, 2011) and approximately 12 percent of total government expenditure in Sub-Saharan Africa.

The provision of education in many low-income countries, including the countries surveyed here, is characterized by a combination of centralized, but typically weak, state control and often low-capacity, locally governed institutions. At the same time, the institutional incentives for teacher performance are largely missing, with both career progression and financial rewards delinked from performance. Teachers' salaries and promotions are largely determined by seniority and educational qualifications, and are unrelated to effort or performance. In most settings, parents have little influence on how teachers are hired or schools are managed, and the various state and local authorities provide limited technical support or supervision.

In the sections that follow, we draw upon evidence from the Service Delivery Indicators program—an ongoing Africa-wide program with the aim of collecting informative and standardized measures of what primary teachers know, what they do, and what they have to work with.[1] To date, the SDI program has collected data, including from the two pilot countries, from a total of seven countries (eight surveys): Kenya (2012), Mozambique (2014), Nigeria (2013), Senegal (2010), Tanzania (2010, 2014), Togo (2013), and Uganda (2013).

[1] The SDI program – piloted in Tanzania and Senegal in 2010 (Bold et al, 2010, 2011) – grew out of concern about poor learning outcomes observed in various student tests as well as evident shortcomings, most clearly (and perhaps most damagingly) manifested at the school level, in fast-expanding systems of education.

Primary schools with at least one fourth-grade class formed the sampling frame.[2] The samples were designed to provide representative estimates for teacher effort, knowledge, and skills in public primary schools, broken down by urban and rural location. For five of the six non-pilot surveys, representative data were also collected for private primary schools. Private schools—both informal and formal—account for around 20 percent of total primary school enrollment in low-income countries (Baum et al. 2014). The surveys collected a broad set of school, teacher, and student specific information, with an approach that relies as much as possible on direct observation, rather than on respondent reports, like visual inspections of fourth-grade classrooms and the school premises, direct physical verification of teacher presence by unannounced visits, and teacher and student tests.

For the countries covered by the survey, we address the three questions posed above. We then provide some explanation for the results by discussing what the pipeline to a teaching position looks like, what kind of teachers emerge from it, and what incentives these teachers face to teach well when deployed in schools. Finally, we conclude with a brief discussion of the core implications of the findings, both for education systems and education policy reform and for the experimental and quasi-experimental research agenda on ways to improve education quality.

How Much Time Do Teachers Teach?

Being present in the classroom is a *conditio sine qua non* for teachers to exert effort at teaching. To measure the time teachers spend teaching, an extended approach of that

[2] In each country, representative surveys of between 150 and 760 schools were implemented using a multistage, cluster-sampling design. In Nigeria, due to security constraints, surveys representative at the state level were implemented in four states (Anambra, Bauchi, Ekiti, and Niger). Across the eight surveys, the SDI collected data on 2,600 schools, over 21,000 teachers and 24,000 students in Sub-Saharan Africa (see Bold et al. 2017a, for details of the sample).

described in this journal by Chaudhury et al. (2006) was employed. In each school, during a first announced visit, up to 10 teachers were randomly selected from the teacher roster. At least two teaching days after the initial survey, an unannounced visit was conducted, during which the enumerators were asked to identify whether the selected teachers were in the school, and if so, if they were in class teaching. Both assessments were based on directly observing the teachers and their whereabouts.

Table 1 summarizes the findings and the online appendix provide country-specific details. Averaging across countries, 44 percent of teachers were absent from class, either because they were absent from school or in the school, but not in the classroom. In three of the eight surveys, more than half of the teachers were absent from the classroom, and only in one country—Nigeria—do we observe average absence below 30 percent. Being absent from school is about as common as being present in the school, but absent from class. The rank correlation coefficient between the two measures is less than 0.5 at the country level, making the *school* absence rate at best a partial measure of teacher effort. This is most starkly illustrated in the case of Kenya and Tanzania, both of which have relatively low school absence rates (15 percent) but relatively high classroom absence rates conditional on being in school (38 percent).

When a large share of teachers is not teaching, unsurprisingly, a large share of classrooms will be occupied by only students. Consistent with the absenteeism findings discussed above, we find, averaging across countries, that one third of the classrooms, and almost half of the classrooms in Uganda, were “orphaned” classrooms, where students are present but there is no teacher.

Over time in these countries, these absenteeism rates appear remarkably stable. In this journal, Chaudhury et al. (2006) estimated a school absence rate of 27 percent in Uganda in 2002–03, which compares to our measure of 30 percent in 2013. Similarly, while absence

from school fell by one-third in Tanzania between 2010 and 2014, this was largely offset by an increase in absence from the classroom conditional on being in school; the net result being a small decline in absence from class between the two surveys.

What do these results imply for the amount of instruction time that students receive? To answer this, the surveys first recorded the scheduled time of a teaching day—after break times—according to school records. Averaged across schools and countries, this comes to 5 hours and 27 minutes. We then multiply this number by the proportion of teachers absent from class. If ten teachers are supposed to teach 5 hours and 27 minutes per day, yet four teachers are absent from either the school or the classroom at any one time, then the scheduled teaching time is reduced to 3 hours and 16 minutes.

