EDUCATION QUALITY IN SOUTH AFRICA AND SUB-SAHARAN AFRICA: AN ECONOMIC APPROACH

By

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Chapter 3

Spaull, N., and Kotze, J. (2015). Starting behind and staying behind in South Africa: The case of insurmountable learning deficits in mathematics. International Journal of Educational Development. Vol 41 (March) pp12-24

Chapter 4:

Spaull, N., Taylor, S., (2015). *Access to what? Creating a composite measure of educational quantity and educational quality for 11 African countries*. Comparative Education Review. Vol. 58, No. 1.

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Chapter 5:

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Declarations with respect to co-authoring:

With regard to Chapter 2, the nature and scope of my contribution were as follows:

Nature of contribution	*Extent of contribution (%)*
Developing the method of calibrating learning deficits using multiple data sets, analysis of the following datasets: Systemic Evaluation, SACMEQ, TIMSS, majority of the write-up and editing of the paper.	80%

The following co-author(s) have contributed to Chapter 2:

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Date: 1 October 2014

Declaration by co-authors:

The undersigned hereby confirm that:

1. the declaration above accurately reflects the nature and extent of the contributions of the candidate and the co-authors to Chapter 2,
2. no other authors contributed to Chapter 2 besides those specified above, and
3. potential conflicts of interest have been revealed to all interested parties and that the necessary arrangements have been made to use the material in Chapter 2 of this dissertation.

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With regard to Chapters 4 and 5, the nature and scope of my contributions were as follows:

Nature of contribution	Extent of contribution (%)
Chapter 4: Developing the conceptual framework behind the access-to-quality measure, undertaking the literature review, analysing the DHS and SACMEQ data to create the composite statistic. Writing up the analysis.	80%
Chapter 5: Automating the data-combination process in STATA and generating graphs and tables for the analysis. Helped with the write-up and editing of the paper.	40%

The following co-authors have contributed to Chapter 4 and 5:

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		Chapter 5: First co-author contributing to the write-up of the research, the data analysis and sensitivity checks, and the literature review.	60%

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ABSTRACT

Education has always occupied a central role in the discipline of economics, featuring prominently in the theoretical constructs of the discipline and, more recently, in their empirical applications. While one can trace the origins of Human Capital theory all the way back to Adam Smith's 'The Wealth of Nations', the two major advances in our understanding of education's role in economic development transpired in the last 50 years. The first was half way through the 20th century with the work of work of Mincer (1958), Schultz (1961) and particularly that of Becker (1962) who formalized the idea of Human Capital. The second advance was at the turn of the 21st century when Hanushek and Kimko (and later Wößmann) incorporated measures of education quality into their models of economic growth. This latest strand of research serves as the point of departure for this thesis, placing education quality at the centre of the discussion.

The thesis begins by focussing on the South African case and highlighting three broad issues that characterise education in the country: (1) the high levels of inequality that can be seen when comparing student performance by race, language, geographic location and socioeconomic status. New evidence is presented to show that South Africa does indeed have two public schooling systems, reiterating and confirming the findings of other South African scholars. (2) Using intra-survey benchmarks of student achievement, Chapter 2 develops a new method of quantifying learning deficits in mathematics by using three different datasets covering grades 3, 4, 5, 6 and 9. The learning gap between the poorest 60% of students and the wealthiest 20% of students is found to be approximately three grade-levels in grade 3 and grows to between four and five grade-levels by grade 9. (3) The focus then shifts to the complex issue of language and performance, which is addressed in Chapter 3. Here the aim is to exploit an unusual occurrence whereby a large group of South African students were tested twice, one month apart, on the same test in different languages. Using a simplified difference-in-difference methodology it becomes possible to identify the causal impact of writing a test in English when English is not a student's home language.

The final two chapters of the thesis widen the remit of analysis to include 11 countries in Sub-Saharan Africa, viz. Kenya, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe. Here the aim is to develop a composite measure of education access and education quality by combining household data (DHS) on grade completion and survey data (SACMEQ) on cognitive outcomes. The new measure, termed *access-to-literacy* and *access-to-numeracy* is reported for all countries and important sub-groups in Chapter 4. The method is then used in Chapter 5 to compare access-to-learning over a period of increased access to schooling (2000-2007). In all countries there was an improvement in access to literacy and numeracy, challenging the widely held perception that there is always an access-quality trade-off in education. In particular, girls and those in relatively poor households benefited most from this improvement in access to literacy and numeracy.

The thesis ultimately concludes that if children are to realize their full potential, the expansion of physical access to schooling in the developing world must be accompanied by meaningful learning opportunities. The acquisition of knowledge, skills and values must be the central aim of educational expansion.

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OPSOMMING

Onderwys het nog altyd ŉ rol in ekonomie as vakgebied gespeel. Dit is verstaanbaar, want vaardighede en onderwys was nog altyd ŉ prominente deel van die teoretiese konstrukte en meer onlangs ook van empiriese toepassings in die dissipline. Terwyl die oorsprong van menslike-kapitaalteorie teruggevoer kan word na Adam Smith se *Wealth of Nations*, het die twee grootste deurbrake met die verstaan van onderwys se rol in ekonomiese ontwikkeling in die laaste vyftig jaar plaasgevind. Die werk van Mincer (1958), Schultz (1961) en veral Becker (1962), wat in die middel van die vorige eeu formele gestalte aan die begrip 'menslike kapitaal' gegee het, was die eerste deurbraak. Die tweede deurbraak was teen die eeuwending toe Hanushek en Kimko (en later Wößmann) maatstawwe van onderwysgehalte in hulle ekonomiese groeimodelle begin insluit het. Hierdie nuwe tak van die navorsing plaas onderwys vierkant in die sentrum en dien as vertrekpunt vir hierdie proefskrif.

Die proefskrif begin deur aandag op drie breë kwessies te vestig wat kenmerkend is van onderwys in Suid-Afrika: (1) Die hoë vlakke van ongelykheid volgens ras, taal, geografiese gebied en sosio-ekonomiese status in studente se prestasie. (2) In hoofstuk 2 word ŉ nuwe metode aangebied om leeragterstrande kwantitatief te meet met behulp van norme van leerlingprestasie in skoolvlak-opnames vir grade 3, 4, 5, 6 en 9. Daar word bevind dat die leergaping tussen die armste 60% en die rykste 20% van studente in graad 3 ongeveer drie jaar is en teen graad 9 tot vier of vyf jaar aangroei. (3) Die fokus verskuif daarna na die verwikkelde kwessie van taal en skoolprestasie, wat in hoofstuk 3 bespreek word. Hier is die doel om die ongewone geval uit te buit waar ŉ groot groep Suid-Afrikaanse leerlinge binne die verloop van ŉ maand tweemaal dieselfde toets geskryf het, maar in twee verskillende tale. Met behulp van ŉ vereenvoudigde verskil-tussen-verskille-benadering is dit moontlik om te bepaal hoe groot die kousale effek is waar ŉ leerling wie se moedertaal nie Engels is nie die toets in Engels moes skryf.

Die laaste twee hoofstukke van die proefskrif bevat ŉ wyer analise van elf lande in Sub-Sahara Afrika, naamlik Kenia, Lesotho, Malawi, Mosambiek, Namibia, Suid-Afrika, Swaziland, Tanzanië, Uganda, Zambië en Zimbabwe. Die doel is om ŉ saamgestelde maatstaf van onderwys-toegang en -gehalte te skep deur huishoudingsdata (DHS) oor graadvoltooiing en skoolopnamedata (SACMEQ) oor kognitiewe uitkomste te kombineer. Die nuwe maatstaf, genaamd 'toegang-tot-geletterdheid' en 'toegang-tot-syfervaardigheid', word in hoofstuk 4 vir al die lande en subgroepe opgestel. Die metode word dan in hoofstuk 5 gebruik om toegang-tot-leergeleenthede te vergelyk oor ŉ periode waartydens skooltoegang verbreed het (2000-2007). Daar was ŉ verbetering in toegang tot geletterdheid en syfervaardigheid in alle lande, teenstrydig met die wyd-gehuldigde siening dat daar altyd ŉ afruiling tussen toegang en gehalte van onderwys bestaan. In besonder word bevind dat meisies sowel as kinders uit arm huishoudings die meeste by die toename in toegang tot geletterdheid en syfervaardigheid gebaat het.

Die gevolgtrekking is dat die vervulling van die potensiaal van kinders in die ontwikkelende wêreld vereis dat die verbreding van fisiese toegang tot skole met beduidende leergeleenthede gepaard moet gaan. Die aanleer van kennis, vaardighede en waardes moet die sentrale doel van die uitbreiding van onderwysgeleenthede wees.

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List of abbreviations

- ANA Annual National Assessment
- DBE Department of Basic Education
- ECD Early Childhood Development
- EFA Education For All
- DET Department of Education and Training
- DHS Demographic and Health Survey
- EMIS Education Management Information System
- FAL First Additional Language
- FR Free Response
- GER Gross Enrolment Rate
- GHS General Household Survey
- GPI Gender Parity Index
- IEA International Association for the Evaluation of Educational Achievement
- LOLT Language of Learning and Teaching
- MC Multiple Choice
- MDG Millennium Development Goals
- NAR Net Attendance Rate
- NCS National Curriculum Statement
- NER Net Enrolment Rate
- NGO Non-Governmental Organization
- NSES National School Effectiveness Study
- PASEC Programme d'Analyse des Systèmes Educatifs de la CONFEMEN
- PCA Principal Component Analysis
- PIRLS Progress in International Reading Literacy Study
- SACMEQ Southern and Eastern African Consortium for Monitoring Educational Quality
- SE Systemic Evaluation
- SES Socioeconomic Status
- SERCE Segundo Estudio Regional Comparativo y Explicativo
- TIMSS Trends in International Mathematics and Science Study

- *Wealth groups*
  - Poor40 Poorest 40% of the distribution
  - Mid40 Middle 40% of the distribution
  - Rich20 Richest 20% of the distribution
  - Poor40M Poorest 40% of boys in the distribution of boys
  - Poor40F Poorest 40% of girls in the distribution of girls

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CHAPTER 1: INTRODUCTION AND BACKGROUND

Education occupies a pre-eminent role in the disciplines of sociology, anthropology, economics, philosophy and psychology, and particularly so in their sub-fields focussing on development, modernization and social stratification. In the discipline of economics, numerous authors have stressed the economic benefits of education, both to the individual and to society at large. This is understandable since skills and education have always featured in the theoretical constructs of economics and, more recently, in their empirical applications. For example, if one agrees that the discipline of economics was born with the publication of Adam Smith's '*The Wealth of Nations'*, then the notion of labour quality (i.e. human capital) has been present in nascent form since the inception of the discipline. As early as 1776, Smith had already identified that the quality of labour should be seen in the same way as that of traditional capital:

> "The improved dexterity of a workman may be considered in the same light as a machine or instrument of trade which facilitates and abridges labour, and which, though it costs a certain expense, repays that expense with a profit" (Smith, 1776, p. 166).

Slightly over a decade later, Alfred Marshall (1890, p. 115) also illustrated that his understanding of capital included what we now term human capital: "Capital consists in a great part of knowledge and organisation…Knowledge is our most powerful engine of production; it enables us to subdue Nature and force her to satisfy our wants."

Although ideas of skills, training and education were regularly included in the thinking of economists during the 19^{th} century, it was only in the middle of the 20^{th} century that American economists created the theory of Human Capital and operationalized it in empirical analyses. The work of Mincer (1958), Schultz (1961) and particularly that of Becker (1962), pioneered a new field of economics and significantly expanded the borders of what counted as economics.

While it is true that economists increasingly tried to incorporate new and different measures of education into their analyses, it is also true that these measures were particularly inadequate and required unreasonably stringent assumptions. Most economists used enrolment ratios, primary or secondary completion rates, educational expenditure or some combination thereof. However this assumes that a year of education (or primary school completion) in Japan is equivalent to a year of education (or primary school completion) in Peru or Mali or Mongolia, for example. This is an obviously untrue assumption with large

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confounding potential. These limitations were usually not unacknowledged by authors, they were rather stated but left unexplored. Already in 1976 Blaug speaks about the "unresolved problem" in rate of return studies and explains that "students choose, not just schooling, but schooling of a certain type and quality, and few rate-of-return calculations have succeeded in successfully standardizing the calculated yields for quality of educational institutions" (Blaug, 1976, p. 841). This was the case throughout the second half of the 20th century, and it was only in 2000 that the quality problem began to be addressed using an approach that was more theoretically and empirically legitimate.

The first substantial study to incorporate a measure of education quality was that of Hanushek and Kimko (2000) who developed indices of educational quality for 38 countries using cross-national tests of educational achievement in mathematics and science between 1965 and 1991. By using a direct measure of cognitive outcomes that was comparable across countries and over time, Hanushek and Kimko began to solve one of the major problems that had been plaguing economics for 40 years. Other researchers subsequently built on these findings and expanded the number of countries under review (Bosworth and Collins, 2003; Ciccone and Papaioannou, 2009). Perhaps the single best summary of this new approach is the seminal article by Hanushek and Wößmann (2008) titled "*The Role of Cognitive Skills in Economic Development."* Here they show that when trying to explain economic growth using a model of income and years of schooling, the share of the variation in economic growth explained by the model jumps from 0,25 to 0,73 when cognitive skills are added to the model. (Importantly, the coefficient on years of education is no longer statistically significant).

In a very real sense, one can see distinct research programmes before and after the pivotal work of Hanushek and Kimko/Wößmann in the early 2000's. Where pre-2000 research focussed on the *quantity* of education, the most influential economic research on education post-2000 has prioritized and privileged the notion of *quality*. Incorporating measures of educational quality has greatly increased our understanding of the relative contribution of education quality (as proxied by test scores) to economic growth. It has also forced economists to re-evaluate and ultimately change their assumptions and interpretations of purely quantitative proxies of education. The research of Hanushek and his co-authors shows all too clearly that there are significant gains to be had from incorporating education research into economics and from applying the methods and habitus of economics to the field of education. By using this inter-disciplinary approach, the research presented in this thesis aims to contribute to the education-quality debates in both fields.

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This distinction between quantity and quality, or access and learning, is one of the motifs that runs throughout my thesis. Indeed, the method of combining educational quantity and quality that is developed in Chapter 4, and applied in Chapter 5, is arguably the main contribution of my research. In the process of surveying the economic and educational literatures on education quality it became apparent that authors in both fields make important assumptions that are simply untrue, and can be shown to be untrue. On the one hand educationists frequently make claims about causality and generalize their findings to large populations without any discussion about endogeneity, external validity or sample size - something I take issue with in Chapter 3 with respect to language research in South Africa.

On the other hand, economists frequently make unfounded assumptions about schooling in Sub-Saharan Africa that are empirically unfounded. In their quest to include in their analyses as many countries as possible they typically brush over regional peculiarities and use statistics such as Net Enrolment Rates which are widely reported and readily available, but also highly suspect, as is illustrated in Chapter 4. Furthermore, even if one looks to the most prolific and influential economists in the field (Filmer, 2010; Hanushek and Wößmann, 2008; Pritchett, 2013), all of them make assumptions about age-for-grade progression and late-completion that have little bearing in reality, at least not in sub-Saharan Africa (according to DHS data). These assumptions are non-trivial and lead to findings that substantially underestimate grade completion in more than a few countries in Africa.

Lastly, researchers who use cross-national data on educational achievement (both educationists and economists) almost never take into account how non-enrolment, late entry, grade repetition and dropout affect the samples' representivity. While 95% of a cohort of South African children will complete grade 6, only 53% of a Mozambican cohort will do so. If one simply compares the unadjusted average test scores of Mozambican and South African grade 6 children – as many researchers do - the picture will be necessarily misleading. In Chapter 4 and Chapter 5 I present one way of taking these differentials into account, differentials that are particularly important in Sub-Saharan Africa.

Thus the central aim of this thesis is to add to the existing body of knowledge that is broadly related to the quality of education in South Africa and sub-Saharan Africa. By using some of the econometric methods and approaches typically employed in economics I am able to contribute to the educational literature on learning deficits in mathematics (Chapter 2) and the impact of language on performance (Chapter 3). By giving sufficient attention to concerns that are the mainstays of economic research – notably sample selection, endogeneity, external validity, and causality – I am able to shed light on South African

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problems that were previously un(der)-analysed. Furthermore, by identifying regional peculiarities and adjusting assumptions and analyses in light of them, I show that there is far less empirical support for the commonly held notion that there was an access-quality trade-off in Sub-Saharan Africa between 2000 and 2007. Ultimately I argue that we need to be more nuanced in our discussions about access and quality and engage more meaningfully with the data that can answer the kinds of questions we are asking.

1.1 THESIS STRUCTURE

The central motif that runs through most of my thesis is that the *quality* of education must become the central focus of education policy and research in South Africa, and indeed throughout Sub-Saharan Africa. Using a variety of different datasets and methodologies, and analysing a number of different - but interconnected - topics my aim is to show that focussing on the over-arching goal of improving the quality of education in Africa is supported by the empirical evidence and is one of the most judicious uses of limited human and physical resources.

The thesis begins by focussing on the South African case and highlighting three broad issues that characterise education in the country: (1) inequality - Chapter 1, (2) cumulative learning deficits - Chapter 2, and (3) language and performance – Chapter 3. The first is addressed in the remainder of this chapter and explains how and why South Africa is a nation divided. Given the political history of colonisation and then apartheid, it is not possible to speak of South Africa without also speaking about inequality. When looking specifically at education one can see two distinct public education systems that operate quite differently to each other and produce vastly different outcomes. After establishing this fact and elucidating some of the implications arising from it, Chapter 2 explores the second characteristic feature of insurmountable learning deficits in mathematics in South Africa.

It is now well acknowledged that irrespective of which grade one chooses to assess, the vast majority of South African children are well behind as far as the curriculum is concerned, and perhaps more importantly, have not reached most of the local and international age-appropriate educational benchmarks. Yet most of the research in the field of educational backlogs in South Africa is either qualitative, empirically unsophisticated, or cross-sectional in nature. All of these limitations make it difficult to determine whether learning deficits in South Africa grow, shrink or remain unchanged as students progress through school. Answering this last question is the aim of Chapter 2.

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The focus then shifts to the complex issue of language and performance, which is addressed in Chapter 3. Here the aim is to exploit an unusual occurrence whereby a large group of South African students were tested twice, one month apart, with the first test being administered in the language-of-learning-and-teaching (LOLT) of the school in grade 3 (usually an African language) and the second test being administered in English. Using a simplified difference-in-difference methodology it becomes possible to identify the causal impact of writing a test in English when English is not a student's home language. The chapter concludes by framing the analysis within the broader language debate in South Africa and specifically the extent to which language factors (relative to non-language factors) can explain the high levels of underperformance in South Africa.

The remaining chapters in the thesis (Chapter 4 and Chapter 5) widen the remit of analysis and move beyond South Africa to look at 11 countries in Sub-Saharan Africa. The quality of education remains the focus of the research but is now analysed and discussed in relation to educational access (enrolment and grade survival). Chapter 4 situates the 'access-quality' discussion and develops a new composite measure encompassing both education quantity (grade survival) and quality (learning outcomes), what I refer to as access-to-literacy and access-to-numeracy. The chapter concludes by using the new method and reporting differences in access-to-learning by important sub-groups for each country.

Chapter 5 extends the analysis presented in the previous chapter by adding an inter-temporal element to the analysis. This is in contrast to Chapter 4, which reported the new statistic for only one point in time (2007). Doing so allows me to show how access-to-learning has changed over a period of increased access (2000 to 2007) for 10 countries in Sub-Saharan Africa and ultimately show that the traditional idea that there is a strong access-quality trade-off has less empirical support than was previously thought to be the case. Chapter 6 concludes.

1.2 BACKGROUND TO SOUTH AFRICAN EDUCATION

Preamble to the South African Schools Act (South Africa, 1996):

> "This country requires a new national system for schools which will redress past injustices in educational provision, provide an education of progressively high quality for all learners and in so doing lay a strong foundation for the development of all our people's talents and capabilities, advance the democratic transformation of society, combat racism and sexism and all other forms of unfair discrimination and intolerance, contribute to the eradication of poverty and the economic well-being of society…"

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In the years following the political transition in South Africa, the most important item on the national agenda was the social, economic and political integration of all South African people, particularly those marginalized under apartheid. After decades of systematic segregation and legislated racial exclusivity, the post-apartheid government faced the mammoth task of expanding service delivery, reducing widespread unemployment, and facilitating economic growth. As a means to this end, and to promote social cohesion, education was prioritized as an area for expansion and reform. Under apartheid there were multiple racially defined departments of education, each of which provided very different types and qualities of education based on the perceived role of that race-group in the apartheid society (Fiske and Ladd, 2004). Given the centrality of education to the inculcation and maintenance of the apartheid ideology, it is unsurprising that this area of social policy was highlighted for systemic reform in the post-apartheid years.

However, while there was a sharp break in political ideology between the pre and post apartheid governments, many of the country's social institutions, such as schools, continued to function as they did under apartheid. The racially defined departments were abolished in favour of nine provincial Departments of Education that operated in collaboration with a single national Department of Education. This being said, schools were and are still managed and run at the school-level by principals and, in the new dispensation, also by school governing bodies. Although the formal schooling institutions of apartheid were abolished (particularly racial segregation and inferior curricula), the informal schooling institutions inherent in non-White[1] schools remained largely intact. These on-going informal institutions of disorder, distrust, rebellion, and lack of cooperation have undermined efforts to create an appropriate culture of teaching and learning in these schools. As the African National Congress (ANC) noted in 1994,

> "Apartheid education and its aftermath of resistance has destroyed the culture of learning within large sections of our communities, leading in the worst-affected areas to a virtual breakdown of schooling and conditions of anarchy in relations between students, teachers, principals, and the education authorities" (ANC, 1994).

Fiske and Ladd (2004, p. 59) further elaborate on this concept and explain that in low income families there was a "lingering fear of education as an instrument of political subjugation" in the years following the political transition. Partly as a result of this social

[1] The use of race as a form of classification and nomenclature in South Africa is still widespread in the academic literature with the four largest race groups being Black African, Indian, Coloured (mixed-race) and White. This serves a functional (rather than normative) purpose and any other attempt to refer to these population groups would be cumbersome, impractical or inaccurate.

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inertia, in combination with a host of other factors, many of the ex-Black schools, which were entirely dysfunctional under apartheid, remain largely dysfunctional today. They are characterized by severe underperformance, high grade repetition, high dropout, and high teacher absenteeism (Fleisch, 2008; Taylor et al., 2003). While many of these factors are certainly attributable to the socio-economic disadvantage of the students they serve, there is also an undeniable impact of more intangible elements such as ill discipline, inefficient management, and low cognitive demand – all legacies of apartheid. This low quality of education is further accentuated when compared to former ‘Model-C’ schools (ex-White) that are not dissimilar to schools in developed countries – both in terms of educational inputs and educational outcomes.

In comparison to some other developing countries, South Africa has a relatively small percentage of students in private schools (called Independent schools in South Africa). Of the 12,489,648 students enrolled in 2013, only 531,804 (or 4.3%) were in Independent schools (DBE, 2013: p1). Of the 425,023 teachers only 33,194 (or 7.8%) were in Independent schools, and of the 25,720 schools in the country, only 1584 (or 6.2%) were Independent schools (DBE, 2013: p1).

1.3 South Africa: A nation divided

Apartheid, which literally means ‘separateness’ in Afrikaans, aimed to create separate, and racially homogenous states, each of which would be ruled by its own people. While this aim was never fully realized, the systematic racial segregation practiced under apartheid, in conjunction with an overtly white supremacist ideology, has had, and continues to have a profound impact on the face of South African society. Twenty years after the political transition, race remains the sharpest distinguishing factor between the haves and the have-nots, and while the upper-class of society is no longer entirely White - due largely to the slow emergence of a Black middle class - approximately 90% of the South African poor are Black (Leibbrandt et al., 2011). The links between affluence and educational quality in South Africa can partially explain this outcome since the poor receive a far inferior quality of education when compared to their wealthier counterparts (Van der Berg, 2007). It is now well established in the literature that the quality and duration of schooling that individuals receive is directly correlated with their labour-market prospects. Consequently, offering an inferior quality of education to the poor disadvantages them in the labour market and entrenches their poverty. What is all the more disconcerting is that this does not refer to a minority of students, but rather the vast majority of the student population.

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In the previous decade, South African primary education has been the subject of much research and debate. Of particular importance are the results of national and international assessments of student achievement. Internationally, South Africa has participated in three major cross-national comparisons of primary school student achievement, namely: SACMEQ[2] (2000 and 2007, grade 6), TIMSS (2003 and 2011, grade 8 and 9), and PIRLS (2006 and 2011, grade 4 and 5), as well as a host of national standardized testing programmes, the most important of which are the Systemic Evaluations (2001 and 2007, grade 3), National School Effectiveness Study - NSES (2007-2009, grades 3-5), and most recently, the Annual National Assessments - ANA (2011-2014, grades 1-6 and 9). All of these datasets have been analysed by academic researchers, policy-makers and educational NGO's yielding a considerable amount of insight[3] into the performance of South African students, and the generative mechanisms behind that performance (Carnoy et al., 2012; Van der Berg et al., 2011). Unfortunately the picture that emerges time and again is both dire and consistent: However one measures learner performance, and at whichever grade one chooses to test, the vast majority of South African primary school learners are significantly below where they should be in terms of the curriculum, and more generally, have not reached a host of normal literacy and numeracy milestones.

National averages of 30-35% on tests of numeracy and literacy are the norm for tests calibrated to measure grade-appropriate performance as a 50% score, and can be seen in both the NSES (Taylor et al., 2013) and the ANA evaluations (DBE, 2011a). Similarly, South Africa either has the lowest average score of all developing countries participating in international assessments (as in TIMSS and PIRLS), or, when the sample is limited to only Sub-Saharan Africa (as in SACMEQ) performs worse than many other countries which are considerably poorer, such as Kenya, Swaziland and Tanzania (Hungi et al., 2010).

In addition to low and unequal performance, the South African education system also exhibits low levels of social mobility (Adato et al., 2006). One way of measuring and comparing educational inequality and social mobility across countries is to calculate what proportion of the variation in reading and mathematics achievement is explained by a student's socioeconomic background. If a high proportion of the variation in achievement is explained by family background and socioeconomic status, this means that we can predict

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[2] SACMEQ – Southern and Eastern African Consortium for Monitoring Educational Quality, TIMSS – Trends in International Mathematics and Science Study, PIRLS – Progress in International Reading and Literacy Study.

[3] The most comprehensive reports for each of these datasets are as follows: SACMEQ (Moloi and Chetty, 2011), TIMSS (Reddy, 2006), PIRLS (Howie, et al., 2008), Systemic Evaluations (Department of Education, 2008), National School Effectiveness Study (Taylor et al., 2013),and the Annual National Assessments (DBE, 2011a).

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educational success or failure based largely on non-schooling factors like parental education and income. Figure 1 and Figure 2 below show this relationship for the fifteen education systems that took part in SACMEQ 2007. The x-axis shows the proportion of the variation in student achievement that is explained by an index of asset wealth (whether or not students had 31 possessions in their homes) and the square of this asset index, mother's education, father's education and the number of books at home – collectively defined as socioeconomic status. One can see that countries such as Tanzania and Swaziland perform well in that they have high quality (SACMEQ scores) and high equity (low proportion of variation explained by socioeconomic status alone). In contrast, South Africa performs slightly below average in terms of quality, but is the most inequitable country by a large measure. More than 30% of the variation in student reading and mathematics achievement in South Africa can be explained by socioeconomic status alone. Many countries both rich (Japan, Finland, Canada) and poor (Tanzania, Kenya, Swaziland) manage to provide adequate basic education to most students, not only the rich, and thus they show that "poor performance in school does not automatically follow from a disadvantaged background" (Schleicher, 2009, p. 253), as indeed it does in South Africa.

As Schleicher (2010) explains, the strength of the relationship between social background and educational outcomes is a good indication of how well a country is utilizing its human capital potential. If the relationship is strong – as it is in South Africa (i.e. socioeconomic status largely determines outcomes) - this means that a country is wasting a lot of its human capital potential.

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FIGURE 1: READING PERFORMANCE IN SACMEQ III (2007) AND THE IMPACT OF SOCIOECONOMIC BACKGROUND

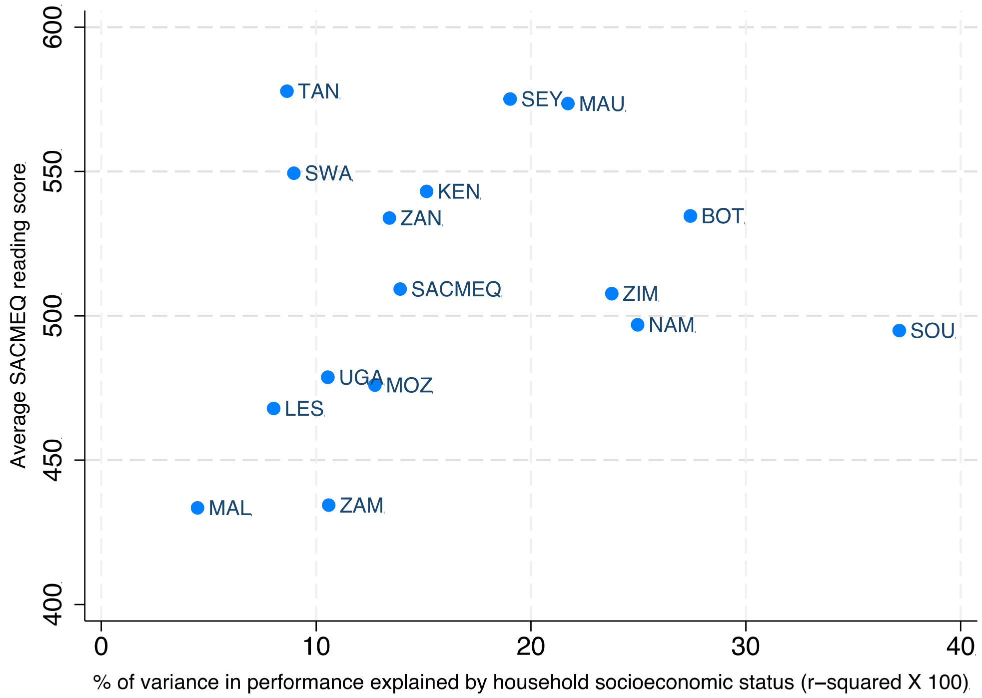
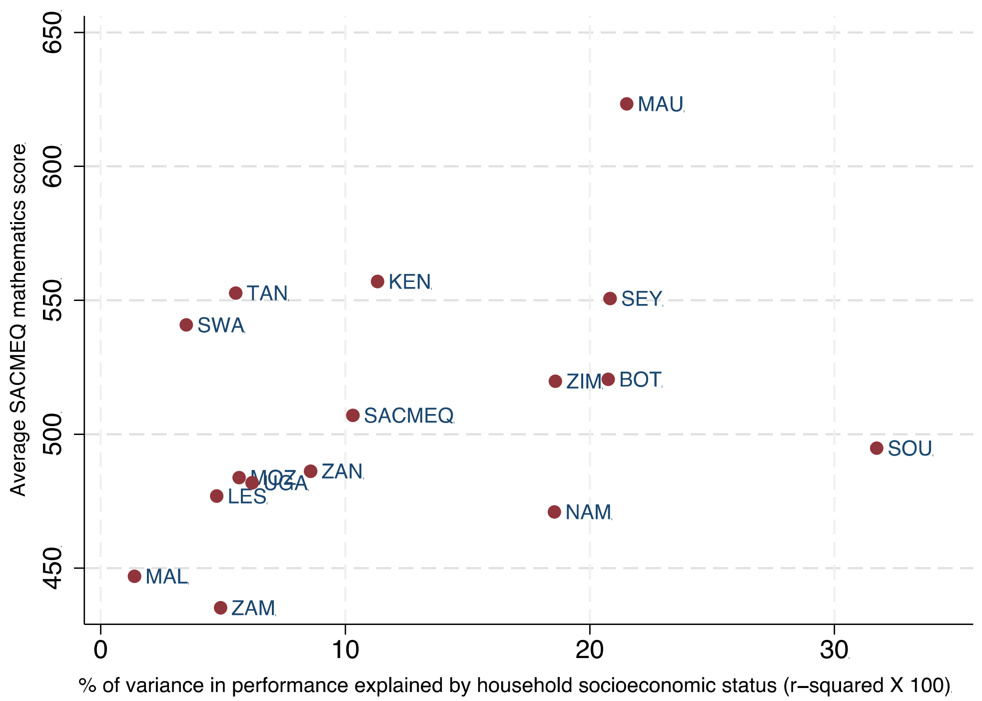


FIGURE 2: MATHEMATICS PERFORMANCE IN SACMEQ III (2007) AND THE IMPACT OF SOCIOECONOMIC BACKGROUND



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Given the highly unequal nature of the South African education system, averages are uniquely misleading. It is now commonly accepted that when looking at learner performance in South Africa there is a minority of learners (roughly 25%) who attend mostly functional schools and perform acceptably on local and international tests while the majority of learners (roughly 75%) perform extremely poorly on these tests (Fleisch, 2008). Thus, there is a bimodal distribution of achievement in the country. As a result, the median reading score (SACMEQ - 464) is significantly lower than the mean (SACMEQ - 495), that is to say that the better performing 25% of students raise the extremely low average of the bottom 75%. Consequently, national averages overestimate the performance of the majority of South African learners since the distribution is skewed to the right. Because of this, the 'average' South African learner does not exist in any meaningful sense. However misleading this measure is, the national and provincial averages of learner performance remain the most commonly reported measure of achievement in government and international reports.

1.4 Bimodality

The bimodality of South African student performance is impervious to the grade or subject under assessment or the dataset under analysis. It can be seen as early as Grade 3 (S. Taylor, 2011), and remains unabated until the national school leaving exam (Van der Berg, 2007). Furthermore, the bimodality of performance can be seen not only when the sample is split by wealth quartiles (Figure 3 - SACMEQ), but also by school language (Figure 4 - PIRLS), and former-department (Figure 5 - NSES). This is unsurprising given the strong correlations between language, socioeconomic status, and current school choice. The fact that these three figures are drawn from three independently conducted surveys at three different grades and at three different points in time further illustrates the consistency of the bimodal distribution in South Africa.

FIGURE 3: DISTRIBUTION OF GRADE 6 READING PERFORMANCE BY SCHOOL WEALTH QUARTILE (DATA: SACMEQ 2007)

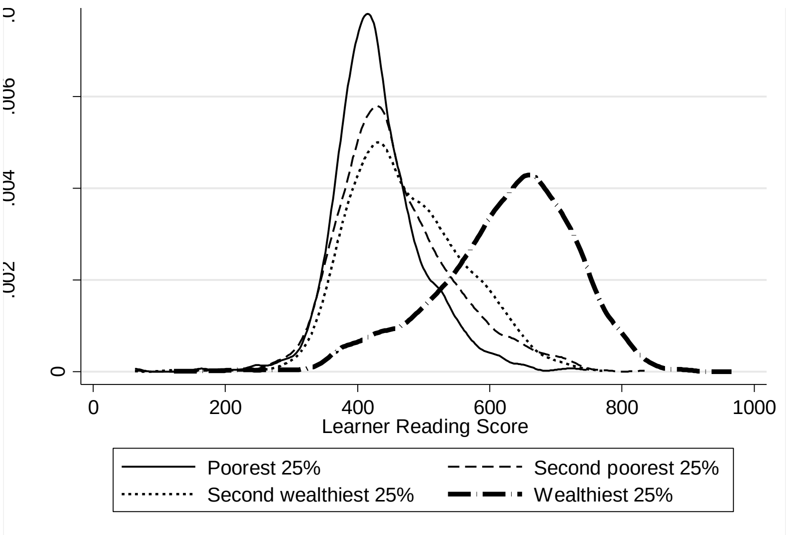

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FIGURE 4: DISTRIBUTION OF GRADE 5 LITERACY ACHIEVEMENT BY LANGUAGE OF SCHOOL (DATA: PIRLS 2006), SOURCE: SHEPHERD (2011)

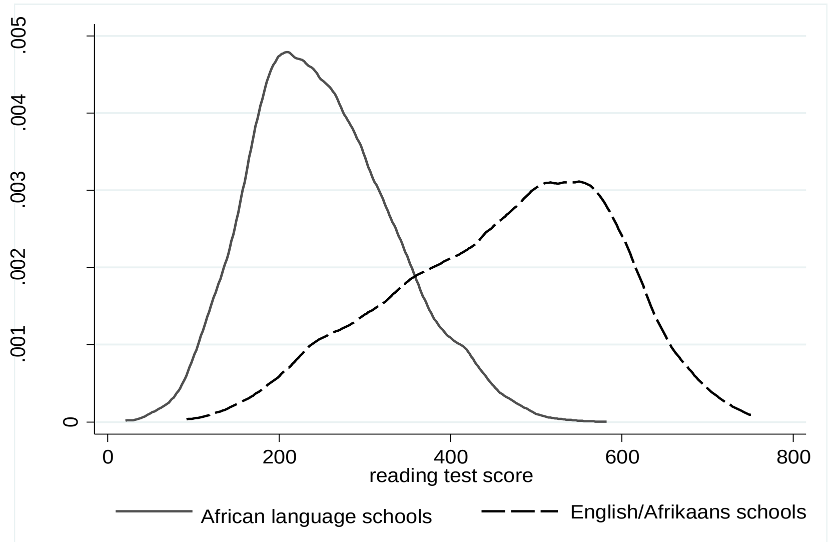
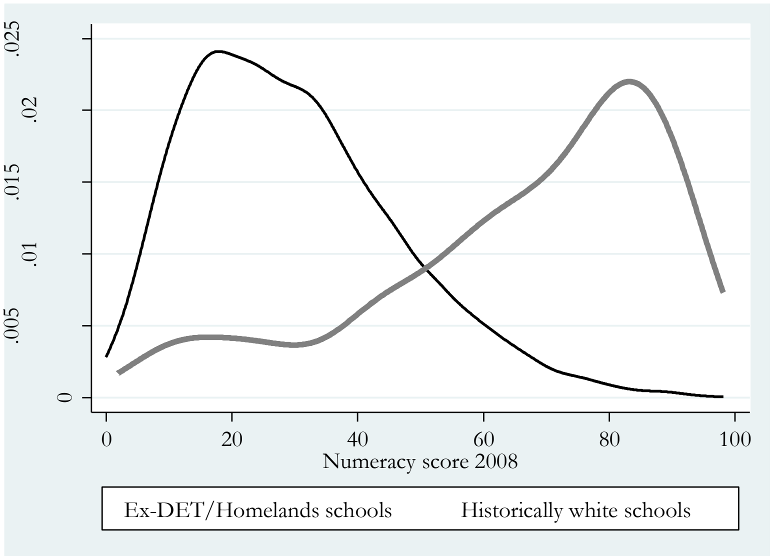


FIGURE 5: DISTRIBUTION OF GRADE 4 NUMERACY ACHIEVEMENT BY HISTORICAL EDUCATION DEPARTMENT (DATA: NSES 2007/8/9) SOURCE: TAYLOR (2011)



Importantly, it is not only student performance that is distributed in this dualistic way, but also various school level and home-background factors. Observing Table 1 shows that the wealthiest quartile (25%) of students seems to attend vastly differing schools than the remaining three quartiles (75%). In top quartile schools students are far more likely to have their own textbook, receive homework frequently, experience less teacher absenteeism, repeat fewer grades, live in urban areas, speak English more frequently at home, and have more educated parents (Table 1). All of these factors are likely to contribute to the better performance of this school sub-system. It is important to note that there is not a steady progression in any of these measures from quartiles one to three (as is the case in most

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other countries); the poorest three quartiles all have similar levels of grade repetition, teacher absenteeism, and textbook access.

The main explanation behind the bimodality of the schooling system in South Africa is twofold: (1) For whatever reason, historically disadvantaged schools remain dysfunctional and unable to produce student learning, while historically advantaged schools remain functional and able to impart cognitive skills; (2) The constituencies of these two school systems are vastly different with the historically Black schools still being racially homogenous (i.e. Black, despite the abolition of racial segregation) and largely poor; while the historically White and Indian schools serve a more racially diverse constituency, although almost all of these students are from middle and upper class backgrounds, irrespective of race.

It is helpful to provide an overview of the extent of racial transformation in the schooling system. Using the Annual National Assessments (ANA), a population-wide testing program implemented in 2011, it becomes possible to do so. Looking at ANA 2012 Grade 6 one can see that of the 950,459 students in the database, 85.6% where Black, 8.4% were coloured, 1.3% were Indian, 4.2% were White and 0.5% were classified as Other. The racial breakdown of schools by ex-department is also revealing. Of the 63,353 students in former White schools (House of Assembly, HOA), 54% were Black, 6.6% were Coloured, 4.1% were Indian 34.3% were White and 1.1% were Other. That is to say that more than half of students in former White schools are Black. These formerly 'White-only' schools are now much more representative of the population (although still not fully representative). In contrast, of the 232,332 students in former Black schools (Department of Education and Training, DET[4]) in 2012, 97.5% were Black. If one looks at the racial breakdown of "good" schools, this shows that Black children also make up the majority in these schools. Of the 87,823 grade 6 students in the best-performing[5] 10% of schools 46,017 (52.4%) were Black and 26,494 (30.2%) were White. In contrast, in the worst performing 50% of schools 93% were Black and 0.08% were White. Importantly those 46,017 Black students in well-performing schools make up only 6.2% of all Black students in grade 6.

An important recent contribution by Yamauchi (2011) provides one explanation for this

[4] Given that there were 18 different education department's, of which the HOA and DET are only two, these figures do not sum to the total number of students in the system. However the DET education department had the largest single number of schools (5,483 schools) among the other systems

[5] Using the average grade 6 mathematics score for each school to rank them in deciles of performance.

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scenario. Using multiple data sources he shows that the spatial segregation policies of apartheid have had lasting impacts on the inequality of opportunity to quality education. Black students usually live far from good schools (situated in expensive neighbourhoods), which make such schools geographically inaccessible, and those same schools usually charge higher school fees, which makes them financially inaccessible. Consequently, ex-Black schools have remained Black, while ex-White schools have become more racially diverse, with wealthier Black, Coloured and Indian students (Soudien, 2004).

The specific reasons for this bimodality are beyond the purview of this chapter; they have been dealt with elsewhere in the literature (Fleisch, 2008; Gustafsson, 2005; Taylor et al., 2013; Van der Berg et al., 2011). It is sufficient for the purposes of this chapter to accept that there is in fact a bimodal distribution of performance in South Africa, and that there are in fact two types of school systems, largely split along historical-school-system and socioeconomic lines. This is not a hypothesis, but rather stating one of the consistent characteristics of education data in South Africa.

There is an important distinction to be made between the South African case and that of most developed countries. In the latter the ‘dysfunctional’ part of the schooling system makes up a minority whereas in South Africa this is the vast majority of the schooling system. Looking at the SACMEQ (2007) Grade 6 data one can see that although the national average reading score was 495 (SD 116), in the poorest 80% of schools the mean reading score was only 460 (SD 91). The fact that this represents 80% of the schooling system and that the standard deviation is 91 means that this ‘dysfunctional’ part of the schooling system may still contribute a large portion of human capital to the economy. For example, of the 1825 students that achieved more than 600 on the reading test, 564 students (31%) came from the poorest 80% of schools.

Following on from the preceding discussion on the bimodality of the South African schooling system, it is worth asking whether the Department of Basic Education in South Africa has taken sufficient cognizance of this feature of the South African schooling system. Two areas where it has particular relevance are (1) for descriptive or reporting purposes, and (2) for prescriptive or policy-making purposes.

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TABLE 1: DISTRIBUTION OF VARIOUS SCHOOLING STATISTICS ACROSS SCHOOL WEALTH QUARTILES (GRADE 6 - SACMEQ 2007 OWN CALCULATIONS)

Category	Variable	School Wealth Quartiles					Quartiles relative to national average				
		1	2	3	4	Total	1	2	3	4	Total
Performance	Reading score	430.5	457.8	474.0	623.7	**494.9**	-13%	-8%	-4%	26%	0%
	Mathematics score	450.9	467.1	470.7	593.8	**494.8**	-9%	-6%	-5%	20%	0%
	Proportion functionally illiterate	43.3%	33.3%	25.6%	4.1%	**27.3%**	59%	22%	-6%	-85%	0%
	Proportion functionally innumerate	56.9%	48.6%	44.8%	8.4%	**40.2%**	42%	21%	12%	-79%	0%
	Reading teacher reading score	731.8	738.9	732.9	827.0	**757.7**	-3.4%	-2.5%	-3.3%	9.1%	0%
	Maths teacher mathematics score	719.6	729.1	751.7	863.5	**763.6**	-5.8%	-4.5%	-1.6%	13.1%	0%
Textbooks	Has own reading textbook	34.4%	42.3%	38.2%	66.1%	**45.0%**	-24%	-6%	-15%	47%	0%
	Has own mathematics textbook	27.6%	35.8%	32.3%	50.9%	**36.4%**	-24%	-2%	-11%	40%	0%
School factors	Homework "Most days of the week"	49.9%	52.1%	46.1%	75.8%	**56.1%**	-11%	-7%	-18%	35%	0%
	Self-reported teacher absenteeism	24.2	22.7	20.1	11.6	**19.7**	23%	15%	2%	-41%	0%
	Repeated at least 2 grades	10.9%	9.3%	10.3%	1.8%	**8.1%**	34%	15%	27%	-78%	0%
	Pupil-Teacher-Ratio	36.3	34.8	35.5	30.5	**34.3**	6%	1%	3%	-11%	0%
	School in urban area	5.5%	21.4%	31.2%	73.3%	**31.9%**	-83%	-33%	-2%	130%	0%
	Student very old (14y+)	23.7%	20.1%	14.0%	2.0%	**15.3%**	55%	31%	-9%	-87%	0%
Home background	Speaks English at home 'Always'	5.6%	7.4%	9.2%	39.5%	**15.3%**	-64%	-52%	-40%	158%	0%
	Student has used a PC before	11.8%	39.9%	51.4%	94.9%	**47.8%**	-75%	-16%	7%	99%	0%
	More than 10 books at home	17.3%	23.0%	30.8%	67.2%	**34.1%**	-49%	-33%	-10%	97%	0%
	At least one parent has matric	29.9%	40.6%	49.3%	77.2%	**48.5%**	-38%	-16%	2%	59%	0%
	At least one parent has a degree	4.7%	7.8%	10.7%	28.7%	**12.8%**	-63%	-39%	-16%	125%	0%

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1.5 IMPLICATIONS OF A DUALISTIC EDUCATION SYSTEM

1.5.1 DESCRIPTIVE AND REPORTING PURPOSES

The practice of regularly reporting educational statistics is important for a variety of reasons. The most prominent of these is to tell if an education system is improving or deteriorating over time, which is necessary for accountability purposes, as well as being able to ascertain what does and does not work. This is especially true in developing countries where it is possible for relatively large changes in educational outcomes to occur in a single decade. In South Africa, most government reports present educational statistics at the provincial level of aggregation, rather than by wealth quartile or quintile[6] (see DBE, 2011b, 2009 for examples). Given that the school system is administrated at the provincial level, and that provinces have a large degree of autonomy, this would seem to be the most logical practice. However, since there are two different types of education systems in South Africa distributed across all provinces, one functional, the other not, reporting mean achievement scores can potentially be very misleading. For example, national and provincial averages always overestimate the achievement of the majority of South African learners because the median is so far below the mean, as discussed above. Similarly for other measures of school functionality, averages shroud the true picture. Looking at self-reported teacher absenteeism, the national average of 19.7 days per year hides significant variation between the four wealth quartiles (Table 1). While teachers in quartile 1, 2 and 3 reported that they were absent for 24, 22, and 21 days respectively, teachers in the wealthiest quartile reported being absent for only 12 days in the preceding year. The same is true for functional illiteracy: while more than 25% of students in the poorest 3 quartiles are functionally illiterate, only 4% of quartile four students are thus classified (Table 1). If one only observed the national average, 27% functional illiteracy, this would not be apparent (see Spaull, 2011, p. 34 for a discussion on the definition of functional literacy used here).

Since there is reason to believe that schools, students and school sub-systems are far more homogenous within wealth quartiles than within provinces, it is somewhat perplexing that the

[6] The Department of Basic Education uses “quintiles” to rank schools based on need. Quintile 1 is supposed to represent the poorest 20% of schools and quintile 5 the wealthiest 20% of schools. However, because funding is allocated based on quintile status, with more funding allocated to lower quintiles, there is a strong incentive for schools to be classified in lower quintiles. Consequently the DBE quintiles do not each represent 20%. For example if one looks at the National EMIS database of December 2011, the proportion of the 24,062 schools in each quintile are as follows: quintile 1 (33%), quintile 2 (24%), quintile 3 (24%), quintile 4 (10%) (This excludes schools without a quintile classification). As one would expect, the number of students in each quintile differs substantially: quintile 1 (2,789,127), quintile 2 (2,292,880), quintile 3 (3,031,453), quintile 4 (1,811,770), and quintile 5 (1,578,450). These do not sum to the total number of students due to “Not applicable” and “To be updated” categories.

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former measure of aggregation is not used more frequently in government reports in addition to provincial averages, which are also important (although for different reasons). If student achievement was reported by wealth quartile or quintile in addition to province, one could determine if national trends are being driven by improvements in the wealthier or poorer schools, or one of a number of possible combinations of results. There is no reason to believe that these vastly differing school sub-systems would both rise or fall uniformly over time, as would be suggested if only a single average score was reported per province. If one agrees that there are indeed two underlying data-generating processes involved (and that average school wealth is strongly associated with performance), then reporting educational statistics by wealth quartile/quintile in addition to province is the most logical way forward.

1.5.2 RESEARCH PURPOSES

The distinction between the two school sub-systems in South Africa is useful not only for descriptive purposes, but also for modelling and analytic purposes. In their report "Low quality education as a poverty trap" Van der Berg et al. (2011, p. 11) explain some of the quantitative reasons why modelling a single education system, when in fact there are two, can lead to spurious results:

> "There are important statistical and methodological reasons to analyse the two sub-systems separately when investigating what drives educational achievement in South Africa. Particular school inputs, teacher practices or other characteristics may affect student achievement differently across the two sub-systems. It is possible, for example, that an advanced media technology may be effective in the well-functioning system but ineffective in the historically disadvantaged system where schools may not have the expertise to implement the technology or the security to protect the equipment from theft and vandalism. In this way, important dynamics in one section of the school system can be glossed over by estimating a single model for the entire school system, alternatively, it is possible that a single model will suggest a relationship that is in fact invalid and is driven by differences between the two sub-systems. For example, it may be that within each sub-system additional resources do not produce improved student achievement, but that the one system has far superior resource endowments than the other and also produces better student achievement. Treating these two systems in a single model would suggest that additional resources do lead to better student achievement, when in fact this merely reflects overlapping differences between the two systems" (Van der Berg et al., 2011, p. 11).

Given the bimodality of student performance seen in the SACMEQ 2007 South Africa data (Figure 1), and the dualistic nature of many educational inputs and indicators (Table 1), student performance is disaggregated by socioeconomic quintile in Chapter 2, Chapter 4 and Chapter 5. Given that the focus of Chapter 3 is on language (rather than socioeconomic status), the analysis in that chapter is split along linguistic lines. Language is one of the

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numerous inter-connected and highly correlated factors in the South African context and thus provides a useful lens through which to observe South African student performance. Unless otherwise stated, the measures of socioeconomic status used throughout this thesis are either those created by particular research organizations (like SACMEQ or TIMSS) or is the first component of a Principal Component Analysis (PCA) of available possession questions.

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CHAPTER 2: THE CASE OF INSURMOUNTABLE LEARNING DEFICITS IN MATHEMATICS

2.1 INTRODUCTION

Few would argue that the state of mathematics education in South Africa is something other than dire. This belief is widespread among academic researchers and those in civil society, and is also strongly supported by a host of local and international assessments of mathematical achievement extending back to at least 1995 (Fleisch, 2008; Howie and Hughes, 1998; Reddy, 2006; Spaull, 2013; Taylor et al., 2013). Many of these studies, and particularly those that focus on mathematics, have identified that students acquire learning deficits early on in their schooling careers and that these backlogs seem to be the root cause of underperformance in later years. They argue that any attempts to raise students' mathematical proficiency must first address these deficits if they are to be successful (Taylor et al., 2003). The present study adds further evidence to this body of work by using nationally representative data over multiple grades to provide some indication of the true size and scope of these learning deficits.

Both Prichett and Beatty (2012) and Banerjee and Duflo (2012) have identified that students in developing countries have large learning deficits. They show that even children with relatively high levels of educational attainment often have very few cognitive skills to show for all their years of schooling. They theorise that this is the result of weaker students falling progressively further and further behind the curriculum to the extent that they eventually fall so far behind that no learning takes place whatsoever. Muralidharan and Zieleniak (2013) found support for this hypothesis with data from the Andra Pradesh Randomized Evaluation Studies from India, by means of tracking the learning of a group of students over a five year period. Their results show that only 60% of students reach a grade 1 level after five years of formal full-time schooling, and furthermore, that the learning trajectories of the weakest performers flatten off completely in the later grades. This provides empirical support to Lewin's (2007, p. 10) notion of 'silent exclusion' where students are enrolled and attending school but learning little.

In South Africa, research in this area has generally focussed on in-depth localized studies of student workbooks and classroom observation (Ensor et al., 2009). For some examples, Carnoy *et al.* (2012) observe mathematics learning in grade 6 classrooms from 60 schools in one South African province (North West) and compare these classrooms to 60 schools in neighbouring Botswana (see also Carnoy and Arends, 2012). On a smaller scale, Venkat

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and Naidoo (2012) focus on 10 primary schools in Gauteng and analyse coherence for conceptual learning in a grade 2 numeracy lesson. Similarly Schollar (2008) conducted interviews and classroom observations as well as analysed a large sample of learner scripts to determine the development (or lack thereof) of mathematical concepts through the grades.

Where the present research differs from these earlier studies is that it focuses on quantifying national learning deficits in mathematics, rather than in specific mathematical learning areas. While the latter are essential for understanding what the problems are and how to fix them, analyses at the national level are also needed if we are to understand the extent and distribution of the problem, both of which are imperative for policy-making purposes. This is only possible by analysing multiple nationally representative surveys of student achievement, which is the focus of the present study. The two core research questions that are addressed in this chapter are as follows:

1. How large are mathematics learning deficits in South Africa and how are they distributed in the student population?
2. Do mathematics learning deficits grow, shrink or remain unchanged as students progress to higher grades?

To answer these questions analysis was performed on four nationally representative datasets of mathematics achievement, namely: (1) the Systemic Evaluation 2007 (grade 3), (2) the National School Effectiveness Study 2007/8/9 (grade 3, 4 and 5), (3) the Southern and Eastern African Consortium for Monitoring Educational Quality (SACMEQ) 2007 (grade 6), (4) and the Trends in International Mathematics and Science Study (TIMSS) 2011 (grade 9).

2.2 Background

Independent studies in economics, neuroscience and developmental psychology all confirm that the mastery of the skills which are essential for economic success and personal development largely follow hierarchical rules (Knudsen et al., 2006). The later acquisition of these skills builds on the foundations laid down in earlier years. That is, earlier mastery of certain cognitive, social and emotional capabilities help foster more efficient learning at later ages. Conversely, the lack of certain capabilities creates a low ceiling beyond which progress is improbable. Developing a theory of learning that incorporates these insights, Robert Gagné (1962) proposed the notion of 'learning hierarchies' as a set of ordered intellectual skills which are hierarchically inter-related. He posited that a final capability can

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be broken into subordinate skills in such a manner that lower-level capabilities generate a substantial amount of positive transfer to the learning of higher order capabilities that have not yet been acquired (see also Scandura and Wells, 1967). These theories have considerable empirical support, with numerous studies finding early numeracy skills to be good predictors of later mathematics performance (Aubrey and Godfrey, 2003; Aubrey et al., 2006; Aunio and Niemivirta, 2010). Counting skills, in particular, have been shown to estimate basic arithmetic skills in the early grades of primary school relatively accurately (Aunola et al., 2004; Desoete et al., 2008; Jordan et al., 2007).

An epistemological analysis of mathematics reveals a latent hierarchy of knowledge and intellectual skill - what Posner and Strike (1976) refer to as content structure; "Content structure refers to the content elements and the ordering relationships that exist between them … Most questions about content structure can be reduced to questions concerning what content comes before what other content and the rationale for that order" (Posner and Strike, 1976, p. 666 cited in; Reeves and McAucliffe, 2012, p. 11). Consequently the acquisition of higher order knowledge and intellectual skills requires first the mastery of subordinate skills and a clear understanding of foundational mathematical knowledge. This implicit knowledge structure is made explicit in the sequencing and structuring of curricula where simple antecedents precede more complex concepts and ways of thinking. Although this is true of many - if not most - subjects, mathematics is perhaps the best example of such a subject due to the strong vertical demarcation and integration of concepts. For example, without an understanding of the concepts of number and equipartitioning a student will not be able to understand or manipulate fractions which are necessary for fraction equivalence and comparison.

The extant research on mathematics learning in South Africa strongly supports this conclusion with numerous researchers highlighting the inadequate acquisition of basic skills and the consequent negative effects on furtherP learning. Taylor and Vinjevold (1999) summarise the findings from 54 studies[7] commissioned by the President's Education Initiative and conclude that:

> "At all levels investigated by the [President's Education Initiative], the conceptual knowledge of students is well below that expected at the respective grades. Furthermore, because students are infrequently required to engage with tasks at any but the most elementary cognitive level, the development of higher order skills is stunted" (Taylor and Vinjevold, 1999, p. 231).

[7] The full list of research papers can be found at http://www.jet.org.za/publications/pei-research

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This lack of engagement with higher order content is the prime focus of Muller and Reeves' (2005) analysis of Opportunity-to-Learn (OTL) and mathematics achievement in South Africa, where OTL is the curriculum actually made available to learners in the classroom (see also Reeves et al., 2013a). Taylor et al. (2003, p. 129) in their book *Getting Schools Working* summarise succinctly the debilitating effects of cumulative learning deficits:

> "At the end of the Foundation Phase [grades 1-3], learners have only a rudimentary grasp of the principles of reading and writing. ... it is very hard for learners to make up this cumulative deficit in later years ... particularly in those subjects that ... [have] vertical demarcation requirements (especially mathematics and science), the sequencing, pacing, progression and coverage requirements of the high school curriculum make it virtually impossible for learners who have been disadvantaged by their early schooling to 'catch-up' later sufficiently to do themselves justice at the high school exit level.'

And lastly, Schollar (2008) summarises the findings of the Primary Mathematics Research Project which looked at over 7000 learners from 154 schools in South Africa and concludes as follows:

> "Phase 1 concluded that the fundamental cause of poor learner performance across our education system was a failure to extend the ability of learners from counting to true calculating in their primary schooling. All more complex mathematics depends, in the first instance, on an instinctive understanding of place value within the base-10 number system, combined with an ability to readily perform basic calculations and see numeric relationships … Learners are routinely promoted from one grade to the next without having mastered the content and foundational competences of preceding grades, resulting in a large cognitive backlog that progressively inhibits the acquisition of more complex competencies. The consequence is that every class has become, in effect, a 'multi-grade' class in which there is a very large range of learner abilities and this makes it very difficult, or even impossible, to consistently teach to the required assessment standards for any particular grade. Mathematics, however, is an hierarchical subject in which the development of increasingly complex cognitive abilities at each succeeding level is dependent on the progressive and cumulative mastery of its conceptual frameworks, starting with the absolutely fundamental basics of place value (the base-10 number system) and the four operations (calculation)" (Schollar, 2008, p. 1).

However, few of these studies use nationally representative samples in their analysis of student achievement, and none when looking specifically at learning deficits. This is not to say that there have not been a number of reports that have looked at the nationally

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representative datasets of educational achievement in South Africa[8]. However, these reports do not focus on learning deficits but rather the levels and trends of performance in the country. In this sense there is a bifurcation in the literature where small-scale studies focus on learning deficits without being able to make population-wide claims, while large-scale studies which can make population-wide claims do not look specifically at learning deficits.

2.3 Data

To construct the learning trajectories of South African children, it is necessary to have objective measures of achievement at multiple points in the education system. For the present analysis three data sets are used which cover five grades from grade 3 to grade 9. The data are drawn from the National School Effectiveness Study (NSES) for grades 3, 4 and 5; from the Southern and Eastern African Consortium for Monitoring Educational Quality (SACMEQ) for grade 6; and from the Trends in International Mathematics and Science Study (TIMSS) for grade 9. Given that some reference is made to the Systemic Evaluation of 2007 (grade 3) background information for that data set is also provided.

2.3.1 Systemic Evaluation – grade 3 (2007)

The 2007 Systemic Evaluation tested a nationally representative sample of grade 3 students in numeracy and literacy. A random sample of about 54 000 grade 3 students from 2 340 primary schools participated in the study (DoE, 2008). These students were assessed though standardised literacy and numeracy tests that measured their levels of achievement in terms of the grade appropriate curriculum. To achieve this measure, the test included grade 1 to grade 4 level questions, with the vast majority being set at the grade 3 level. The tests were administered in all 11 official South African languages according to the Language of Learning and Teaching (LoLT) specified by the school.

2.3.2 National School Effectiveness Study (NSES) – grade 3 (2007), grade 4 (2008), grade 5 (2009)

The NSES study is the first large-scale (almost nationally representative[9]) panel data set which focuses specifically on schooling and educational outcomes (for a full discussion see

[8] For some examples see Fiske and Ladd (2004), Reddy (2006), Fleisch (2008), Taylor and Yu (2009), Van der Berg, et al., (2011), Moloi and Chetty (2011) and Spaull (2013).

