“Effective enrolment” - Creating a composite measure of educational access and educational quality to accurately describe education system performance in sub-Saharan Africa

NICHOLAS SPAULL AND STEPHEN TAYLOR

Stellenbosch Economic Working Papers: 21/12
NOVEMBER 2012

KEYWORDS: ACCESS TO EDUCATION, QUALITY OF EDUCATION, EDUCATIONAL STATISTICS, EDUCATION FOR ALL, MILLENIUM DEVELOPMENT GOALS, SACMEQ, DHS
JEL: I21, I24, I25, I28, I32

NICHOLAS SPAULL
DEPARTMENT OF ECONOMICS
UNIVERSITY OF STELLENBOSCH
PRIVATE BAG X1, 7602
MATIELAND, SOUTH AFRICA
E-MAIL: NICHOLASSPAULL@GMAIL.COM

STEPHEN TAYLOR
DEPARTMENT OF ECONOMICS
UNIVERSITY OF STELLENBOSCH
PRIVATE BAG X1, 7602
MATIELAND, SOUTH AFRICA
E-MAIL: STEPHEN@SUN.AC.ZA

UNIVERSITEIT STELLENBOSCH UNIVERSITY

BER BUREAU FOR ECONOMIC RESEARCH

A WORKING PAPER OF THE DEPARTMENT OF ECONOMICS AND THE
BUREAU FOR ECONOMIC RESEARCH AT THE UNIVERSITY OF STELLENBOSCH

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NICHOLAS SPAULL* AND STEPHEN TAYLOR

ABSTRACT

In this paper we question the existing practice of reporting enrolment statistics that ignore quality, but also quality-statistics that ignore enrolment differentials. The extant literature on education in Africa is bifurcated in that reports focus either on the quality of education *or* on access to education, but not both. This is problematic for two reasons: 1) observing access to education without regard for the quality of that education clouds the analysis, primarily because labour-market prospects and social mobility are driven by cognitive skills acquired rather than only by years of education attained, and 2) analysing the quality of education without taking cognizance of the enrolment and dropout profiles of the countries under review is likely to bias the results due to sample selection. In the paper we propose a new composite statistic - *effective enrolment* - that calculates the proportion of the age-appropriate population that has reached some basic threshold of numeracy and literacy proficiency. Put simply, it is enrolment that produces learning. To do so we combine household data on enrolment (from the Demographic and Health Surveys - DHS) with survey data on cognitive outcomes (from the Southern and Eastern African Consortium for Monitoring Educational Quality - SACMEQ III) for ten sub-Saharan African countries: Kenya, Lesotho, Malawi, Namibia, South Africa, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe. We calculate and report the effective enrolment rates for each country by gender, location and wealth quintile as well as highlighting the patterns of differential access and achievement across countries and sub-groups. As far as we are aware, these figures are the most accurate and comprehensive statistics on basic education system performance for each of the ten countries under review. Using these figures for analyses overcomes the selection bias inherent in all cross-national comparisons of educational achievement, and is far superior to simple comparisons of traditional enrolment rates. We argue that the method should be applied to all developing regions, and outline the prerequisites for doing so. The paper refocuses the discussion on education system performance in Africa by providing a composite measure of access and quality and in so doing places educational *outcomes* at the centre of the discourse.

Keywords: Access to education, quality of education, educational statistics, Education For All, Millenium Development Goals, SACMEQ, DHS
JEL codes: I21, I24, I25, I28, I32

*Corresponding author: NicholasSpaull@gmail.com

"Effective enrolment" - Creating a composite measure of educational access and educational quality to accurately describe education system performance in sub-Saharan Africa

Nicholas Spaull & Stephen Taylor

> "Defining the scope of the problem of "lack of education" must begin with the *objectives* of education – which is to equip people with the range of competencies…necessary to lead productive and fulfilling lives fully integrated into their societies and communities. Many of the international goals are framed exclusively as targets for universal enrolments or universal completion. But getting and keeping children 'in school' is merely a means to the more fundamental objectives of…. creating competencies and learning achievement" (Pritchett, 2004, p. 1).

1. Introduction and research question

The importance of human capital for the determination of personal and national incomes is now part of the received wisdom in economics. Ever since the pioneering work of Mincer (1958), Schultz (1961) and Becker (1962), education has been studied by economists in order to understand its contribution to economic growth and income distribution. Similarly, education also occupies a central role in various theories of social development, notably that of Amartya Sen for whom education is a prerequisite for expanding the capabilities and freedoms of individuals, enabling them to pursue the sort of lives they have reason to value (Sen, 1999). It is largely because of this consensus that universal access to primary education is one of the eight Millennium Development Goals.

However, a sequential analysis of the access-to-education literature, and subsequent policy dialogues, shows an important development in the thinking of educational researchers. What started out as an almost single-minded focus on access, 'Education For All', has slowly developed into a more nuanced concept of *quality* education for all (UNESCO, 2005; Lewin, 2007). It is now widely accepted that the ability of a country to educate its youth cannot be measured by access to schooling or enrolment rates alone, but rather by its ability to impart to students the knowledge and skills necessary to function as literate and numerate members of the broader society. While access is a necessary condition for this type of education, it is by no means a sufficient one.

Notwithstanding the above, the extant literature is almost entirely bifurcated on this issue: reports either focus on the quality of education *or* on access to education, but not both. This is problematic for two reasons: 1) Observing access to education without regard for the quality of that education clouds the analysis, primarily because labour-market prospects and social mobility are driven by cognitive skills acquired and not only years of education attained, as will be discussed below; 2) Analysing the quality of education without taking cognizance of the enrolment and dropout profiles of the countries under review is likely to bias the results. Countries with lower enrolments and higher dropout rates perform better on average, than otherwise similar countries that have higher enrolments and fewer dropouts (UNESCO, 2005, p. 48). This is largely due to the selection effects

We would like to thank Servaas van der Berg and Lant Pritchett for their helpful comments and suggestions on an earlier draft of this paper.

involved where the 'strongest' (i.e. wealthiest, most advantaged, and most able) students enrol and then remain in the schooling system.

In this paper we combine two different datasets (DHS[2] & SACMEQ[3] III) for ten African countries and create a single composite measure of educational quality and educational access. We show why our composite measure is superior to existing enrolment statistics, and report the combined statistic for important subgroups (by gender, location and wealth) of each country.

1.1 Excluding educational quality from studies of educational access yields a distorted picture

While it is now widely acknowledged amongst researchers that enrolment rates provide an incomplete picture of a country's education system, they are still the most widely reported educational statistic in the developing world. Enrolment rates alone do not provide any indication whatsoever that learning is actually taking place in the classroom. As we will show, many students in Africa sit through six years of formal full-time schooling yet do not acquire even the most basic numeracy and literacy skills. Such schooling is of dubious value. It does not impart foundational cognitive skills and thus it does not create the choices and freedoms that ignorance denies (Sen, 1999). More recently, the economic benefits of such "education" has also been called into question by researchers such as Hanushek and Wößmann (2008) who show that cognitive skills acquired, rather than years of education completed, are the more appropriate measure of human capital. They provide a critical overview of the current fixation on access to education, to the exclusion of quality:

> "It is both conventional and convenient in policy discussions to concentrate on such things as years of school attainment or enrolment rates at schools. These things are readily observed and measured. They appear in administrative data, and they are published on a consistent basis in virtually all countries of the world. And they are very misleading in the policy debates. Cognitive skills are related, among other things, to both quantity and quality of schooling. But schooling that does not improve cognitive skills, measured here by comparable international tests of mathematics, science, and reading, has limited impact on aggregate economic outcomes and on economic development…We provide strong evidence that ignoring differences in cognitive skills significantly distorts the picture about the relationship between education and economic outcomes" (Hanushek & Wößmann , 2008, p. 608).

Thus, additional years of education do not necessarily increase human capital or expand the capabilities of students. By contrast, the cognitive skills of the population are a far more direct, intuitive, and theoretically legitimate measure of human capital and thus life prospects. Improving these skills is likely to be associated with economic gains, as indeed Hanushek and Wößmann (2008) find. These new discoveries and the proliferation of cross-national standardised testing have led to a renewed focus on the *quality* of education, as can be seen from the hundreds of reports and journal articles related to various international assessment programs (such as PISA, PIRLS, TIMSS, SACMEQ, and PASEC). In sum, reporting statistics on educational access without reference to the quality of

[2] Demographic and Health Surveys (DHS) – various years
[3] Southern and East African Consortium for Monitoring Educational Quality (SACMEQ) – 2007.

that schooling is misleading and paints an overly optimistic picture of educational system progress in the developing world.

1.1.1 Millennium Development Goals post 2015

While it is true that the access-dominated Education For All (EFA) movement has evolved and become more quality-conscious, the Millennium Development Goals (MDGs) as they stand at the moment are phrased entirely in terms of access and progression, not quality. The second MDG states that "By 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling." It is implicitly assumed that children who progress through school learn as they go, something that may not in fact be true. Indeed, passing grades in the absence of quality-assured standardised assessments is a very poor indication of learning. As Pritchett (2004, p. 11) notes, "The completion of primary schooling or higher in itself does not guarantee that a child has mastered the needed skills and competencies. In fact, all of the available evidence suggests that in nearly all developing countries the levels of learning achievement are strikingly, abysmally low." The statistics reported in this paper highlight the prevalence of this in Africa. Our analysis will show that 39% of Zambian 14 year olds were functionally illiterate despite being enrolled and completing six years of formal full time schooling (Figure 4). Similarly large figures can be found in Malawi (31%), South Africa (25%) and Lesotho (19%).