Moreover, even when in the classroom, teachers may not necessarily be teaching. We carried out classroom observation as part of the survey, recording a minute-by-minute snapshot of what the teacher was doing, for a randomly selected fourth-grade mathematics or language class. The percentage of the lesson lost to non-teaching activities varied from 18 percent in Nigeria, the country with the lowest classroom absence rate, to 3 percent in Uganda, the country with the highest classroom absence rate. We then combine the absence-adjusted teaching time with the proportion of classroom time devoted to actual teaching activities to estimate instruction time as experienced by students.

Students are taught, on average, 2 hours and 49 minutes per day, or roughly half of the scheduled time (as shown in Table 1). Estimated instruction time varies from 3 hours and 16 minutes in Tanzania to 1 hour and 43 minutes in Mozambique. Only about 10 percent of the schools provide more than 5 hours of teaching per day. About the same share provide no teaching (because none of the ten randomly selected teachers was found in the classroom). More than a quarter of schools teach less than two hours, and half the schools teach less than three hours. To put this in perspective, on average across the OECD countries the compulsory

instructional time per school day in primary education is about four and half hours (OECD 2015).

Our results on teacher absence and time in the classroom are broadly similar to findings from other studies. In this journal, Chaudhury et al. (2006) present results from a multi-country study spanning Asia, Africa and Latin America, where enumerators made unannounced visits to public schools to measure teacher presence in schools. Pooling data across countries, they find an average teacher absence rate of 19 percent, which is similar to the 23 percent absence rate we report in Table 1. Bruns and Luque (2014) further document, drawing on data from a large sample of classrooms in seven Latin American and the Caribbean countries, that teachers only spend 52-85 percent of class time on academic activities, implying a loss of potential instructional time equivalent to one day of instruction per week. Consistent with the findings we report here, they also show that in every Latin American and the Caribbean country studied, teachers in classrooms spend about 10 percent of time completely "off-task." In India, Kremer et al. (2005) report that not only were 25 percent of teachers absent from work, but another 25 percent were in school but not teaching and thus only about half of the teachers were found to be actually engaged in teaching, again a result strikingly close to what we document across the seven countries we surveyed.

What Do Teachers Know?

To measure the subject content knowledge of primary school teachers, and specifically those teaching in the lower primary grades, all language and mathematics teachers teaching Grade 4 in the current year (or Grade 3 in the previous year) were assessed. On average, five teachers were tested in each school. In contrast to other approaches to assess teachers' knowledge, where teachers take exams, teachers here were asked to mark (or

"grade") mock student tests in language and in mathematics.[3] This method of assessment has two potential advantages. First, it aims to assess teachers in a way that was consistent with their normal activities—namely, marking student work. Second, by not testing teachers in the same way as students are tested, it recognizes teachers as professionals. In the analysis, we assess the language knowledge of those teachers who teach language, and the mathematics knowledge of those teachers who teach mathematics. All questions on the teacher test were based on common items taken from the primary curricula of each country.

We start by assessing language tasks on the teacher test that covered (roughly) the lower primary curriculum (first till third year of primary school) – specifically, spelling and simple grammar exercises. We count a teacher as "mastering" the student curriculum if he or she marked 80 percent or more of the spelling and grammar questions correctly. Two-thirds of teachers make it over this low bar, though with wide variation across countries as shown in Table 2. While over 90 percent of teachers in Kenya and Uganda master the knowledge that their students are supposed to learn, only a quarter of Nigerian teachers do.

Possessing knowledge equivalent to the fourth grade curriculum is, of course, not sufficient to teach language in lower primary, because language teaching is "monolithic." That is to say, teaching a student how to compose even a simple text requires knowledge that goes well beyond what is graded in the curriculum. We therefore deem a language teacher in Grade 4 to have minimum subject content knowledge if the teacher can competently correct children's work in such aspects of literacy as reading comprehension, vocabulary, and formal correctness (grammar, spelling, syntax, and punctuation), all of which are competencies a teacher in lower primary would routinely be required to use. To this end, the language test contained (in addition to the spelling and grammar exercises) items involving sentences with

[3] The subject test was designed by experts in international pedagogy and validated against 13 Sub-Saharan African primary curricula and national teacher standards (Botswana, Ethiopia, Gambia, Kenya, Madagascar, Mauritius, Namibia, Nigeria, Rwanda, Seychelles, South Africa, Tanzania, and Uganda). See Johnson, Cunningham and Dowling (2012) for details.

blank spaces where students need to fill in words—so-called *Cloze* passages—to assess vocabulary and reading comprehension, and a letter written to a friend describing the student's school, which the teacher had to mark and correct.

We formally define "minimum knowledge in language" as marking at least 80 percent of the items on the language test correctly. Only 7 percent of the language teachers meet this minimum subject knowledge, with the level uniformly low across the eight countries: in Kenya, 34 percent of language teachers have minimum subject knowledge, and no teachers in Togo, Mozambique, Tanzania, or Nigeria meet the threshold (again as shown in Table 2).