[9] The panel does not include Gauteng but is representative of the other 8 provinces. Gauteng was not included in the NSES sample due to the fact that other testing was being conducted in that province at the same time. To give some idea of how this could influence the results, I briefly analysed the SACMEQ (2007) grade 6 reading and maths data sets and calculcated summary statistics including and excluding Gauteng. The mean reading score for SACMEQ South Africa was 495 (SD 116) and the mean maths score was 495 (SD 98). However when

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Taylor et al., 2013). The panel followed one cohort of students and tested them in grade 3 (2007), grade 4 (2008) and grade 5 (2009). Approximately 15 000 students from 266 schools were tested each year with 8 383 students matched consistently across the three years and 24 000 tested in total across the three years. In this chapter the 8 383 students who were observed in all three years are referred to as the panel sample, while the full 24 000 students are referred to as the full sample. The students wrote the exact same literacy and numeracy tests in each consecutive year, thereby producing comparable results over time. Both the literacy and numeracy test paper were exact replicas of the Systemic Evaluation (2007) test papers, with the exception that the NSES was administered only in English. The questions included in the literacy and numeracy tests ranged from grade 1 to grade 4 level, specified according to the National Curriculum Statement (NCS).[10] Additional information with regards to student background, teacher characteristics and school principal characteristics were also collected over those years.[11]

2.3.3 Southern and Eastern African Consortium for Monitoring Educational Quality (SACMEQ) – grade 6 (2007)

SACMEQ is a consortium of 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 participating countries in Africa (Moloi and Strauss, 2005, p. 12; Murimba, 2005). These surveys collect extensive background information on the schooling and home environments of grade 6 students, and in addition, test students and teachers in both numeracy and literacy (see Hungi et al., 2010; Ross et al., 2005). Currently there are 15 participating countries including South Africa. The data set used for the present analysis is SACMEQ III (2007) South Africa, which tested 9071 grade 6 students from 392 schools, forming a large nationally representative sample (Moloi and Chetty, 2011).

2.3.4 The Trends in International Mathematics and Science Study (TIMSS) – grade 9 (2011)

one excludes Gauteng the mean scores and the standard deviations drop. The mean reading score for the 8 provinces (i.e. excluding Gauteng) was 479 (SD 108) and the mean maths score for this group was 484 (SD 94). This is to be expected since Gauteng is a relatively well-performing province with above-average variation in acheivment.

[10] The National Curriculum Statement is the curriculum which was taught in schools from 2002 until 2009 (Department of Education, 2002).

[11] Teacher questionnaires were only administered in the years 2008 and 2009.

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TIMSS is a cross-national study which tests the mathematics and science knowledge of grade 8 students in over 60 countries in such a way that they are comparable across countries and over time (Mullis et al., 2012). In the 2002 TIMSS, South Africa tested grade 9 students in addition to grade 8 students, since earlier rounds of TIMSS indicated that the international grade 8 test was too difficult for South African students, and consequently too many students were performing at guessing level on the multiple choice questions (i.e. no better than random). This decreases the reliability and accuracy of the tests (Foy et al., 2010) and thus in 2011, only grade 9 South African students wrote the TIMSS grade 8 test. In TIMSS 2011 South Africa tested a nationally representative sample of 11 969 grade 9 students from 285 schools in both mathematics and science (Reddy et al., 2012).

2.4 Learning Deficits

2.4.1 The South African case

Given the cumulative nature of learning deficits, it seems logical to determine when these learning deficits arise, as well as their size and distribution in the student population. In an ideal world one would have longitudinal data on the social, emotional and cognitive skills of children before they enter school and then follow these same children as they progress through school, assessing them at each grade. Such data would allow for the disaggregation of learning deficits and indicate which portion of the deficit is from a child's home background and which portion is from the child's schooling experiences (see, for example, the Early Childhood Longitudinal Study by the Institute of Educational Science in the USA). Unfortunately these data do not yet exist in South Africa. Although the recent Annual National Assessments (ANAs) tested all South African grade 1-6 students in 2011, 2012, 2013 and 2014, these tests were not psychometrically calibrated to be comparable over time or across grades making them unusable for comparison purposes (for a full discussion see Spaull, 2013). Although there are no reliable nationally-representative data sets for grades 1 or 2, there are two studies which tested nationally representative samples of grade 3 students in 2007. The first of these studies was the 2007 Systemic Evaluation (SE) conducted in September 2007 and the second study, the National School Effectiveness Study (NSES) tested a sub-sample of students from the Systemic Evaluation one month later in October 2007. The only difference between the Systemic and NSES grade 3 tests was that the Systemic Evaluation (September) was conducted in the language of learning and teaching (LOLT) of the school – i.e. all 11 official languages - whereas the NSES test (October) was conducted only in English.

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The school language policy in South Africa is currently implemented in such a way that the language of learning and teaching (LOLT) for the vast majority of students is their home-language for grades 1, 2 and 3 and that from grade 4 there is a LOLT switch to English for the remaining school years (Taylor and Coetzee, 2013).[12] Given that the grade 3 Systemic Evaluation of 2007 was conducted in the language of learning and teaching of the school, this should provide an accurate reflection of the state of mathematics learning at the grade 3 level since there are no obvious confounding language factors. The grade 3 Systemic Evaluation mathematics test consisted of 53 questions which varied according to the nature of the mathematical tasks, the difficulty level of the items, whether the item was in verbal or symbolic form, and whether the item was multiple choice or free response (Vorster et al, 2013) . Furthermore, the question items were also classified by learning area and grade-level in accordance with the prevailing curriculum, the National Curriculum Statement (NCS). Of the 53 questions in the test, three were set at a grade 1 level, 14 at a grade 2 level, 30 at a grade 3 level, and six at a grade 4 level. Using this information I calculate the average numeracy score for each child using only the subset of 30 grade-3 level questions. The reason for this sub-classification is to calculate the proportion of students that are performing at the grade-appropriate level in grade 3. Following Muralidharan and Zieleniak (2013) students are classified as performing at the grade-appropriate level if they obtain a mean score of 50% or higher on the full set of grade 3 level questions.

Figure 6 below shows the distribution of mean grade 3 performance on grade 3 level items disaggregated by quintile of student socioeconomic status into the wealthiest 20% of students (Quintile 5) and the poorest 80% of students (Quintile 1-4). All students achieving a mean score of 50% or higher can be said to be performing at the grade-appropriate level. The graph reveals the dire situation in South Africa where the vast majority (88%) of Quintile 1 – 4 students in grade 3 are not performing at the grade-appropriate level. Looking at the distribution of Quintile 1-4 students, it becomes clear that these students are substantially behind the benchmark (50%). The majority of Quintile 1-4 students are concentrated around the 20% performance mark, a full one and a half standard deviations below the 50% threshold. Although Quintile 5 students perform much better than their poorer counterparts, only slightly more than half (51%) are performing at the grade-appropriate level (see Table 2 below).

[12] English and Afrikaans students learn in their home-language from grade 1 to grade 12 and do not switch in grade 4. For a full discussion of the school language dynamics in South Africa see Taylor and Coetzee (2013).

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FIGURE 6: KERNEL DENSITY OF MEAN GRADE 3 PERFORMANCE ON GRADE 3 LEVEL ITEMS FOR QUINTILE 1-4 (POOREST 80% OF STUDENTS) AND QUINTILE 5 (WEALTHIEST 20% OF STUDENTS) (SYSTEMIC EVALUATION 2007)

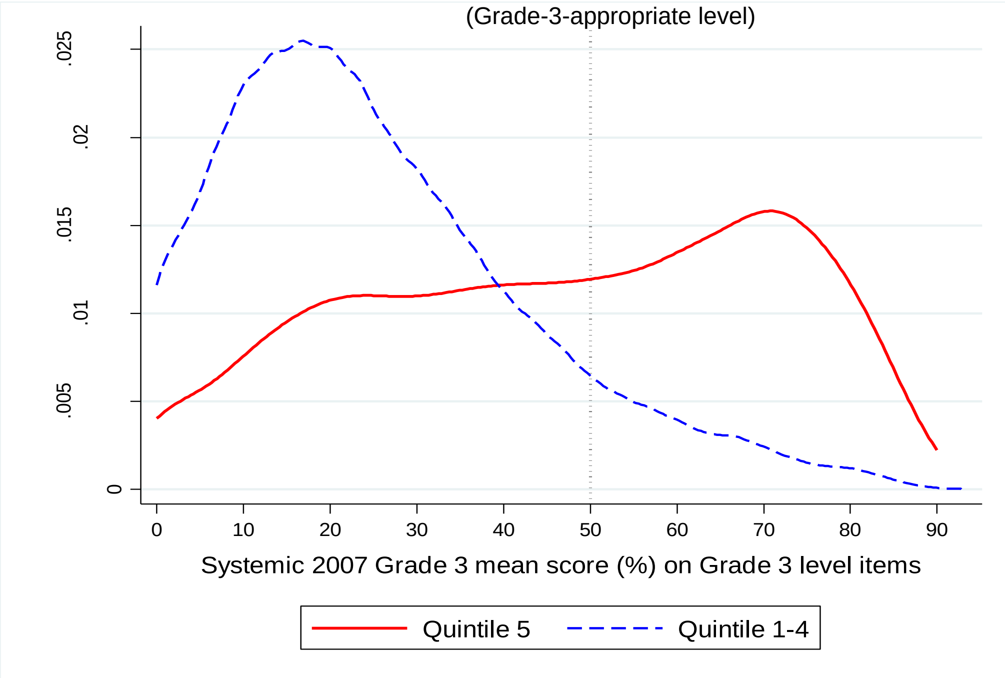

TABLE 2: PROPORTION OF GRADE 3 STUDENTS PERFORMING AT THE GRADE 3 LEVEL BY PROVINCE AND STUDENT SOCIOECONOMIC QUINTILE (SYSTEMIC EVALUATION 2007)

Province	Proportion of grade 3 students performing at the appropriate grade 3 level*	Quintile of student SES	Proportion of grade 3 students performing at the appropriate grade 3 level*
Eastern cape	17%	Quintile 1	10%
Free State	25%	Quintile 2	10%
Gauteng	26%	Quintile 3	12%
KwaZulu-Natal	13%	Quintile 4	29%
Limpopo	6%	Quintile 1-4	11%
Mpumalanga	11%	Quintile 5	51%
North West Province	10%		
Northern Cape	17%		
Western Cape	32%		
South Africa	16%		

** Students are classified as performing at the grade-appropriate level if they obtain a mean score of 50% or higher on the full set of grade 3 level questions. Quintile 1 is the poorest 20% of students and Quintile 5 is the wealthiest 20% of students using an index of student socioeconomic status.*

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If one looks at the country as a whole, less than one in five (16%) grade 3 students are performing at the grade 3 level. That is to say that only the top 16% of grade 3 students are performing at the grade 3 level. Importantly, these Systemic assessments were conducted in the language of learning and teaching (LOLT) of the school in grade 3, i.e. before any switch to English in grade 4.

It is indisputable that by grade 3 there already exist large learning deficits such that the vast majority of South African students (eight year olds) are well behind the curriculum. However, the origin of these learning deficits is less clear. Without longitudinal data on student achievement which covers the period before and during primary school, one cannot determine the source of these deficits, i.e. are they primarily attributable to having a disadvantaged home background, weak early childhood development or weak instruction in grades 1, 2 and 3? Although we cannot answer this question with the data available in South Africa, we can answer another important and related question; whether learning deficits grow, shrink or remain constant as students' progress through the schooling system. To answer this question one needs to look at surveys of student performance at multiple points in the education system.

2.4.2 Learning deficits in grades 3, 4 and 5

One of the major nationally-representative datasets of student achievement in South Africa - and the only educational panel dataset in the country - is the National School Effectiveness Study (NSES) covering grades 3, 4 and 5. All NSES tests were written in English only. Given the complex language dynamics in South Africa, with most students switching language in grade 4, I chose to sub-classify the items in the mathematics test into "high-language" items and "no-language" items. An item was said to be a "high language" item if it was practically impossible to solve the problem without an understanding of the language, whereas items were classified as "no language" items if they required no language proficiency to solve them (i.e. they were entirely in number/symbol format). Of the 53 questions in the test 12 items[13] had high language content and 15 items[14] had no language content.

By focussing on the 'no-language' items and observing how students perform on these items as they progress from grade 3 to grade 5 it is possible to isolate the effect of increased mathematical proficiency from any confounding language factors. If we use the 50%-on-grade-three-level-items threshold as a measure of the proportion of students operating at a

[13] These 12 items were questions 10, 19, 22, 27, 29, 30, 33, 38, 43, 51, 52 and 53.

[14] These 15 items were questions 20, 21, 24, 25, 26, 28, 31, 32, 35, 36, 37, 39, 40, 41 and 42.

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grade three level (as in Figure 6 above), and now also impose the "no language" restriction, we are left with nine items. In Panel 1 of Figure 7 below, only 8% of grade 3 students from Quintile 1-4 were performing at the grade 3 level according to these nine items. By contrast, 35% of Quintile 5 students were performing at the grade-appropriate level. The second panel of Figure 7 shows that by grade 5 this figure has increased substantially to 26% for Quintiles 1-4 and 55% for Quintile 5 students. It is disconcerting to note that only one in four (26%) grade *five* students from Quintile 1-4 were operating at a grade *three* level in 2009, at least according to these nine items, and furthermore that 45% of the wealthiest students (Quintile 5) are still not operating at a grade 3 level by the end of grade 5.

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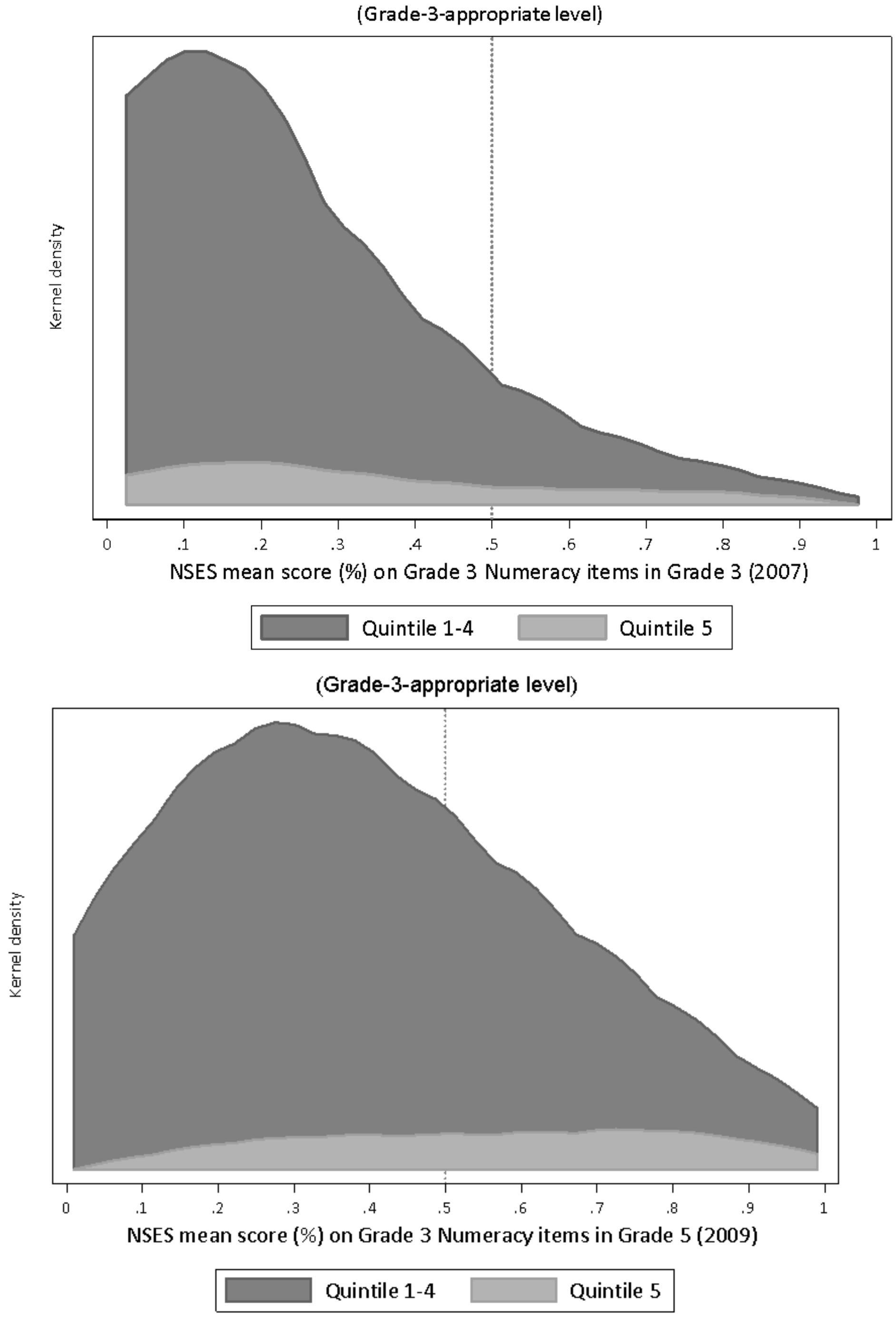
FIGURE 7: NSES GRADE 3 (PANEL 1) AND GRADE 5 (PANEL 2) PERFORMANCE ON NO-LANGUAGE ITEMS BY QUINTILE OF STUDENT SOCIOECONOMIC STATUS (WEIGHTED AND OVERLAYED - FULL SAMPLE)



The above graphs clearly show that the majority of South African children are underperforming relative to the grade-appropriate curriculum. However, such aggregated measures make it difficult to appreciate just how low the levels of performance really are, and how little learning occurs over the three years from grades 3 to 5. To provide an alternative measure of performance, two examples of no-language items in NSES are

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included below. The graphs show when students answer the question correctly – i.e. in grade 3, grade 4, grade 5 or not by the end of grade 5. Given that one needs to follow the same students from grade 3 to 5 the sample is limited here to the panel sample of NSES students only (8383 students). Figure 8 below shows a simple question testing two and three digit addition with no carrying. This is within the grade 3 curriculum which states that students should be able to "perform calculations using the appropriate symbols to solve problems involving addition of whole numbers with at least three digits." Although this is a grade 3 level item and contains no language content, only 20% of Quintile 1-4 students could answer this correctly in grade 3, with the proportion in Quintile 5 being twice as high (42%) but still low. While there is evidently some learning taking place in grade 4 and 5, more than 40% of Quintile 1-4 children still could not answer this grade 3 level problem at the end of grade 5. In Quintile 5 this figure was only 22%.

FIGURE 8: NATIONAL SCHOOL EFFECTIVENESS STUDY - PROPORTION OF STUDENTS ANSWERING THE ITEM CORRECTLY BY GRADE AND QUINTILE OF STUDENT SOCIOECONOMIC STATUS (NSES QUESTION 21)

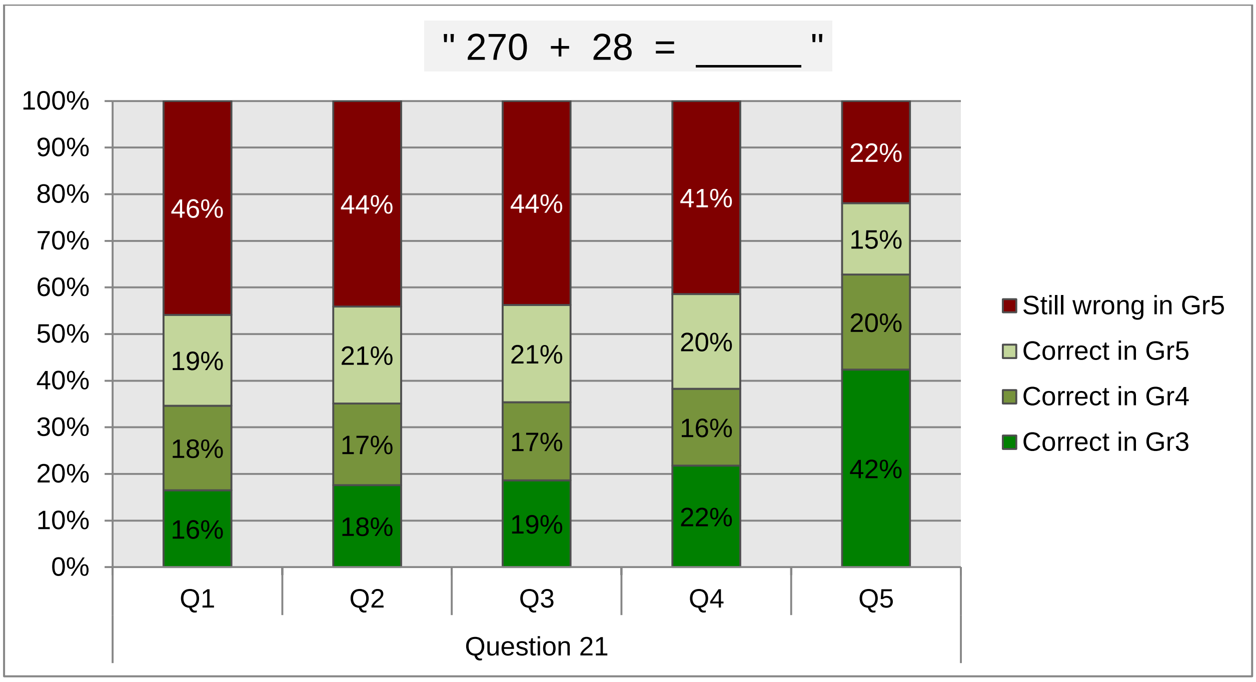
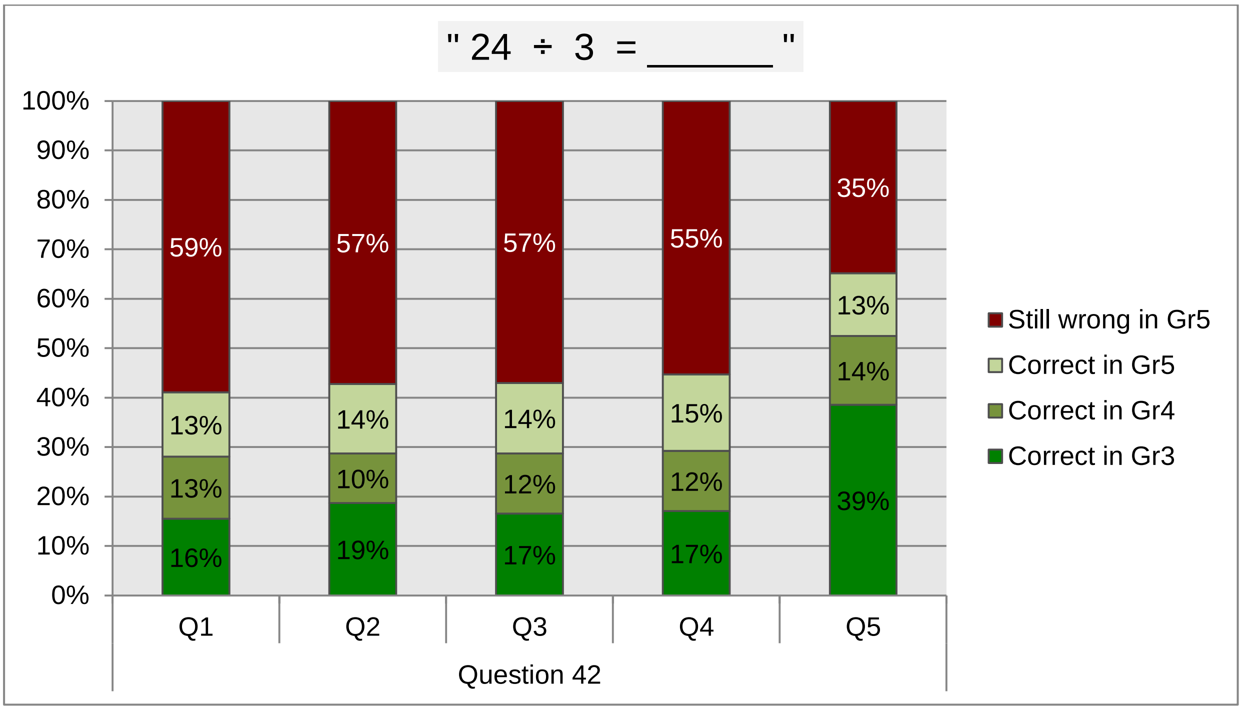


Figure 9 below shows a similar situation where the vast majority of grade 3 children cannot answer this grade 3 division problem. While some children learn the skill in grade 4 or 5, the majority of children still cannot answer this problem at the end of grade 5, despite it being set at the grade 3 level.

FIGURE 9: NATIONAL SCHOOL EFFECTIVENESS STUDY - PROPORTION OF STUDENTS ANSWERING THE ITEM CORRECTLY BY GRADE AND QUINTILE OF STUDENT SOCIOECONOMIC STATUS (NSES QUESTION 42)



It is important to remember that while the NSES mathematics test (set at the grade 3 level) was the same in grades 3, 4 and 5, the expectations of the curriculum in each year proceeded unhindered by the fact that most children still had not acquired the necessary foundational skills in the previous grade. Weak assessment practices combined with low expectations and institutional inertia mean that most students are promoted to the next grade irrespective of whether or not they have acquired the necessary skills in the previous grade (Van der Berg et al., 2011). The growing disconnect between the real mathematics proficiency of students relative to the expectations of the curriculum mean that students fall further and further behind even while they proceed to higher grades eventually leading to a situation of “silent exclusion” (Lewin, 2009).

2.5 MOVING FROM LEARNING DEFICITS TO LEARNING TRAJECTORIES

While the previous sections have identified the proportion of students that are not operating at a grade 3 level, they do not provide much guidance in terms of learning trajectories into later grades. The figures above show that some students are only learning part of the grade 3 curriculum in either grade 4 or grade 5 and that many never seem to acquire these skills. However one cannot say to what extent they are also acquiring grade 4 level skills in grade 4 and grade 5 level skills in grade 5, although this is unlikely. This is because the NSES test was set at a grade 3 level with only a small number of questions set at the grade 4 level.

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One could use SACMEQ (grade 6) and TIMSS (grade 9) as measures of mathematical proficiency at higher levels, but these tests are not calibrated to be comparable to each other, or to earlier tests like the NSES. This is problematic since learning trajectories require data points distributed across the full range of educational phases. One alternative method to overcome the lack of *inter*-survey comparability is to measure the size of learning deficits in each data set using *intra*-survey benchmarks.

While most benchmarks in education are norm-referenced benchmarks (like being able to read by the age of eight), it is also possible to use the achievement level of an identifiable group as one benchmark, particularly when the composition of that group is relatively stable over time. For the purposes of the present analysis a benchmark was created which was equal to the average performance of South Africa's quintile five students (i.e. wealthiest 20% of students) in each survey. There are three reasons why this is a useful and appropriate benchmark: (1) Given the low intra-generational social mobility in South Africa, there is a strong case to be made that the size and composition of the wealthiest 20% of students is relatively stable over time; (2) Previous South African research has shown that this particular grouping of students performs noticeably better than the South African average, and can be seen as having its own data generating process, as discussed in Chapter 1 (Spaull, 2013); and (3) The quintile[15] system is a widely used and recognized form of classification, appearing in government reports and academic research alike.

For the analysis the average performance of quintile five students was calculated for each of the following three assessments: NSES[16] 2007/8/9 for grades 3, 4 and 5; SACMEQ 2007 for grade 6; and TIMSS 2011 for grade 9. This level of performance was then used as the reference category to compare other levels of performance (by quintile and province) relative to these within-survey benchmarks. The Quintile 5 average was set to be equal to the "grade-appropriate level" and used to compare all other levels of performance relative to this Quintile 5 average. It is important to note that this is necessarily a lower-bound estimate of curriculum mastery or grade-appropriate performance since some Quintile 5 students will not be performing at the grade appropriate level. The preceding analysis of the Systemic Evaluation 2007 and NSES 2007/8/9 has shown that this is in fact the case – many Quintile

[15] This can be a source of confusion since researchers and departmental officials can mean different things when they talk about "quintiles." As mentioned earlier, departmental 'quintiles' are not quintiles in the sense that they represent 20% of the underlying population. In contrast the quintiles used in this thesis are actual quintiles (20% each). They are all quintiles of students socioeconomic status unless otherwise mentioned.

[16] To ensure that there are no confounding language factors we only use the sub-set of 15 no-language items for the NSES grade 3, 4 and 5 scores. A sensitivity analysis is provided later in the Chapter which compares the full test results with that of the sub-set of 15 no-language items. This can be found in Table 3.

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5 students are performing well below the expectations of the curriculum. Notwithstanding the above, this is still a useful benchmark against which to compare other sub-groups. While the ultimate aim of any education system is to ensure that all children attain the full curriculum and exhibit sufficient mastery of it, comparisons to the tangible group of Quintile 5 students in the country has more conceptual purchase than pegging the benchmark to a somewhat arbitrary point of curriculum mastery that is in any event not possible to do with the current data.

By using all three data sets (NSES, SACMEQ and TIMSS), it is possible to calculate the difference in scores between the average Quintile 5 student and the average student in a particular sub-group, say Quintile 1 (poorest 20% of students). However, given that each of the three surveys uses a different metric to measure student performance it is not possible to use raw survey-specific scores to make comparisons across all the grades. To overcome this comparability problem I use the within-survey national standard deviation of South Africa as a unit of measurement. Given that the standard deviation is not a function of the specific unit of measurement (like SACMEQ points or TIMSS points) but rather a statistic describing the distribution of performance, it is possible to compare differences in student achievement across surveys that are otherwise not comparable.

One can go further and convert these standard deviation differences into grade-level differences, as has been done in other countries. Using seven nationally normed tests of student reading and mathematics achievement, Hill *et al.* (2007, p. 172) compare the annual learning gain per grade for American students from grade K – 12 in standard deviations. They find that the annual learning gains vary by grade with greater gains at earlier grades. For example, in mathematics the learning from grade 1 to 2 was 1.03 standard deviations, from grade 4 to 5 was 0.56 standard deviations and from grade 8 to 9 was 0.22 standard deviations (Hill et al., 2007, p. 3). The average math test score gain across all seven grade levels was 0.47 standard deviations per year, which has been used elsewhere as a benchmark for one grade-level of learning in America (Washington State Institute for Public Policy, 2011). Unfortunately, similarly rich data do not exist for South Africa. The only two data sets which allow for the estimation of learning gains in South Africa are the NSES study (2007/8/9) for primary school, and TIMSS (2003) study for high school. Given that NSES followed the same students over time as they moved from grade 3 into grade 4 and 5 and tested these students using the same test, one can estimate the amount of learning between grade 3 and 4 as a percentage of the average standard deviation between the two years. One can also calculate the learning gains between grade 4 and 5 using NSES although these are likely to be biased given that the NSES test was set at the grade 3 level.

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When using the NSES numeracy tests to calculate learning gains there are two important caveats: Firstly, one should use only those items that have no language content in them to ensure that the gains are due to increased numeracy proficiency rather than increased language proficiency (as discussed above), and secondly, the results of the analysis are likely to be different based on whether one uses the panel sample (i.e. only those we can follow across all years), or the full sample (i.e. all students in each grade). Table 3 below reports the average numeracy score for grade 3, 4 and 5 as well as the learning gains (both in percentage points and as a percentage of the average standard deviation between the two years) for both the full numeracy test and the sub-set of 15 no-language items. As a robustness check I also impute[17] scores for those grade 3 children who are not found in the grade 4 and grade 5 NSES sample either due to dropout, moving or grade repetition.

[17] The predicted scores were calculated by first regressing the 2008 numeracy scores on the 2007 numeracy scores and including other explanatory variables such as a student's gender, socio-economic status, whether the student is over age or too old, whether a student's home language is English, whether the student is part of a large household as well as school fixed effects. This regression included only those students who were observed in both 2007 and 2008, and the coefficients were then used to predict the 2008 scores of those students who were not observed in 2008. The resultant scores were imputed into the 2008 numeracy distribution to render a new numeracy score distribution with which to do the sensitivity analysis. The process was repeated for the 2009 numeracy scores, regressing the 2009 scores on the new 2008 numeracy scores, including the imputed values.

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TABLE 3: QUANTIFICATION OF A YEAR'S WORTH OF LEARNING IN SOUTH AFRICA (NSES 2007/8/9 TIMSS 2002)

	NSES		Percentage Points				Gains as % SD
			Grade 3	Grade 4	Grade 5	Gains	
Full numeracy test	Panel sample	Gr3 - Gr4	29.38	35.5		6.12	0.28
		Gr4 - Gr5		35.5	47.04	11.54	0.54
	Full sample	Gr3 - Gr4	20.22	27.88		7.66	0.38
		Gr4 - Gr5		27.88	39.66	11.78	0.58
	Full sample – imputed	Gr3 - Gr4	25.85	32.33		6.48	0.31
		Gr4 - Gr5		32.33	44.16	11.84	0.61
Sub-set of 15 no-language items only	Panel sample	Gr3 - Gr4	27.64	34.53		6.88	**0.28**
		Gr4 - Gr5		34.53	40.99	6.46	0.43
	Full sample	Gr3 - Gr4	17.92	26.47		8.54	0.38
		Gr4 - Gr5		26.47	38.84	12.38	0.52
	Full sample – imputed	Gr3 - Gr4	23.78	31.43		7.65	0.33
		Gr4 - Gr5		31.43	42.81	11.37	0.52
	TIMSS		**Standardized TIMSS Points**				**Gains as % SD**
			Grade 8	**Grade 9**		**Gains**	
	Full sample	Gr8 - Gr9	264	285		21	0.2

While the NSES is helpful to estimate the amount of learning per grade in grade 3, the best data set to calculate the amount of learning at a higher grade is TIMSS 2003. In TIMSS 2003 the principal investigators decided to test both grade 8 students and grade 9 students (from the same sampled schools) using the same grade 8 test. This was out of a concern that the TIMSS grade 8 test was too difficult for South African grade 8 students and thus that future administrations of TIMSS may be done at the grade 9 level and would need a baseline for comparability (Reddy et al., 2012). This is in fact what happened in TIMSS 2011 when only grade 9 students were tested using the grade 8 test. By comparing the average TIMSS score of grade 8 and 9 students in 2003 (from the same schools) on the same test and calculating this as a percentage of the South African TIMSS 2003 standard deviation, one can get an estimate of the amount of learning in one grade at the high school level. While it would be ideal to follow the same students from grade 8 to grade 9 (as NSES did between grades 3, 4 and 5), this has not been done before in South Africa and thus the best estimate

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available is that of the TIMSS 2003 grade 8 and 9 students from the same schools on the same test.

One other method of calculating grade-level equivalents is to use the benchmarks calculated by cross-national testing regimes themselves. For example, the Trends in International Mathematics and Science Study (TIMSS) study estimates that within a 4-year testing cycle a country could improve by a maximum of 40 points which is referred to elsewhere as “one grade level” (Reddy et al., 2012, p. 3). This is equal to 0.4 TIMSS standard deviations and 0.5 South African TIMSS standard deviations.[18] While this is a useful measure for comparing improvements across countries, it has not been calibrated using South African data and is therefore not specific to South Africa but rather a generic loose measure for cross-country comparisons. As we have shown in Table 3 above, the real level of learning occurring between grade 8 and grade 9 in South Africa is only 20 points (0.2 TIMSS 2003 South Africa standard deviations).

Since there are numerous estimates for “learning gains” presented in Table 3, it is important to motivate for the particular learning gain estimates used below. Given that the test was calibrated at the grade 3 level, the distribution of the grade 5 students on the grade 3 test may not be an accurate reflection of the true grade 5 distribution since it may be constrained due to a ceiling-effect leading to over-concentration at the top end of the distribution. Consequently, it is arguable that the learning gains between grades 3 and 4 are a more accurate reflection of true learning gains than those between grades 4 and 5 in NSES. Secondly, given that we are only trying to measure the increase in mathematical proficiency and not the portion attributable to increased language competency, it is arguable that the estimates using the sub-set of no-language items is more accurate than those for the full test. Furthermore, if one uses the full test results for grade 3 NSES, it will necessarily overestimate the learning between grades 3 and 4 due to underestimating the baseline learning in grade 3 due to language issues. Lastly, if one has to choose between the full sample and the panel sample (i.e. only those we can follow from grades 3 to 4), it is arguable that when trying to estimate learning in a year it makes sense to choose the panel sample. This is because the students who are in the NSES grade 4 sample but who are not in the grade 3 sample are more likely to have repeated grade 4 and thus this would overestimate the amount of learning occurring in grade 4. As a result of the above I use the no-language balanced panel estimate for the learning gain for a single year between grades 3 and 4, i.e. 0.28 standard deviations. Incidentally this is the same as the learning gain seen

[18] The TIMSS standard deviation is roughly 100 points while the South African TIMSS 2011 standard deviation was 86 points (Mullis et al., 2012, p. 488).

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in the full test balanced panel sample for the same grades. For the learning gain between grade 8 and grade 9 there is only one estimate: 0.2 standard deviations (using TIMSS). Given that all of these tests were administered at the end of the year, the learning gains are for the later grade, i.e. 0.28 is the learning that occurs in grade 4 and 0.2 is the learning gain that occurs in grade 9, on average, in South Africa.

Given that there are in essence only two points in the South African system for which we have psychometrically comparable data for a year of learning (grades 3 to 4 and grades 8 to 9), and also due to a lack of South African scholarship in this area with which to compare the above results, I provide two types of analysis. The first uses a single rough estimate applied uniformly across the grades. Given the estimates presented in Table 3 above and the preceding motivation, a reasonable rule of thumb for a year of learning in South Africa is 0.3 standard deviations. After this I allow for the amount of learning (in standard deviations) to differ by grade.

Applying the above method it is possible to calculate the difference in average achievement between Quintile 1 (poorest 20% of students) and Quintile 5 (wealthiest 20% of students) for the different surveys and then convert these into a common standard-deviation metric. The difference between Quintiles 1 and 5 is 28 percentage points in NSES grade 3, 130 SACMEQ points in grade 6, and 122 TIMSS points in grade 9. These different metrics are not directly comparable and there is no simple way of equating the scores. Consequently I convert the differences into within-survey standard deviations using the full national standard deviation and then, using the 0.3 standard deviation benchmark as one year of learning, one can convert the difference and say that it is equal to 4 grade-levels in grade 3[19] (NSES), 4.4 grade-levels in grade 6 (SACMEQ) and 4.7 grade-levels in grade 9 (TIMSS).

Lewin (2007) provides a useful conceptual model for the trajectory needed to reach a particular goal – in this case matric (grade 12). He refers to an ‘on-track-line’ and an ‘off-track-line’ where the off-track-line is any line below the on-track-line. In the present example, the on-track-line is calibrated to be equal to the average performance of Quintile 5 students.

To illustrate the above in a graph, I set the average Quintile 5 achievement to be equal to the ‘grade-appropriate’ benchmark such that the learning trajectory of these students is on the “on-track” trajectory and will reach matric (grade 12) performing at roughly a grade 12 level. I then calculate the difference between this ‘benchmark performance’ and the average

[19] This would essentially place most Quintile 1 grade 3 students at a level below grade 1, i.e. grade R.

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performance of Quintiles 1, 2, 3 and 4 and then convert this difference into grade-level equivalents using 0.3 standard deviations as equal to one grade-level of learning. Doing so is essentially create a learning trajectory spanning from grade 3 (NSES) to grade 9 (TIMSS) with linear projections for those grades where there is no data (grade 7, 8, 10, 11 and 12). The exact figures for all calculations are provided in Appendix A. Figure 10a below shows the likely learning trajectories of the average student in each quintile of student socioeconomic status. It shows that the average student in Quintile 1, 2 and 3 is functioning at approximately three grade-levels lower than the Quintile 5 benchmark in grades 3, 4, 5 and 6. Observing average performance by quintile in grade 9 shows that the difference between Quintile 1, 2 and 3 students and Quintile 5 students (the benchmark) has now grown to more than four grade-levels. If it is assumed that Quintile 5 students in grade 9 are functioning at roughly a grade 9 level, then Quintile 1 and 2 students are functioning at roughly a grade 4.5 level in grade 9. The trajectory lines, one for Quintile 5 and one for the average of Quintiles 1-4, show that in grade 3 there already exist large differences in performance (approximately three grade-levels) and that by the time children enter grade 9 this gap in performance has grown to about four grade-levels. The linear trend in performance between these two groups suggests that if the same number of students in Quintiles 1-4 in grade 9 continued in schooling until grade 12 (i.e. no drop out between these two periods) they would be functioning at approximately 4.9 grade levels lower than their Quintile 5 counterparts in grade 12 (1,5 standard deviations lower).

The reason why one cannot easily use the matric (grade 12) data as another point in the learning trajectory is the substantial number of students that drop out of schooling between grade 9 and grade 12 in South Africa. Taylor (2012, p. 6) shows that the average enrolment in grades 4, 7 and 10 between 2008 and 2011 in South Africa was approximately 1 000 000 in each grade, but by grade 12 this figure drops to roughly 600 000 students. Consequently, if one were to include grade 12 as a data point one would need to make a number of assumptions about dropout and the differential distribution of dropout across the socioeconomic spectrum. This is not included in the present chapter.

Returning to Lewin's (2007) notion of an "on-track" progress line, perhaps the most important conclusion arising from this conceptual framework is that any performance below the "on-track" line creates an increasing gradient of expectation as the pupil moves into higher grades. As pupils' learning deficits grow, the gradient of what needs to be achieved to reach the goal then progressively steepens to the point where it enters what Lewin (2007, p. 7) refers to as a 'Zone of Improbable Progress.' For example, the improvement that is required to bring the average grade 9 Quintile 1 student in South Africa up to the required benchmark

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by grade 12 is unrealistic given that they are performing at roughly a grade 5 level in grade 9. By contrast, the gradient of achievement required to bring the average Quintile 1 grade 3 pupil up to the required benchmark by matric is slightly more manageable. The clear conclusion arising from this analysis is that intervening early to correct and prevent learning deficits is the only sustainable approach to raising average achievement in under-performing schools.

What we would add to this conclusion is that the root cause of these weak educational outcomes is that children are acquiring debilitating learning deficits early on in their schooling careers and that these remain with them as they progress through school. Because they do not master elementary numeracy and literacy skills in the foundation and intermediate phases, they are precluded from further learning and engaging fully with the grade-appropriate curriculum, in spite of being enrolled in school. Lewin (2007, p. 10) refers to these children as 'silently excluded' since they are enrolled and attending school but learning little.

Variable learning gains per year

Given that the international literature shows that there are in fact differential learning gains (in standard deviations) by level of study, with larger gains at earlier years (Hill et al, 2007), I calculate probable learning gains for each grade between grade 3 and 9. Table 3 above shows that the learning gain in grade 3 was 0.28 standard deviations and in grade 8 was 0.2 standard deviations. Using a linear interpolation I calculate the learning gains (in standard deviations) for each intervening grade. I then recalibrate the graph (Figure 10a) using these new learning metrics and create Figure 10b. From the latter figure one can see that although students are still approximately three grade levels behind in grade 3, this grows to 5,5 years behind by grade 9. Using differential learning gains across different grades shows that poorer students fall further and further behind their wealthier peers as they progress into higher grades.

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FIGURE 10A: SOUTH AFRICAN MATHEMATICS LEARNING TRAJECTORIES BY NATIONAL SOCIOECONOMIC QUINTILES USING A CONSTANT STANDARD DEVIATION (0.28) FOR ONE YEAR OF LEARNING (BASED ON NSES 2007/8/9 FOR GRADES 3/4/5, SACMEQ 2007 FOR GRADE 6 AND TIMSS 2011 FOR GRADE 9, INCLUDING 95% CONFIDENCE INTERVAL)

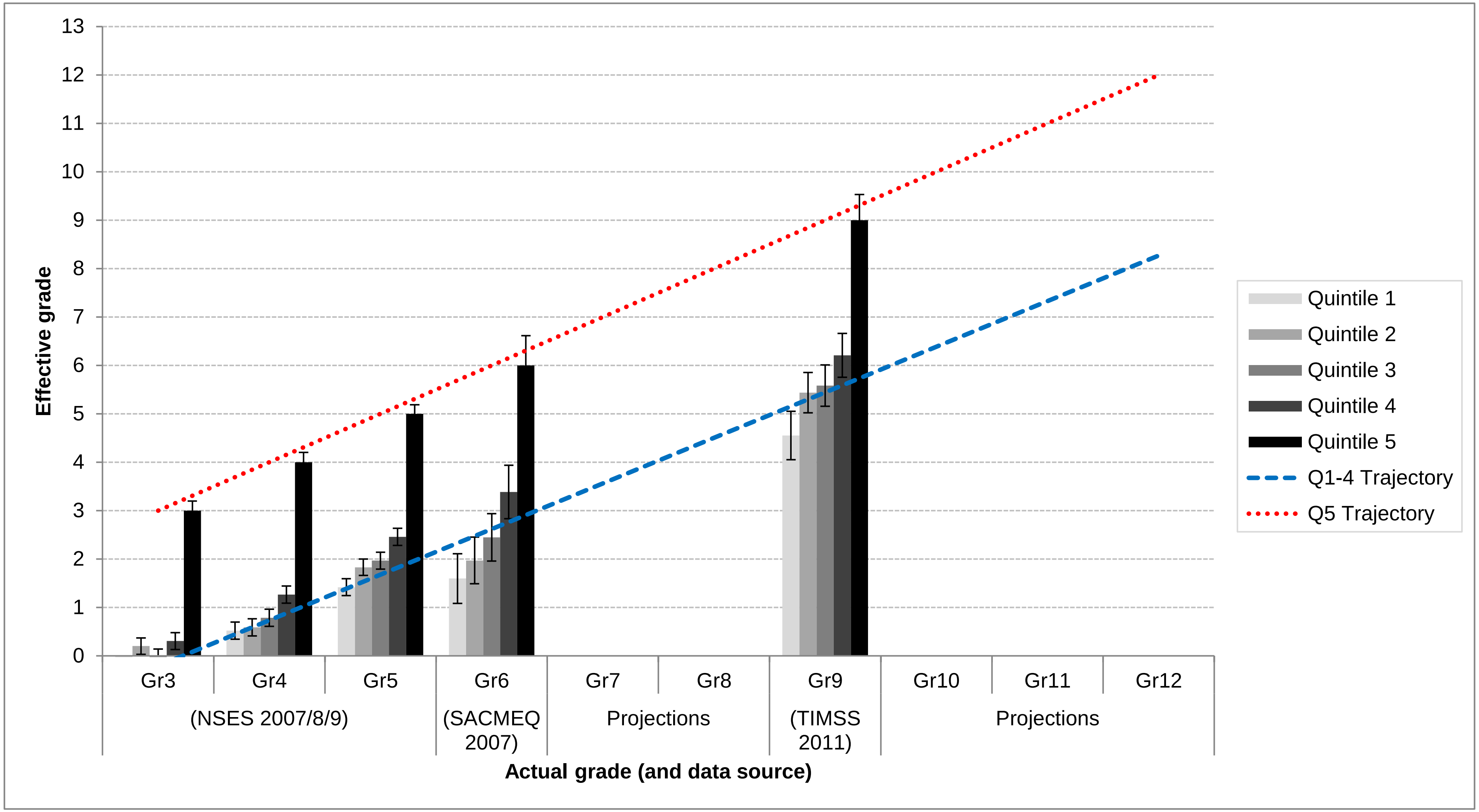

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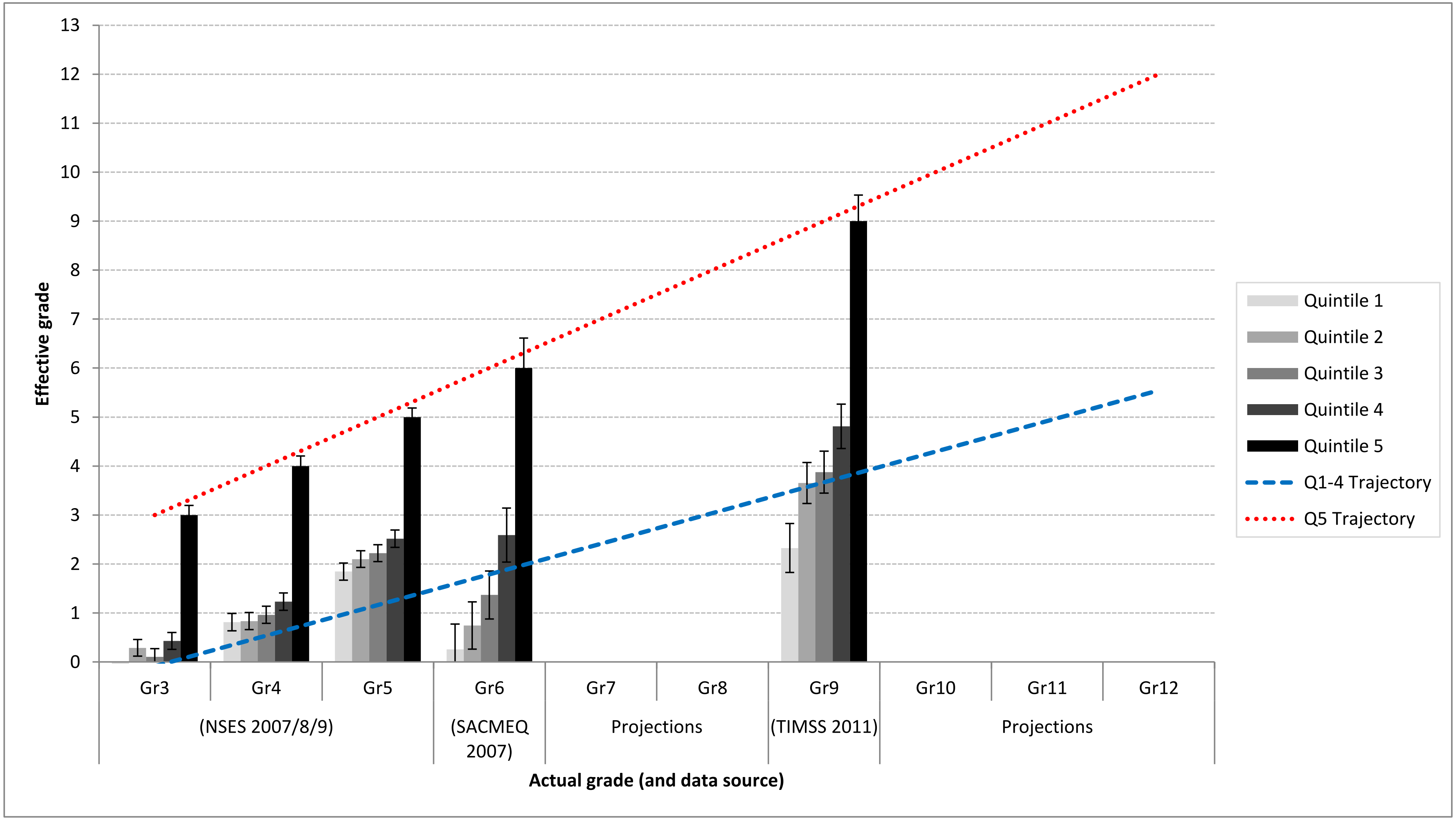
FIGURE 10B: SOUTH AFRICAN MATHEMATICS LEARNING TRAJECTORIES BY NATIONAL SOCIOECONOMIC QUINTILES USING A VARIABLE STANDARD DEVIATION FOR A YEAR OF LEARNING (0.28 IN GRADE 3 TO 0.2 IN GRADE 8 WITH INTERPOLATED VALUES FOR IN-BETWEEN GRADES (BASED ON NSES 2007/8/9 FOR GRADES 3/4/5, SACMEQ 2007 FOR GRADE 6 AND TIMSS 2011 FOR GRADE 9, INCLUDING 95% CONFIDENCE INTERVAL)



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METHODOLOGICAL CAVEAT

Given that each of the three tests used in this analysis was developed and administered by a different organization, it is useful to provide some indication of how these tests were developed, the content that they covered and whether or not they were aligned to the South African curriculum at each grade. Full discussions of the psychometric properties of the items in each test are beyond the scope of this study but are available for each test; NSES (Taylor et al, 2013, Ch. 2), SACMEQ (Ross et al, 2005, Ch. 2) and TIMSS (Foy, Arora, & Stanco, 2013).

The NSES numeracy test was constructed to be completely aligned with the National Curriculum Statement, which was the curriculum at the time. As mentioned previously, the test was the same as the grade 3 Systemic Evaluation of 2007, which was commissioned by the Department of Basic Education to monitor grade 3 outcomes relative to the grade 3 curriculum (Taylor et al., 2013). Approximately 60% of the items in the test covered four tasks which forms the fundamental building blocks of mathematics namely: counting and ordering whole numbers, addition, multiplication and subtraction (Taylor et al. 2013). The remainder of the problems were split between items dealing with fractions, decimals, patterns, graphs, shapes and measurement (Taylor & Taylor, 2013). The difficulty level of these questions ranged from a Grade 1 level to a Grade 4 level, as discussed in the data section above. Given that the same test was administered in grades three, four and five, one can think of the test becoming easier over time as students acquire new skills and find the test questions from earlier grades easier to understand and answer correctly. Since the NSES test was predominantly a grade 3 test, we do not interpret the learning gains from grade 4 to grade 5 as being authoritative and prefer to use the gains between grade 3 and grade 4. This is discussed in more detail below with reference to Table 1.

The construction of the SACMEQ test was done so as to ensure congruence with the curricula, syllabi, exams and textbooks used in all of the participating countries (Ross et al., 2005). The content of the SACMEQ test falls under three broad domains namely number, space and data, and measurement. Given that there are multiple countries that participate in SACMEQ, and that the SACMEQ assessments need to find common domains across most education systems, these tests can be thought of as assessing the core mathematics curriculum and competencies at the grade 6 level (Ross et al, 2005). In the South African SACMEQ 2007 report, written by the South

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African Department of Basic Education, they explain that "In the national curriculum statement emphasis is placed on teachers designing tasks in such a way as to ensure that a variety of skills are assessed. The eight SACMEQ levels for reading literacy and mathematics presented in this report provide an *appropriate benchmark* to model assessments and structure learning such that learners may be exposed to the expected range of competencies for their age group (Moloi & Chetty 2011, p. 7; emphasis added).

The TIMSS mathematics test covered the broad content areas of number, data and chance, algebra and geometry, and the cognitive domains of reasoning, knowing and applying (Mullis et al., 2012). A comparison between the TIMSS 2011 mathematics assessment framework and the Revised National Curriculum Statement (the curriculum in use at the time of testing) indicates that there is a 94% overlap (Reddy, et al., 2012). It is also important to remember that South Africa takes part in TIMSS by testing its grade 9 students despite this being a grade 8 test internationally.

As can be seen in the discussion above, the type of mathematics tested in each of these tests differs to some degree between the three assessments since each test may place more or less weight on a particular learning area. This is an important point since it is possible that student outcomes (or the gaps between rich and poor students) are also a function of the items on the test rather than their true performance (or the true gaps between rich and poor students). For example, if one looks at TIMSS, South African students achieved at the bottom of the international TIMSS 2011 mathematics rankings, with 32% performing no better than random guessing (Mullis et al., 2012, p. 457). Consequently, it is prudent to ask whether or not the 2011 TIMSS international grade 8 test was more challenging than the grade 9 curriculum in South Africa. If this is the case – and the performance of quintile 5 students declines less than that of students in quintile 1-4 as a result - then the gap between rich and poor could be seen to grow between grade 6 (SACMEQ) and grade 9 (TIMSS) when perhaps the gap remained unchanged in reality.

However this does not seem to be the case. If one looks at the performance of South African grade 9 students on the TIMSS 2011 grade 8 mathematics test, one can see that only 3% of students achieved the 'High' or 'Advanced' TIMSS benchmarks (Reddy et al., 2012, p. 11). If one compares this to the performance of all grade 9 students on the South African grade 9 Annual National Assessments (ANA) conducted in 2012 and 2013 in South Africa, one sees similar results. Only 2-3% of

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grade 9 students in each year reached "Acceptable achievement" as defined by the Department of Basic Education (DBE, 2013, p. 53). Importantly these tests are specifically aligned to the South African curriculum. Given these low results the Minister of Basic Education in South Africa convened a task team to look at the grade 9 mathematics ANA test to determine if it was too difficult. The task team concluded that the test was "fair, valid and reliable" leading the Minister to conclude: "the results are a genuine and credible reflection of the learning achievements in grade 9 maths" (Motshekga, 2013). Therefore, while it is true that South African students do seem to find the TIMSS test more difficult, this is largely because they are falling behind relative to the curriculum not because the tests are unreasonably difficult relative to the curriculum.

To summarize the methodological discussion above, it has been argued that the three tests (NSES, SACMEQ and TIMSS) are a relatively accurate representation of the broad mathematics achievement of South African students at each stage (grade 3, 4, 5; 6 and 9 respectively). The aim in using these three assessments is not to estimate the gaps in learning with pinpoint precision – that would require longitudinal data. However, longitudinal data spanning these seven years is not available in South Africa. Consequently, we use multiple cross-sectional datasets and argue that they are broadly aligned to the curriculum at grade 3, 6 and 9. It is possible that this curriculum-alignment assumption is false. If, for example the grade 9 test (TIMSS) is more difficult that the average mathematics found in the curriculum at grade 9, the gap between quintile 5 and quintile 1 could possibly increase even if the 'true' gap remains unchanged. This would only be the case if the standard deviation did not increase and simultaneously quintile 1-4 students did disproportionately worse than quintile 5 students. However it is also possible that a more right-skewed distribution (due to a more difficult test) could decrease the standard deviation due to additional bunching at the bottom of the distribution. Given that the gap in years is a function of both the standard deviation and the absolute gap between the quintile 5 and the other quintiles (and that these could move in different directions), it is unclear what the net-effect would be on the size of the gap if the tests were of vastly differing curriculum-alignment. However, as is argued above, we do not believe that any of these tests is grossly misaligned with the curriculum at that grade.

The practice of comparing standard deviations across different samples and different assessments (as I do in this chapter) is something that has only recently begun to be

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scrutinized by the academic community. For example, McKenzie (2015) in reflecting on the most recent American Economic Association conference (2015) questions whether the difference in observed effect sizes between NGO interventions and government interventions can be explained by different samples. He explains by using the following example:

> "Consider the following example, where both run the same intervention to try to improve test scores in India. The NGO works with a very homogeneous group (control mean score 50%, standard deviation of 5%). The NGO increases test scores by 1 percentage point, which is a 0.2 S.D. improvement. The Government works with a much more diverse set of kids, with the same control mean (50%), but standard deviation of 20%. The Government program increases test scores by 2 percentage points. Despite this being twice as large as the NGO effect, when converted into units of S.D., it is only half the size (0.1 S.D.). *i.e. comparing effect sizes in terms of units of standard deviations artificially inflates the effectiveness of interventions done on more homogeneous groups, all else equal"* (emphasis in original) (McKenzie, 2015).

Commenting on McKenzie's review, Singh (2015) cautions against comparing standard deviations when there are different samples, different tests and/or different scaling procedures, arguing that all of these can influence the standard deviation and thus comparability across samples, tests and contexts. The caution regarding different samples and different contexts is less applicable here given that all three studies tested nationally representative[20] samples in the same context (South Africa). However, it is possible that the standard deviation in each study is influenced by the content covered and the scaling procedures used. Given that these differ somewhat across the three studies, these factors could influence the results. Given that this is a particularly recent concern raised in the literature there are currently no clear solutions or alternatives.

2.6 Conclusion

The above analysis has provided an overview of the size and distribution of learning deficits in the South African education system. Using local and international assessments of mathematics achievement and converting test-score gaps into standard deviations and then into grade-levels of learning, it was possible to estimate

[20] The National School Effectiveness Study (NSES) is not nationally representative because it did not include Gauteng (as explained earlier) but still spans the full socioeconomic spectrum of South African students and schools.

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empirically and illustrate graphically the learning trajectories of wealthy and poor students in South Africa. The key finding emerging from this research is that by grade 3, children in Quintiles 1-3 are already three years' worth of learning behind their Quintile 5 peers and that this gap grows as they progress through school to the extent that by grade 9 they are four years' worth of learning behind their Quintile 5 peers. Previous studies have shown that this low quality of education offered to the poor eventually becomes a poverty trap (Van der Berg et al., 2011). Thus one can say that poor children in South Africa, who make up the majority, are starting behind and staying behind, casting doubt on the ability of the South African schooling system to impart to students the knowledge, skills and values they need to become full members of society and thus promote social mobility.

The clear policy recommendation that proceeds from these findings is that any intervention to improve learning in South Africa needs to intervene as early as possible. Given South Africa's egregiously high levels of inequality, it should come as no surprise that poor children in South Africa find themselves at a nexus of disadvantage, experiencing a lack of social, emotional and cognitive stimulation in early childhood. These children then enter a primary school system that is unable to equip them with the skills needed to succeed in life, let alone to remediate the large learning deficits they have already accumulated to date.

When faced with limited resources and a choice of where to intervene in the schooling system, the counsel from both the local and international literatures is unequivocal; the earlier the better. The need to focus on the primary grades, and especially the pre-primary years, is not only driven by the fact that underperformance is so widespread in these phases, but also because remediation is most possible and most cost-effective when children are still young (Heckman, 2000). Due to the cumulative negative effects of learning deficits - particularly for vertically-integrated subjects like mathematics - it is not usually possible to fully remediate pupils if the intervention is too late (i.e. in high school), as too many South African interventions are. Nobel Laureate Professor James Heckman summarises the above succinctly when he explains that:

> "Policies that seek to remedy deficits incurred in early years are much more costly than early investments wisely made, and do not restore lost capacities even when large costs are incurred. The later in life we attempt to repair early deficits, the costlier the remediation becomes" (Heckman, 2000, p. 5).

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CHAPTER 3: HOW LARGE DOES LANGUAGE LOOM FOR LEARNERS' LITERACY AND NUMERACY PERFORMANCE IN GRADE THREE IN SOUTH AFRICA

3.1 INTRODUCTION

The topic of language in education is a contentious one internationally, and this is particularly the case in the South African context. While many countries have suffered the subjugating effects of colonisation and linguistic imperialism – including South Africa under the British – South Africa was also subject to 46 years of legislated racial exclusivity and linguistic inequality under apartheid. The language policies introduced during apartheid held both symbolic and practical value for the ruling government and were consequently resented by the majority of black South Africans. This resentment reached its zenith in the Soweto Uprising on the 16th of June 1976 when over 20,000 students protested in the streets in opposition to the introduction of Afrikaans as the medium of instruction, with hundreds of students massacred by the police (Ndlovu, 2004).

While the Soweto Uprising is chiefly remembered as a reaction to the Afrikaans language policy, it was also precipitated by the unequal quality of education offered to black students under apartheid (see also Fiske and Ladd, 2004; Mesthrie, 2002). While it may seem strange to discuss the intricacies of the Soweto Uprising in a chapter dedicated to the causal impact of language on performance, this is done so as to highlight an important parallel between the two topics: the distinction between the *language* of instruction and the *quality* of instruction. More often than not language scholars conflate these two issues of language and quality but then proceed to talk about only language, as if quality was somehow subsumed under the all-encompassing umbrella of language. As will become clear, it does not. Isolating the causal impact of either of these factors is particularly difficult in South Africa given that they are both highly correlated and also strongly associated with other factors that influence performance, factors such as parental education, teacher quality, resources, geographic location, school functionality and socioeconomic status.