Even in the unlikely event that we do manage to meet the MDG concerned with education by 2015 (i.e. all children complete primary school), without a reference to the quality of that primary schooling this will be a hollow achievement, at odds with the United Nations Millennium Declaration. Children may very well have completed primary school, but if they remain illiterate and innumerate we cannot say that they have been empowered to pursue a life of their own choosing.

In light of the approaching expiration of the MDG's, and the ongoing talks surrounding the form of their replacement, we would like to propose that learning outcomes be made an explicit criteria of any post-2015 educational goals. The 'effective enrolment' statistic developed in this paper may provide one such measure.

1.2 Excluding educational <u>access</u> from studies of educational <u>quality</u> biases the results

In the same way that many studies of educational access ignore the quality of that education, studies of educational quality often make implicit decisions that effectively ignore all non-enrolled students. Almost all studies that compare countries based on the results of cross-national school-based assessments do not take into account differential enrolment and dropout rates. This is primarily because the assessments themselves use the school-population as their sampling frame, excluding individuals who are not in school. By using unadjusted data from TIMSS, PIRLS or SACMEQ (for example), the researcher makes the implicit assumption that the enrolment and dropout rates of various countries are either equal or inconsequential to the analysis at hand, neither of which is likely to be true – especially in developing countries. As Lambin (1995, p. 174) explains, "The greater the dropout rate is and/or the smaller the proportion of an age group participating in the study, the better the average performance of those who are taking the test." This is largely due to the selection effects involved where the 'strongest' (i.e. wealthiest, most advantaged, and most able) students remain in the schooling system. These enrolment and dropout differentials are significantly different across developing countries, and, within countries, between sub-groups (see Filmer & Pritchett, 1999; Lewin, 2009). This points to the need to correct for those students who are not currently in school due to dropout or non-enrolment. Thus, excluding educational access from studies of educational quality biases the results, at least where non-enrolment is non-zero and endogenous.

The only exception to the 'bifurcated literature' discussion above that we are aware of is the seminal article by Hanushek & Wößmann (2008). In this article, the authors combine World Bank survey data with micro data from at least one international student achievement test. By sub-dividing the Grade 9 aged population into "never enrolled", "dropout", "finished grade 9 without basic reading skills" and "finished grade 9 with basic reading skills", the authors are able to combine measures of both access and quality and provide a more accurate depiction of the educational system in those countries. However, the only sub-Saharan African countries to feature in their paper are Ghana (using TIMSS 2003) and South Africa (using TIMSS 1999). Given that the world's lowest enrolment rates and highest dropout rates are in sub-Saharan Africa, it is unfortunate that most countries from this region did not participate in any TIMSS surveys and thus were excluded from Hanushek and Wößmann's analysis.

2. Data

In this paper, we rectify the above situation by using the latest results from the Southern and Eastern African Consortium for Monitoring Educational Quality (hereafter SACMEQ) survey. SACMEQ is a consortium of African education ministries, policy-makers and researchers who, in conjunction with UNESCO's International Institute for Educational Planning (IIEP), aims to improve the research capacity and technical skills of educational planners in Africa (Moloi & Strauss, 2005: 12). To date, it has conducted three nationally representative school surveys in participating countries, specifically SACMEQ I (1995), SACMEQ II (2000), and SACMEQ III (2007). These surveys collect extensive background information on the schooling and home environments of students, and in addition, test students and teachers in both numeracy and literacy (Ross, et al., 2005; Murimba, 2005). SACMEQ III, which was conducted in 2007, tested 61396 Grade 6 students, 8026 Grade 6 teachers, in 2779 schools in 14 countries (Hungi, et al., 2010). This dataset represents the most recent and comprehensive survey on educational quality in Sub-Saharan Africa.

For the data on educational access, we use the Demographic and Health Surveys (DHS) of each country. DHS surveys are an important source of data for public health and social science research, and are widely used in both fields. Some of the benefits of using the DHS data over other sources are explained below:

1) Self-reported enrolment rates are often more accurate than administrative records - the quality of which varies widely between countries. Unlike country-specific administrative data, the uniformity of the DHS surveys means that DHS data are in fact comparable across countries and over time.
2) They can be linked with household characteristics like socioeconomic status (Filmer & Pritchett, 1999), and not simply gender as is the case with most administrative data.
3) When calculating an enrolment or attendance rate from DHS, the numerator (number of the age-specific population that are enrolled) and the denominator (total number of the age-

specific population) are taken from the same source whereas traditional Gross Enrolment rates (GERs) and Net Enrolment Rates (NERs) use administrative data for the numerator and population estimates from a different source for the denominator, leading to potentially large biases (Stukel & Feroz-Zada, 2010).

4) It provides accurate age-specific attendance rates, which are necessary for the present analysis. Calculating age-specific enrolment rates from administrative data is problematic because the UN Population Division only publishes population figures in five-year age groups. However, given that entry and exit ages for primary school are different for different countries, it is necessary to disaggregate this five-year group into single-year-of-age estimates. To do this one has to use Sprague's fifth difference osculatory interpolation formula and then re-aggregate for each country. This introduces additional variance into the estimator and can lead to inaccurate enrolment rates, particularly in certain countries. See Stukel and Feroz-Zada (2010, p.21) for further discussion. In addition to the above, if one uses the readily available primary school Net Enrolment Rates (NER) from UNESCO's EFA reports, one makes the implicit assumption that the entry, progression and drop-out profiles across countries are either equal or inconsequential, neither of which are likely to be true. Our approach of calculating the attendance rate for the median age of grade six students allows us to remain agnostic on these issues without jeopardising the accuracy of the results.
5) Enrolment rates from UNESCO's EFA reports often do not agree with the on-the-ground reality in many African countries. The primary school NER reported in the EFA Global Monitoring Report (2011, p.344) for our ten countries, based on 2008 enrolment data, are completely at odds with the expectations of anyone doing research on education in Africa. For example, observing the primary school NERs for our ten country sample shows that the poorest countries have almost complete primary school enrolment (Zambia 95%, Uganda 97%, Tanzania 99% and Malawi 91%) while the wealthier countries have the lowest NER's (South Africa 87%, Namibia 89%). The results from the DHS surveys used in our analysis (reported in Table 1) are far more congruent with the existing body of knowledge on primary school enrolment in sub-Saharan Africa. Whether this is due to methodological complications in the calculation of NER, as outlined above, or incorrect administrative data[4] provided by member countries is inconsequential for our purposes.

It would be remiss not to include a brief list of the limitations of survey data. Some of the problems associated with household survey data include: sampling errors, household non-response, excluding homeless children from the sampling frame, measurement error, and the problems with capturing school attendance. However, given that DHS data has been used in hundreds of peer-reviewed academic publications for a variety of purposes, including educational attainment (Filmer & Pritchett, 1999) and enrolment (Hanushek & Wößmann, 2008), we do not believe that any of these problems outweigh the serious limitations of the alternative.

Of the 14 SACMEQ countries, 10 have reliable and recent survey data on school attendance (Filmer, 2010) and therefore we include these 10 countries in our analysis. The specific dates that each DHS survey was conducted in 9 of the SACMEQ countries are: Kenya (2008-9), Lesotho (2009), Malawi

[4] Local schools may misrepresent their enrolment figures since school funding or personnel are often allocated based on enrolment figures. In addition, small local discrepancies in enrolments can become large once aggregated to the national level.

(2010), Namibia (2006-7), Swaziland (2006-7), Tanzania (2010), Uganda (2006), Zambia (2007) and Zimbabwe (2005-6). For South Africa, we follow Filmer (2010) and use the South African General Household Survey of 2006, given that the South African DHS data have not been released to date. Observing only these 10 countries, the SACMEQ survey tested 46364 Grade 6 students in 2117 primary schools.

3. Method

3.1 Combining access and quality at the national level

Given that educational quality, as measured by student test scores, is a continuous variable and educational access is binary (enrolled or not), some transformation is necessary in order to create a single indicator of education system performance. This is possible by making certain assumptions about the numeracy and literacy competency of grade 6 aged children who are not in school. Since we have data on both the educational competencies of the school-going population (from SACMEQ), and also the age-specific attendance rates of the population (from DHS), we calculate what proportion of school-aged children (whether in school or out) have acquired basic numeracy and literacy skills (Table 2).