Which areas of language teaching are especially problematic? Table 3 offers a breakdown of specific tasks on the language and math tests. First, some teachers are weak in all areas of the curriculum: 14 percent could not spell a simple word ("traffic," for example), and a similar share could not correctly answer a grammar exercise that asked them to identify the option, out of three, that would complete a sentence such as "[_____] [Who, How much, How many] oranges do you have?" Second, most teachers struggled with those tasks that required at least some knowledge beyond the lower primary curriculum to mark. Less than half of the items in the *Cloze* passage were marked correctly, which included "student" responses such as "[Where] do I have to go to the market?" (In this case, a correct answer could be either "Why or When."). Teachers corrected only a quarter of the spelling, grammar, syntax, and punctuation mistakes in a child's letter that included segments such as "I went to tell you that my new school is better the oldone I have a lot of thing to tell you about my new school in Dar es Salaam."

In mathematics, we classify a teacher as having minimum subject content knowledge if the teacher can accurately correct children's work in such aspects of numeracy as manipulating numbers using whole number operations. This requirement amounts to correctly scoring 80 percent or more of the questions on the lower primary portion of the

mathematics test. In essence, the test thus measures whether the math teacher masters his or her students' curriculum, allowing for 20 percent points margin of error. Fewer than 70 percent of mathematics teachers have minimum knowledge according to this definition (as shown in Table 2), although there is again wide variation across countries, with less than half of the mathematics teachers in Togo deemed to have minimum knowledge. Looking at specific tasks in mathematics listed in Table 3, almost a quarter of the teachers cannot subtract double-digit numbers and one-third of the teachers cannot multiply double-digit numbers.[4]

Of course, we would expect a competent math teacher to have knowledge beyond that of his or her students, and the mathematics test, therefore, also included questions one would only encounter in upper primary school. Many mathematics teachers struggled with these tasks: only a minority of teachers, and in some countries very few, could interpret information in a Venn diagram and/or a graph (see Table 3). As we will see below, this low competence in interpreting data has implications for teachers' ability to monitor their students' progress. Finally, only a few teachers could solve a more advanced math story problem, and only one third could solve a simple algebraic equation.

There are few direct studies outside of Africa about how much teachers know about the subjects they teach, but those available show very low results.[5] Bruns and Luque (2014) report findings from a national evaluation of teachers (and students) by the Ministry of Education in Peru. More than eight of ten sixth-grade teachers scored below level 2 on a 2006

[4] As Table 2 illustrates, our two measures of teacher knowledge—knowing the students' curriculum and minimum knowledge for teaching—coincide for mathematics but not for language teaching. The underlying argument here is that it is it is possible, in principle, to teach fourth graders how to divide two numbers without having a deeper knowledge of algebra. As a consequence, the number of teachers considered to "master" their students' curriculum is very similar for language and mathematics, while there is a large difference in the number of teachers considered to have "minimum knowledge" for teaching between the two subjects.

[5] The Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) collects average achievement scores of grade 6 teachers (data collected in 1995, 2000, and 2007). However, SACMEQ only reports scale scores for teachers (see for example Makuwa, 2011), which makes it possible to do comparisons of teacher test scores over time and across the participating countries, but does not make it possible to assess teachers' absolute subject knowledge.

test where level 3 meant mastery of sixth-grade math skills and performance below level 2 implied the "teachers were unable to establish mathematical relationships and adapt routine and simple mathematical procedures and strategies".

How Well Do Teachers Teach?

Good teaching also requires that teachers know how to translate their subject knowledge into effective pedagogy and then apply this in the classroom. Teachers must also know how to assess student capabilities and react appropriately, for example, by asking questions that require various types of responses and by giving feedback on those responses, commonly referred to as "knowledge of the context of learning" (Johnson, 2006; Danielsson, 2007, Pianta et al., 2007, Coe, Aloisi, Higgins and Major, 2014; Ko and Sammons, 2013, Mujis et al., 2014; Vieluf et al., 2012). In a recent review, although not focused on Africa specifically, Mujis et. al. (2014) identifies a set of elements when it comes to behavior in the classroom that are consistently associated with gains in student learning: i) structuring lessons, and in particular, introducing topics and learning outcomes at the start of the lesson and reviewing them at the end; ii) frequently checking for student understanding by asking questions, and allowing time for students to review and practice what they learned, either individually or in groups; iii) varying the cognitive level of questions by mixing lower- and higher-order questions; and iv) providing substantive feedback to students by acknowledging correct answers in a positive fashion and correcting wrong answers, as skills and practices that are consistently associated with gains in student learning. To assess how well teacher teach, therefore, we first measure teachers' pedagogical knowledge; then, we examine how

well teachers can assess students and monitor their progress; and finally, we gauge the extent to which teachers apply that knowledge in the classroom based on direct lesson observation.[6]

To measure general pedagogical knowledge, we asked teachers to prepare for a lesson with a specified topic by reading and extracting information from a factual text on that topic (general content knowledge) and to state (in 1-2 sentences) what they would expect their students to learn from the lesson. Both these tasks are consistent with professional tasks normally expected of primary teachers, and we therefore consider a teacher who scores 80 percent or more on this portion of the test to have minimum general pedagogy knowledge.