The aim of this chapter is to try and disentangle these two highly correlated impacts in order to provide some empirical evidence regarding the size of these effects, and

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particularly the impact of language *after accounting for quality and home background*. To do so I exploit two factors: (1) the fact that the vast majority of South African students are taught in their mother tongue for the first three years of schooling before switching to English[21] in grade four, and (2) that it is possible to identify and match 3402 grade three students who were sampled and included in both the Systemic Evaluation of September 2007 and then also the National School Effectiveness Study (NSES) of October 2007. These two surveys used the same test instrument with the exception that the first test (Systemic Evaluation) was written in the language of learning and teaching (LOLT) of the school – typically an African language when the majority of the students are black - and the second test (NSES) written one month later was written in English. Importantly, the NSES sample was a sub-sample of the Systemic Evaluation, making it possible to match a significant number of students across the two surveys. Using these matched students and their performance in the two tests one can identify what proportion of the score achieved by students in numeracy and literacy is attributable to writing in English and what proportion is attributable to other factors.

3.2 LITERATURE REVIEW AND BACKGROUND

Throughout the world scholars have been at pains to stress the links between language and nationhood (Weber, 1976), language and identity (Edwards, 2012), language and culture (Kramsch, 1993) and language and power (Fairclough, 1989). Most of these scholars – and particularly those that deal with language and education – have argued that policy decisions about language in education must consider far more than simply communicative efficiency, test scores or functional literacy. Applying these insights to the South African context, Neville Alexander has argued persuasively that South Africa's colonial and apartheid history further cement these links between language, class, power and identity (see Alexander, 2005 for an overview).

While it is true that that the issue of language in education cannot be reduced to a discussion of fluency, proficiency and literacy scores (in either home language or in

[21] Technically students can switch to either English or Afrikaans, but in reality almost all students who do switch language in grade four switch to English (Taylor and Coetzee, 2013). See also Figure 11 below. For the remainder of the chapter I therefore speak about "switching to English" rather than "switching to English or Afrikaans." The language used by teachers in South African primary and secondary schools is often not a clear cut match to the Language of Learning and Teaching due the widespread practice of code-switching and code-mixing (Fleisch, 2008; Heugh, 2012). Consequently, much of the switch to English from an African language occurs through books students are given.

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English), it is also true that these are legitimate areas of enquiry when speaking about language in South Africa, or any other country. Given that this is the focus of the present study, and that the broader issues have been discussed at length elsewhere (see Mesthrie, 2002 and Murray, 2002 for overviews), the discussion turns to the relationship between language proficiency and academic achievement.

Fleisch (2008) and Hoadley (2012) usefully summarize the most prominent causal theories showing how these two outcomes (language and achievement) are inter-related. The five “mutually reinforcing and interconnected causal mechanisms” (Fleisch, 2008, p. 105) that they identify are (1) transfer theory and the density of unfamiliar words, (2) emotions of second-language teaching, (3) code-switching, (4) English language infrastructure, and (5) language and power. Table 4 below summarises some of the literature from each of these areas and categorises each one according to the purposes of this study. These are (1) language factors, (2) non-language factors, and (3) factors where there is an interaction between language and non-language factors. It further splits the literature by (1) learners/learning, households/parents (2) teachers/teaching, and (3) assessment. The intention here is not to provide an exhaustive list of factors but rather a list that is indicative of the types of factors in each category. Unfortunately almost all of the studies reported here are small in size and their account of the “language question” continues to underemphasize unobservable characteristics that are correlated with language. They have not attempted to tease these out empirically, or at least not with any technical rigor.

While most of the issues in Table 4 are self-explanatory, it is worth briefly discussing the issue of transfer theory and the density of unfamiliar words (Fleisch, 2008, p. 105), partly because this has received considerable scholarly attention (both locally and internationally) but also because it provides a good case study of the limitations of qualitative research, particularly as related to language. Drawing on language acquisition theory and particularly the work of Cummins (2000, 1984) and Skutnabb-Kangas (2000, 1988), researchers have argued that students need to first master the decontextualized discourse of schooling before switching to a second language (Alidou et al., 2006; Heugh, 2012, 2005a, 2005b, 1993). For example, Macdonald (1990) identified that black grade five Setswana children had at most 700 words in English when the curriculum required at least 7000 words (Hoadley, 2012, p. 189). This, together with their insufficient grasp of the linguistic structure of English, seriously limited their ability to read (and particularly to read for meaning) in English. Following on from this, children who have not learnt to read cannot read to learn.

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TABLE 4: FACTORS RELATED TO LANGUAGE OF LEARNING AND TEACHING (LOLT) AND STUDENT PERFORMANCE ON ASSESSMENTS

Factors related to LOLT, performance and assessments	**Teachers/teaching**	**Learners/learning and households/parents**	**Assessment**
Language factors	(1) Teacher proficiency in LOLT (Cazabon et al., 1997; Heugh, 2012; Macdonald and Burroughs, 1991), (2) Teacher training in LOLT, (3) Teacher confidence in LOLT, (4) Lack of teacher support material in the LOLT (Welch, 2011)	(1) Density of unfamiliar words and the inability to 'move' to a new language (Heugh, 2012; Macdonald and Burroughs, 1991) (2) Emotions of learning in a second language (Probyn, 2001), (3) Lack of exposure to English language infrastructure in the school, community and the home (especially for rural students) (Setati et al., 2002; Welch, 2011)	(1) Lack of exposure to the test language (English) at home (Howie et al., 2007; Reddy, 2006) (2) understanding of the language-content of the test (3) the quality of the translation/versioning (Stubbe, 2011)
Non-language factors	(1) Teacher content knowledge (Carnoy and Chisholm, 2008; N. Taylor and Taylor, 2013; Venkat and Spaull, 2014), (2) Pedagogical content knowledge (Ball et al., 2005; Carnoy et al., 2012), (3) curriculum coverage (Reeves et al., 2013b) (4) teacher absenteeism (Prinsloo and Reddy, 2012), (5) teacher professionalism (NPC, 2012; N. Taylor, 2011), (6) school functionality (NEEDU, 2013).	(1) Parental education and household socioeconomic status (Timæus et al., 2013) (2) Exposure to quality preschool education (Heckman, 2000), (3) nutrition, socio-emotional stimulation and child health (Shonkoff et al., 2012)	(1) Psychometric validity of the test, (2) difficulty level of the test, (3) length of the test (for overviews see Greaney and Kellaghan, 2008; Postlethwaite and Kellaghan, 2008)
Interaction between language and non-language factors	(1) Teachers restrict classroom interactions to low-level cognitive tasks due to children's insufficient language proficiency (Heugh, 2005a, 2005b; Macdonald and Burroughs, 1991; Macdonald, 1990), (2) Teaching using code-switching and language-translation takes additional time that the curriculum may not accommodate (Setati and Adler, 2000).	(1) Students that cannot read (properly) in the LOLT cannot learn (properly) in the LOLT (Macdonald, 1990; Mullis et al., 2011)	

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One of the most prominent research projects looking at language and the transition from mother tongue to English in South Africa was the Threshold Project carried out by Carol Macdonald and various colleagues in 1987. These case studies focussed on the language learning difficulties of black children when they switch from their mother tongue to English in four schools. In their discussion of this project, Macdonald and Burroughs (1991, p. 58) conclude as follows:

> "In the DET[22] curriculum, the present policy means that not enough time is given to English in order to prepare the children for learning in English in Standard 3 [Grade 5]. In other words, English is merely taught as a subject in the lower primary, which is unsatisfactory if English is to become the language of instruction in Standard 3 [Grade 5]. Up to a third of the total teaching and learning time should be devoted to the learning of English."

The research emanating from the Threshold Project has been particularly influential as far as South African language policy and research is concerned. For example, despite being conducted in 1987, the above quote from 1991 essentially summarises the view that has subsequently found its way into the new curriculum (DBE, 2011c, p. 9), which introduces a minimum time requirement for First Additional Language (English in most cases). It is also expressed in the National Development Plan which states that, "Learners' home language should be used as medium of instruction for longer and English introduced much earlier in the foundation phase" (NPC, 2012, p. 304). The Threshold Project is still regularly referred to in the literature (Fleisch, 2008; Heugh, 2012; Hoadley, 2012) despite having been conducted in 1987. To be sure, the influence of these case studies is largely warranted given their in-depth, innovative, and methodologically rigorous approach to the topic.

Notwithstanding the above, it is worth emphasising three points that call into question the external validity of the study: (1) the Threshold Project was essentially a case study of four schools (Lefofa, St Camillus, Selang and Seroto) which were all situated in one circuit (Moretele Circuit) in one homeland (Bophuthatswana) (Macdonald, 1990, p. 8), (2) due to the fact that homelands were linguistically-zoned, all of these students were Setswana speakers (Setswana is now one of the 11 official South African languages), and (3) the majority of the research was conducted almost three decades ago in 1987 when there was a different curriculum, with different teacher training institutions, different levels of resources, and when the language switch to English happened one year later (grade five) than it does now (grade four). It is unfortunate that the study has not been replicated in other contexts or

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[22] The term 'Department of Education and Training' (DET) referred to the education system reserved for Black South Africans under apartheid.

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in more recent years since these newer studies could point to context-specific factors (if there are any) or how things have changed since 1987.

In essence the Threshold Project tells us a great deal about how the children in these four Setswana schools managed the transition from an African language to English in grade 5. Many of these findings do seem to be generalizable to other African-language students who face similar constraints (linguistic and otherwise) when switching from an African language to English. This being said, we should be cautious about immediately generalizing findings from any case study to the thousands of South African schools where students switch from an African language to English. The four schools that were included in the Threshold Project may have been more or less functional than the average school, may have had more or less resources than the average school, may have had more or less capable teachers than the average school, may have had students who were more or less linguistically homogenous than the average school, etc. All of these factors are likely to affect how students transition from their home language into English at school.

While these four schools may have been relatively representative of primary schools in the Bophuthatswana homeland, one should be cautious of extending the generalizability to schools in other homelands, since Bophuthatswana may have been quite different to the other homelands. For example Chisholm (2013) explains that by 1985 the vast majority of primary schools in Bophuthatswana (760/840 schools) had experienced the Primary Education Upgrade Programme (PEUP). In this regard she explains that “A decade after it was first introduced, the PEUP was described as having ‘infused primary education in Bophuthatswana with a new spirit and orientation’ and for being responsible for its much better educational showing than other Bantustans (Taylor, 1989)” (Chisholm, 2013, p. 403).

The aim in highlighting these potential external validity concerns is not to call into question the findings of the Threshold Project - findings which seem to have been confirmed in other less in-depth studies (Setati et al., 2002; Taylor et al., 2013) -, but rather to stress the paucity of rigorous research on language transition in South Africa post-apartheid. Thus Hoadley (2012, p. 193) is correct in stating that:

> “The question of why, and by how much language and especially learning in an additional language, affects achievement remains open. Fleisch (2008) makes the important observation that it is very likely that the use of English as the language of instruction is likely to have different effects across different groups of learners, especially with regard to social class and those in rural and urban areas. In other words, a consideration of the social context in which any language is being taught needs to be considered.”

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This is in stark contrast to Heugh (2012), who summarises the “large body of South African research on bilingual education and transitional bilingual programmes” and concludes that:

> “There is no need for more research to identify the problem or how to remedy it. The answers to these questions have already been established through research conducted in South Africa. There is no reliance on international research in this regard” (Heugh, 2012, p. 14).

However, it is not entirely clear which ‘large body’ of South African research Heugh is referring to. It is perhaps telling to look at the studies which Heugh (2012, p. 13) presents as her selection of this large body. Apart from the work of Malherbe (1946), the remaining three references are two case studies and a policy document. The first case study (Ianco-Worrall, 1972) observes 30 White Afrikaans-English bilinguals in Pretoria, the second (Macdonald, 1990) looks at four schools in Bophuthatswana in 1987, as discussed above, and the policy document (LANGTAG, 1996) is not even a research document and does not present research findings, it was meant to advise the Minister of Education on developing a National Language Plan for South Africa. For a similarly small, case-study type approach, Brock-Utne (2007) observes two classes of isiXhosa children and concludes that they learn better when being instructed in their home language (for similar studies in other African coutries see Alidou et al., 2006).

While case studies are especially important in this field, they cannot be generalized to large populations unless they are designed in such a way that they can be regarded as a sample that is representative of that underlying population (which has never been done in South Africa), or are replicated in a number of different contexts. Case studies are indicative and can point to underlying problems and potential solutions, but before they can inform policy they need to be replicated in multiple contexts or with a large sample of schools, both of which ensure that findings are not context-dependent. Unfortunately educationists continue to limit themselves to largely qualitative methodologies and undertake small-scale studies that lack external validity. (For a recent exception to this general paucity, see Taylor and Coetzee (2013) who employ a quantitative approach using administrative and assessment data for 9 180 schools in South Africa).

3.3 Caveats and extension

Where the present study differs from most previous quantitative work on language and achievement is that it focuses on grade three, the period *before* students switch to English in grade four. By observing students ‘pre-switch’ we are essentially controlling for all the

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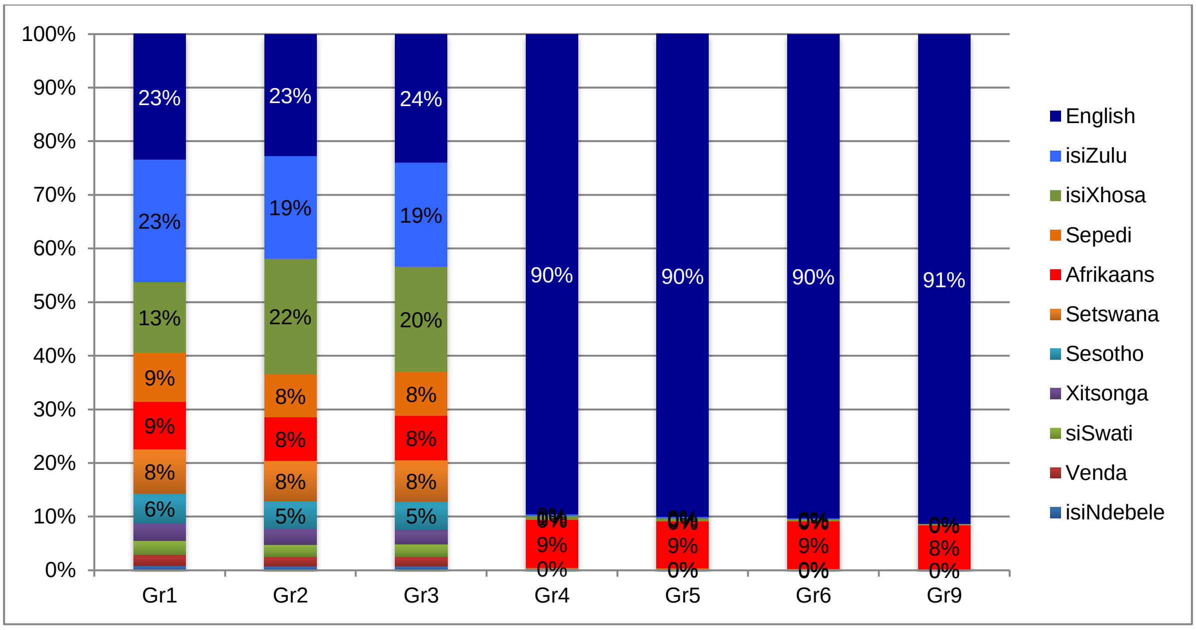
“language factors” in Table 4 and avoiding confounding influences inherent in any analysis of language *post*-switch. If one were to analyse students in grade 6, for example, it would be difficult to disaggregate what proportion of a student’s performance was ‘attributable’ to language and what proportion to other factors like teacher quality, parental education or resources at home – all of which interact with language in complex ways. Given how highly correlated language and non-language factors are, if non-English grade 6 students write a test in English it is unclear what proportion of their performance is attributable to language factors and what proportion to non-language factors. Even if one tried to control for language by testing these grade 6 students in their home language this would be problematic since they would then be writing in a language (home language) that they had not been learning in for the previous two years (English). One would also not be able to disaggregate factors such as the impact of being taught in English for two years by a teacher who may not be familiar with (or sufficiently proficient in) English. By looking at grade 3 these confounding factors fall away – students are assessed in the language they know best and in which they have been taught for three years, most teachers are teaching in their mother tongue (which is also the LOLT of the school) and students have not yet switched to English. Thus, there are few (if any) confounding language factors that could affect a child’s numeracy or literacy performance at the end of grade 3. Put differently, one cannot talk about language factors being a main cause of poor performance for non-English students at the end of grade 3 - something which is probably not true of student performance in grade 4 or grade 6, for example.

By the end of grade 3 most non-English students have had very little (if any) exposure to English in or outside the classroom (Fleisch, 2008). Tellingly, English instruction was not timetabled in the grade 3 National Curriculum Statement (NCS) – the prevailing curriculum in 2007, the period under analysis. The Department of Basic Education (DBE), for example, explains that, “In 2009, less than 1% of learners studied English as an additional language in the Foundation Phase [grades 1-3]…this despite the fact that the majority of learners in grade 4 learnt via the medium of either English or Afrikaans” (DBE, 2010, p. 20). Given that almost all non-English students switch to English as LOLT in grade 4, the difference in performance when students write a test in their home language relative to English is likely to be higher in grade 3 than in any subsequent grade. This is the reason why the estimates presented in this paper cannot be generalized to higher grades. In higher grades students’ prior exposure to English should decrease the difference in performance between a test written in their home language and one written in English. Thus one can think of the estimates presented here as the maximum possible language disadvantage attributable to writing a test in English for non-English students.

3.4 Language in Education in South Africa

The language in education policy in South Africa encourages that children should be taught in their home language for at least the first three grades of primary school and thereafter to switch to either English or Afrikaans. Figures from the 2011 Census show that only 23% of South African citizens speak either English or Afrikaans as their first language (StatsSA, 2012, p. 23), and consequently it is the vast majority of students that experience a LOLT switch in grade 4. Figure 11 vividly illustrates this switch to English using data from the Annual National Assessments (ANAs) of 2013, which tested all students in grades 1-6 and 9 in languages and mathematics. From Figure 11 one can see that while 32% of students learn in English or Afrikaans in grades 1-3, this figure increases dramatically to 99% in grade 4. Almost all students that learn in an African language in grades 1-3 switch to English in grade 4.

FIGURE 11: BREAKDOWN OF LANGUAGE OF LEARNING AND TEACHING (LOLT) BY GRADE - ANNUAL NATIONAL ASSESSMENTS 2013 (N=7 630 240, OWN CALCULATIONS USING VARIABLE '*LOA_LANG*')



The reasons for the aspirational status of English in South Africa are not difficult to identify. English is the language of commerce, law, government, parliament, higher education, and the media in South Africa and is also widely seen as a necessary (although not sufficient) condition for entry into the upper parts of the labour market. Given its status as "the language of power" (Murray, 2002, p. 440), there are also significant returns to English proficiency in South Africa (Posel and Casale, 2011). Internationally, English is also regarded as the language of global interchange given that it is spoken in more countries

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(101 countries) than any other language and has the third largest number of speakers in the world (behind Chinese and Spanish) (Wiley et al., 2014, p. xii). For these reasons, English is often perceived as the language of social and economic mobility, as it is in other post-colonial countries. To provide one poignant example, in India English is seen as a "passport to the future" (Tollefson and Tsui, 2014, p. 200).

The present study does not look at whether, when, why or how students should transition from an African language to English, this chapter is instead aimed at contributing some empirical evidence to the debate regarding how much language (as opposed to other factors) affects student achievement.

Research questions

The aim of the present chapter is to isolate the causal impact of writing a test in English when English is not a student's home language. This broad research area can be broken down into the following research questions:

1. What is the "cost" (in terms of lost marks) when students are forced to write a *numeracy* test in English when English is not their home language?
    a. How much worse do students do on high-language-content numeracy items versus no-language-content numeracy items when they are posed in English when English is not their home language?
2. What is the "cost" (in terms of lost marks) when students are forced to write a *literacy* test in English when English is not their home language?
    - For students' whose home-language is not English, does the "cost" mentioned above differ between items testing the five different literacy processes of: (1) cloze items and items requiring students to match words to pictures, (2) items which require that students focus on and retrieve explicitly stated information, (3) items which require students to make straightforward inferences, (4) items which require students to interpret and integrate ideas and information, and (5) items which require students to write sentences. If so, how large are these differences?
    - For students' whose home-language is not English, does the "cost" mentioned above differ when items are phrased in multiple-choice format or free-response format? If so, how large is the difference?

The major problem inherent in answering these questions in the South African context is that one cannot simply use a single test written in English and compare the outcomes of students

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whose home language is English with the outcomes of students for whom English is a second (or third) language. This is because English and non-English students differ in a number of observable and unobservable ways which confound the comparison. This is a fact that is widely acknowledged in the South African literature:

> "There is an association between lower achievement and not speaking the language of the test at home. However, the effect of language proficiency and achievement scores is not straightforward. While it is acknowledged that proficiency in the language of the test is a contributor to the average achievement score…there are factors other than language that contribute to low achievement scores – factors such as socioeconomic variables, the nature of teaching and, importantly, the level of cognitive demand in classroom interactions in whatever language is used" (Reddy, 2006, p. 90).

> "The extent to which language factors contribute to this low performance is not clear, given that language disadvantages are so strongly correlated with other confounding factors such as historical disadvantage, socio-economic status, geography, the quality of school management and the quality of teachers" (Taylor and Coetzee, 2013, p. 3).

3.5 DATA AND IDENTIFICATION STRATEGY

To estimate the causal impact of test-language on test-performance in the South African context one can employ one of two methods; either one can sample a large group of students and then randomly allocate half to writing the test in English and the other half to writing it in their mother-tongue. Provided that the group is sufficiently large, any observed or unobserved differences in student attributes should be negligible across the two groups. Alternatively, one can test the same group of students twice in a relatively short space of time, once in the LOLT of the school and once in English. The advantage of the second method is that one does not need as large a sample since factors that do not change between the tests will be differenced out (things like teacher quality, home background, parental education, etc.). By using the same group of students across the two tests one is effectively imposing ceteris paribus conditions with two exceptions: (1) Because students will have already seen the test, they may perform better on Test 2 than on Test 1 simply because they remember some of the items, and (2) students may learn new skills or reinforce previous work in the period between the two tests, which would lead to better marks in the second test that are independent of language. Both of these instances would lead to a positive bias in the second test. Given that our a priori is that students perform

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better on assessments when they are set in their home-language it is arguable[23] that the best sequencing of the two tests would be to test students in their mother-tongue first and in English second, rather than the other way around. This is the conservative method of estimating the difference since the positive biases mentioned above (if they exist) will decrease the difference between the two tests rather than increase the difference as would be the case if students were tested in English first.

Running a large experiment for the sole purpose of testing the causal impact of test-language was not possible in the present instance, however, it was possible to exploit a unique situation in South Africa where a group of students happened to be sampled twice - for two different surveys – with tests written one month apart. In September 2007 the Systemic Evaluation tested a nationally representative sample of 54 298 grade 3 students from 2 327 primary schools (DoE, 2008, p. 1). The aim was to measure the levels of achievement in literacy and numeracy relative to grade-appropriate curriculum outcomes. At the same time, the National School Effectiveness Study (NSES) was being planned and implemented by the Joint Education Trust (JET), the same organization that was providing technical support to government for the Systemic Evaluation (SE) Test. The NSES decided to test a sub-sample of grade 3 students from the Systemic Evaluation sample one month later (October) and tested approximately 16000 students from 268 schools. The NSES used the same instrument as the Systemic Evaluation, with one major exception: where the Systemic Evaluation tests (Test 1) were written in the LOLT[24] of the school at the grade 3 level, the NSES tests (Test 2) were written in English (Taylor et al., 2013, p. 18). The implementers of the NSES explain their rationale as follows:

> "While SE tests were written in the home language of the learners at Grade 3 level, the NSES tests were written in English. The reason behind this decision

[23] It is perhaps easiest to explain by example: if we assume that students score 25% when they write a test in English and 45% when they write the same test in their home-language the 'true' causal impact would be negative 20 percentage points. Let us further assume that the two biases mentioned above contribute to an additional 5 percentage points for the second test relative to the first test due to their "learning effect". Given that we do not know the size of this learning effect bias, if we tested students first in English and second in mother-tongue we would estimate the causal impact to be 25 percentage points (25% - (45%+5%). If we tested students first in mother-tongue and second in English we would estimate the causal impact to be 15 percentage points (45% - (25%+5%). Given that we would rather be conservative in our estimate we would argue that it is better to test students first in their mother-tongue and secondly in English and estimate a lower-bound causal impact of writing a test in English when English is not a student's mother-tongue. Furthermore, by including a *within*-test difference (in addition to the *between*-test difference), the present difference-in-difference analysis accounts for both of these biases as long as they affect all item categories equally – this is discussed in more detail later in the chapter where the difference-in-difference method is explained further.

[24] Although the Vorster et al. (2013) quote says "in the home language of the learners", this is technically not true. To the extent that the home language of the learner corresponds to the LOLT of the school (which is not always the case) this is correct, since the Systemic Evaluation was conducted in the LOLT of the school, not in the home language of the learner.

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was that the NSES followed the same cohort of learners for three years, administering the same test annually. Because most schools for African learners change their medium of instruction in Grade 4 from mother tongue to English, we wanted to have comparable scores for the same learners for each of the three years. Thus while at Grade 4 level the learners would have been disadvantaged by writing in a language with which they are unfamiliar, this design enabled us to compare scores directly across the three years. Because the NSES schools were a subsample of the SE sample the design also provided a unique opportunity to compare scores by the same Grade 3 learners on the same test written first in their mother-tongue and second in English." (Taylor et al., 2013, p. 18).

3.5.1 Matching students across tests

Given that South African students do not have unique identification numbers, it was not possible to match all students between the two tests. In addition the selection procedures employed by the NSES were different to that of the Systemic Evaluation. Where the Systemic Evaluation randomly selected 25 students from a class, the NSES tested all students in the class (Vorster et al., 2013, p. 147). In their analysis of learner performance in the NSES, Vorster et al. (2013) also compare the performance of students between the Systemic Evaluation and the NSES using a similar method to that employed here. To match individuals between the two samples they used four initial matching criteria: (1) the unique school administrative (EMIS[25]) number, (2) the first three letters of the child's surname, (3) the first letter of their first name, and (4) the child's gender (Vorster et al., 2013, p. 147). Using this approach they were able to match 2 119 learners in both the NSES and the Systemic Evaluation datasets. The matching criteria employed by these authors is relatively stringent as the authors themselves acknowledge: "The matching process was conservatively done in the sense that errors of excluding learners who did in fact participate in both evaluations were far more likely than errors of false matches" (Vorster et al., 2013, p. 147). Given that Vorster et al. (2013) were only able to match 2 119 students of the 16 000 that participated in NSES, and that these 2 119 may be quite different to the unmatched students, they provide a sensitivity analysis comparing performance on the NSES between the matched and unmatched sample – reproduced below in Table 5. It is important to note that the lack of Gauteng's participation in the NSES study will lower the possible matching rate (since no Gauteng students that participated in SE will be able to be matched in NSES).

[25] EMIS stands for the Education Management Information System. Schools' EMIS numbers uniquely identify all schools in South Africa.

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TABLE 5: VORSTER ET AL'S (2013: P. 150) COMPARISON BETWEEN THE MATCHED (SE AND NSES) AND UNMATCHED (NSES ONLY) SAMPLES (REPRODUCED VERBATIM)

	NSES Literacy Score	NSES Numeracy score	Number of learners
Unmatched (NSES only)	17,34%	24,57%	14 384
Matched sample	23,08%	33,62%	2 119

Vorster et al. (2013) explain that the difference in performance between the matched and unmatched sample could be driven by two factors, (1) that weaker children were more likely to make mistakes writing their names than more literate children leading to more non-matches among weaker children, and (2) because the selection of the 25 students in the Systemic Evaluation may not have been entirely random and instead teachers may have somehow ensured that better students were selected for the Systemic Evaluation (and could thus effectively be matched) (Vorster et al., 2013, p. 148).

The present comparison employs a different matching technique facilitating the matching of significantly more students. To match students I used two initial criteria: (1) the school's unique administrative (EMIS) code, and (2) the student's birthday, birth-month and birth-year. Doing so allowed me to match 3402 unique students, which amounts to 61% more students than those matched by Vorster et al. (2013). The major problem with this matching strategy is that there is a relatively high probability that two children in a particular class will share a birthday. Using the formula below one can see that in a class of 30 students the probability is 70,6% that two randomly chosen students share the same birthday.

$$p(n) = 1 - \frac{365!}{365^n(365-n)!}$$

While this may seem problematic at first, the reduction in sample size from dropping all students who share birthdays in a particular school is relatively small compared to more stringent matching criteria. Furthermore, it is arguable that sharing a birthday with someone else in the class is completely random and therefore exogenous to student achievement or selection. Consequently, dropping these students from the analysis should not bias the results. However, given that one can only match students with non-missing birthday information, it is possible that in matching we select stronger students who are more numerate and therefore less likely to make mistakes. This is unavoidable but is also partially

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accounted for in the difference-in-difference analysis as discussed below. Table 6 shows the average numeracy and literacy scores for students in the Systemic Evaluation and the NSES for 'unique' students (i.e. no common birthdays) and duplicate students (common birthdays), as well as all students (both groups). One possible reason why duplicates (or students missing date of birth information) perform worse is if weaker students are more likely to either forget their birthdays, make mistakes in writing them down, or forget to fill them in. If one compares the average numeracy and literacy scores for the total sample of students and those who do not share a birthdate (i.e. unique observations after duplicates and missing data have been dropped), the average scores are not statistically significantly different.[26]

TABLE 6: LITERACY AND NUMERACY SCORES FOR GRADE 3 STUDENTS IN THE SYSTEMIC EVALUATION AND NSES BY UNIQUELY IDENTIFIED INDIVIDUALS AND DUPLICATES

	Test 2 - NSES Gr3 (October)			**Test 1** - Systemic Evaluation Gr 3 (September)		
	Total	**Unique**	**Duplicates and missing** (on school and birthdate)	**Total**	**Unique**	**Duplicates and missing** (on school and birthdate)
Mean literacy %	18,2%	19,2%	14,6%	32,4%	32,6%	30,2%
Std Err	*0,75%*	*0,77%*	*0,87%*	*0,25%*	*0,25%*	*0,53%*
Mean numeracy %	26,0%	27,5%	20,4%	33,8%	34,0%	31,7%
Std Err	*1,18%*	*1,19%*	*1,50%*	*0,36%*	*0,36%*	*0,76%*
Sample size	16525	**13033**	3492	54298	**49456**	4842

One further potential source of false matching is if students forget their birthdates and write something else down. This is unlikely to lead to false matches since it would require that two students both forget their birthdate in one of the assessments and then both decide to pick the other student's birthdate as their own for the next assessment. This is highly improbable.

Table 7 below reports the average numeracy and literacy performance for the matched and unmatched samples of the NSES and the Systemic Evaluation. Summing the number of students between the unmatched Systemic Evaluation (46 054) and matched Systemic Evaluation and NSES (3402) provides the total unique observations in the Systemic

[26] Throughout the present analysis, standard errors are calculated with clustering at the school level if average scores are being calculated and clustering at the individual level if the analysis is at the item-level.

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Evaluation (49 456) in Table 6 above and similarly for the NSES where the unmatched (9 631) and matched (3402) samples sum to the total unique observations in the NSES (13 033) in Table 6.

TABLE 7: AVERAGE STUDENT PERFORMANCE IN NUMERACY AND LITERACY IN THE SYSTEMIC EVALUATION AND THE NSES BY MATCHED AND UNMATCHED SAMPLES

	Number of students	Numeracy		Literacy	
		SE	NSES	SE	NSES
Unmatched Systemic Evaluation Gr3 (Sept 2007)	46054	34,0%		33,8%	
Std. Err.		*0,10%*		*0,08%*	
Unmatched NSES Gr3 (Oct 2007)	9631		25,7%		18,7%
Std. Err.			*0,22%*		*0,15%*
Matched NSES-SE sample	3402	33,4%	32,7%	34,4%	23,2%
Std. Err.		*0,38%*	*0,40%*	*0,29%*	*0,26%*

From Table 7 above one can see that matched students perform significantly better in the NSES than unmatched students in the NSES in both numeracy and literacy. However, for the Systemic Evaluation matched and unmatched students perform essentially the same. Given that the method employed here takes into account almost all observed and unobserved heterogeneity – as discussed below – this is not particularly problematic.

One additional concern when employing any matching technique is the impact of matching on the representivity of the underlying sample. While the NSES[27] and the Systemic Evaluation were both sampled in such a way that they were nationally representative, the subset of matched students is not necessarily nationally representative. I return to this in section 3.7.4 'Limitations and caveats."

3.5.2 DATA STRUCTURE

In order to perform the difference-in-difference analysis, the data needs to be at the item level rather than the student level. That is to say that it should be transformed from a person-level database with N rows to an item-level database with $N \times K \times T$ rows, where N is the

[27] As mentioned previously, the NSES test did not sample students from Gauteng because there were alternative testing programs under way in that province in 2007. In this sense the NSES is nationally representative except for Gauteng.

number of students, K is the number of items (40 in the case of literacy and 53 in the case of numeracy) and T is the number of tests (2). That is to say that the traditional dataset of one row per student should be transformed, reshaping twice from wide to long to a dataset of one row per item per test per student. In matrix-vector format this transformation is represented as follows:

$$\boldsymbol{A}:\begin{bmatrix} \boldsymbol{q}_{11} & \boldsymbol{q}_{12} & \boldsymbol{q}_{13} & \cdots & \boldsymbol{q}_{1K} \\ \boldsymbol{q}_{21} & \boldsymbol{q}_{22} & \boldsymbol{q}_{23} & \cdots & \boldsymbol{q}_{2K} \\ \boldsymbol{q}_{31} & \boldsymbol{q}_{31} & \boldsymbol{q}_{31} & \cdots & \boldsymbol{q}_{3K} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \boldsymbol{q}_{N1} & \boldsymbol{q}_{N2} & \boldsymbol{q}_{N3} & \cdots & \boldsymbol{q}_{NK} \end{bmatrix} \rightarrow \boldsymbol{B}:\begin{bmatrix} (\boldsymbol{q}_{11})' & (\boldsymbol{q}_{12})' & \cdots & (\boldsymbol{q}_{1K})' \\ (\boldsymbol{q}_{21})' & (\boldsymbol{q}_{22})' & \cdots & (\boldsymbol{q}_{2K})' \\ (\boldsymbol{q}_{31})' & (\boldsymbol{q}_{32})' & \cdots & (\boldsymbol{q}_{3K})' \\ \vdots & \vdots & \ddots & \vdots \\ (\boldsymbol{q}_{N1})' & (\boldsymbol{q}_{N2})' & \cdots & (\boldsymbol{q}_{NK})' \end{bmatrix} \rightarrow \boldsymbol{C}:\begin{bmatrix} (\boldsymbol{q}_{11})' \\ (\boldsymbol{q}_{12})' \\ (\boldsymbol{q}_{13})' \\ \vdots \\ (\boldsymbol{q}_{1K})' \\ (\boldsymbol{q}_{21})' \\ (\boldsymbol{q}_{22})' \\ (\boldsymbol{q}_{23})' \\ \vdots \\ (\boldsymbol{q}_{2K})' \\ \vdots \\ (\boldsymbol{q}_{N1})' \\ (\boldsymbol{q}_{N2})' \\ (\boldsymbol{q}_{N3})' \\ \vdots \\ (\boldsymbol{q}_{NK})' \end{bmatrix}$$

where $\boldsymbol{q}_{11} = [q_{1a} \quad q_{1b}]_{n=1}$ where *a* represents the NSES test and *b* represents the Systemic Evaluation.

It is not possible to use the weights provided in either the NSES or the Systemic Evaluation since the weights attached to students correspond to the original samples and not the smaller matched sample. Consequently the sample is not weighted and is not necessarily nationally representative. Standard errors are adjusted to account for clustering. When calculating mean scores clustering is calibrated at the school level (student responses are clustered in schools), and when calculating mean scores for item-categories clustering is calibrated at the individual level (item responses are clustered within an individual).

3.5.3 Difference-in-difference analysis

Estimating the difference-in-difference model for the language test can be accomplished in one of two ways: One could estimate the regression equation:

$$L_{nkt} = \lambda + \delta NSES_{nt} + \varphi_{1-4} Lit\_Cat_{ik} + \beta_{1-4}(NSES * Lit\_Cat)_{nkt} + \varepsilon_{nkt}$$

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Where L_{nkt} = is the average percentage correct in the literacy test for individual n on item-category k in test t where $n \in (1,2811); k \in (1,5); t \in (0,1)$ where $t = 0$ for the Systemic Evaluation, $t = 1$ for the NSES, $k = 1$ for the 'cloze/word-matching' category of items, $k = 2$ for the 'retrieve' category of items, $k = 3$ for the 'infer' category of items, $k = 4$ for the 'interpret' category of items and $k = 5$ for the 'write a sentence' category of items. φ_{1-4} are the four coefficients corresponding to the four dummy variables of literacy categories (with 'cloze/word-matching' as reference group). This is typically the strategy employed where there is no data for the "no treatment state" (Angrist and Pischke, 2009, p. 227). However, for the present analysis we have data for all individuals on all items for both tests (i.e. for the treatment and control arms), and thus do not need to make additional assumptions about omitted variable bias and the required level of aggregation for differentiation.

Given that we have data on all outcomes (treatment and non-treatment) for all students, using the regression equation to predict outcomes for sub-groups – the purpose of the present analysis - is mathematically equivalent to a table of means with t rows and k columns. Calculating the difference-in-difference from this table of means is equivalent to predicting the outcomes for each combination of literacy category (k) and specific test (t). Given that the regression coefficients are not directly interpretable (they must be summed across the combinations of dummy-variable categories and multiple interaction terms) we decided to rather use the table of means approach, which is more parsimonious and easier to interpret.

For the present difference-in-difference analysis, the first difference is the difference between the student's score on a particular item in the Systemic Evaluation relative to that student's score on that item in the NSES, i.e. a *between*-test difference. The second difference is the difference between item categories within a particular test, i.e. a *within*-test difference. The between-test difference takes into account the difference in the language of the test and the within-test difference takes into account any student-specific or test-specific factors that may be different between the two tests but similar between item categories.

3.6 BACKGROUND INFORMATION ON THE TEST INSTRUMENTS

For the language test the item categories follow the literacy-process categorization of the items (match, retrieve, infer, interpret, write). For the numeracy test the items are categorized according to the language content of the item (no language content, high language content, ambiguous language content). These categories are all discussed below.

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3.6.1 LITERACY TEST

The literacy test that was administered to grade three students in both the Systemic Evaluation (SE) and the National School Effectiveness Study (NSES) was designed to reflect the reading and writing proficiency of grade 3 students in South Africa. Of the 40 items included in the test, most were set at the grade 3 level (30 items) but there were also questions set at earlier grade levels, specifically at the grade 2 (7 items) and grade 1 (3 items) levels. Vorster et al. (2013, p. 31) have classified the 40 items that made up the literacy assessment according to the PIRLS[28] framework. PIRLS identifies four processes of comprehension: (1) *focus on and retrieve explicitly stated information*, (2) *make straightforward inferences*, (3) *interpret and integrate ideas and information*, and (4) *examine and evaluate content*, *language and contextual elements* (Howie et al., 2007). Although PIRLS is a reading assessment, the literacy assessment used in the Systemic Evaluation and NSES covered both reading and writing. Consequently, Vorster et al. (2013) extend the PIRLS framework and include two additional categories: (1) cloze items and matching words to pictures, and (2) writing tasks. The literacy test did not contain any items in the '*examine and evaluate content, language, and textual elements'* category and consequently this category is dropped from the analysis in this chapter. Thus Vorster et al. (2013) end up with five categories which they refer as 'literacy processes.' Test items were also classified on whether they are multiple-choice items (MC) or free-response items (FR). The distribution of test items by text type, literacy process and answering format can be seen in Table 8 below (reproduced from Vorster et al., 2013, p. 33). For the present analysis I use the same categorisation of items and collapse the categories of "*matching a word to a picture*" and "*fill in a missing word (cloze)*" primarily because the National Curriculum Statement (NCS), the prevailing curriculum at the time of testing, prescribes that these types of items should be mastered at the grade 1 level.

[28] PIRLS stands for the Progress in International Reading Literacy Study

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TABLE 8: DISTRIBUTION OF LITERACY TEST ITEMS IN TEST 1 AND TEST 2 ACCORDING TO TEXT TYPE AND LITERACY PROCESS (SOURCE: VORSTER ET AL., 2013, P. 33)

		Format	**Item number by purposes of reading (types of text)**					**Total no. Items**
			Visual cue	Poster	Bar graph	Non-fiction descriptive	Fiction narrative	
Literacy processes	Matching word to picture	MC	1, 2					**2**
	Fill in missing word (cloze)	MC	3, 4, 5, 6, 7, 8, 9					**7**
	Retrieve	MC		10, 11	14, 15	19, 20, 21, 22, 23, 24	30, 31, 31	**13**
		FR			12, 13	25,26		**4**
	Infer	MC					33, 34	**2**
		FR				27, 28		**2**
	Interpret	MC					35, 36, 37	**3**
		FR				29	38, 39, 40	**4**
	Evaluate							**0**
	Write a sentence	FR	16, 17, 18					**3**
	Write a paragraph							**0**
Total number of items			**12**	**2**	**4**	**11**	**11**	**40**

3.6.2 NUMERACY TEST

The numeracy test used in the Systemic Evaluation and the NSES consisted of 53 questions with items set at the grade 1 (2 items), grade 2 (14 items), grade 3 (30 items) and grade 4 level (7 items). Table 9 below reports the breakdown of items by grade-level and language-content. The grade-level distinctions are sourced from Vorster et al. (2013, p. 34). Given that the focus of the present analysis is the causal impact of writing a test in a second-language, the 53 numeracy items were split into one of three categories based on the language-content of the item. If a question consisted only of numbers and symbols (for example "24 ÷ 3 = ___") it was classified as a "No language content" item. If a question had some language content but could be solved by deductive reasoning without any understanding of the language, that item was classified as an "Ambiguous item." For example question 4 is worded as follows: "*Count forward in 2s. Fill in the next number in the space provided; 74*

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76 78 ___." An item was classified as a "High language content item" if it was not possible to solve the problem without understanding the language content of the question. For example question 22 asked, "*Mother is 77 years old. Father is 6 years older than her. How old is father?* ____." The aim in grouping items along a language-content dimension was to test the finding in the literature that students who write a test in a second language find word-problems more difficult than those problems posed in symbolic format (for some examples see Adetula, 1990; Bernardo, 1999; Ní Ríordáin and O'Donoghue, 2008).

TABLE 9: DISTRIBUTION OF ITEMS IN TEST 1 AND TEST 2 GRADE 3 NUMERACY TEST BY GRADE-LEVEL AND LANGUAGE-CONTENT

		Item number by language-content			
		No language content	**Ambiguous items**	**High language content**	**Total**
Grade-level	Grade 1	28		13	**2**
	Grade 2	35, 36	2, 3, 4, 16, 17	1, 10, 14, 19, 22, 29, 30,	**14**
	Grade 3	20, 21, 23, 24, 25, 37, 39, 42, 49	6, 7, 8, 18, 31, 32, 38, 45	9, 11, 12, 15, 33, 43, 44, 46, 47, 48, 51, 52, 53	**30**
	Grade 4	26, 34, 40, 41,	5	27, 50	**7**
	Total	**16**	**14**	**23**	**53**

3.6.3 IDENTIFYING HOME LANGUAGE

In order to estimate the causal impact of writing a test in English when English is not a student's home-language, it is necessary to identify which students have English as their home language and which do not. This involves a second round of matching based on the question asking what a student's home-language was. Table 10 below shows the breakdown between matched and unmatched students by home-language. From the table one can see that 459 students from 158 schools could not be matched on the home-language variable across the two surveys, either because the variable was missing in one of the two surveys or because the listed home-language was different between the two surveys.[29]

[29] Note that the total number of matched schools (223) does not equal the sum of the total number of matched-schools-by-language. This is because it is possible to have students from multiple home-languages in a single school. This is also the reason why the framing of the research question refers to students "whose home-language is not English" rather than "for whom English is a second language" since many of these students will

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The focus of most of this chapter is on the 2 811 students who do not share a birthday with someone in their class (the first round of matching) and whose home-language was consistently matched between the two tests (the second round of matching) and was also not English. The 132 successfully matched English home-language students will be used for robustness checks since these students wrote the same test twice in the same language one month apart and therefore create a useful reference category for test-specific differences.

TABLE 10: TOTAL NUMBER OF STUDENTS MATCHED CONSISTENTLY ON HOME-LANGUAGE VARIABLE BETWEEN SYSTEMIC EVALUATION AND NSES

Language groups matched consistently on home-language	English home language	Non-English home-language	Total number of unique schools	Total
Afrikaans		499	43	
English	132		24	
isiNdebele		49	10	
isiXhosa		498	58	
isiZulu		786	66	
Sepedi		286	37	
Sesotho		131	23	
Setswana		256	26	
SiSwati		109	13	
Tshivenda		66	7	
Xitsonga		131	17	
Total matched	132	2811	223	2943
Total unmatched	459		158	459
Total				3402

3.7 FINDINGS

3.7.1 LANGUAGE RESULTS AND LITERACY PROCESSES

Table 11, Figure 12 and Figure 13 below report the main findings from the literacy test analysis for students whose home language is English (n=132) and those for whom it is not (n=2811). As one would expect, students' whose home language is not English performed statistically significantly better when they wrote the test in the LOLT of the school (Test 1:

only learn English as a third or fourth language. For example, an isiXhosa student living in KwaZulu-Natal may be in an isiZulu school and therefore learning in isiZulu in grades one to three before switching to English (their third language) in grade 4.

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average score 33%) than when they wrote it one month later in English (Test 2: average score 22%). Given that the standard deviation[30] for these students in the Systemic Evaluation literacy test (n=2811) was 15,8%, one can say that students performed 0,69 (10,97/15,8) of a standard deviation worse in Test 2 (in English) than they did in Test 1 (in the LOLT of the school).

One could argue that the 0,69 estimate is a lower bound estimate since it is the net effect of the positive "learning/familiarity" gain (from writing the same test twice, albeit in a different language) and the negative language cost (from writing Test 2 in English, a language with which they are unfamiliar). If we assume that the learning/familiarity gain (or measurement error) among the English students between the two tests (2 percentage points) is the same as the learning/familiarity gain among the non-English students between the two tests, then the language effect grows from 0,69 of a standard deviation to 0,82 of a standard deviation.

Observing the outcomes in the Systemic Evaluation (Test 1 – in the LOLT of the school) one can clearly see that students found the 'cloze/matching' items easiest (average score of 57%) and the 'interpret' questions most difficult (average score of 9%). Importantly, the average score for the whole test when written in the LOLT of the school was still only 33%. This is after students have been learning in their home-language for three years and before any switch to English in grade 4. This low level of performance 'pre-language-switch' provides some backing to the arguments made by Murray (2002) and reiterated by Hoadley (2012), who argue that there should be as much attention paid to the quality of instruction as there is to the language of instruction. This is one of the motifs that runs through much of the present analysis.

If one thinks that the three main factors affecting students' performance are (1) home background, (2) school quality, and (3) language factors, it is possible to provide rough estimates for the size of the impact of (3) and a composite estimate of (1) and (2) combined. We have already seen that non-English students performed 0,69-0,82 of a standard deviation worse when writing in English relative to the LOLT of the school. This could be considered one estimate for the size of the 'language factor.' If one then only looks at the Systemic Evaluation and compares the performance of English home language students

[30] The standard deviations for the various groups are as follows: For all matched students (n=3402) the standard deviation for the Systemic Evaluation (Test 1) literacy test was 16,4% and the standard deviation for the Systemic Evaluation numeracy test was 22,2%. For students whose home language was English (n=132) the figures for the Systemic Evaluation literacy test standard deviation were 18,6% and for the numeracy test 26,9%. If one looks only at students who do not speak English as a home language (n=2811) the figures were 15,82% for literacy and 21,6% for numeracy.

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(average score 50%) and non-English home language students (average score 33%) the difference amounts to 1,08 (0,17/0,158) of a standard deviation.[31] This can be thought of as a composite estimate of (1) home background and (2) school quality. Disentangling (1) and (2) is far more difficult since one does not have exogenous variation in either (1) or (2) as we do for language with the two tests.

Observing the outcomes in the NSES (Test 2 – in English), one can see that non-English home language students performed statistically significantly worse in this test than in the Systemic Evaluation (Test 1) in three of the five categories (cloze/matching, retrieve, write a sentence), with roughly similar performance in the 'infer' and 'interpret' categories. By contrast, English-home-language students – who wrote the same test in English twice - performed better in Test 2 than in Test 1 for all literacy processes except the three "write a sentence" items.

[31] This is calculated relative to the standard deviation of non-English home language students in the Systemic Evaluation. One could argue for using a different standard deviation – perhaps the full Systemic Evaluation sample standard deviation. However, the differences can become confusing (and potentially misleading) since it is not only the difference that is changing but also the standard deviation that one is using to scale the difference. Furthermore the difference in standard deviations between non-English Systemic Evaluation (15.8%) and total-matched Systemic Evaluation (16.4%) is not large. For this reason I use the same standard deviation (Systemic Evaluation non-English sample) but have already reported alternate standard deviations in a previous footnote.

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TABLE 11: AVERAGE PERFORMANCE (%) BY LITERACY PROCESS IN TEST 1 (SYSTEMIC EVALUATION) AND TEST 2 (NSES) FOR STUDENTS WHOSE HOME LANGUAGE IS AND IS NOT ENGLISH [STANDARD ERRORS CLUSTERED AT THE INDIVIDUAL LEVEL].

Non-English-home-language students (n=2811)						
	Cloze /matching-word-to-picture (9 items)	**Retrieve** (17 items)	**Infer** (4 items)	**Interpret** (7 items)	**Write a sentence** (3 items)	***Total (40 items)***
Test 2 (in English)	51,14	27,09	15,48	7,00	8,90	***22,07***
Standard error	*0,41*	*0,36*	*0,31*	*0,16*	*0,34*	***0,25***
Test 1 (in Home Language)	56,69	33,91	16,03	8,51	43,51	***33,04***
Standard error	*0,45*	*0,40*	*0,32*	*0,18*	*0,58*	***0,30***
Difference (Test2 -Test1)	-5,55	-6,82	-0,55	-1,51	-34,61	***-10,97***
Standard error	*0,61*	*0,54*	*0,45*	*0,24*	*0,67*	***0,39***

English home-language students (n=132)						
	Cloze /matching-word-to-picture (9 items)	**Retrieve** (17 items)	**Infer** (4 items)	**Interpret** (7 items)	**Write a sentence** (3 items)	***Total (40 items)***
Test 2 (in English)	81,57	64,87	39,85	22,04	42,23	***52,06***
Standard error	*1,05*	*1,93*	*2,37*	*1,54*	*2,23*	***1,46***
Test 1 (in Home Language)	75,42	57,58	36,21	14,60	57,32	***50,04***
Standard error	*1,52*	*2,30*	*2,23*	*1,04*	*2,56*	***1,62***
Difference (Test2 -Test1)	6,14	7,30	3,64	7,44	-15,09	***2,02***
Standard error	*1,85*	*3,00*	*3,25*	*1,86*	*3,40*	***2,19***

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FIGURE 12: AVERAGE PERFORMANCE (%) IN TEST 1 (SYSTEMIC EVALUATION) AND TEST 2 (NSES) BY LITERACY PROCESS FOR STUDENTS WHOSE HOME LANGUAGE IS NOT ENGLISH (N=2811)

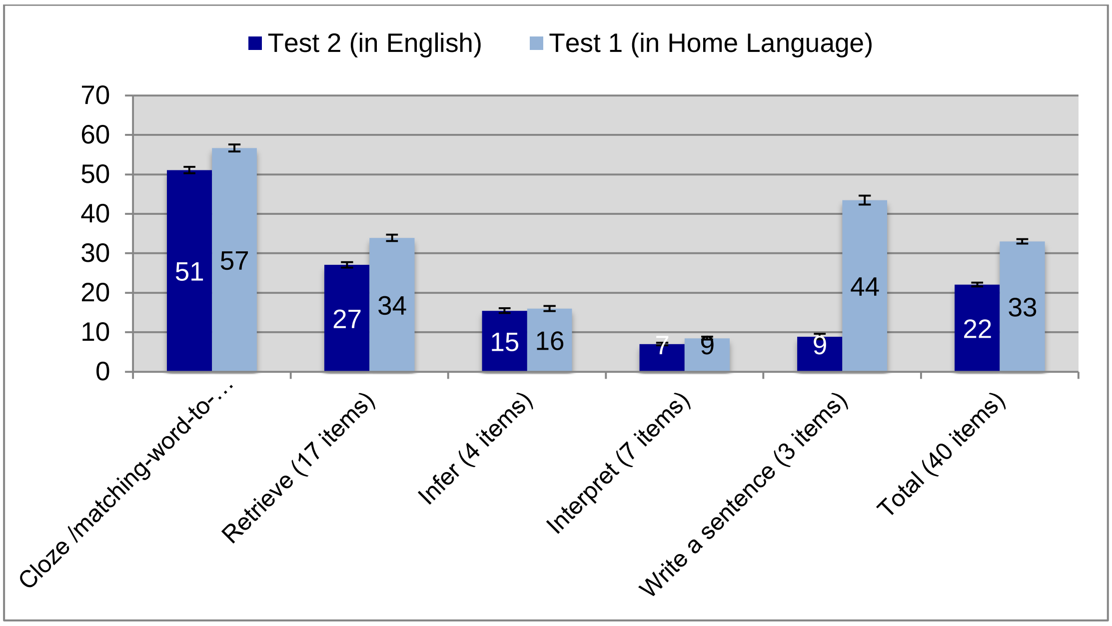
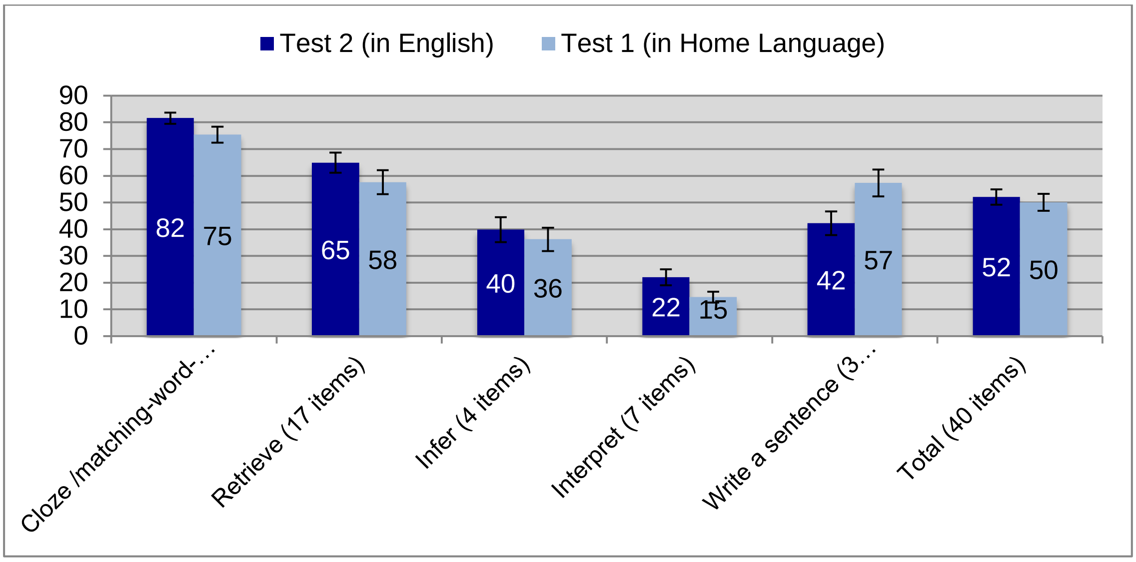


FIGURE 13: AVERAGE PERFORMANCE (%) IN TEST 1 (SYSTEMIC EVALUATION) AND TEST 2 (NSES) BY LITERACY PROCESS FOR STUDENTS WHOSE HOME LANGUAGE IS ENGLISH (N=132)



The most striking feature of the comparison between the two tests for non-English home language students is their performance on the three items that require students to write a sentence about a picture. On these three items[32] students performed considerably better when they were able to write in the LOLT of the school (average score 44%) than when they

[32] An example of one of these items is included in Appendix B.

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were forced to write in English (average score 9%). While this could reflect the fact these items were the most heavily influenced by the language of the test, it is also possible that the Test 2 markers marked these items more strictly than the Test 1 markers. Given that the "write a sentence" items were out of four marks, there is more room for marker-discretion than there is for the items in the other categories, which were mostly out of one mark. Given that the people marking the two tests were not the same people, it is possible that Test 2 markers marked more strictly than Test 1 markers[33]. This hypothesis is supported by the results of the 132 English-home-language students who performed worse in Test 2 only in the "write a sentence" category. A priori we would expect the English students to do the same, or better, on all items in Test 2 than in Test 1 given that they wrote the same test twice, both times in their home language. The fact that English students do worse in Test 2 on the "write a sentence" questions is most likely due to differential marking practices on these items across the two tests. It is highly unlikely that their sentence-writing abilities have deteriorated substantially over the one-month period, though stochastic processes may also have been at work.

One could look at English home-language students and use the difference between Test 1 and Test 2 on the "write a sentence" items as a lower bound estimate of the cost of the presumed harsher marking (i.e. negative 15.09 percentage points). This is a lower bound estimate since this is the effect of the positive learning-bias, the positive test-familiarity bias, and the negative stringency-bias from the harsher marking in Test 2. Using this estimate as a lower-bound estimate of the cost of harsher marking requires us to assume that Test 2 markers were equally strict when marking the scripts of English and non-English home-language students. If markers were not consistent across language groupings within an item-category, it is not possible to benchmark across language groupings, as we do here. Comparing the differences across item categories and language-groupings (English and non-English home language), it is clear that non-English home language students did considerably worse than English home language students and that this difference was largest for the "write a sentence" items, even after accounting for harsher marking in Test 2.

Looking at the nine 'cloze/matching' items, students whose home language is not English perform 9.8% worse (5.55 percentage points) when they wrote the test in English as

[33] This was clarified through personal communication with Carla Perreira (2014), the Chief Operating Officer at JET Education Services (the technical adviser for the Systemic Evaluation, and the implementing agent for the NSES). The Systemic Evaluation markers were recruited and managed by the Department of Basic Education (DBE). Although JET provided training and supported the process of the Systemic Evaluation, the DBE was responsible for the marking and moderation processes. For the NSES, JET did the marking and moderation using the same marking memos and the same training procedures, albeit with different markers.

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compared to writing the test in the LOLT of their school. Looking at the 17 '*retrieve'* items, these same students perform 20% worse (6.82 percentage points) when they write the test in English as compared to writing the test in the LOLT of their school. There is a strong case to be made that both of these estimates represent the *causal* impact of writing these kinds of items in English relative to the LOLT of the school, when a student's home language is not English.

Looking at the differences between the two tests for the four '*infer*' items and the seven '*interpret'* items, it is less clear that these differences represent the causal impacts of anything. It would seem that most students whose home language is not English found these items to be too difficult for them to provide meaningful information on the impact of language. When written in the LOLT of the school (Test 1) students scored an average of 16,03% on the '*infer*' items and 8,51% on the '*interpret'* items, dropping to 15,48% and 7,00% respectively. Given that half of these questions were structured as multiple-choice questions with four choices (see Table 8) and that multiple-choice questions overestimate true ability due to random guessing, it is highly likely that the 'true score' here is essentially zero – that is if we corrected for guessing. In these instances it would seem that language is a second-order concern. If students already perform extremely poorly in their home-language (as in the '*infer'* and '*interpret'* items) – perhaps because the cognitive demand was too high - then asking the same questions in English is unlikely to lead to a significant drop in average performance. On the other hand, if students are able to answer the questions in their home-language but not in English this suggests that the language-content of the items is preventing them from understanding the questions rather than not having the ability, skill or understanding to answer the question (as in '*cloze/matching'* and '*retrieve'* items).

An alternative to grouping items by literacy process is to group items by item format, that is to say whether the item is a multiple-choice item or a free-response item. Table 12 below reports the average literacy score by language groups and question format. From the table one can see that the difference in performance between the two tests for non-English students is largest for free-response items, while for English students the difference is largest for free-response items. As mentioned previously, for the multiple-choice items one would expect that the difference between the two tests would be smaller the lower the students' performance (i.e. that the attenuation of the difference is largest for non-English students where the impact of guessing is highest).

One method of illustrating the above is to correct these scores for random guessing using Frary's (1988, p. 33) formula FS = R – W/(C – 1) where FS is the 'corrected' score, R is the

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number of items answered correctly, W is the number of items answered incorrectly and C is the number of choices per item. Using this formula the MCQ marks for non-English students fall to 33,3% (Systemic Evaluation) and 21,3% (NSES) and for English students they fall to 50,6% (Systemic Evaluation) and 60,5% (NSES). The difference between the two groups also changes. The uncorrected difference for non-English students was negative -5,6 percentage points while the corrected difference was negative -12 percentage points.

For the 13 free-response items (which include the three "write a sentence" items), the difference is much larger at -15,95 percentage points for students whose home language is not English. Looking at the 132 English home language students, one can see that these students did slightly better in Test 2 than on Test 1 on free-response items, and much better on the multiple choice items. These increases are, again, presumably a result of learning or test-familiarity. The average impact of stricter marking on some free-response items in Test 2 (NSES) was clearly smaller than the learning/test-familiarity effect, yielding a net-positive result. Given that one cannot easily compare English home language and non-English home language students, it is not clear what proportion of the -15,95 percentage point decline between Test 1 and Test 2 for students whose home language is not English is a result of harsher marking and what was due to writing in an unfamiliar language.