Based on the results of the numeracy and literacy tests, SACMEQ classifies school-going children into one of eight categories for reading, ranging from *pre-reading* (level 1) to *critical reading* (level 8), and similarly for mathematics, where the levels range from *pre-numeracy* (level 1) to *abstract problem solving* (level 8). The eight competency levels are described in Appendix A, and a more detailed discussion can be found in Hungi, et al. (2010, p. 6). According to this classification system, if children have not reached level 3 in either reading (*'basic reading'*) or mathematics (*'basic numer*acy') they are deemed functionally illiterate[5] and functionally innumerate respectively. As Ross et al. (2005, p. 262) explain, "It is only at Level 3 that pupils can be said to read [otherwise they] could be said to be illiterate." By this definition, if students are functionally illiterate they cannot read a short and simple text and extract meaning; and if students are functionally innumerate they cannot translate graphical information into fractions or interpret common everyday units of measurement. This threshold of competency has been used in the literature before, for example, Shabalala (2005, p. 222) also uses the bottom two SACMEQ levels and deems students below this threshold as 'non-readers' and 'non-numerate.'

In this paper we assume that all grade 6 aged children that are not enrolled in school are illiterate and innumerate. Whether these children never enrolled in the first place, or enrolled but dropped out prior to grade 6, is an important question, but not relevant for our purposes. For those children that never enrol, it is highly unlikely that they would learn to read, write and compute at a sufficient

[5] The terms "illiterate" and "innumerate" have a number of possible meanings ranging from the inability to write a sentence or complete a one-step arithmetic sum, to more demanding definitions which include reading for meaning or using numerical skills in everyday life. We take the latter approach and use the terms 'functionally illiterate' and 'illiterate' interchangeably in the paper. It is of little use if children can write down and read a memorised paragraph if they do not understand what they are reading or writing. Similarly, if children cannot relate basic arithmetic skills into real world situations, these skills are only of limited value.

level to be able to pass competency level one and two on the SACMEQ tests[6]. For those children that do enrol but drop out before grade 6, it is also improbable that they would have acquired these skills prior to dropping out. Many students that drop out do so because they failed previous grades or repeated grades multiple times. Those that drop out due to income constraints or remoteness are also statistically less likely to be in the better performing part of the distribution prior to dropout. Lastly, given that many of the students that remain in school do not reach level 3 by grade 6 (our literacy threshold), it is unlikely that those that have dropped out would have already reached level 3 prior to dropping out. For example, it is reasonable to assume that the 8% of Zimbabwean 12 year olds who were not enrolled in school would not have been a more literate group than the 17% of Zimbabwean 12 year olds that *were* enrolled in school but were not yet literate by grade 6 (see Figure 1). Moreover, given that non-enrolled children are mainly found in poor communities and remote areas, it is unlikely that such children would have gained significantly from home-based literacy activities.

The above assumption that unenrolled grade-6-aged children are illiterate and innumerate may not hold for countries where practically the entire grade 6 school-going cohort is literate and numerate. In these countries (like Swaziland, Tanzania and Kenya), a child who dropped out in Grade 5 may very well have already acquired foundational numeracy and literacy skills prior to dropout. However, given that the purpose of our classification method is to create a measure of primary school system performance, we maintain that the schooling system has failed these students because they have dropped out before six years of full-time schooling, even if they did have basic literacy prior to dropout. That is to say that for a primary school system to be deemed successful according to our measure it should both retain students at least until the end of grade 6, and impart foundational numeracy and literacy skills.

In addition to the above, it is possible to calculate dropout by grade in each of the ten countries. Table 3 in Appendix A reports the grade survival rates for each country, while Figures 6 and 7 (Appendix A) show the incremental change in grade survival relative to the previous grade. In all countries, the percentage of children who survive to Grade 5 but not Grade 6 is never more than 6% (Uganda), and the average is 3%. In Tanzania, Kenya and Swaziland – the countries where almost the entire Grade 6 cohort is literate, and therefore potential examples of literate pre-Grade-6 dropout – the prevalence of dropout in Grades 4 and 5 is extremely low, with most dropout concentrated in the "unenrolled or dropout prior to Grade 1" category. Even if some proportion of children who dropout in Grades 4 or 5 have acquired foundational numeracy and literacy skills, their numbers are sufficiently small that they would not change the overall picture by more than a few percentage points.

In addition to the illiteracy category, we group competency levels three, four and five (*basic reading*, *reading for meaning*, and *interpretive reading*) under the heading 'basic reading skills', and competency levels six, seven and eight (*inferential reading*, *analytical reading*, and *critical reading*) as 'higher order reading skills'. The corresponding numeracy designations are 'basic numeracy skills' with competency levels 3, 4 and 5 (basic numeracy, beginning numeracy, and competent numeracy), and 'higher order mathematics skills' with competency levels 6, 7 and 8 (mathematically skills,

[6] While there will obviously be exceptions to the rule where educated parents may teach their children informally at home, this is so small as to be negligible on a national scale.

concrete problem solving, and abstract problem solving (Ross, et al., 2005). Figure 1 below uses these designations and follows the approach of Hanushek and Wößmann (2008, p. 656). This makes it possible to combine educational access (enrolment) and educational quality (cognitive skills) in a single graph.

3.2 Combining access and quality at the sub-national level: gender, location and wealth

While *national* comparisons of access and quality are useful in and of themselves, there are also significant *sub*-national differences by gender, school location and wealth for both access (Filmer & Pritchett, 1999) and quality (Hungi, et al., 2010). Table 1 shows the differences in enrolment rates by gender, location and wealth[7] calculated at the median age of grade 6 students in each country, using DHS data. Two countries may have the same average enrolment rate (i.e. the national enrolment rate), but different levels of gender, geographical or socioeconomic inequality. For example, observing 14 year olds in Lesotho, it becomes evident that there are significantly more girls enrolled (95%) than there are boys (82%), with similarly large differences found in rural areas (87%) compared to urban areas (96%). However, Uganda, which has the same *overall* enrolment rate as Lesotho, has far smaller enrolment differentials between boys (88%) and girls (91%), and urban (87%) and rural (89%) areas. Therefore, due to the large differences in enrolment rates *within* countries, comparing school quality across sub-groups without taking into account sub-national enrolment differentials will necessarily bias the results in cases where sub-national enrolment differences are non-trivial.

In keeping with the above, we calculate the proportion of grade 6 aged children (whether in school or out) that are literate and numerate in each country, and, within each country by important sub-groups (Table 2). Given the assumption that non-enrolled grade 6 aged children are illiterate and innumerate, it becomes possible to simply multiply the literacy rates of boys and girls in grade 6 (from SACMEQ) by the respective enrolment rates for median aged grade 6 boys and girls (from DHS). For example, in Malawi the SACMEQ tests showed that 60% of girls enrolled in grade 6 were literate. However, according to the DHS survey, only 82% of 14 year old girls (the median age for grade 6 in Malawi) were actually enrolled in school. Assuming that the 18% of non-enrolled 14 year old girls are illiterate, one can say that 49.7% (60.3*82.4) of all 14 year old girls in Malawi were literate. We apply the same logic to urban and rural areas (Table 2).

In addition to gender and geographical differences, previous studies have shown that large wealth-based differentials also exist for both school quality (Hungi, et al., 2010) and enrolments (Filmer & Pritchett, 1999). Taking Zambia as an example, only 47% of quintile one grade 6 students in SACMEQ were classified as literate, compared to 67% in quintile five. If instead one looks at Zambian 14 year olds in terms of *enrolment*, only 80% of 14 year old children in quintile one were enrolled in school, compared to 96% of 14 year old children in quintile five (Table 1). Unfortunately one cannot simply multiply literacy rates for SACMEQ quintile one with enrolment rates for DHS quintile one because these quintiles do not represent the same underlying population. DHS quintile one consists of the

[7] To calculate a measure of wealth in SACMEQ we used Multiple Correspondence Analysis (MCA) on 31 possession questions in order to create a wealth index. This was subsequently split into five equal quintiles with quintile one being the poorest 20% of students, quintile two the second poorest 20%, and so on.

poorest 20% of 14 year olds in the country, while SACMEQ quintile one consists of the poorest 20% of those children who *are enrolled* in grade 6. Since poorer quintiles have lower enrolment rates, one would expect that poorer quintiles would be underrepresented in the school-going population.

This is made clearer using a hypothetical example: assume that a country has 100 14 year olds in the population and therefore each DHS quintile will consist of 20 children. If the enrolment rate for quintile one is 75%, only 15 of the 20 children from the poorest DHS quintile will actually enrol in school (and thus make it into the SACMEQ sample). The enrolment rate in quintile two is 80% and therefore only 16 of the 20 children from the second poorest DHS quintile will actually enrol in school, and so on. In quintile three 17 students are enrolled (85% enrolment), in quintile four 18 students are enrolled (90% enrolment rate), and in quintile five 19 students are enrolled (93% enrolment rate). Adding up all these students gets to the total enrolment rate of 85% (15+16+17+18+19 = 85 students), i.e. the 85 students in the SACMEQ sample. If we want to apply the literacy performance of SACMEQ students to their relative DHS quintiles, then one should regard the poorest 15 students in the SACMEQ sample as representative of that country's DHS quintile one; the next poorest 16 students in SACMEQ would represent DHS quintile two, etc. It would be incorrect to simply divide the SACMEQ sample by five (85/5=17) and compare these to the DHS quintiles.

