Better measures of progress: Developing reliable estimates of educational access and quality in Francophone sub-Saharan Africa

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Better Measures of Progress: Developing Reliable Estimates of Educational Access and Quality in Francophone sub-Saharan Africa

Abstract

When it comes to development goals, an estimate is only as good as its measurement. There is a long history of developmental goal setting by national governments and international organisations, but far less emphasis on how those goals are measured accurately, especially over time. The measurement of new goals, such as learning, needs to be carefully thought-through and published estimates should reflect this process. This research tackles one prominent source of measurement error in large-scale cross-national cognitive assessment data: sample selection bias. Sample selection bias is a problem in assessment data wherever assessments are conducted within schools and there is below universal access to schooling. Francophone sub-Saharan Africa has some of the lowest schooling rates worldwide and therefore some of the largest bias in its regional assessment data. This paper follows and updates a methodology first conceptualized by Spaull and Taylor in 2015. The new aspects of the methodology allow estimates adjusted for sample selection to be calculated immediately on the release of assessment data, rather than many years hence. After adjusting for sample selection, this paper finds that published learning estimates in Francophone sub-Saharan Africa are vast overestimates of the true rates of literacy and numeracy in the region.

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1. Introduction

There is a long history of developmental goal setting by national governments and international organisations, but far less emphasis on how those goals are measured accurately, especially over time. As a common example, GDP growth per capita over time is a standard measure of development as well as a common, if not universal, development goal. While GDP per capita has been measured accurately for a long time, measurement of less well-established and new goals are not nearly as straight-forward.

In education, the learning that takes place in schools – as opposed to education more generally – has been a concern to policy-makers and international organisations since at least the World Conference on Education for All in Jomtien, Thailand (1990) and the World Education Forum in Dakar, Senegal (2000). The rising concern with education quality was strongly reflected in the protocols of these meetings. However, the measurement of learning has lagged behind even this quite recent time.

Measuring learning has its history in human capital theory, which views schooling and training as an investment in skills and competences (Becker, 1964; Schultz, 1960; Shultz, 1961), and relatedly, in the economic growth literature, which made a profound leap when it began to include education, or human capital, as part of its production function. Since 1957 the existence of the Solow residual has been influencing economic research (Mata & Louçã, 2009). This refers to the portion of output growth in the US economy that could not be attributed to the growth in labour hours or capital stock. In 1970, Griliches estimated that one third of the Solow (1957) residual could be accounted for by the increased educational attainments of the labour force. The importance of capturing and including human capital in such estimations was reiterated in 1979 when Denison reported the same findings with per capita income. Clearly, education contributes to economic growth.

Human capital theory did not initially distinguish between schooling and learning, and only very recently began to disassociate cognitive achievement from educational attainment (or years of schooling completed), notably after seminal work by Hanushek and Woessman (2007). As will be discussed below, the inclusion of test scores as a measure of learning in economic growth studies has provided a particularly striking account of how deceptive and inadequate educational attainment can be as a measure of learning.

When the Millennium Development Goals were established in 2000, as an outcome of both the World Conference on Education for All (1990) and the World Education Forum (2000), the stated education goal and the associated metric did not account for learning explicitly. The goal (United Nations, 2015), Goal 2, was to: “Achieve universal primary education” and the target measured was Target 2.A: “Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling”. Although this access to schooling goal saw moderate success, with enrolment in primary schooling up from 83% in 2000 to 91% in 2015 (United Nations, 2020a), learning within schools still lags. The United Nations (UN) estimates that the global literacy rate among youth 15 to 24 years was 91% in 2015 (United Nations, 2020a), but this statistic is unlikely to be reflective of the poorest nations. A different source also within the UN (2020b) recognises that basic literacy and numeracy skills are indeed lacking within schools.

The more recent Sustainable Development Goals (2015) do explicitly state the need for increased learning, making the measurement of learning, as a very new global goal, of particular importance. Goal 4 of the SDGs is specifically concerned with quality education and Target 4.1 states, “By 2030, ensure all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and Goal-4 effective learning outcomes” (United Nations, 2019b). The measurement issue we encounter with the

new set of goals comes from numerous sources, one substantial source being the context in which learning is typically measured, which is within schools.

2. Background

The cause of the discrepancy between schooling and learning (or cognitive achievement and educational attainment, equally), is on the one hand, that schooling does not necessarily lead to learning. In a discussion by Smith-Greenaway (2015a), the author points out that there are many instances from Demographic and Health Survey (DHS) data in 31 African countries where women are illiterate despite reporting several years of primary schooling. The author cites reasons for this as underachievement within schools (Ansong et al. 2015), high rates of absenteeism, and prolonged periods out of school (Zuze & Reddy, 2011).

On the other hand, measuring learning is complex in countries without universal access to education because the population of children within schools generally have a higher level of academic competency than those who are not in school. Therefore, measuring the ability of the in-school population of children over-estimates the ability of children within a country in general. As an illustration, the SDG index monitoring dashboard for Africa (The Sustainable Development Goals center for Africa & the Sustainable Development Solutions Network, 2019) reports that the literacy rate of 15-24 year olds in Côte d'Ivoire was 53% in 2019 (and gives the same statistic for 2020). Although the tool does not indicate what data this estimate is based on, the calculations herein (based on the most recent known source of comparable literacy data for the country[1]) indicate that in 2014 the literacy rate of the in-school population of Grade 6 children in Côte d'Ivoire was 47%. However, the country average, which includes the out-of-school population (a method which will be described Section 7 below), is estimated to be only 25%, less than half the SDG estimate.

The 53% statistic available online is not specific about whether it refers to the in-school population or the full population, or even when the data were collected. However, given that (1) the most reliable data is from 2014, (2) it is highly unlikely that literacy rates would have doubled between 2014 and 2019 (given the trajectory of improvement in sub-Saharan Africa in general [Taylor & Spaull, 2015]), and (3) such a conversion from in-school rates to country averages requires quite an involved processes, it is probably the case that the monitoring of sub-Saharan African learning outcomes has taken a largely in-school, and therefore biased, approach.

The bias emerging when measuring learning outcomes within schools and applying the results to the country as a whole is fundamentally a sample selection issue. This is a common problem with survey designs, and researchers in psychology, economics, and beyond have gone to great lengths to document ways in which this happens and can be avoided. Sample selection bias occurs when a subset of the sample has not been captured during sampling, and this subset differs from the chosen sample in ways that are related to the research question and associated outcomes measured.

In the case of learning outcomes and the in-school sample, selection would not be an issue if (1) we were interested exclusively in the performance of children who go to school, or (2) if children who do not go to school did not differ from the in-school population on measures of learning. In the case of a learning goal generally, or the SDGs specifically, we want to make statements about learning outcomes within

[1] PASEC 2014, to be discussed below

countries, not schools, and the out-of-school subset of children certainly differ from those who are in school in terms of their learning.

In the second instance, besides the fact that we hope that some learning takes place in schools which would lead to a difference between those attending and those not, there is also almost always a selection process at play which determines who accesses school and who does not. Wealthier students and those from urban areas have a higher probability of enrolment in almost all developing countries (Lambin 1995). In addition, those who perform better in school are more likely to continue their education (Lambin 1995). Given these realities, it can be confidently stated that children who are out of school have lower levels of learning than their in-school peers, and therefore that the learning outcomes seen from the in-school population are an over-estimate of learning within the country as a whole. This bias decreases as access rates increase. Indeed, the average level of cognitive ability observed on international school assessments often varies inversely with the enrolment rate of the population in developing countries (Postlethwaite, 2004). This can lead to the incorrect conclusion that countries with lower enrolment rates have better schooling systems. Given that access in sub-Saharan Africa is still low in many cases (for example, the primary school completion rate was 57% in Senegal in 2018 [World Bank, 2020]), we expect this bias to be large a nontrivial number of times within the region. In short, using estimates of in-school literacy rates cannot be applied to the country as a whole because those in and out of school are fundamentally different.

Progress toward development goals often include inter-temporal comparisons either within countries or between them. This presents another challenge given the bias present in learning outcome data, and in this comparison, it is the case that progress is often underestimated. Test scores may be seen to stagnate over time or even to decrease as access rates increase, since it is the more disadvantaged children that enter schools last (Taylor & Spaull, 2015). This is a real issue when one hopes to make valid comparisons of the quality of schooling over time, since most developing countries have vastly increased their primary school enrolment and completion rates in the last few decades (Barro & Lee, 2013; Spaull & Taylor, 2015). The conclusion that can easily be made is that increasing access overloads the school system and quality suffers as a result. However, Taylor and Spaull (2015) show that this is simply a sample selection issue and that in fact, increased access in 10 sub-Saharan African countries was associated with an increase in learning in all ten cases they reviewed.

The distinction between schooling and learning is particularly important not just for theoretical reasons but because of the role that learning plays in individual and national livelihoods. Research is clear on the benefits of education both to the individual and collectively. For the individual, education is associated with higher levels of subjective well-being (Melin, Fugl-Meyer, & Fugl-Meyer, 2003; Murrell & Meeks, 2001), better mental and physical health (Murrell & Meeks, 2002), and improved child health (Currie, 2009). Education also plays a central role in expanding the capabilities and freedoms of individuals (Sen, 1999). At a broader level, education is associated with improved labour productivity and faster economic growth (Hanushek & Zhang, 2009; Heckman, Stixrud, & Urzua, 2006; McIntosh & Vignoles, 2000; Appleton, Atherton, & Bleaney, 2013; Barro & Lee, 2013).

In addition, learning has a distinct effect on well-being that independent from schooling. This has been shown in adults for fertility (Thomas, 1999), health knowledge (LeVine, 2012; Stuebing, 1997), and health outcomes (Smith-Greenaway, 2015b), as well as on children's health and survival (Blunch, 2013; Glewwe, 1999; Khandke, Pollitt, and Gorman, 1999; Smith-Greenaway, 2013). Child health benefits associated with female literacy has been shown to be substantially and significantly larger than the benefits associated with educational attainment (Smith-Greenaway, 2013).

In the human capital literature, models that directly account for learning can explain roughly three times the variation in economic growth than models that only include years of schooling (Hanushek & Woessmann, 2008). In addition, the inclusion of learning as distinct from schooling reduces the coefficients on schooling to zero, and these models are more robust to variations in model specification.

Given the now undisputed importance of measuring learning as distinct from schooling in both the literature and public opinion, there has been a proliferation of cross-national learning assessments. These include, but are not limited to: ERCE in Latin America and the Caribbean[2], SACMEQ in Anglophone sub-Saharan Africa[3], PASEC in Francophone sub-Saharan Africa[4], TIMSS[5] which focuses on mathematics and science and included 57 countries in 2015, PIRLS[6] which focuses on reading literacy and included 50 countries in 2016, PISA[7] which looks at literacy, numeracy, and science, and has included 83 countries to date, and PISA-D[8] which looks at literacy, numeracy, and science in eight developing countries.

Furthermore, Beatty and Pritchett (2012) advocate for the importance of goals to be centered on cohorts. To quote from Beatty and Pritchett:

> "We advocate that learning goals be based on the assessment of cohorts or age groupings, like "all ten year olds should be able to read fluently" or "all fifteen year olds should be capable of interpreting graphical information." Cohort-based learning goals apply to children whether they are in or out of schooling. This avoids heated but pointless debates between "access" of children to enroll in school and "quality" defined as the learning of only those in school. To meet cohort learning goals, children have to be a) in school, b) progressing through grades, and c) making learning progress as they go from grade to grade." (Beatty & Pritchett, 2012: 4).

There are two ways to undertake the measurement of a cohort learning goal: Either the dataset must include both in school and out of school children or the analysis must account for sample selection bias. In the stock of cognitive assessments, only three get around the sample selection problem. Uwezo in East Africa and ASER in India sample from households and not from schools. ASER stands for the Annual Status of Education Report Survey and Uwezo means 'capability' in Kiswahili. Both run assessments on cognitive achievement in their respective areas. In addition, PISA-D offers the option of sampling 15-year-olds both in and out of school. The first PISA-D assessment was completed in 2019 and included seven developing countries - Cambodia, Ecuador, Guatemala, Honduras, Paraguay, Senegal, and Zambia (OECD, 2018a). Although Panama and Bhutan also signed PISA for Development Participation agreements, Panama is not mentioned in the PISA-D report and Bhutan signed later than the other countries (in 2017) and did not collect contextual data and is thus left out of the OECD analysis (OECD, 2018a).

[2] ERCE: Regional Comparative and Explanatory Study. Conducted in grades 3 and 6. It looks at literacy, numeracy, and science. Developed by the Latin American Laboratory for Assessment of the Quality of Education (LLECE).
[3] SACMEQ: Southern and Eastern Africa Consortium for Monitoring Education Quality. Conducted in grades 3 and 6. Looks at literacy, numeracy, and science.
[4] PASEC: Programme for the Analysis of Education Systems of CONFEMEN countries. Established by CONFEMEN (Conference of Ministers of Education of African Countries and Madagascar in French). Conducted in grades 2 and 5 prior to 2014 and in grades 3 and 6 in 2014. Looks at literacy and numeracy.
[5] TIMSS: Trends in International Mathematics and Science Study.
[6] PIRLS: Progress in International Reading Literacy Study.
[7] PISA: Programme for International Student Assessment.
[8] PISA-D: PISA for Development

Despite the importance of the above assessments (Uwezo, ASER, Pisa-D), collectively they only cover eleven countries. Therefore, we must also use the data we have from the remaining assessments and analyse them in ways which allow for accurate learning estimates – that is, we must account for the sample selection bias when analyzing these datasets to determine progress toward learning goals. This is critical wherever access is not universal.

Although quality education is a global concern, access to education has become a particularly sub-Saharan African concern due to large progress toward universal access to education globally over the last two decades. Sub-Saharan Africa has also made great strides towards universal access, but remains short of the goal. Of the roughly 60 million primary-aged children who remain out of school, more than half of these reside in sub-Saharan Africa (UNDP, 2020). Given this, monitoring education quality becomes a particularly, although not exclusively, sub-Saharan African problem as well. At least in so far as access issues are concerned. However, wherever learning goals are based on data from earlier years, such as earlier rounds of PISA, this challenge remains for other developing countries as well.

Access-related quality issues are only one of the many ways in which quality can be mis-measured and mis-estimated. Gustafsson (2019) argues that implementation plays a big role in whether data can be reliably compared across time. He points out that seemingly large improvements in learning outcomes can be explained by implementation changes in certain instances. For example, Brazil's PISA improvements between 2000 and 2009 in mathematics were initially estimated at around 6 PISA points on average annually. This represented steep progress and led to international examination into how Brazil managed to achieve such an improvement (Bruns, Evans, & Luque, 2012). However, Klein (2011) and Carnoy et al (2015) showed that changes in the date on which the PISA tests were written resulted in biases, the overall effect of which was an over-estimation of Brazil's gains over time. The 2009 tests were run later in the school year than those in 2000. After controlling for these distortions, Brazil's mathematics improvements were estimated to be closer to 3 PISA points on average annually (Carnoy et al., 2015), representing a much smaller improvement.

Measurement and estimation of learning goals is a relatively new sphere, and improvements in data collection and analysis will have to be honed in the coming years if accurate and comparable statistics are to be reported. This paper uses PASEC data to adjust for sample selection with in-school measurement as one particular source of measurement error.

This is not a new problem, and the solution presented here isn't wholly new either. Section 4 will discuss research which attempts to get around this issue. The purpose of the current paper is to extend previous research to new data, with an adjusted methodology, and thus contribute to our understanding of progression toward SDG Target 4.1 in sub-Saharan Africa, and Francophone sub-Saharan Africa specifically. This research is relevant for any and all learning goals which cover countries and time periods in which there is not universal access. The focus here on the SDGs comes in part from the global coverage of the goals – which therefore include all countries with less than universal access – as well as the substantial amount of finance that flows through the programme and the associated political influence. By 2017, more than 1.5 trillion US Dollars had been committed to SDG projects, and 17 billion US Dollars had been committed to SDG projects related to Goal 4, Quality Education, specifically (Sethi et al., 2017).

In previous work on this topic (Lilenstein, 2018; Spaull & Taylor, 2015; Taylor & Spaull, 2015; Spaull 2017), the methodology used necessitated that the assessment data be somewhat dated before it can be transformed from learning rates into access to learning rates. For the first time, the used here no longer requires that to be the case. This will allow for more timely analysis of access to learning in future research.

3. Defining quality in education

Thus far education quality and cognitive skills have been treated synonymously. Regional assessments used to track education quality, including all those discussed above, only test up to three cognitive skills and do not look at any other aspects of quality education. PASEC focuses on math and language skills (in French). Other assessments such as TIMSS also look at science. Although such skills are relatively easy to measure, they are clearly not the only important aspects of quality education.