To measure teachers' ability to assess students' learning and give feedback (which we shorten here to "assessing students"), teachers were asked to prepare questions that required students to recall what was learned (lower order) and questions that asked students to apply the material to new contexts (higher order) on the basis of their reading of the factual text. In a second task, teachers were asked to use a marking scheme to give feedback on strengths and weaknesses in students' writing and to distinguish weak and strong learners. In a third task, teachers were provided with a list of students' grades; they were then asked to turn the raw scores into averages and to comment on the learning progression of individuals and groups of students with the help of a bar chart. We define a teacher as having "minimum knowledge in assessing students" if he or she could answer 80 percent of the items in the three tasks correctly.

As reported in Table 4, Panel A, only 10 percent of teachers reached the threshold for minimum general pedagogy knowledge. In four countries, fewer than 5 percent of teachers met the threshold. While teachers could usually read and understand the factual text (average score of 47 percent), they were typically not able to translate this information into teaching, as they struggled to formulate what they wanted children to learn from the lesson based on

[6] The observation schedule is based on a modified Stallings (1980) snapshot module.

their reading (average score of 22 percent on this task), leading to an overall score of 33 percent on the lesson preparation task.

As with general pedagogical knowledge, the results in Panel B show that few teachers demonstrated an ability to assess student learning and respond to that assessment. Very few could formulate questions that checked basic understanding based on what they had read, and fewer still could formulate a question that asked students to apply what they had learned to other contexts. Eighteen percent of teachers could give feedback on strengths and weaknesses in students' writing using a marking scheme—ranging from 8 percent in Nigeria to 32 percent in Kenya. Furthermore, just over 12 percent could monitor and comment on the learning progression of students—ranging from 5 percent in Nigeria to 26 percent in Kenya.

Poor knowledge of general pedagogy was mirrored in behavior in the classroom, as shown in Panel C. Less than half of the teachers explained the topic of the lesson at the start and summarized what was learned at the end, and around 40 percent of lessons seemed unplanned to the observers. During their lessons, many teachers asked questions that required students to recall information or to practice what was learned, but significantly fewer asked questions that required higher order skills and encouraged students to apply what was learned to different contexts and be creative. Overall, 31 percent of teachers mixed lower and higher order questions in their class—ranging from 14 percent of teachers in Mozambique to 44 percent of teachers in Uganda. In response to students' answers, around half the teachers consistently gave positive feedback and corrected mistakes without scolding students, with a low of 32 percent in Mozambique and a high of 75 percent in Uganda.

In summary, general pedagogical knowledge and the ability to assess students' learning and respond to that assessment is poor across the seven countries, with less than 1 in 10 teachers being classified as having minimum knowledge in general pedagogy or student assessment. Inside the classroom, many teachers deploy some of the teaching practices

identified in the literature as promoting learning, but few (less than one in ten) apply the full set of beneficial skills—structuring, planning, asking questions and giving feedback—in their lessons.

Our approach to assess how teachers perform in the classroom differs from other studies in that it combines observational data from inside the classroom with test results from pedagogical assessments of the teachers. As mentioned earlier, Bruns and Luque (2014), draw on data from a large sample of classrooms in seven Latin American and the Caribbean countries. Although students in their sample are offered a relatively enriched learning environment—in contrast to the typical primary school in Sub-Saharan Africa—in the sense that students are almost universally equipped with workbooks and writing materials and textbooks are generally available, a significant share of students is visibly not involved in whatever activity the teacher is leading.

Comparing our findings with data from middle and high income countries, interesting parallels emerge. Although teachers in high-income countries generally display better classroom practices than their counterparts in poorer countries (Araujo et al. 2016, Bruns et al., 2016), teachers show the same relative strengths and weaknesses across a variety of contexts and observation schedules. That is, they tend to perform relatively well when it comes to classroom management and creating a positive climate for their students, but poorly when it comes to instructional support including using questions and discussion techniques as well as assessment in instruction (Bruns et al., 2016, Kane and Staiger, 2012, Tyler et al. 2010).

Why does the system used to select, train, and remunerate teachers not produce high quality teaching?

Many low income countries have witnessed a huge expansion in the provision of primary education in the last two decades: we find that twice as many teachers have entered the profession in Sub-Saharan Africa in the last ten years than in the decade before. This expansion will likely continue. According to recent population projections, close to half the world population of children will live in Africa by the end of the 21st century (UNICEF, 2014). Looking at a not too distant future, the number of children in the primary school age group in Sub-Saharan Africa is set to rise from 170 million to 220 million in the next 15 years, reaching 280 million by the mid-century. Simply to keep pace with population growth—adjusting for teacher retirement—and to maintain pupil teacher ratios at a rough benchmark of 40 students per teacher (the average in our sample if 46 student enrolled per teacher and 34 students present in the classroom per teacher), would require the hiring of two million new teachers by 2030 and five million by 2050.[7] Such a rapid expansion of the teaching force provides a real opportunity for updating the pipeline—an opportunity that will be lost if the system for selecting, training and motivating teachers does not ensure good teachers in schools.