Thus, we calculate the cumulative distribution of students in SACMEQ from poorest to wealthiest and then split this distribution according to the enrolment rates of each DHS quintile to obtain SACMEQ population quintiles[8]. This process of splitting the SACMEQ sample into quintiles that are representative of DHS quintiles is shown mathematically by the following formula:

$$\begin{aligned} Total\ SACMEQ\ sample = \\ &= \int_{0}^{\left(\frac{NAR_{Q1}}{5*NAR_{total}}\right)*N} CN_{ses} + \int_{\left(\frac{NAR_{Q1}}{5*NAR_{total}}\right)*N}^{\left(\frac{NAR_{Q2}}{5*NAR_{total}}\right)*N} CN_{ses} + \int_{\left(\frac{NAR_{Q2}}{5*NAR_{total}}\right)*N}^{\left(\frac{NAR_{Q3}}{5*NAR_{total}}\right)*N} CN_{ses} \\ &+ \int_{\left(\frac{NAR_{Q3}}{5*NAR_{total}}\right)*N}^{\left(\frac{NAR_{Q4}}{5*NAR_{total}}\right)*N} CN_{ses} + \int_{\left(\frac{NAR_{Q4}}{5*NAR_{total}}\right)*N}^{\max(N)} CN_{ses} \end{aligned}$$

where NAR_{Q1} is the net attendance rate for quintile one, N is the total population of grade six students obtained by inflating the SACMEQ sample to the population of grade six students using the SACMEQ raising factor variable "*rf2*". This is the inverse of the probability of selecting a student into the sample and is derived from the SACMEQ sampling procedure (Ross, et al., 2005, p. 36). The variable CN_{ses} is the cumulative distribution of the grade six school-going population sorted from poorest to wealthiest. The first integral is the SACMEQ population quintile one (i.e. representative of the same population in DHS quintile one), the second integral is the SACMEQ population quintile two, and so on.

[8] Given that SACMEQ is a sample of the total school-going population, we created a cumulative distribution of students using the SACMEQ "*rf2"* (raising factor) variable.

4. Discussion

It is common sense that for a school to be useful it needs to be able to impart to students some basic level of learning. Schooling that does not confer even the most basic numeracy and literacy skills in six years of formal full-time enrolment cannot be considered of "reasonable quality" by anyone. Similarly, at the individual level, if a child is enrolled and attending but learning little that child could be thought of as being "silently excluded" (Lewin, 2007, p. 10). As Lewin further explains: "Initial access has little meaning unless it results in…meaningful learning which has utility." It is largely because of this that plain enrolment rates are so misleading, since they do not provide any indication that basic skills are being mastered. Thus, there is need to draw a distinction between traditional "nominal" enrolment and a more comprehensive composite notion of "*effective*" enrolment. By effective we mean enrolment that has the ability to bring about the desired result of basic learning. By multiplying enrolment rates and literacy rates we essentially generate effective enrolment, i.e. only that enrolment which has led to the acquisition of basic skills. Table 1 below reports the traditional "nominal" enrolment rates of grade 6 aged children taken from the respective household surveys, while Table 2 reports our composite measure of "effective enrolment". The contents of these tables are discussed in sections 4.1 and 4.2 below.

4.1 Differentials in traditional "nominal" enrolment rates

Table 1 below shows that there are a number of large enrolment differentials between sub-groups of the national population. These include enrolment disparities by:

- ***Gender,*** in Lesotho (12.4 percentage points higher for girls) and Malawi (6.4 percentage points higher for boys).
- ***Location,*** with large urban-rural enrolment differentials in Lesotho (9.5 percentage points), Zambia (6.8 percentage points), Malawi (6.6 percentage points), and Tanzania (4.6 percentage points). Surprisingly, Kenya and Uganda have higher enrolment rates in rural areas than in urban areas (approximately a 2 percentage point differential).
- ***Wealth,*** with large differentials between quintile five enrolment rates and quintile one enrolment rates in Malawi (18 percentage points), Zambia (17 percentage points), Lesotho (13 percentage points), Namibia (12 percentage points), and Uganda (11 percentage points).

4.2 Differentials in composite "effective" enrolment rates

Table 2 highlights that the differences in "effective enrolment" (which can also be thought of as literacy/numeracy rates for the age-appropriate population) are larger than the differences in "nominal enrolment". This is to be expected since it is far easier to increase the number of children simply attending a school than it is to increase the number of children attending a school *and acquiring basic numeracy and literacy skills*. This is especially true when the newly enrolled children come from marginalized groups in society. Figure 2 and Figure 3 below visualize the differences in numeracy and literacy rates by gender, location and wealth. A number of observations are worth highlighting:

- Countries with high "nominal" enrolment rates do not always have high "effective" enrolment rates. South Africa is a case in point. While 98% of grade 6 aged children are enrolled in a school, only 71% of grade 6 aged children are functionally literate and only 59%

are functionally numerate, indicating that at least a quarter of children are enrolled but have learnt so little in six years of formal full-time schooling that they have not even mastered functional literacy or numeracy. This is in stark contrast to Tanzania where only 85% of grade 6 aged children are enrolled in school, but practically all of those children are acquiring basic numeracy and literacy skills. Thus, while South Africa's nominal enrolment rate is much higher than Tanzania's, when one looks at whether enrolled children are actually acquiring basic skills (i.e. effective enrolment), Tanzania does significantly better than South Africa.

- ***Gender*** differences in effective enrolment are large in both Lesotho and Malawi. In Lesotho, 63% of grade 6 aged boys are acquiring basic literacy skills compared to 77% of grade 6 aged girls. The reverse is true in Malawi, where 59% of grade 6 aged boys are acquiring basic literacy skills compared to only 50% of grade 6 aged girls.
- ***Location*** differences in effective enrolment are relatively large for seven of the ten countries. The largest geographical differences in literacy are found in South Africa and Zimbabwe. In South Africa 58% of rural grade 6 aged children are literate, compared to 85% of urban grade 6 aged children (a 27 percentage point differential). In Zimbabwe 70% of rural grade 6 aged children are literate, compared to 91% of urban grade 6 aged children (a 21 percentage point differential). The largest geographical differences in numeracy are found in Namibia and South Africa. In Namibia, only 37% of grade 6 aged rural children were numerate, compared to 69% of grade 6 aged urban children. In South Africa, only 44% of grade 6 aged rural children were literate, compared to 73% of grade 6 aged urban children.
- ***Wealth*** differences are largest in South Africa and Namibia. In South Africa, only 42% of quintile one students are numerate, compared to 85% of grade 6 aged quintile five students. In Namibia, only 33% of quintile one students are numerate compared to 71% of grade 6 aged quintile five students. Similar trends can be seen for literacy (Figure 2).

Looking at the overall picture presented in Figure 2 and Figure 3, one can see that those countries with the largest wealth gaps also tend to have large location gaps. This indicates the geographical dynamic that prevails in countries with high economic and educational inequality. As one might expect, the countries with the highest levels of income inequality (measured using the Gini coefficient) also have the highest wealth differentials in effective literacy enrolment – South Africa, Zambia and Namibia. It is also worth noting that for these ten countries gender is not the most relevant dimension of educational disadvantage, contrary to popular belief. Indeed, for literacy the *largest* "pro-boy" bias of 9 percentage points (Malawi) is only marginally bigger than the *smallest* wealth gap of 6 percentage points (Swaziland). The same is true for numeracy. In Malawi the wealth gap is twice as large as the gender gap, while in Zambia it is five times as large; yet these are the two countries with the largest pro-boy effective enrolment differentials.

A cursory analysis of Table 2 will show that the effective enrolment rates for each country differ by literacy and numeracy. This is because we have chosen to report these effective enrolments rates separately. Thus one can think of them as effective literacy enrolment and effective numeracy enrolment. While it would be possible to calculate a combined measure which reports the number of age appropriate children that are both functionally literate and numerate, in the current instance this is not necessary since numeracy effective-enrolment rates are universally lower than literacy effective-enrolment rates and almost all of those who are functionally illiterate are also innumerate, thus the combined measure would simply be the numeracy effective-enrolment rates.

4.3 Education system performance – moving beyond basic skills

Up until this point in our discussion of education system performance, we have focussed exclusively on the acquisition of basic skills. However, many may rightfully object that the milestones of emergent literacy and numeracy are too low as benchmarks for education system performance. Indeed, it is arguable that one of the end goals of education is the acquisition of critical thinking and higher order reasoning skills. To this end, for each country we calculate the proportions of the grade 6 aged population that are 1) not enrolled, 2) enrolled but illiterate, 3) enrolled and have acquired basic skills (SACMEQ Levels 3-5), and 4) enrolled and have acquired higher order skills (SACMEQ Levels 6-8) (see Figure 4 and Figure 5).

In terms of higher order skills, Figure 4 and Figure 5 show that there are essentially two groups of countries; one where a significant number of children reach higher order skills (Tanzania, Kenya, Swaziland, South Africa and Zimbabwe), while in the other group barely any children reach higher order skills (Zambia, Malawi, Lesotho, Namibia and Uganda). Looking specifically at Tanzania, it is interesting to note that while more than half of grade 6 aged children in that country reach higher order reading skills (52%), of the ten countries it is also the one with the highest proportion of non-enrolled grade 6 aged children (15%).