TABLE 12: AVERAGE LITERACY SCORE (%) BY QUESTION FORMAT BETWEEN TEST 1 (SYSTEMIC EVALUATION) AND TEST 2 (NSES) FOR STUDENTS WHOSE HOME LANGUAGE IS NOT ENGLISH AND THOSE FOR WHOM IT IS [STANDARD ERRORS CLUSTERED AT THE INDIVIDUAL LEVEL]

	Non-English-home-language (n=2811)			**English home-language (n=132)**		
	Multiple choice questions (27 items)	**Free response items** (13 items)	**Total (40 items)**	**Multiple choice questions** (27 items)	**Free response items** (13 items)	**Total** (40 items)
Test 2 (in English)	37,46	7,75	22,07	70,48	34,90	52,06
Standard error	*0,32*	*0,22*	*0,25*	*1,47*	*1,65*	*1,46*
Test 1 (in Home Language)	43,08	23,70	33,04	62,99	37,98	50,04
Standard error	*0,36*	*0,31*	*0,30*	*1,93*	*1,55*	*1,62*
Difference (Test 2-Test 1)	-5,62	-15,95	-10,97	7,49	-3,08	2,02
Standard error	*0,48*	*0,38*	*0,39*	*2,42*	*2,27*	*2,19*

3.7.2 Numeracy results and language-content

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In addition to comparing the literacy test results from Test 1 (written in the LOLT of the school) and Test 2 (written in English), one can also compare the numeracy test results between these two tests. One of the major advantages when looking at the numeracy test is that all items were either correct or incorrect (one mark questions) and therefore it left little room for differential marking across the two tests, unlike the literacy test – as discussed above. Rather than compare numeracy processes across the two tests (see Taylor and Reddi, 2013), the focus here is on the difference in performance on item-groupings based on the language-content of those items. As mentioned, the three groups are (1) high language items, (2) no language items, and (3) ambiguous items (i.e. items that could not be classified as either 'high language' or 'no language' items).

Table 13 below reports the numeracy results for Test 1 (in the LOLT of the school) and Test 2 (in English) for students whose home language is not English, and for those for whom it is. Looking first at students' whose home language is not English, it is interesting to note that the overall difference between Test 1 and Test 2 is not statistically significant – on average students scored 33% on both tests. However if one looks at the results disaggregated by language-content, one can see that students did slightly better in Test 2 on the 'no-language' and 'ambiguous' items than they did in Test 1, and slightly worse in Test 2 on the 'high-language' items, as one might expect. On both tests students found the 23 high-language items slightly easier than the 16 no-language items. From Table 13 below one can see that students whose home language is not English scored 5,2% (1,87 percentage points) worse when writing high-language content items in English compared to writing those same items in the LOLT of their school. This is arguably the causal impact of writing high-language content mathematics items in English when English is not a student's home language.

If students learned new skills or consolidated old skills in the month between the two tests, one would expect them to perform better on Test 2 than on Test 1. Similarly, if students became familiar with the test (remembered test items), we would also expect them to perform better in Test 2 than in Test 1. We do in fact see improvement in performance for the 'no-language' and 'ambiguous' items for students whose home language is not English. If we assume that these three effects are equal across the three item categories (something which may or may not be true), we can employ a second-difference to difference out these biases. By comparing the difference between the two tests (first difference) and the difference between the item-categories (second difference), one can estimate the causal impact of writing high-language content items relative to low-language content items for students whose home language is not English (accounting for all biases, assuming that these biases affect all three categories equally).

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Table 13 below shows that this effect is negative, -8,1% (-2,91 percentage points) for high-language content items. One can thus think of these two estimates (-5,2% and -8,1%) as a lower bound and an upper bound estimate of the causal impact of writing high-language content items in English relative to writing them in the LOLT of the school, when English is not a student's home language.

Students whose home language *is* English perform better in Test 2 (67%) than in Test 1 (60%), and the gains are largest for the high language content items. The difference-in-difference analysis shows that the difference between high-language and no-language items was larger in Test 2 than in Test 1, that is to say that English students either (1) learned more content relating to the high-language items than the no-language items in the intervening month between the tests, or (2) remembered the high-language items better than the no-language items between the two tests. While this is an interesting finding in and of itself, one could possibly use this information to inform the difference-in-difference analysis for students whose home language is not English. However, this would require that we assume that the same amount of learning takes place in schools that English-home-language students attend, and those that non-English-home-language students attend, something that is almost certainly untrue (Shepherd, 2011; Spaull, 2013; Taylor and Yu, 2009). Furthermore, the sample of 132 English students is relatively small with concomitantly large standard errors.

Using a similar framework for the numeracy test as for the literacy test, one can identify what difference in achievement is attributable to (1) home background and (2) school quality (jointly); and (3) language for non-English home language students. Table 13 shows that there is practically no difference between Test 1 and Test 2 suggesting that the language factor is only a very small part of the story in the underperformance of non-English students in mathematics. It would be prudent to ask whether the "learning/familiarity gains" (between Test 1 and Test 2) and the "language cost" (due to writing in English) are not simply cancelling each other out, creating a net effect of zero. While this may be true, it is difficult to estimate the size of the "learning/familiarity gain." However, if we assume that non-English students learn as much in the intervening month as do their English peers, and remember as much of the test as their English peers (which is unlikely given that they have seen the test in two languages whereas the English students saw the exact same test twice), then we can use the gains seen in the English home language sample (7 percentage points) as an upper bound estimate of the "learning/familiarity gain" and thus as an upper bound estimate of the "language cost." This amounts to 0.32 (0.07/0.22) of a standard deviation.

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Using the standard deviation of 22,2% (from non-English students in the Systemic Evaluation Numeracy - Test 1), the difference between English home language students (average score 60%) and non-English home language students (average score 33%) amounts to 1,22 (0.27/0.222) standard deviations. This can be thought of as a composite estimate of the impact of (1) home background and (2) school quality.

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TABLE 13: AVERAGE NUMERACY PERFORMANCE (%) BY LANGUAGE-CONTENT IN TEST 1 (SYSTEMIC EVALUATION) AND TEST 2 (NSES) FOR STUDENTS WHOSE HOME LANGAUGE IS NOT ENGLISH [STANDARD ERRORS CLUSTERED AT THE INDIVIDUAL LEVEL]

	Non-English-home-language students (n=2811)			
	High language items (23 items)	**Ambiguous items** (14 items)	**No language items** (16 items)	**Total** (53 items)
Test 2 (in English)	34,02	34,88	30,03	33,04
Standard error	*0,41*	*0,49*	*0,48*	*0,41*
Test 1 (in Home Language)	35,89	33,13	29,00	33,08
Standard error	*0,39*	*0,49*	*0,47*	*0,41*
Difference (Test2-Test1)	-1,87	1,75	1,03	-0,04
Standard error	*0,57*	*0,69*	*0,67*	*0,58*
Difference-in-difference (relative to no language items)	-2,91	-2,78	-	-1,07
Standard error	*0,88*	*0,97*	*-*	*0,89*
	English-home-language students (n=132)			
	High language items (23 items)	**Ambiguous items** (14 items)	**No language items** (16 items)	**Total** (53 items)
Test 2 (in English)	69,47	68,99	62,26	67,17
Standard error	*2,01*	*1,97*	*2,45*	*2,00*
Test 1 (in Home Language)	59,22	64,94	56,82	60,01
Standard error	*2,24*	*2,49*	*2,69*	*2,34*
Difference (Test2-Test1)	10,24	4,06	5,45	7,16
Standard error	*3,01*	*3,18*	*3,64*	*3,08*
Difference-in-difference (relative to no language items)	4,80	-1,39	-	1,72
Standard error	*4,72*	*4,83*	*-*	*4,76*

3.7.3 SUMMARY OF FINDINGS AND ROBUSTNESS CHECKS

Table 14 presents the various "effect sizes" discussed in this paper. The composite effect of (1) home background and (2) school quality was calculated as the difference between the score of English students on the Systemic Evaluation and the score of non-English students on the Systemic Evaluation. Given that all students wrote the Systemic Evaluation in the

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LOLT of the school, we argue that this is the sum of all non-language factors (summarised as “home background and school quality”). The effect of language was calculated as the difference between Test 2 (NSES written in English) and Test 1 (Systemic Evaluation written in LOLT of the school). The lower-bound estimate is the straight-forward difference between the two tests while the upper-bound estimate assumes that non-English students would have learnt as much in the intervening month as English students did and would remember as much of the test as English students, and is thus calculated as the difference between Test 2 and Test 1 in addition to the learning/familiarity gain seen among the English students. All differences are expressed as a percentage of a standard deviation found among non-English students in the Systemic Evaluation test (15,6% for literacy and 22,2% for numeracy). It is perhaps helpful to contextualise the standard deviation metric; half of a standard deviation improvement would take somebody from the middle of the distribution (50th percentile) to the 69th percentile, and a one standard deviation improvement would take them to the 84th percentile.

TABLE 14: SIZE OF VARIOUS "EFFECTS" IN STANDARD DEVIATIONS FOR STUDENTS WHOSE HOME LANGAUGE IS NOT ENGLISH

	Literacy		**Numeracy**	
	Lower-bound	*Upper-bound*	*Lower-bound*	*Upper-bound*
(1) Home background (2) School Quality	-1,08		-1,22	
(3) Language	-0,69	-0,82	0	-0,32
(1a) Home background (2a) School Quality	-1,13		-1,22	
(3a) Language (excluding 3 *write-a-sentence* items)	-0,29	-0,71	0	-0,32

In addition to the effect sizes, Table 14 also reports the results of a sensitivity analysis for the literacy results. Given that NSES markers seemed to be more strict than the Systemic Evaluation markers on the “write a sentence” questions (as discussed above), the analysis was re-done excluding the three “write a sentence” items. These results are reported as (1a) (2a) and (3a) in Table 14**.** Given the data presented in Table 13 and the discussion about the different marking procedures employed, there is a strong case to be made that the results in (1a) (2a) and (3a) are more reliable than those in (1) (2) and (3).

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Perhaps the most important finding emerging from Table 14 is the relative size of the impact of language as compared to the composite impact of home-background and school-quality. While it is not possible to disentangle the separate impacts of home-background and school-quality with the existing data, it is still useful to compare the size of the language factor and the composite non-language factor. The findings presented here suggest that one should exercise caution when comparing the results of English and non-English students in South Africa. While it is true that non-English students perform considerably worse than English students, and also true that part of this underperformance *is* attributable to language, claiming that language is the *main* cause of underperformance lacks empirical evidence. Howie (2003), for example, states that, "The most significant factor in learning science and mathematics isn't whether learners are rich or poor. It's whether they are fluent in English" (cited in Fleisch, 2008, p. 99). Using slightly less totalising language, Motala (2009) provides a similar argument explaining that, "For those children who struggle with its expressions and idioms, for those who listen but cannot understand, English is *the* fundamental barrier to learning" (Motala, 2009, p. 5; emphasis added). While the latter statement seems quite reasonable, it cannot explain why students perform so poorly *before* switching to English in grade 4. Therefore these arguments do not hold weight in the Foundation Phase when the child is still learning in the LOLT of the school (which, in most instances, is the home language of the child).

3.7.4 LIMITATIONS AND CAVEATS

Given the nature of the language debate in South Africa, it is worth reiterating what these findings do and (importantly) do not show. They provide no evidence on the impact of learning in an African language relative to learning in an additional language (English). They provide no evidence about whether or not non-English students should transition to English earlier or later than they currently do (grade 4). Both of these issues have been discussed in the local and international literature (Heugh, 2012; Macdonald, 1990; Skutnabb-Kangas, 2000; Taylor and Coetzee, 2013). While it is true that almost all studies in Africa have been small-scale qualitative studies, it is telling that there are currently no studies (that I am aware of) that show that a straight-for-English approach is superior to learning initially in a child's home language in the African context. As Heugh (2012, p. 40) concludes:

> "Almost every commission of enquiry into language and education, every language in education conference and every set of recommendations on the matter, in Africa, over the last 100 years, has concluded that education must begin in the mother tongue of the child or in that language of the immediate community which the child knows and uses best."

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As a caveat to this last statement, one should note that in some environments there is no obvious dominant mother tongue among students due to the high levels of linguistic diversity in the classroom – particularly in urban areas (NEEDU, 2013). In these instances a straight-for-English approach may be the best alternative, even if it is not ideal. For example, Gustafsson (2013) shows that there is considerable within-school linguistic diversity in the highly urban province of Gauteng, with 41% of schools being in a situation where less than 50% of students in the school speak the largest home language. It is unclear which home-language one should use in these instances. However in provinces like KwaZulu-Natal and the Eastern Cape – which are both far more linguistically homogenous - the comparable figures are 1% and 2% respectively. The full table is reported in Appendix B.

Another important caveat regarding the existing study is that it is not nationally representative, even though it does cover a large number of students in each of eight provinces. Although it uses large-scale data from nationally representative[34] samples, it is unclear how the matching procedure employed affected the representivity of the underlying samples. Notwithstanding the above, Table B2 in Appendix B does show that the overall provincial breakdown of students in the NSES and the matched NSES-Systemic-Evaluation samples do not differ by more than three percentage points in any one province.

3.8 Summary and Conclusion

To summarise the main findings from this analysis:

- Non-English grade 3 students performed between 0,29 and 0,71 standard deviations worse in **literacy** when writing the test in English compared to writing the test in the LOLT of the school. This impact can be regarded as causal.
- Non-English grade 3 students performed 1,08 standard deviations worse in **literacy** than English grade 3 students when both groups of students wrote the test in the LOLT of their respective schools. This can be regarded as the size of the effect on literacy of home background and school quality factors combined.
- Non-English grade 3 students performed between 0 and 0,32 standard deviations worse in **numeracy** when writing the test in English compared to writing the test in the LOLT of the school. This impact can be regarded as causal.

[34] As mentioned previously, the NSES test did not sample students from Gauteng because there were alternative testing programs under way in that province in 2007. In this sense the NSES is nationally representative except for Gauteng.

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- Non-English grade 3 students performed 1,22 standard deviations worse in **numeracy** than English grade 3 students when both groups of students wrote the test in the LOLT of their respective schools. This can be regarded as the size of the effect in numeracy of home background and school quality factors combined.
- The analysis of the literacy tests showed that students whose home language is not English found it particularly difficult to write a sentence in English, even after accounting for the fact that the test markers for Test 2 (NSES in English) seemed to mark more strictly than those for Test 1 (Systemic Evaluation in the LOLT of the school). The results further showed that student performance on the '*infer' and interpret'* items in Test 1 (written in the LOLT of the school) was so low to begin with that there was hardly any difference in performance when it was written in English in Test 2 (NSES). This is keeping with the findings of Vorster et al. (2013: 150) who find that "at the lowest levels of achievement there was little difference between performance in the SE and NSES (non-English speakers only). This may reflect that the knowledge base of these learners was so low that writing in their home language yielded no substantial improvement, or in other words, learners are not learning much in either language."
- The analysis of the literacy test confirmed the international literature (Adetula, 1990) that student's whose home language is different to the language of the test find free-response questions more difficult than multiple choice questions.
- Analysis of the numeracy test for non-English students showed only slight differences in performance across the two tests, with a slightly larger 'cost' for high-language items relative to no-language items.

Where the present study differs from earlier research is that it focuses on the grade 3 level, which is *before* any LOLT-switch to English. By taking this approach it was possible to isolate the impacts of *language-factors* on the one hand, and *home-background* and *school-quality* on the other. In essence this chapter has extended the analysis of Vorster et al. (2013) in two important ways; firstly by improving their matching algorithm (matching 61% more students), and secondly by disaggregating students' numeracy and literacy performance by item category, language content and question format. This was done in an attempt to provide empirical estimates of the language cost associated with different literacy processes and question types for literacy; and for numeracy the differences between high language and no language items. The findings presented here agree with those of Vorster et al. (2013) who found that the performance gap between the SE and NSES was largest for non-English speakers.

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Perhaps the most important finding emerging from the present analysis is that the size of the composite effect of home-background and school-quality is 1,6 to 3,9 times larger than the impact of language for literacy and at least 3,8 times larger for numeracy. To put this in terms of 'years worth of learning', if one uses 0,3 standard deviations as an approximation of one year of learning in South Africa (as per the discussion in Chapter 2), then the size of the 'language cost' is approximately one to two years worth of learning for literacy and one year for numeracy. By contrast, the size of the composite effect of home background and school quality is roughly four years worth of learning for both numeracy (1,2 standard deviations) and literacy (1,15 standard deviations). This finding reiterates those expressed by other authors in the literature (Fleisch, 2008; Hoadley, 2012; Murray, 2002), for example Hoadley (2012) concludes that:

> "Divided opinions over the language of instruction issue have masked the issue of poor literacy teaching per se, as is evident in the low home language literacy levels amongst learners…To a certain extent, in other words, debates around language deflect attention from the quality of instruction, irrespective of the language of instruction" (Hoadley, 2012, p. 192).

The intention of these authors is not to negate the importance of language, but rather to situate the language effect within the discussion of a generally dysfunctional schooling system. By doing so, these findings – including those presented in this chapter - aim to stress the importance of the quality of instruction, not only the language of learning. The fact that the literacy and numeracy achievement of South African children is so low ***prior*** *to* any language switch to English should give pause to those who argue that language is the most important factor in determining achievement, or lack thereof, in South Africa.

The results from the quantitative analysis presented in this chapter give us some indication of the average size of the impacts of language and non-language factors on achievement. This is something that is not possible using qualitative research methods. In order to move the language debate forward we need to avoid basing language policies on ideological statements or solely on case-study research, and instead use systematic evidence to improve our understanding of the language dynamics in South Africa.

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CHAPTER 4: ACCESS TO WHAT? CREATING A COMPOSITE MEASURE OF EDUCATIONAL ACCESS AND EDUCATIONAL QUALITY FOR 11 AFRICAN COUNTRIES

> "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)

4.1 INTRODUCTION AND RESEARCH QUESTION

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 (Lewin, 2007; UNESCO, 2005). As more and more countries approach universal enrolment, there is a shift away from simplistic measures of access to schooling and towards a fuller concept of access to learning. 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, skills, abilities, cultural understandings and values that are necessary to function as full members of their society, their polity, and their economy (Pritchett, 2013). While access is a necessary condition for this type of education, it is by no means a sufficient one.

As a result of this new consensus view, few would argue that access and quality are not intimately related. The inter-relationships between these two dimensions of education are many, varied and complex and important for both academic inquiry and policy-analysis. Yet the extant literature on education is almost entirely bifurcated with research focussing on either access to education or the quality of education, but rarely both simultaneously. This is problematic for two reasons: 1) Observing access to education without regard for the quality of that education clouds the analysis, primarily because the underlying assumption that enrolment and attainment are correlated with learning is often not true, as will become evident; 2) Analysing educational outcomes for those attending school without taking cognizance of the enrolment and dropout profiles of the countries under review is likely to

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bias the results. Developing 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 involved where the ‘strongest’ (i.e. the wealthiest, most advantaged, and most able) students enroll and then remain in the schooling system (Lambin, 1995).

The aim of the present study is to integrate these two dimensions of education by providing a composite measure of educational access and educational quality, what we call access-to-literacy and access-to-numeracy. To do so we combine country-specific household data on grade completion (from Demographic and Health Surveys) with cross-national data on cognitive outcomes (from the Southern and Eastern African Consortium for Monitoring Educational Quality – SACMEQ 2007) for 11 African countries, namely, Kenya, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe. In doing so we aim to answer the following research questions:

1. In each country what proportion of children:
   - i) never enrol,
   - ii) enrol but drop out prior to grade 6,
   - iii) enrol and complete grade 6 but without acquiring functional literacy and functional numeracy by this time,
   - iv) enrol and complete grade 6 having acquired basic numeracy and literacy skills,
   - v) enrol and complete grade 6 having acquired higher order numeracy and literacy skills.
2. In each country how do the proportions of children identified in (1) above differ by the sub-national categories of:
   - i) gender (boys and girls),
   - ii) wealth (poorest 40%, middle 40% and wealthiest 20%), and
   - iii) a gender-wealth interaction (poorest 40% of girls compared to poorest 40% of boys, middle 40% of girls compared to middle 40% of boys, and wealthiest 20% of girls compared to the wealthiest 20% of boys).

4.2 Access and quality: the extant literature

That education is important for economic growth is now part of the received wisdom in economics. Numerous authors have made compelling arguments linking both the quantity of education and the quality of education to increased economic growth (Barro and Lee, 2001; Bosworth and Collins, 2003; Ciccone and Papaioannou, 2009; Hanushek and Kimko, 2000;

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Hanushek and Wößmann n, 2008). Historically, much of the associated empirical work on education and economic growth focussed on within country analyses (see for example Solow, 1957; Jorgenson and Griliches, 1967; and Denison, 1985). The introductory chapter of this thesis outlined the intellectual trajectory of human capital studies and argued that the most recent findings have fore-grounded the notion of education quality over education quantity when looking at economic growth. However, given that most of these studies have had an economic agenda – focussing on either individual or national incomes – there has been less emphasis on the non-economic benefits of education. If one looks at the motivations behind what is arguably the most successful educational 'movement' in the last three decades - the Education For All (EFA) movement – one can see that it cannot be linked solely to an economic rationale. Improved labour-market outcomes and increased economic growth are only two of a myriad of benefits associated with expanding educational opportunity to those currently excluded from formal education.

Some of these non-economic benefits include: lower fertility (Basu, 2002), improved child health (Currie, 2009), reduced societal violence and improved human rights (Salmi, 2000), promotion of a national - as opposed to a regional or ethnic - identity (Glewwe, 2002), and lastly, increased social cohesion (Heyneman, 2003). Moving beyond these specific atomised benefits of education, Sen (1999) and Nussbaum (2006) provide a generalized theory where education occupies a central role in expanding the capabilities and freedoms of individuals, enabling them to pursue the sort of lives they have reason to value.

Largely as a result of the above consensus view on the importance of education for development (both social and economic), the EFA initiative was created as a vehicle to facilitate and monitor the expansion of primary education in developing countries. The commitments to universal primary education that were outlined at education conferences in Jomtien, Thailand in 1990, and reiterated in Dakar, Senegal 2000, have been met with widespread approval both within developing countries, and by external stakeholders. The movement has also been tremendously successful. Between 1980 and 2010 the proportion of people aged 15 and over living in developing countries that had no schooling decreased by 54% from 37.7% in 1980 to 17.4% in 2010, with the average years of schooling increasing from 4.3 years to 7.1 years over the same period (Barro and Lee 2013).

Recent education scholarship, however, has begun to draw attention to the increasing disconnect between schooling (access) and learning (quality) in developing countries. Filmer et al. (2006) for example, provide a detailed critique of the access-dominated Millennium Development Goal on education (Goal 2), namely: "To ensure that by 2015, children

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everywhere, boys and girls alike will be able to complete a full course of primary schooling." In their article titled "*A Millennium Learning Goal: Measuring real progress in education*" they conclude as follows:

> "We demonstrate that even in countries meeting the [Millennium Development Goal] of primary completion, the majority of youth are not reaching even minimal competency levels, let alone the competencies demanded in a globalized environment … While nearly all countries' education systems are expanding *quantitatively* nearly all are failing in their fundamental purpose. Policymakers, educators and citizens need to focus on the real target of schooling: adequately equipping their nation's youth for full participation as adults in economic, political and social roles. A goal of school completion alone is an increasingly inadequate guide for action … focusing on the learning achievement of all children in a cohort a [Millennium Learning Goal] eliminates the false dichotomy between "access/enrolment" and "quality of those in school": reaching an MLG depends on both" (Filmer et al. 2006, 1).

There is growing evidence of exceedingly low levels of learning in many developing countries including, India, Indonesia, Malaysia, Mexico, Pakistan, Thailand, Turkey and South Africa (Pritchett 2013; Muralidharan and Zieleniak 2013; Taylor et al. 2013). Not only are the levels of learning typically low, but the actual learning associated with a year of schooling differs widely across countries. Majgaard and Mingat (2012, 7), for example, demonstrate for a selection of African countries that adults with the same years of schooling differ widely in their reading ability depending on which country they are from. Following logically from the above, Hanushek and Wößmann (Hanushek and Wößmann n, 2008) show that cognitive skills acquired, in addition to years of education attained, is an important determinant of human capital and economic growth:

> "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 and Wößmann 2008, 608).

While Filmer *et al.* (2006) and Hanushek and Wößmann (Hanushek and Wößmann n, 2008) both use cognitive skills as a proxy for education quality, this is primarily because these are

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the elements of education quality that are more easily quantifiable. If one were to create an indicator which comprehensively reflects the quality of education provided it would have to include factors like artistic creativity, empathy, democratic values, preference for political participation, the extent to which schooling successfully socializes children into their societies, whether children have an increased appreciation for social diversity, inclusivity and the need for egalitarian principles (attitudinal modernity) (Heneveld and Craig 1996; UNESCO 2005, 30). The most prominent reason why these are not included in empirical studies of education is that they are notoriously difficult to measure reliably. Consequently we too use cognitive outcomes, and specifically numeracy and literacy, as a proxy for education quality. This was a pragmatic, rather than ideological, choice and does not deny the importance of other subjects or the myriad of (as yet) unquantifiable benefits associated with education. We see the acquisition of basic numeracy and literacy skills as a low benchmark that is a necessary but not sufficient condition for quality education.

On a practical level, the existing emphasis on enrolment and attainment in developing countries over-estimates the progress that has been made in education because these statistics ignore learning, or the absence of learning. While many more children now have a physical place in a building called a school, there is mounting evidence that too many of these children are not acquiring even the most basic numeracy and literacy skills.

In the same way that many studies of educational access ignore the quality of that education, studies of educational quality often make implicit assumptions 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 (see for examples Fehrler et al., 2009; Hungi and Thuku, 2010; Lee et al., 2005). This is primarily because the assessments themselves use the school-going-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, 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"[35]. This is largely due to the

[35] This may seem contradictory to the findings of Hanushek and Wößmann (2011, p. 79) who find that "Countries having more schools and students excluded from the targeted sample, having schools and students who are less likely to participate in the test, and having higher overall school enrolment at the relevant age level tend to perform better on the international tests." However, this statement is made with respect to countries that

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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 between developing countries, and, within countries, between sub-groups (Filmer and 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.

The only three exceptions to the ‘bifurcated literature’ discussion above that we are aware of are the aforementioned article by Filmer *et al.* (2006), the seminal article by Hanushek and Wößmann (Hanushek and Wößmann n, 2008) and the recent book by Pritchett (2013). In each of these instances, the authors combine World Bank survey data with micro data from at least one international student achievement test. For example, Hanushek and Wößmann (Hanushek and Wößmann n, 2008) sub-divide 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 thus 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. Filmer *et al* (2006), and Pritchett (2013) both include a variety of developing countries but do not aim, as we do, to develop a single metric for measuring both access to education and the quality of that education. Furthermore, we use a different – and we argue, more correct – measure of access than either Filmer et al. (2006) or Pritchett (2013). In this way we hope to contribute to the literature and build on the work of these earlier authors.

4.3 DATA

In this paper, we use the latest data from the Southern and Eastern African Consortium for Monitoring Educational Quality (hereafter SACMEQ) survey in combination with data on grade completion from the most recent Demographic and Health Survey (DHS) conducted in each country.

SACMEQ is a consortium of African education ministries, policy-makers and researchers who, in conjunction with UNESCO’s International Institute for Educational Planning (IIEP),

participate in PISA and TIMSS, the bulk of whom are either high-income countries or upper-middle-income countries, in contrast to Lambin (1995) who is referring to education systems generally.

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aims to improve the research capacity and technical skills of educational planners in Africa (Moloi and 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)[36]. 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 (Murimba, 1991; Ross et al., 2005). SACMEQ 2007 tested 61,396 Grade 6 students from 2,779 schools in 14 countries (Hungi et al., 2010). This dataset represents the most recent and comprehensive survey on educational quality in Sub-Saharan Africa[37].

For the data on educational access, we use the grade 6 completion rate from the most recent 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.

DHS uses a stratified, two stage cluster design. Countries are stratified by rural-urban location and region that is usually defined as a province or district[38]. Enumerator areas are used as primary sampling units and are selected with probability proportional to size. DHS surveys use existing, officially recognized sampling frames with weights calculated as the product of the selection probability and the inverse of the response rate group. Further information on sampling can be found in Appendix A of the final country reports (ICF International, 2012)

There are a number of benefits to using the DHS data over other sources:

1) Self-reported enrolment and grade completion rates are often more accurate than administrative records - the quality of which varies widely between countries (UNESCO Institute for Statistics, 2010). Unlike country-specific administrative data, the uniformity of the DHS surveys means that DHS data are in fact more comparable across countries and over time.
2) They can be linked with household characteristics like socioeconomic status (Filmer and Pritchett, 2001), and not simply gender which is one of the limitations of administrative data.

[36] Although SACMEQ IV (2013) has been conducted, the data from this round is only expected to be released in 2015.

[37] SACMEQ is not representative of sub-Saharan Africa since this includes Central and West Africa. SACMEQ seems representative of about half of sub-Saharan Africa.

[38] Tanzania is stratified by mainland / Zanzibar as well as urban / rural.

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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 (UNESCO Institute for Statistics, 2010).
4) It provides accurate age-specific grade-completion rates, which are necessary for the present analysis. Calculating age-specific grade completion 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 grade completion rates, particularly in certain countries. See UNESCO Institute of Statistics (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.
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 (UNESCO, 2011, p. 344) for our eleven 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 sample of countries 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 15) 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

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incorrect administrative data[39] provided by member countries is inconsequential for our purposes.

6) Grade completion rates, which we regard as the most meaningful measure of access to education at least for the purposes of this paper, cannot be calculated reliably using administrative education data.

It would be remiss not to include a brief list of the limitations of household survey data. These 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 and Pritchett, 1999) and enrolment (Hanushek and Wößmann n, 2008), we do not believe that any of these problems outweigh the serious limitations of the alternative.

In order to calculate a measure of socioeconomic status DHS uses information on assets (electricity, radio, television, bicycle and refrigerator), services (sanitation, drinking water and electricity), vehicles (motorcycle, scooter, car and truck), building material quality (floor, wall and roof material), ownership of agricultural land, employing a domestic servant and other country specific assets. These variables are then converted to dichotomous variables and principal component analysis is used to construct a wealth index (Ruthstein and Jonson, 2004). For the SACMEQ data we use the socioeconomic status variable created by SACMEQ which was created by combining variables that described the educational level of the students' parents, the materials used in the construction of students' homes, and the number of possessions in students' homes (Ross et al., 2005, p. 37). Figure 14 below shows the box-plots of the SACMEQ student socioeconomic status (SES) variable for each of the 11 countries. If one compares students from South Africa and those from the poorest 6 countries (Malawi, Tanzania, Mozambique, Uganda, Kenya, and Zambia), one can see that South African students who are at the 25th percentile in the South African SES distribution have a higher level of socioeconomic status than their peers in these poorer countries who are at or above the 75th percentile in their respective countries. It is important to bear these inter-country differences in mind when comparing the poorest 40% of South African students with the poorest 40% of Malawian students (for example), since the former are considerably wealthier than the latter.

[39]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.

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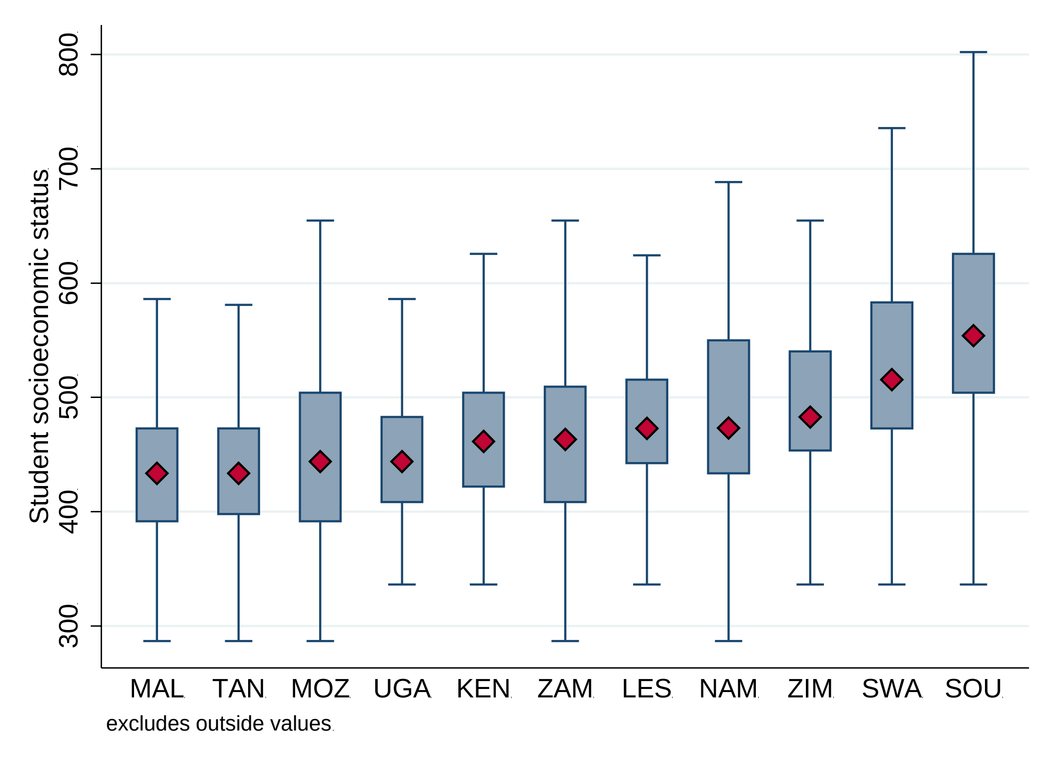
FIGURE 14: BOXPLOTS OF STUDENT SOCIOECONOMIC STATUS BY COUNTRY (SACMEQ 2007) DIAMOND REPRESENTS THE MEDIAN



Of the 14 SACMEQ countries, 11 have reliable and recent survey data on grade completion and therefore we include these 11 countries in our analysis. The specific dates that each DHS survey was conducted in 9 of the 11 countries are: Kenya (2008-9), Lesotho (2009), Malawi (2010), Mozambique (2011), Namibia (2006-7), Tanzania (2010), Uganda (2011), Zambia (2007) and Zimbabwe (2010/11). For South Africa, we follow Filmer (2010) and use the South African General Household Survey from 2009 given that the South African DHS data have not been released to date. In order to find a sufficiently recent dataset for Swaziland, we use the Multiple Indicator Cluster Survey (MICS) for 2010. MICS And DHS collaborate closely using inter-agency processes to harmonize their survey tools to ensure maximum comparability (Hancioglu and Arnold, 2013). Observing only these 11 countries, the SACMEQ survey tested 49,733 Grade 6 students in 2,247 primary schools.

4.4 Method

Educational quality, as proxied by student numeracy and literacy test scores, is a continuous variable while educational access is binary (completed grade 6 or not). Thus 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 children who will never complete grade 6. Since we have data on

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both the educational competencies of the school-going population (from SACMEQ), and also the proportion of a cohort that will complete grade 6 (from DHS), we calculate the proportion of a cohort of children (whether in school or out) that have acquired basic numeracy and literacy skills – what we call the access-to-literacy and access-to-numeracy rates.

Given that the present study aims to combine statistics on access and quality, and that the only cross-national measure of education quality in Africa is at the grade 6 level, an accurate measure of access to the grade 6 level was required. There are various different methods for calculating such a measure. We provide an overview of each method (in increasing order or technical correctness) and explain their limitations:

1. **Use the primary school Net Enrolment Rate (NER).** These rates are reported in the UNESCO Global Monitoring Reports (UNESCO 2005, 291 for example) and are available for almost all countries. Two problems are immediately evident: (1) the primary school NER overstates access to grade 6 since it calculates enrolment over the full range of primary grades such that many children who are "enrolled" by this measure will never actually complete grade 6. While single-year-of-age enrolment estimates are technically possible, they are also problematic[40]; (2) The NER is calculated by using administrative data for the numerator and population estimates from a different source for the denominator, leading to potentially large biases (for a comprehensive discussion see UNESCO Institute for Statistics, 2010).
2. **Calculate age-specific Net Attendance Rates (NAR) from household survey data**. Instead of using administrative data, one could use nationally representative household survey data on enrolment. This ensures that both the numerator and denominator are sourced from the same data and thus overcomes some of the problems highlighted in (1) above. This was the first approach we employed in a preliminary[41] version of the present analysis. There we calculated the country-specific median age of children in SACMEQ and then observed the Net Attendance Rate for children of that age in the DHS (Spaull and Taylor, 2012). However, this method overstates access to grade 6 since it assumes that all children of the median

[40] 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 UNESCO Institute for Statistics (2010, 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.

[41] We are indebted to an anonymous reviewer who highlighted the shortcomings of the methods we used in two earlier versions of this paper, and particularly the limitations of the Kaplan-Meier method for the present analysis. Their detailed and constructive comments and suggestions led to significant improvements in our methodology.

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age that are attending school have reached, or will reach, grade 6. Given the large variance in ages across grades in sub-Saharan Africa (Lewin and Little, 2011), many children of the SACMEQ median-age have not yet reached grade 6 and may never reach grade 6.

3. **Use Kaplan-Meier survival probabilities to estimate grade survival**. In the second iteration of the present study (Spaull and Taylor, 2014) we used Filmer's (2010) estimates of grade survival probabilities to grade 6 for the 10-19 year old cohort in each country. Filmer (2007) calculates these probabilities by using the Kaplan-Meier method which, he argues, "implicitly accounts for the fact that some in the cohort are still in school and will ultimately complete a higher grade than they are currently observed to be in" (Filmer 2007, 166). The Kaplan-Meier method was developed for medical trials to estimate the probability of survival from data that may be incomplete (i.e. in the presence of censoring). However, this method requires independence between censoring and survival (Szklo and Nieto 2012, 55). That is to say that individuals who are censored, or "lost to follow up" (i.e. no longer in the sample) have the same prospect of survival as those who continued to be followed (i.e. remain in the sample). If this assumption is not met the resulting probabilities will be biased. In Filmer's educational application of the method, the number who have dropped out of school is analogous to the number in the medical sample who died, while the number of children who are delayed (i.e. who have not dropped out of school but are behind their age-appropriate peers) are analogous to those who are "lost to follow up" (censored observations) in the medical sample. Because the Kaplan-Meier method assumes that censored observations have the same probability of survival as those who remain in the sample, Filmer is essentially assuming that those who are delayed have the same probability of dropping out of school as those who are not delayed (i.e. those who are progressing at the appropriate rate), something that is almost certainly not true. Research has consistently shown that overage students are more likely to drop out than their age-appropriate peers (Lewin and Little, 2011).

4. **Use Grade completion of an older cohort.** One method that overcomes the limitations of methods (1), (2) and (3), is to use household survey data (DHS) but to calculate the grade 6 completion rate for a cohort of children where practically all children who *will* complete grade 6 *have* completed grade 6. Pritchett (2013, 76) employs this method and, using DHS data, calculates the grade 6 completion rate for 15-19 year olds in each SACMEQ country. Pritchett does not explicitly motivate why he uses the 15-19 year old cohort. We assume he selected this cohort since they are a few years beyond the usual statutory age for grade 6 completion (approximately 13

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years old), and thus most students should have already completed grade 6. However, this underestimates the true extent of grade-repetition and late entry in sub-Saharan Africa. If there are children who only complete grade 6 when they are 15, 16, 17, 18 or 19, this method will underestimate the grade 6 completion rate (potentially quite severely). To explain by example, Pritchett (2013, 76) reports that only 54% of Ugandan 15-19 year olds had completed grade 6. Using the same data as Pritchett (Uganda DHS 2006) we find that 23% of Ugandan 15-19 year olds were still enrolled in grade 1-6 and therefore may yet go on to complete grade 6. Indeed, DHS data show that the grade 6 completion rate for Ugandan 14-16 year olds (36%) is almost half that of Ugandan 17-18 year olds (64%) illustrating that many Ugandan children only complete grade 6 when they are 17 or 18 years old. It is worth emphasizing that Uganda is by no means unique among SACMEQ countries[42]. Table 15 below shows the proportions of children currently enrolled in grades 1 to 6 and the proportion who have completed grade 6 for two cohorts and four countries: (1) 15-19 year olds and 19-21 year olds. The year of each DHS was chosen to match those used by Pritchett (2013). The higher grade 6 completion rates among the 19-21 year old cohort are clearly driven by the fact that many students are only completing grade 6 at ages well beyond those stipulated by their governments. The fact that Hanushek and Wößmann (2008, p. 656) also use 15-19 year olds in their analysis of developing countries is also problematic, particularly because they also look at an even higher grade (grade nine) which is likely to exacerbate this problem further. While systemic over-age enrolment is obviously a problem in and of itself, for the purposes of calculating a measure of access to grade 6, one has to include students that are over-age or risk seriously underestimating access. Importantly, SACMEQ takes as its sampling frame all students that are enrolled in grade 6 in a country (irrespective of age), which explains the high proportions[43] of students aged 15 and older in each country; a full 22% of the SACMEQ 2007 grade 6 sample is 15 years or older. For the purposes of the present study we needed to calculate the proportion of a cohort that made it into the SACMEQ sampling frame (i.e. made it to grade 6[44]), while the age at which they do so is less important for our purposes.

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[42] For each country the proportion of students aged 15-19 currently enrolled in grades 1-6 is as follows (using the same DHS data as Pritchett (2013)): Kenya (11%), Lesotho (8%), Malawi (18%), Mozambique (35%), Namibia (7%), South Africa (1%), Swaziland (13%), Tanzania (6%), Uganda (23%), Zambia (14%), Zimbabwe (2%).

[43] The specific proportions of SACMEQ III (2007) children aged fifteen and older for each country are as follows: Kenya (23.7%), Lesotho (26.7%), Malawi (32%), Mozambique (30.3%), Namibia (18.4%), South Africa (7.2%), Swaziland (25.6%), Tanzania (36.8%), Uganda (28,7%), Zambia (29%), and Zimbabwe (2.1%).

[44] Given that the SACMEQ test was administered towards the end of the grade 6 academic year, and due to dropout during grade 6, grade 6 completion is arguably a better measure of access than grade 5 completion.

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TABLE 15: COMPARISON BETWEEN ENROLMENT AND COMPLETION RATES FOR 15-19 YEAR OLDS AND 19-21 YEAR OLDS IN FOUR COUNTRIES (USING THE SAME DHS DATA AS PRITCHETT, 2013)

DHS year	Country	Currently enrolled in Grades 1-6		Completed Grade 6	
		15-19 years	19-21 years	15-19 years	19-21 years
2008	Kenya	11%	1%	81%	88%
2005	Malawi	18%	2%	54%	60%
2006	Uganda	23%	2%	55%	64%
2007	Zambia	14%	2%	73%	76%

5. **Use Grade completion of a *sufficiently* older cohort.** In order to decide which cohort of DHS students to use, the proportion of students currently enrolled in grades 1-6 by year of age was calculated with the intention of selecting a cohort where almost no children were still enrolled in grades 1-6. By 19 years of age, less than 5% of individuals were enrolled in grades 1-6 in all countries and thus, to ensure sufficiently large samples in each country we chose the cohort of 19-23 year olds for the present analysis. While one could use an even lower threshold (<1%), this would require an even older cohort, which would be problematic in a context where there has been a recent rapid expansion of access to schooling, as in some sub-Saharan African countries. Much older cohorts would not have been exposed to this newly expanded education system, and thus their grade 6 completion rates would underestimate the “true” current grade 6 completion rate. There is thus a tension between selecting a cohort of students that is old enough to have been given sufficient time to complete grade 6, but young enough that they represent the current reality in each country. In order to decrease the potential downward bias of selecting older cohorts (that have not benefited from very recent expansions), we use the most recent DHS data that is available for each country. Thus, although we are reporting grade 6 completion rates for 19-23 year olds who are much older than most SACMEQ students in 2007, in 8 of the 11 countries the most recent DHS data was collected in 2009 or later. For example, 30% of grade 6 students in the SACMEQ Mozambique sample were 15 years or older in 2007 (when SACMEQ was conducted) and thus these 30% of students would be 19 years or older in 2011 when the DHS Mozambique was conducted. Therefore the 19-23 year old sample in DHS Mozambique 2011 is not a bad estimate of the schooling opportunities available to the SACMEQ cohort of Mozambican children. Although it would be ideal if all countries had DHS data for 2011 or later, we are restricted to use the most recent

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DHS data for each country. We would argue that excluding countries entirely simply because their most recent DHS was only in 2006/7 is like throwing the baby out with the bath water.

Based on the results of the numeracy and literacy tests, SACMEQ classifies participants 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 the online technical appendix, and a more detailed discussion can be found in Ross *et al.* (2005) and Hungi *et al*. (2010, 6). According to this classification system, if children have not reached level 3 in either reading (*'basic reading'*) or mathematics *('basic numer*acy') by the time they complete grade 6 they are deemed functionally illiterate and functionally innumerate respectively. As the SACMEQ researchers Ross *et al*. (2005, 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[45] 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 elsewhere in the literature before. For example, Shabalala (2005, 222) also uses the bottom two SACMEQ levels and deems students below this threshold as 'non-readers' and 'non-numerate' (see also Spaull, 2013).

In this paper we assume that all children who never complete grade 6 are functionally illiterate and functionally innumerate. Whether these children never enrolled in the first place, or enrolled but dropped out prior to grade 6, is an important question, and one which we return to later in the paper. For those children that never enroll, it is highly unlikely that they would learn to read, write and compute at a sufficient level to be able to pass competency level one and two on the SACMEQ tests[46]. For those children that do enroll but drop out before grade 6, it is also improbable that they would have acquired these skills prior to

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[45] 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.

[45] 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.

[46] 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.

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dropping out[47]. Many students that drop out do so because they have 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 who remain in school do not reach level 3 by grade 6 (our literacy threshold), it is unlikely that those who have dropped out would have already reached level 3 prior to dropping out. For example, we believe it is reasonable to assume that the 4% of Zimbabwean children who enroll initially but do not complete grade 6 would not have been a more literate group than the 17% of Zimbabwean children that complete grade 6 but were not yet literate (see Figure 15). Moreover, given that non-enrolled children are mainly found in poor communities and remote areas (Lewin, 2007), it is unlikely that such children would have gained significantly from home-based literacy activities.

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 skilled*, *concrete problem solving*, and *abstract problem solving* (Ross et al., 2005). Figure 15 and Figure 16 below use these designations and follow the approach of Hanushek and Wößmann (2008, 656). This makes it possible to combine educational access (enrolment and grade completion) and educational quality (cognitive skills) in a single graph.

[47] There are only two countries where this is a possibility, Swaziland and Tanzania. In both of these countries almost all children that complete grade 6 are functionally literate. Thus it is sensible to ask whether or not some children that only complete grade 5 (but not grade 6) may also be functionally literate. To test this we calculated the proportion of children that complete grade 5 but not grade 6 in Tanzania (2.3%) and Swaziland (4.1%). Given that these are small proportions, even in the event that children with only grade 5 completion were literate, this would not change the overall picture significantly.

FIGURE 15: PROPORTION OF 19-23 YEAR OLDS IN EACH COUNTRY BY ENROLMENT STATUS AND LITERACY PROFICIENCY

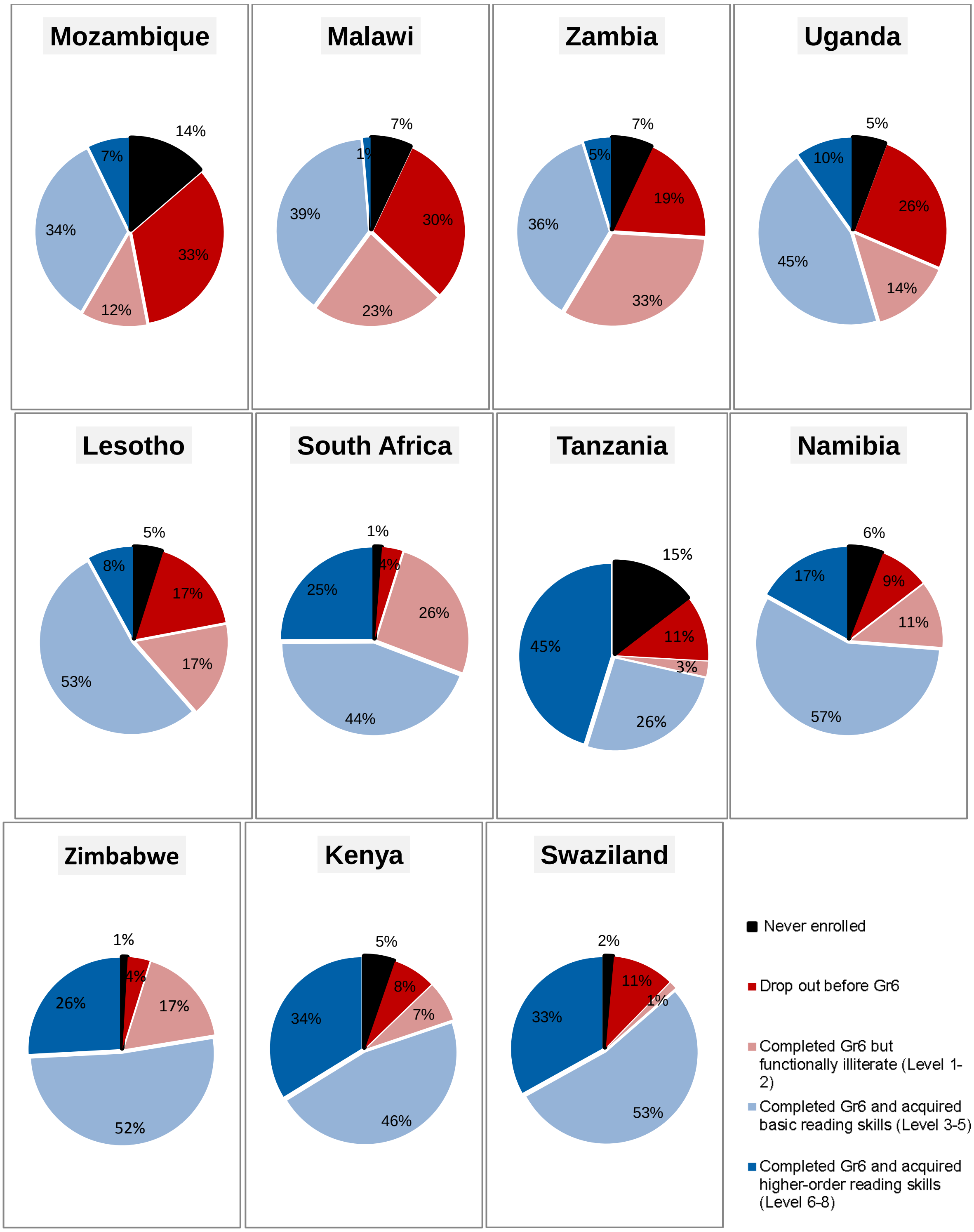

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FIGURE 16: PROPORTION OF 19-23 YEAR OLDS IN EACH COUNTRY BY ENROLMENT STATUS AND NUMERACY PROFICIENCY

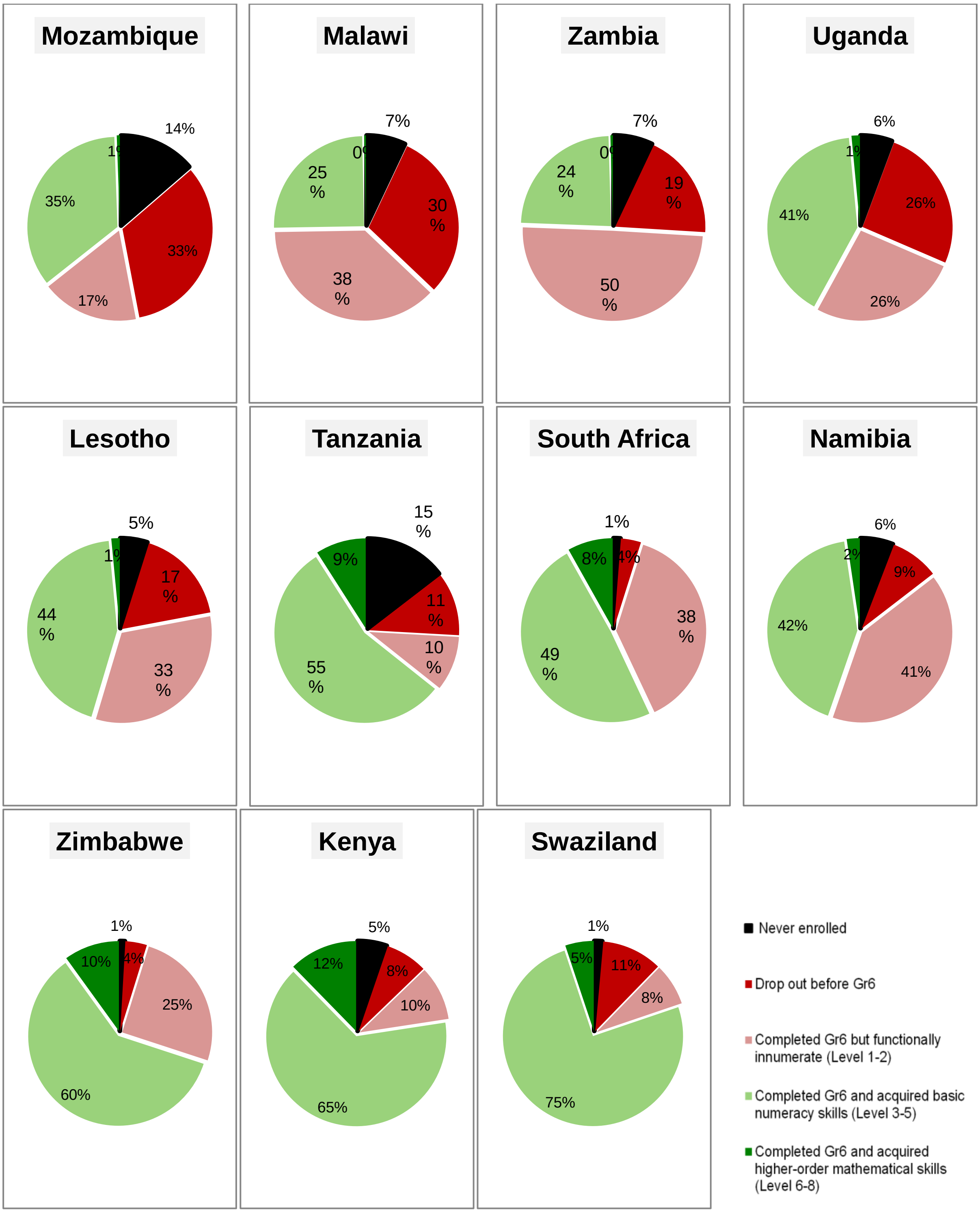

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TABLE 16: DEMOGRAPHIC AND HEALTH SURVEY (DHS) GRADE 6 COMPLETION RATE FOR 19-23 YEAR OLDS [M=MALE; F=FEMALE]

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)
Kenya	87,21	1,00	88,36	1,13	86,20	1,43	78,49	2,07	89,44	1,36	93,92	1,35
Lesotho	77,97	1,00	65,48	1,52	90,00	0,84	61,13	1,70	82,95	1,14	95,82	0,81
Malawi	62,86	0,99	67,10	1,26	58,85	1,11	42,21	1,32	64,57	1,36	89,23	0,89
Mozambique	53,01	1,37	62,79	1,57	44,93	1,62	25,64	1,72	52,07	1,94	87,94	0,96
Namibia	85,42	0,84	81,42	1,25	88,98	0,88	76,18	1,59	85,99	1,07	97,57	0,71
South Africa	95,42	0,33	94,16	0,48	96,64	0,37	92,58	0,67	97,24	0,30	98,90	0,33
Swaziland	87,73	2,41	86,39	6,98	94,43	2,10	77,90	5,53	89,78	2,67	95,38	2,47
Tanzania	74,12	1,41	78,50	1,45	70,24	1,79	57,37	2,43	78,00	1,36	92,36	1,19
Uganda	68,53	1,34	70,49	1,54	67,05	1,72	48,98	2,19	71,56	2,09	89,46	1,20
Zambia	74,03	1,22	80,91	1,36	67,98	1,60	51,58	2,26	76,89	1,56	95,21	1,11
Zimbabwe	95,21	0,46	94,73	0,61	95,59	0,56	89,41	1,16	96,98	0,48	99,29	0,33

	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	82,49	2,21	74,96	2,97	89,97	1,57	88,93	2,12	93,03	2,00	94,57	1,53
Lesotho	42,63	2,09	81,26	1,88	73,40	1,85	92,29	1,05	92,77	1,60	98,14	0,62
Malawi	48,50	1,90	37,03	1,50	67,39	1,89	61,80	1,67	89,25	1,18	89,20	1,28
Mozambique	39,05	2,68	15,22	1,90	62,93	2,45	43,45	2,24	88,92	1,14	87,03	1,33
Namibia	71,82	2,24	80,37	1,95	81,33	1,66	90,15	1,07	96,84	1,28	98,15	0,75
South Africa	90,42	0,94	94,69	0,76	96,59	0,50	97,87	0,34	98,76	0,52	99,03	0,41
Swaziland	85,99	6,53	90,49	7,09	81,88	11,09	95,19	2,57	99,75	0,26	96,41	2,84
Tanzania	64,78	2,71	51,29	2,85	79,62	1,82	76,36	2,17	97,19	1,09	88,56	1,79
Uganda	56,85	2,92	43,00	2,72	72,13	2,37	71,09	2,64	86,39	2,32	91,60	1,24
Zambia	65,71	3,08	40,54	2,69	81,92	1,68	72,20	2,34	95,21	1,63	95,21	1,40
Zimbabwe	87,72	1,60	90,71	1,35	97,26	0,62	96,75	0,73	98,83	0,71	99,64	0,23

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TABLE 17: PROPORTION OF SACMEQ 2007 SAMPLE THAT ARE LITERATE (SACMEQ LEVEL 3+) (NOT CORRECTED FOR THOSE WHO DO NOT COMPLETE GRADE 6)

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)
Kenya	91,96	1,00	91,45	0,97	92,48	1,39	87,58	1,97	92,88	0,75	97,51	0,55
Lesotho	78,80	1,30	76,06	1,71	81,09	1,31	72,89	1,90	78,00	1,48	87,73	1,68
Malawi	63,40	1,77	66,40	2,04	60,31	1,95	58,29	2,77	62,56	2,04	69,45	2,26
Mozambique	78,49	1,13	79,46	1,25	77,34	1,42	66,48	3,07	76,66	1,48	87,65	1,22
Namibia	86,37	0,76	83,50	0,99	89,01	0,81	80,61	1,28	86,60	0,90	94,94	0,76
South Africa	72,74	1,19	68,83	1,32	76,52	1,25	57,76	1,60	76,13	1,17	94,08	0,85
Swaziland	98,52	0,40	97,96	0,53	99,09	0,33	97,65	0,79	98,76	0,33	99,50	0,26
Tanzania	96,50	0,52	96,77	0,65	96,24	0,62	94,54	0,98	96,64	0,70	98,71	0,39
Uganda	79,65	1,30	80,82	1,39	78,50	1,51	72,53	2,09	77,62	1,45	90,67	1,16
Zambia	55,91	1,68	58,25	1,88	53,45	2,15	48,34	2,41	51,72	2,00	70,85	2,41
Zimbabwe	81,50	1,55	77,64	1,95	84,47	1,72	74,92	2,24	80,55	2,05	95,12	1,37

	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	87,18	1,57	87,97	2,68	92,48	1,08	93,50	1,18	97,03	0,93	97,68	0,79
Lesotho	67,88	2,83	75,97	1,99	74,24	1,98	81,32	1,70	86,44	1,89	89,10	1,93
Malawi	58,48	3,27	54,93	3,30	65,77	2,67	60,20	2,57	75,95	2,70	64,91	2,53
Mozambique	69,26	3,34	63,69	4,60	79,36	1,67	74,54	2,07	88,56	1,36	84,90	1,66
Namibia	77,35	1,75	83,49	1,46	82,76	1,30	89,66	0,98	93,88	1,08	96,83	0,71
South Africa	54,14	1,77	60,71	1,92	71,08	1,57	81,74	1,18	91,32	1,28	96,39	0,85
Swaziland	96,93	0,99	98,68	0,55	98,48	0,49	99,01	0,38	98,87	0,59	100,00	
Tanzania	95,05	1,42	93,53	1,37	97,03	0,74	96,78	0,91	98,64	0,53	98,46	0,63
Uganda	74,59	2,30	72,26	2,30	78,79	1,76	75,85	1,83	92,37	1,43	88,46	1,51
Zambia	51,02	2,87	45,43	3,56	55,14	2,38	49,05	2,69	73,57	2,64	66,92	3,37
Zimbabwe	69,92	3,25	78,72	2,25	77,35	2,26	83,71	2,45	91,90	2,59	96,43	1,76

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TABLE 18: PROPORTION OF THE SACMEQ 2007 SAMPLE THAT ARE NUMERATE (SACMEQ LEVEL 3+) (NOT CORRECTED FOR THOSE WHO DO NOT COMPLETE GRADE 6)

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)
Kenya	88,77	1,04	89,92	1,07	87,59	1,47	84,65	1,89	89,44	0,97	94,40	1,04
Lesotho	58,19	1,59	57,72	1,93	58,59	1,74	50,64	2,03	57,05	1,82	69,79	2,40
Malawi	40,12	1,80	44,50	2,07	35,61	2,18	37,87	2,86	40,22	1,97	42,10	2,36
Mozambique	67,27	1,26	70,38	1,42	63,58	1,69	55,41	2,27	65,97	1,77	75,69	1,59
Namibia	52,31	1,35	52,39	1,56	52,24	1,48	38,28	1,82	50,38	1,53	77,60	1,71
South Africa	59,83	1,38	57,53	1,55	62,05	1,46	43,08	1,74	61,30	1,37	88,40	1,13
Swaziland	91,41	0,93	92,76	0,92	90,07	1,17	89,00	1,34	91,53	1,10	95,13	0,86
Tanzania	86,76	1,07	89,67	1,05	83,96	1,45	81,30	1,92	86,80	1,21	93,49	0,88
Uganda	61,26	1,58	63,45	1,76	59,14	1,81	52,86	2,25	58,64	1,74	74,62	1,89
Zambia	32,68	1,42	36,09	1,75	29,08	1,73	25,73	2,03	28,34	1,50	47,16	2,89
Zimbabwe	73,45	1,70	71,76	2,34	74,76	1,84	62,80	2,60	73,36	1,90	92,69	1,44

	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	86,98	1,74	83,34	2,40	90,06	1,15	87,85	1,59	94,86	1,56	93,83	1,40
Lesotho	49,85	2,90	50,51	2,24	54,70	2,42	59,00	2,36	69,71	2,92	71,17	2,91
Malawi	40,61	3,11	31,45	4,11	45,86	2,73	37,29	2,50	46,63	3,21	36,71	3,08
Mozambique	58,08	2,79	52,99	3,79	70,98	2,03	59,43	2,44	80,25	1,94	71,37	2,12
Namibia	38,24	2,17	38,70	2,09	49,65	2,04	50,95	1,77	77,95	2,05	76,73	2,00
South Africa	41,66	2,12	44,58	1,99	57,97	1,68	64,51	1,49	85,97	1,56	90,49	1,28
Swaziland	90,56	1,60	87,55	1,65	93,33	0,96	90,14	1,67	95,63	0,98	94,62	1,29
Tanzania	85,60	2,03	77,51	2,82	91,10	1,13	83,66	1,55	92,72	1,33	91,94	1,33
Uganda	56,31	2,60	52,30	2,66	61,08	1,93	54,61	2,30	76,71	2,27	72,56	2,23
Zambia	28,31	2,74	22,89	2,20	33,44	2,10	24,94	1,95	51,42	3,34	40,48	3,67
Zimbabwe	60,94	3,76	64,03	2,56	71,81	2,85	75,07	2,22	90,79	2,27	93,63	2,11

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By using the SACMEQ categories and assuming that children who will never complete grade 6 are illiterate and innumerate we are able to create a single composite statistic of educational access and educational quality. Rather than simply report the grade 6 completion rate, which can be thought of as an access-to-grade-6-schooling rate, we use the SACMEQ levels and create an access-to-learning rate, what we term the access-to-literacy and access-to-numeracy rates. Using the example of South Africa to illustrate, Figure 15 above shows that 1% of children never enrolled, 4% of children enrolled initially but did not complete grade 6, 26% completed grade 6 but were functionally illiterate, 44% completed grade 6 and acquired basic literacy skills, and 25% completed grade 6 and acquired higher order reading skills. Traditionally one would only see the grade 6 completion rate for South Africa (95%), whereas we combine this with the SACMEQ levels and report the access-to-literacy rate. To calculate the access-to-literacy rate one simply multiplies the grade 6 completion rate (Table 16, 95% for South Africa) by the proportion of the SACMEQ sample that is literate (Table 17, 73% for South Africa) yielding an access-to-literacy rate of 69% (95% x 73%). This is the same as summing the proportion of children in South Africa who had acquired basic (44%) or higher order (25%) reading skills. That is to say that only 69% of the 19-23 year old cohort in South Africa completed grade 6 *and* acquired basic literacy skills (Table 19). The access-to-numeracy rate is considerably lower at 57%, meaning that of the 19-23 year old cohort in South Africa, only 57% will complete grade 6 *and* acquire basic numeracy skills (Table 20).