Cognitive skills such as mathematics and language abilities are related to growth across countries (Altinok, 2007; Appleton, Atherton, & Bleaney, 2013; Gundlach, Rudman, & Woessmann, 2002) and individual wages within countries (Bedard & Ferrall, 2003; Hanushek & Zhang, 2009; Heckman, Stixrud, & Urzua, 2006; McIntosh & Vignoles, 2000), suggesting that they are a valid measure of learning and that they do have some worth. However, this does not negate the possibility that other skills are also or more related to national and individual success and well-being.

Heneveld and Craig (1996) and UNESCO (2005) also point to the cultivation of empathy, democratic values, and egalitarian principles as other aspects of schooling that are critical for quality education but not measured as part of regional assessments.

Furthermore, Nussbaum (2006) argues that many cognitive skills aimed for in education policy are imparted through internalization of information involving information gathering and rote memorization, which may represent a suboptimal learning strategy. Further to this, they argue that the fostering of critical thinking and imaginative capabilities are often neglected. Nussbaum (2006) characterizes successful as distinct from unsuccessful education as follows:

> "Nothing could be more crucial to democracy than the education of its citizens. Through primary and secondary education, young citizens form, at a crucial age, habits of mind that will be with them all through their lives. They learn to ask questions or not to ask them; to take what they hear at face value or to probe more deeply; to imagine the situation of a person different from themselves or to see a new person as a mere threat to the success of their own projects; to think of themselves as members of a homogeneous group or as members of a nation, and a world, made up of many people and groups, all of whom deserve respect and understanding." – Nussbaum (2006, p.387)

In sum, Nussbaum (2006) argues that the difference between primary and secondary school completers who have learned how to question and how to see themselves as part of a global society and those who have not, lies in the development of imaginative skills and critical thinking within schools, and that these should be the fundamental aims of education systems.

Such claims, despite being difficult to refute, are not reflected in any large-scale regional assessments of schooling quality. Therefore, this research paper will focus on literacy and numeracy skills specifically. It is important to bear in mind that although the existence of cross-national cognitive assessments provide a critical resource for education research and development, there remain equally critical aspects of quality education that are not captured and therefore are ignored by these assessments.

4. Literature overview

As already discussed above, the literature on education outcomes is mostly bifurcated into research on education access (research coming out of the Millennium Development Goals era) or education quality (research coming out of the Sustainable Development Goals era). However, there are some studies that

have looked at both simultaneously in an effort to make unbiased statements about education systems within countries. Although PISA-D made plans to collect data on out-of-school children in 2018 (OECD, 2018b), a web search does not pick up any results of this and as such all available PISA-D data appears to be based on the in-school population only at this point in time. All work on UWEZO and ASER data are automatically inclusive of access and learning.

Work which combines access and literacy rates, such as this paper, is scarce. In 2015 Spaull and Taylor (2015) formalized a method which combines measures of access (completion rates) and quality (learning outcomes) into an indicator of the overall health of an education system. They term this indicator *access to learning* or access to numeracy and access to literacy for these domains specifically. Spaull and Taylor (2015) apply their method to 11 Anglophone sub-Saharan African countries and follow up this investigation with a temporal analysis of access to learning in 10 of the same countries (Taylor & Spaull, 2015). The authors find low levels of access to learning in most countries, but with increases over time evident as well. In the current paper, this method is adapted for eight countries in Francophone sub-Saharan Africa using PASEC and DHS data.

Spaull (2018) also used this methodology to explore what effect ignoring sample selection has on PISA data in Turkey. Spaull (2018) provides evidence that the omission of the out-of-school sample or those who had delayed education progress in PISA resulted in an underestimate of both progress and inequity in Turkey. The proportion of 15-16 year-olds that were eligible for the PISA sample in Turkey nearly doubled from 45% in PISA 2003, to 80% in PISA 2012, substantially changing the sample. Spaull (2017) shows that estimates of improvements which take sample selection into account are actually twice as large as stated in official PISA reports, that the gap between the rich and poor is more than twice as large as previously estimated, and that the gap between the rich and poor has not declined between 2003 and 2012, contrary to prior research.

Most recently, Lilenstein (2018) conducted the same exercise for Francophone sub-Saharan Africa. Five of the eight countries included in this paper were also included in Lilenstein (2018). That work used older PASEC data, which was less rigorous[9] and is now quite dated. However, the overall conclusions reached are similar to those found here – that (1) literacy and numeracy rates are even lower than reported, (2) access to literacy and access to numeracy is statistically indistinguishable from zero in some cases, and (3) there is an education crisis in Francophone sub-Saharan Africa. Unfortunately, there is no way to link PASEC outcomes from data conducted prior to 2014 with the latest available (2014) outcome data. Not only were the assessment items and grades assessed changed, but the methodology was altered substantially as well – to be more in line with international standards[10].

The first study that combines access and quality was conducted by Michaelowa in 2001 on 1996 outcomes data. Michaelowa used the first round of PASEC data and created a single statistic to describe education access and quality. Michaelowa used UNESCO's Net Enrolment Rates (NERs) to estimate education quantity which, according to Spaull and Taylor (2015) as well as UNESCO themselves (UNESCO Institute for Statistics, 2010), can potentially lead to large biases in estimates. It is therefore likely that despite finding very low levels of access and access to learning (for example, only a 34% enrolment rate and a 20%

[9] Pre-2014, PASEC did not use psychometric techniques to arrive at learning outcome estimates and benchmarks were chosen arbitrarily.

[10] All of these changes can be seen in a comparison of the PASEC 2014 report with the earlier reports available for each country (there is no single report available for PASEC data pre 2014). In addition, this information was confirmed by personal communication with a PASEC representative in 2016.

access to learning rate for Burkina Faso), that these are in fact inflated estimates of both the proportion of students enrolled as well as the proportion of individuals who acquired basic literacy and numeracy skills at that time.

Three other papers in this sphere combine access and learning in their research (making eight research papers doing so overall). Filmer et al. (2006), Hanushek and Woessmann (2008), and Pritchett (2013) all use household survey data (specifically, Demographic and Health Survey [DHS] data, also used here) and at least one cross-national student assessment. Filmer et al. (2006) and Pritchett (2013) look at access and learning in a number of developing and developed countries. Although their discussion is balanced and acknowledges biases in each statistic, they don't combine access and learning into a single metric.

Hanushek and Woessman (2008) do combine access and learning rates into a single statistic. Unfortunately, the sample used only included a small number of developing countries, three of which are in Africa and none of which are investigated in this paper. The focus of the paper is on growth rates rather than target monitoring.

All learning data coming out of ERCE, TIMSS, PIRLS, and PISA could benefit from this type of analysis in so far as their participants have less than universal enrolment rates. Although many countries in Latin America and the Caribbean, such as Mexico and Brazil, currently have universal primary school completion rates (World Bank, 2020), The second ERCE study was conducted in 2006 (SERCE) and the third and latest in 2013 (TERCE), making access rates and therefore sample selection a valid concern in this data. Of the 14 countries which participated in both SERCE and TERCE, six have primary school completion rates that are both below universal and have changed substantially between 2006 and 2013, according to the World Bank (2020). These are Costa Rica (90% to 99%), Guatemala (74% to 85%), Nicaragua (80% to 85% in 2010[11]), Panama (90% to 100%), Paraguay (93% down to 88% in 2012[12]), and the Dominican Republic (86% to 94%).

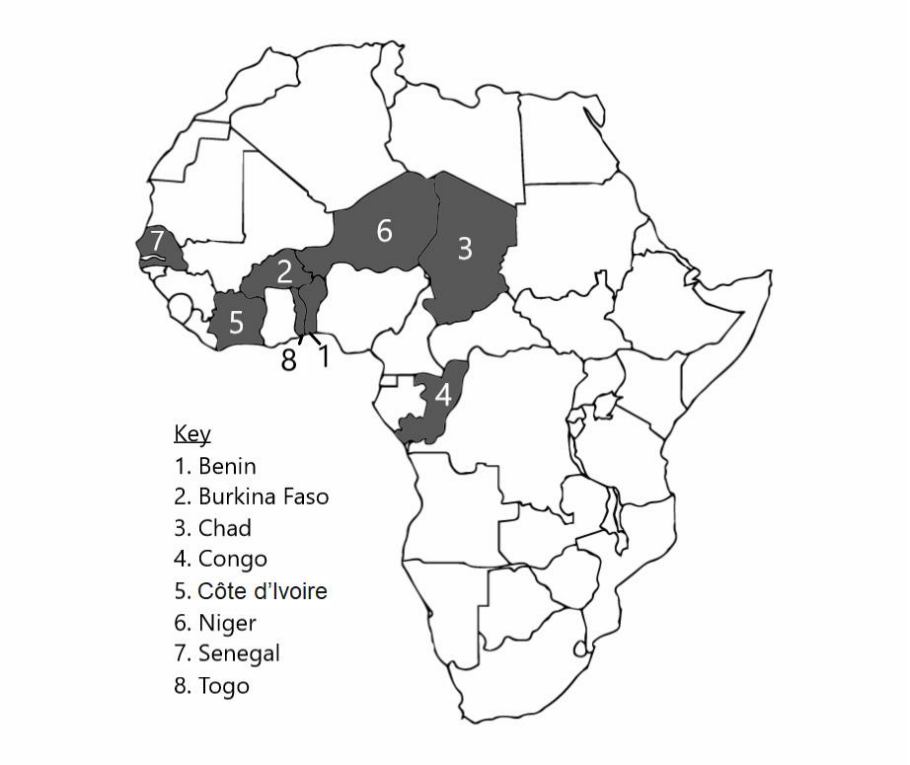
TIMSS, PIRLS, and PISA will face the same issue in their samples of developing countries, especially in their earlier years. These data need to be adjusted for completion rates to be comparable to the more recent TIMSS, PIRLS, and PISA datasets.

5. Francophone African countries in PASEC 2014

Figure 1 below displays the eight countries that we are working in: Benin, Burkina Faso, Chad, Congo, Côte d'Ivoire, Niger, Senegal, and Togo.

[11] Latest year available. A different data source was not investigated to ensure the comparability of this data.
[12] Ibid.

Figure 1. Map of Africa with Relevant Countries Highlighted



Each of these countries confronts quite significant development issues. The Human Development report (UNDP, 2019) ranks each of these countries in the bottom third of 189 countries in terms of human development using 2018 indicators. All countries except for the Congo are ranked in the bottom 15%. The Human Development Index (HDI) is made up of four components – Life expectancy, expected years of schooling for a child of school entrance age, mean years of schooling for adults 25 years and older, and Gross National Income (GNI) per capita in USD. The HDI theoretically ranges from zero to one, but practically Norway is ranked first with an HDI of 0.954, and Niger is ranked last – 189 – with an HDI of 0.377. Table 1 below displays each country alongside their HDI ranking as well as the value of each component and the same for Norway for comparison.

According to the Human Development Report (UNDP, 2019), the life expectancy of this sample of countries ranges from 54 years in Chad to 68 years in Senegal. At the lowest end, life expectancy in Chad is only two-thirds of that in Norway, and 20% lower than in Senegal. The expected years of schooling for a child just entering Grade 1 is 13 years at the top end (Benin and Togo) and 7 years at the lowest end (Niger). This indicates that it is expected that the average child will leave school with at least a primary school education in the coming decades, and a secondary school education in some cases. This is encouraging, especially as compared to the average adult education measure. Here, the Congo leads with the mean years of schooling at only 7 years, all seven other countries have a mean years of schooling at or below 5 years. The lowest is in Burkina Faso, with an average of only 1.6 years. The GNI per capita ranges from a high of $5 804 in the Congo to a low of $912 in Niger. For comparison, the GNI per capita in the Congo and Niger are less than 10% and 2% of that in Norway, respectively. Rankings have not changed substantially since the previous year's estimates. The Congo has moved down two places but no other country has moved more than one notch.

Table 1. Human Development Index Rankings, 2018

Ranking	Country	HDI	Life expectancy	Schooling (Expected)	Schooling (Mean)	GNI per capita ($)	HDI rank 2017
1	Norway	0.954	82.3	18.1	12.6	68, 059	1
138	Congo	0.608	64.3	11.6	6.5	5, 804	136
163	Benin	0.520	61.5	12.6	3.8	2, 135	163
165	Côte d'Ivoire	0.518	57.4	9.6	5.2	3, 589	165
166	Senegal	0.514	67.7	9.0	3.1	3, 256	166
167	Togo	0.513	60.8	12.6	4.9	1, 593	166
182	Burkina Faso	0.434	61.2	8.9	1.6	1, 705	183
187	Chad	0.401	54.0	7.5	2.4	1, 716	187
189	Niger	0.377	62.0	6.5	2.0	912	189

Source: Human Development Report (2019)

Notes: HDI: Human Development Index; Schooling (expected): the expected years of schooling for a child of school entrance age; Schooling (mean): the mean years of schooling for adults 25 years and older; GNI: Gross National Income.

Although this work represents the most accurate cross-country comparable literacy and numeracy statistics on these countries to date, besides Senegal in PISA-D, it is useful to ascertain as a starting point what other research says about them. Table 2 displays the results gathered by the three other studies that look at access to literacy and numeracy in Francophone sub-Saharan Africa. In her 2001 study, Michaelowa included three of the same countries that are investigated here: Burkina Faso, Côte d'Ivoire, and Senegal. Lilenstein (2018) included five of the same countries: Benin, Burkina Faso, Côte d'Ivoire, Senegal, and Togo. PISA-D (OECD, 2018) sampled from one of the same countries: Senegal. Although all of these studies are working in the same areas, and some with the same data programme (PASEC), none of these results are comparable either to each other or to the research that will be put forward here.

Table 2. Literacy and Numeracy in Francophone Africa

Benin	Burkina Faso	Chad	Congo	Côte d'Ivoire	Niger	Senegal	Togo
Michaelowa (2001) PASEC 1996 data, Grade 5							
	L: 15% N: 16%			L: 27% N: 22%		L: 19% N: 21%	
Lilenstein (2018) PASEC data between 2005 and 2010, Grade 5							
L: 13% N: 17%	L: 11% N: 13%			L: 17% N: 7%		L: 21% N: 32%	L: 17% N: 24%
OECD (2018) PISA-D data between 2014 and 2017, 15-year-olds							
						L: 9% N:8%	

Notes: L: access to literacy; N: access to numeracy.

As may be expected given the lack of comparability between these studies, the results obtained by each differ substantially. Using 1996 PASEC data, Michaelowa (2001) estimated an access to literacy rate of 15% in Burkina Faso. In the following round of PASEC, a decade later, Lilenstein (2018) estimated an access to literacy rate in the same country of only 11%. Similarly for numeracy in Burkina Faso, the estimated results are 16% in 1996 and 13% in 2006. Differences in the two studies are even more stark in Côte d'Ivoire, with literacy estimates of 27% in 1996 and only 17% in 2009, and numeracy estimates of 22% in 2001 and only 7% in 2009. However, Senegal does show an improvement between the two studies, with access to literacy increasing from 19%in 1996 to 21% in 2006 and access to numeracy increasing from 21% in 1996 to 32% in 2006.

These differences come from two sources. Firstly, the Michaelowa (2001) results are over-estimates due to the methodology used (see Section 4 – Literature overview), and secondly, the two PASEC datasets are not comparable.

The PISA-D differences are even more severe. While Michaelowa (2001) and Lilenstein (2018) estimate access to literacy and access to numeracy to be roughly between 20% and 30% in Senegal in 1996 and 2006 respectively, the OECD (2018), with PISA-D data collected between 2014 and 2017, only estimates an access to literacy rate of 9% and an access to numeracy rate of 8%. This difference comes both from the methodology as well as, and probably primarily, from the measure itself. Although there is no way to compare the difficulties of these items, it appears as though the PISA-D assessment may be more challenging.

The current research paper uses the latest round of PASEC data, collected in 2014. Once again, the data used is not comparable to earlier rounds of PASEC, nor is it comparable to PISA-D, although it will be comparable to later rounds of PASEC. The methodology used here is similar to Lilenstein (2018), with some adjustments where necessary. Given the unfortunate assessment and methodological differences in the literature just discussed, there is no way to know what an 'accurate' estimate should look like in the current study. However, we can say that access to literacy and numeracy are likely to be very low in all countries under study.

Based on the above discussions the following research questions will be under consideration in this paper:

1. In each country, what proportion of children
    1.1. never enrol,
    1.2. enrol initially but drop out before completing the assessed grade,
    1.3. enrol and complete the assessed grade but do so without having acquired grade-appropriate basic literacy and basic numeracy skills by this time, and
    1.4. enrol and complete the assessed grade having acquired grade-appropriate basic literacy and numeracy skills?
2. In each country, how does the above differ by the sub-national categories of
    2.1. Gender (females and males)
    2.2. Wealth (the poorest 40%, middle 40%, and richest 20%), and
    2.3. A gender-wealth interaction (poorest 40% of females and males, middle 40% of females and males, and richest 20% of females and males)?