4.4 Extending the analysis to other developing regions

The high proportions of children in the "enrolled but illiterate" and "enrolled but innumerate" categories highlight the reality that many children in Africa are attending school, but not acquiring foundational numeracy and literacy skills. These children are at greater risk of repetition and dropout largely because their achievement is so low that they cannot follow the curriculum (Lewin, 2007). Furthermore, the demand for primary schooling itself is partially driven by the belief that schooling does actually deliver knowledge and skill – something that may not be true in the weakest performing schools. In these instances, it is possible that low quality education may in fact be a cause of declining enrolments in some countries, and especially for those sub-groups who are disproportionately affected by low quality education.

Importantly, this new method of measuring education system performance distinguishes between those children who have been excluded from school (unenrolled) as well as those who are in school but have been excluded from learning (enrolled but illiterate and innumerate). We believe this distinction is an important one both from a research and reporting point of view, and from a policy-making and planning perspective. For the single statistic of basic education system performance these figures are combined to create a composite a measure of performance.

The issues discussed in this paper are likely to extend to other developing regions such as francophone West Africa, South East Asia and South America. This new method of measuring education system performance can, in principle, be applied to all countries as long as three conditions are met: 1) there is at least one national survey of cognitive outcomes at an appropriate grade (perhaps Grade 6), 2) that survey includes common thresholds of competency to ensure cross-national comparability, and 3) there is a nationally representative household survey which reports grade-specific enrolment. Given the importance of education in the development discourse, there is a case to be made to extend SACMEQ-like surveys to all developing countries, and standardising reporting in terms of the threshold levels of performance. This move towards standardization and comparability across regions has already begun, and in May 2012 SACMEQ and its francophone West African equivalent PASEC[9], together with the IEA[10] met to discuss the need for international comparability of educational data (SACMEQ, 2012).

5. Conclusion

The main contribution of this paper has been to expose the existing practice of reporting enrolment statistics that ignore quality, or quality statistics that ignore enrolment differentials. The former are misleading while the latter are biased. Any analysis which aims to compare primary education systems across countries in Sub-Saharan Africa is patently incomplete if it does not take into account *both* educational access *and* educational quality. Neglecting either element leads to inaccurate conclusions and recommendations.

Schooling that does not improve cognitive outcomes is of limited value: it does not expand the range of possibilities available to children or yield national economic benefits. Therefore we proposed a new composite statistic, *effective enrolment,* that depicts the proportion of the age-appropriate population that has reached some basic level of numeracy and literacy proficiency. In short, it is enrolment that produces learning. To do so we combined household data on enrolment (DHS) with survey data on cognitive outcomes (SACMEQ III) for ten African countries. This is in accordance with the conceptual framework of Pritchett (2004), and also extends the empirical work of Hanushek and Wößmann (2008) by including ten countries from sub-Saharan Africa where their study reported on only two. We calculated and reported the effective enrolment rates of each country by gender, location and wealth quintile as well as highlighted the patterns of differential access and achievement across countries and sub-groups. It was found that large national and sub-national differences exist between traditional enrolment rates and effective enrolment rates. These differences range from one percentage point (Swaziland) to 38 percentage points (Zambia) for literacy enrolment, but are as high as 59 percentage points (Zambia) for numeracy enrolment (Table 1 and 2). Furthermore, the results showed that the greatest educational inequalities are between rich and poor children (wealth) rather than between boys and girls (gender).

In addition to creating and reporting this new statistic, we also highlighted the necessity for any educational goals, such as the post-2015 MDG replacements, to include a reference to the acquisition of minimum competencies and not simply the necessary but insufficient condition of access to school. As we have shown, learning deficits are far greater than access deficits in all ten countries. The most striking example of this is in South Africa where 97% of quintile one South African 13 year olds are enrolled, but only 56% of them are literate.

As far as we are aware, the figures reported in this paper are the most accurate and comprehensive statistics on basic education system performance for each of the ten countries under review. Using these figures for analyses overcomes the selection bias inherent in all cross-national comparisons of educational achievement, and is far superior to simple comparisons of traditional enrolment rates that do not take into account educational quality or efficacy. In sum, the paper refocuses the discussion on education system performance in Africa by providing a composite measure of access and quality and in so doing places educational *outcomes* at the centre of the discourse.

[9] Programme d'analyse des systemes educatifs de la CONFEMEN (PASEC)
[10] International Association for the Evaluation of Educational Achievement (IEA)

Table 1: Traditional "nominal" enrolment rates for select sub-groups of the median aged population

				Enrolment rates for sub-groups of median age population								
				Gender		Location		Wealth quintiles				
Country	Median age of Grade 6 students (from SACMEQ)	Year of World Bank survey/data (DHS)	Enrolment rates for median Grade 6 age	Male	Female	Urban	Rural	Q1	Q2	Q3	Q4	Q5
Kenya	13.5	2008/9	94.9	93.8	96.1	92.8	95.1	91.2	94.8	96.4	97.4	95.2
Lesotho	13.9	2009	88.9	82.3	94.7	96.2	86.7	80.5	85.3	91.9	94.4	93.7
Malawi	14.0	2010	85.7	88.8	82.4	91.5	84.9	75	79.5	90.3	89.8	93.1
Namibia	13.2	2006/7	92.7	91.5	93.9	95.3	91.6	86.6	93.4	93	95.9	98.3
South Africa	12.6	GHS 2006	98.0	97.5	98.5	97.5	98.2	96.5	97.2	98.3	99.2	99.7
Swaziland	13.6	2006/7	89.5	89.5	89.4	90.3	89.4	89.2	86.4	87.2	92.5	93.6
Tanzania	14.3	2010	85.3	83.8	86.9	88.9	84.3	79.9	83	89.2	85.7	89
Uganda	14.0	2006	89.1	90.5	87.6	87.1	89.3	77.8	90.6	89.6	95.9	89.2
Zambia	13.9	2007	88.1	89.1	87.1	92.4	85.6	79.9	84.2	84.1	93.8	96.4
Zimbabwe	12.3	2005/6	92.3	92.2	92.5	94.9	91.6	89.2	90.3	94.4	92.1	98

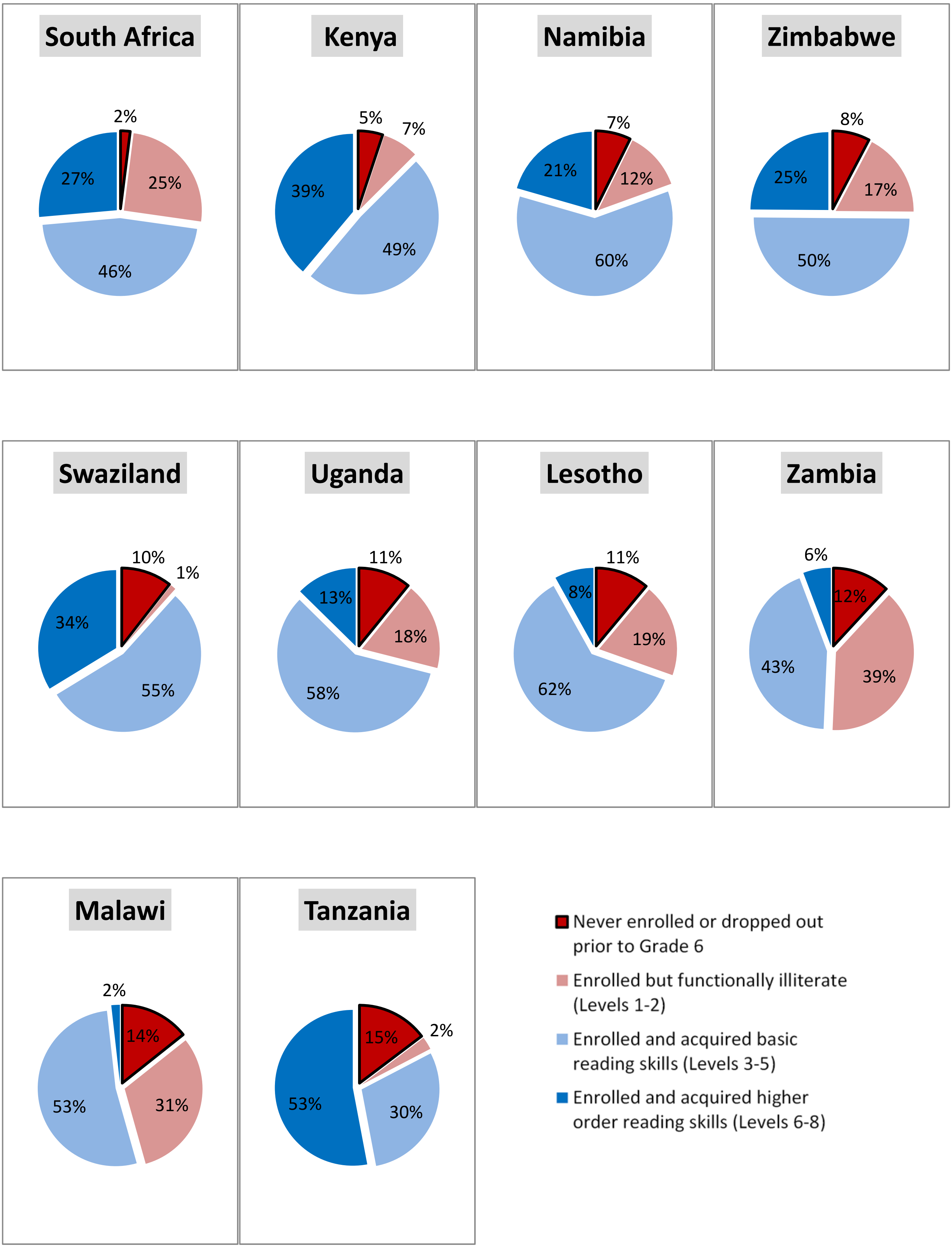
Note: All enrolment rates are taken from Filmer's analysis (2010) of World Bank databases. The World Bank enrolment rates for South Africa are taken from the General Household Survey (GHS) of 2006 while all other enrolment rates are from the Demographic and Health Survey (DHS) of that country that is closest to 2007, which is when the SACMEQ III study was conducted. The DHS data for South Africa has not been released to date.