This highlights the fact that 26% of a South African cohort will not acquire basic literacy skills even though they do complete grade 6 (Figure 15), and that 38% of children will not acquire basic numeracy skills even though they do complete grade 6 (Figure 16). Given that these children do not have access-to-learning (literacy and numeracy respectively) for our purposes we group them with those that never complete grade 6. The access-to-numeracy and access-to-literacy rate statistics are meant to complement existing enrolment, grade-survival and quality assessment statistics, rather than replace them. There are clear administrative reasons why ministries of education collect separate statistics for access and quality. However the argument presented here is that these data should be used together to provide a more accurate and holistic picture of access, throughput and learning.

4.4.1 Sub-national differences

While *national* comparisons of access and quality are useful, there are also significant *sub*-national differences by gender and wealth for both access (Filmer and Pritchett, 1999) and quality (Hungi et al., 2010). Table 16 shows the differences in grade 6 completion rates by

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gender and wealth as well as an interaction between gender and wealth, using DHS data. We use the same categories as those of Filmer (2010), namely separating students into one of three categories: the poorest 40% of students, the middle 40% of students, and the wealthiest 20% of students[48]. Due to the large differences in grade 6 completion rates *within* countries, comparing school quality across sub-groups without taking into account sub-national grade-completion differentials will necessarily bias the results in cases where sub-national completion differences are non-trivial.

In keeping with the above, we calculate the proportion of a cohort (whether in school or out) that is literate and numerate in each country, and, within each country by important sub-groups (Table 19 and Table 20). Given the assumption that children who never complete grade 6 are illiterate and innumerate, it becomes possible to simply multiply the functional literacy rates of boys and girls in grade 6 (from SACMEQ) by the respective grade 6 completion rates for boys and girls (from DHS). For example, in Lesotho the SACMEQ tests showed that 81% of girls and 76% of boys in school in grade 6 were functionally literate (Table 17). However, according to the DHS survey, only 65% of boys will complete grade 6 in contrast to 90% of girls (Table 16). If one assumes that those boys and girls who never complete grade 6 (35% of boys and 10% of girls) are functionally illiterate, one can say that 73% (81.1% x 90.0%) of a cohort of girls in Lesotho are functionally literate. In contrast, only 50% (76.1% x 65.5%) of a cohort of boys in Lesotho are functionally literate (I return to the reasons for this Lesotho gender differential later in the chapter).

One of the most consistent findings in the educational literature is that children from rural areas are at a distinct disadvantage relative to their urban peers (Sahn and Stifel, 2003; UNESCO, 2005). Consequently it would be logical to include school location (urban-rural) as one of the sub-national differences. Unfortunately this was not possible with the existing data. In the DHS there is an objective measure of whether the household is in a rural area or an urban area, whereas in SACMEQ principals were asked to identify whether their school was in an urban area or not. In order to combine statistics from SACMEQ and DHS the underlying populations should be broadly equal (as in the case of gender or socioeconomic status), which is not the case with geographic location. The proportion of households classified as rural in DHS is sometimes significantly different to the proportion of schools classified as rural in SACMEQ, with particularly large discrepancies in some countries (Mozambique and Zambia) and very small discrepancies in other countries (Malawi and Tanzania). In Mozambique for example, the DHS shows that 59% of households were in a

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[48] The wealth quintiles used here were created by DHS (variable: hv270).

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rural area, whereas in SACMEQ, only 37% of principals reported that they were in a rural area (i.e. a 23 percentage point difference). One cannot therefore multiply statistics from these two (different) categories and thus geographic location has been excluded from the present analysis.

In addition to gender, previous studies have shown that large wealth-based differentials also exist for both school quality (Hungi, et al., 2010) and enough (Filmer and Pritchett, 1999). Taking Mozambique as an example, only 26% of the poorest 40% of children will complete grade 6, compared to 88% of the richest 20% of children. Unfortunately one cannot simply multiply literacy rates for the poorest 40% of children in SACMEQ with the grade 6 completion rates for the poorest 40% of children in DHS because these categories do not represent the same underlying population. The poorest 40% of children in DHS represent the poorest 40% of children *in the country*, while the poorest 40% of children in SACMEQ represent the poorest 40% of children *who completed grade 6*.

This is made clearer using a hypothetical example. If one assumes that there are 1000 children in a particular cohort and that the national grade 6 completion rate is 85% and we know that the grade 6 completion rate for each of the three wealth groups are as follows: of the poorest 400 students only 300 complete grade 6 (**75%** grade 6 completion rate), of the middle 400 students 350 complete grade 6 (**87.5%** grade 6 completion rate), and of the wealthiest 200 students all complete grade 6 (**100%** grade 6 completion rate). This would equate to a national grade 6 completion rate of 85% {(300 + 350 + 200)/1000}.

If one were to ignore the grade 6 survival rate differentials for these three groups, and simply calculate the poorest 40%, middle 40% and richest 20% of students using the SACMEQ sample of 850 students one would get categories that had 340 students in the poorest 40%, 340 students in the middle 40% and 170 students in the richest 20% category. However, only 300 of the 850 students actually come from the poorest 40% of households, not 340, and 200 students come from the richest 20%, not 170. Thus if one did not apply a correction to account for the differential grade 6 survival rates one would overestimate the literacy achievement of the poorest 40% of children.

Thus, the distribution of students in SACMEQ is ordered from poorest to wealthiest and then split according to the grade 6 completion rates of each wealth group to obtain SACMEQ

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wealth groups that are comparable to DHS wealth groups[49]. This process of splitting the SACMEQ sample into groups that are representative of DHS categories is shown mathematically by the following formula:

$$Total\ SACMEQ\ sample = \int_{0}^{\left(\frac{CR_{poor40}}{0.4*CR_{total}}\right)*N} CN_{ses} + \int_{\left(\frac{CR_{poor40}}{0.4*CR_{total}}\right)*N}^{\left(\frac{CR_{mid40}}{0.4*CR_{total}}\right)*N} CN_{ses} + \int_{\left(\frac{CR_{mid40}}{0.4*CR_{total}}\right)*N}^{\left(\frac{CR_{rich20}}{0.2*CR_{total}}\right)*N} CN_{ses}$$

where CR_{poor40} is the grade 6 completion rate for the poorest 40% of 19-23 year olds in the country, CR_{mid40} is the grade 6 completion rate for the middle 40% of 19-23 year olds in the country, SR_{rich20} is the grade 6 completion rate for the richest 20% of 19-23 year olds in the country, CR_{total} is the national grade 6 completion rate, 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, 36). The variable CN_{ses} is the cumulative distribution of the grade six school-going population sorted from poorest to wealthiest. The first integral represents the SACMEQ students that correspond to the poorest 40% of 19-23 year olds from DHS, the second integral represents the SACMEQ students that correspond to the middle 40% of 19-23 year olds in the DHS sample and the last integral represents the SACMEQ students that correspond to the richest 20% of the 19-23 year olds in the DHS sample.

[49] 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.

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TABLE 19: ACCESS-TO-LITERACY RATES FOR 19-23 YEAR OLDS BY SUB-GROUPS - COMBINING SACMEQ AND DHS[50]

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)
Kenya	80,19	1,42	80,80	1,49	79,71	2,00	68,74	2,86	83,08	1,55	91,59	1,46
Lesotho	61,44	1,64	49,80	2,29	72,98	1,55	44,56	2,55	64,70	1,86	84,06	1,87
Malawi	39,86	2,03	44,56	2,39	35,49	2,24	24,60	3,07	40,40	2,45	61,97	2,43
Mozambique	41,61	1,77	49,90	2,01	34,75	2,15	17,05	3,52	39,92	2,44	77,08	1,55
Namibia	73,77	1,13	67,99	1,60	79,20	1,19	61,41	2,04	74,47	1,40	92,63	1,04
South Africa	69,41	1,23	64,81	1,40	73,95	1,31	53,47	1,74	74,03	1,21	93,05	0,91
Swaziland	86,44	2,44	84,63	7,00	93,56	2,12	76,07	5,59	88,66	2,69	94,90	2,48
Tanzania	71,52	1,50	75,96	1,59	67,60	1,89	54,24	2,62	75,37	1,52	91,17	1,25
Uganda	54,58	1,87	56,97	2,07	52,64	2,29	35,52	3,03	55,54	2,55	81,12	1,67
Zambia	41,39	2,08	47,13	2,32	36,33	2,68	24,94	3,30	39,77	2,54	67,46	2,65
Zimbabwe	77,59	1,62	73,55	2,05	80,75	1,81	66,98	2,53	78,12	2,10	94,44	1,41

	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	71,92	2,71	65,95	4,00	83,20	1,90	83,14	2,42	90,27	2,20	92,38	1,72
Lesotho	28,94	3,52	61,74	2,74	54,49	2,71	75,05	2,00	80,19	2,48	87,44	2,03
Malawi	28,36	3,78	20,34	3,63	44,32	3,27	37,20	3,07	67,79	2,94	57,89	2,84
Mozambique	27,05	4,29	9,69	4,98	49,94	2,97	32,39	3,05	78,74	1,77	73,89	2,13
Namibia	55,55	2,84	67,10	2,44	67,31	2,11	80,83	1,45	90,91	1,67	95,04	1,03
South Africa	48,95	2,00	57,49	2,06	68,65	1,65	79,99	1,23	90,20	1,38	95,46	0,94
Swaziland	83,35	6,60	89,30	7,11	80,64	11,10	94,24	2,60	98,62	0,65	96,41	2,84
Tanzania	61,57	3,06	47,97	3,16	77,26	1,97	73,90	2,35	95,88	1,21	87,20	1,90
Uganda	42,41	3,71	31,07	3,56	56,83	2,96	53,93	3,21	79,79	2,73	81,03	1,96
Zambia	33,52	4,21	18,42	4,46	45,17	2,92	35,42	3,57	70,05	3,10	63,71	3,65
Zimbabwe	61,33	3,62	71,40	2,62	75,23	2,34	80,99	2,56	90,82	2,68	96,07	1,78

[50] Given that SACMEQ and DHS use different samples in their surveys, the samples are independent and thus the composite standard errors are simply the square-root of the sum of the squared standard errors of each sample, i.e. Sqrt($SE1_{DHS}^2 + SE2_{SACMEQ}^2$).

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TABLE 20: ACCESS-TO-NUMERACY RATES FOR 19-23 YEAR OLDS BY SUB-GROUPS - COMBINING SACMEQ AND DHS[51]

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)
Kenya	77,42	*1,44*	79,45	*1,56*	75,50	*2,05*	66,44	*2,80*	80,00	*1,67*	88,66	*1,70*
Lesotho	45,37	*1,88*	37,79	*2,46*	52,73	*1,93*	30,96	*2,65*	47,32	*2,14*	66,88	*2,53*
Malawi	25,22	*2,05*	29,86	*2,42*	20,96	*2,44*	15,99	*3,15*	25,97	*2,39*	37,56	*2,52*
Mozambique	35,66	*1,86*	44,19	*2,12*	28,57	*2,34*	14,21	*2,85*	34,35	*2,63*	66,57	*1,85*
Namibia	44,68	*1,59*	42,65	*2,00*	46,48	*1,73*	29,16	*2,42*	43,33	*1,87*	75,71	*1,85*
South Africa	57,09	*1,42*	54,18	*1,62*	59,96	*1,51*	39,88	*1,87*	59,61	*1,40*	87,43	*1,17*
Swaziland	80,20	*2,58*	80,14	*7,04*	85,05	*2,40*	69,33	*5,69*	82,18	*2,89*	90,73	*2,62*
Tanzania	64,31	*1,77*	70,39	*1,79*	58,98	*2,30*	46,64	*3,10*	67,70	*1,81*	86,34	*1,48*
Uganda	41,98	*2,07*	44,72	*2,34*	39,65	*2,49*	25,89	*3,14*	41,96	*2,72*	66,76	*2,24*
Zambia	24,19	*1,88*	29,20	*2,22*	19,77	*2,36*	13,27	*3,04*	21,79	*2,16*	44,90	*3,10*
Zimbabwe	69,94	*1,76*	67,98	*2,41*	71,47	*1,93*	56,15	*2,84*	71,15	*1,96*	92,03	*1,48*

	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	71,75	*2,82*	62,47	*3,81*	81,03	*1,94*	78,12	*2,65*	88,26	*2,53*	88,74	*2,08*
Lesotho	21,25	*3,58*	41,05	*2,92*	40,15	*3,05*	54,45	*2,58*	64,67	*3,33*	69,85	*2,98*
Malawi	19,69	*3,65*	11,65	*4,37*	30,91	*3,32*	23,05	*3,01*	41,62	*3,41*	32,75	*3,34*
Mozambique	22,68	*3,87*	8,07	*4,24*	44,67	*3,19*	25,82	*3,32*	71,36	*2,25*	62,11	*2,50*
Namibia	27,47	*3,11*	31,10	*2,86*	40,38	*2,63*	45,93	*2,06*	75,49	*2,42*	75,31	*2,14*
South Africa	37,67	*2,32*	42,21	*2,13*	55,99	*1,75*	63,14	*1,53*	84,91	*1,65*	89,62	*1,35*
Swaziland	77,86	*6,72*	79,23	*7,28*	76,42	*11,13*	85,80	*3,06*	95,39	*1,01*	91,22	*3,12*
Tanzania	55,45	*3,39*	39,76	*4,01*	72,54	*2,15*	63,89	*2,66*	90,12	*1,72*	81,42	*2,23*
Uganda	32,01	*3,91*	22,49	*3,80*	44,06	*3,06*	38,82	*3,50*	66,27	*3,24*	66,47	*2,55*
Zambia	18,60	*4,12*	9,28	*3,47*	27,39	*2,69*	18,01	*3,04*	48,96	*3,72*	38,55	*3,92*
Zimbabwe	53,46	*4,09*	58,08	*2,90*	69,84	*2,91*	72,63	*2,34*	89,72	*2,38*	93,29	*2,12*

[51] Given that SACMEQ and DHS use different samples in their surveys, the samples are independent and thus the composite standard errors are simply the square-root of the sum of the squared standard errors of each sample, i.e. $Sqrt(SE1_{DHS}^2 + SE2_{SACMEQ}^2)$.

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TABLE 21: PROPORTION OF 19-23 YEAR OLDS WHO NEVER ENROLLED IN SCHOOL FROM THE DEMOGRAPHIC AND HEALTH SURVEY (DHS)

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)
Kenya	5,26	0,72	2,81	0,54	7,40	1,20	10,41	1,67	3,32	0,91	2,20	0,79
Lesotho	4,87	0,46	9,26	0,87	0,63	0,19	10,42	1,01	2,32	0,38	0,90	0,39
Malawi	7,09	0,45	6,03	0,55	8,09	0,61	12,43	0,94	5,96	0,60	1,32	0,35
Mozambique	13,67	0,84	7,95	0,85	18,39	1,21	22,10	1,60	14,03	1,31	2,81	0,50
Namibia	5,89	0,46	7,41	0,66	4,53	0,54	8,80	0,96	6,20	0,67	1,08	0,49
South Africa	1,13	0,21	1,29	0,26	0,98	0,23	1,38	0,45	0,99	0,18	0,74	0,27
Swaziland	1,42	0,32	2,44	1,09	1,89	0,94	3,08	1,02	0,82	0,23	0,57	0,25
Tanzania	14,56	1,16	10,44	1,19	18,20	1,49	27,71	2,34	10,10	0,98	2,61	0,68
Uganda	5,68	0,61	5,29	0,74	5,97	0,71	11,33	1,47	3,03	0,56	2,03	0,49
Zambia	7,03	0,56	3,28	0,54	10,33	0,95	13,87	1,31	5,18	0,69	2,09	0,75
Zimbabwe	0,91	0,18	0,71	0,20	1,06	0,29	1,70	0,39	0,75	0,32	0,21	0,13

	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	5,70	1,35	14,56	2,59	1,66	0,62	4,96	1,71	1,14	0,70	2,96	1,19
Lesotho	18,72	1,77	1,40	0,48	4,29	0,71	0,39	0,21	2,08	0,88	0,00	0,00
Malawi	9,88	1,11	14,52	1,29	6,04	0,96	5,88	0,68	1,34	0,46	1,29	0,54
Mozambique	10,48	1,67	31,12	2,47	9,89	1,55	17,31	1,65	2,59	0,55	3,00	0,76
Namibia	9,93	1,31	7,70	1,15	8,31	0,98	4,32	0,79	1,52	0,84	0,74	0,41
South Africa	1,46	0,49	1,32	0,48	1,25	0,29	0,74	0,19	0,80	0,42	0,69	0,35
Swaziland	6,29	4,48	3,66	3,18	1,98	0,96	0,95	0,80	0,00	0,00	2,17	1,97
Tanzania	20,39	2,38	33,71	2,96	8,00	1,26	12,21	1,55	0,00	0,00	4,65	1,21
Uganda	8,65	1,65	13,36	1,75	3,55	0,96	2,61	0,67	3,33	0,94	1,12	0,49
Zambia	5,03	1,21	20,78	2,11	3,32	0,78	6,92	1,14	1,40	0,95	2,72	1,22
Zimbabwe	1,92	0,58	1,53	0,50	0,27	0,22	1,15	0,55	0,00	0,00	0,36	0,00

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4.5 Discussion

The objective of the 'access-to-learning' method presented in this paper is to calculate the proportion of a cohort of youth (whether in school or out) that are functionally literate and the proportion that are functionally numerate by the end of grade 6 (the access-to-literacy and access-to-numeracy rates). Figure 15 and Figure 16 above provide an introduction to this way of thinking by including on the same graph the proportions of children who never enrol, those who never complete grade 6, those who complete grade 6 but remain functionally illiterate and innumerate, and those who complete grade 6 and acquire either basic or higher order reading and mathematics skills.

Clearly some countries have a greater problem ensuring that all children enrol, while others have near universal initial enrolment but high drop out before grade 6 (i.e. low grade 6 completion rates). Compare for example two neighbouring countries, Tanzania and Uganda, and the literacy achievement of their children (Figure 15). In Tanzania a large proportion (15%) of children never enrol, while in Uganda, the proportion of children never enrolling is considerably lower (5%). Yet Uganda has a far higher proportion of children that drop out before grade 6 (26%) compared to Tanzania (11%). Furthermore, of those children who do complete grade 6 in Tanzania, almost all are functionally literate (only 3% will complete grade 6 but remain functionally illiterate) In contrast, in Uganda a considerable proportion of children will complete grade 6 but remain functionally illiterate (14% of Ugandan children remain in school and complete grade 6 but are functionally illiterate). Using these three criteria (initial access, dropout and learning) one can characterize countries in a relatively parsimonious way. South Africa, for example, is a country with very high initial access (only 1% never enrol), very low dropout before grade 6 (only 4% enrol but do not complete grade 6) but low learning for those who do complete grade 6 (26% complete grade 6 but remain functionally illiterate), with Zimbabwe having a similar profile. By contrast, Zambia has moderately high initial access (only 7% never enrol), high dropout (19% enrol but do not complete grade 6) and very low levels of learning for those who do reach grade 6 (33% will complete grade 6 but remain functionally illiterate), with Malawi having a similar profile.

Figure 16 shows that in all countries there are more children that are functionally innumerate than there are children that are functionally illiterate, with the same holding true for the acquisition of basic and higher order mathematics skills compared to basic and higher order reading skills. Clearly children in all countries found the numeracy test more challenging than the literacy test.

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A useful way of summarizing the above results is to collapse the proportion of children that acquired basic literacy skills and those that acquired higher order literacy skills and refer to these children as functionally literate, and to collapse the categories of (1) never enrolled, (2) enrolled but never completed grade 6, and (3) completed grade 6 but remained functionally illiterate; and to refer to these children as those who are functionally illiterate. The proportions of children in a cohort that has access-to-literacy (i.e. completed grade 6 and acquired basic literacy skills) are reported in Table 19, while those that have access-to-numeracy (i.e. reached grade 6 and acquired basic numeracy skills) are reported in Table 20. For the remainder of the paper we refer to the former as the access-to-literacy rate and the latter as the access-to-numeracy rate.

Looking at the national access-to-literacy rates in Table 19, one can see that there are effectively three groups of countries: the first group consists of those that have relatively high access-to-literacy rates (>80% of a cohort of youth) with this group consisting of Swaziland (86%) and Kenya (80%). The second group consists of those that have relatively low access-to-literacy rates (60-80%) and includes Zimbabwe (78%), Namibia (74%), Tanzania (72%), South Africa (69%) and Lesotho (61%). The last group consists of those that have extremely low access-to-literacy rates (<60%) and includes Uganda (55%), Mozambique (42%), Zambia (41%) and Malawi (40%).

Looking at national access-to-numeracy rates in Table 20 and using the same grouping as above one can see that only Swaziland is in the top category with an 80% access-to-numeracy rate. The countries in the middle category (60-80%) are Kenya (77%), Zimbabwe (70%) and Tanzania (64%), and all the remaining countries are in the low category (<60%): South Africa (57%), Lesotho (45%), Namibia (45%), Uganda (42%), Mozambique (36%), Malawi (25%) and Zambia (24%).

Table 21 reports the proportion of 19-23 year olds that never enrolled in school for each of the sub-groups. Comparing Table 6 and Table 1 allows one to determine if a low grade 6 completion rate is due to dropout or due to low levels of initial access, an important distinction for policy and research purposes.

The exceedingly low levels of literacy and numeracy learning in Zambia, Malawi and Mozambique are cause for grave concern. Furthermore, Figure 15 illustrates that this is not caused primarily by a lack of access since only 7-14% of children in these countries never enrol. Rather it is due to dropout and especially due to the high prevalence of what Lewin (2007, 10) refers to as ‘silent exclusion’ – that is, children that are in school but learning so

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little that they are in effect excluded. In Zambia 33% of children in a cohort will enrol in school and complete grade 6 but remain functionally *illiterate*. Half (50%) of Zambian youth will enrol and complete grade 6 but remain functionally *innumerate*. Even in a middle-income country like South Africa there are a high proportion of children that remain functionally illiterate (26%) and functionally innumerate (38%) despite completing six years of formal full time schooling.

Table 19 and Table 20 also report the access-to-literacy and access-to-numeracy rates for three important subgroups: (1) boys and girls, (2) the poorest 40%, middle 40% and richest 20% of children, and (3) the poorest 40% of girls and the poorest 40% of boys, the middle 40% of girls and the middle 40% of boys, and the richest 20% of girls and the richest 20% of boys. We report the gender-wealth interaction primarily because previous studies have shown that girls who are poor face a double disadvantage which is compounded by being jointly part of two groups that are both at risk of being socially excluded from education – girls and the poor (Lewis and Lockheed, 2007, 2006). We summarize the differences between the "top" and "bottom" categories for each group in Figure 17 (for access-to-literacy rates) and Figure 18 (for access-to-numeracy rates). To provide one example, the access-to-literacy wealth differential is 60 percentage points for Mozambique. This is calculated by subtracting the access-to-literacy rate for the poorest 40% of children in Mozambique (17.1%) from the access-to-literacy rate for the richest 20% of children in Mozambique (77.1%). We also calculate the confidence intervals by combining the standard errors from the grade 6 completion rate from the DHS with the standard errors from the proportion literate and numerate from SACMEQ. Given that the two samples are independent we take the square root of the sum of the squared standard errors[52].

[52] In a formula this is $SE_{COMPOSITE} = Sqrt((SE_{SACMEQ})^2+(SE_{DHS})^2)$

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FIGURE 17: GAPS IN ACCESS-TO-LITERACY RATES BY GENDER, GENDER-WEALTH INTERACTION, AND WEALTH WITH 95% CONFIDENCE INTERVALS

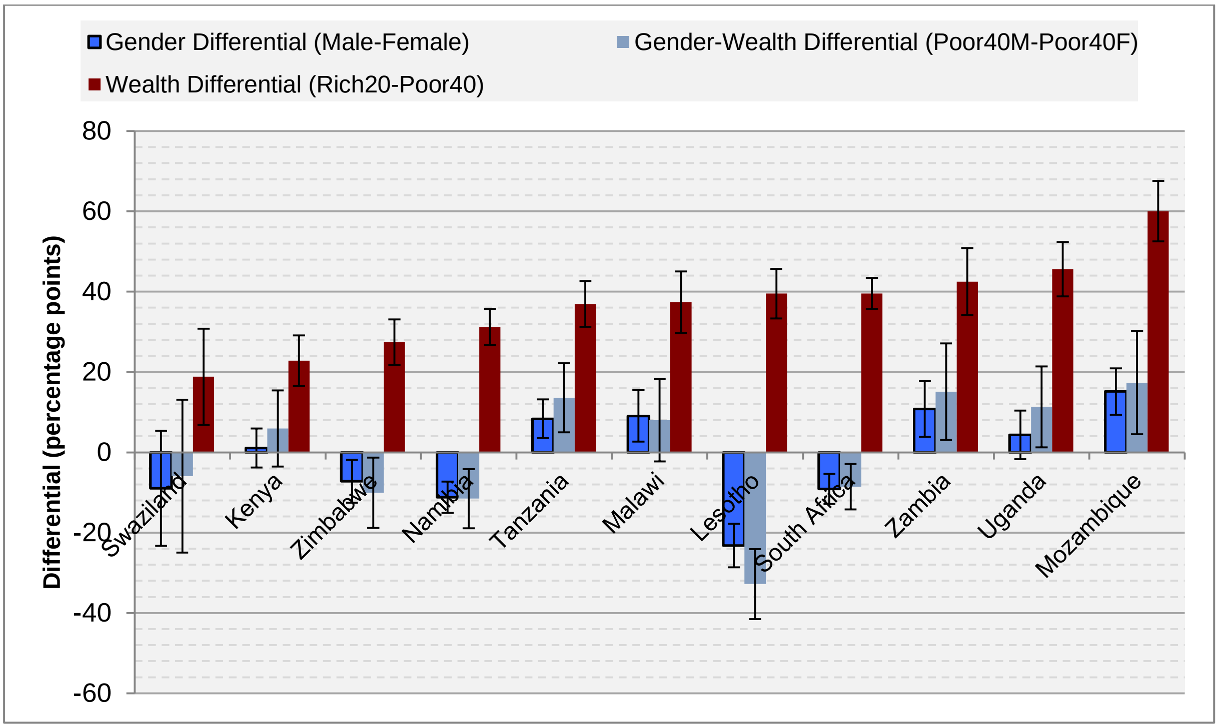
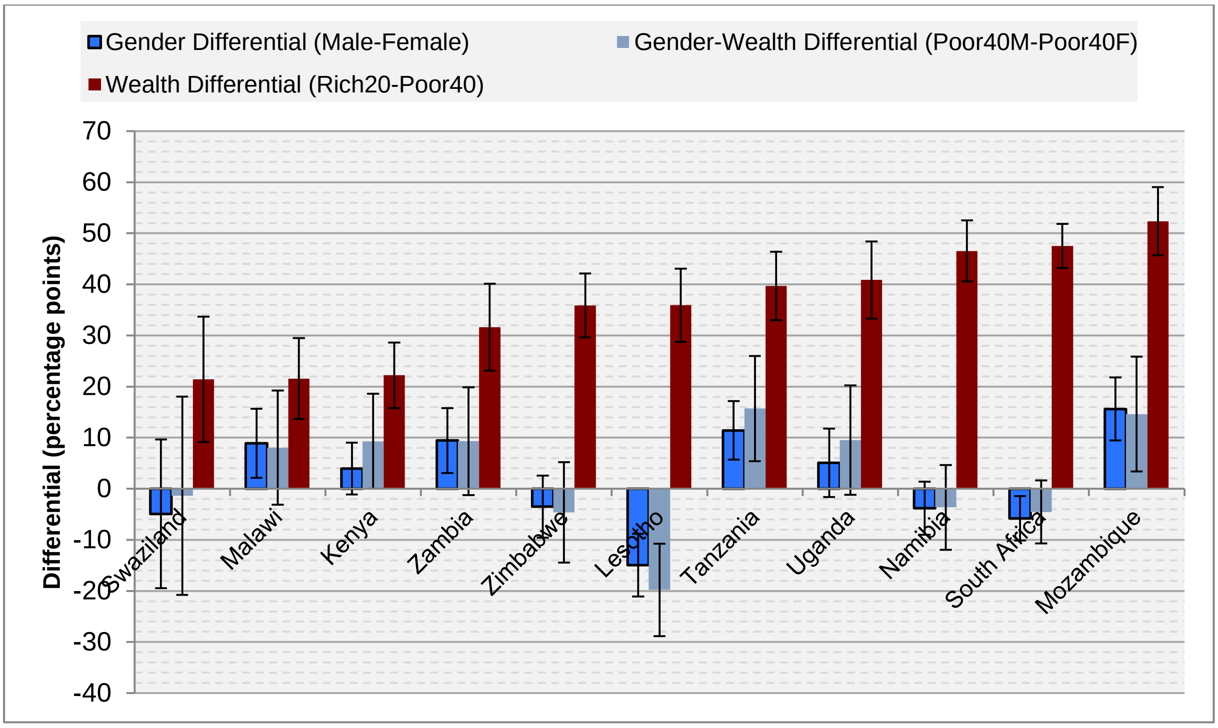


FIGURE 18: GAPS IN ACCESS-TO-NUMERACY RATES BY GENDER, GENDER-WEALTH INTERACTION, AND WEALTH WITH 95% CONFIDENCE INTERVAL



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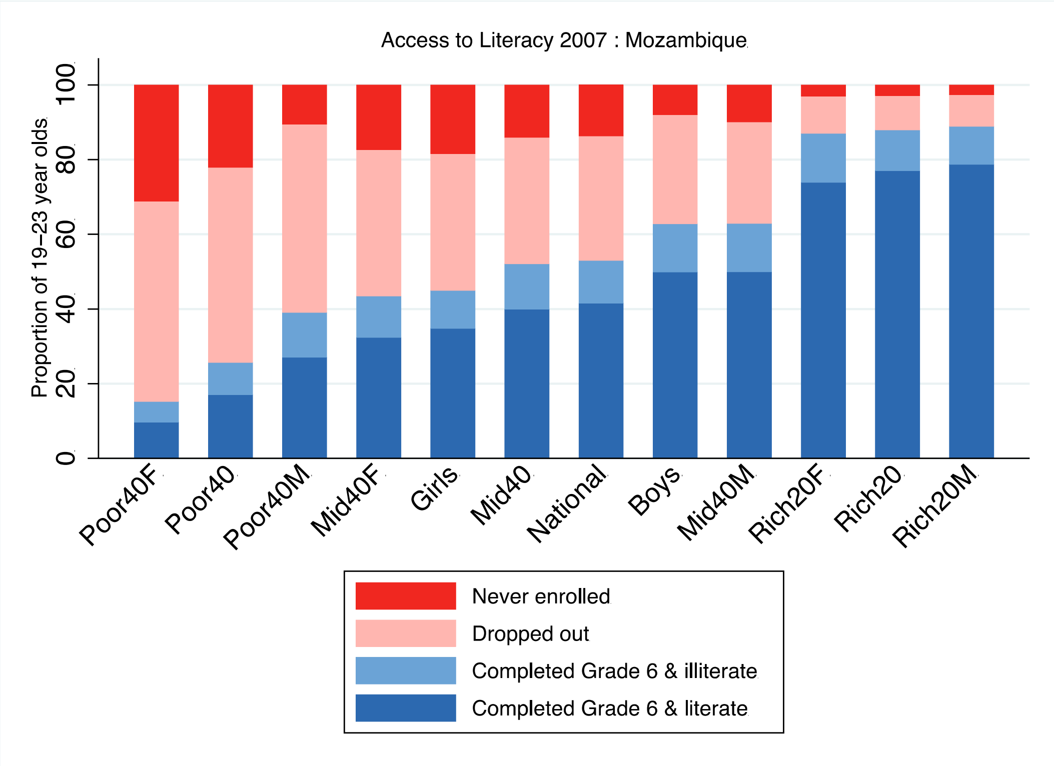
There are a number of notable findings that emerge from Figure 17 and Figure 18:

1. In all countries, the access-to-literacy gap between rich and poor is considerably larger than the gap between boys and girls. Even in the country with the largest pro-boy access-to-literacy gap (Mozambique), the gap between rich and poor (60 percentage points) is four times larger than the gap between boys and girls (15 percentage points).
2. In poorer countries (Mozambique, Zambia, Tanzania and Malawi) boys have higher access-to-literacy and access-to-numeracy rates than girls, driven primarily by higher grade 6 completion rates rather than superior learning outcomes.
3. Only 17% of the poorest Mozambican 19-23 year olds had completed grade 6 and acquired basic literacy skills (for numeracy the figure is 14%) (Table 19 and Table 20), primarily due to low initial access (26% grade 6 completion rate). Furthermore, poor girls are considerably worse off than poor boys. While 28% of the poorest 19-23 year old boys completed grade 6 and acquired basic literacy skills, only 9% of the poorest 19-23 year old girls had completed grade 6 and acquired basic literacy skills in Mozambique. Figure 19 below illustrates that this is primarily due to high dropout rather than low initial access. It is interesting to note that Mozambique has a comparatively small proportion of children who reach grade 6 but remain illiterate yet very high proportions that drop out without completing grade 6. That is to say that most of the children who do complete grade 6 in Mozambique do also acquire basic reading skills in Portuguese (the language of assessment in grade 6). One possible explanation is that Mozambique is one of only three countries in the sample that has a national primary-school level exam.[53] In Mozambique this national exam is administered at the end of grade 5 and is used for grade promotion purposes (World Bank, 2009, p. 6). It is highly plausible that this exam acts as a gateway such that only well-performing students pass the exam and thus make it into grade 6 (and into the SACMEQ sampling frame). While quality-assurance exams clearly have a place in national education policies, they can also lead to early dropout (Greaney and Kellaghan, 2008, p. 15). A further issue complicating the matter is that this grade promotion test is conducted in Portuguese, which is a second-language for most Mozambican students. Many students are only starting to become proficient in this language when they are tested in it, with the results from this test determining whether or not they proceed to a higher grade. Given when and how this test is administered in Mozambique – and the fact that it is used for grade-promotion

[53] The other two countries are Malawi and Uganda.

purposes -, further research is needed to understand the implications for equity and fairness, particularly for those students who are not fluent in Portuguese.

FIGURE 19: ACCESS TO LITERACY RATES FOR MOZAMBICAN SUB-GROUPS (DHS 2011, SACMEQ 2007)



4. Closer inspection of Lesotho shows an atypical case where boys are considerably *less* likely to have access-to-literacy (and access-to-numeracy) than girls, with the effect being compounded for the poorest 40% of boys. While 73% of a cohort of girls will be functionally literate and complete grade 6, the figure for the corresponding cohort of boys is only 50%. If one looks specifically at the poorest 40% of boys and the poorest 40% of girls the situation becomes even starker. While 62% of the poorest girls have access-to-literacy, only 29% of the poorest boys have access to literacy. Looking at Table 16 it becomes clear that this trend is driven by the fact that boys (and poor boys in particular) are significantly less likely to complete grade 6 than girls (and poor girls). While 90% of girls will complete grade 6, only 65% of boys will do so (Table 16). Similarly, while 81% of poor girls in Lesotho will complete grade 6, only 43% of poor boys will do so. Table 16 shows that this low grade 6 completion rate is largely due to dropout rather than low initial access. Only 19% of poor boys aged 19-23 had never enrolled in school. This can further be illustrated by looking at the changing enrolment status of poor boys and poor girls as they get older. Figure 20 shows that the low grade 6 completion rate among poor boys is driven by dropout rather than non-enrolment. Comparing Figure 20 (poor boys) and Figure 21 (poor

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girls) in conjunction with one can see that this pattern of dropout is unique to poor boys

FIGURE 20: STACKED AREA CHART FOR ENROLMENT STATUS BY AGE FOR LESOTHO DHS 2009, POOREST 40% OF BOYS

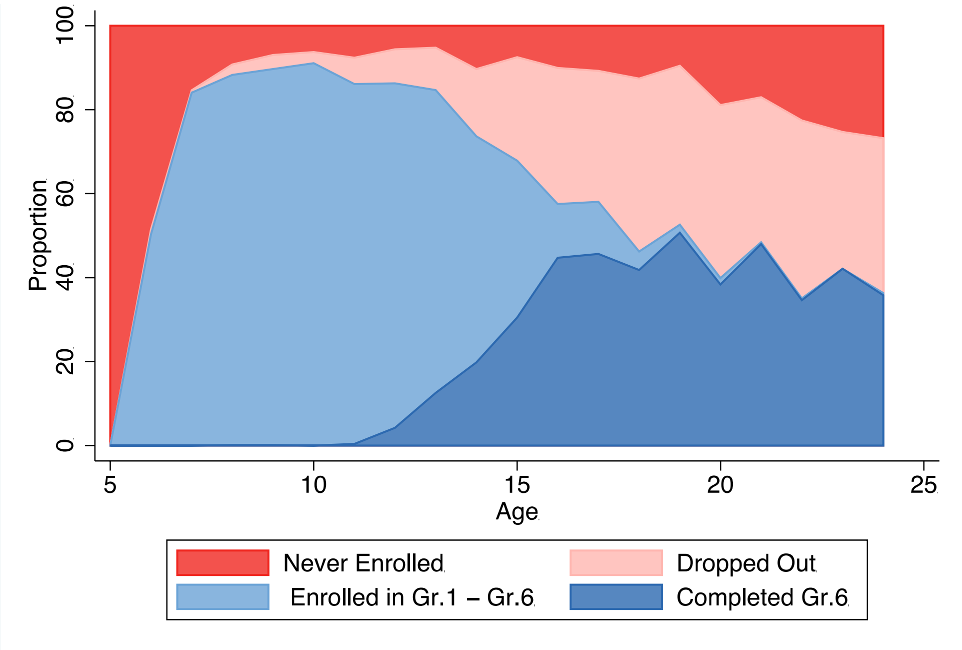

FIGURE 21: STACKED AREA CHART FOR ENROLMENT STATUS BY AGE FOR LESOTHO DHS 2009, POOREST 40% OF GIRLS

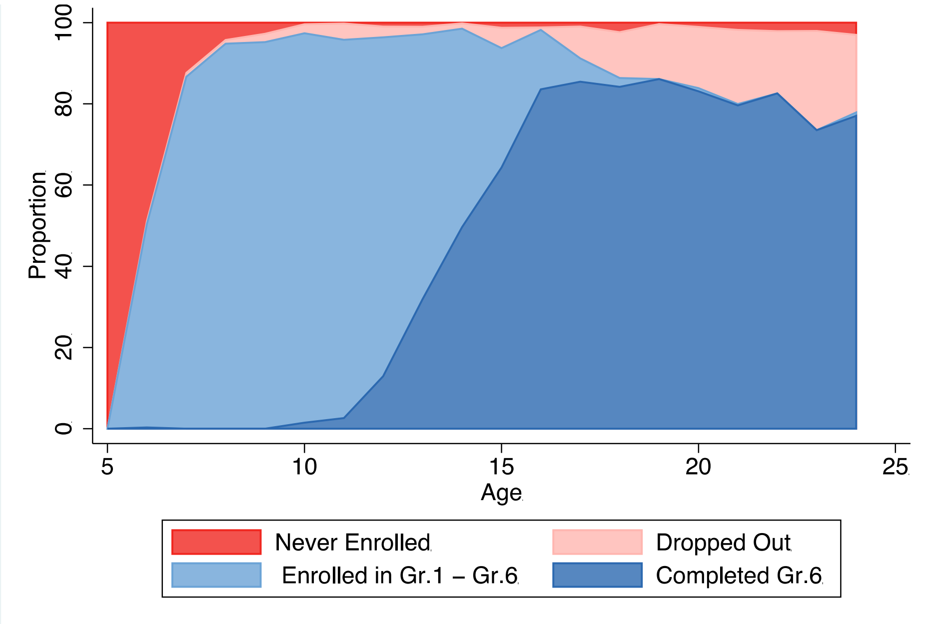

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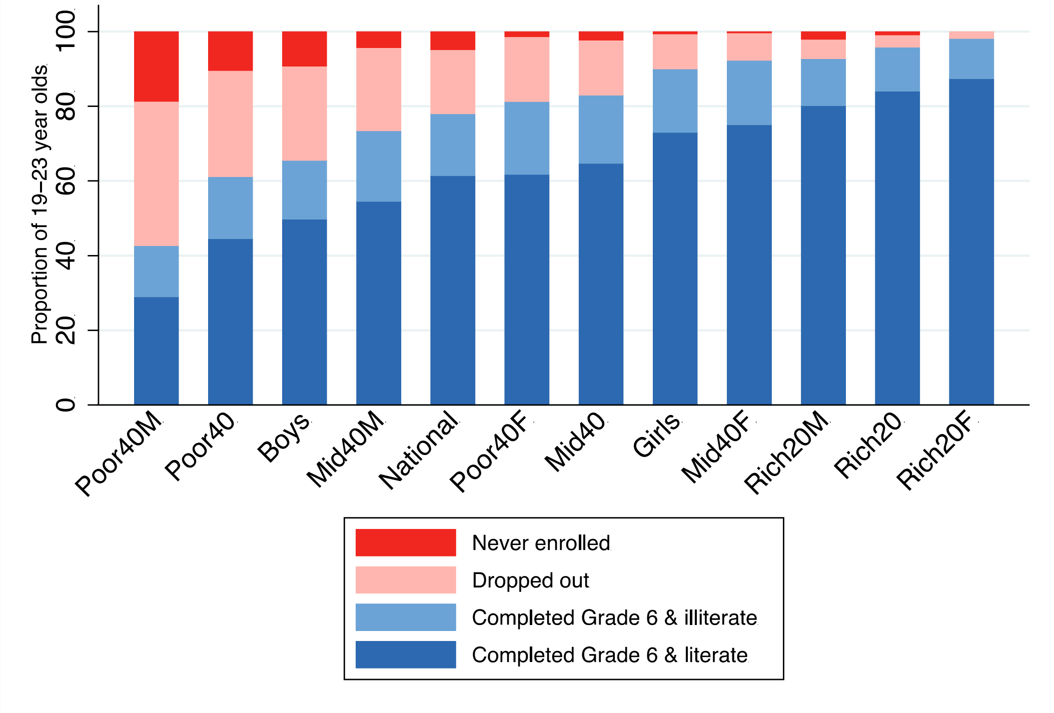
FIGURE 22: ACCESS TO LITERACY FOR LESOTHO 19-23 YEAR OLD SUB-GROUPS (DHS 2009, SACMEQ 2007)



The situation of under-participation of boys in Lesotho is driven primarily by the cultural and economic tradition of boys (and particularly poor boys) herding livestock (Jha and Kelleher, 2006). This leads to a situation where boys have higher rates of non-enrolment, absenteeism, grade-repetition and drop-out (Jha and Kelleher 2006, 96). It is worth noting that Jha and Kelleher use primary school NER data to illustrate the gap between boys and girls and report that the NER was 83% for boys and 89% for girls. However, this seriously underestimates the true disadvantage boys face in Lesotho. If we instead compare the access-to-literacy rates for boys (50%) and girls (73%) and poor boys (29%) and poor girls (62%) one begins to appreciate how large these differentials really are. This also further illustrates why traditional measures of access (such as NER) are inadequate and inferior relative to this new method.

In South Africa, Namibia and Zimbabwe girls have higher access-to-literacy rates than boys and this is primarily because they do better in school rather than due to grade completion advantages. In contrast, where boys have higher access-to-literacy rates than girls (Mozambique, Tanzania, Malawi and Zambia), it is primarily because boys are more likely to complete grade 6 (Table 16), rather than due to any superior performance in school (Table 17 and Table 18). That is to say that in countries where the gap is pro-boy, the majority of the difference in access-to-literacy rates between boys and girls is driven by considerably higher dropout (or non-enrolment) rates among girls.

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5. The gaps in access-to-literacy and access-to-numeracy rates between the richest 20% of students and the poorest 40% of students in Mozambique, South Africa, Namibia, Uganda and Tanzania are truly astounding. While 67% of the richest of children in Mozambique will complete grade 6 and acquire basic numeracy skills, only 14% of the poorest Mozambican children will do so (a gap of 53 percentage points). From Table 16 one can see that this is primarily driven by inequalities in grade 6 completion, rather than inequalities in learning (Table 17 and Table 18). To be specific, in Mozambique the grade 6 completion rates for the poor (26%) are only a fraction of the grade 6 completion rate for the rich (88%) (Table 16). The situation in South Africa is completely different; here the access-to-numeracy differential between rich and poor (47 percentage points) is driven almost exclusively by differential school quality (low learning) rather than differential grade 6 completion. Ninety-three percent of poor children in South Africa will complete grade 6, compared to 99% of rich children in the country (Table 16). However, of those that are in school (i.e. looking at the SACMEQ sample only – Table 18), only 46% of poor children are functionally numerate in South Africa compared to 85% of rich children.[54] Figure 23 below illustrates the situation graphically by showing the differentials between the richest 20% of students and the poorest 40% of students for grade 6 completion rates (from DHS) and numeracy and literacy rates (from SACMEQ).

[54] The gaps in learning outcomes between the richest 20% and the poorest 40% of students reflect more than merely the "value-added" by schools. While the quality of schools may well differ by wealth, those schools serving poorer communities also must work with children who had less effective early childhood stimulation, less educational support at home, worse nutrition, etc. Differences in functional literacy and numeracy by wealth thus reflect wider societal inequalities, rather than merely the school "value-added".

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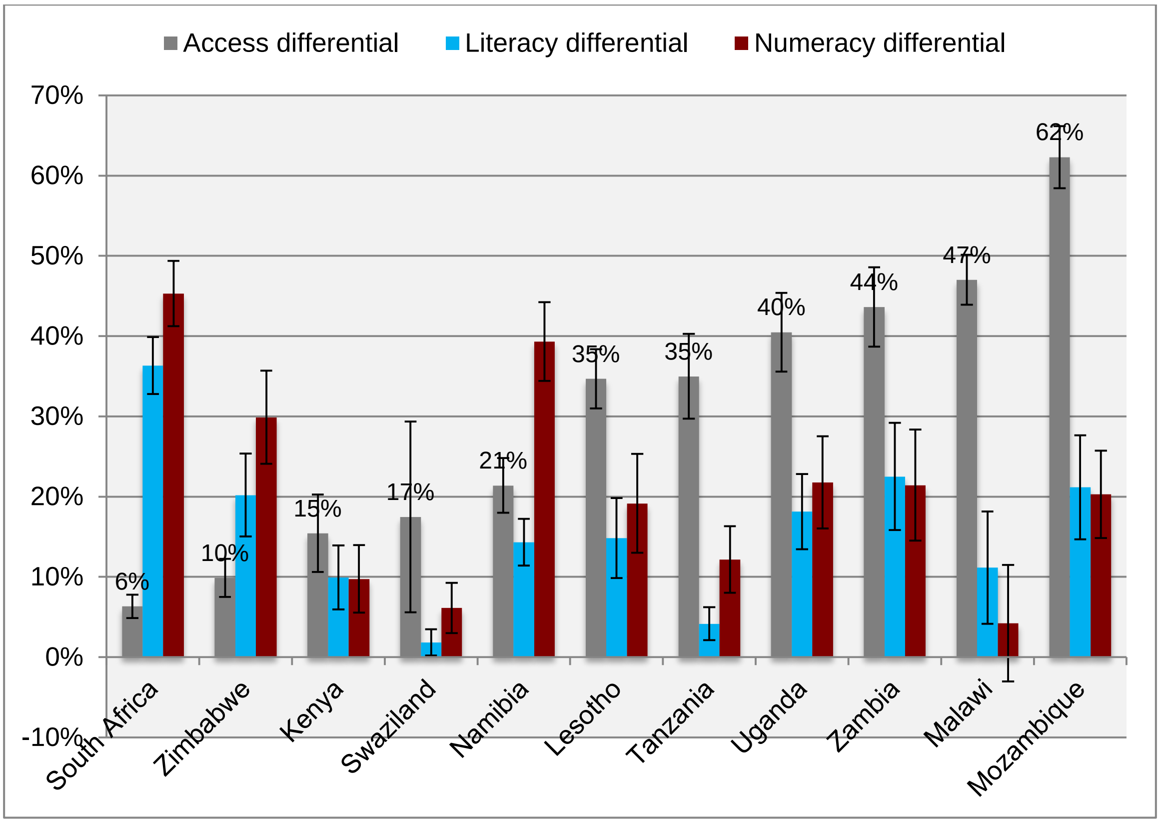
FIGURE 23: GRADE 6 COMPLETION DIFFERENTIAL (ACCESS) AND NUMERACY AND LITERACY DIFFERENTIAL (QUALITY) BETWEEN RICHEST 20% AND POOREST 40% OF STUDENTS WITH 95% CONFIDENCE INTERVAL (ALL CALCULATIONS ARE RICHEST 20% MINUS POOREST 40%)



4.6 ACCESS, QUALITY AND THE POST-2015 MILLENNIUM DEVELOPMENT GOALS

Over the last two decades the Millennium Development Goals (MDG) developed by the United Nations have been tremendously influential on foreign aid allocations and on the global development agenda more broadly. These goals are set to expire in 2015 at which time new targets will be set. The existing MDG relating to education is worded as follows: "By 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling." In this goal 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 standardized assessments is a very poor indication of learning. As Pritchett (2004, 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 Sub-Saharan Africa.

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The increased emphasis on learning (quality), rather than a naïve focus on schooling (access) has prompted a variety of stakeholders to lobby for quality-informed targets for the post-2015 MDG replacements. The United Nations 'Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda", for example, argues for an education-related goal worded as follows: "Ensure every child, regardless of circumstance, completes primary education able to read, write and count well enough to meet minimum learning standards" (United Nations 2013, 36). Similarly the UNESCO Institute for Statistics and the Center for Universal Education at the Brookings Institution have convened the Learning Metrics Task Force (LMTF) to "Catalyse a shift in the global education conversation from access to access *plus* learning" (UNESCO/CUE 2013, 2). The statistics presented in this paper – access-to-literacy rates and access-to-numeracy rates – which combine measures of access and quality, could be one such statistic on which to base the post-2015 MDG replacements.

4.7 Conclusion

The aim of the present study has been to create a composite measure of educational access and educational quality. Doing so allows for the calculation of the proportion of a particular cohort that are functionally numerate and the proportion that are functionally literate. Building on the conceptual framework of Pritchett (2004) and extending the empirical work of Hanushek and Wößmann (Hanushek and Wößmann n, 2008) we calculated the proportion of a cohort of youth (19-23 years old) that were functionally literate and functionally numerate for each country, and within each country by gender and wealth – what we term the access-to-literacy and access-to-numeracy rates. Importantly, this new method of measuring education system performance distinguishes between those children who have been excluded from school (those who never enrol and those who drop out before grade 6) and those who are in school but have been excluded from learning (those who complete grade 6 but remain 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.

The results presented here show that learning deficits are considerably greater than access deficits in all of the 11 countries, and that late (or delayed) grade 6 completion is widespread in sub-Saharan Africa. Large wealth differentials (greater than 30 percentage points) exist in all countries except Zimbabwe, Kenya and Swaziland, and pro-boy gender differentials of around 10 percentage points were found in Malawi, Tanzania, and Zambia, rising to 15 percentage points in Mozambique. Lesotho shows an atypically large pro-girl trend in both

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access-to-literacy and access-to-numeracy rates, driven primarily by boys' lower rate of grade 6 completion, particularly for poor boys.

In light of the approaching expiration of the MDGs and the on-going talks surrounding the form of their replacement, the analysis presented in this paper provides strong evidence that any post-2015 educational goals should include learning outcomes as explicit criteria. Achieving Schooling For All (rather than Learning For All) will be an important but hollow achievement which is at odds with the United Nations Millennium Declaration. If children are to realize their full potential, the expansion of physical access to schooling in the developing world must be accompanied by meaningful learning opportunities. The acquisition of knowledge, skills and values must be the central aim of educational expansion.

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CHAPTER 5: MEASURING ACCESS TO *LEARNING* OVER A PERIOD OF INCREASED ACCESS TO *SCHOOLING*: THE CASE OF SOUTHERN AND EASTERN AFRICA 2000-2007

5.1 INTRODUCTION

The aim of the previous chapter was to create a composite statistic of educational access and educational quality, providing a cross-sectional snapshot of the state of education in 11 countries in sub-Saharan Africa. The measures – termed access-to-literacy and access-to-numeracy - used data from SACMEQ 2007 and grade-survival data from the most recent DHS survey in each country. In the present chapter I extend this analysis by introducing an inter-temporal comparison and calculate the composite measure at two points in time (2000 and 2007). Perhaps most importantly, the present inter-temporal analysis sheds light on the interplay between access to and quality of education in sub-Saharan Africa – and specifically whether or not there seems to be a trade-off between expanding access and declining quality - a topic of perennial interest to both policy-makers and academics.

The substantial improvements in access to primary education in many African countries has led to a growing perception that school quality may have suffered as a result. Strong policy drives have led to considerable expansions in school access, although enrolment rates in Sub-Saharan Africa continue to lag behind the rest of the developing world (Easterly, 2009; Majgaard and Mingat, 2012). Meanwhile, the dismal performance of African countries in recent international assessments of educational achievement such as PISA, TIMSS, PIRLS and SACMEQ[55] has led many critics to argue that schooling which fails to produce learning is of limited value (Lewin, 2009; Pritchett, 2013). Furthermore, Hanushek and Wößmann (Hanushek and Wößmann, 2008) have shown that the quality of education is more important than educational attainment in determining both the economic growth of nations and the labour market performance of individuals, as discussed in the previous chapter. Consequently, the call for a shift of attention from education access to education quality is now becoming familiar, and rightly so.

However, in much of the literature on schooling in Africa there is a notion, either implicit or explicit, that this increased access has caused deterioration in the effectiveness of education

[55] PISA stands for Programme for International Student Assessment; TIMSS stands for Trends in International Maths and Science Study; PIRLS stands for Progress in International Reading Literacy Study; SACMEQ stands for Southern and East African Consortium for Monitoring Educational Quality.

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systems to produce learning. Colclough, Kingdon and Patrinos (2009, p. 2), for example, suggest that "in some African cases, the expansion of the primary system appears to have been accompanied by sharp declines in school quality, such that literacy and numeracy are no longer so readily delivered by the primary system." Chimombo, Kunje, Chimuzu, and Mchikoma (2005, p. 16) maintain that the introduction of free primary education in Malawi led to a deterioration in the quality of education being offered. Chimombo (2009, p. 309) argues that, "the impressive achievements made in improving access to school have to be balanced against issues of declining quality" and that the poor are most at risk of a consequently low quality education. Zuze and Leibbrandt (2011), in view of the low quality of education observed in Uganda, suggest that the expansion of access to schooling should perhaps have been phased in more slowly so as to allow better planning and preparation. Crouch and Vinjevold (2006) argue that while many countries have managed to improve both access and quality, the region of Southern Africa is unique in that there has been an over-emphasis on access at the expense of learning, thus creating an imbalance between access and quality and therefore demonstrating the tension between access and quality. Most recently, when discussing education in sub-Saharan Africa Glewwe et al. (2014, p. 391) state that "the rapid increases in school enrolment almost certainly have *reduced* school quality as schools became overcrowded and existing resources were strained."

There are a number of mechanisms through which one might expect increased access to schooling to cause a decline in quality, as measured by test scores; (1) the changing social composition of schools (i.e. an influx of disadvantaged children) is likely to drive down average scores even if the value added by schools remains unaffected; (2) the changing social composition of schools could negatively influence the learning outcomes of children who would have been enrolled even in the absence of the increased access through peer effects; (3) a strain on resources such as pupil-teacher ratios may reduce school effectiveness; and (4) if the expansion is driven by abolishing school fees this may weaken local accountability if, as is often believed, school fees promote accountability. [56]

To some extent, the perception of deteriorating quality arose due to a lack (until recently) of comparable test score data over time. For example, Kadzamira and Rose (2003, p. 511),

[56] There may also be other less expected consequences of free primary education. Two recent studies find that abolishing fees in Kenya in 2003 created a perception of lower public school quality amongst parents (mainly signalled by higher pupil-teacher ratios), which led to substantially increased enrolments in private schools (Bold et al., 2011b; Nishimura and Yamano, 2013). As a consequence, public school enrolments stagnated while more affluent children migrated to the expanding private school sector. Moreover, Bold, Kimenyi, Mwabu and Sandefur (2011a) find that private schools caused improved performance amongst those attending with the result that overall education performance in Kenya remained stable despite the increased numbers of poor children attending public schools.

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who maintain that free primary education in Malawi had a negative impact on school quality, concede that they were not able to "compare what would have happened in the absence of the rapid expansion of enrolments nor with test results in previous years." Therefore, as test score data became available in recent years analysts, perhaps reasonably, suspected that the dismal performance may have been linked to the rapid expansions of earlier periods.

Perhaps to a greater extent, confusion about the relationship between educational access and school quality has arisen because measures of access, such as gross and net enrolment ratios, are invariably treated separately from measures of quality, such as country average test scores. Consequently, deteriorating education system quality is typically conceptualized as a decline in average test scores amongst those enrolled. This chapter argues that education system quality should rather be conceptualized as the amount of learning that takes place in the overall population of children (those enrolled *and* those not enrolled). Measurement of this concept requires that enrolment or grade survival data (access) be combined with test score data (quality), as per the method developed in the previous chapter.

An important reason for the confusion around the relationship between education access and education quality is that quality, which can be defined in various ways, is often not clearly defined. School quality could be defined as the average performance within a school (proxied by test scores). Or, it could be defined as the 'value-added' by a school, which allows for the possibility that one school may record lower test scores than another school but is more effective given its social composition of pupils. In this chapter, the focus is primarily on the success of the education system as a whole in providing the entire population of children with access to learning. In this conception of quality, a successful education system is one in which children remain in school *and* acquire specific learning outcomes.

The present chapter does not attempt to identify the causal impact of increased access to school on education quality, however quality is defined. Measuring the causal impact of increased access is problematic because many other factors change over time apart from access to schooling. These include economic growth, political dispensations as well as specific education policies. For example, economic growth may simultaneously contribute to increased access (through various mechanisms such as increased demand for schooling and increased government capacity to build schools) and to increased school quality (through for instance increased government ability to procure educational resources).

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In order to estimate the causal impact of increased access one would therefore require some exogenous factor (unrelated to school quality) that caused some countries or regions to expand school participation, thus creating a natural experiment. However, we know of no such factor. Alternatively, one would need to identify a “treatment group” of enrolled students in a time period of “high access” and a similar “comparison group” of pupils enrolled in a time period of “low access”. However, even if one is able to identify pupils with similar observable characteristics (such as parental education level) enrolled at two different time periods, these two groups will no doubt be different on unobservable characteristics (such as parental motivation or disposition towards education).

However, as Bold *et al* (2011a, p. 36) argue, free primary education and other Education For All policy initiatives provided a substantial supply-side shock. The evidence presented in this chapter about the production of literacy and numeracy in countries that expanded access to schooling is therefore relevant to policy questions and development theory regarding expanding access to education.

After briefly discussing the relevant data on access to schooling and learning achievement, the main results of how access to learning changed in the ten countries under consideration between 2000 and 2007 are presented followed by several extensions and robustness checks.

5.2 Data and Methodology

As mentioned in the previous chapter, the salient goal for an education system is to increase the proportion of all children in the population who attain particular levels of academic performance.[57] Although previous initiatives such as the Jomtien declaration explicitly aimed for wider access to a better quality of schooling (e.g. article IV of the Jomtien Declaration), the policy response within countries and the monitoring of Education For All targets has largely focussed on *either* access *or* test score data, but without a suitable composite measure.

5.2.1 Data on educational achievement

The present chapter uses the same methodology as that employed in the previous chapter with the extension that I now consider both SACMEQ 2000 and SACMEQ 2007 with corresponding DHS data for both 2000 and 2007. Because the present chapter aims to

[57] While there are no doubt other important non-academic purposes of education, this goal is salient in so far as it is more relevant than merely increased school attendance or increased country average test scores.

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compare access to learning at two points in time, only those countries that participated in both SACMEQ 2000 and SACMEQ 2007 were included in the analysis. Thus, while Zimbabwe was included in the previous chapter, it is excluded here since it only participated in SACMEQ 2007 and not SACMEQ 2000. Consequently the 10 education systems analysed in this chapter are those of Kenya, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Uganda and Zambia.[58]

In 2000, SACMEQ tested 41686 students in 2294 schools across 14 education systems (treating Tanzania and Zanzibar as separate systems). In 2007, with the addition of Zimbabwe, SACMEQ tested 61396 students in 2779 schools across 15 education systems (Hungi et al., 2010). Administrative data on school enrolments were used as the basis for sampling. Consequently, the SACMEQ datasets contain a raising factor variable which inflates the sample to the estimated size of the grade 6 population, thus providing a measure of the number of grade 6 enrolments in 2000 and 2007 (Ross et al., 2005). This raising factor variable is used later in the chapter as a robustness check on the DHS grade survival data. In all calculations involving SACMEQ data the appropriate adjustments for complex sampling and weighting were made.