So why does the existing system not produce high quality teaching, as suggested by the evidence presented above? Here, we argue that this has two reasons: the system used to select and train teachers does not deliver high-quality candidates and the system used to employ and remunerate teachers does not motivate them to deliver high-quality teaching.[8]

De-jure, all seven countries we study possess well-established systems of teacher training. To enter teacher training, teachers must have completed at least lower secondary

[7] We arrive at these numbers by linearly extrapolating number of births per year from 2000-2050 using data reported in UNICEF (2014) for years 1980, 2015, 2030, and 2050. We assume that under-five mortality in the region will fall from 90 per 1,000 live births in 2015 to 50 per 1,000 live births in 2050. Finally, we use our survey data to estimate the age profile of the current stock of teachers and based on that age profile derive the expected number of teachers that will retire each 10-year period from 2015 and forward.

[8] This section draws on Breeding et al. (2012, 2014a, 2014b), Nordstrum (2015), Scanlon et al. (2017), information provided by the Ministry of Public Services in Senegal and findings from the data.

education. In our sample, this is true for 50 percent of the teachers, while the majority of the remainder have either completed upper secondary education (28 percent) or post-secondary, non-tertiary education (18 percent). The length of teacher training courses varies among countries, ranging from two years in the case of Kenya, Tanzania and Uganda to one year in the case of Senegal. At the end of the program, which confers training at the post-secondary, non-tertiary level, teachers qualify with a teaching certificate, held by 90 percent of teachers in our sample. Ten percent of teachers hold (in addition to their certificate) a bachelor or master's degree in education.

De facto, however, training systems fall short of international best practice (Bruns and de Luque, 2014). First, standards for entry into teacher training are low compared to high-performing education systems around the world. Second, the teacher training programs are often of low quality, delivered by former teachers rather than trained instructors, and ill-suited to the needs of the candidates, who, having gone through their country's primary and secondary education system, often arrive poorly prepared, and are then confronted by curricula that focus on teaching methods and pedagogy theory rather than content knowledge.[9] In addition, while research suggests that pre-service training that focuses on the work teachers face in classrooms produces more effective teachers and higher learning for students (Boyd et al., 2009), little time is devoted to actual classroom practice, which can be as low as six weeks in Kenya, for example. Scheduled teaching time can also be low, both because programs are de facto condensed into a few months as is the case in Senegal, and because absenteeism among trainers is anecdotally high.

In short, it is easy to see how a vicious circle is created in which today's teachers have gone through an education system that does not prepare them adequately, through a training

[9] For example, the Nigerian curriculum devotes more than twice the amount of time to pedagogy (theory) than to Mathematics, English and Science—and even the time spent on subjects is mostly devoted to subject-specific learning methods. In the case of Kenya, all qualified teachers are expected to teach mathematics at primary level, but mathematics is not a compulsory subject during their training.

system with low entry requirements that does not compensate for the flaws in the education system, or through no training at all, to be sent into school where they struggle to teach the next generation of students. While we find a positive relationship between a teacher's education and training and their subject and pedagogy knowledge and classroom skills, even teachers with the highest education levels achieve significantly less than full marks.

Despite the inadequate training, teaching remains an attractive profession in most countries in Sub-Saharan Africa. There is typically a surplus of applicants both for teacher training and to fill new teaching slots. For example, in Kenya, the Diploma Teacher Colleges admit 300 out of 8000 candidates in a year, in Uganda, the acceptance rates into teacher training are 71 percent and in Nigeria they range from 50-90 percent, suggesting that the sector is at least somewhat competitive. Official criteria used to determine who gets hired among the applicants include time since graduation, degree, and sometimes grades received during teacher training. In practice, however, deviations from the official rule appear to be relatively common. For example, a third of the 18,000 new teaching posts in Kenya 2010 were misallocated, i.e., district education officers deviated from the official algorithm to favor certain applicants (see Barton, Bold, and Sandefur, 2017).

In our sample, the large majority of teachers are employed on permanent and pensionable civil service contracts. These teachers are relatively well-paid. As a ratio of GDP per capita, for example, teachers in Sub-Saharan Africa earn on average more than four times as much as their counterparts in high income countries (OECD, 2011; UIS, 2011). However, there is large variation in remuneration of teachers across Africa. The average monthly teacher salary in 2010 in Senegal was $380 (in current dollars), equivalent to 4.5 times GDP/capita, while the average teacher salary in Tanzania was $115, or twice GDP/capita, in the same year. There is also evidence suggesting that teachers are well-paid relative to other workers with similar education background. Barton, Bold and Sandefur (2017), for example,

find, exploiting the Kenyan government's algorithm for hiring new teachers in 2010 in a regression discontinuity design, a civil service wage premium of over 100 percent.

Hence, it would appear that the current system of employment and remuneration confers substantial benefits to teachers, but—based on our findings—without ensuring that quality teaching is delivered. To be sure, there are effectively no systems in Sub-Saharan Africa that tie salaries and promotions to the performance of teachers. Consistent with this, we find that salary is most strongly predicted by experience and age, characteristics which in turn have little systematic relationship with teacher quality.