Table 2: Effective enrolment: literacy and numeracy rates post enrolment corrections

Percentage of grade 6 aged population that are literate (post enrolment correction)										
		Gender		Location		Wealth quintiles				
Country	Total	Male	Female	Urban	Rural	Q1	Q2	Q3	Q4	Q5
Kenya	87.3	85.8	88.9	88.4	85.8	80.2	85.5	87.8	91.9	91.4
Lesotho	70.1	62.6	76.8	82.7	65.2	63.1	64.2	70.1	74.0	79.9
Malawi	54.4	59.0	49.7	69.9	50.4	44.2	49.5	57.2	56.3	64.0
Namibia	80.1	76.4	83.6	89.0	74.9	70.1	77.2	78.4	86.4	91.4
South Africa	71.2	67.1	75.4	84.5	57.8	56.1	63.4	69.5	76.6	91.5
Swaziland	88.2	87.7	88.6	89.7	87.8	87.5	84.4	86.1	91.2	93.1
Tanzania	82.3	81.1	83.6	87.8	80.5	74.9	79.8	85.6	84.4	87.2
Uganda	71.0	73.1	68.8	79.6	67.2	57.9	67.7	70.5	78.8	78.0
Zambia	49.3	51.9	46.6	58.8	44.2	37.4	44.5	44.4	56.0	62.8
Zimbabwe	75.3	71.6	78.1	90.8	70.1	70.9	71.3	75.1	73.6	87.2

Percentage of grade 6 aged population that are numerate (post enrolment correction)										
		Gender		Location		Wealth quintiles				
Country	Total	Male	Female	Urban	Rural	Q1	Q2	Q3	Q4	Q5
Kenya	84.2	84.3	84.2	85.4	82.8	76.8	81.4	85.1	89.7	88.6
Lesotho	51.7	47.5	55.5	66.2	45.8	41.6	46.7	49.6	57.6	63.9
Malawi	34.4	39.5	29.3	44.7	31.7	28.8	32.1	35.2	34.6	40.9
Namibia	48.5	47.9	49.1	67.5	37.0	33.1	39.5	44.9	55.7	71.2
South Africa	58.6	56.1	61.1	73.0	44.0	42.0	47.8	55.3	63.5	85.2
Swaziland	81.8	83.0	80.5	85.3	80.5	80.1	77.2	79.2	84.8	89.0
Tanzania	74.0	75.1	73.0	82.7	70.7	64.9	70.7	78.8	75.2	80.7
Uganda	54.6	57.4	51.8	67.2	49.4	40.7	52.4	52.1	62.5	63.8
Zambia	28.8	32.2	25.3	36.5	24.8	22.0	20.8	23.6	35.2	41.5
Zimbabwe	67.8	66.2	69.2	87.7	60.6	58.4	63.4	66.2	70.7	82.2

Figure 1: Combining educational access and education quality



Note: Own calculations for all countries using SACMEQ III data for educational achievement and World Bank data (Filmer, 2010) for attendance rate. Also see Hanushek and Wößmann (2008, p. 64) for a similar graphic for other developing countries