These questions form the basis of this work and the remainder of this paper is structured around answering them. The 40/40/20 split for wealth categories was chosen following the work of Filmer (2010), Spaull and Taylor (2015), and Lilenstein (2018).

6. Data

Creating access to learning indicators involves combining information from two sources of data; literacy and numeracy rates are derived from PASEC data and combined with completion rates, which are derived from the most relevant DHS data set for each country involved. PASEC samples follow a randomised stratification design and are conducted at the Grade 3 and Grade 6 level in 2014. PASEC is the most comprehensive dataset on education quality in Francophone Africa. This research uses the latest PASEC data available which was collected in 2014. The items selected for the tests were discussed among education specialists and members of the different education ministries in order to equally reflect the curricula in all countries.

DHS data is used to estimate completion rates. The DHS is a household survey which is available for a wide array of countries globally and is therefore an important source of cross-country comparable data. The DHS has been used extensively in public health and social science research (Spaull & Taylor, 2015) and has been used in hundreds of peer-reviewed papers for a variety of analyses, including both educational attainment (Filmer & Pritchett, 1999) and enrolment (Hanushek & Woessman, 2008). DHS data are particularly useful for calculating completion rates because, unlike administrative data, they are comparable across countries and can be linked to household characteristics. In addition, Spaull and Taylor (2015) purport that administrative data is generally less reliable than self-reported data in this context, and that the quality of administrative data varies widely.

We use the closest DHS datasets available for each of the countries participating in PASEC. Of the ten countries available, eight have DHS datasets available and all of these were collected within the five years prior to PASEC. The DHS data is restricted to the age cohort of interest. This is determined by taking the modal age in the PASEC data plus two additional years (to limit inflated standard errors). Table 3 below displays the years that each DHS dataset was collected, as well as the relevant PASEC and DHS sample sizes.

Table 3. PASEC and DHS Sample Descriptive Statistics

Country	DHS (Year)	PASEC Schools[a] (N)	PASEC Participants[a] (N)	DHS age group	DHS Households (N)	DHS Participants (N)
Benin	2011/12	165	3 033	12-14	5 855	7 549
Burkina Faso	2010	182	3 416	13-15	4 699	5 923
Chad	2014	157	2 484	14-16	5 386	6 766
Congo	2013/14	164	2 673	12-14	6 428	8 117
Côte d'Ivoire	2011/12	169	2 972	12-14	2 838	3 750
Niger	2012	176	3 196	13-15	3 447	4 293
Senegal	2012/13	160	2 905	12-14	2 132	3 162
Togo	2013/14	189	3 256	12-14	3 125	3 933

Note: [a]Excluding observations with missing achievement data.

For learning outcomes, PASEC includes five plausible value estimates for both literacy and numeracy. All five are used in these calculations. The PASEC 2014 report (PASEC, 2015) does not detail how to deal with these plausible values. However, the use of plausible values is common in large scale cross-national assessments and is therefore detailed particularly well in the PISA Data Analysis Manual (OECD, 2009: 93). Statistical packages are also available which deal with plausible values automatically. Given that this work only needs the mean and standard error of each estimate, these were calculated manually.

Mean estimates using plausible values are unbiased and therefore the correct mean estimate of any set of plausible values is simply the mean of the plausible values themselves. That is,

$$mean\ parameter\ estimate\ (a) = \frac{PV1 + PV2 + PV3 + PV4 + PV5}{5}$$

The standard error of any plausible value contains the sampling variance component and not the measurement variance. It will therefore slightly underestimate the total uncertainty in the estimate. The standard error is corrected by calculating the measurement error from the mean parameter estimate above and adding this to the sampling error to get the total variance of the parameter estimate. The square root of the variance is then the standard error. Mathematically,

Step 1. Estimate the mean parameter estimate (a) as above

Step 2. Estimate the sampling variance (b) as the average of the standard deviations of each plausible value:

$$Sampling\ variance\ (b) = \frac{PV1_{sd} + PV2_{sd} + PV3_{sd} + PV4_{sd} + PV5_{sd}}{5}$$

Step 3. Estimate the measurement variance (c) as the variance of each plausible value from the mean parameter estimate:

$$measurement\ variance\ (c) = \frac{(PV1 - a)^2 + (PV2 - a)^2 + (PV3 - a)^2 + (PV4 - a)^2 + (PV5 - a)^2}{5}$$

Step 4. Estimate the variance of the parameter estimate (d) as the sum of the sampling variance and the measurement variance, where the latter is multiplied by a factor related to the number of plausible values used (denoted by PV_n in the following):

$$Variance\ of\ parameter\ estimate\ (d) = b + (1 + \frac{1}{PV_n})c$$

Step 5. Estimate the corrected standard error as the square root of the variance of the parameter estimate:

$$Corrected\ standard\ error = \sqrt{d}$$

DHS reports the highest grade completed for each respondent as well as whether the individual is currently enrolled in an education institution or not. These two variables are combined to determine who never enrolled in school, who dropped out before completing Grade 6, and who completed Grade 6. The

age band used allows children two additional years to complete Grade 6 or they are not captured in this variable. Late grade completion above two years is accounted for in an adjustment that will be detailed in the Methodology section below.

7. Methodology

Getting from test scores to learning benchmarks. PASEC 2014 has developed competency scales for literacy and numeracy, each divided into several levels, on the basis of the statistical characteristics within the data and the knowledge and abilities required in answering different questions. Sufficient and advanced thresholds are defined based on the concepts assessed in the PASEC tests and according to the priority goals of school curricula in literacy and numeracy. The levels, their associated score in PASEC, and their ability descriptions are presented in Table 4 (literacy) and Table 5 (numeracy) below.

PASEC scores of 518.4 and above on the literacy component are defined here as basic literacy (the sufficient threshold). PASEC scores of 595.1 and above on the literacy component are defined here as advanced literacy. PASEC scores of 521.5 and above on the numeracy component are defined here as basic numeracy (the sufficient threshold). PASEC scores of 609.6 and above on the numeracy component are defined here as advanced numeracy.

Table 4. Description of literacy levels in PASEC

Levels	Minimum Pupil Scores	Distribution of Pupils throughout the Levels of the Scale	Description of Competencies
Level 4	595,1	17,1%	Pupils can gain an overall understanding of narrative passages, informative texts and documents. Pupils are then able to interpret several implicit ideas in these texts while drawing from their experience and knowledge. When reading literary texts, pupils are able to identify the author's intention, determine implicit meaning and interpret characters' feelings. When reading informative texts and documents, they can connect information and compare data prior to using it.
Level 3	518,4	25,6%	Pupils are able to combine two pieces of explicit information from a document or can carry out simple inferences in a narrative or informative text. They can extract implicit information from written material while giving meaning to implicit connectors, anaphora or referents. Pupils locate explicit information in long texts and discontinuous documents.
"Sufficient" Competency Threshold			
Level 2	441,7	27,7%	Pupils draw on their orthographic decoding skills to identify and understand isolated words taken from their everyday lives. They are also able to locate explicit information in short and medium length texts by identifying clues in the text and questions. Pupils can paraphrase explicit information from a text.
Level 1	365,0	21,2%	Pupils have developed decoding skills and can draw on them to understand isolated words taken from their everyday lives but are in difficulty when it comes to understanding the meaning of short and simple texts.
Below Level 1	72,1	8,4%	Pupils at this level do not display the competencies measured by this test. These pupils are in difficulty when it comes to Level 1 knowledge and competencies.

Source: PASEC (2015)

Table 5. Description of numeracy levels in PASEC

Levels	Minimum Pupil Scores	Distribution of Pupils throughout the Levels of the Scale	Description of Competencies
Level 3	609,6	14,7 %	Pupils are able to answer arithmetic and measurement questions, usually presented in the form of a short text of two or three lines, requiring them to analyze situations and then decide on the appropriate approach. In arithmetic, they can solve problems involving fractions or decimal numbers; in measurement they can solve problems involving surface area or perimeter calculations. Pupils can find data on a diagram prior to calculating distances while abiding by the constraints set out in the wording of the exercise. They are also able to perform calculations and conversions involving hours, minutes and even seconds.
Level 2	521,5	26,3 %	Pupils are able to answer brief arithmetic, measurement and geometry questions by resorting to the three assessed processes: knowing, applying and reasoning. Some questions call on factual knowledge or a scientific approach; others require analysis of a situation prior to determining the appropriate approach. In arithmetic, pupils perform operations with decimal numbers and can also solve familiar problems by analyzing the wording of the question or extracting data from a double-entry table. They know how to complete logical series with decimal numbers or fractions. In measurement, pupils can tell the time and convert units of measurement with or without a conversion table. They are also able to solve arithmetic problems involving operations with days, hours and minutes, or units of length. In geometry, pupils know the names of certain solids, basic geometric shapes and some characteristic lines (diagonal, median).
"Sufficient" Competency Threshold			
Level 1	433,3	31,8 %	Pupils can answer very brief questions by calling upon factual knowledge or a specific procedure. In arithmetic, they are able to carry out the four basic operations with whole numbers which might require writing down the operation using regrouping. In measurement, they recognize the length measurement unit: the meter. In geometry, they are able to orientate themselves in space by identifying directions and positions and by reading coordinates on a graph.
Below Level 1	68,1	27,2 %	Pupils at this level do not display the competencies measured by this test. These pupils are in difficulty when it comes to level 1 knowledge and competencies.

Source: PASEC (2015)

Creating the composite indicator. Combining DHS and PASEC data ptovides (1) the grade completion rate from DHS and (2) the basic and advanced literacy and numeracy rates of in-school learners. The grade completion rate gives how many of the children in the population of the country are represented in the in-school sample in PASEC. Inversely, it provides the proportion of learners who are not represented in PASEC and therefore do not have associated learning outcomes in this data. Therefore, In order to get a full picture of literacy and numeracy in the country, assumptions have to be made about the learning rates of the out-of-school population.

In this paper the assumption is made that all leaners who are not in school at the time of the PASEC assessment do not possess basic and advanced literacy and numeracy skills, as defined by the levels explained above. This is the same strategy used by Spaull and Taylor (2015), Spaull (2017), Lilenstein

(2018) and Michaelowa (2001). Spaull and Taylor (2015) motivate this assumption with two underlying tenants. Firstly, they point out that it is unlikely that individuals who never enrol in school will learn to read, write, and do math at a sufficient level. Secondly, they assert that it is also unlikely that individuals who enrol but drop out would have acquired these skills before dropping out. The authors justify their position on the latter tenant with the fact that those leaners who drop out of school are likely to (1) come from the weakest part of the learning distribution, having repeated or failed earlier grades (Lambin, 1995), and (2) come from poorer households and more remote areas (Lambin, 1995). They further justify this assumption by pointing out that (3) a large proportion of students who do complete the grade do not acquire basic skills, making it unlikely that those who drop out before completing the grade would have acquired these skills prior to dropout.

Having made this assumption about the out-of-school population it is now simple to calculate the proportion of children of a particular age-cohort in a country who achieve a certain level of learning. The access to learning rate is found by multiplying the proportion of the cohort who complete the grade with the proportion of the in-school cohort who reach the competency standards outlined above. For example, if 60% of the age cohort have completed Grade 6 and 50% of these acquired basic literacy skills at the Grade 6 level, then 30% of the age cohort completed Grade 6 with basic literacy skills (0.6x0.5=0.3). The inverse of this proportion – 70% in this case – represents the proportion of the age cohort who did not acquire basic literacy skills.

When combining two estimates as is done here (grade completion and learning rates) one must be cognizant of what happens to the standard errors associated with each measurement. Combining multiple estimates results in standard errors higher than either measurement and higher even than the sum of both standard errors. The combined standard error is found by squaring the standard errors, adding them together, and then taking the square root of the total.

Three adjustments must be made to the estimates described above. These are (1) accounting for the underrepresentation of poorer learners in schools, (2) accounting for late grade completion, and (3) accounting for old DHS data. Each of these will be discussed in turn below.

Accounting for the underrepresentation of poorer learners in schools. This paper presents the learning rates of different socioeconomic status (SES) groups separately (the richest 20%, the middle 40%, the poorest 40%). In order to get an accurate account of the learning rates of different SES groups, an adjustment must be made for what proportion of each group makes it into the PASEC sample. For example, if 80% of the wealthiest 20% of students make it into the PASEC sample, and the literacy rate of this subgroup is 60%, then the access to literacy rate of the wealthiest 20% of the population is 48% (0.6x0.8=0.48). If on the other hand, the completion rate for the poorest 40% of the sample is only 30%, and the literacy rate for those who make it to school is also 30%, then the access to literacy rate for the poorest 40% of the population is 9% (0.3x0.3=0.09). Given that the SES calculation for the in-school population is based on PASEC data and only includes those who are in school, the completion rates of the different SES groups are first calculated from DHS and incorporated into the PASEC data before SES calculations are made in PASEC. This process is documented in detail in Spaull and Taylor (2015: 153) and a graphical representation is available in Lilenstein (2016: 25-26).

Incorporating access rates of wealth groups into the PASEC assessment data is done in four steps: (1) the assessment data is sorted by wealth, (2) a cumulative distribution of the sample raising factor is created, (3) this distribution is split according to the completion rates of the different wealth quintiles taken from the DHS data, and (4) wealth quintiles in the assessment data are created according to this split.

Mathematically, this process can be represented by the following equation, which is given in Spaull and Taylor (2015):

Equation 1. Creating Wealth Quintiles in PASEC Data: Mathematical Representation

$$P = \int_{0}^{\left(\frac{\mathrm{CR_{poor40}}}{0.4 \times \mathrm{CR_{total}}}\right) \times N} \mathrm{CN_{ses}} + \int_{\left(\frac{\mathrm{CR_{poor40}}}{0.4 \times \mathrm{CR_{total}}}\right) \times N}^{\left(\frac{\mathrm{CR_{mid40}}}{0.4 \times \mathrm{CR_{total}}}\right) \times N} \mathrm{CN_{ses}} + \int_{\left(\frac{\mathrm{CR_{mid40}}}{0.4 \times \mathrm{CR_{total}}}\right) \times N}^{\left(\frac{\mathrm{CR_{rich20}}}{0.2 \times \mathrm{CR_{total}}}\right) \times N} \mathrm{CN_{ses}},$$

Where *P* is the total PASEC sample, CR_{poor40}, CR_{mid40}, *and* CR_{rich20}, are the grade completion rates for the poorest 40%, the middle 40%, and the richest 20% of the relevant age cohort in the respective country. CR_{total} is the national grade completion rate, and *N* is the total Grade 6 population. *N* is obtained by inflating the PASEC sample to the population of Grade 6 students using the PASEC raising factor variable, which is derived from the PASEC sampling procedure (i.e. the sample weight). CN_{ses} is the cumulative distribution of the Grade 6 school-going population, sorted from poorest to wealthiest

Accounting for late grade completion. It is common practice in many developing countries for children to complete school at much later ages than intended. Therefore, selecting an appropriate age cohort is an important consideration. Previous work (Spaull & Taylor, 2015; Lilenstein, 2018) used a DHS age cohort considerably older than the PASEC children (and collected in later years) to ensure that all those who would eventually complete the grade investigated would already have done so by the time they were included in the sample. A different approach is taken here for two reasons. Firstly, using older data would only allow the inclusion of three countries (Benin, Burkina Faso, and Senegal) as the remaining five do not have DHS datasets collected in years post-2014. Secondly, this methodology allows for a more general application which means that in future, data can be analysed as it is collected, rather than many years hence.

The calculation which accounts for late grade completion involves three stages. In stage one, dropout by Grade 6 is estimated by looking at the dropout rates of the age cohort (e.g. 12-14) separately by gender and SES. That is, dropout rates are calculated separately for males, females, the different wealth categories, poor males and poor females, and so on.

In the second stage, the additional learners who could potentially go on to complete Grade 6 (late completers) is estimated. Here it is assumed that all those aged 12-14 in DHS who are currently enrolled in Grades 3-6 could go on to complete Grade 6, while those who are currently enrolled in Grades 1 and 2, or not enrolled at all, will not complete Grade 6. This may be a slight underestimate of late grade completion, as some individuals aged 12-14 who are not currently enrolled in school or who are in Grades 1 and 2 could end up completing Grade 6.