More recently, some attempts have been made to redress the balance and adapt the system, especially as new teachers are hired in the wake of expansion. Overall, 15 percent of teachers in Sub-Saharan Africa are now employed on some form of non-permanent contract. In countries where contract teachers are prevalent (5 out of 7), almost one third of teachers are employed on short-term contracts and this share swells to 50 percent for teachers with less than ten years of experience. This reflects both an age and a cohort effect, as many contract teachers graduate to civil service status over time. Contract teachers tend to have less education and lower training than regular teachers and tend to earn substantially less, though with wide variation across the continent. There are also differences in the institutional setting of contract teachers in the countries we surveyed. In West Africa, the contract teacher program is primarily used as a way to lower costs, although contract teachers still tend to be relatively well paid—about $250 a month which as a reference is the average regular teacher salary in Kenya. In essence, contract teachers here are effectively junior teachers employed by the government waiting, or hoping, for full civil service status. In East Africa, at least within Kenya, contract teachers originate from a system where parents clubbed together to pay for extra teachers at the school level. Contract teachers in Kenya earn on average $40 per month and since their employment is outside the civil service system, their tenure is subject

to parental approval, at least in principle. Despite having less training and experience, we do not find any systematic differences in teacher knowledge or classroom skills between regular and contract teachers across the sample of teachers surveyed here. When it comes to absence, contract teachers are—if anything—absent less often (though this is not true in all countries), with significant differences emerging in both Kenya and Senegal.

Taken together, the system employed to train, hire, and motivate teachers falls short in several dimensions. But with a major increase and turnover in teachers—on average 130,000 new teachers are anticipated to be hired each year in the next 15 years in Sub-Saharan Africa—a focus on how to ensure that the next cohort of teachers is better prepared to teach well, and rewarded for doing so when deployed, can potentially go a long way to improve outcomes.

Discussion

The main finding of this paper is that teachers in Sub-Saharan Africa perform poorly in several, likely complementary, dimensions. They teach too little and they lack the necessary skills and knowledge to teach effectively when they actually teach. If "adequate" teaching is characterized as being taught by teachers with at least basic pedagogical knowledge and minimum subject knowledge in language and mathematics for the full scheduled teaching day, then essentially no public primary school students in these countries offer adequate quality education.

In Bold et al. (2017b) we show that these shortcomings, and especially poor teacher knowledge, can account for a large share of the dramatic loss in human capital we observe already after 4 years, with the majority of fourth graders failing to master tasks covered in the

second year curriculum and more than a quarter of them deemed to have knowledge equivalent to a first grader, or below.

Given the results presented here, it is easy at a general level to list what governments "should" do to improve service performance in the education sector. For example, teacher training programs should seek to attract talented candidates and prepare them to teach the curriculum effectively. After teachers are hired, the need is for effective incentive schemes that ensure high effort and continued upgrading of knowledge and skills.

But it is an unfortunate reality that reforms aimed at systematically raising the quality of the teaching body along these lines should be viewed as more of a longer run solution. For example, the huge improvement in the delivery of high quality education in countries such as South Korea and Singapore resulted from system-wide efforts over several decades (Murnane and Ganimian 2014). Millions of children in low income countries, who lack even basic literacy and numeracy skills even after several years of schooling, cannot afford to wait for system-wide reforms to be identified and implemented. Therefore, while planning for longer-term solutions, it is also important to consider shorter-term improvements.

There are now hundreds of experimental studies about different methods of raising student achievement in low-income countries, many of them from the very countries we surveyed here, looking at a wide range of possible interventions. Table 5 offers a few sentences of summary of some findings related to improving the quality of teaching from several recent literature reviews on the subject, which strike some common themes. For example, one step might focus on complimentary resources involved in classroom teaching, such as teacher guides and lesson plans, which were available in three quarters of classrooms. Our survey finds that while most students have pencil and notebooks and 80 percent of teachers have a functioning board to write on, this equipment is in place simultaneously in half the classrooms. One in ten classrooms are deemed too dark for students to read without

straining their eyes and an average of two to three students have to share a text book. However, there is by now a clear consensus that student learning, even in settings with limited resources, is remarkably unresponsive to just providing more of the same inputs.

There is stronger evidence, some of it reviewed in Banerjee and Duflo (2006) in this journal, that teacher effort, broadly defined, can be raised, leading to improved learning outcomes which can be substantial, especially in settings with very low student achievement and high teacher absenteeism. The strongest evidence comes from studies providing financial incentives tied either to attendance or student performance (Duflo, Hanna, and Ryan, 2012; Muralidharan and Sundararaman, 2011), or short term contracts predicated on the operation of dynamic incentives; i.e., contract teacher programs (Bold et al., 2013; Duflo, Dupas, and Kremer, 2015). But the experimental evidence also highlights barriers to the implementation of incentive systems, especially in the public sector, due to bureaucratic or political constraints. An important question going forward is therefore to identify ways to make these types of program effective within the government system.