Table 22 reports the country average reading and mathematics scores in SACMEQ 2000 and 2007 for the 10 education systems considered in this chapter. The scores in the 2000 survey were set to have a scale average of 500 and a standard deviation of 100 across all students from all countries with sampling weights applied (Ross et al., 2005). The 2007 scores were then calculated on the same scale as the 2000 scores so as to ensure comparability. Zambia and Malawi had the worst performing grade 6 students on average. In 2007, Tanzania had the best-performing grade 6 students in reading while Kenya had the highest-performing students in mathematics. Most countries improved their average scores in both reading and mathematics between 2000 and 2007, especially in the cases of Namibia and Tanzania. On the other hand, average reading and mathematics scores declined in Mozambique and mathematics scores declined in Uganda.

[58] The other education systems in SACMEQ are Botswana, Mauritius, Seychelles, Zimbabwe and Zanzibar, which, though part of Tanzania, participated in SACMEQ as a separately analysed education system. We were not able to locate comparable household data for Botswana, Mauritius and Seychelles. This is not too unfortunate since these countries have high levels of primary school participation and did not substantially expand access over the relevant period.

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TABLE 22: COUNTRY AVERAGE SCORES, PROPORTION OF GRADE 6 CHILDREN FUNCTIONALLY LITERATE AND FUNCTIONALLY NUMERATE IN 2000 AND 2007

Literacy	SACMEQ 2000				SACMEQ 2007			
Country	Average score	SE	Proportion functionally literate	SE	Average score	SE	Proportion functionally literate	SE
Kenya	546.50	4.58	94.39	0.81	543.11	5.08	91.96	1.00
Lesotho	451.23	3.07	70.64	1.96	467.87	2.86	78.80	1.30
Malawi	428.92	2.41	55.51	2.18	433.50	2.62	63.40	1.77
Mozambique	516.66	2.44	93.84	0.63	476.04	2.82	78.49	1.13
Namibia	448.78	3.53	56.55	1.49	496.92	2.99	86.37	0.76
South Africa	492.26	9.06	68.99	2.11	494.95	4.55	72.74	1.19
Swaziland	529.59	3.79	98.01	0.47	549.39	2.99	98.52	0.40
Tanzania	545.88	4.82	91.70	0.90	577.76	3.45	96.50	0.52
Uganda	482.39	6.21	74.48	2.18	478.68	3.57	79.65	1.30
Zambia	440.12	4.51	52.33	2.22	434.41	3.36	55.91	1.68

Numeracy	SACMEQ 2000				SACMEQ 2007			
Country	Average score	SE	Proportion functionally numerate	SE	Average score	SE	Proportion functionally numerate	SE
Kenya	563.25	4.30	89.29	1.01	556.96	4.11	88.77	1.04
Lesotho	447.18	3.33	34.13	2.08	476.91	2.61	58.19	1.59
Malawi	432.93	2.28	25.77	1.52	447.02	2.87	40.12	1.80
Mozambique	530.01	2.18	87.01	0.90	483.81	2.29	67.27	1.26
Namibia	430.86	3.23	23.38	1.35	471.03	2.51	52.31	1.35
South Africa	486.15	7.26	47.74	2.63	494.84	3.81	59.83	1.38
Swaziland	516.54	3.45	77.97	1.38	540.84	2.39	91.41	0.93
Tanzania	522.40	4.17	74.53	1.54	552.72	3.54	86.76	1.07
Uganda	506.28	8.29	61.18	2.58	481.90	3.03	61.26	1.58
Zambia	435.21	3.54	28.82	1.73	435.15	2.44	32.68	1.42

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Educational experts from SACMEQ have categorized scores in these tests into eight competency levels ranging from pre-reading (level 1) to critical reading (level 8) in the case of literacy, and from pre-numeracy (level 1) to abstract problem solving (level 8) in the case of mathematics (Ross et al., 2005). The eight competency levels for literacy and numeracy are described in detail by Hungi *et al* (2010) in Appendix C. According to this categorisation, children failing to reach level 3 in either reading ('basic reading') or mathematics ('basic numeracy') can be regarded as functionally illiterate and functionally innumerate respectively, as discussed in the previous chapter.

Table 22 also reports the proportions of grade 6 students that were functionally literate and functionally numerate in 2000 and in 2007, by country. In 2007, Zambia had the smallest proportions of grade 6 students that were functionally literate (56%) and functionally numerate (33%). Interestingly, Swaziland had the highest proportions of students reaching functional literacy and numeracy in 2007, despite not having the highest country average score in either reading or mathematics. This indicates that Swaziland has a relatively equitable school system that succeeds in providing basic skills to the majority of students. Namibia recorded the greatest improvement in the proportions of grade 6 children reaching functional literacy and numeracy between 2000 and 2007. In contrast, the proportions of students reaching functional literacy and numeracy declined substantially in Mozambique.

5.2.2 Data on access (grade 6 completion)

In addition to measuring the proportion of grade 6 children acquiring basic literacy and numeracy, one has to estimate the proportion of children who reach grade 6 in the first place, in order to arrive at a meaningful estimate of access to learning amongst the full population.

As per the previous chapter, we obtain data on survival to grade 6 for these countries from the Demographic and Health Surveys (DHS), or strictly comparable data from other household surveys. In the case of Swaziland, we use the Multiple Indicator Cluster Surveys (MICS) and for South Africa we use the annual General Household Surveys (GHS). These surveys are all widely used for research purposes and contain comparable information on educational participation and attainment.

In order to estimate survival to grade 6 we make use of the question in these surveys on highest grade completed. This meant that we had to either use grade 6 completion rates (which underestimates the proportion of people who attend grade 6) or grade 5 completion rates (which overestimates the proportion of children who attend grade 6). Since the

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SACMEQ testing was conducted fairly late in the school year, we decided to use grade 6 completion rates.

An important question when estimating grade 6 completion rates is what age group of survey respondents to use. Although this was covered briefly in the previous chapter, it is worth emphasizing why we chose the age group 19-23 year olds. Table 23 shows the proportion of children enrolled in grades 1 to 6 by age for each country.[59]

TABLE 23: PROPORTION OF CHILDREN ENROLLED IN GRADES 1 TO 6 BY AGE FOR EACH COUNTRY

Country	Year of Survey	Age16	Age 17	Age 18	Age 19	Age 20	Age 21
Kenya	2007-2008	14.70	7.24	4.55	1.78	0.96	0.50
Lesotho	2009	10.16	6.00	2.19	1.06	0.95	0.13
Malawi	2010	23.36	12.54	7.53	3.92	1.52	0.91
Mozambique	2011	18.82	9.56	5.96	3.58	2.27	1.63
Namibia	2006-2007	8.22	3.86	2.24	0.59	0.68	0.74
South Africa	2009	3.86	1.18	0.62	0.47	0.20	0.00
Swaziland	2007	19.33	9.98	4.50	0.71	0.31	0.16
Tanzania	2010	7.39	2.41	1.17	1.06	0.09	0.18
Uganda	2010	43.55	22.24	7.60	4.31	1.30	1.43
Zambia	2007	14.26	12.79	4.78	2.41	1.67	1.04

As evident in Table 23, 19-year-olds were the youngest single-year age group for which all countries satisfied the rule of having less than 5% of an age-group still enrolled in grades 1-6. The upper limit of the age bracket was set to 23-year-olds so as to include enough observations for an acceptable level of precision (i.e. small enough standard errors).

Since the best measure of grade 6 completion is obtained from 19- to 23-year-olds it has to be recognised that this reflects school participation roughly two to six years prior. Unfortunately, comparable household survey data is not available on an annual basis for the

[59] Appendix D2 shows stacked area plots of four categories of education status (not yet enrolled, currently enrolled in grades 1 to 6, dropped out prior to completing grade 6, and completed grade 6) by age for each country and various sub-groups within each country.

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countries in the sample, but only every few years, depending on each particular case. Therefore, we used household data as close as possible to 2003 to reflect access to grade 6 in 2000 (when SACMEQ was administered) and household data as close as possible to 2010 to reflect access to grade 6 in 2007 (when SACMEQ was administered again).

Table 24 shows grade 6 completion rates amongst 19-23 year-olds around 2003 and around 2010 for the ten countries in the sample. Arguably, these estimates provide a more meaningful picture of access to primary schooling in the region than most other commonly reported statistics, such as Gross Enrolment Ratios (GERs) or Net Enrolment Ratios (NERs). In both time periods, the grade 6 completion rate was highest in South Africa and lowest in Mozambique, although the increase over the interim period was the largest for Mozambique. In many of these countries there were substantial increases in the proportion of children who completed grade 6 (Kenya-7%, Lesotho-9%, Malawi-7%, Mozambique-96%, Swaziland-12%, Tanzania-11%, Uganda-8% and Zambia-8%; all in percentage points).

TABLE 24: GRADE 6 COMPLETION RATES AROUND 2003 AND AROUND 2010 (19-23 YEAR-OLDS)

	Circa 2003			**Circa 2010**		
Country	**Year of Survey**	**Grade 6 completion rate (%)**		**Year of Survey**	**Grade 6 completion rate (%)**	
Kenya	2003	81.26	*(1.07)*	2007-2008	87.21	*(1.00)*
Lesotho	2004	71.26	*(1.01)*	2009	77.97	*(1.00)*
Malawi	2004	58.61	*(1.26)*	2010	62.86	*(0.99)*
Mozambique	2003	26.99	*(1.14)*	2011	53.01	*(1.37)*
Namibia	2000	82.45	*(1.43)*	2006-2007	85.42	*(0.84)*
South Africa	2004	94.04	*(0.31)*	2009	95.42	*(0.33)*
Swaziland	2000	76.66	*(1.51)*	2007	85.69	*(1.45)*
Tanzania	2004-2005	66.89	*(1.67)*	2010	74.12	*(1.41)*
Uganda	2006	63.36	*(1.29)*	2010	68.53	*(1.34)*
Zambia	2001-2002	68.56	*(1.33)*	2007	74.03	*(1.22)*

Source: Own calculations using DHS, MICS (for Swaziland) and GHS (for South Africa data. Standard errors in parenthesis.

When one considers these enrolment trends in combination with the educational achievement trends (Table 22) it is clear that there is a need for a combined indicator of

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education system performance. A comparison of South Africa and Tanzania demonstrates this. South Africa has the highest grade completion rate but a relatively large proportion of functionally illiterate and innumerate grade 6 students. In contrast, a high proportion of Tanzanian grade 6 students reach functional literacy and numeracy but a considerable proportion of the population does not reach grade 6. Moreover, there is ambiguity regarding the development of the education system since 2000 in a case such as Mozambique where access to primary schooling increased impressively but the country average score declined. It is therefore not immediately clear if the net effect was positive or negative.

There were also some countries where both access and country scores improved between 2000 and 2007, such as Tanzania, Lesotho and Swaziland. The 2011 EFA Global Monitoring Report recognizes this and argues that these trends "call into question the widespread claim that increased enrolment across the region has been universally accompanied by a steep decline in quality, implying a trade-off between learning levels and access" (UNESCO, 2011, p. 85). The EFA report, however, still uses separate measures of access and quality and therefore remains ambiguous about the cases of Mozambique and Uganda.

The composite measure of access-to-literacy and access-to-numeracy is calculated in the same way as in the previous chapter and is therefore not discussed further here.

5.3 Empirical findings: Access to learning since 2000

Appendix D4 reports the proportions of 19-23 year olds[60] that never enrol and those that complete grade 6 as well as the proportion of the SACMEQ sample reaching basic literacy and numeracy, access-to-literacy rates (grade 6 completion rate multiplied by the proportion of grade 6 pupils that reached basic literacy) and access-to-numeracy rates (grade 6 completion rate multiplied by the proportion of grade 6 pupils that reached basic numeracy). All statistics are reported for the years 2000 and 2007, for all ten countries and for the following sub-groups: boys, girls, the poorest 40% of the population, the middle 40% of the population, the richest 20% of the population, the poorest 40% of boys, the poorest 40% of

[60] The results in the Appendix are also reported for the sub-groups of gender, wealth and a gender-wealth interaction, as per Chapter 4.

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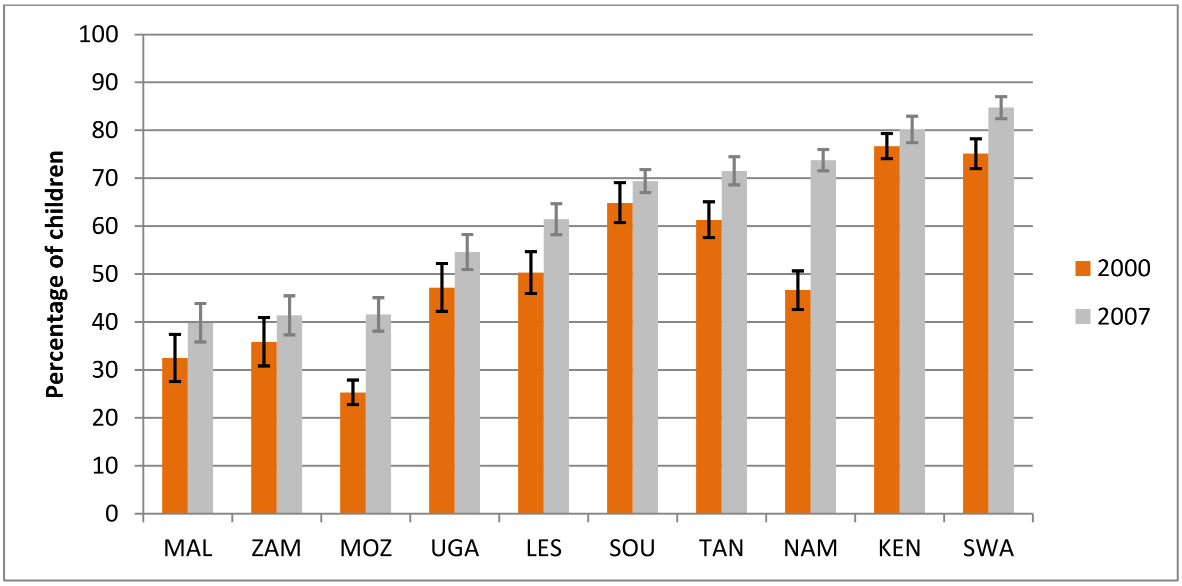
girls, the middle 40% of boys, the middle 40% of girls, the richest 20% of boys, and the richest 20% of girls.[61] Standard errors are also reported.

5.3.1 COUNTRY ACCESS-TO-LITERACY AND ACCESS-TO-NUMERACY RATES IN 2000 AND 2007

Figure 24 shows access-to-literacy rates for all ten countries in 2000 and 2007. Figure 25 shows the same information for numeracy. The figures also show the 95% confidence intervals of the estimated rates, which were calculated by combining the standard errors from the grade 6 completion rates with the standard errors from the proportion literate and numerate from SACMEQ. Since the two samples are independent, the standard error of the composite index is the square root of the sum of the squared standard errors.[62]

FIGURE 24: ACCESS-TO-LITERACY RATES IN 2000 AND 2007



[61] The procedure for calculating access-to-literacy (or numeracy) rates when interacting gender and wealth, is the same as that for overall wealth, but done separately for the population of females and of males in turn.

[62] In a formula this is $SE_{COMPOSITE} = Sqrt((SE_{SACMEQ})^2+(SE_{DHS})^2)$

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FIGURE 25: ACCESS-TO-NUMERACY RATES IN 2000 AND 2007

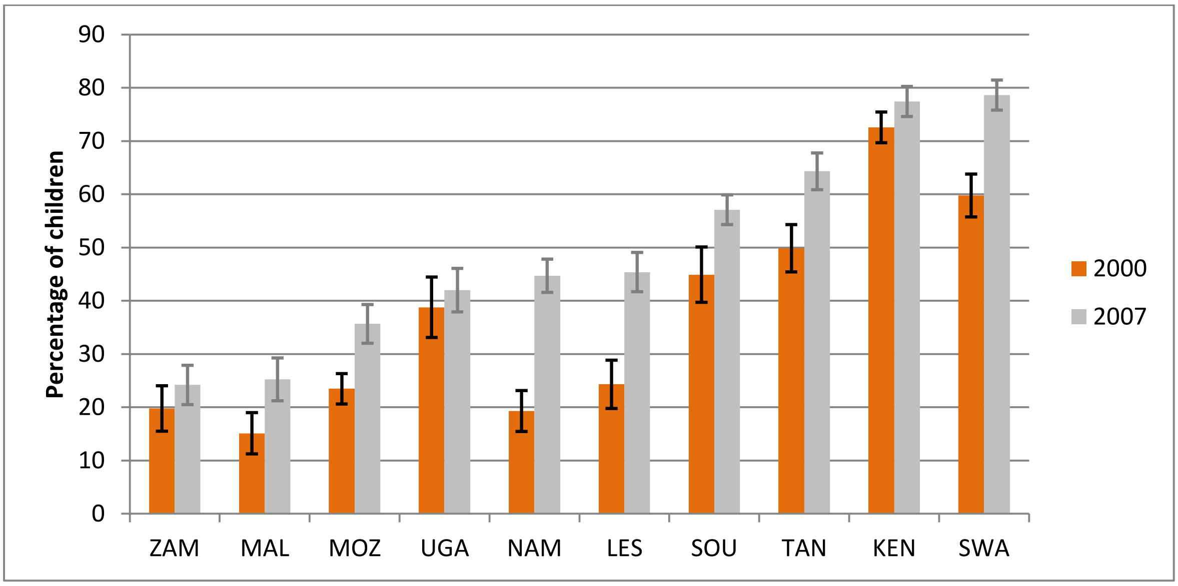

Figure 24 and Figure 25 indicate that the best performing education systems, according to the combined measures of access and learning, were Tanzania, Kenya and Swaziland. In contrast, the countries with the lowest access to learning were Malawi, Zambia and Mozambique. Some countries have similar access-to-learning rates but have very different patterns in grade survival and in learning outcomes. For example, South Africa – with high grade 6 completion rates but low levels of learning amongst grade 6 pupils – has a similar access-to-literacy rate to Tanzania – with low grade 6 completion but high levels of learning amongst grade 6 pupils.

Perhaps the most striking feature of Figure 24 and Figure 25 is that in all countries access-to-literacy and access-to-numeracy improved between 2000 and 2007. In some countries the improvement was not statistically significant but in other countries the improvement was both statistically significant and substantial (Mozambique, Lesotho, Tanzania, Namibia, Swaziland). Irrespective of the impact of expanded school participation on specific schools or individuals, this represents compelling evidence that during a period of considerable expansion to primary schooling, there was a concomitant improvement in access to learning.

Figure 26 (for literacy) and Figure 27 (for numeracy) consolidate all the information about changes in grade 6 completion, changes in average test scores and changes in access to learning into a single graph. The horizontal axis shows the percentage point change in the grade 6 completion rate for each country. The vertical axis shows the ratio of access-to-literacy (or numeracy) in 2007 to access-to-literacy (or numeracy) in 2000. A ratio above

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one means that access-to-literacy (or numeracy) was higher in 2007 than in 2000. The size of the bubbles indicates the magnitude of the change in the country average test score between SACMEQ 2000 and SACMEQ 2007. For thick red bubbles the change in SACMEQ average score was negative while for thin black bubbles the change was positive.

FIGURE 26: ACCESS TO SCHOOLING AND ACCESS TO LITERACY OVER TIME

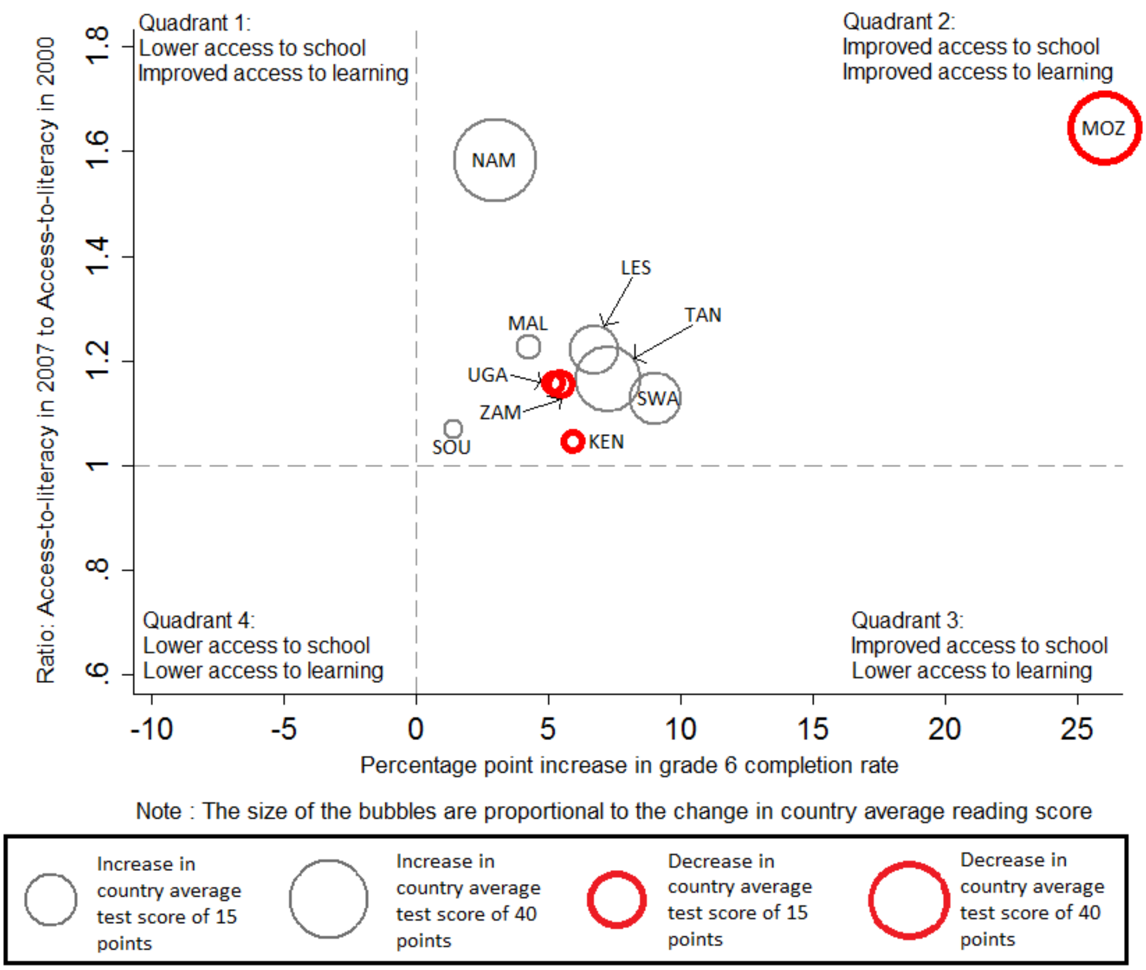

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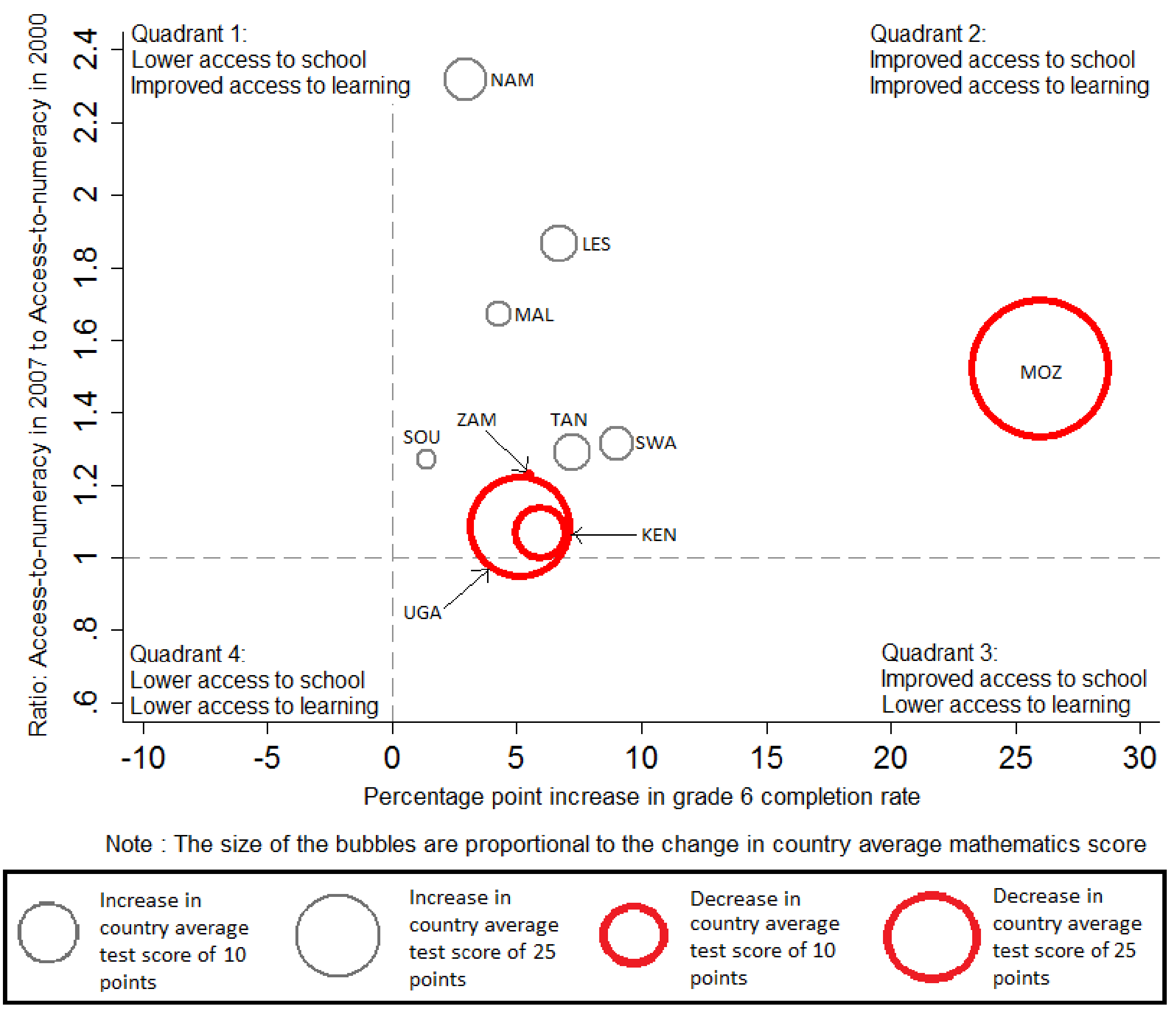
FIGURE 27: ACCESS TO SCHOOLING AND ACCESS TO NUMERACY OVER TIME



The graphs show four quadrants corresponding to the four possible combinations of increases or decreases in grade completion (access) and increases or decreases in access to learning. For both literacy and numeracy, all countries are located in the top right quadrant, indicating that both access to schooling *and* access to basic learning improved over the period for all countries. Some countries improved access to learning between 2000 and 2007 without substantial changes in the grade 6 completion rate. Namibia is the chief example of this. Some countries (Tanzania, Swaziland and Lesotho) experienced higher grade 6 completion rates and still achieved higher average test scores. Some countries, most notably Mozambique, achieved improved access to learning in the overall population but experienced a decline in average test scores amongst those reaching grade 6.

Using the case of literacy in Mozambique, Figure 28 illustrates how improved access to learning for the population can be consistent with lower average test scores. The graph

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shows the numbers of grade 6 students in Mozambique who reached each of the eight competency levels of reading performance in 2000 and 2007. The numbers were obtained using the raising factor variable ("*rf2*") in the SACMEQ datasets[63]. From the figure there are two important findings worth emphasizing: (1) There was a shift in the distribution of performance with many more children achieving at lower competency levels (levels 1-3) in 2007 than in 2000; and (2) At every competency level there were more students in 2007 than in 2000 due to the expansion of the schooling system and including previously excluded children. These two points in conjunction with each other explain how it is possible to say that the Mozambican education system improved access to *learning* at the same time that the average Mozambican test score declined. The majority of those children bringing the average down in 2007 would not have been in school had the grade 6 completion rate of 2000 still prevailed. The fact that these previously excluded children were not included in SACMEQ 2000, but were included in SACMEQ 2007 (and achieved at relatively low levels) helps explain how a reduction in average test scores following a rapid expansion of access is not necessarily an obviously negative outcome. The important thing here is that there were also more children reaching higher competency levels in 2007 than in 2000, even after adjusting for population growth. When one looks at the case of Mozambique in this way it would seem that expanded access to primary schooling was an unambiguously positive development. For the overall population of children, there was greater access to literacy in 2007 than in 2000.

[63] The 2007 numbers of grade 6 pupils were deflated to adjust for population growth between 2000 and 2007.

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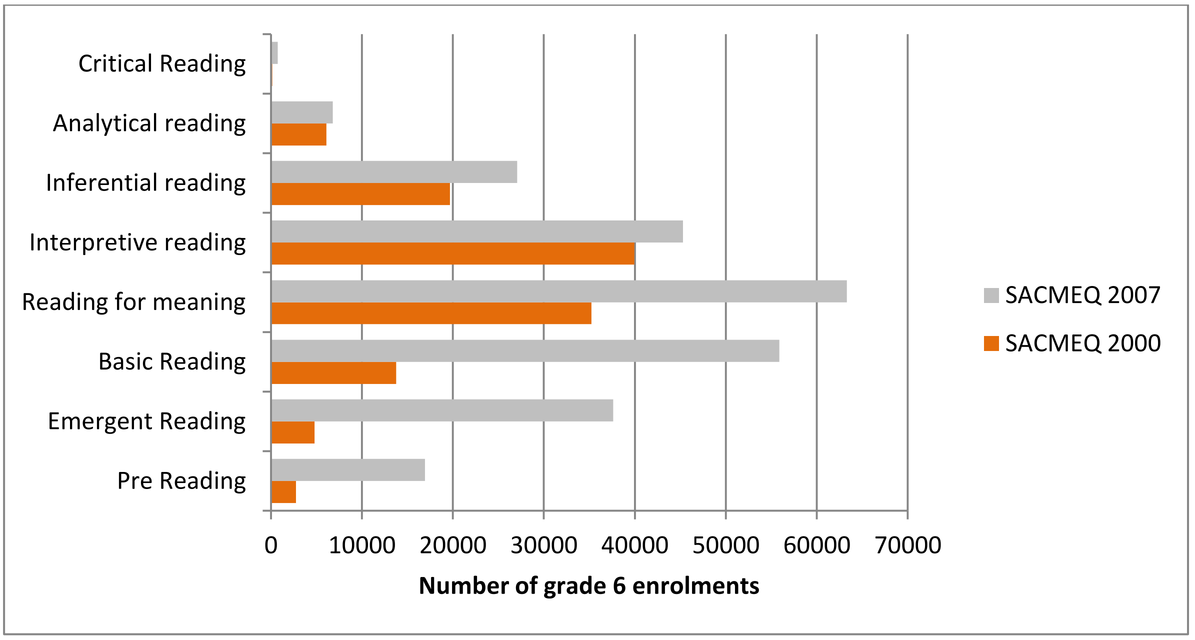
FIGURE 28: NUMBERS OF GRADE 6 PUPILS ACHIEVING AT VARIOUS PERFORMANCE LEVELS IN LITERACY IN MOZAMBIQUE IN 2000 AND 2007



5.3.2 ACCESS-TO-LITERACY AND ACCESS-TO-NUMERACY BY GENDER

Appendix D4 reports the access-to-literacy and access-to-numeracy rates by gender for all ten countries in 2000 and 2007. To facilitate an overview of the trends between 2000 and 2007, we derived a Gender Parity Index (GPI) for each of the two periods, defined as the access-to-literacy rate for girls over the access-to-literacy rate for boys. Figure 29 shows this GPI for access-to-literacy in 2000 and in 2007. Figure 30 presents the same analysis for access-to-numeracy.

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FIGURE 29: GENDER PARITY INDEX WITH RESPECT TO ACCESS-TO-LITERACY IN 2000 AND 2007

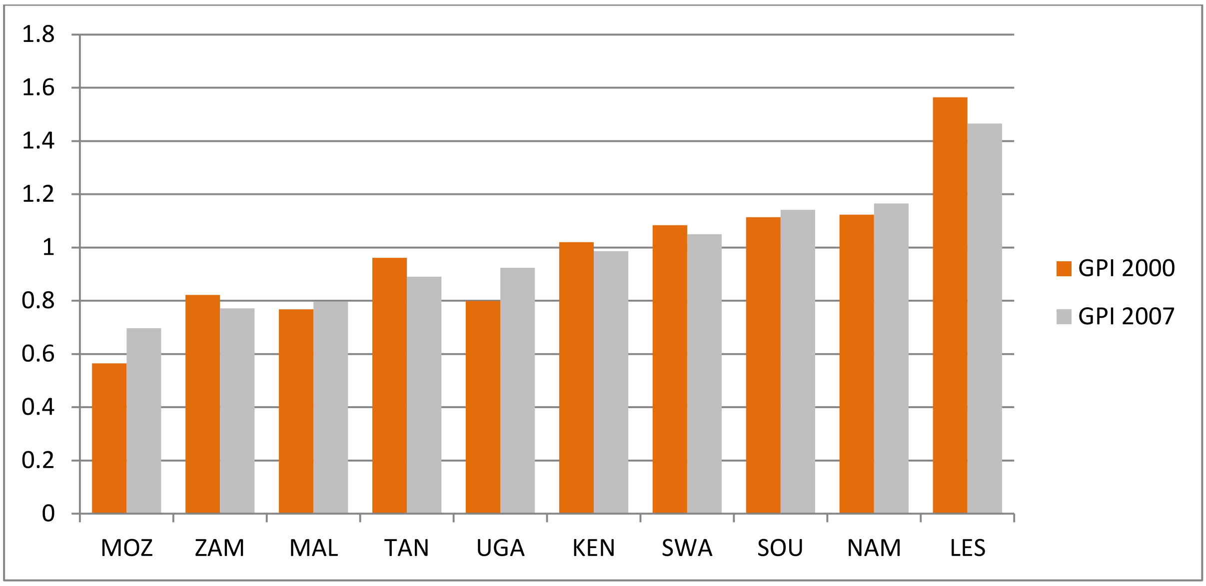
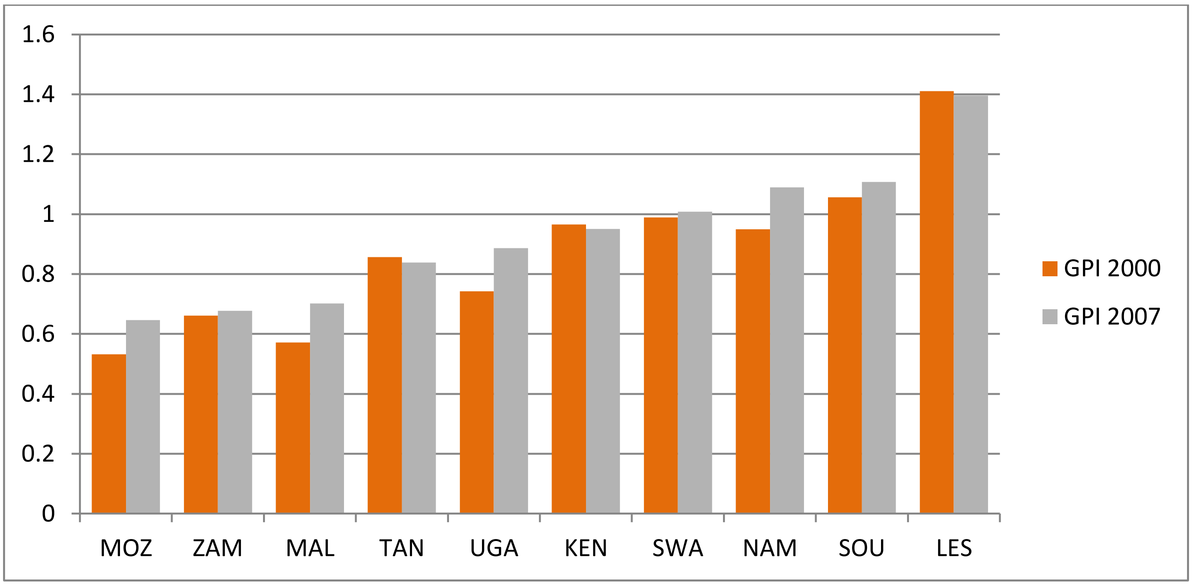


FIGURE 30: GENDER PARITY INDEX WITH RESPECT TO ACCESS-TO-NUMERACY IN 2000 AND 2007



Based on Figure 29 and Figure 30, several points can be made about gender patterns in access to learning in the region. Firstly, girls typically have lower access to learning than boys in poorer countries (Mozambique, Uganda, Kenya) and in the East African countries (Tanzania, Uganda, Kenya). Secondly, analysing only gender inequalities in access to schooling or only gender inequalities in test scores generally understates the overall gender gap in access to learning. For example, 64% of girls in the Mozambique SACMEQ sample had acquired basic numeracy compared with 70% of boys, which would yield a GPI of 0.90.

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The grade 6 completion rate for girls was 45% compared with 63% for boys, which would yield a GPI of 0.72. When combining these figures, however, the access-to-numeracy rate for girls is 28.57% compared with 44.19% for boys, which yields a GPI of 0.65 (see Lewis and Lockheed, 2006 for a full discussion of this "double disadvantage")

Thirdly, girls are outperforming boys in most Southern African countries, especially in Lesotho – as was discussed in the previous chapter. Fourthly, access-to-learning GPIs in 2007 were lower in numeracy than in literacy for all ten countries, with the percentage point differential ranging from 3.4 in South Africa to 9.4 in Zambia. This is consistent with the traditional perception that numeracy tends to favour boys – though of course this result may not reflect any inherent advantage for boys in numeracy, but rather the effects of a self-fulfilling socially constructed perception of such an advantage.

Fifthly, in most cases the GPI increased between 2000 and 2007, indicating a relative improvement for girls. In Mozambique, Uganda and Malawi, the improvement in access to learning for girls relative to boys was substantial. In these countries, the benefits of expanded access to primary schooling were enjoyed disproportionately by girls. This points to the equity-enhancing nature of the recent expansions in school access in the region.

5.3.3 Access-to-literacy and access-to-numeracy by household wealth

Table 25 shows access-to-literacy rates for the poorest 40%, middle 40% and richest 20% of households in all ten countries in 2000 and in 2007. Table 26 shows the same information for numeracy. In all countries the gap in access to learning between the wealthiest 20% of the population and the poorest 40% of the population is substantial. The inequalities in access to learning are clearly of a larger magnitude across the wealth dimension than by gender. The two right-hand columns in Table 25 and Table 26 show the ratio of access-to-literacy (numeracy) rates amongst the poorest 40% to those amongst the richest 20%. For 2000 and 2007 and for both literacy and numeracy, the lowest ratios (i.e. most unequal) were obtained for Mozambique, indicating that in this country the poor are at an extreme disadvantage in having access to learning. For example, the access to numeracy rate for the wealthiest 20% of children in Mozambique (67%) was almost five times as much as that of the poorest 40% of children (14%).

In contrast, Swaziland is the most equitable country on this measure. The most encouraging trend that is evident in these two tables is that the gaps between the richest 20% and the poorest 40% in access to learning declined in most cases. For access-to-literacy, there was a decline in inequality in nine of the ten countries, while for numeracy there was a decline in

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inequality in eight of the ten countries. This reduction in inequality in access to learning was driven mainly by increased grade 6 completion rates amongst the poor. This again points to the equity-enhancing nature of the expanded access to schooling in the region since 2000.

TABLE 25: ACCESS-TO-LITERACY RATES BY SOCIOECONOMIC STATUS IN 2000 AND 2007

	2000			2007			2000	2007
Country	Poor 40%	Mid 40%	Rich 20%	Poor 40%	Mid 40%	Rich 20%	Ratio: Poor40: Rich20	Ratio: Poor40: Rich20
Kenya	62.15	79.88	89.77	69.25	82.61	91.48	0.69	0.76
Lesotho	35.17	53.56	70.98	44.38	64.68	84.48	0.50	0.53
Malawi	19.85	29.40	59.46	24.10	40.26	63.24	0.33	0.38
Mozambique	6.42	21.00	51.71	17.33	39.66	77.03	0.12	0.23
Namibia	32.31	44.59	76.83	61.32	74.42	92.92	0.42	0.66
South Africa	48.82	67.60	93.24	53.80	73.74	92.96	0.52	0.58
Swaziland	67.31	75.79	85.32	76.23	85.60	92.97	0.79	0.82
Tanzania	37.27	68.44	86.51	54.32	75.47	90.81	0.43	0.60
Uganda	34.26	44.31	70.51	35.65	55.57	80.80	0.49	0.44
Zambia	16.25	36.56	70.90	25.02	39.60	67.65	0.23	0.37

TABLE 26: ACCESS-TO-NUMERACY RATES BY SOCIOECONOMIC STATUS IN 2000 AND 2007

	2000			2007			2000	2007
Country	Poor 40%	Mid 40%	Rich 20%	Poor 40%	Mid 40%	Rich 20%	Ratio: Poor40: Rich20	Ratio: Poor40: Rich20
Kenya	58.49	75.63	85.43	66.71	79.82	88.47	0.68	0.75
Lesotho	16.50	25.24	36.68	30.68	47.28	67.52	0.45	0.45
Malawi	9.67	12.12	29.99	15.65	26.22	37.73	0.32	0.41
Mozambique	5.83	19.64	48.02	14.23	34.20	66.79	0.12	0.21
Namibia	8.18	14.28	50.75	29.36	43.40	75.19	0.16	0.39
South Africa	27.83	44.19	81.36	39.87	59.66	87.32	0.34	0.46
Swaziland	52.72	59.23	71.77	69.40	79.31	89.13	0.73	0.78
Tanzania	27.37	56.51	75.64	47.27	67.66	85.15	0.36	0.56
Uganda	25.75	38.21	58.58	26.20	41.65	66.77	0.44	0.39
Zambia	8.53	19.15	42.09	13.62	21.89	44.02	0.20	0.31

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5.4 Extensions

5.4.1 Access to higher order literacy and numeracy

Thus far the focus has been on access to basic literacy and basic numeracy, as defined by reaching at least level three of the eight achievement levels in the SACMEQ tests. It is conceivable that an expansion of primary school participation may lead to increased acquisition of basic literacy and numeracy in the population but may adversely affect the acquisition of higher order skills due to a trade-off between quantity and quality. To investigate this, we analyse access to higher order literacy and higher order numeracy, as defined by reaching at least level five out of the eight achievement levels in the SACMEQ test. Level five literacy ("interpretive reading") requires the ability to combine information from various parts of a text and interpret it relative to external or recalled information in order to complete and contextualise meaning (Ross et al., 2005). Level five numeracy ("competent numeracy") requires the ability to solve multiple-operation problems, using whole and mixed numbers as well as the conversion of measurement units from one level to another. A full description of all eight levels of literacy and numeracy in the SACMEQ tests is provided in Appendix C.

The calculation of access to higher literacy and higher numeracy was the same as that for access-to-literacy and access-to-numeracy. The grade 6 completion rate was multiplied by the proportion of grade 6 pupils who reached at least level five in SACMEQ. As before, we assume that those who did not enrol in school or dropped out before grade 6 did not acquire higher order skills. Figure 31 shows access to higher order literacy in 2000 and 2007, and Figure 32 shows the same for access to higher order numeracy. Clearly there are substantial differences in the proportion of students attaining higher-order numeracy and literacy skills. If one looks at the results for 2007 one can see that more than 50% of children in Kenya, Tanzania and Swaziland achieved at least level five in literacy (interpretive reading), compared to less than 20% in Malawi, Zambia, Mozambique and Lesotho.

The general trend is again positive. In most countries there was greater access to higher order literacy and higher order numeracy in 2007 than in 2000. In Lesotho, Namibia, Tanzania and Swaziland there were substantial increases in access to higher order learning. The only decreases were observed for Zambia, Mozambique (numeracy only) and Uganda (numeracy only), but these declines were not statistically significant. Therefore, the period of increased school participation between 2000 and 2007 in Southern and Eastern Africa was accompanied by increased access to higher order learning (in most countries) in addition to increased access to basic learning (in all countries).

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FIGURE 31: ACCESS TO HIGHER LITERACY IN 2000 AND 2007

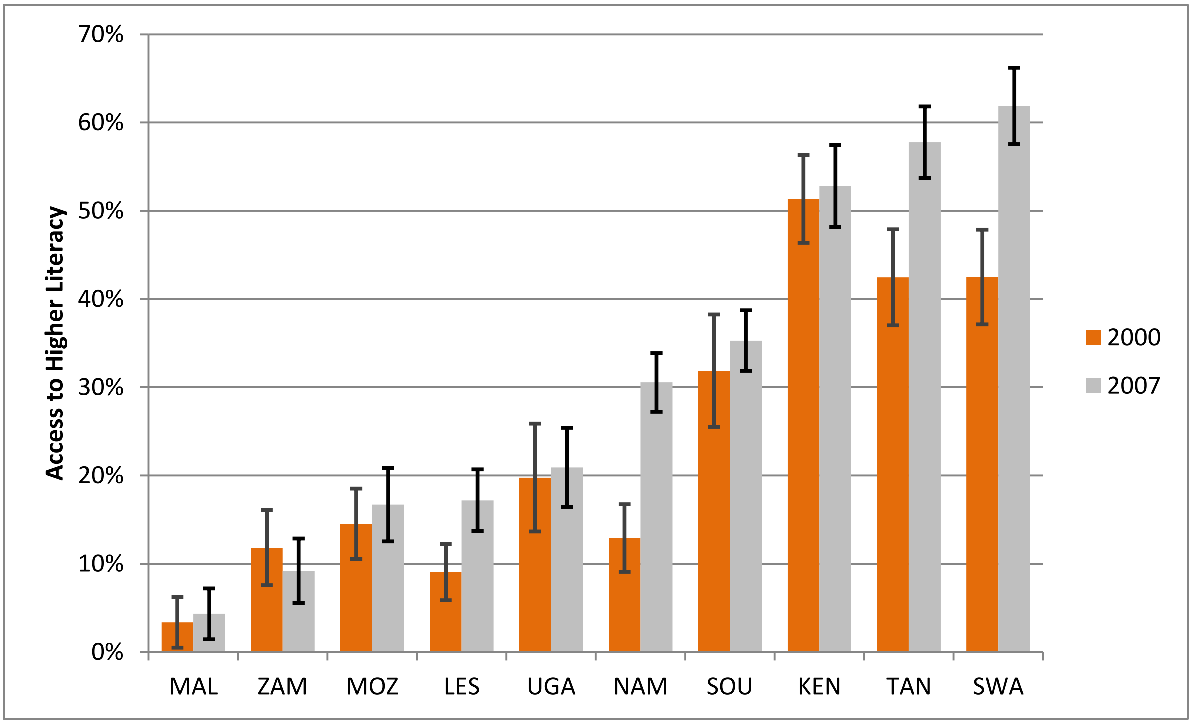
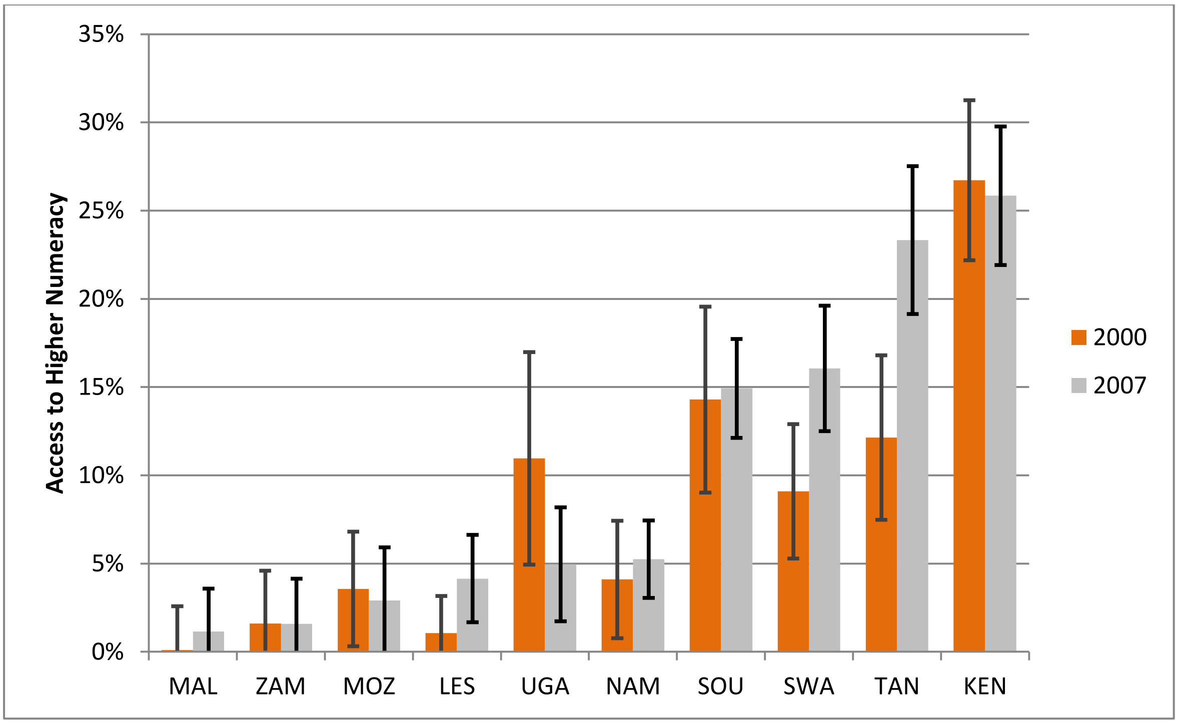


FIGURE 32: ACCESS TO HIGHER NUMERACY IN 2000 AND 2007



5.4.2 Completion of higher levels of schooling

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Lewin (2007) observes that increased primary school access can lead to bottlenecks later in the system if there are binding resource constraints at higher levels of education. This may occur when aid programmes are earmarked for primary schooling only and are limited for a specific time period. Somerset (2007) argues that Kenya's abolition of school fees in 1974 led to a massive increase in grade 1 enrolments but a huge increase in drop-out thereafter.

To investigate whether increased access to primary schooling was accompanied by increased throughput to higher levels of schooling, we calculated grade 9 completion rates amongst 22- to 24-year-olds using the same household survey data as for the calculation of grade 6 completion rates. The results are reported in Table 27. In all ten countries, the grade 9 completion rate increased over the period. In Mozambique, Swaziland and Tanzania, where the grade 6 completion rate had increased substantially, the grade 9 completion rate also increased substantially.[64] This would suggest that increased primary school access has also been associated with improved participation in higher levels of education.

[64] For Tanzania, this contradicts a study by Hoogeveen and Rossi (2013), who use a difference-in-difference approach to estimate the impact of the introduction of free primary schooling on grade attainment. They argue that although children under the reform achieved more schooling than those who were just too young to be affected, the marginal impact of the reform was to decrease grade attainment by 0.6 years of schooling. However, there are some reservations about their identification of treatment (i.e. being born in 1992 or after versus being born in 1991 or earlier) and about the use of baseline grade attainment for treated and non-treated groups. Given that grade attainment was higher overall for those under the reform but the coefficient on the interaction between time and treatment was negative, we suspect that strong baseline grade attainment amongst the younger cohort (perhaps due to earlier school enrolment) may have affected the comparability of baseline measures between the older and younger cohorts and may have driven the result.

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TABLE 27: GRADE 9 COMPLETION RATES AROUND 2003 AND AROUND 2010 (22-24 YEAR OLDS)

	Grade 9 completion rate *Circa* 2003	***SE***	**Grade 9 completion rate *Circa* 2010**	***SE***
Kenya	40.06	*1.53*	43.34	*1.94*
Lesotho	36.97	*1.39*	42.16	*1.62*
Malawi	28.78	*1.48*	33.75	*1.12*
Mozambique	8.37	*0.81*	22.53	*1.25*
Namibia	59.01	*2.19*	65.67	*1.32*
South Africa	79.00	*0.71*	83.91	*0.66*
Swaziland	59.64	*2.24*	85.14	*1.59*
Tanzania	9.97	*1.02*	18.12	*1.26*
Uganda	30.62	*1.52*	37.03	*1.52*
Zambia	36.19	*1.72*	41.44	*1.78*

5.4.3 Measuring access to learning using administrative data

The main disadvantage with using grade 6 completion rates obtained from household survey data to calculate access to learning is that there is a lag between the year of grade 6 testing and the year of the household survey and that the magnitude of this lag is slightly different across countries due to limited data availability. Therefore, as a robustness check we employ an alternative method to measure access to literacy and access to numeracy in our sample of ten countries.

The number of grade 6 pupils achieving basic literacy or basic numeracy can be estimated directly from the SACMEQ data using the raising factor variable ("*rf2*"). This raising factor inflates the total weighted number of students in the sample to be equal to the estimated population of grade 6 pupils in each country. The SACMEQ project adjusted official school census data estimates of grade 6 enrolments in response to actual enrolments as observed in schools during fieldwork. These were then used to adjust the sampling frame to re-calculate the probability of selection into the sample and hence the raising factor variable. Therefore, these estimates of the total grade 6 population in each country should be more accurate than official administrative data, which are typically used to calculate Gross

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Enrolment Ratios and the like. It is possible to inflate any subgroup within the SACMEQ sample to the estimated population total of enrolled grade 6 pupils for that subgroup. For example, one can calculate and compare the estimated total number of functionally literate grade 6 pupils in a country in 2000 with that in 2007.

Because of population growth, however, it is possible that a country may have had more functionally literate grade 6 pupils in 2007 than in 2000 even though the proportion of children in the population that were functionally literate declined. To adjust for this, the United Nations (2012) medium variant population estimates for 10 - 14 year olds were used to calculate an appropriate population growth deflator so as to make the total number of grade 6 students in 2007 comparable with that in 2000. Under the assumption that population growth was not significantly correlated with the likelihood of being enrolled, the population growth deflator was multiplied by the total number of functionally literate (numerate) children in 2007 to obtain an adjusted number of grade 6 pupils reaching basic literacy (numeracy) in 2007. This process is analogous to adjusting for inflation.

The disadvantages of using this alternative method include concerns around the quality and comparability of administrative data on enrolments across countries and time, the need to incorporate population growth estimates, which opens up another possible source of measurement error, and the sensitivity of the method to changing rates of grade repetition. The SACMEQ data indicate that in 2007 there were generally lower rates of grade repetition than in 2000. Since grade repetition leads to a type of “double-counting”, declining grade repetition should have a diminishing effect on the number of grade 6 enrolments.

The estimated numbers of functionally literate (and numerate) grade 6 children and the UN medium variant population estimates (as well as the formulas applied to calculate country-specific deflators) are reported in Appendix D1. Column J in Tables A1 (literacy) and A2 (numeracy) report the ratio of the number reaching basic literacy (or numeracy) in 2007 to the number reaching basic literacy (or numeracy) in 2000. In all countries, for both literacy and numeracy, the ratios were greater than one, indicating that access-to-learning also improved between 2000 and 2007 using this alternative method. Although these ratios differ somewhat from those reported in the rest of the chapter (based on household survey data), this sensitivity analysis confirms the broad pattern that access to learning improved over the period of expanded school participation between 2000 and 2007.

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5.4.4 CHANGES IN SOCIAL COMPOSITION

The household data analysed in this paper confirm that children from poor households are less likely to complete grade 6 than more affluent children. Therefore, as access is expanded one would expect the social composition of schools to reflect a larger proportion of children of lower socio-economic status. Table 28 provides an indication of the changing social composition amongst grade 6 pupils in 2000 and 2007, using mother's educational attainment as a proxy for socio-economic status.

TABLE 28: PROPORTION OF MOTHERS WITH AT LEAST COMPLETE SECONDARY EDUCATION (SACMEQ)

Country	2000	*SE*	2007	*SE*	Percentage increase
Kenya	35.06	*0.02*	30.64	*0.02*	-12.60
Lesotho	19.49	*0.02*	23.46	*0.01*	20.34
Malawi	13.94	*0.02*	10.25	*0.01*	-26.46
Mozambique	13.23	*0.01*	7.61	*0.01*	-42.46
Namibia	34.74	*0.02*	33.46	*0.01*	-3.67
South Africa	42.77	*0.02*	42.99	*0.01*	0.51
Swaziland	31.67	*0.02*	38.55	*0.02*	21.74
Tanzania	17.74	*0.02*	7.33	*0.01*	-58.67
Uganda	21.09	*0.02*	14.87	*0.01*	-29.52
Zambia	31.57	*0.02*	19.51	*0.01*	-38.20

Table 28 shows that in most countries where grade 6 completion rates had increased over the period the proportion of grade 6 pupils whose mother had completed secondary school declined between 2000 and 2007. One would generally expect that the proportion of mothers in the overall population (i.e. irrespective of whether their children reach grade 6) with at least complete secondary education would be increasing over time due to historical expansions in access to schooling. Therefore, the fact that in most countries the proportion of pupils whose mothers had completed secondary education declined can be taken to reflect the changing social composition due to increased access to primary schooling. In some countries the changing social composition according to this measure was substantial (Mozambique, Tanzania, Zambia). In Lesotho and Swaziland, the proportion of pupils whose

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mothers had completed secondary school actually increased. This is a bit unexpected given that the grade 6 completion rate increased over the period, but it may reflect sizable historical increases in secondary school completion.

The changing social composition is likely to have had a direct negative effect on country average test scores since poorer children tend to achieve lower test scores. However, there may also have been an indirect effect of the changing social composition through peer effects – pupils in 2007 perform worse than similar children in 2000 because of a weaker peer group.

5.4.5 School resources

One of the main reasons why one might expect a trade-off between access and school performance is the stretch on resources as more students enter the system. Table 29 describes the state of selected school inputs in 2000 and in 2007. Pupil-teacher ratios increased in most of the countries in which substantial expansions occurred (Kenya, Malawi, Mozambique, Tanzania and Zambia). The same countries also experienced increases in the ratio of pupils to physical classrooms. There was no clear pattern with respect to changes in access to reading textbooks, with some countries improving access to textbooks and others going backwards.[65] In no countries were there substantial increases in parent financial contributions and in some countries there were noticeable declines (Kenya, Lesotho, Tanzania and Zambia).[66] This is what one might expect to observe in a context of fee abolitions and increasing participation of children with parents of low socio-economic status. Apart from the effect on school budgets and resources, declining parental contributions may be expected to reduce local accountability. Teacher content knowledge, as measured by detailed tests taken by grade 6 teachers, declined on average in Kenya (although Kenya remained the top-performer on this measure), Mozambique and Zambia, and increased in Namibia, Tanzania and Uganda.

[65] Good access to textbooks was defined as either each child has a textbook or children share a textbook with at most one other child.

[66] A summative index was generated based on 14 questions in the school principal questionnaires about whether parents contribute in various ways, including helping with building maintenance, purchasing of stationary and paying examination fees.

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TABLE 29: SELECTED SCHOOL INPUTS IN 2000 AND 2007

	Pupil teacher ratio		Pupils per classroom		Access to reading textbooks		Parent financial contributions		Mathematics teacher content knowledge	
Country	**2000**	**2007**	**2000**	**2007**	**2000**	**2007**	**2000**	**2007**	**2000**	**2007**
Kenya	33.36	42.85	46.98	63.51	51.11	39.28	9.00	4.50	968.52	906.05
Lesotho	53.85	41.80	84.15	60.23	71.57	75.37	8.64	3.70	739.38	738.79
Malawi	69.97	87.96	146.86	160.26	71.67	36.60	3.52	4.18	776.03	762.42
Mozambique	51.32	57.99	157.98	189.95	73.37	66.91	2.65	2.46	782.79	745.57
Namibia	31.47	31.08	50.77	40.16	76.73	63.25	4.03	4.92	734.83	771.13
South Africa	36.53	34.33	47.20	50.45	66.25	73.17	5.11	4.54	-	763.62
Swaziland	35.11	34.24	40.90	41.82	90.12	99.38	8.91	8.36	808.06	811.10
Tanzania	47.06	62.86	96.30	100.15	15.89	13.19	5.70	4.06	794.29	825.79
Uganda	57.98	55.67	132.72	114.14	26.60	31.97	4.18	4.39	822.88	833.27
Zambia	53.71	74.52	81.05	97.94	41.76	43.45	6.25	4.81	759.12	740.39

Any strong conclusions about what successful countries did to manage expansions in access without large quality deteriorations based on only ten countries would be tenuous. A much closer analysis would be required. However, there are one or two broad points worth noting from Table 29. In Kenya and Tanzania – two of the top-performing countries in the sample and both having experienced increases in grade 6 completion – pupil-teacher ratios and pupil-to-classroom ratios increased considerably but the quality of teachers, as measured by content knowledge, remained at a high level compared with other countries. This is consistent with Mingat's (1998) argument that Asian countries that successfully managed to expand access and quality placed more emphasis on teacher quality (as reflected in teacher remuneration) than on pupil-teacher ratios. These observations are at least consistent with one of the main findings from the education production function literature, namely that additional resources are no guarantee of better outcomes, but rather that aspects of teacher quality, teacher motivation and school management are likely to be the important drivers of school performance (Hanushek, 2003; Van der Berg, 2008).

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Figure 33 provides a crude assessment of how children of similar socio-economic status performed in 2000 and in 2007. Mother's education is again used as a proxy for socio-economic status. The figure shows that some countries (Kenya, Malawi, South Africa, Uganda and Zambia) achieved similar levels of reading achievement in 2000 and in 2007 at given levels of mother's education. Other countries (Lesotho, Swaziland and Tanzania) actually achieved higher reading scores in 2007 at given levels of mother's education. Namibia achieved considerably higher reading achievement in 2007, controlling for mother's education, but this was not in the context of a substantial change in grade 6 completion. Only in Mozambique was there a decline in reading achievement for children with the same mother's education. This is in line with Crouch's (2011) conclusion that changes in social composition cannot fully explain Mozambique's decline in average achievement. It should also be mentioned that holding mother's education constant does not adequately control for socio-economic differences between grade 6 pupils in 2000 and 2007. This is because, even amongst children with the same maternal education, there are likely to be unobserved differences in socio-economic status and parental support of education, that would systematically be educationally less favourable amongst those in 2007 (since more children were enrolled in this year). Therefore, the finding that in most countries test scores were no worse in 2007, holding mother's education constant, is conservatively made.

A broad interpretation of Figure 33 thus points to the following conclusion: Either the combined effects of negative peer group influences and resource constraints were small or they were offset by other positive educational factors, such as improved policies, school management and instructional practice.