Figure 2: Literacy gaps in effective enrolment by gender, location and wealth

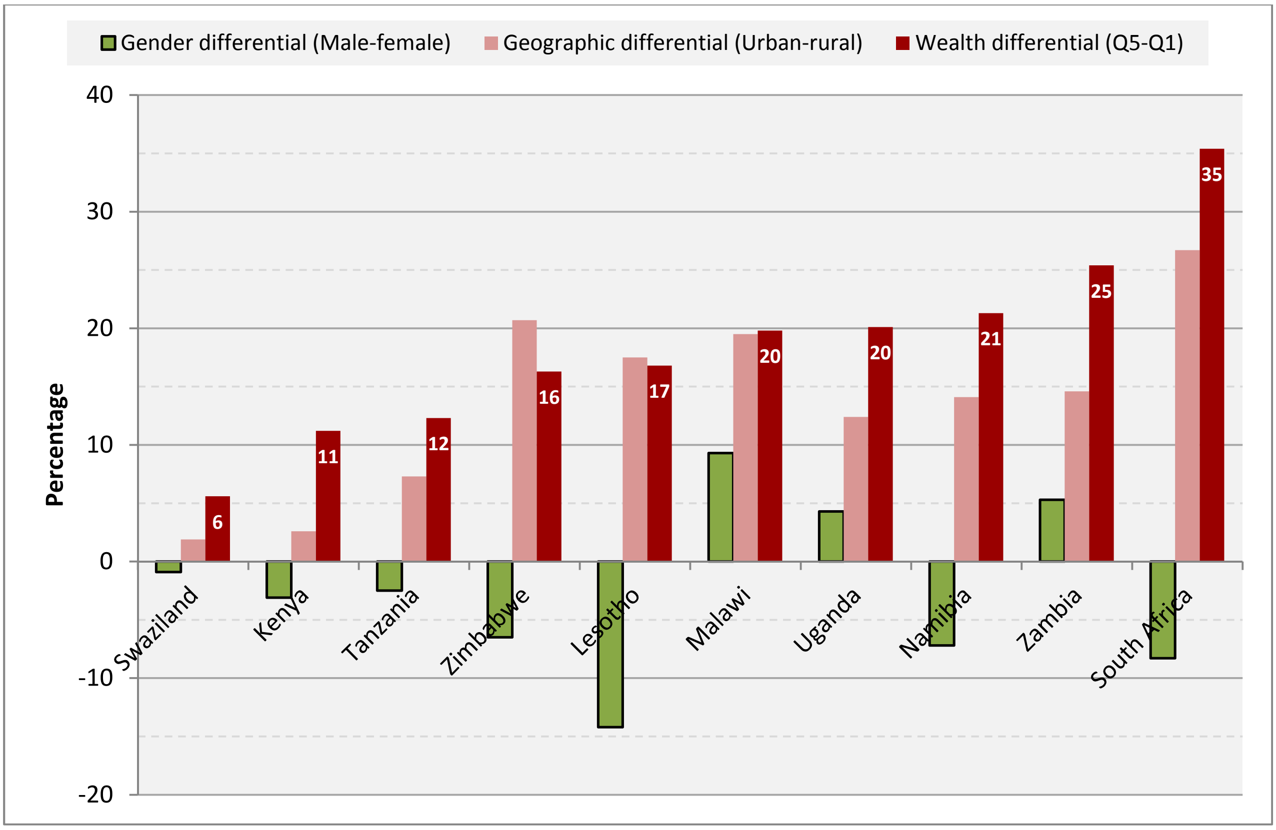


Figure 3: Numeracy gaps in effective enrolment by gender, location and wealth

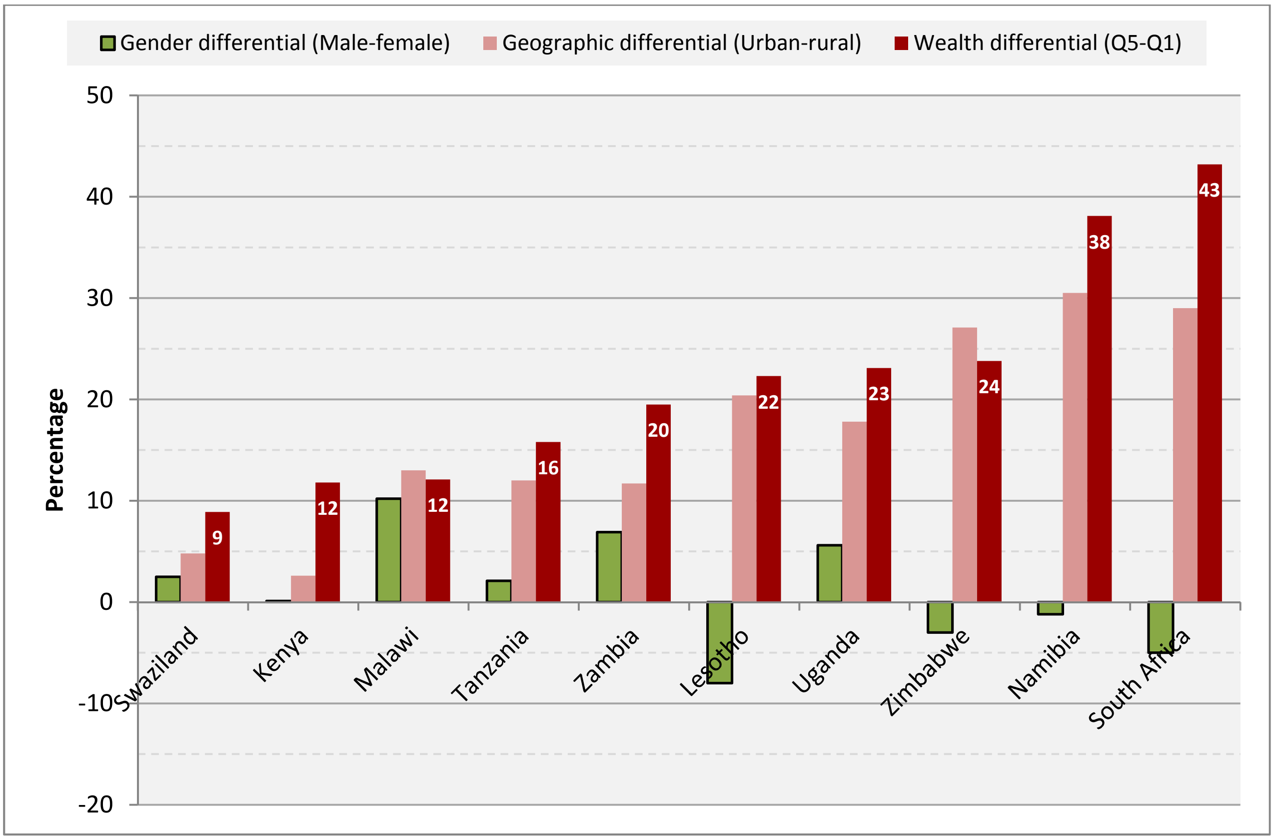


Figure 4: Literacy skills breakdown of the grade 6 aged population

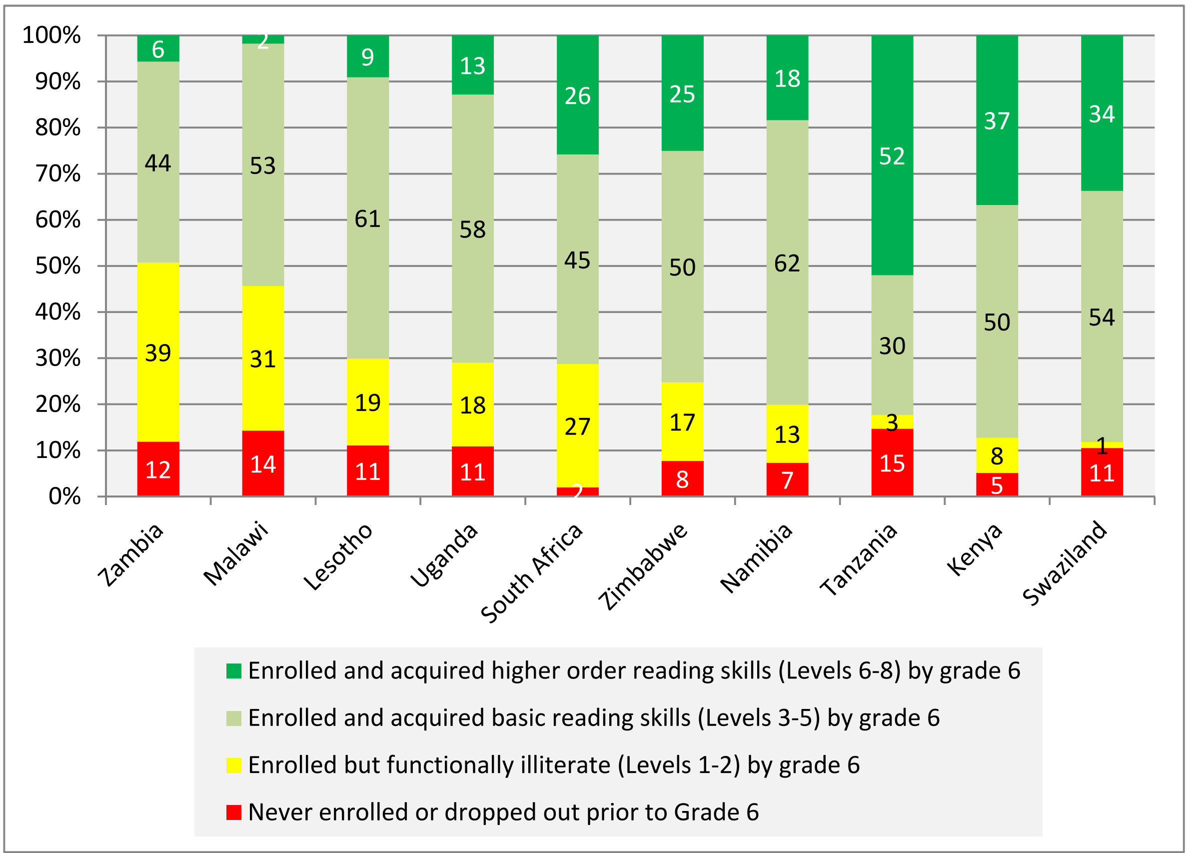
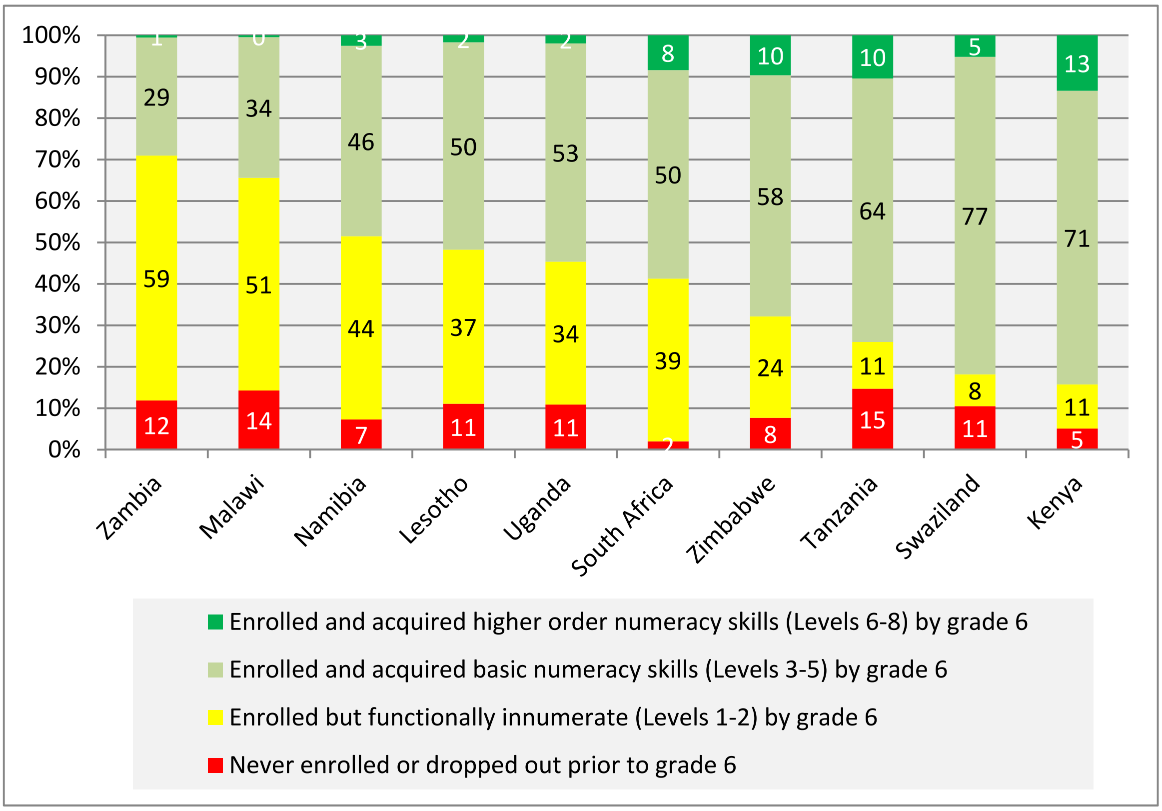


Figure 5: Numeracy skills breakdown of the grade 6 aged population



Appendix A

SACMEQ Reading Competency Levels

Description of levels	Range on 500 point scale[11]	Skills
Level 1 *Pre-reading*	< 373	Matches words and pictures involving concrete concepts and everyday objects. Follows short simple written instructions.
Level 2 *Emergent reading*	373 → 414	Matches words and pictures involving prepositions and abstract concepts; uses cuing systems (by sounding out, using simple sentence structure, and familiar words) to interpret phrases by reading on.
Level 3 *Basic reading*	414 → 457	Interprets meaning (by matching words and phrases, completing a sentence, or matching adjacent words) in a short and simple text by reading on or reading back.
Level 4 *Reading for meaning*	457 → 509	Reads on or reads back in order to link and interpret information located in various parts of the text.
Level 5 *Interpretive reading*	509 → 563	Reads on and reads back in order to combine and interpret information from various parts of the text in association with external information (based on recalled factual knowledge) that “completes” and contextualizes meaning.
Level 6 *Inferential reading*	563 → 618	Reads on and reads back through longer texts (narrative, document or expository) in order to combine information from various parts of the text so as to infer the writer’s purpose
Level 7 *Analytical reading*	618 → 703	Locates information in longer texts (narrative, document or expository) by reading on and reading back in order to combine information from various parts of the text so as to infer the writer’s personal beliefs (value systems, prejudices, and/or biases).
Level 8 *Critical reading*	703+	Locates information in a longer texts (narrative, document or expository) by reading on and reading back in order to combine information from various parts of the text so as to infer and evaluate what the writer has assumed about both the topic and the characteristics of the reader – such as age, knowledge, and personal beliefs (value systems, prejudices, and/or biases).