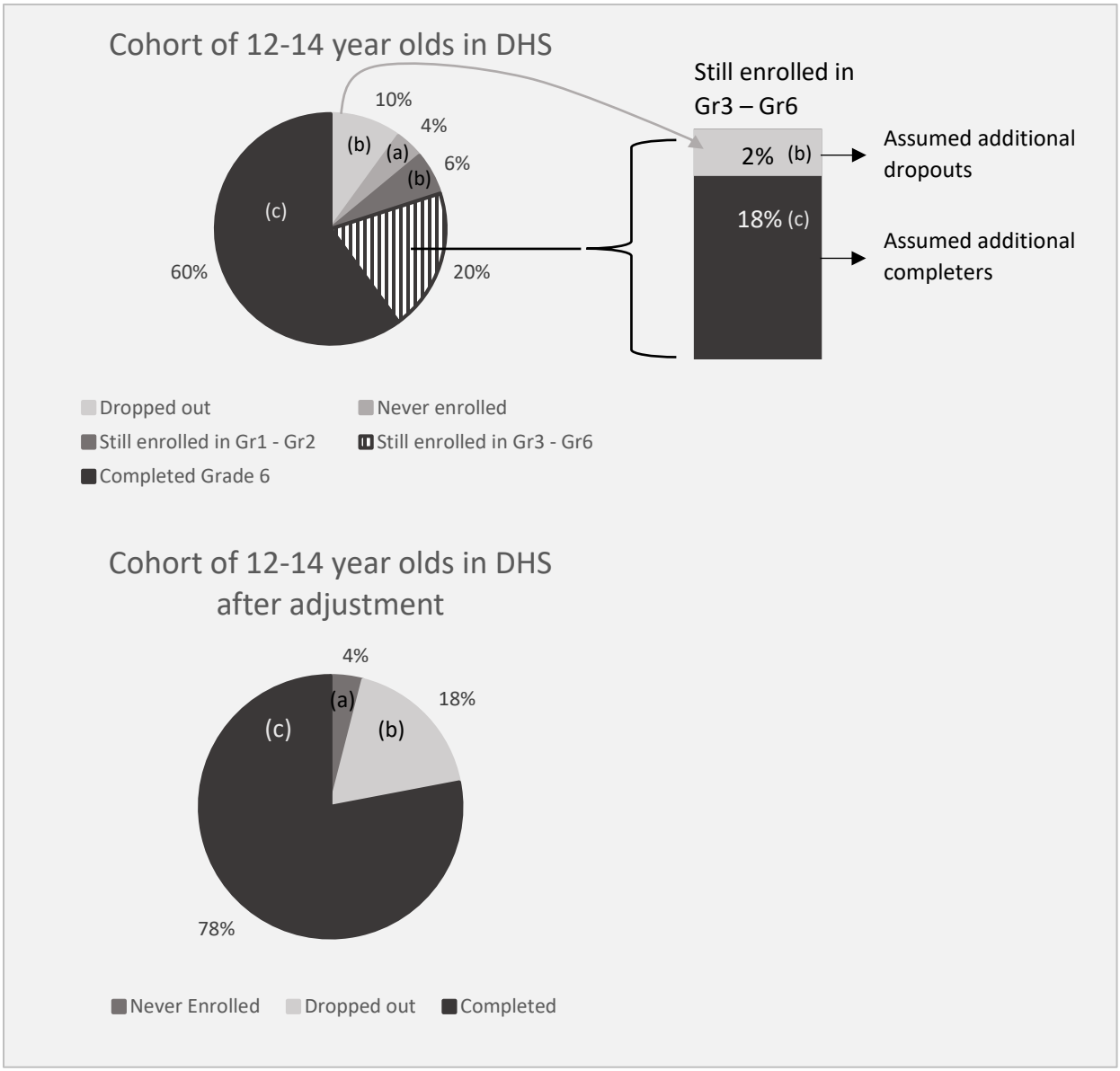
In stage three, the dropout rates calculated in stage 1 are applied to the potential completion rate calculated in stage 2. In theory, we are making an assumption that those who are still enrolled in Grades 3-6 will complete Grade 6 with the same probability as the 'on-time' completers. This is likely to be an overestimate of the probability of completion since those who are older but still in lower grades are less likely to complete than those who do so on time. In practice, the proportion of learners who are still enrolled in Grades 3-6 is multiplied by the retention rate (1 minus the dropout rate), and added to the unadjusted completion rate. For example, assume that in a cohort of 12-14 year olds, 4% never enrolled

in school or are enrolled in grades 1-2, 20% are enrolled in Grades 3-6, 10% dropout between Grade 1 and completing Grade 6, and 60% complete Grade 6. Then, the unadjusted completion rate is 60% and the adjusted completion rate is 0.6 + (0.2*(1-0.1))= 0.78 or 78%. The process is illustrated in the diagram below in

Figure *2*.

In the figure, two pie charts are presented. The first represents the data as it is seen in DHS, and the second represents what the data looks like after the adjustment for late grade completion. In the pie charts, (a) represents the proportion of children who never enrol in school. In this example this is 4%. This does not change between the two charts. The proportion (b) represents the dropout rate. In the second pie chart, this is given by the initial dropout rate in the DHS sample (10% in the first pie chart), plus the proportion of the DHS sample still enrolled in grades 1 and 2 (6% in the first pie chart), plus the proportion of the potential completers that we assume will dropout (2% in the blowout of the first pie chart). The third proportion comes from multiplying the potential completion rate (all those who are still enrolled in Grades 3 to 6 – 20%) by the initial dropout rate (10%), giving 2% additional dropouts. Similarly, the proportion (c) represents the completion rate. In the second pie chart, this is given by the initial completion rate (60% in the first pie chart) plus the proportion of potential completers that we assume do complete (18%). The latter proportion comes from multiplying the potential completion rate (all those who are still enrolled in Grades 3 to 6 – 20%) by the retention rate (100-10= 90%), giving 18% additional completers, for a total of 78% completion overall.

Figure 2. Estimating Late Grade Completion



The decision to include those currently enrolled in Grade 3 and Grade 4 as potential completers rather than dropouts is based on a desire to overestimate enrolment rather than to run the risk of underestimating it. Overestimates are less concerning than underestimates, since given the low learning rates it is important that this work cannot be considered to be over representing the issue at hand. Table 6 below gives the proportion estimated to have competed Grade 6 with and without this adjustment. This is by no means a trivial exercise. If these estimates are accurate, then close to half of those who will ever complete Grade 6 do so more than two years late. Given the substantial difference between the unadjusted and adjusted completion rates, this method is tested and compared to the original method

formalized by Spaull and Taylor (2015). The results of this test are given below, after discussion of the adjustments made for old DHS data.

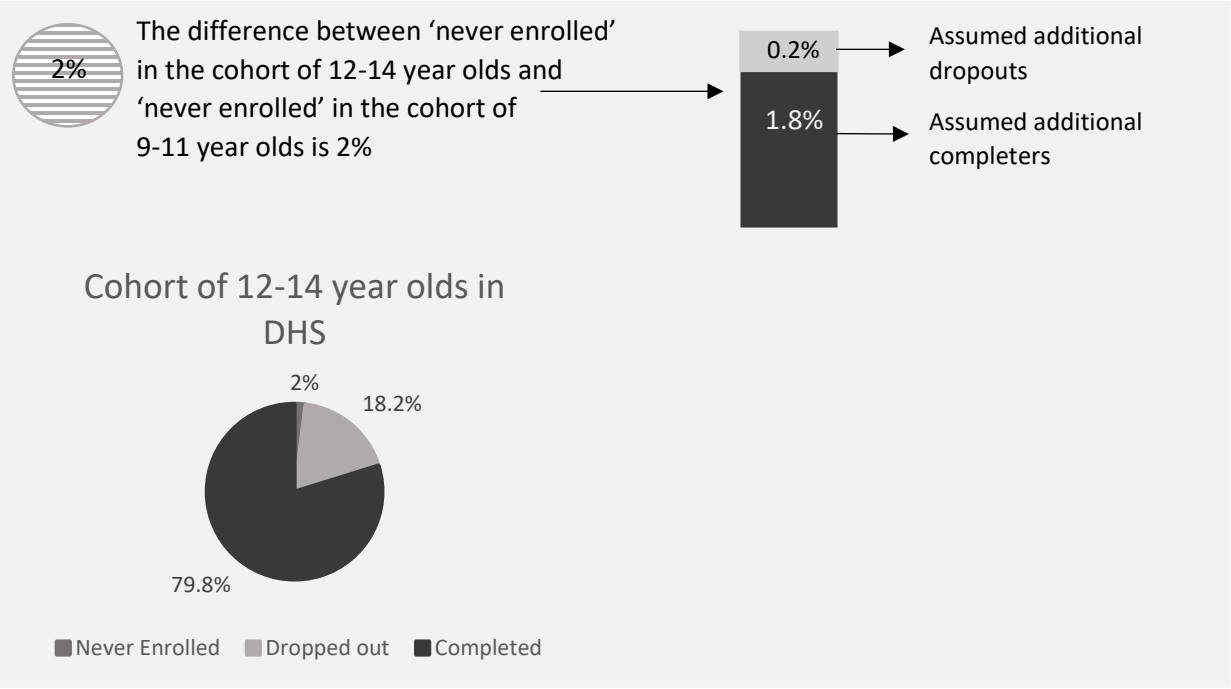
Table 6. Late Grade Completion Adjustment Estimates

	Grade 6 Completion			
Country	No adjustment	Late grade completion adjustment	Percentage point difference	Percentage difference
Benin	39	62.3	23.3	37.4
Burkina Faso	21.8	37.3	15.5	41.6
Chad	27.3	43.5	16.2	37.2
Congo	31.1	62.9	31.8	50.6
Ivory Coast	27.1	50.8	23.7	46.7
Niger	21.4	31.7	10.3	32.5
Senegal	23.2	45	21.8	48.4
Togo	39.7	71.2	31.5	44.2

Accounting for old DHS data. Most of the DHS datasets are at least one year old. The oldest DHS dataset is Burkina Faso, collected in 2010, four years prior to PASEC. Given the rapid expansion of schooling systems in many developing countries, a difference of a few years could mean big changes. For example, 13-15 year olds (the relevant age cohort in PASEC) in Burkina Faso in 2014 would have been 9-11 year olds in the DHS sample in 2010. The initial Grade 1 enrolment levels of 13-14 year olds in DHS in 2010 are therefore reflective of different and less advanced schooling policies. However, using the 9-11 year old age cohort to estimate Grade 6 completion is not viable, as most of these children won't even be in Grade 6 yet. To account for this, completion for 13-14 year olds in DHS in 2010 is estimated, as well as Grade 1 enrolment of 9-11 year olds (or the relevant adjusted age cohort for each country). An assumption is then made that all those additional children that entered the school system between the two age cohorts could potentially go on to Complete Grade 6. That is, the Grade 6 completion rate is increased by the difference between Grade 1 enrolment for the older and younger cohorts. This adjustment is zero for Chad and Senegal, as they both have DHS datasets collected in 2014. The dropout rates discussed above are then applied to this additional potential completion rate in the same manner as already shown. This process is given in Figure 3 below.

The figure assumes the same initial enrolment and completion rates as in the example above. The difference in the rate of children who never enrolled in Grade 1 between the older (12-14) and younger (9-11) cohorts is given as 2%. The dropout rate (10%) is then applied to these potential completers, giving 0.2% additional dropouts (2 X 0.1 = 0.2) and 1.8% additional completers (2 X 0.9 = 1.8). Combining the adjustments for late grade completers and old DHS data then gives us the final completion rates, as indicated in the pie chart in Figure 3. The proportion who never enrolled is given by the enrolment rate of the younger cohort – 2%, the proportion who dropped out is given by the dropout rate calculated above plus the additional dropout – 18.2% (18% + 0.2%), and the proportion who complete is given by the completion rate calculated above plus the additional completion rate – 79.8% (78% + 1.8%).

Figure 3. Adjusting for old DHS data



The decision to use the initial dropout rate (10%) rather than the estimated dropout rate including late completers (18%) is again based on a desire to overestimate enrolment rather than to run the risk of underestimating it, given that dropout is likely to be lower in later years. Table 7 below gives the proportion estimated to have competed Grade 6 with and without this adjustment. Chad and Senegal are not included since the DHS data here are from 2014. Unlike with the late grade completion estimates, this adjustment can be insubstantial. The largest adjustment is made in Burkina Faso (4.4 percentage points), which had the oldest DHS dataset.

Table 7. Old DHS Data Adjustment Estimates

	Grade 6 Completion			
Country	No adjustment	Late grade completion adjustment	Percentage point difference	Percentage difference
Benin	39	42.4	3.4	8.0
Burkina Faso	21.8	26.2	4.4	16.8
Congo	31.1	31.1	0.0	0.0
Ivory Coast	27.1	30.1	3.0	10.0
Niger	21.4	24.9	3.5	14.1
Togo	39.7	40.8	1.1	2.7

Testing assumptions. While the adjustment for the underrepresentation of poorer children in PASEC is a straightforward mathematical exercise and one that has been tested extensively by Spaull and Taylor

(2015), the adjustments for late grade completion and older DHS datasets are a new, untested, methodology. The method is based on semi-arbitrary decisions (such as whether to assume 14 year olds in Grade 2 and Grade 3 could complete Grade 6) and built-in biases (such as the deliberate overestimation of completion rates).

The use of this methodology instead of that originally conceptualized by Spaull and Taylor (2015) is necessitated by the lack of recent DHS data for most of the countries in PASEC 2014. Senegal does have a more recent dataset available, 2016, which was used to test the differences between the two methodologies. The Senegal 2016 dataset is inappropriate for estimating Grade 6 completion in 2014 using the Spaull and Taylor (2015) method – it is too close to the PASEC collection date. Therefore the Taylor and Spaull (2015) method is used to estimate Grade 6 completion in 2012, and the method used in this paper is applied to Senegal 2012 DHS data. These results are therefore valid for comparing the two methodologies but are not relevant for the results of this paper in any other way. Table 8 displays the Senegal 2012 Grade 6 completion rates using the original method employed by Spaull and Taylor (2015) in the first column, and the completion rates using the methodology described here in the second column. The percentage point differences and the percentage difference as a proportion of the Spaull and Taylor (2015) methodology are given in the third and fourth columns in the table. Underestimates are shaded.

Table 8. Testing a new method of calculating late grade completion

	Grade 6 Completion Rate in Senegal in 2012			
	Spaull & Taylor (2015)	New method	Percentage point difference	Percentage difference
National	50.6	54.1	3.5	6.9
Males	53.2	55.6	2.4	4.5
Females	48.7	52.7	4	8.2
Poorest 40%	35.3	38.9	3.6	10.2
Middle 40%	56.1	62	5.9	10.5
Richest 20%	70.6	68.3	-2.3	-3.3
Poorest 40% of males	38.7	40.4	1.7	4.4
Poorest 40% of females	32.8	37.3	4.5	13.7
Middle 40% of males	56.9	61.4	4.5	7.9
Middle 40% of females	55.5	62.5	7	12.6
Richest 20% of males	75.3	76.6	1.3	1.7
Richest 20% of females	67.2	60.9	-6.3	-9.4

As predicted, the estimates using the new methodology are generally overestimates of the Grade 6 completion rate. These overestimates range from 2% to 14% of what was found using the Spaull and Taylor (2015) methodology. However, even at 14% of the Spaull and Taylor (2015) methodology, this constitutes an overestimate of only 5 percentage points.

Some underestimates are found – for the richest 20% of the sample and for the richest 20% of females specifically. The completion rates of the rich are less concerning than that of the poor, since the rich always have higher completion rates and are not the portion of the sample that this work is aiming to bring policy attention to. The underestimates are of the same proportion as the overestimates.

Overall, this the results of this test are encouraging and suggest that the method employed here is valid and useful. In general, we can expect that these results are a slight overestimate of access and access to learning for the poorest 80% of children.

Estimating SES in PASEC data. Unfortunately, while PASEC do collect a host of background information, including on assets, they do not construct SES identifiers. Therefore, Multiple Correspondence Analysis (MCA) was used to create wealth indices from asset, housing quality, and other variables that were available in the data. The method employed in creating the wealth indices follows that of Wittenberg and Leibbrandt (2015) as well as Lilenstein (2018). The decision to conduct an MCA and not a Principal Component Analysis (PCA) was arbitrary but non-consequential since the differences between the results of a PCA and an MCA are slight. This is evidenced in the paper by Wittenberg and Leibbrandt (2015) using DHS data and Lilenstein (2018) using PASEC data.

Following the approach by Wittenberg and Leibbrandt (2015), the PASEC variables were specifically chosen to maximise the likelihood that the index would differentiate well between different wealth levels. The authors discuss the case of rural assets in the DHS data for South Africa – variables such as livestock are negatively correlated with the other assets and commodities used to create the DHS wealth index. This negative correlation means that the Principal Component Analysis (PCA) conducted by DHS sees the livestock variables as a 'bad' rather than a 'good' and hence those with such assets are ranked as poorer than those without them in the DHS wealth index. This is of course an incorrect ranking (and it violates the PCA assumption of monotonicity – that more goods mean more wealth). The authors suggest removing the negatively correlated 'goods' from the analysis for a more accurate index to be constructed.