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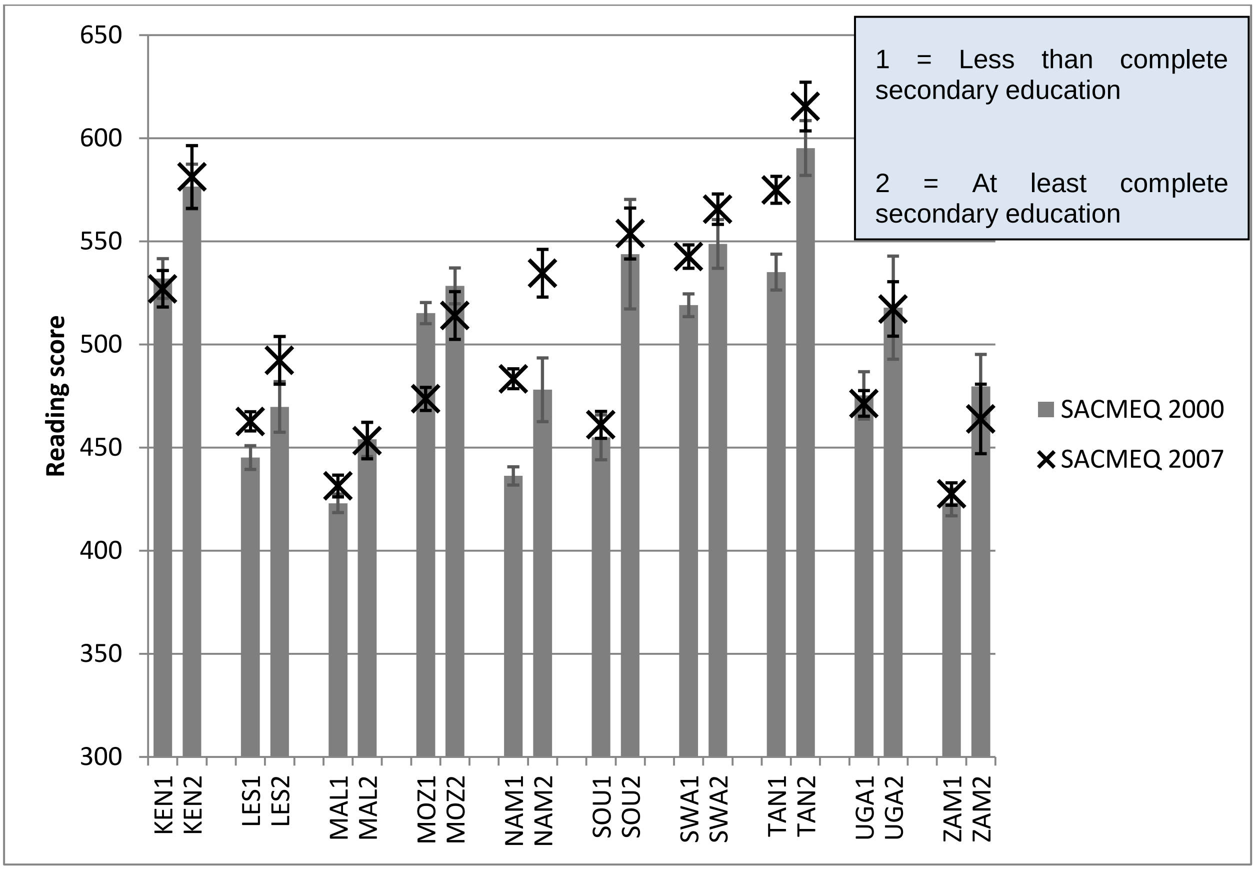
FIGURE 33: MEAN READING ACHIEVEMENT BY MOTHER'S EDUCATION IN 2000 AND 2007 (WITH 95% CONFIDENCE INTERVALS)



5.5 CONCLUSION

Viewing country average test scores or enrolment rates in isolation is misleading, particularly when evaluating trends over time. A decline in a country average score does not necessarily reflect deterioration in the education system. In order to meaningfully assess education system performance in countries with incomplete (or changing) access to education it is imperative to use a combined measure of access and quality. In this chapter it was argued that education system performance should be re-conceptualized and measured as the amount of learning that takes place in the overall population of children (those enrolled and those not enrolled).

Using a new measure of “access to learning” – the proportion of children who reach a particular grade and have acquired specific learning outcomes – it was shown that the expansion of access to primary schooling in Southern and Eastern Africa since 2000 contributed to improved access to literacy and numeracy in these countries. In particular, girls and those in relatively poor households benefited most from this improvement in access

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to literacy and numeracy. Not only did access to basic literacy and numeracy improve, but so did access to higher order literacy and numeracy learning. The improvements in access to learning at the grade 6 level were also accompanied by increased attainment of higher levels of schooling, as measured by grade 9 completion rates. The results are robust to an alternative method for measuring access to learning that uses administrative data on school enrolments rather than household survey data.

The analysis presented here illustrates the general principle that a downward shift in the distribution of test scores (amongst those enrolled) can be completely congruent with improved access to learning (in the overall population). Having noted this, there may well be merit in retaining some focus on the average quality of achievement within particular schools. The new measure proposed in this paper should therefore be seen as a complement to existing measures of quality rather than as a substitute.

This main contribution of this analysis is limited to describing access to learning between 2000 and 2007. The paper does not separate out the "value-added" by teachers and schools from the influence of peers; nor does it measure the causal effect of an expansion on children who would otherwise have been enrolled in the absence of an expansion.

As countries approach universal primary education a similar challenge is bound to emerge around the expansion of access to secondary and pre-school education. While these expansions may have their own unique challenges, this paper has shown that simply increasing the opportunity to learn through school attendance is likely to lead to a superior production of human capital in the overall population.

Despite these large gains through expanded access, the key challenge going forward is to improve the quality of schooling in these countries. The participation of some Southern African countries in PIRLS and TIMSS, interpreted in combination with the SACMEQ assessments, has indicated that most countries in the region are performing far below developed country standards and some perform significantly worse than otherwise similar developing countries. Raising the quality of primary schooling in these countries may now be the most important component in improving access to secondary and tertiary education, and consequently, improving the economic prospects and social development of these countries.

By describing what actually happened in Southern and Eastern Africa between 2000 and 2007, this chapter has shown that the perception of an access-quality trade-off may not have as much empirical support as was previously thought. Indeed, it was found that the

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substantial expansions of access to primary education since 2000 did not reduce education system effectiveness, when properly defined, but rather facilitated a greater proportion of children enjoying access to learning.

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CHAPTER 6: CONCLUSION

The research presented in this thesis began with the specific case of South Africa and then moved toward the generalized case of Sub-Saharan Africa. The aim in doing so was to show in as vivid terms as possible, that access to education alone is not enough. South Africa is a middle-income country with almost universal primary school completion, comparatively high grade-attainment and significant government expenditures on education. Yet, in spite of this, educational outcomes are abysmal. Most countries in Sub-Saharan Africa have not yet reached universal primary school enrolment or completion, but they are well on their way to doing so (Pritchett, 2013). However, without an appropriate focus on the quality of education that is being provided at these buildings we call 'schools', we are likely to see many more examples like South Africa on the rest of the continent. While it is true that the idea of a strong access-quality trade-off has less empirical support than was previously believed to be the case, this does not mean that the quality of education in Sub-Saharan Africa should receive less attention in the coming decades. If anything the focus on quality needs to move to the front and centre. Educational outcomes in Sub-Saharan Africa are still exceedingly low when compared to developing countries around the world. In a rapidly globalizing and increasingly knowledge-based world, the skills and education of a country are of paramount importance for sustained prosperity. Equally as important, citizens in Sub-Saharan Africa deserve as much as anyone else the meaningful opportunities that would allow for the free unfolding of their personalities and the full exploration of their talents.

6.1 SUMMARY OF MAIN FINDINGS

The scope of the research presented in this thesis is large, ranging from the impact of language, the size of mathematical learning deficits and the interplay between access and quality in 11 Sub-Saharan African countries. Consequently, it is perhaps helpful to summarise the main findings presented in this thesis and explain how they contribute to the economic and education literatures.

6.1.1 Education quality in South Africa: Inequality, language and learning deficits

- Chapter 1: Inequality: Given the country's colonial and apartheid history, South Africa is an extremely unequal country. This inequality is reflected in - and propagated by - the education system. Apartheid policies discriminated along multiple criteria and consequently the inequalities found in education can still be seen along any of these dimensions: race, geographic location, language, province and former educational department. It was argued that in South Africa we have two public schooling systems

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not one. The lower tier system consists of approximately 75-80% of students attending largely dysfunctional schools with the upper tier of the system consisting of approximately 20-25% of students attending mostly functional schools. Because there are two data generating processes at play – one in each system, if one reports averages for the system as a whole this is uniquely misleading. Furthermore, conflating two systems that operate very differently to each other can lead to spurious results. The major contribution here was to collate existing studies (Fleisch, 2008; Shepherd, 2011; Spaull, 2013; S. Taylor, 2011) and show that the two schooling systems can be seen across numerous dimensions. Also to quantify how large the two systems are relative to each other and to do so on empirical grounds.

- Chapter 2: Learning deficits: Chapter 2 quantified a year's worth of mathematics learning in South Africa (0.3 standard deviations) and used this measure to develop empirically calibrated learning trajectories. This was made possible by using within-survey benchmarks and comparing actual and effective grades using three nationally representative surveys of educational achievement across grades 3, 4, 5, 6 and 9. Two main findings were, (1) only the top 16% of South African grade 3 children are performing at an appropriate Grade 3 level. (2) The learning gap between the poorest 60% of students and the wealthiest 20% of students is approximately three grade-levels in grade 3, growing to four to five grade-levels by grade 9. Quantifying learning deficits across multiple grades using numerous surveys adds further empirical support to a host of qualitative and small-scale studies that find similar results.
- Chapter 3: Language: The analysis presented in chapter 3 exploited an unusual occurrence whereby the same students were tested twice, one month apart, once in the LOLT of the school and once in English. Using a difference-in-difference approach it was possible to tease out the causal impact of language on performance in grade 3. The size of the composite effect of home-background and school-quality was found to be 1,6 to 3,9 times larger than the impact of writing a test in English (for non-English students) for literacy and at least 3,8 times larger for numeracy. To put this in terms of 'years worth of learning', if one uses 0,3 standard deviations as an approximation of one year of learning in South Africa (as per the discussion in Chapter 2), then the size of the 'language cost' is approximately one to two years worth of learning for literacy and one year for numeracy. By contrast, the size of the composite effect of home background and school quality is roughly four years worth of learning for both numeracy (1,2 standard deviations) and literacy (1,15 standard deviations). The data and methods used in this chapter allow for causal interpretations of the impact of language, something that is especially rare in the field

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of language and education. It also shows that while writing a test in English is costly for non-English students, this cannot explain the full extent of underperformance in South Africa, contrary to the conclusions of some language scholars.

6.1.2 Educational access and educational quality in Sub-Saharan Africa

Chapter 4: Access and quality: This chapter created a composite statistic of educational quantity and educational quality by combining household data (DHS) on grade completion and survey data (SACMEQ) on cognitive outcomes for 11 countries in Sub-Saharan Africa. It showed why various measures of access that have been used in the past (and particularly the assumptions made about progression and late completion) are inappropriate and potentially misleading. By using a cohort of 19-23 year olds it was possible to avoid these untrue assumptions. The composite statistic, termed access-to-literacy and access-to-numeracy, was reported for all countries and all sub-groups for 2007. It was found that learning deficits are considerably greater than access deficits in all of the 11 countries, and that late (or delayed) grade 6 completion is widespread in Sub-Saharan Africa. Large wealth differentials in access-to-literacy/numeracy (greater than 30 percentage points) exist in all countries except Zimbabwe, Kenya and Swaziland, and pro-boy gender differentials of around 10 percentage points were found in Malawi, Tanzania, and Zambia, rising to 15 percentage points in Mozambique. Lesotho shows an atypically large pro-girl trend in both access-to-literacy and access-to-numeracy rates, driven primarily by boys' lower rate of grade 6 completion, particularly for poor boys. Although access to literacy and numeracy rates were reported for all 11 countries for both periods, the aim was not to provide extended analysis on individual countries. The examples of Lesotho and Mozambique were included as case-study examples of how these composite statistics can shed new light on education in these countries. The chapter concluded by situating the analysis in the discussions around the post-2015 Millennium Development Goals and argued that the new goals should have an explicit 'quality element' to ensure that children receive meaningful learning opportunities rather than simply physical places in buildings called schools.

- Chapter 5: Access and quality over time: Using the method developed in chapter 4 this chapter showed how access-to-literacy and access-to-numeracy changed over the period 2000-2007, a period of substantial increase in access to schooling for many countries. In all 10 countries[67] there was an improvement in access to literacy and numeracy, challenging the widely held perception that there is always an access-

[67] Only 10 countries had test score data for both periods since Zimbabwe did not participate in SACMEQ 2000.

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quality trade-off in education. In particular, girls and those in relatively poor households benefited most from this improvement in access to literacy and numeracy. Furthermore, there was also greater access to higher order literacy and numeracy learning and improvements in higher grade attainment levels, as measured by grade 9 completion rates. The results were also shown to be robust to an alternative method for measuring access to learning that uses administrative data on school enrolments rather than household survey data. The chapter concluded by stressing that the quality of education needs to remain the focus of the discourse, but also that we need to look at what has actually happened in Africa before making conclusions about an access-quality trade-off.

The research presented in this thesis was deliberately inter-disciplinary in nature aiming to contribute to both the education and economic literatures. By using the methods of economics and the insights of education it was possible to expand our understanding of how and why learning does or does not happen in South Africa. Perhaps most importantly, this approach birthed a new way of looking at education system performance in Sub-Saharan Africa and indeed in any developing country with incomplete access or significant dropout. The relatively simple measures of access-to-literacy and access-to-numeracy developed in this thesis have displayed an amazing fecundity, providing new insight into the access-quality dynamics within and between countries in Sub-Saharan Africa. There is no reason why this method could not be applied to francophone West Africa (using PASEC[68] data) or Latin America (using SERCE[69] data) or any developing country with a reliable cross-national test of educational achievement and DHS or comparable household survey data. Similarly the method for calculating learning trajectories developed in Chapter 2 could easily be applied to other countries provided that they have multiple data sets of educational achievement across grades, as many developing countries do. This illustrates some of the scientific contributions and research potential of the methods and approaches developed in this thesis.

Education is arguably one of *the* most important generative mechanisms of economic growth and social development in a country. It is the centre-piece of human capital theory, the lynchpin of the capabilities approach, and rightfully occupies pride of place in discussions about equality of opportunity and the dignity of individuals. South Africa is the example par

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[68] PASEC stands for the *Programme d'Analyse des Systèmes Educatifs de la CONFEMEN* and is very similar to SACMEQ but is run in francophone West Africa.

[69] SERCE stands for *Segundo Estudio Regional Comparativo y Explicativo*, and is very similar to SACMEQ but is run in Latin America.

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excellence; hundreds of thousands of South Africa children attend dysfunctional schools that are unable or unwilling to teach students even the most basic cognitive skills that they should be acquiring in this formative phase of their lives. In the absence of such meaningful learning opportunities it is imperative to draw the distinction between access-to-schooling and access-to-learning. If one thinks of education as the process of refining consciousness it becomes clear that this will not occur unless that education is of sufficient quality. The underlying motivation behind most of the research presented here is this very topic, that there is a need to return to the fundamentals of why we care about education. We care about education because we care about learning. Schools gain their legitimacy by fulfilling the function for which we created them; to provide the knowledge, skills and values children need to flourish in society.

In sum, this thesis has intended to refocus the discussion on education in Africa by prioritizing educational quality. Looking at mathematical learning deficits in South Africa, as well as the language-dynamics and high levels of inequality in the country, it was argued that the education system is failing the majority of youth in South Africa. Moving beyond South Africa, the research presented in chapters 4 and 5 refocused the discussion on education system performance in Sub-Saharan Africa and placed educational outcomes at the centre of the discourse. If children are to realize their full potential, the expansion of physical access to schooling in the developing world must be accompanied by meaningful learning opportunities. The acquisition of knowledge, skills and values must be the central aim of educational expansion.

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Appendix A: Chapter 2

Achievement scores for various assessments (NSES using no-language items only) – constant standard deviation for a year of learning by grade

		NSES 2007/8/9						SACMEO 2007		TIMSS	
		Grade 3	*SE*	**Grade 4**	*SE*	**Grade 5**	*SE*	**Grade 6**	*SE*	**Gr9**	*SE*
Student wealth quintiles	Quintile 1	13.74	*0.039*	27.25	*0.039*	37.44	*0.044*	452.80	*4.14*	316	*5.7*
	Quintile 2	24.56	*0.040*	27.56	*0.039*	40.06	*0.044*	463.80	*3.15*	318	*3.6*
	Quintile 3	23.49	*0.040*	29.09	*0.041*	41.10	*0.047*	478.00	*3.42*	336	*4*
	Quintile 4	25.93	*0.046*	32.30	*0.045*	44.39	*0.052*	505.70	*5.14*	360	*5.6*
	Quintile 5	43.30	*0.064*	48.90	*0.066*	59.11	*0.062*	583.10	*6.56*	438	*9.7*
Province averages	ECA	26.34	*0.047*	29.83	*0.046*	42.55	*0.052*	468.77	*10.3*	316	
	FST	28.26	*0.072*	31.78	*0.069*	42.48	*0.068*	491.57	*10.1*	359	
	KZN	26.31	*0.047*	36.72	*0.045*	45.35	*0.048*	485.23	*8.22*	337	
	LMP	14.60	*0.040*	24.31	*0.045*	36.27	*0.053*	446.72	*5.3*	322	
	MPU	26.23	*0.074*	31.76	*0.071*	45.08	*0.074*	476.12	*8.2*	344	
	NCA	26.46	*0.142*	35.88	*0.134*	44.82	*0.158*	498.72	*10.8*	366	
	NWP	27.71	*0.077*	30.36	*0.076*	45.54	*0.086*	503.00	*13.1*	350	
	WCA	36.74	*0.089*	46.85	*0.081*	59.85	*0.079*	565.69	*12*	404	
Province averages excluding Q5	ECA	23.83	*0.046*	27.65	*0.043*	40.30	*0.050*	465.14	*9.8*		
	FST	21.82	*0.061*	26.92	*0.062*	38.41	*0.063*	471.74	*6.4*		
	KZN	23.66	*0.044*	33.52	*0.039*	42.23	*0.044*	465.88	*6.4*		
	LMP	14.17	*0.041*	24.06	*0.047*	35.39	*0.055*	441.45	*3.3*		
	MPU	22.29	*0.073*	28.55	*0.069*	41.33	*0.076*	460.89	*4.1*		
	NCA	20.83	*0.128*	32.68	*0.132*	39.72	*0.157*	473.00	*5*		
	NWP	22.71	*0.070*	25.76	*0.063*	41.09	*0.086*	462.11	*4.8*		
	WCA	24.49	*0.107*	39.02	*0.105*	54.31	*0.112*	518.53	*8.1*		
	National avg	25.85	*0.023*	32.74	*0.022*	44.34	*0.024*	494.84	*3.8*	352	*2.5*
	National SD	22.04		20.87		21.46		98.68		86	

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Number of years behind relative to Quintile 5 (benchmark) – constant standard deviation for a year of learning

		NSES 2007/8/9						SACMEQ		TIMSS	
		Grade 3	*SE*	**Grade 4**	*SE*	**Grade 5**	*SE*	**Grade 6**	*SE*	**Gr9**	*SE*
Student wealth quintiles	Quintile 1	4.7	*0.011*	3.4	*0.012*	3.4	*0.012*	4.4	*0.262*	4.7	*0.436*
	Quintile 2	3.0	*0.011*	3.4	*0.012*	3.0	*0.012*	4.0	*0.246*	4.7	*0.401*
	Quintile 3	3.1	*0.011*	3.1	*0.012*	2.9	*0.012*	3.6	*0.250*	4.0	*0.407*
	Quintile 4	2.8	*0.012*	2.6	*0.013*	2.3	*0.013*	2.6	*0.282*	3.0	*0.434*
	Quintile 5	0.0	*0.014*	0.0	*0.015*	0.0	*0.014*	0.0	*0.313*	0.0	*0.532*
Province averages	ECA	2.7	*0.012*	3.0	*0.013*	2.6	*0.013*	3.9	*0.412*	4.7	
	FST	2.4	*0.015*	2.7	*0.015*	2.6	*0.014*	3.1	*0.407*	3.1	
	KZN	2.7	*0.012*	1.9	*0.013*	2.2	*0.012*	3.3	*0.355*	3.9	
	LMP	4.6	*0.011*	3.9	*0.013*	3.6	*0.013*	4.6	*0.285*	4.5	
	MPU	2.7	*0.015*	2.7	*0.015*	2.2	*0.015*	3.6	*0.355*	3.6	
	NCA	2.7	*0.024*	2.1	*0.024*	2.3	*0.026*	2.9	*0.427*	2.8	
	NWP	2.5	*0.015*	2.9	*0.016*	2.2	*0.017*	2.7	*0.495*	3.4	
	WCA	1.0	*0.017*	0.3	*0.017*	-0.1	*0.016*	0.6	*0.462*	1.3	
Province averages excluding Q5	ECA	3.1	*0.012*	3.4	*0.013*	3.0	*0.012*	4.0	*0.398*		
	FST	3.4	*0.013*	3.5	*0.014*	3.3	*0.014*	3.8	*0.310*		
	KZN	3.1	*0.012*	2.4	*0.012*	2.7	*0.012*	4.0	*0.310*		
	LMP	4.6	*0.012*	3.9	*0.013*	3.8	*0.013*	4.8	*0.248*		
	MPU	3.3	*0.015*	3.2	*0.015*	2.8	*0.015*	4.1	*0.261*		
	NCA	3.6	*0.022*	2.6	*0.024*	3.1	*0.026*	3.7	*0.279*		
	NWP	3.3	*0.014*	3.7	*0.015*	2.9	*0.017*	4.1	*0.275*		
	WCA	3.0	*0.019*	1.6	*0.020*	0.8	*0.020*	2.2	*0.352*		
	National avg	2.8	*0.010*	2.6	*0.011*	2.3	*0.010*	3.0	*0.256*	3.3	

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Calculating effective grade by sub-group – constant standard deviation for a year of learning

		(NSES 2007/8/9)			**(SACMEQ 2007)**	**Projections**		**(TIMSS 2011)**	**Projections**		
		Gr3	**Gr4**	**Gr5**	**Gr6**	**Gr7**	**Gr8**	**Gr9**	**Gr10**	**Gr11**	**Gr12**
Student wealth quintiles	Quintile 1	-1.69	0.56	1.56	1.60			4.27			
	Quintile 2	0.02	0.61	1.98	1.97			4.35			
	Quintile 3	-0.14	0.86	2.14	2.45			5.05			
	Quintile 4	0.24	1.36	2.66	3.39			5.98			
	Quintile 5	3.00	4.00	5.00	6.00			9.00			
	Q1-4 Trajectory	-0.39	-0.39	-0.39	-0.39	-0.39	-0.39	4.91	4.91	4.91	4.91
	Q5 Trajectory	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00
Province averages	ECA	0.31	0.97	2.37	2.14			4.27			
	FST	0.61	1.28	2.36	2.91			5.94			
	KZN	0.30	2.07	2.81	2.69			5.09			
	LMP	-1.55	0.10	1.37	1.39			4.50			
	MPU	0.29	1.28	2.77	2.39			5.36			
	NCA	0.33	1.93	2.73	3.15			6.21			
	NWP	0.52	1.06	2.85	3.29			5.59			
	WCA	1.96	3.67	5.12	5.41			7.68			
Province averages excluding Q5	ECA	-0.09	0.63	2.01	2.02						
	FST	-0.41	0.51	1.71	2.24						
	KZN	-0.12	1.56	2.32	2.04						
	LMP	-1.62	0.06	1.23	1.22						
	MPU	-0.33	0.77	2.18	1.87						
	NCA	-0.57	1.43	1.92	2.28						
	NWP	-0.27	0.33	2.14	1.91						
	WCA	0.01	2.43	4.24	3.82						

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APPENDIX B: CHAPTER 3

Table B1: Grades 1 to 3 learners by home language majority within that school (Annual Survey of Schools 2011). Source: Gustafsson[70] (2013)

% of learners using the largest home language in grades 1 to 3	EC	FS	GP	KN	MP	NC	NW	WC	SA
100%	79	10	5	76	24	33	21	12	42
≥95%, <100%	4	26	6	7	10	29	29	34	13
≥90%, <95%	2	13	6	3	7	7	12	9	6
≥75%, <90%	5	24	13	7	17	14	15	14	11
≥50%, <75%	8	22	29	6	24	14	14	26	16
>0%, <50%	2	6	41	1	18	3	8	5	12
Total	100	100	100	100	100	100	100	100	100

Table B2: Provincial distribution of NSES sample and NSES-Systemic Evaluation matched sample

	NSES Sample (%)	NSES-Systemic Evaluation matched sample (%)
Western Cape	9,66	10,11
Eastern Cape	17,15	16,87
Northern Cape	6,91	5,29
Free State	8,7	8,41
KwaZulu-Natal	21,25	23,6
North West	7,57	9,23
Mpumalanga	14,98	12,9
Limpopo	13,78	13,58
Gauteng	-	-
Total (%)	100	100
Total (students)	13033	3402

[70] I am grateful to Martin Gustafsson who kindly shared with me his own language research on the Annual Survey of Schools.

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APPENDIX C: CHAPTER 4

SACMEQ Reading Competency Levels

Description of levels	Range on 500 point scale	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: (Hungi et al., 2010)

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SACMEQ Mathematics Competency Levels

Description of levels	Range on 500 point scale	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: (Hungi et al., 2010)

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APPENDIX D1: CHAPTER 5

Table A1

Calculating the population growth-adjusted ratios of functional literacy in 2007 to functional literacy in 2000

	A	B	C	D	E	F	G	H	I	J
	Number of grade 6 children Flit in 2000	**Number of grade 6 children Flit in 2007**	**Population of 10 -1 4 year-olds in 2000**	**Population of 10 -1 4 year-olds in 2005**	**Population of 10 -1 4 year-olds in 2010**	**Annual population growth rate (2005 - 2010)**	**Calculated estimate of 2007 population**	**Population Deflator (τ)**	**Deflated Number of grade 6 children Flit in 2007**	**Population growth adjusted ratio of Flit2007 : Flit2000**
Kenya	549857	685722	4283000	4387000	4821000	0.0190	4555703	0.064	642061	1.17
Lesotho	27425	35554	256000	265000	270000	0.0037	266989	0.043	34028	1.24
Malawi	88395	122846	1400000	1688000	1914000	0.0254	1775008	0.268	89940	1.02
Mozambique	114805	250581	2218000	2523000	2918000	0.0295	2674142	0.206	199048	1.73
Namibia	27360	41674	230000	258000	268000	0.0076	261954	0.139	35884	1.31
South Africa	622080	675350	5021000	4979000	4963000	-0.0006	4972594	-0.010	681861	1.10
Swaziland	24593	27639	158000	156000	149000	-0.0091	153161	-0.031	28486	1.16
Tanzania	450163	931624	4345000	4831000	5467000	0.0250	5076003	0.168	774888	1.72
Uganda	246078	487165	3181000	3752000	4392000	0.0320	3995974	0.256	362353	1.47
Zambia	85465	135219	1283000	1436000	1688000	0.0329	1531940	0.194	108982	1.28
Source	SACMEQ 2	SACMEQ 3	UN	UN	UN	-	-	-	-	-
Formula	-	-	-	-	-	$F_i = \left(\frac{E_i}{D_i}\right)^{0.2} - 1$	$G_i = D_i(1 + F_i)^2$	$H_i = \frac{G_i - C_i}{C_i}$	$I_i = B_i - B_i.H_i$	$J_i = \frac{I_i}{A_i} = \frac{\tau \sum LIT_{i,t+1}}{\sum LIT_{i,t}}$

Notes: The source of population growth rates was the United Nations Medium Variant Population Estimates (United Nations, 2012).. The letters in the formulas refer to the columns. 'Flit' stands for functionally literate.

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Table A2

Calculating the population growth-adjusted ratios of functional numeracy in 2007 to functional numeracy in 2000

	A	B	C	D	E	F	G	H	I	J
	Number of grade 6 children Fnum in 2000	**Number of grade 6 children Fnum in 2007**	**Population of 10 -1 4 year-olds in 2000**	**Population of 10 -1 4 year-olds in 2005**	**Population of 10 -1 4 year-olds in 2010**	**Annual population growth rate (2005 - 2010)**	**Calculated estimate of 2007 population**	**Population Deflator (τ)**	**Deflated Number of grade 6 children Fnum in 2007**	**Population growth adjusted ratio of Fnum2007 : Fnum2000**
Kenya	520192	662040	4283000	4387000	4821000	0.0190	4555703	0.064	619887	1.19
Lesotho	13325	26259	256000	265000	270000	0.0037	266989	0.043	25131	1.89
Malawi	41495	77816	1400000	1688000	1914000	0.0254	1775008	0.268	56972	1.37
Mozambiqu	106735	215352	2218000	2523000	2918000	0.0295	2674142	0.206	171064	1.60
Namibia	11744	25242	230000	258000	268000	0.0076	261954	0.139	21735	1.85
South Africa	437075	556346	5021000	4979000	4963000	-0.0006	4972594	-0.010	561710	1.29
Swaziland	19565	25646	158000	156000	149000	-0.0091	153161	-0.031	26431	1.35
Tanzania	366154	837643	4345000	4831000	5467000	0.0250	5076003	0.168	696718	1.90
Uganda	203222	375081	3181000	3752000	4392000	0.0320	3995974	0.256	278985	1.37
Zambia	47870	79704	1283000	1436000	1688000	0.0329	1531940	0.194	64239	1.34
Source	SACMEQ 2	SACMEQ 3	UN	UN	UN	-	-	-	-	-
Formula	-	-	-	-	-	$F_i = \left(\frac{E_i}{D_i}\right)^{0.2} - 1$	$G_i = D_i(1 + F_i)^2$	$H_i = \frac{G_i - C_i}{C_i}$	$I_i = B_i - B_i.H_i$	$J_i = \frac{I_i}{A_i} = \frac{\tau \sum NUM_{i,t+1}}{\sum NUM_{i,t}}$

Notes: The source of population growth rates was the United Nations Medium Variant Population Estimates (United Nations, 2012). The letters in the formulas refer to the columns. 'Fnum' stands for functionally numerate.

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Appendix D2: Chapter 5 cont.

D2.1 Enrolment profiles by age circa 2003 for countries and sub-groups

For the graphs below the following labelling abbreviations are used:

- National = 'national'
- Males = 'boys'
- Females = 'girls'

- Poorest 40% of students = 'sespoor'
- Middle 40% of students = 'sesmid'
- Richest 20% of students = 'sesrich'

- Poorest 40% of male students = 'Msespoor'
- Middle 40% of male students = 'Msesmid'
- Richest 20% of male students = 'Msesrich'

- Poorest 40% of female students = 'Fsespoor'
- Middle 40% of female students = 'Fsesmid'
- Richest 20% of female students = 'Fsesrich'

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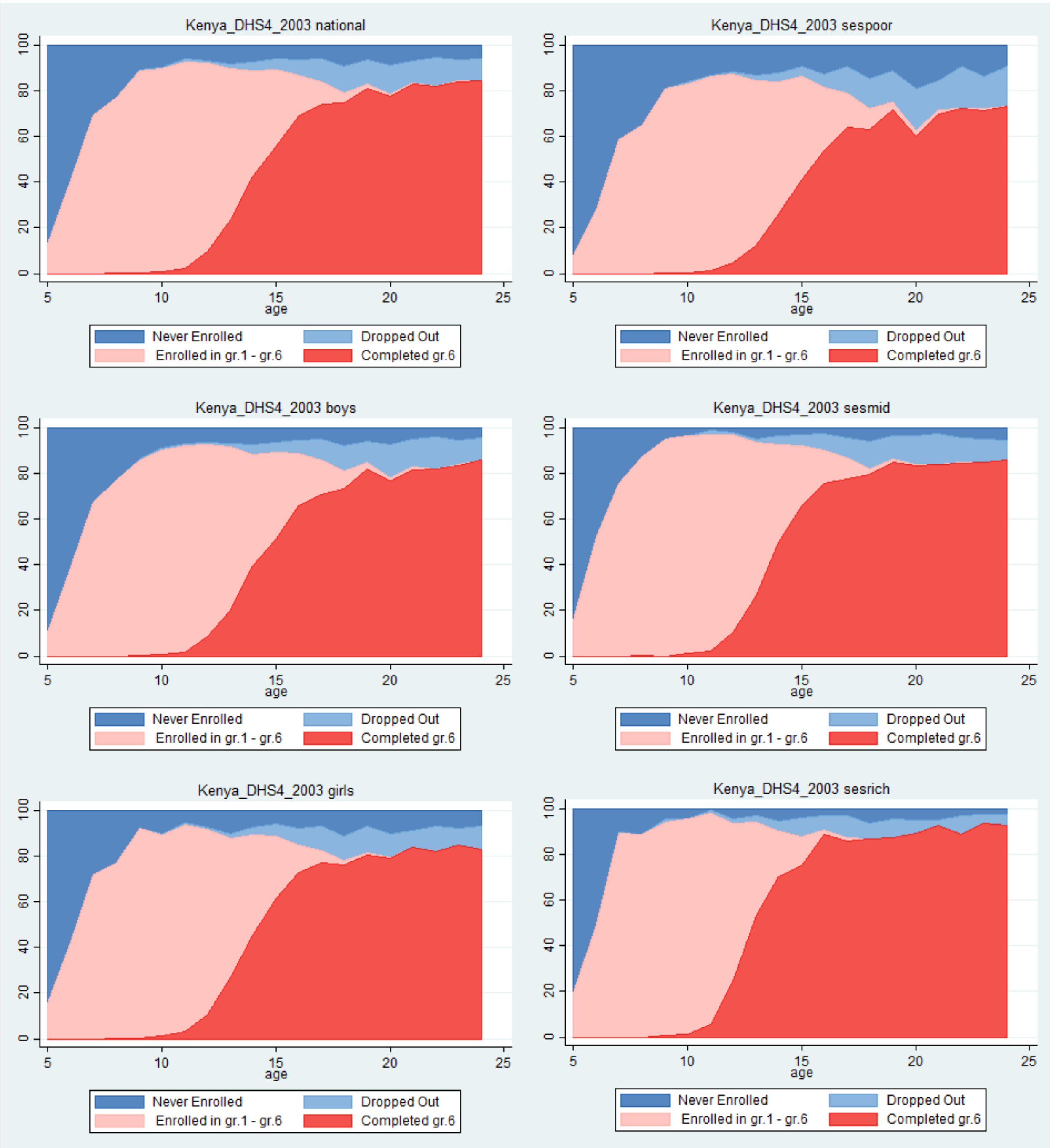
Kenya 2003



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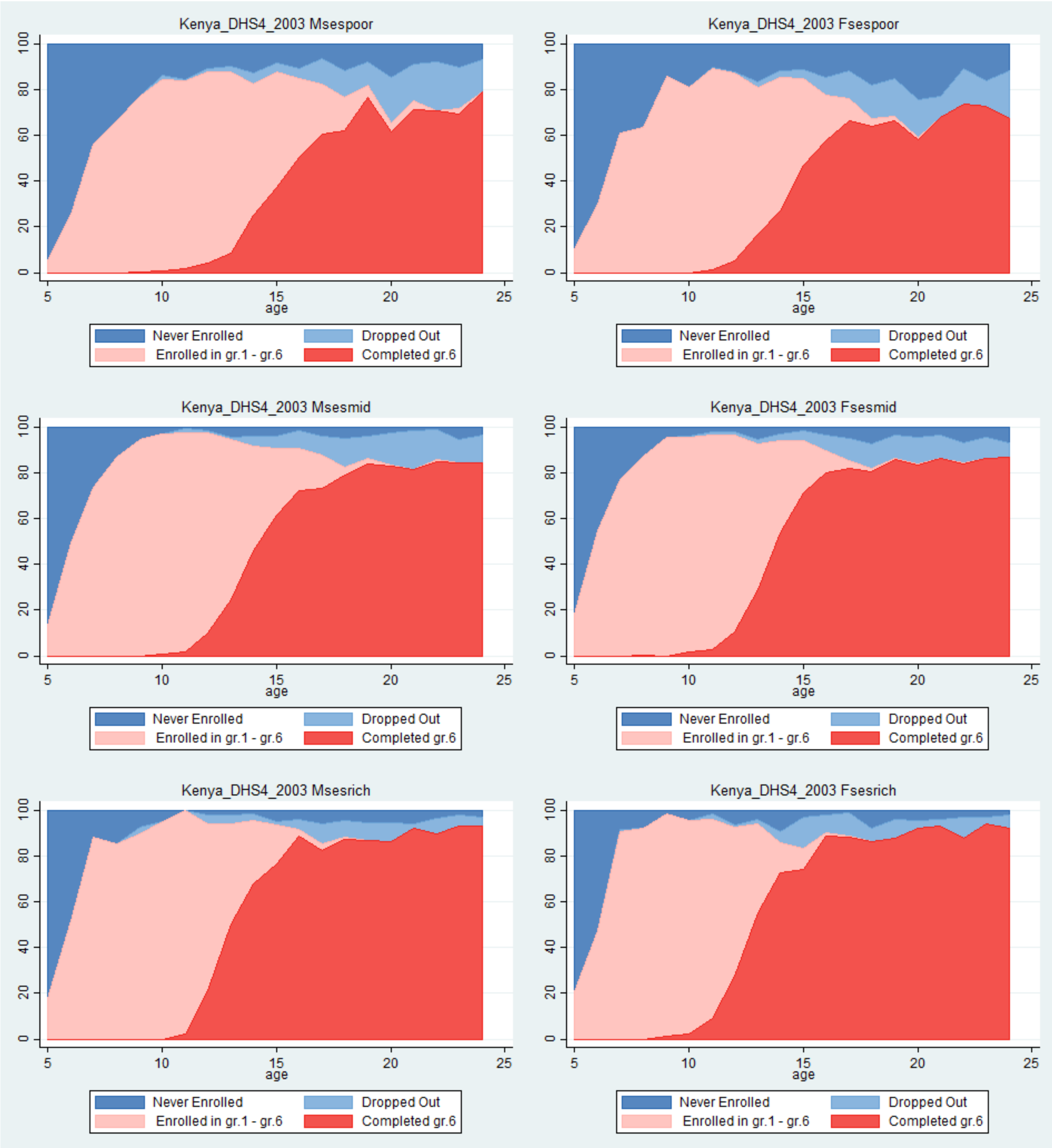
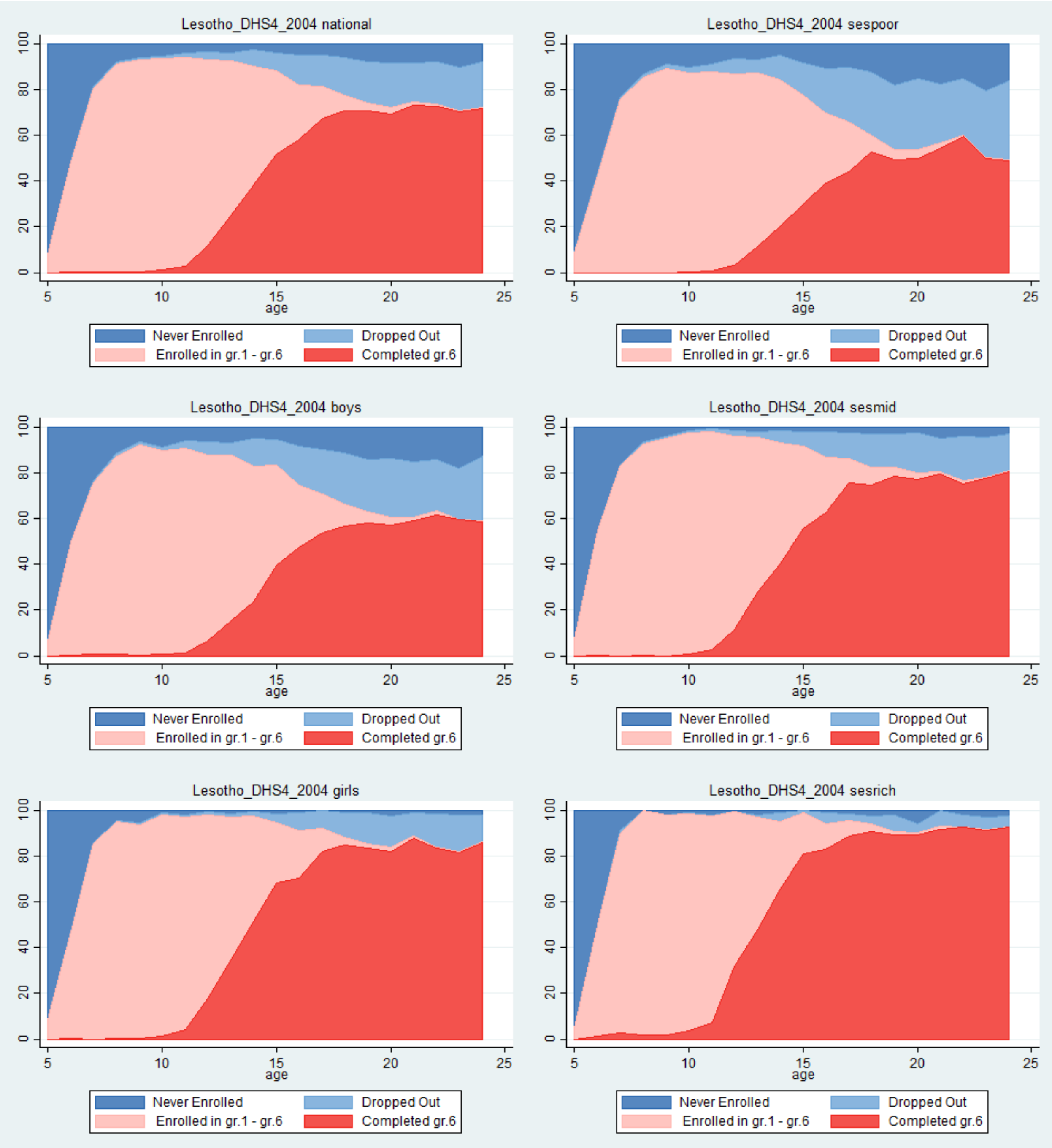
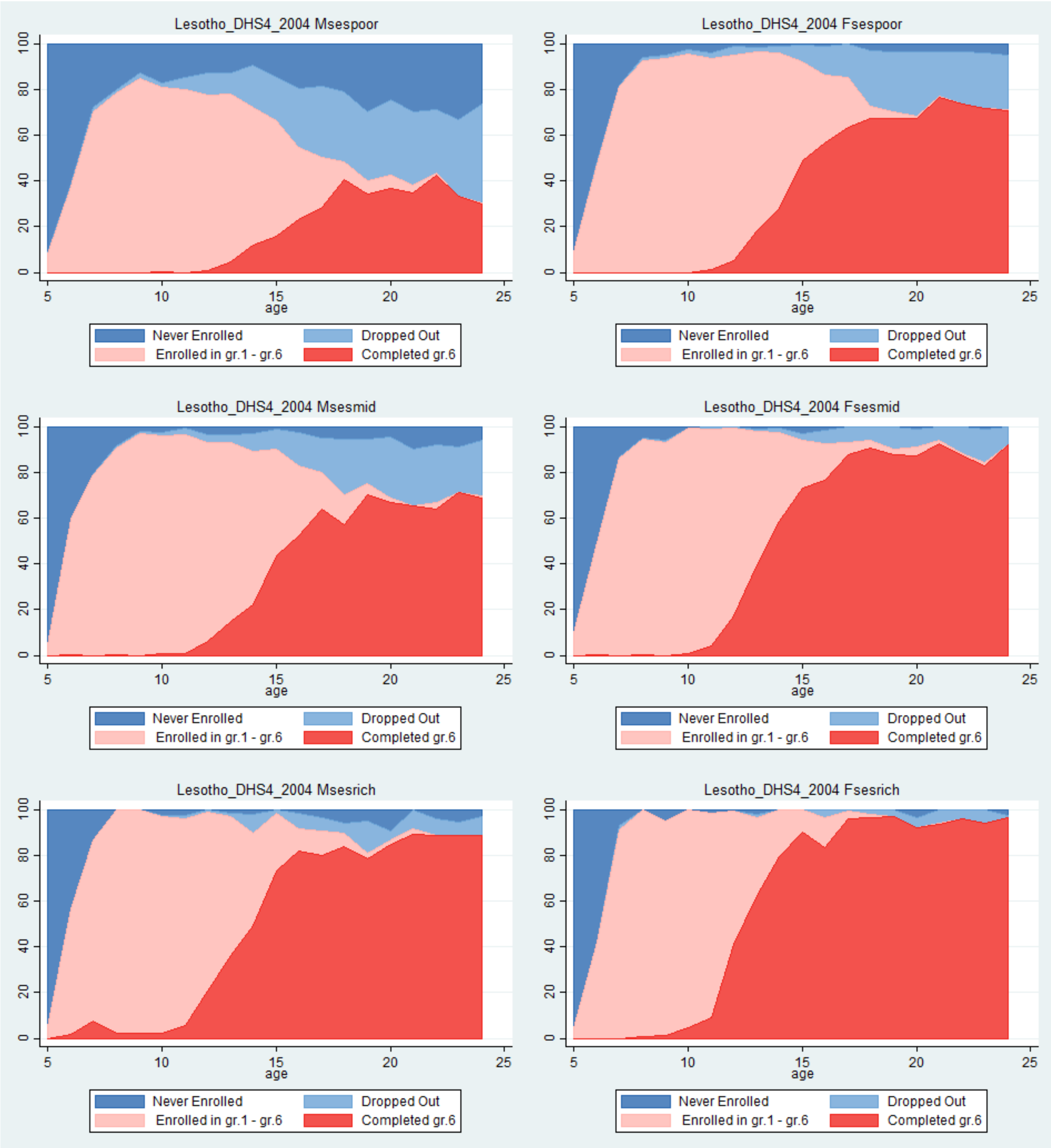


Stellenbosch University https://scholar.sun.ac.za

Lesotho 2004



Stellenbosch University https://scholar.sun.ac.za



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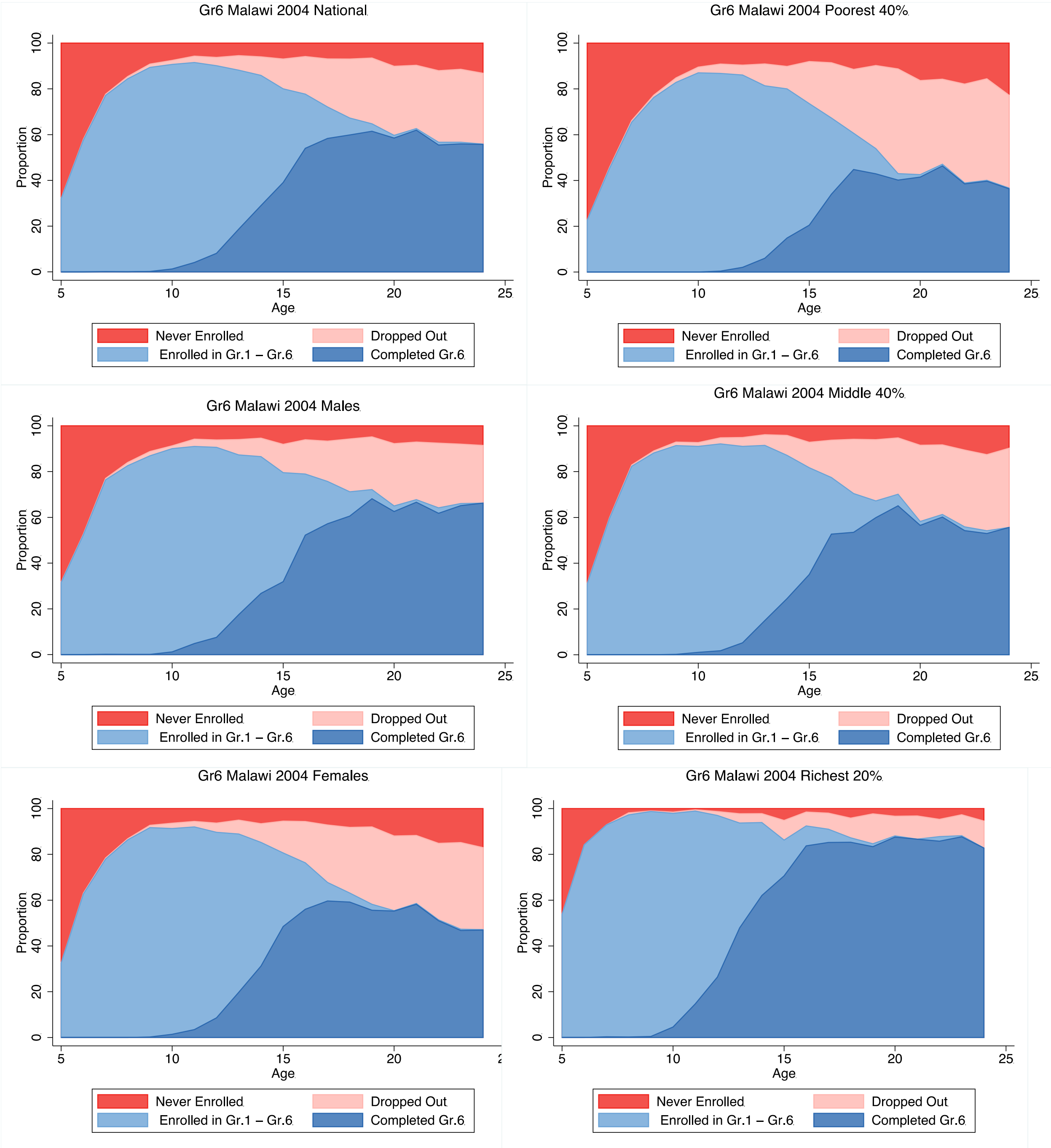
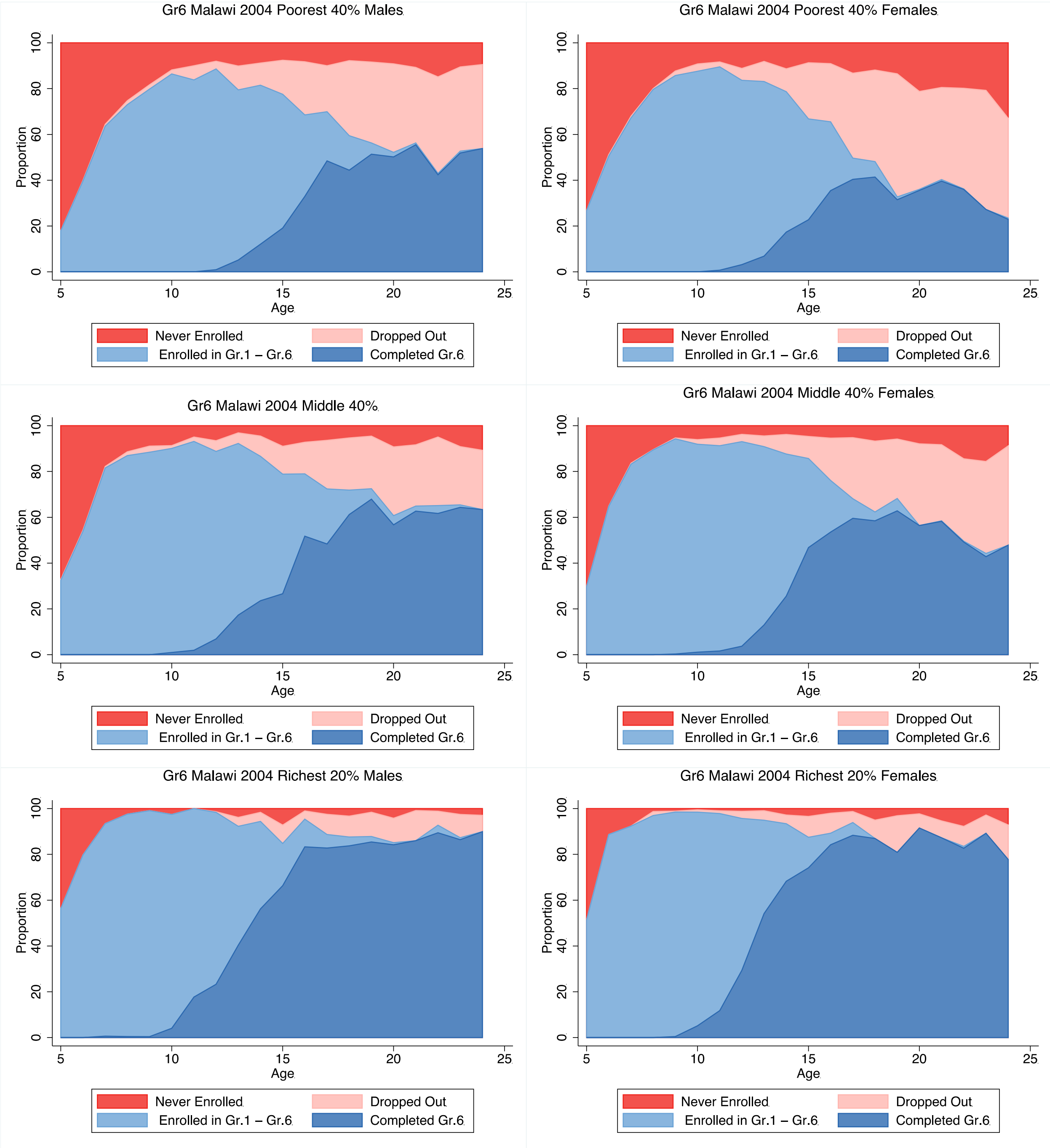
Malawi 2004



Stellenbosch University https://scholar.sun.ac.za



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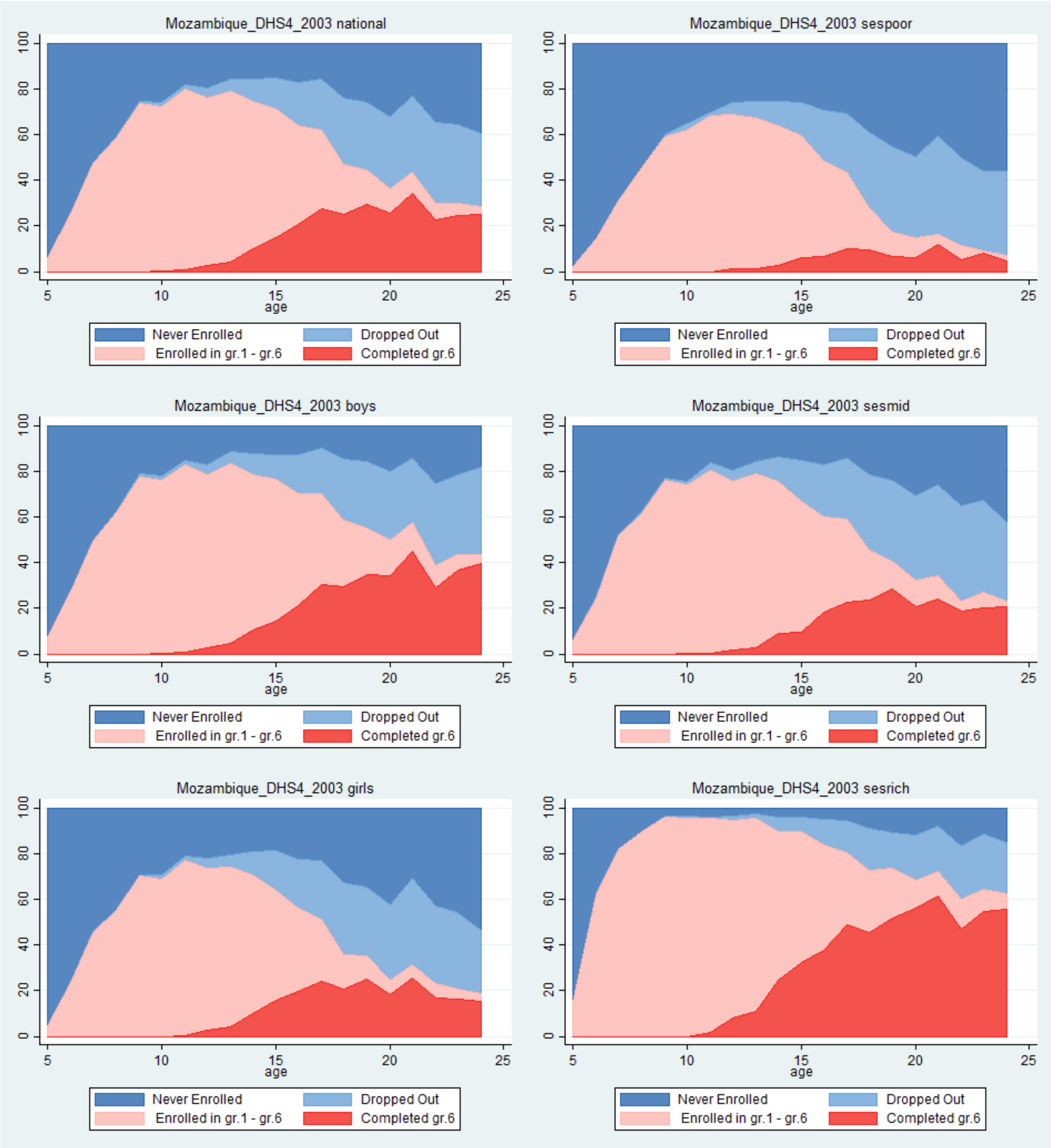
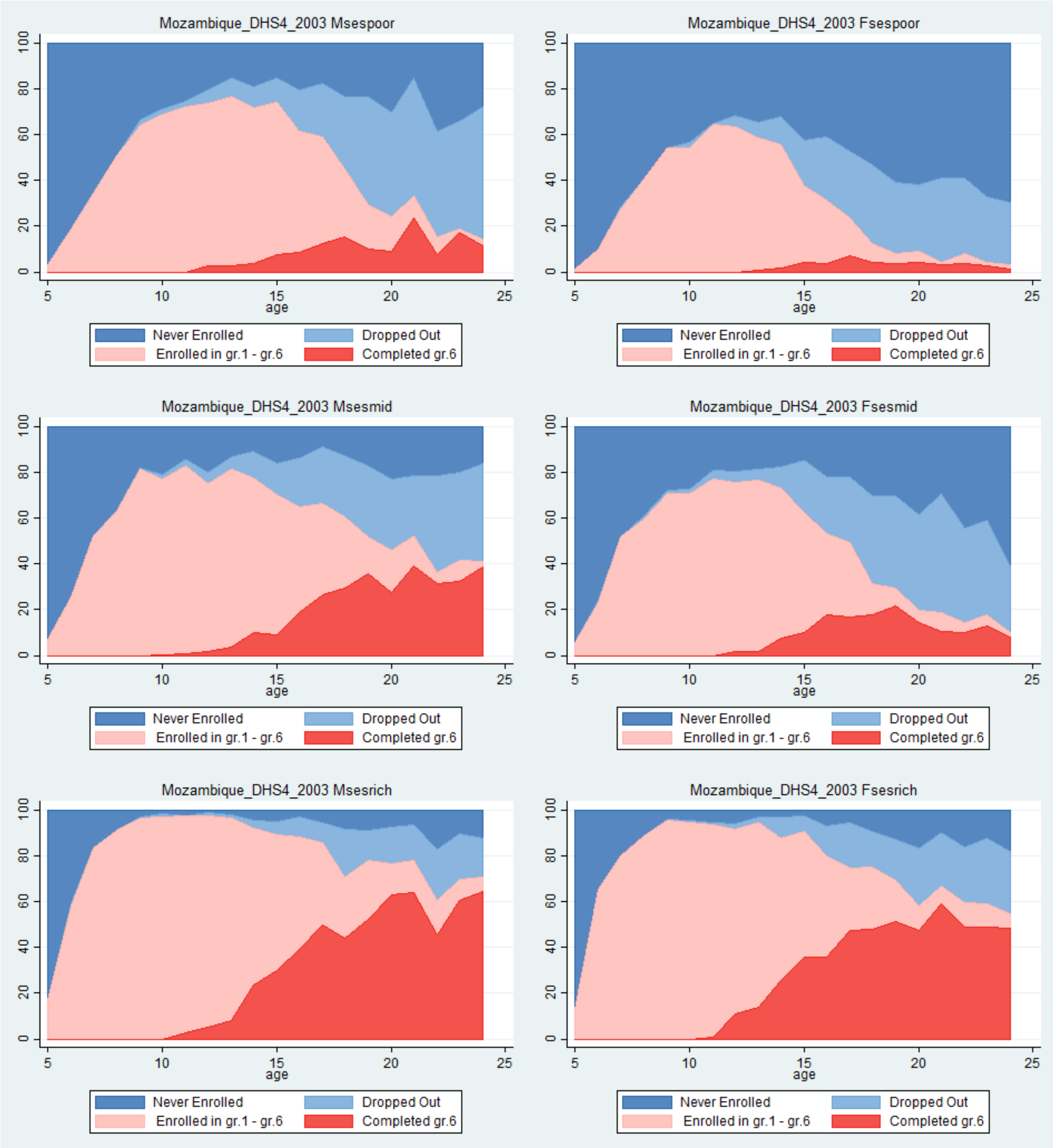
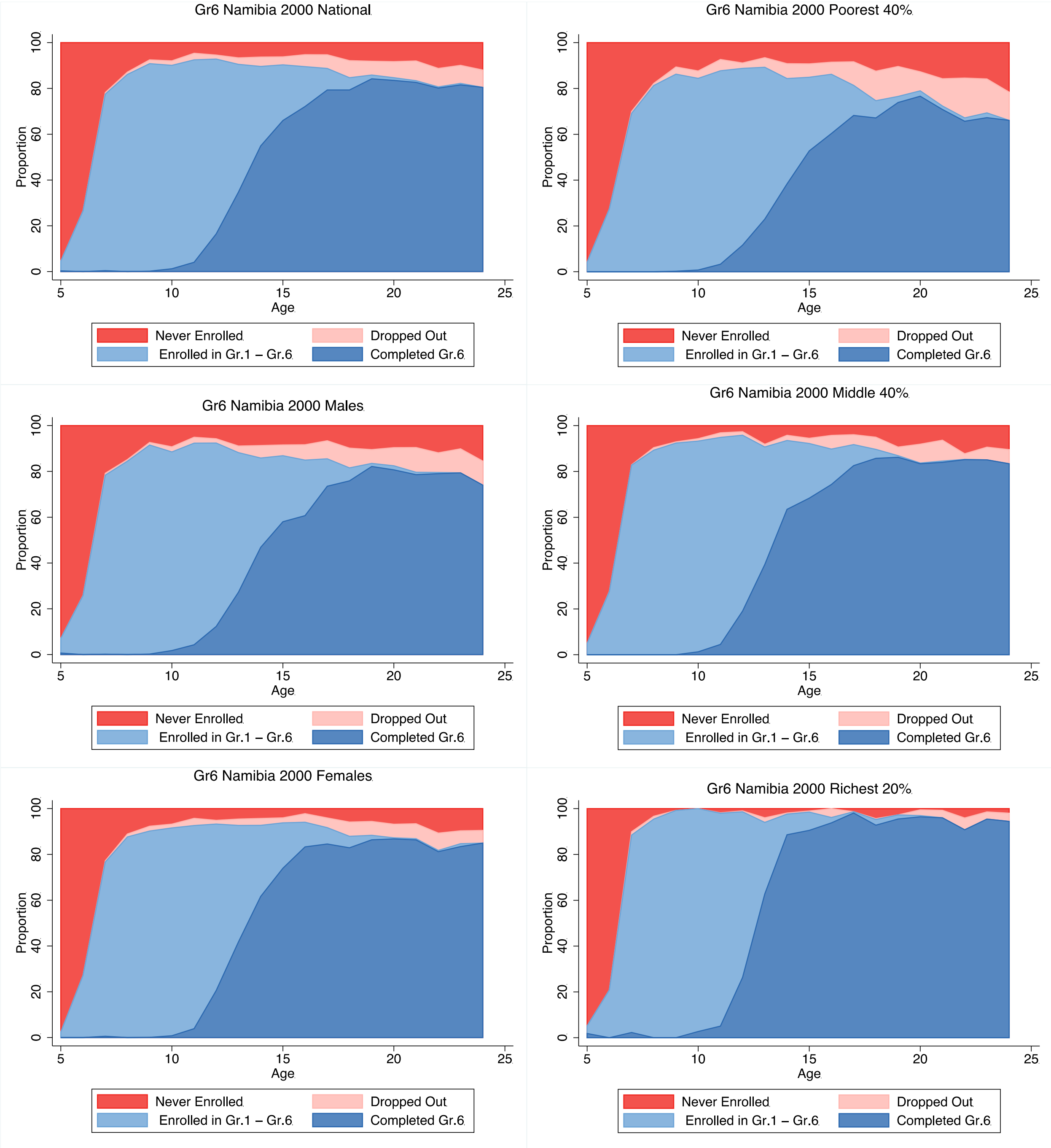
Mozambique 2003