Unfortunately, there are few, if any, well-identified studies on how to effectively improve teacher knowledge and skills and the impact thereof. This evidence gap is important to address and the continued rapid expansion of new teachers ought to provide amble opportunities to do so. One should then also draw on related evidence that do exist. For example, a growing number of studies have shown that providing detailed guidance on both what teachers should teach and how they should do it, for instance by re-organizing instruction based on children's actual learning levels, can result in large gains in learning outcomes, especially for low-performing students. We are now also seeing the start of studies, such as Banerjee at al. (2016), that take the insights from individual studies and scale them up for broader application. Automated teaching, through computer-aided learning programs or scripted lesson plans, may also be a promising approach, especially when it

comes to basic skills and lower-order skills, areas which are undoubtedly in need of improvement. Scripted lessons, however, may not work as well in improving the more complex aspects of teaching that are important for higher order learning and that teachers especially struggle with: assessing students and responding through that assessment, asking thought-provoking questions to further understanding and knowledge, and giving appropriate feedback.

Dramatic improvements in teaching are hard. But the kinds of changes that would be useful, both for short-run improvements and longer-run systemic reforms, are becoming reasonably clear.

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Table 1: Teacher Absence

	All	Min	Max
Absence from class (%)	44	23 (NGA)	57 (UGA)
Absence from school (%)	23	15 (KEN)	45 (MOZ)
No. of teachers	16,543		
Scheduled teaching time (h min)	5h 27m	4h 21m (MOZ)	7h 13m (UGA)
Time spent teaching (h min)	2h 49m	1h 43m (MOZ)	3h 16m (TZA)
No. of schools	2,001		
Orphaned classrooms (%)	33	24 (TGO)	45 (UGA)
No. of schools	1,647		

Notes: The table reports the absence rate for all teachers, the scheduled teaching time, actual teaching time and number of orphaned classrooms for all government schools. All individual country statistics are calculated using country-specific sampling weights. The average for all countries, reported under the heading "All", is taken by averaging over the country averages. The ISO 3-digit alphabetic codes of the countries with the lowest and highest score for each item are given in brackets. Teachers are marked as absent from school if during the second unannounced visit, they are not found anywhere on the school premises. Otherwise, they are marked as present. Teachers are marked as absent from class if during the second unannounced visit, they are absent from school or present at school but absent from the classroom. Otherwise, they are marked as present. The scheduled teaching time is the length of the school day minus break time. Time spent teaching adjusts the length of the school day by the share of teachers who are present in the classroom, on average, and the time the teacher spends teaching while in the classroom. The orphaned classrooms measure is the ratio of the classrooms with students but no teacher to the number of classrooms with students with or without a teacher (not collected for the pilot countries). ISO 3-digit alphabetic codes are: KEN (Kenya), MOZ (Mozambique), NGA (Nigeria), SEN (Senegal), TZA I (Tanzania I, pilot), TZA (Tanzania II), TGO (Togo), UGA (Uganda). For country-specific estimates, see Bold et al (2017).

Table 2: Teachers' Content Knowledge: Minimum Thresholds

Percentage (%) of teachers with …	All	Min	Max
Subject knowledge: Language			
80% of knowledge equivalent to a 4th grader	66	26 [NGA]	94 [KEN]
Minimum knowledge	7	0[a]	34 [KEN]
No. of teachers	3,770		
Subject knowledge: Mathematics			
Minimum knowledge	68	49 [TGO]	93 [KEN]
No. of teachers	3,957		

Notes: The table reports minimum content knowledge indicators for teachers in grade 4 or who taught grade 3 in the previous year in government schools. Language knowledge is computed for teachers teaching language and mathematics knowledge is computed for teachers teaching mathematics. All individual country statistics are calculated using country-specific sampling weights. The average for all countries, reported under the heading "All", is taken by averaging over the country averages. The ISO 3-digit alphabetic codes (see table 1 for details) of the countries with the lowest (Min) and highest (Max) score for each item are given in brackets. A language teacher is defined as having 80% of knowledge equivalent to a fourth grader in language if he/she score at least 80% on the tasks covered in the curriculum up to grade 4. A language teacher is defined as minimum knowledge if he/she score at least 80% on the grammar, Cloze test and correcting a student's composition task of the language assessment. A mathematics teacher is defined as having minimum knowledge (=80% of knowledge equivalent to a 4th grader) if he/she score at least 80% on the tasks covered in the curriculum up the grade 4. (a) MOZ, NGA, TZA I, TGO. For country-specific estimates, see Bold et al (2017a).

Table 3: Teachers' Performance on Specific Item Groups of Knowledge

	All	Min	Max
Language			
Spelling task, score out of 100	86	86 [TZA I]	86 [TZA I]
Grammar task, score out of 100	79	58 [NGA]	92 [KEN]
Cloze task, score out of 100	44	27 [TGO]	66 [KEN]
Correct composition task, score out of 100	26	9 [MOZ]	50 [KEN]
No. of teachers	3,770		
Math			
Can add double digits (%)	91	75 [TGO]	98 [KEN]
Can subtract double digits (%)	77	59 [NGA]	94 [TZA I]
Can multiply double digits (%)	68	44 [MOZ]	89 [SEN]
Can solve simple math story problem (%)	55	17 [MOZ]	91 [SEN]
Understands a Venn diagram (%)	41	19 [TGO]	70 [KEN]
Can interpret data in a graph (%)	25	12 [TGO]	62 [KEN]
Can solve algebra (%)	35	3 [MOZ]	74 [KEN]
Can solve difficult math story problem (%)[a]	15	7 [SEN]	22 [TZA I]
No. of teachers	3957		