Contrary to the approach by Wittenberg and Leibbrandt (2015) who only used assets in their analysis, other commodities such as housing material were included in this MCA (for example, having mud of concrete walls). This was shown in Lilenstein (2018) to be a better strategy for creating a well-discriminating wealth index. Lilenstein (2018) also showed that for the purposes of creating wealth categories split into 40/40/20, the DHS wealth index performs very similarly to a wealth index constructed according to the methods discussed above. Lilenstein (2018) explains this by reasoning that although the DHS index might slightly mis-rank individuals, when transformed into three large categories this no longer has bearing on the results. Following Lilenstein (2018), the DHS asset index was used rather than creating a new index.

8. Results

8.1. SDG target indicators

This section provides the estimates of literacy and numeracy, which should be considered when assessing progress toward the SDG Target 4.1.1 for Francophone Africa and these eight countries at a glance. Table 9 below displays literacy and numeracy rates by gender and SES. The following sections will look at the components of these results more comprehensively. The standard errors associated with these estimates can be found in the full tables which follow in Section 8.4.

Table 9. SDG target 4.1.1 indicators at a glance

Country	National	Boys	Girls	Poorest 40%	Middle 40%	Richest 20%	
Benin	33.8	36.6	30.9	15.6	33.8	60.5	*Literacy*
Burkina Faso	23.2	24.6	21.7	9.5	21.8	46.8	
Chad	6.7	8.2	4.9	3.4	4.1	16.2	
Congo	25.3	26.1	24.3	6	21.6	57.2	
Côte d'Ivoire	25	26.6	23.4	9.8	20.9	50.8	
Niger	2.7	3.1	2.4	0.5	1.3	9.3	
Senegal	27.4	27	27.9	11	29.8	50.4	
Togo	27.2	27.7	26.6	8.4	24.7	54.1	
Country	National	Boys	Girls	Poorest 40%	Middle 40%	Richest 20%	
Benin	25.6	27.3	23.8	11.9	22.8	50.2	*Numeracy*
Burkina Faso	23.9	26.4	21.5	10.5	23	46.6	
Chad	8	10.6	4.7	4.3	5.8	17.8	
Congo	17.5	20	15.2	6	13.8	38.6	
Côte d'Ivoire	13.3	16	10.6	5	11	27.4	
Niger	2.4	3.1	1.6	0.5	1.3	7.6	
Senegal	26.5	26.5	26.4	11.6	28.2	48.2	
Togo	34.5	37.1	32	14	34.6	60	

The first thing to notice from the table above is that, in general, access to learning is very low in the region. Around one quarter to a third of learners have access to literacy in six of the eight countries: Benin, Burkina Faso, the Congo, Côte d'Ivoire, Senegal, and Togo. In Chad and Niger this rate is only 7% and 3% respectively. Roughly the same is true of access to numeracy, although here rates are even lower for the Congo (18%) and Côte d'Ivoire (13%). The fact that six of these eight countries have higher access to numeracy rates than access to literacy rates is in contrast to Spaull and Taylor (2015), who find that literacy rates are usually higher than numeracy rates in Anglophone sub-Saharan Africa, but in line with Lilenstein (2018) who found the same in the earlier PASEC data.

The difference between girls and boys is small when looking at the average like this (gender by SES is looked at later), although boys have a slightly higher access to learning than girls in general, with the exception of Senegal. It has been seen in previous research in this area that Senegal consistently displays equal rates of access to learning for boys and girls both on average and at different SES levels (Lilenstein, 2018).

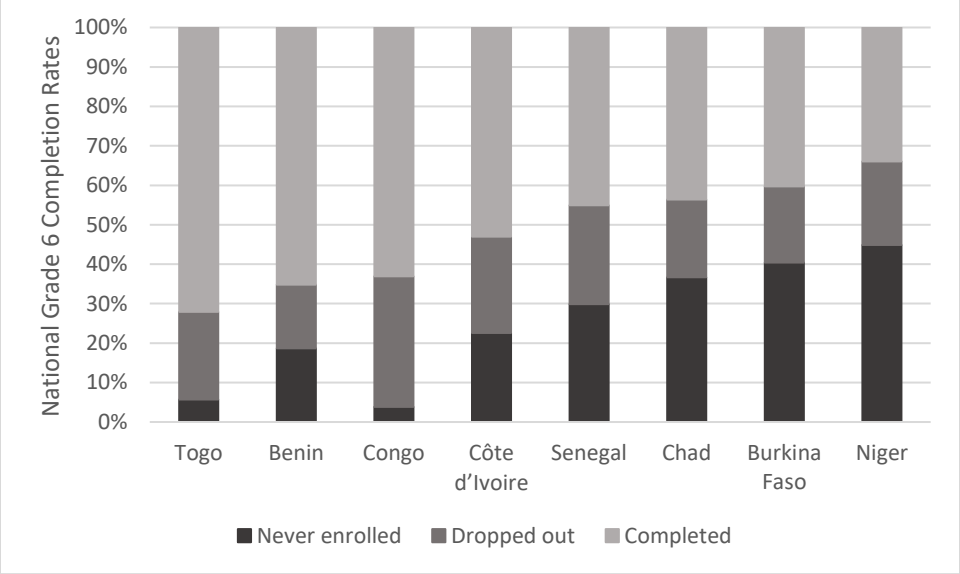
Without exception, the richest children have far higher access to learning rates than the poorest. If these results are indicative of Francophone sub-Saharan Africa in general then socioeconomic inequalities are a major concern throughout the region. Lilenstein (2018) found the same to be true in this region previously and this has also been seen in Anglophone sub-Saharan Africa in Spaull and Taylor (2015).

8.2. Access in Francophone sub-Saharan Africa

Tables displaying Grade 6 completion rates, non-enrolment rates, and dropout rates nationally, by gender, and by SES are available in Appendix A.

Although countries in sub-Saharan Africa have, in general, made great strides in increasing access to schooling (Taylor & Spaull, 2015; Lilenstein, 2018), access is was still far from universal in 2014. Figure 4 below displays Grade 6 completion rates, on average, for each of the eight countries. The Congo and Togo stand out for having low non-enrolment rates (the proportion that did not enrol even in in Grade 1). Niger has the highest non-enrolment rate, with almost half of children never going to school. The remaining rates vary between 20% and 40%. Clearly, there is still a long way to go in access, even in Grade 1. By the time the Grade 6 year comes, dropout has eroded access rates further (crucially, the estimation technique essentially means that this includes all children who will ever access and complete Grade 6). Dropout is the highest in the Congo, which previously had the highest rate of access when considering Grade 1 enrolment. Given the high dropout in all eight countries, the resulting Grade 6 completion rates are low. Togo has the highest Grade 6 completion rate, at 72%. The lowest is seen in Niger, with only around 1 in 3 children ever completing Grade 6.

Figure 4. Grade 6 completion rates in Francophone sub-Saharan Africa



When disaggregated by gender (Figure 5) and SES (Figure 6), there are significant differences in many cases. Gender differences in Grade 6 completion significantly favor boys in five countries: Benin, Chad, Congo, Côte d'Ivoire, and Togo. These differences are around 10 percentage points with the exception of Chad (14 p.p). There are no gender differences in access in Burkina Faso, Niger, and Senegal. The high SES group (richest 20% of the population) consistently have significantly and substantially higher access to education as compared to the rest of the population in each country. While 9 in 10 of the wealthiest children complete Grade 6 in Congo, only 4 in 10 of the poorest children do so. While 7 in 10 of the wealthiest children complete Grade 6 in Burkina Faso and Niger, amongst the poorest this is only 2 in 10. The middle 40% of the SES distribution looks more like the wealthiest in Benin and Togo, but in the other six countries the middle SES group looks more like the poorest children – although differences between the middle and poorest SES groups are also significant in all cases besides for Chad.

Figure 5. Grade 6 completion rates in Francophone sub-Saharan Africa, by gender

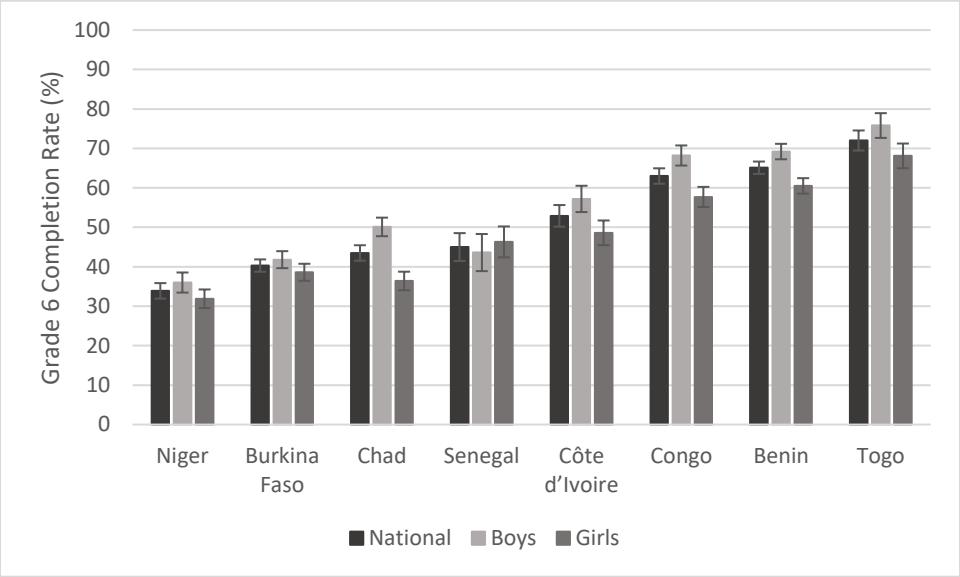
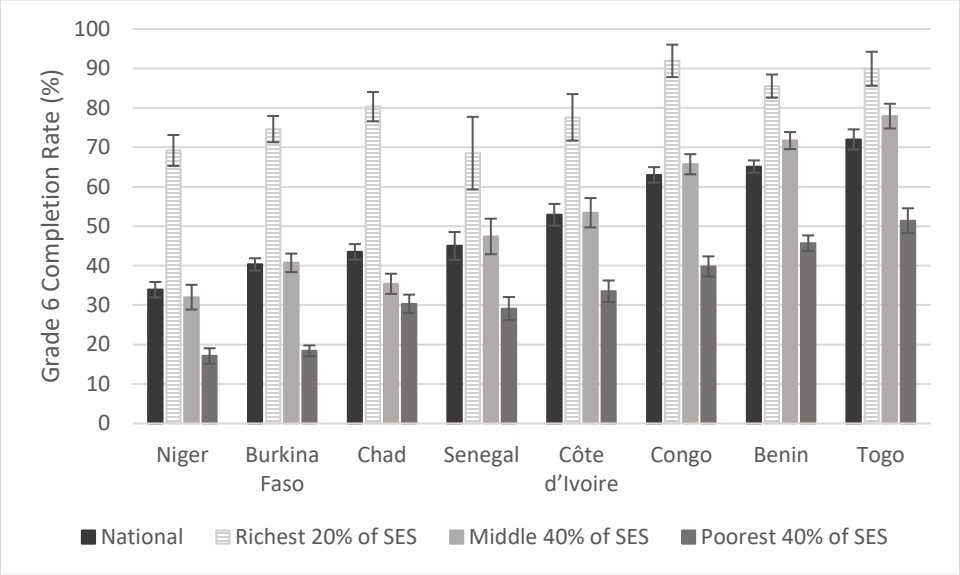


Figure 6. Grade 6 completion rates in Francophone sub-Saharan Africa, by SES

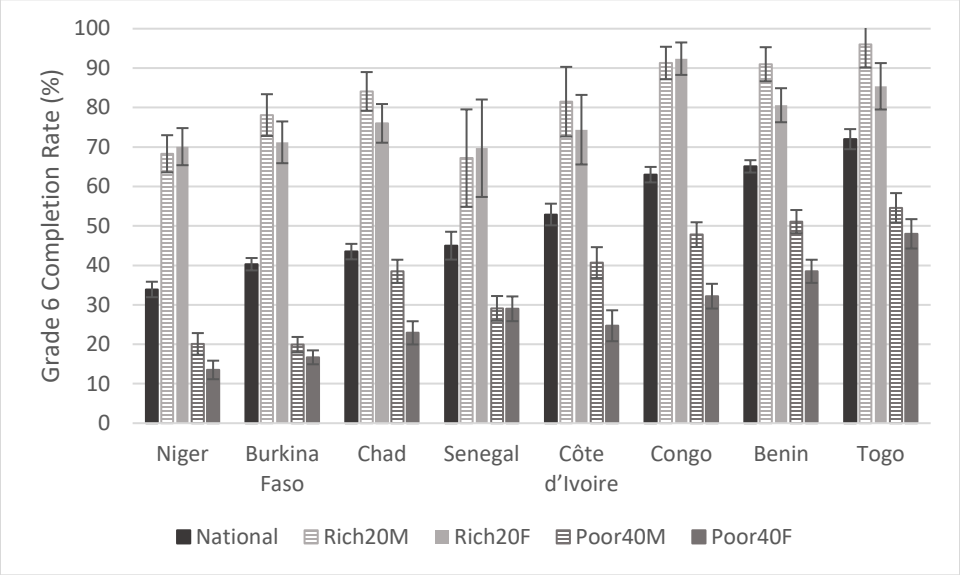


Clearly, and as pointed out by Spaull and Taylor (2015), there is likely to be a 'double disadvantage' effect at play when considering gender and SES. Since girls are more disadvantaged than boys in general, and lower SES groups are more disadvantaged than higher SES groups, the poorest females are likely to have the lowest access rates. This will be looked at in detail in Section 8.4. Here, access rates by both gender and SES are displayed in Figure 7 below. The middle SES category is not included for the sake of clarity.

Significant differences in access to schooling among the poorest girls and boys follow the same pattern as seen previously: Only Burkina Faso, Niger, and Senegal do not display significant access differentials. However, when it comes to the rich, boys and girls have statistically equal access rates in seven of the

eight countries (the exception being Benin). Thus it is gender inequality within the lowest SES group that is the cause of the gender inequality seen more generally.

Figure 7. Grade 6 completion rates in Francophone sub-Saharan Africa, by gender and SES



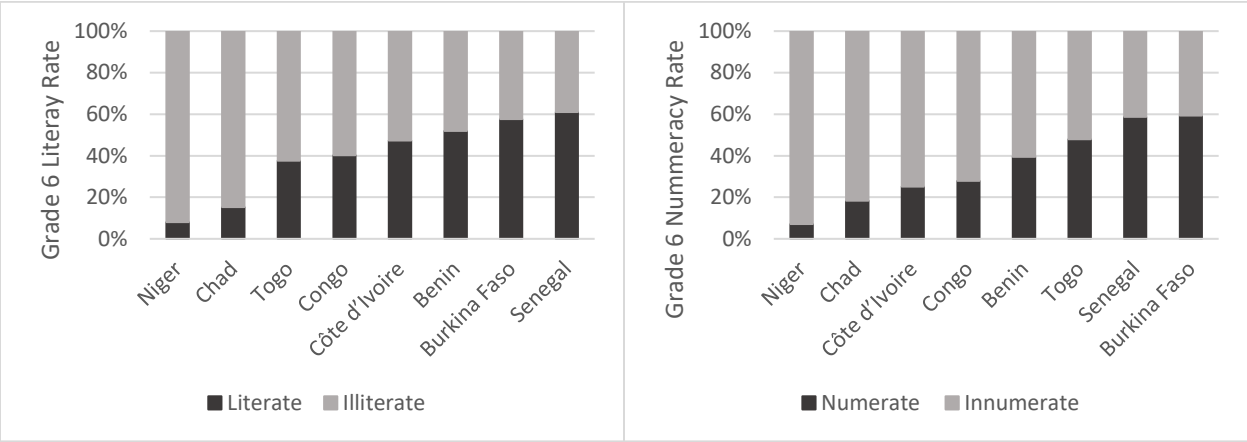
Clearly, access to schooling is still a barrier for many in sub-Saharan Africa. Nations will need to continue the drive to increase access rates, rather than switching to focus completely on learning outcomes, if universal quality education is to be achieved by 2030 according to the SDGs.

8.3. Learning outcomes in Francophone sub-Saharan Africa

The following is a characterization of the learning that takes place within schools. As discussed in the opening sections of this paper, this is not an accurate reflection of the learning levels of the populations within each country. One can think of these learning rates as indicative of the performance of schools, rather than of the education system as a whole. Tables displaying Grade 6 in-school literacy and numeracy rates nationally, by gender, and by SES are available in Appendix B.