Source: (SACMEQ, SACMEQ III Project Results: Pupil Achievement Levels in Reading and Mathematics, 2010)

[11] See (Ross, et al., 2005, p. 95).

SACMEQ Mathematics Competency Levels

Description of levels	**Range on 500 point scale**[12]	**Skills**
Level 1 *Pre-numeracy*	< 364	Applies single step addition or subtraction operations. Recognizes simple shapes. Matches numbers and pictures. Counts in whole numbers.
Level 2 *Emergent numeracy*	364 → 462	Applies a two-step addition or subtraction operation involving carrying, checking (through very basic estimation), or conversion of pictures to numbers. Estimates the length of familiar objects. Recognizes common two-dimensional shapes.
Level 3 *Basic numeracy*	462 → 532	Translates verbal information presented in a sentence, simple graph or table using one arithmetic operation in several repeated steps. Translates graphical information into fractions. Interprets place value of whole numbers up to thousands. Interprets simple common everyday units of measurement.
Level 4 *Beginning numeracy*	532 → 587	Translates verbal or graphic information into simple arithmetic problems. Uses multiple different arithmetic operations (in the correct order) on whole numbers, fractions, and/or decimals.
Level 5 *Competent numeracy*	587 → 644	Translates verbal, graphic, or tabular information into an arithmetic form in order to solve a given problem. Solves multiple-operation problems (using the correct order of arithmetic operations) involving everyday units of measurement and/or whole and mixed numbers. Converts basic measurement units from one level of measurement to another (for example, metres to centimetres).
Level 6 *Mathematically skilled*	644 → 720	Solves multiple-operation problems (using the correct order of arithmetic operations) involving fractions, ratios, and decimals. Translates verbal and graphic representation information into symbolic, algebraic, and equation form in order to solve a given mathematical problem. Checks and estimates answers using external knowledge (not provided within the problem).
Level 7 Concrete problem solving	720 → 806	Extracts and converts (for example, with respect to measurement units) information from tables, charts, visual and symbolic presentations in order to identify, and then solves multi-step problems.
Level 8 *Abstract problem solving*	>806	Identifies the nature of an unstated mathematical problem embedded within verbal or graphic information, and then translate this into symbolic, algebraic, or equation form in order to solve the problem.

Source: (SACMEQ, 2010)

[12] See (Ross, et al., 2005, p. 95).

Table 3: Grade survival rate [Data: World Bank survey data, Filmer (2010)]

	Gr 1	Gr 2	Gr 3	Gr 4	Gr 5	Gr 6	Gr 7	Gr 8	Gr 9
Tanzania	91%	90%	89%	88%	85%	84%	82%	55%	55%
Malawi	94%	92%	90%	86%	83%	79%	74%	69%	61%
Zambia	95%	95%	93%	92%	89%	87%	84%	75%	71%
Kenya	96%	96%	96%	95%	94%	93%	91%	88%	76%
Uganda	96%	95%	94%	91%	88%	82%	74%	59%	56%
Namibia	96%	96%	95%	94%	93%	91%	90%	86%	83%
Swaziland	97%	96%	95%	94%	92%	90%	85%	79%	74%
Lesotho	97%	97%	96%	94%	91%	89%	84%	72%	68%
Zimbabwe	99%	99%	98%	97%	96%	94%	91%	74%	69%
South Africa	99%	99%	99%	99%	98%	98%	96%	94%	91%

Figure 6: Stacked percentage point decrease in grade survival rate relative to previous grade

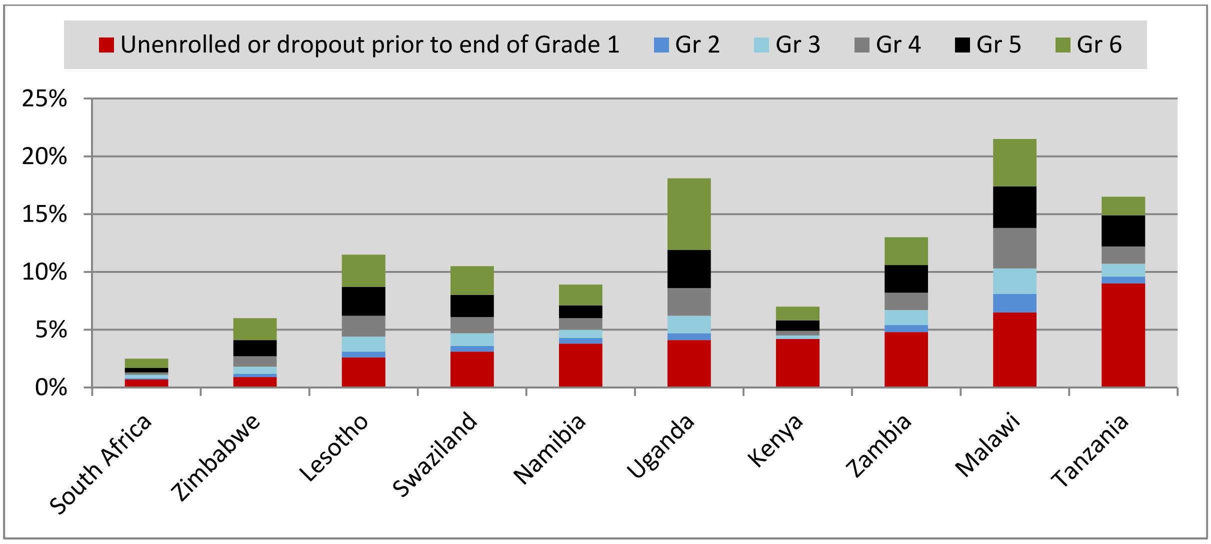
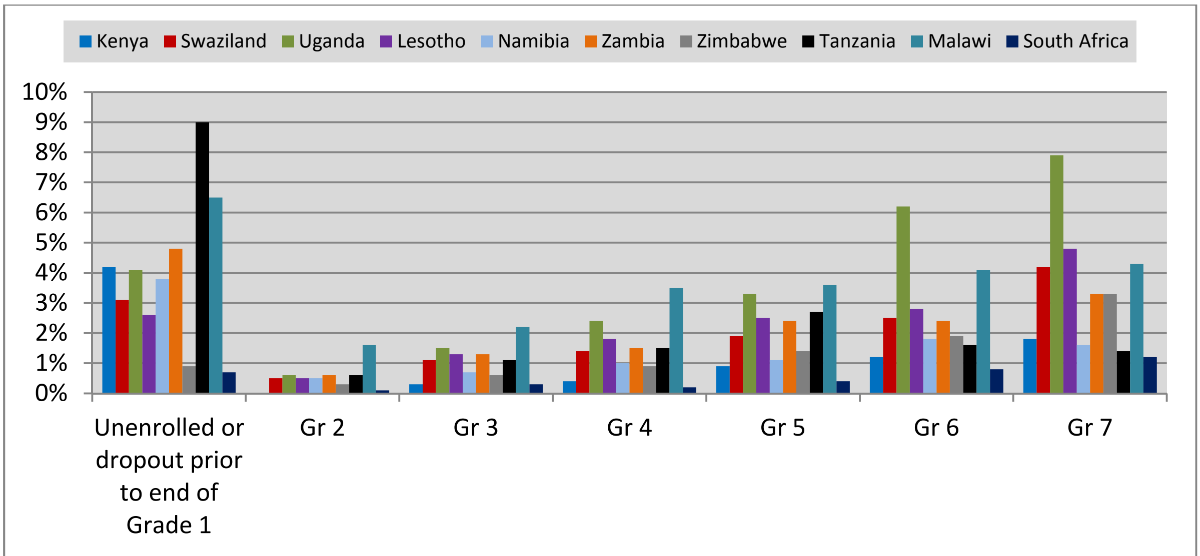


Figure 7: Percentage point decrease in grade survival rate relative to previous grade



Note: In Grade 1 the percentage point decrease is relative to 100% (full enrolment). This figure can be thought of as those children who do not finish a single year of schooling.

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