Notes: The table presents scores on specific tasks for teachers in government schools in grade 4 or who have previously taught grade 3. Language knowledge is computed for teachers teaching language and mathematics knowledge is computed for teachers teaching mathematics. All individual country statistics are calculated using country-specific sampling weights. The average for all countries, reported under the heading "All", is taken by averaging over the country averages. The ISO 3-digit alphabetic codes (see table 1 for details) of the countries with the lowest (Min) and highest (Max) score for each item are given in brackets. (a) Question was asked only in Tanzania (2010). For country-specific estimates, see Bold et al (2017a).

Table 4: Pedagogical Knowledge and Skills

	All	Min	Max
Panel A: Pedagogical knowledge			
Minimum general pedagogy knowledge (%)	11	1 (NGA)	36 (TZA)
Factual text comprehension (0-100)	47	23 (MOZ)	78 (TZA
Preparing a lesson (0-100)	33	15 (NGA)	58 (TZA)
Formulate aims and learning outcomes (0-100)	23	11 (NGA)	41 (TZA)
No. of teachers	5,181		
Panel B: Assessing students			
Minimum knowledge assessing students (%)	0*	0	0
Formulate questions to check understanding (0-100)	23	5 (NGA)	55 (KEN)
Formulate questions to apply to other contexts (0-100)	7	3 (NGA)	15 (TZA)
Assessing students' abilities	19	8 (NGA)	39 (KEN)
Evaluating students' progress	12	5 (NGA)	26 (KEN)
No. of teachers	5,181		
Panel C: Skills and practices in the classroom			
Introduce and summarize topic of the lesson (%)	41	16 (MOZ)	62 (KEN)
Lesson appears planned to enumerator (%)	64	37 (UGA)	75 (KEN)
Ask a mix of lower and higher order questions (%)	31	14 (MOZ)	44 (UGA)
Give positive feedback, praise, corrects mistakes (%)	52	32 (MOZ)	75 (UGA)
Engages in all of the above practices (%)	9	1 (MOZ)	17 (KEN)
No. of teachers (classrooms)	1,551		

Notes: Panel A reports minimum general pedagogical knowledge and scores on specific pedagogical tasks for teachers in government schools in grade 4 or who have previously taught grade 3. A teacher is defined as having minimum knowledge of general pedagogy if they score least 80% on the tasks that relate to general pedagogy (factual text comprehension and being able to formulate learning outcomes and lesson aims). Panel B reports minimum pedagogical knowledge in assessing students and monitor their progress and scores on specific pedagogical tasks for teachers in government schools in grade 4 or who have previously taught grade 3. A teacher in any subject is defined as having minimum knowledge for assessing students if they score least 80% on the tasks that relate to assessment (comparing students' writing and monitoring progress among a group of students). Panel C presents teacher practices in the classroom in government schools in grade 4. The information is not available for Senegal and Tanzania (1st survey). All individual country statistics are calculated using country-specific sampling weights. The average for all countries, reported under the heading "All", is taken by averaging over the country averages. The ISO 3-digit alphabetic codes (see table 1 for details) of the countries with the lowest (Min) and highest (Max) score for each item are given in brackets. All scores are computed for teachers teaching either subject. (*) No teacher assessed had minimum knowledge to assess students. For country-specific estimates, see Bold et al (2017a).

Table 5: Four Literature Reviews on the Promise of Teacher Incentives in Low and Middle-Income Countries

Studies	Sample	Findings
Kremer, Brannen, and Glennerster (2013)	"30 primary school programs in raising test scores subject to randomized evaluation where study authors have made detailed cost information available"	"However, among those in school, test scores are remarkably low and unresponsive to more-of-the-same inputs, such as hiring additional teachers, buying more textbooks, or providing flexible grants. In contrast, pedagogical reforms that match teaching to students' learning levels are highly cost effective at increasing learning, as are reforms that improve accountability and incentives, such as local hiring of teachers on short-term contracts. Technology could potentially improve pedagogy and accountability."
Murnane and Ganimian (2014)	"115 studies in 33 low- and middle-income countries ... based on plausible identification strategies"	"Finally, well-designed incentives increase teacher effort and student achievement from very low levels, but low-skilled teachers need specific guidance to reach minimally acceptable levels of instruction."
Glewwe and Muralidharan (2015)	"118 high quality studies conducted from 1990 to 2014"	"Interventions that focus on improved pedagogy (especially supplemental instruction to children lagging behind grade level competencies) are particularly effective, and so are interventions that improve school governance and teacher accountability."
Evans and Popova (2016)	"six reviews of studies seeking to improve student learning in primary schools in developing countries … 227 of those studies report learning outcomes"	"Pedagogical interventions that match teaching to students' learning ... Individualized, repeated teacher training, associated with a specific method or task ... accountability-boosting interventions. These include two intervention subcategories: (i) teacher performance incentives and (ii) contract teachers."