Figure 8 displays literacy rates (on the left) and numeracy rates (on the right) for Grade 6 learners. Schools are not functioning optimally in any of the eight countries, but clearly schools in Chad and Niger are the most dysfunctional of the group. Only 8% and 15% of learners who reach Grade 6 level do so with basic French competency in Niger and Chad respectively. Even in the best case – Senegal – only 3 in 5 learners are competent in French at a basic level. A similar story can be seen for numeracy: only 7% and 18% of learners who reach Grade 6 develop basic numeracy skills in Niger and Chad respectively. In Burkina Faso – the highest in the region – the rate is 60%, or 3 in 5.

Figure 8. Literacy and numeracy rates of the in-school population in Francophone sub-Saharan Africa



There are no significant differences between boys and girls on tests of either literacy or numeracy either on average or within any of the three SES categories. This is encouraging, especially since Lilenstein (2018) did find some gender differentials. There are, however, often vast socioeconomic differentials once again, as seen in Figure 9 and Figure *10* below.

Figure 9. Literacy rates of the in-school population in Francophone sub-Saharan Africa, by SES

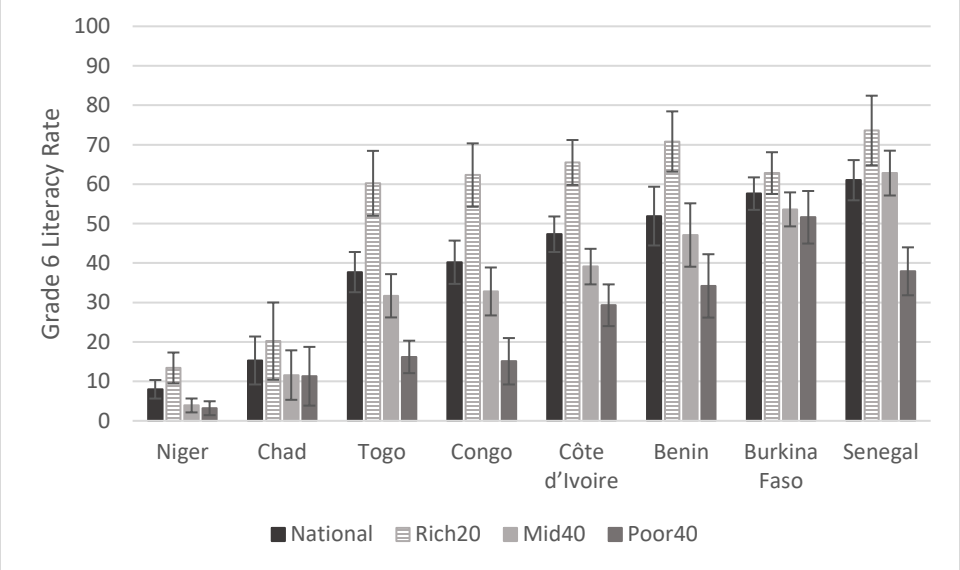
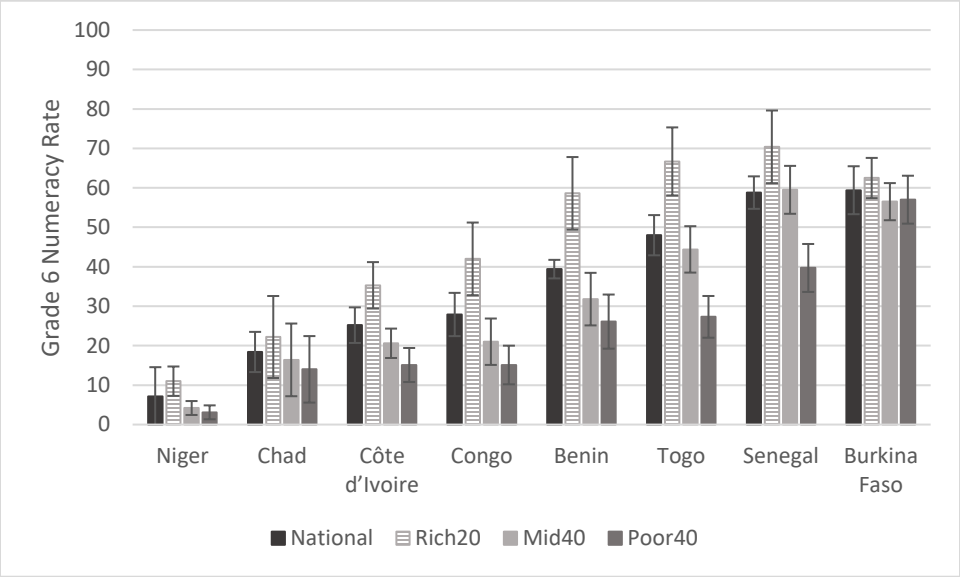


Figure 10. Numeracy rates of the in-school population in Francophone sub-Saharan Africa, by SES



Burkina Faso and Chad stand out as having no significant differences in literacy or numeracy rates between any of the SES categories. However, in the case of Chad, this is because literacy and numeracy are so low that given the confidence intervals rates may be as low as 10% or less. Burkina Faso is therefore the only one of the eight countries that displays both substantial learning rates and socioeconomic equity. Burkina Faso's poorest learners have statistically equal literacy and numeracy rates to the richest learners in Congo and Togo (and far above the richest learners in Chad and Niger). The largest SES differential is seen in Congo, where the wealthiest learners are more than four times as likely to be literate after six years of schooling as the poorest.

The quality of education that takes place within schools – at least so far as literacy and numeracy are concerned – is clearly far off the SDG target for 2030. Contrary to popular belief, however, a focus on gender within schools is perhaps not warranted. This is aside from issues such as sanitation, bullying, sexual assault, etc. which may affect boys and girls differently. The quality of schools must be improved generally, across gender and SES groups, but a focus must be on low SES schools in particular.

8.4. Access to learning in Francophone sub-Saharan Africa

At the start of the results section SDG target indicators were given in terms of access to learning rates. A deeper look into access to learning is presented here, by displaying access and learning in the same figures and including the gender and SES interactions seen above. Tables displaying Grade 6 access to literacy and access to numeracy rates nationally, by gender, and by SES are available in Appendix C.

Reaching the SDGs by 2030 is all about eliminating poverty, ending inequality, and living sustainably on earth. However, countries in general have ambitions for education beyond that. Education is often seen as a means toward productivity and GDP growth, which can serve not only to end poverty but to promote higher levels of prosperity. In previous times, discussions around growth focused on manufacturing as a path out of poverty and toward prosperity. This follows the paths of many East Asian countries and has been regarded as the obvious and necessary path for developing countries to follow, at least in popular

opinion[13]. However, the narrative around growth in sub-Saharan Africa has shifted. We no longer believe it possible for most countries in the region to follow a manufacturing-led growth path, given competition from East Asia and the high cost of labour on the continent (Grabowski, 2015; Bhorat et al., 2020). South Africa in particular appears to be following a high-skill services-led growth path, essentially *deindustrialization* (Bhorat et al., 2018; Bhorat et al., 2020), and it has been questioned whether the same might materialize elsewhere in Africa (Grabowski, 2015; Bhorat et al., 2020). For this to happen, however, the workforce of service-led economies need to have higher levels of literacy and numeracy than the basic proficiency we have been looking at thus far. Furthermore, even if the goal were more modest, even eliminating poverty requires adequate employment, which from the above appears to require more than just basic levels of education. Hence, in the following the proportion of those who scored at an advanced level of literacy and numeracy are also included. Tables displaying Grade 6 access to advanced literacy and access to advanced numeracy rates nationally, by gender, and by SES are available in Appendix D.

Figure 11 below provides national access and access to learning rates for each country. Putting access and literacy rates together has allowed a full picture of learning in the country to emerge. Confirming what has been seen in previous literature (Lilenstein, 2018; Michaelowa, 2001; OECD, 2018), access to learning is low in Francophone sub-Saharan Africa. In the best case, one third of children in Benin develop basic literacy skills. Less than 30% of children in Burkina Faso, Congo, Côte d'Ivoire, Senegal, and Togo do so. Less than 1 in 10 develop basic literacy skills in Chad and only 3% develop basic literacy skills in Niger. Echoing Lilenstein (2018), if education, and literacy specifically is as important for economic and individual development as has been purported, then these results point to an education crisis in Francophone sub-Saharan Africa.

Of those who develop literacy, roughly half also develop advanced literacy in Benin, Congo, Côte d'Ivoire, Senegal, and Togo. This is a higher ratio than seen for South Africa in SACMEQ, where approximately one third of those acquiring literacy also acquire advanced literacy (Spaull & Taylor, 2015). However, one must bear in mind that the two datasets (SACMEQ and PASEC) are not directly comparable. Still, this does suggest that in these five countries there may exist a relatively well-developed education system within the larger education system which could be utilized, expanded, and learned from to advance poorer performing schools.

[13] A glance at the first page of Google results after typing in 'East Asian Tigers' will bring up a horde of articles on how various countries can follow in their footsteps

Figure 11. Access to basic and advanced literacy in Francophone sub-Saharan Africa

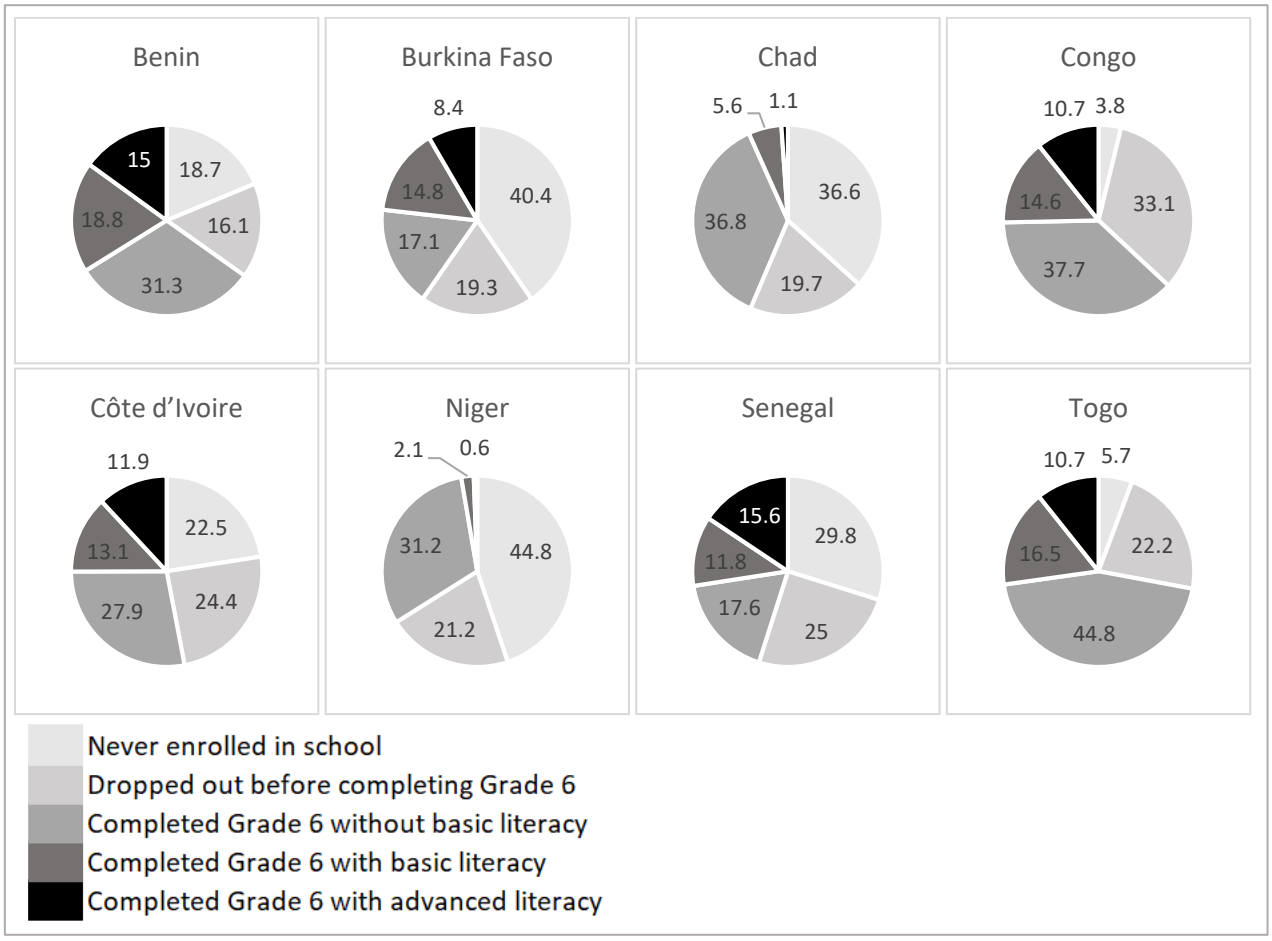
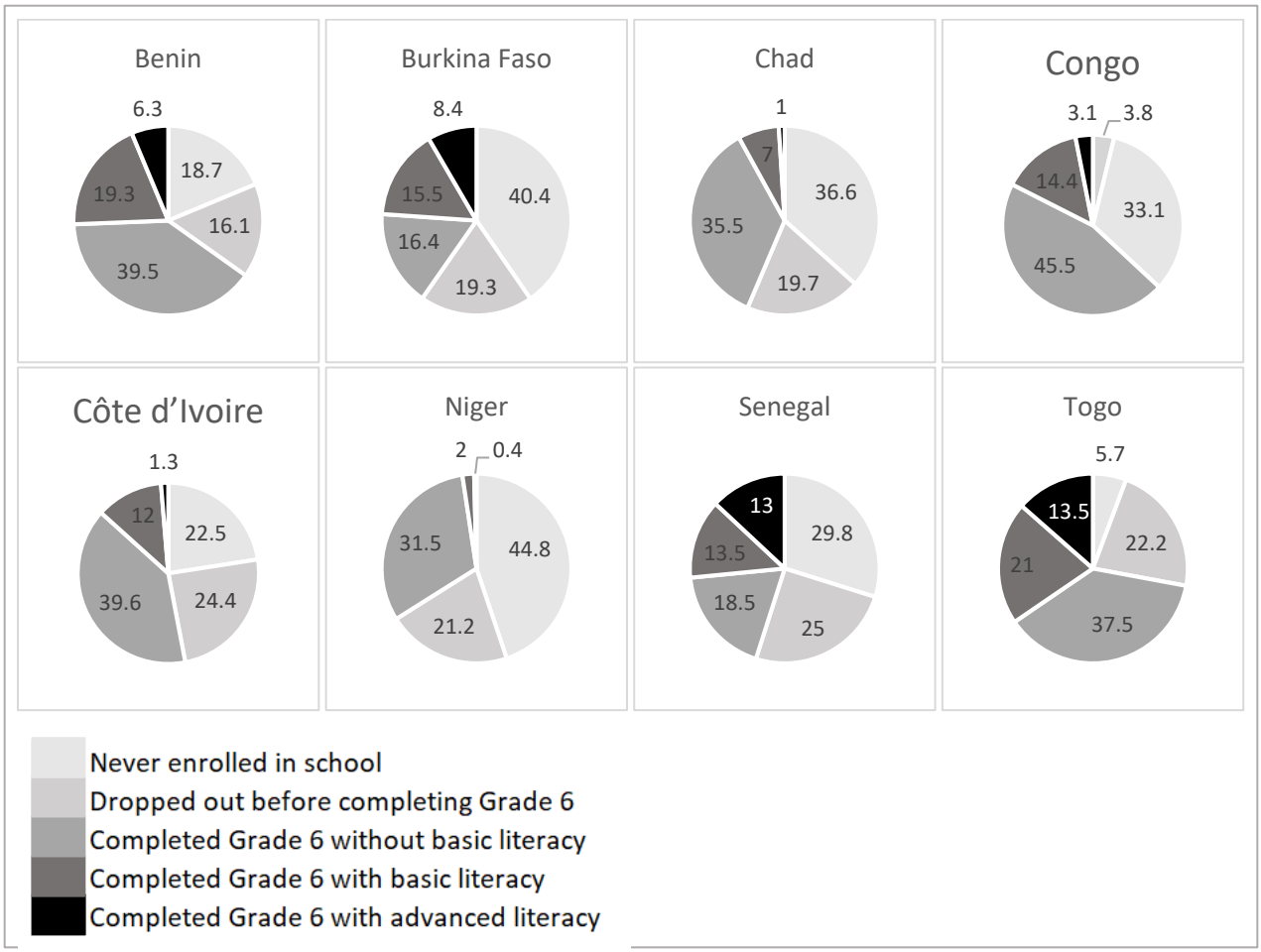


Figure 12 below provides national access and access to numeracy rates for each country. As seen before, the numeracy rates are generally even lower than the literacy rates. In the best case, one third of children in Togo develop basic numeracy skills. That number is 1 in 4 for Benin, Burkina Faso, and Senegal, and roughly 1 in 6 in Congo and Côte d'Ivoire. In Chad, Less than 1 in 10 develop basic numeracy skills and in Niger that's only 1 in 40.

Unlike in literacy, even among those who develop basic numeracy, the rates of advanced numeracy are very low. Less than 1 in 10 children acquire advanced numeracy skills in most cases. The exceptions are Senegal and Togo with 13% and 13.5% advanced numeracy respectively.

Figure 12. Access to basic and advanced Numeracy in Francophone sub-Saharan Africa



In the next table, gender and SES differentials in access to basic literacy and numeracy in each of the countries are displayed. Standard errors are large given the need to combine the standard errors for a second time when creating these estimates (see discussion in Section 7 – Methodology). As already seen, the gender differentials are relatively low while the SES differentials are very high. In addition, this table provides the double disadvantage effect estimates that Spaull and Taylor (2015) and Lilenstein (2018) find evidence of. This refers to the disadvantage experienced by a person who exists at an intersection of two distinct sources of disadvantage. In the case of education, girls who are poor are jointly part of two groups which are both at risk of being socially excluded and thus face a compounded, or double, disadvantage.

Although access to learning rates are too low in Chad and Niger to pick up large SES differentials, in the remaining 6 countries the SES differentials between the richest 20% and the poorest 40% are large and highly significant. Unlike Spaull and Taylor (2015) and Lilenstein (2018), this sample does not show any gender-biases in neither access nor learning rates. It is therefore unsurprising that there are no substantial nor significant gender differentials in access to literacy or numeracy rates. There are also no substantial nor significant double disadvantage effects in this sample. This is encouraging, and reiterates the importance of SES as a sphere within which to focus efforts toward equality.

Table 10. Gender and SES differentials in access to literacy and numeracy

Country	Male - Female	*SE*	Rich - Poor	*SE*	Poor Male - Female	*SE*	
Benin	5.7	*5.8*	44.9***	*6.0*	3.1	*6.6*	*Literacy*
Burkina Faso	2.9	*3.5*	37.3***	*4.7*	1.2	*6.2*	
Chad	3.3	*5.2*	12.8	*6.6*	1.6	*6.7*	
Congo	1.8	*5.0*	51.2***	*5.7*	1.0	*5.2*	
Côte d'Ivoire	3.2	*4.3*	41.0***	*5.2*	6.3	*6.0*	
Niger	0.7	*2.6*	8.8*	*3.1*	0.6	*2.6*	
Senegal	-3.9	*5.2*	39.4***	*7.3*	-1.8	*5.9*	
Togo	6.0	*4.5*	45.7***	*5.5*	0.6	*5.9*	
Country	**Male - Female**	***SE***	**Rich – Poor**	***SE***	**Poor Male - Female**	***SE***	
Benin	3.5	*5.9*	38.3***	*6.1*	1.8	*6.9*	*Numeracy*
Burkina Faso	4.9	*3.5*	36.1***	*4.5*	3.1	*5.9*	
Chad	5.9	*5.6*	13.5	*7.3*	3.4	*7.0*	
Congo	4.8	*4.9*	32.6***	*5.8*	4.1	*4.9*	
Côte d'Ivoire	5.4	*3.8*	22.4***	*4.9*	4.6	*4.7*	
Niger	1.5	*2.6*	7.1*	*3.0*	0.7	*2.4*	
Senegal	0.1	*5.4*	36.6***	*7.5*	-0.7	*5.7*	
Togo	5.1	*4.5*	46.0***	*5.8*	4.0	*5.2*	

Note: SE is the standard error. Values shown are percentage point differences.
*p<0.05; **p<0.01; ***p<0.001.

8.5. Quantifying mismeasurement

This section compares the learning rates of the in-school population to the access to learning rates of the country populations as a whole to get at the magnitude of the measurement error that can be present in assessment data. Given the very low rates of access for these eight sub-Sahara African countries, the measurement error is particularly large in this case. Table 11 illustrates this. The unadjusted statistic (i.e. the learning within schools) is more than double the adjusted estimate in many cases. The unadjusted estimates are closer to the adjusted estimates for the richest 20% of the population and get more inflated

for the poorer, and more out-of-school, population. Overall, the unadjusted estimates are vastly inflated compared to the adjusted estimates, highlighting the importance of sample selection in this work.

Table 11. Access to learning and in-school learning

	Access to Learning							Learning only among those in schools					
Country	Nat	Boys	Girls	Poor 40%	Mid 40%	Rich 20%		Nat	Boys	Girls	Poor 40%	Mid 40%	Rich 20%
Benin	33.8	36.6	30.9	15.6	33.8	60.5	*Literacy*	51.9	52.8	51.1	34.2	47.1	70.8
Burkina Faso	23.2	24.6	21.7	9.5	21.8	46.8		57.6	59	56.3	51.6	53.6	62.8
Chad	6.7	8.2	4.9	3.4	4.1	16.2		15.3	16.4	13.4	11.3	11.6	20.2
Congo	25.3	26.1	24.3	6	21.6	57.2		40.2	38.2	42.2	15.1	32.8	62.3
Côte d'Ivoire	25	26.6	23.4	9.8	20.9	50.8		47.3	46.6	48.2	29.3	39.1	65.5
Niger	2.7	3.1	2.4	0.5	1.3	9.3		8	8.5	7.4	3.2	3.9	13.4
Senegal	27.4	27	27.9	11	29.8	50.4		61	61.8	60.2	37.9	62.8	73.6
Togo	27.2	27.7	26.6	8.4	24.7	54.1		37.7	36.6	39.1	16.2	31.7	60.2
Country	Nat	Boys	Girls	Poor 40%	Mid 40%	Rich 20%		Nat	Boys	Girls	Poor 40%	Mid 40%	Rich 20%
Benin	25.6	27.3	23.8	11.9	22.8	50.2	*Numeracy*	39.4	39.4	39.4	26.1	31.8	58.6
Burkina Faso	23.9	26.4	21.5	10.5	23	46.6		59.4	63.2	55.6	57	56.5	62.5
Chad	8	10.6	4.7	4.3	5.8	17.8		18.4	21.2	13	14	16.4	22.2
Congo	17.5	20	15.2	6	13.8	38.6		27.9	29.3	26.4	15.1	21	42
Côte d'Ivoire	13.3	16	10.6	5	11	27.4		25.2	28	21.7	15.1	20.6	35.3
Niger	2.4	3.1	1.6	0.5	1.3	7.6		7.1	8.6	5	3.1	4.2	11
Senegal	26.5	26.5	26.4	11.6	28.2	48.2		58.8	60.8	57.1	39.7	59.5	70.4
Togo	34.5	37.1	32	14	34.6	60		48	48.9	46.9	27.3	44.4	66.7

9. Discussion and Conclusion

After controlling for sample selection, this paper found that access to literacy and access to numeracy are very low in Francophone sub-Saharan Africa. This is in line with what was found in previous research by Michaelowa (2001), Lilenstein (2018), and the OECD (2018) – although these results are still far higher than those found by the OECD for Senegal using PISA-D data. Echoing Lilenstein (2018), there is an education crisis in Francophone sub-Saharan Africa.

Contrary to previous research (Lilenstein, 2018), no gender differentials were found in either access, learning, or access to learning in any of the countries under study. On the other hand, this research is consistent with that by Spaull and Taylor (2015) and Lilenstein (2018) in the estimation of substantial and highly significant SES differentials in access, learning, and access to learning rates. Socioeconomic inequality poses the biggest challenge to developed countries today, and in the combination of this research with that of Spaull and Taylor (2015), the same pattern is found to be reflected in developing countries across Africa.

There is some evidence of functional literacy education taking place in Benin, Congo, Côte d'Ivoire, Senegal, and Togo, with roughly half of all those who develop basic literacy skills also developing advanced literacy skills. However, the same is only seen for numeracy in Senegal and Togo.

When it comes to development goals, an estimate is only as good as its measurement. The measurement of new goals, such as learning, needs to be carefully thought-through so that accurate estimates can be made. This research paper has tackled one source of measurement error that exists in most learning estimates for developing countries: sample selection bias. Sample selection bias is particularly large in this case because of the low rates of Grade 6 completion in these Francophone sub-Saharan African countries. This paper has built on work previously done by Spaull and Taylor (2015) but applied a new methodology for estimating late grade completion, which allows corrections for sample selection to be made immediately rather than in retrospect.

Despite sample selection issues featuring prominently in most psychology 101 courses, the misunderstanding inherent in assessment data due to in-school sampling is widespread, although decreasing with the work of Dr. Nicholas Spaull and colleagues over the last five years. UNESCO (2018:288) recently published a set of statistics that outlines progress made toward SDG Target 4.1. The statistics include both learning rates (from PASEC data) and completion rates, which suggests that the message that they must be looked at together is being heard. However, the learning and completion rates are published separately and they are unadjusted for late completion (which can be up to 50% of all completion). The completion rates are therefore severely biased downwards and the learning rates are severely biased upwards. As an example, UNESCO (2018: 289) suggests that learning rates in sub-Saharan Africa are around 90%. Neither this work, nor that of Spaull and Taylor (2015) on Anglophone sub-Saharan Africa comes near this.

More time and care should be taken to ensure that published statistics reflect realities. With this methodology, and the widespread availability of DHS data, there is no reason why assessment data should continue to be published without corrections for sample selection. If we are to take development goals seriously then we need to measure progress toward them accurately. There exists a host of assessment data that still requires adjustment for sample selection. Further research needs to look at completion rates during data collection in the many rounds of ERCE, TIMSS, PIRLS, and PISA and adjust for sample selection wherever relevant.

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Appendix A. Full DHS Grade 6 Completion Results

Table 12. Demographic and Health Survey Grade 6 Completion Rate, with Standard Errors (%)

Country	National	SE	Males	SE	Females	SE	Poor40	SE	Mid40	SE	Rich20	SE
Benin	65.1	0.8	69.2	1	60.5	1	45.7	1	71.7	1.1	85.5	1.5
Burkina Faso	40.3	0.8	41.8	1.1	38.6	1.1	18.4	0.7	40.7	1.2	74.6	1.7
Chad	43.5	1	50.1	1.2	36.4	1.2	30.3	1.2	35.4	1.3	80.3	1.9
Congo	63	1	68.2	1.3	57.7	1.3	39.8	1.3	65.7	1.3	91.9	2.1
Côte d'Ivoire	52.9	1.4	57.2	1.7	48.6	1.6	33.5	1.4	53.4	1.9	77.6	3
Niger	33.9	1	36	1.3	31.9	1.2	17.1	1	32	1.6	69.2	2
Senegal	45	1.8	43.6	2.4	46.3	2	29.1	1.5	47.4	2.3	68.5	4.7
Togo	72	1.3	75.8	1.6	68.1	1.6	51.4	1.6	77.9	1.6	89.9	2.2
	Poor40M	SE	Poor40F	SE	Mid40M	SE	Mid40F	SE	Rich20M	SE	Rich20F	SE
Benin	51.1	1.5	38.5	1.2	76.4	1.5	66.5	1.5	91	2.2	80.6	2
Burkina Faso	19.9	1	16.7	0.9	43.6	1.6	37.3	1.5	78.1	2.7	71.2	2.3
Chad	38.5	1.5	22.9	1.6	41.3	1.7	28.3	1.6	84.1	2.5	76	2.8
Congo	47.8	1.6	32.2	1.4	72.5	2.1	57.5	1.7	91.3	2.1	92.4	3.1
Côte d'Ivoire	40.7	2	24.7	1.5	59.6	2.3	47.1	2.3	81.5	4.5	74.4	3.4
Niger	20.1	1.4	13.5	1.2	35.7	2.2	28.1	1.9	68.3	2.4	70.1	2.6
Senegal	29.1	1.6	29	1.8	47.1	3.7	47.6	2.8	67.2	6.3	69.7	5.2
Togo	54.6	1.9	48	2	82.9	2	72.2	2.4	96	3	85.4	2.9

Note: Poor40 refers to the poorest 40% of individuals in the country, Mid40 the middle 40%, and Rich20 the richest 20%. 'SE' is the standard error. An 'M' or 'F' after the wealth bracket refers to 'Males' or 'Females', respectively. Values shown are percentages.

Table 13. Demographic and Health Survey Grade 6 Non-enrolment Rate, with Standard Errors (%)

Country	National	SE	Males	SE	Females	SE	Poor40	SE	Mid40	SE	Rich20	SE
Benin	18.7	0.7	16.3	0.8	21.4	0.9	31.9	1.4	12	0.8	5.9	0.7
Burkina Faso	40.4	1.1	38.6	1.3	42.3	1.3	57.9	1.5	36.6	1.4	12.7	1.2
Chad	36.6	1.3	31.6	1.4	42	1.6	42.1	1.8	43.8	2.1	10.9	1.2
Congo	3.8	0.3	3	0.3	4.6	0.5	5.9	0.6	3.1	0.5	1	0.4
Côte d'Ivoire	22.5	1.2	18.9	1.3	26.3	1.6	25.4	2	24.8	1.7	12.3	1.6
Niger	44.8	1.3	40.4	1.5	49.3	1.5	60	1.7	43.8	1.7	14.6	1.6
Senegal	29.8	2.3	31.2	2.6	28.4	2.6	42.3	3.3	27.6	2.8	8.8	2.3
Togo	5.7	0.6	3.4	0.5	8	1	9.9	1.2	3.2	0.5	1.9	0.6
	Poor40M	SE	Poor40F	SE	Mid40M	SE	Mid40F	SE	Rich20M	SE	Rich20F	SE
Benin	28.5	1.5	35.8	1.7	10.1	1	14.1	1	2.7	0.8	9	1.1
Burkina Faso	55.6	1.8	60.5	1.9	35.2	1.7	38.2	1.7	9.6	1.4	15.6	1.7
Chad	35.9	2	48.3	2.3	39	2.2	49.6	2.6	8	1.3	14.1	1.9
Congo	4	0.6	7.9	0.9	2.8	0.5	3.4	0.7	1.1	0.6	0.8	0.3
Côte d'Ivoire	22.1	2.2	29	2.6	20.3	2	29.5	2.3	8.7	2	15.4	2.3
Niger	54.2	2.2	66.2	2	38.5	2.4	49.1	2.2	14.7	2.2	14.4	2
Senegal	42.8	3.2	41.8	4.3	29	4	26.3	3.4	8.5	2.8	9.2	2.9
Togo	5.9	0.9	14.3	1.8	2.1	0.6	4.5	0.9	0.3	0.3	3.2	1

Note: Poor40 refers to the poorest 40% of individuals in the country, Mid40 the middle 40%, and Rich20 the richest 20%. 'SE' is the standard error. An 'M' or 'F' after the wealth bracket refers to 'Males' or 'Females', respectively. Values shown are percentages.

Table 14. Demographic and Health Survey Grade 6 Dropout Rate, with Standard Errors (%)

Country	National	SE	Males	SE	Females	SE	Poor40	SE	Mid40	SE	Rich20	SE
Benin	16.1	0.4	14.4	0.5	18	0.6	22.4	0.7	16.2	0.6	8.5	0.7
Burkina Faso	19.3	0.5	19.6	0.6	19	0.7	23.6	0.7	22.5	0.7	12.7	0.9
Chad	19.7	0.6	18	0.8	21.4	0.8	27.5	1	20.4	0.9	8.6	0.9
Congo	33.1	0.8	28.8	0.9	37.6	1	54.1	1.3	31.1	1.1	7.1	0.7
Côte d'Ivoire	24.4	0.8	23.7	0.9	24.9	1.2	41	1.4	21.7	1.3	9.9	1
Niger	21.2	0.7	23.5	0.9	18.7	0.9	22.8	1.1	24.1	1.2	16.2	1.1
Senegal	25	0.8	24.9	1	25	1.3	28.4	1.1	24.7	1.2	22.1	2.5
Togo	22.2	0.8	20.7	1	23.7	1	38.5	1.4	18.8	1	8.1	1
	Poor40M	SE	Poor40F	SE	Mid40M	SE	Mid40F	SE	Rich20M	SE	Rich20F	SE
Benin	20.3	0.9	25.7	1	13.4	0.7	19.3	0.9	6.3	0.9	10.4	1.1
Burkina Faso	24.4	1	22.7	1	21.1	1	24.3	1	12.1	1.2	13.2	1.3
Chad	25.6	1.1	28.6	1.4	19.1	1.3	21.9	1.3	7.7	1.2	9.6	1
Congo	48.1	1.5	59.7	1.8	24.6	1.3	39	1.3	7.5	1.1	6.7	1
Côte d'Ivoire	37.2	1.4	46	2.4	20	1.5	23.3	1.7	9.7	1.6	9.9	1.4
Niger	25.6	1.5	20.2	1.3	25.6	1.4	22.7	1.5	16.9	1.5	15.4	1.4
Senegal	27.9	1.4	29	1.5	23.4	2.1	25.9	2	24.4	3.3	20.2	3
Togo	39.3	1.8	37.7	1.7	14.9	1.2	23.1	1.5	3.7	1.1	11.3	1.4

Note: Poor40 refers to the poorest 40% of individuals in the country, Mid40 the middle 40%, and Rich20 the richest 20%. 'SE' is the standard error. An 'M' or 'F' after the wealth bracket refers to 'Males' or 'Females', respectively. Values shown are percentages.

Appendix B. Full PASEC Grade 6 In-School Literacy and Numeracy Rates

Table 15. PASEC Grade 6 Literacy, with Standard Errors (%) - Uncorrected for Those Who Do Not Complete Grade 6

Country	National	SE	Males	SE	Females	SE	Poor40	SE	Mid40	SE	Rich20	SE
Benin	51.9	3.8	52.8	3.8	51.1	4.1	34.2	4.1	47.1	4.1	70.8	3.9
Burkina Faso	57.6	2.1	59	2.2	56.3	2.3	51.6	3.4	53.6	2.2	62.8	2.7
Chad	15.3	3.1	16.4	3.5	13.4	3.4	11.3	3.8	11.6	3.2	20.2	5
Congo	40.2	2.8	38.2	3	42.2	3.6	15.1	3	32.8	3.1	62.3	4.1
Côte d'Ivoire	47.3	2.3	46.6	2.4	48.2	2.7	29.3	2.7	39.1	2.3	65.5	2.9
Niger	8	1.2	8.5	1.4	7.4	1.2	3.2	0.9	3.9	0.9	13.4	2
Senegal	61	2.6	61.8	3.1	60.2	2.8	37.9	3.1	62.8	2.9	73.6	4.5
Togo	37.7	2.6	36.6	2.5	39.1	3	16.2	2.1	31.7	2.8	60.2	4.2
	Poor40M	SE	Poor40F	SE	Mid40M	SE	Mid40F	SE	Rich20M	SE	Rich20F	SE
Benin	31.5	5.1	33.6	3.8	48.9	4	46.7	5.6	74.6	4.3	66.8	3.8
Burkina Faso	50.3	3.7	52.7	4.8	58.6	2.6	49.1	2.6	62.1	3.1	62.9	3
Chad	11.7	4.3	12.4	4.7	16	4	5.1	2	19.5	6.3	18.5	5.4
Congo	13.1	3.6	16.5	3	32.1	3.6	34.8	4.2	63.3	4.1	60.2	5
Côte d'Ivoire	31.8	3.2	26.6	4.3	39	2.7	38.6	3	64.6	3.3	65.7	3.6
Niger	4.1	1.2	1.8	1.2	5.3	1.3	2.7	0.8	13.7	2.4	12.2	2.2
Senegal	35.1	3.2	41.4	4.3	64.5	3.2	60.4	3.6	76.3	5.1	71.6	4.7
Togo	15.1	2.7	16	3.1	31.7	2.6	32.8	3.6	57.5	4.8	62.4	5

Note: Poor40 refers to the poorest 40% of individuals in the country, Mid40 the middle 40%, and Rich20 the richest 20%. 'SE' is the standard error. An 'M' or 'F' after the wealth bracket refers to 'Males' or 'Females', respectively. Values shown are percentages.

Table 16. PASEC Grade 6 Numeracy, with Standard Errors (%) - Uncorrected for Those Who Do Not Complete Grade 6

Country	National	SE	Males	SE	Females	SE	Poor40	SE	Mid40	SE	Rich20	SE
Benin	39.4	3.7	39.4	4.5	39.4	3.3	26.1	3.5	31.8	3.4	58.6	4.7
Burkina Faso	59.4	2	63.2	2.3	55.6	2.2	57	3.1	56.5	2.4	62.5	2.6
Chad	18.4	3.7	21.2	4	13	3.5	14	4.3	16.4	4.7	22.2	5.3
Congo	27.9	2.9	29.3	2.9	26.4	3.4	15.1	2.5	21	3	42	4.7
Côte d'Ivoire	25.2	1.9	28	2.1	21.7	2.2	15.1	2.2	20.6	1.9	35.3	3
Niger	7.1	1.1	8.6	1.4	5	1.1	3.1	0.9	4.2	0.9	11	1.9
Senegal	58.8	2.8	60.8	3.2	57.1	2.9	39.7	3.1	59.5	3.1	70.4	4.7
Togo	48	2.5	48.9	2.5	46.9	3	27.3	2.7	44.4	3	66.7	4.4
	Poor40M	SE	Poor40F	SE	Mid40M	SE	Mid40F	SE	Rich20M	SE	Rich20F	SE
Benin	23.3	5.4	26.2	3.8	31	4.1	33.8	3.8	62.6	5.6	54.3	4.7
Burkina Faso	60.5	4	53.2	4.1	63.7	2.9	50.2	2.7	63.8	3	60.6	2.9
Chad	16	4.7	11.6	4.7	21.2	5.6	8.4	3.4	24.5	6	16.2	5.6
Congo	16.7	3.5	12	2.6	22.9	3.2	19.5	3.7	45.8	4.9	38.6	5.1
Côte d'Ivoire	17.9	2.7	10.7	2.9	23	2.4	18	2.2	40.3	3.5	29.5	3.4
Niger	4.3	1.3	1.2	0.9	6.9	1.5	1.7	0.6	12.4	2.3	8.4	2.1
Senegal	38.6	3.5	40.9	3.8	61.7	3	56.5	3.6	74.3	5.6	67.9	4.7
Togo	28.2	3.2	23.8	2.9	47.4	3	41	3.2	65	4.7	69.8	5.2

Note: Poor40 refers to the poorest 40% of individuals in the country, Mid40 the middle 40%, and Rich20 the richest 20%. 'SE' is the standard error. An 'M' or 'F' after the wealth bracket refers to 'Males' or 'Females', respectively. Values shown are percentages.

Appendix C. Full Grade 6 Access to Literacy and Numeracy Results

Table 17. PASEC Grade 6 Access to Literacy, with Standard Errors (%)

Country	National	SE	Males	SE	Females	SE	Poor40	SE	Mid40	SE	Rich20	SE
Benin	33.8	3.9	36.6	4	30.9	4.2	15.6	4.3	33.8	4.2	60.5	4.2
Burkina Faso	23.2	2.2	24.6	2.5	21.7	2.5	9.5	3.5	21.8	2.5	46.8	3.2
Chad	6.7	3.2	8.2	3.7	4.9	3.6	3.4	4	4.1	3.5	16.2	5.3
Congo	25.3	3	26.1	3.2	24.3	3.8	6	3.3	21.6	3.3	57.2	4.6
Côte d'Ivoire	25	2.7	26.6	2.9	23.4	3.2	9.8	3	20.9	3	50.8	4.2
Niger	2.7	1.5	3.1	1.9	2.4	1.8	0.5	1.4	1.3	1.8	9.3	2.8
Senegal	27.4	3.2	27	3.9	27.9	3.5	11	3.4	29.8	3.7	50.4	6.5
Togo	27.2	2.9	27.7	3	26.6	3.4	8.4	2.7	24.7	3.2	54.1	4.8
	Poor40M	SE	Poor40F	SE	Mid40M	SE	Mid40F	SE	Rich20M	SE	Rich20F	SE
Benin	16.1	5.3	13	4	37.3	4.2	31.1	5.8	67.9	4.8	53.9	4.3
Burkina Faso	10	3.8	8.8	4.9	25.6	3	18.3	3	48.5	4.2	44.8	3.7
Chad	4.5	4.5	2.9	5	6.6	4.3	1.4	2.6	16.4	6.7	14	6
Congo	6.3	4	5.3	3.3	23.3	4.2	20	4.5	57.8	4.6	55.6	5.9
Côte d'Ivoire	12.9	3.8	6.6	4.6	23.2	3.6	18.2	3.8	52.7	5.5	48.9	4.9
Niger	0.8	1.9	0.2	1.7	1.9	2.6	0.8	2.1	9.3	3.4	8.6	3.4
Senegal	10.2	3.5	12	4.7	30.3	4.9	28.8	4.6	51.2	8.1	50	7
Togo	8.3	3.3	7.7	3.7	26.3	3.3	23.7	4.3	55.2	5.7	53.3	5.8

Note: Poor40 refers to the poorest 40% of individuals in the country, Mid40 the middle 40%, and Rich20 the richest 20%. 'SE' is the standard error. An 'M' or 'F' after the wealth bracket refers to 'Males' or 'Females', respectively. Values shown are percentages.

Table 18. PASEC Grade 6 Access to Numeracy, with Standard Errors (%)

Country	National	SE	Males	SE	Females	SE	Poor40	SE	Mid40	SE	Rich20	SE
Benin	25.6	3.9	27.3	4.7	23.8	3.5	11.9	3.7	22.8	3.6	50.2	4.9
Burkina Faso	23.9	2.2	26.4	2.5	21.5	2.5	10.5	3.2	23	2.7	46.6	3.1
Chad	8	3.2	10.6	4.2	4.7	3.7	4.3	4.5	5.8	4.9	17.8	5.7
Congo	17.5	3	20	3.2	15.2	3.7	6	2.8	13.8	3.3	38.6	5.1
Côte d'Ivoire	13.3	2.7	16	2.7	10.6	2.7	5	2.6	11	2.7	27.4	4.2
Niger	2.4	1.5	3.1	1.9	1.6	1.7	0.5	1.4	1.3	1.8	7.6	2.7
Senegal	26.5	3.2	26.5	4	26.4	3.6	11.6	3.5	28.2	3.8	48.2	6.6
Togo	34.5	2.9	37.1	2.9	32	3.4	14	3.1	34.6	3.4	60	4.9
	Poor40M	SE	Poor40F	SE	Mid40M	SE	Mid40F	SE	Rich20M	SE	Rich20F	SE
Benin	11.9	5.6	10.1	4	23.7	4.4	22.5	4.1	57	6	43.8	5.1
Burkina Faso	12	4.1	8.9	4.2	27.8	3.3	18.7	3.1	49.9	4.1	43.1	3.7
Chad	6.1	5	2.7	4.9	8.8	5.8	2.4	3.7	20.6	6.5	12.3	6.2
Congo	8	3.9	3.9	2.9	16.6	3.8	11.2	4.1	41.8	5.3	35.7	6
Côte d'Ivoire	7.3	3.4	2.7	3.2	13.7	3.4	8.5	3.2	32.8	5.7	22	4.8
Niger	0.9	1.9	0.2	1.4	2.5	2.6	0.5	2	8.5	3.3	5.9	3.3
Senegal	11.2	3.8	11.9	4.2	29	4.7	26.9	4.6	49.9	8.4	47.4	7
Togo	15.4	3.8	11.4	3.6	39.3	3.6	29.6	4	62.4	5.6	59.6	6

Note: Poor40 refers to the poorest 40% of individuals in the country, Mid40 the middle 40%, and Rich20 the richest 20%. 'SE' is the standard error. An 'M' or 'F' after the wealth bracket refers to 'Males' or 'Females', respectively. Values shown are percentages.

Appendix D. Full Grade 6 Access to Advanced Literacy and Numeracy Results

Table 19. PASEC Grade 6 Access to Advanced Literacy, with Standard Errors (%)

Country	National	SE	Males	SE	Females	SE	Poor40	SE	Mid40	SE	Rich20	SE
Benin	15	2.5	18	2.8	12.3	2.7	3.8	2.2	11.7	2.4	36.1	5.3
Burkina Faso	8.4	1.8	9.3	2.2	7.6	2.1	2.1	1.9	6.4	1.9	20.9	3.1
Chad	1.1	1.4	1.4	1.6	0.7	1.6	0.2	1.2	0.5	1.6	3.6	2.9
Congo	10.7	2.5	11	2.4	10.4	3.3	1.5	1.9	6.8	2.3	29	4.6
Côte d'Ivoire	11.9	2.6	11.9	2.8	11.9	2.9	2.9	2.3	8.6	2.8	28.4	4.5
Niger	0.6	1.2	0.6	1.4	0.7	1.5	0	1	0	1.6	2.8	2.4
Senegal	15.6	3.3	15.3	4.1	15.8	3.5	3.2	2.4	17.1	3.8	33.1	6.8
Togo	10.7	2.1	10.5	2.2	10.9	2.6	1.5	1.7	6.7	2.1	27.9	4.2
	Poor40M	SE	Poor40F	SE	Mid40M	SE	Mid40F	SE	Rich20M	SE	Rich20F	SE
Benin	3.4	2.5	3.1	2.5	15.9	3.6	9.2	2.6	43.6	5.2	28.9	5.9
Burkina Faso	2.4	2.7	1.7	2.5	7.8	2.4	5.3	2.4	22.7	4.2	18.8	3.4
Chad	0.3	1.5	0	2.5	0.8	2	0.1	1.6	4	3.4	3	3.6
Congo	2.2	2.6	0.8	1.7	7	2.8	6.3	3	29.1	4.5	28.7	5.8
Côte d'Ivoire	3.1	2.8	2.7	3.2	8.2	3.1	9.1	3.7	30.5	5.9	25.8	5
Niger	0	1.4	0.1	1.2	0.1	2.2	0	3.7	2.7	2.7	2.8	3.1
Senegal	2.9	2.7	3.8	3	16.8	4.9	16.7	4.5	34.5	8.4	32.2	7.5
Togo	1.5	2.1	1.2	2.3	6.9	2.4	6.8	2.8	27.2	4.7	28.5	5

Note: Poor40 refers to the poorest 40% of individuals in the country, Mid40 the middle 40%, and Rich20 the richest 20%. 'SE' is the standard error. An 'M' or 'F' after the wealth bracket refers to 'Males' or 'Females', respectively. Values shown are percentages.

Table 20. PASEC Grade 6 Access to Advanced Numeracy, with Standard Errors (%)

Country	National	SE	Males	SE	Females	SE	Poor40	SE	Mid40	SE	Rich20	SE
Benin	6.3	2.5	6.4	2.1	6.2	2	2.3	2.1	4.1	2	15.7	4.1
Burkina Faso	8.4	1.8	10.1	2.2	6.9	2	3.1	2.2	7.6	2.2	18.1	2.9
Chad	1	1.4	1.6	1.6	0.4	1.3	0.4	1.3	0.6	1.5	4.9	3.8
Congo	3.1	2.5	3.4	1.6	2.9	1.8	1.3	1.5	8.1	2.8	11.3	3.2
Côte d'Ivoire	1.3	2.6	1.6	1.7	1	1.7	0.6	2.1	0.6	2	2	3
Niger	0.4	1.2	0.5	1.4	0.3	1.3	0	1	0.6	1.7	1.2	2.1
Senegal	13	3.3	14.5	4.3	11.6	3.4	3.3	2.2	13.5	3.9	28.6	7.1
Togo	13.5	2.1	15.1	2.5	11.8	2.7	2.7	1.8	11.4	2.4	32.2	4.7
	Poor40M	SE	Poor40F	SE	Mid40M	SE	Mid40F	SE	Rich20M	SE	Rich20F	SE
Benin	1.4	2.2	1.7	2.3	4.6	2.6	4.3	2.2	16.7	4.9	14.8	4.6
Burkina Faso	3	2.9	3	3.4	10.1	2.8	5.4	2.7	21.9	4	14.6	3.2
Chad	0.2	1.5	0	3.4	1.3	2.1	0.5	1.8	5	4.1	0	3.2
Congo	2	1.8	1.1	1.8	9.6	5.2	4.7	2.6	12	5.2	7.5	3.7
Côte d'Ivoire	1.2	3.5	0	1.8	0.6	2.5	0.6	2.6	2.5	4.5	1.6	3.4
Niger	0	1.4	0	1.8	0.8	2.3	0.4	2	1.5	2.5	0.9	2.7
Senegal	4.6	2.8	2.9	2.8	17.2	5.5	9.9	4.4	34	9.1	24	6.9
Togo	3.6	2.3	1.5	2.3	10.9	2.7	11.5	3.3	32.9	4.8	34.2	6.6

Note: Poor40 refers to the poorest 40% of individuals in the country, Mid40 the middle 40%, and Rich20 the richest 20%. 'SE' is the standard error. An 'M' or 'F' after the wealth bracket refers to 'Males' or 'Females', respectively. Values shown are percentages.