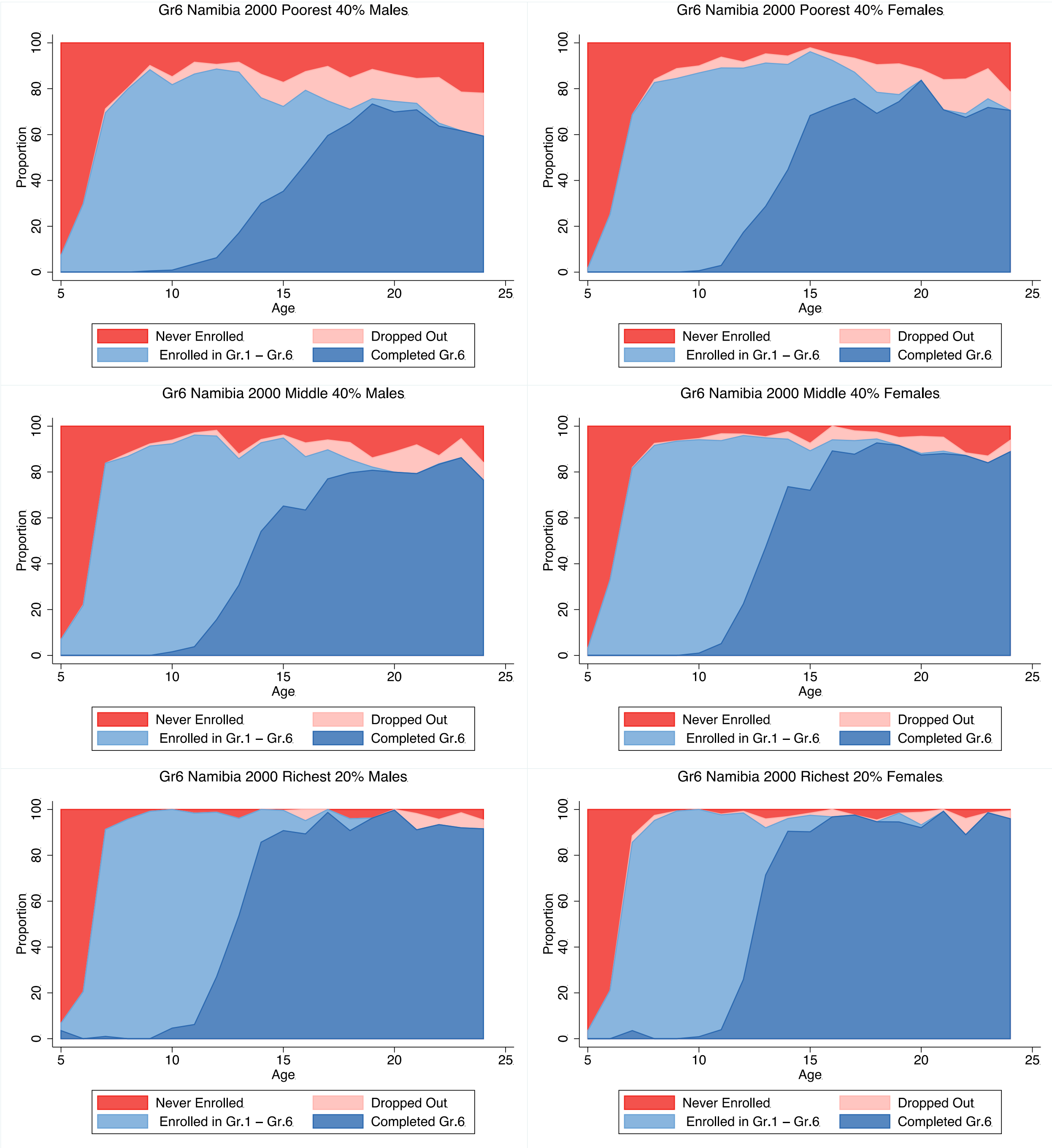
Stellenbosch University https://scholar.sun.ac.za



Namibia 2000



Stellenbosch University https://scholar.sun.ac.za



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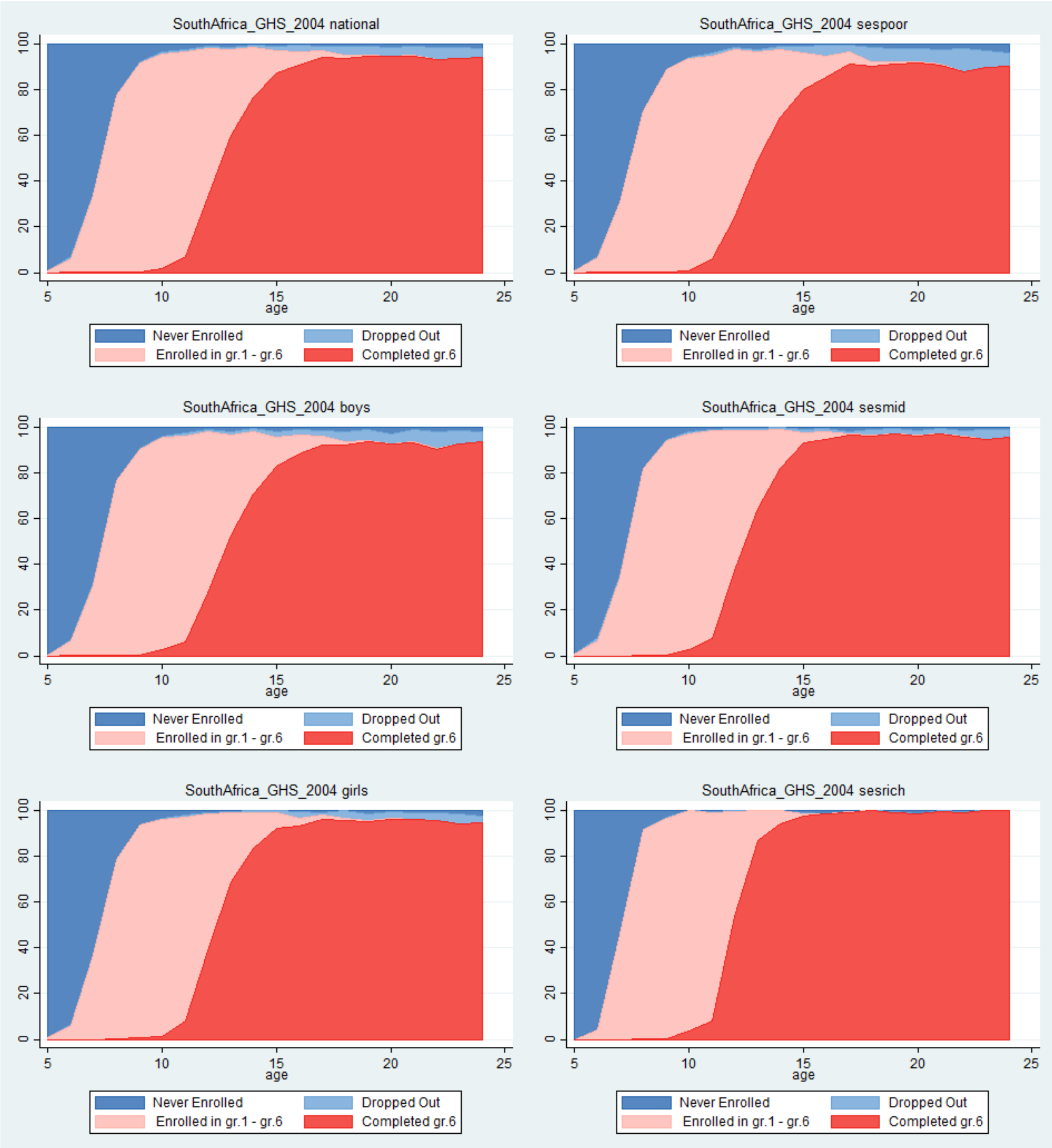
South Africa 2004



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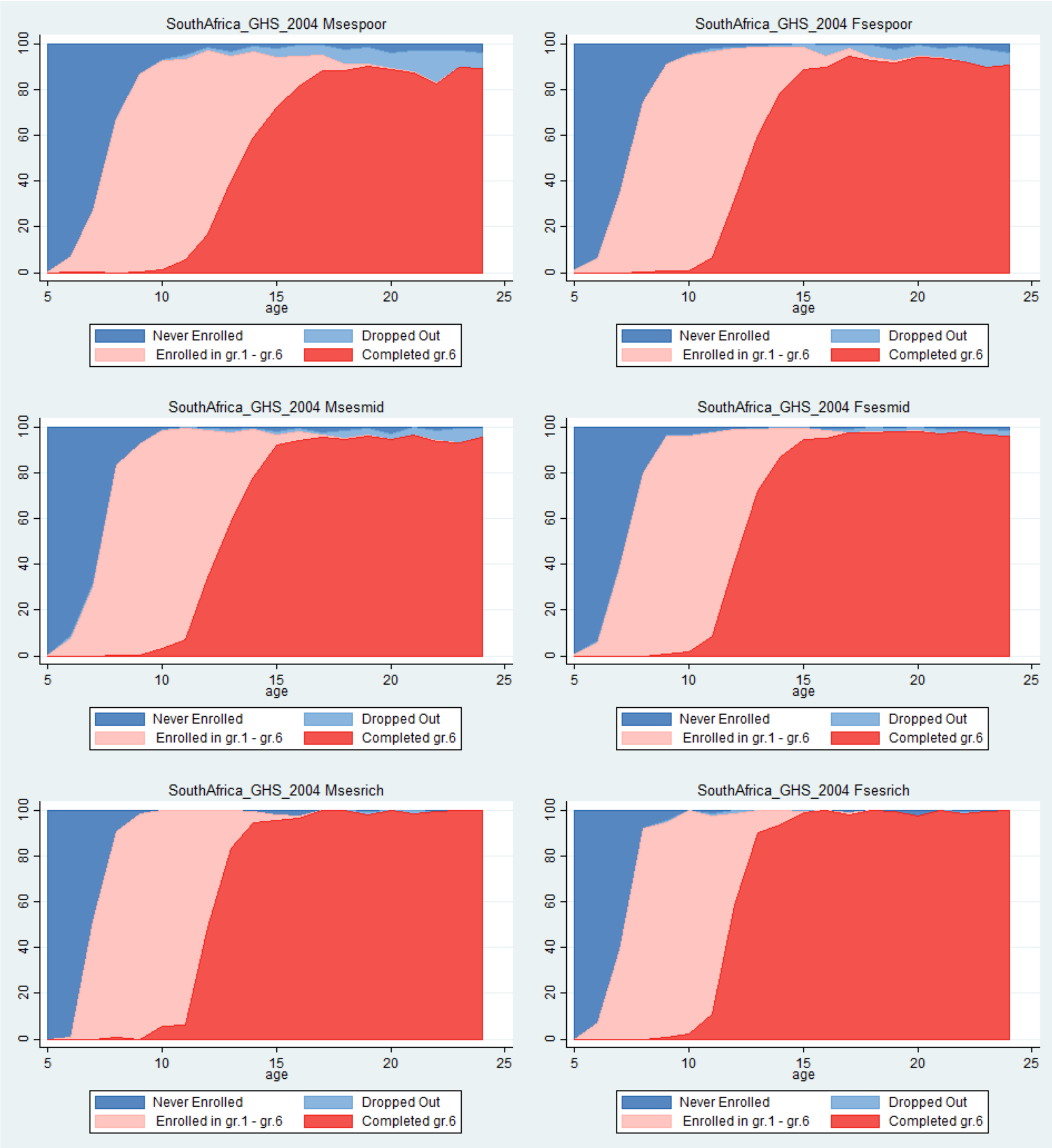
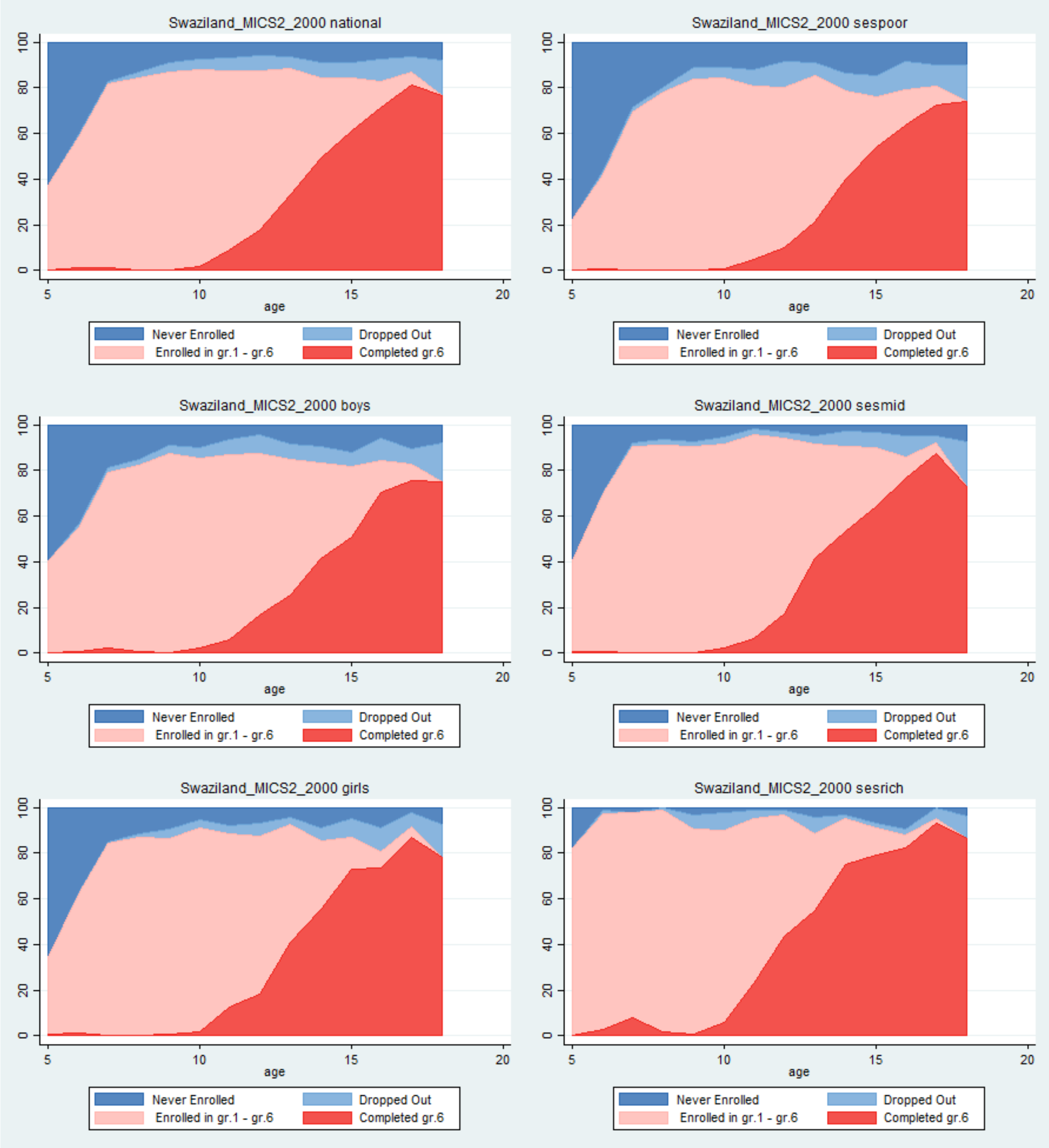
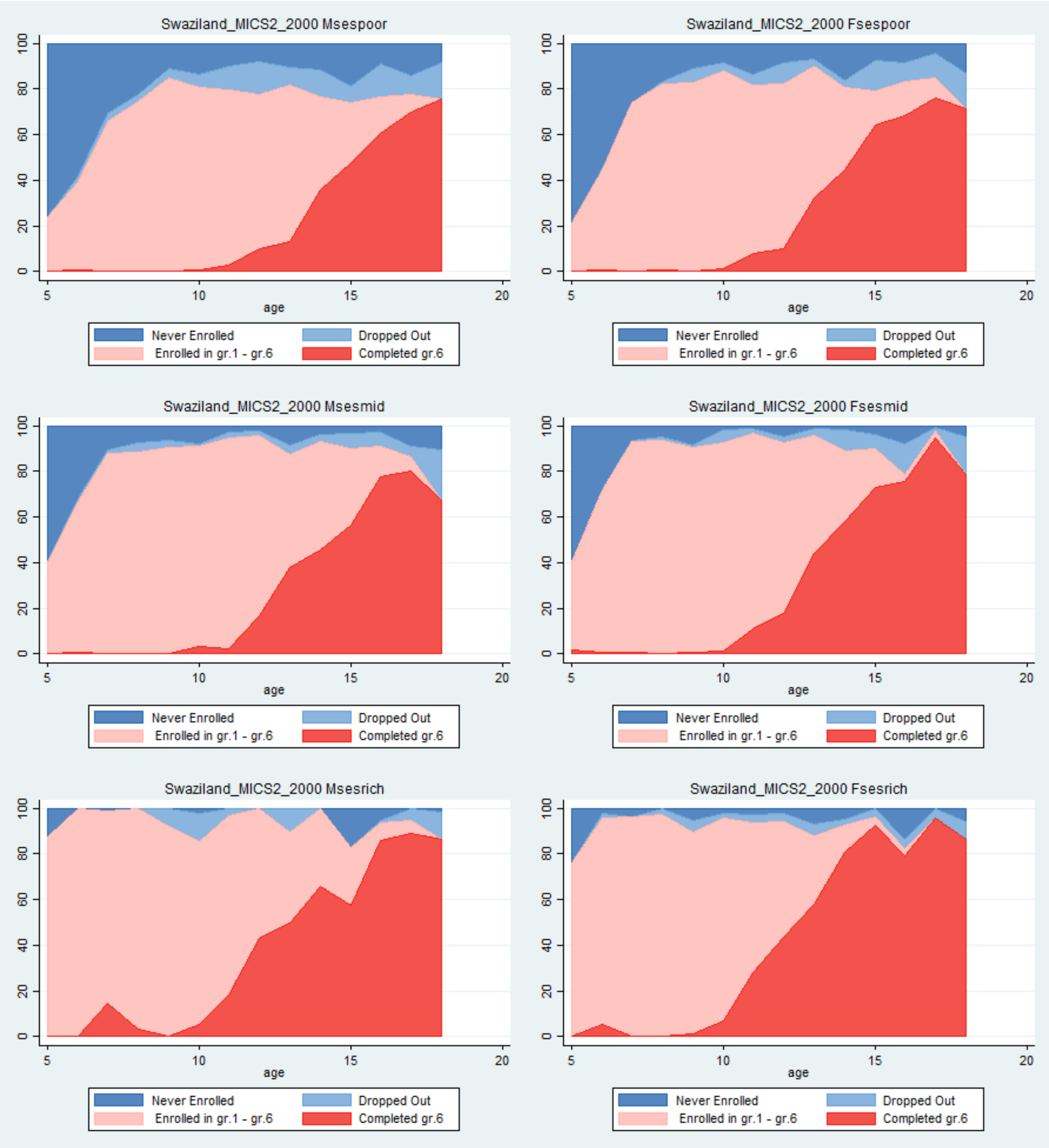


Swaziland 2000



Stellenbosch University https://scholar.sun.ac.za



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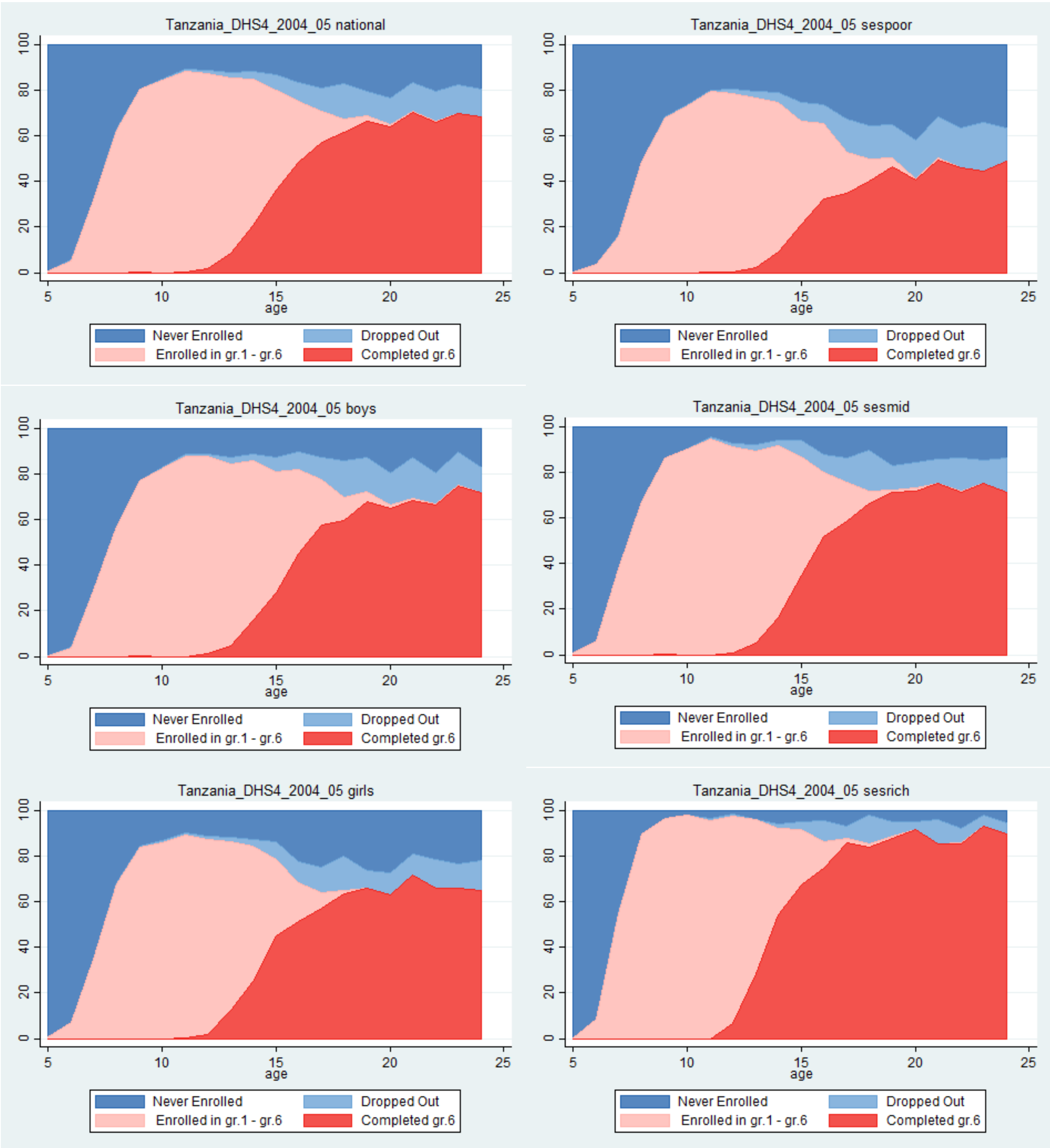
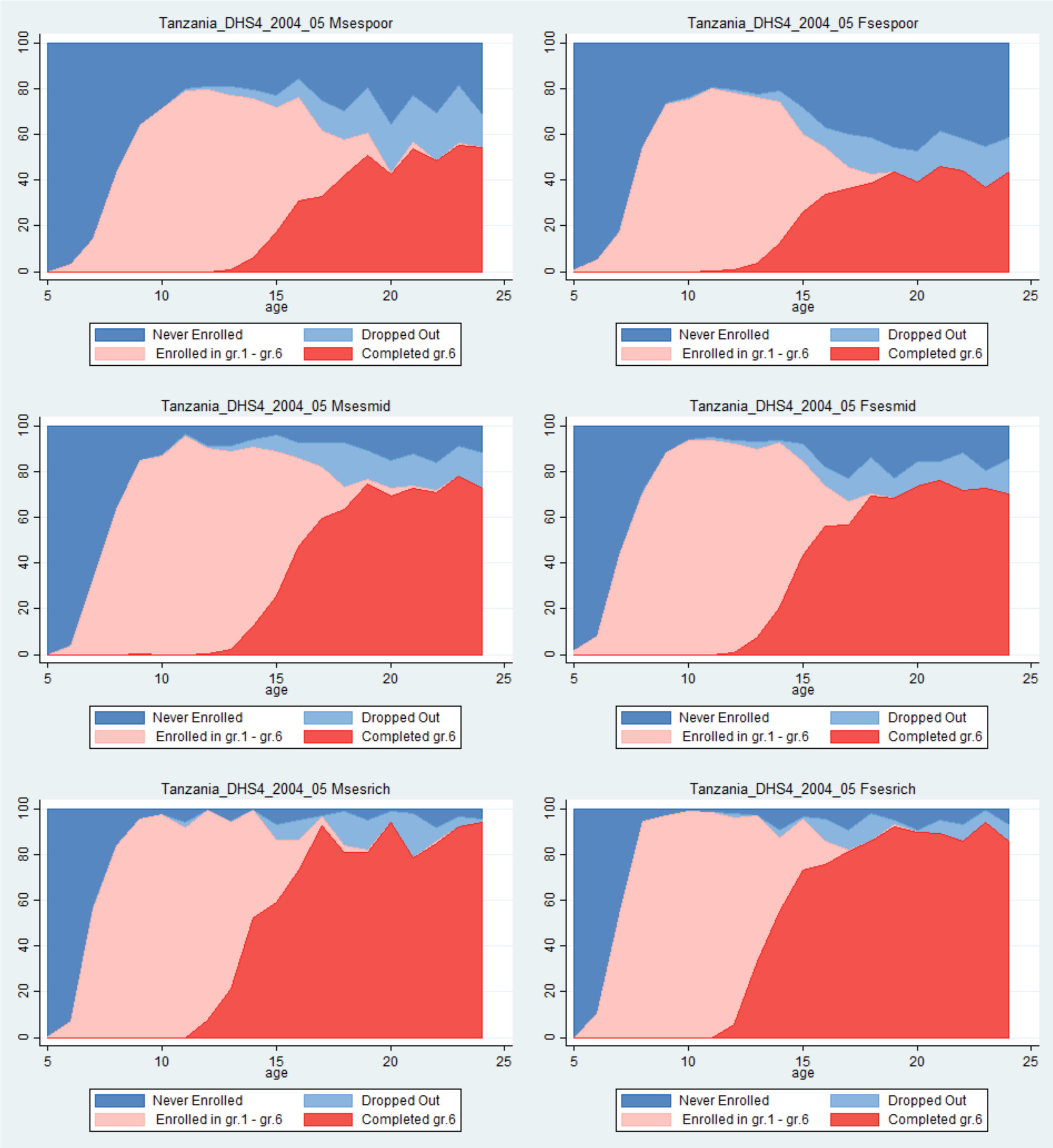
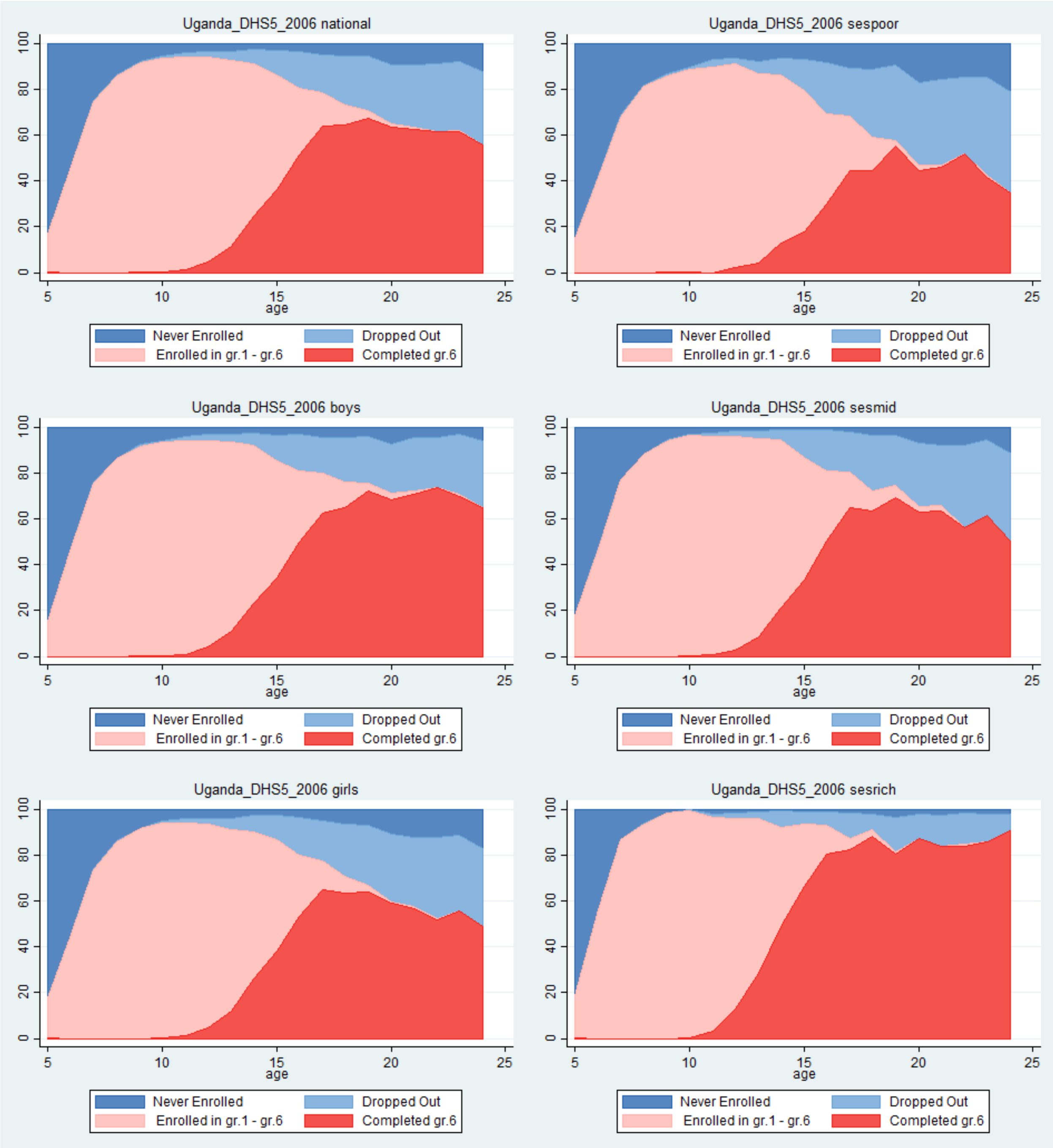
Tanzania 2004/5

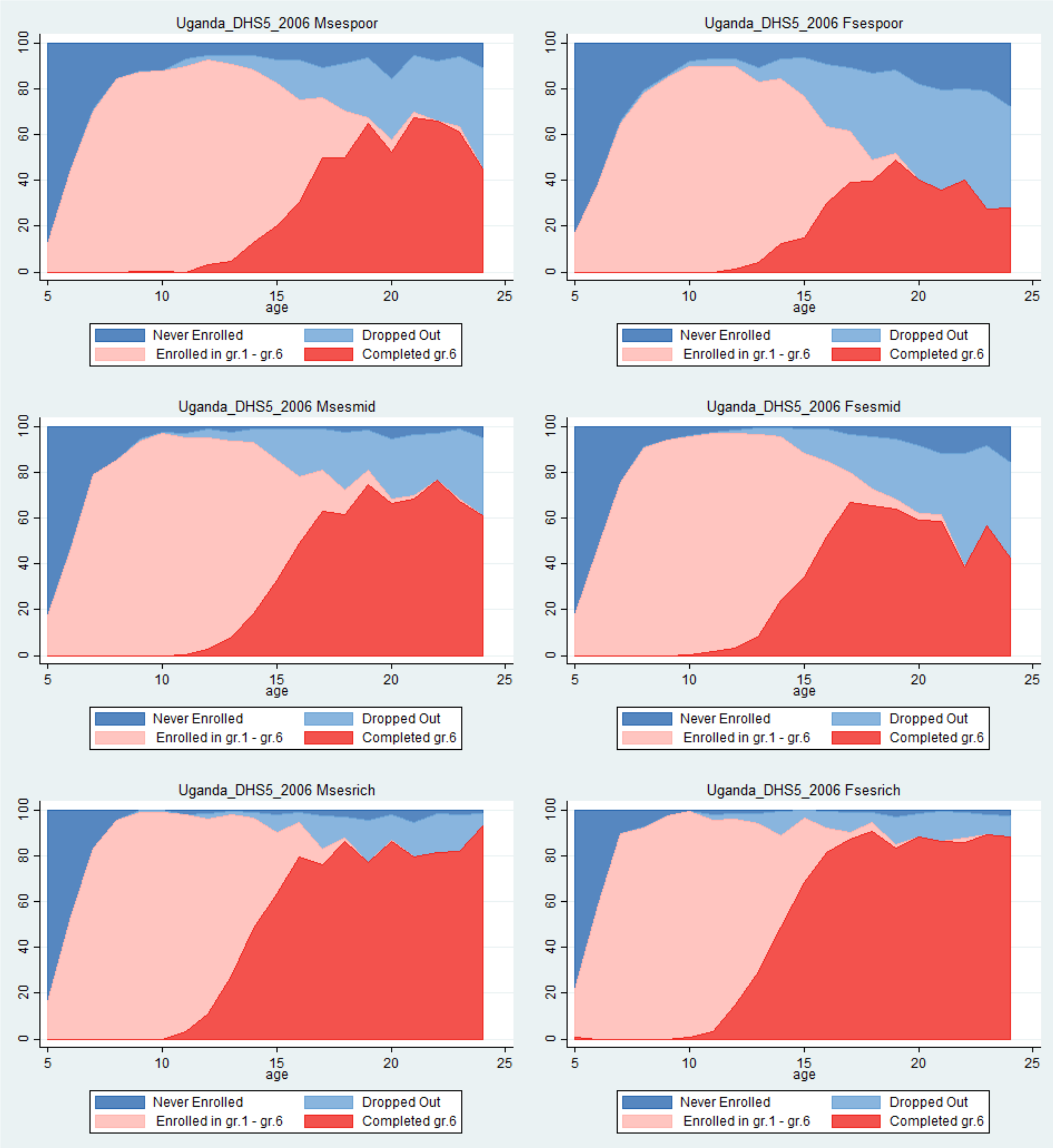


Stellenbosch University https://scholar.sun.ac.za



Uganda 2006


Uganda_DHS5_2006 national
Uganda_DHS5_2006 sespoor
Uganda_DHS5_2006 boys
Uganda_DHS5_2006 sesmid
Uganda_DHS5_2006 girls
Uganda_DHS5_2006 sesrich
age
Never Enrolled
Dropped Out
Enrolled in gr.1 - gr.6
Completed gr.6



Uganda_DHS5_2006 Msespoor
Uganda_DHS5_2006 Fsespoor
Uganda_DHS5_2006 Msesmid
Uganda_DHS5_2006 Fsesmid
Uganda_DHS5_2006 Msesrich
Uganda_DHS5_2006 Fsesrich
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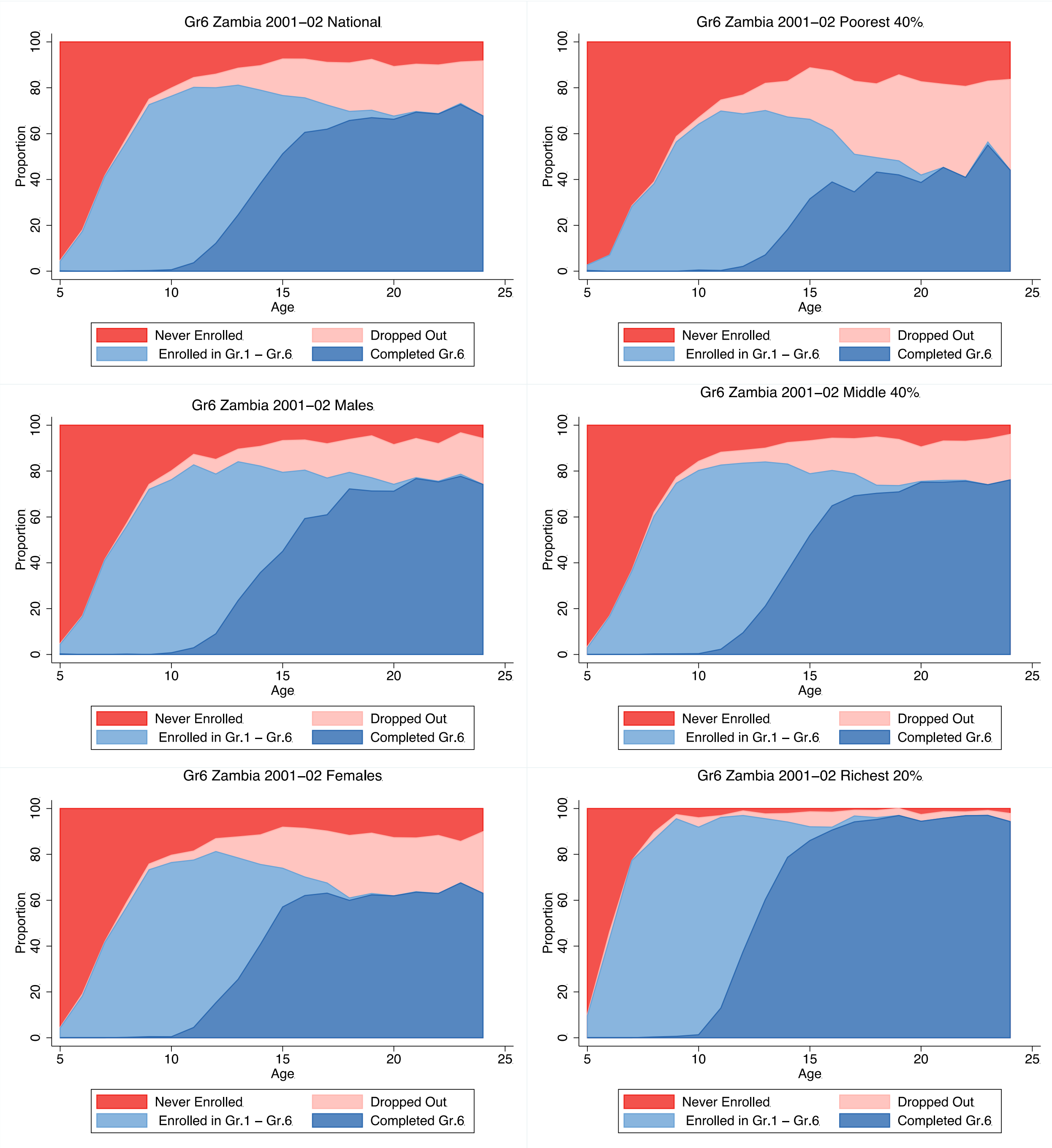
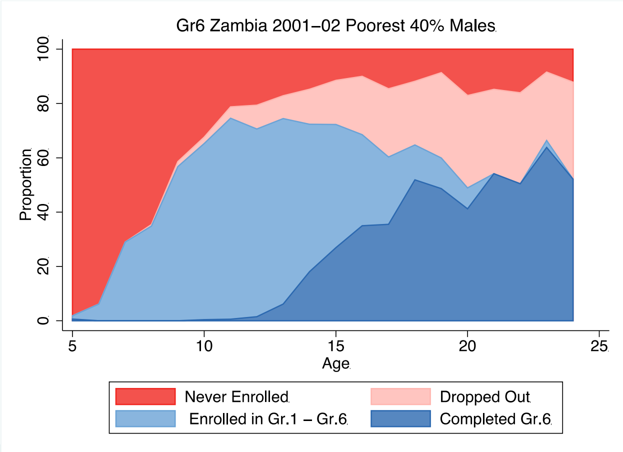
age
Never Enrolled
Dropped Out
Enrolled in gr.1 - gr.6
Completed gr.6

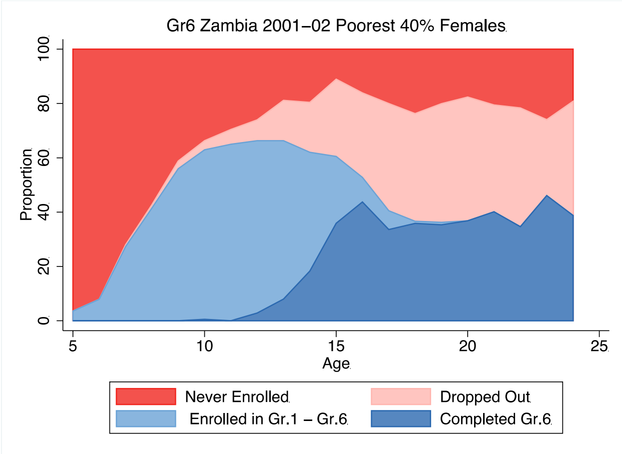
Stellenbosch University https://scholar.sun.ac.za

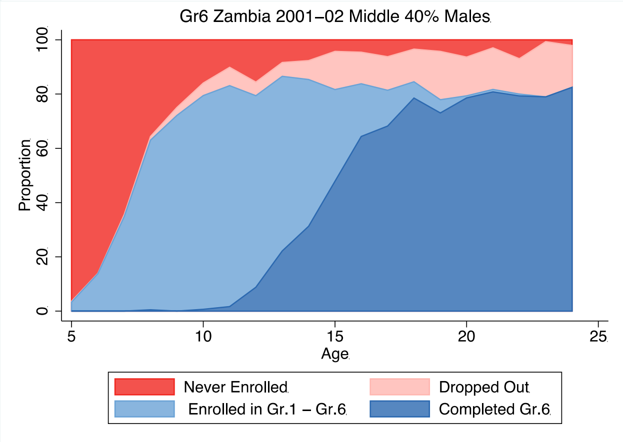
Zambia 2001-02

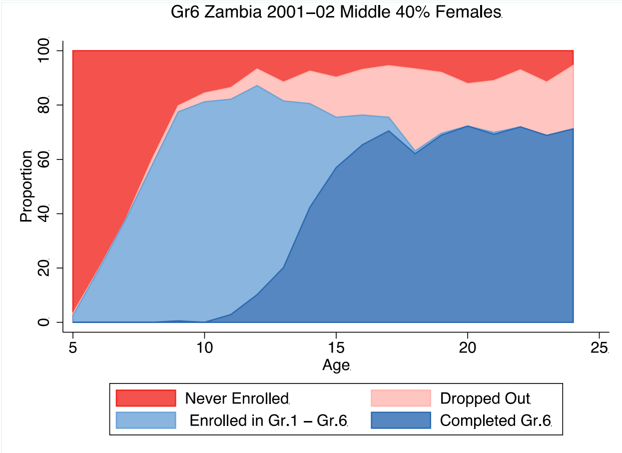


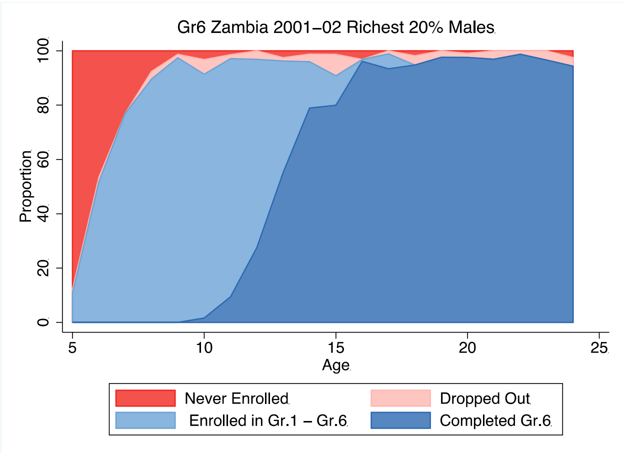
Stellenbosch University https://scholar.sun.ac.za

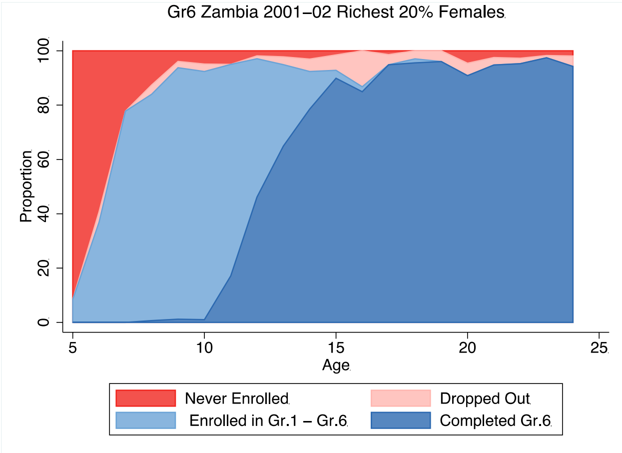




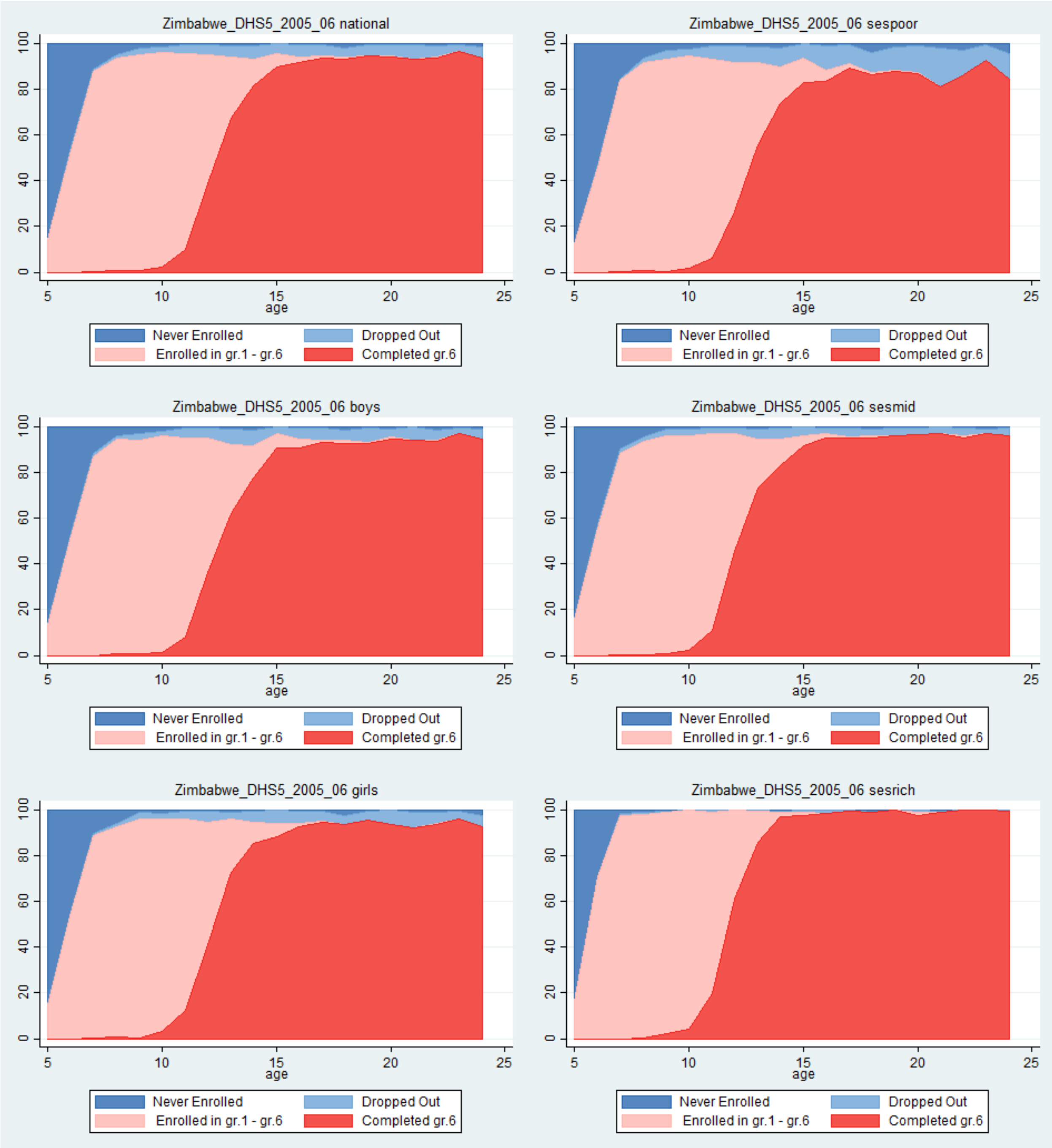








Zimbabwe 2005-06



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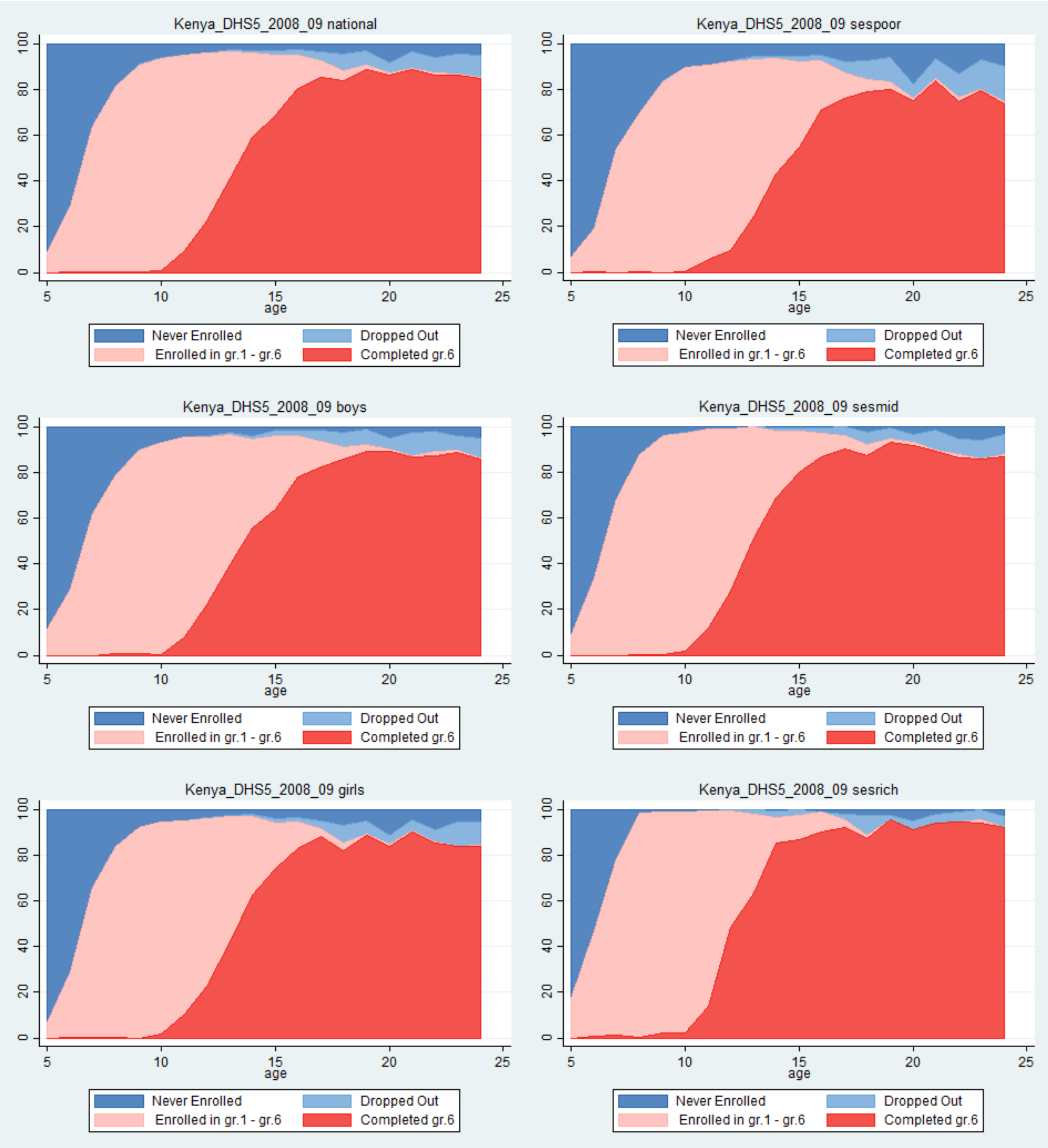
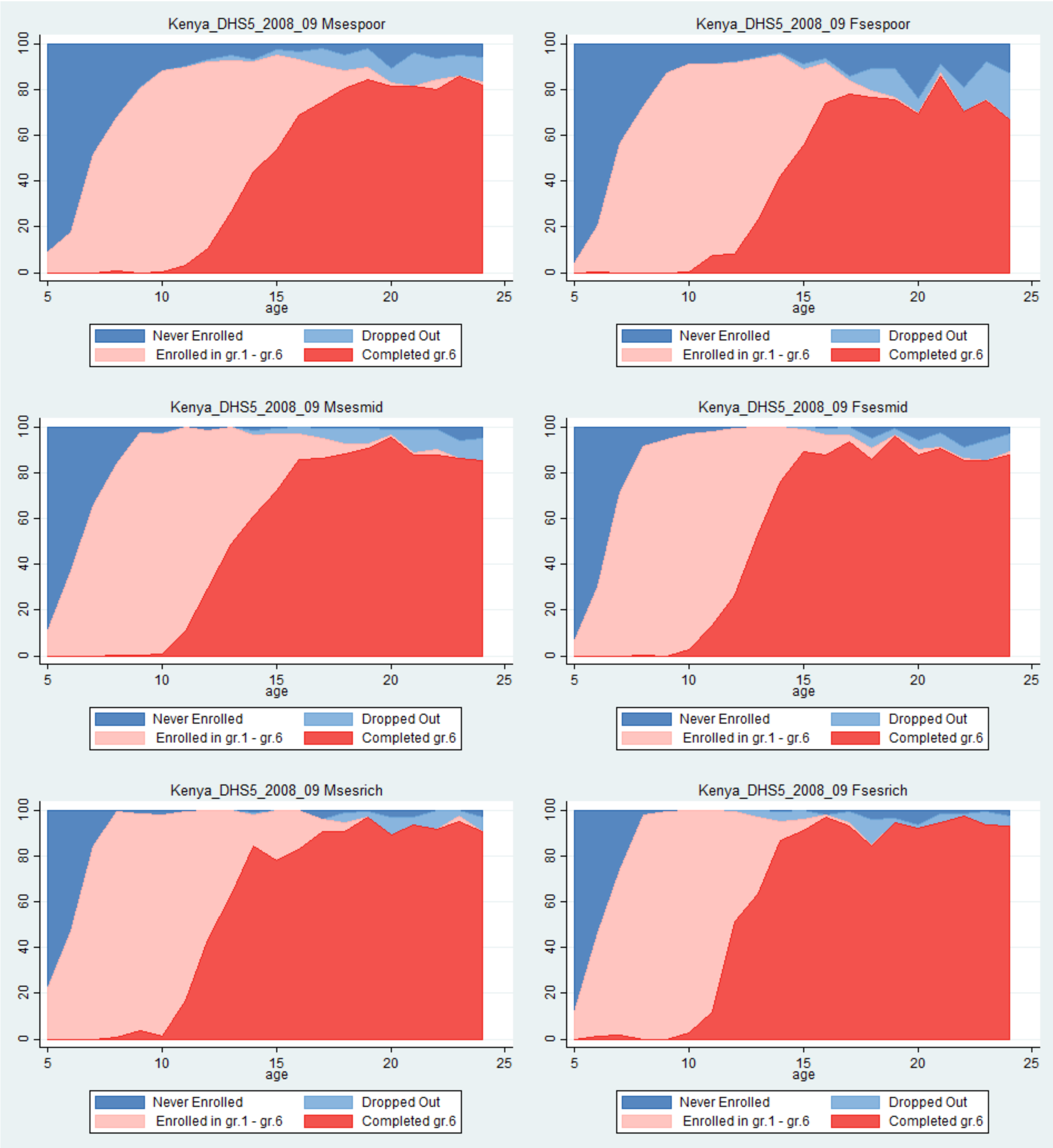
D2.2 Enrolment profiles by age circa 2010 for countries and sub-groups

Kenya 2008/9




Kenya_DHS5_2008_09 Msespoor
Kenya_DHS5_2008_09 Fsespoor
Kenya_DHS5_2008_09 Msesmid
Kenya_DHS5_2008_09 Fsesmid
Kenya_DHS5_2008_09 Msesrich
Kenya_DHS5_2008_09 Fsesrich
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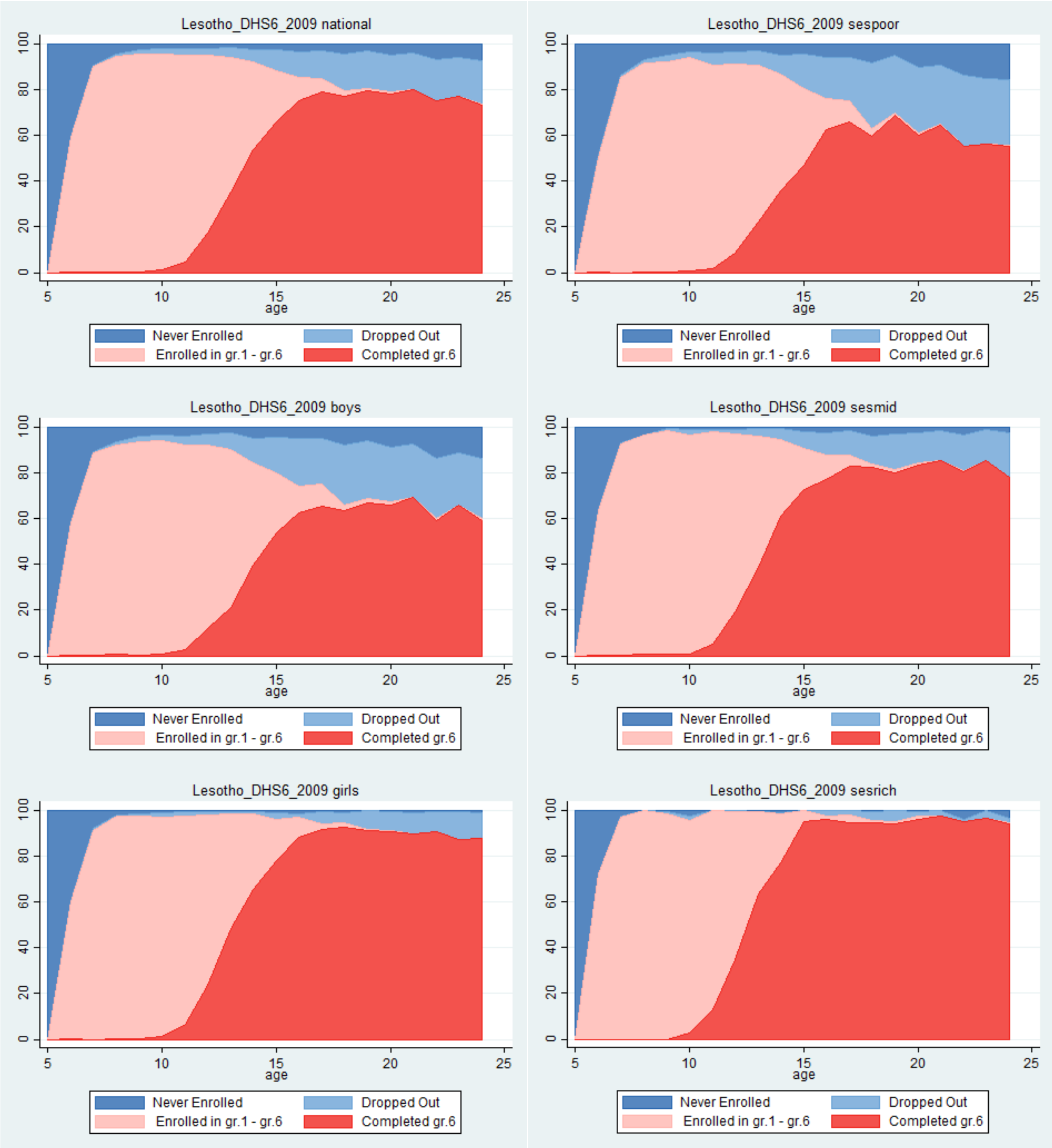
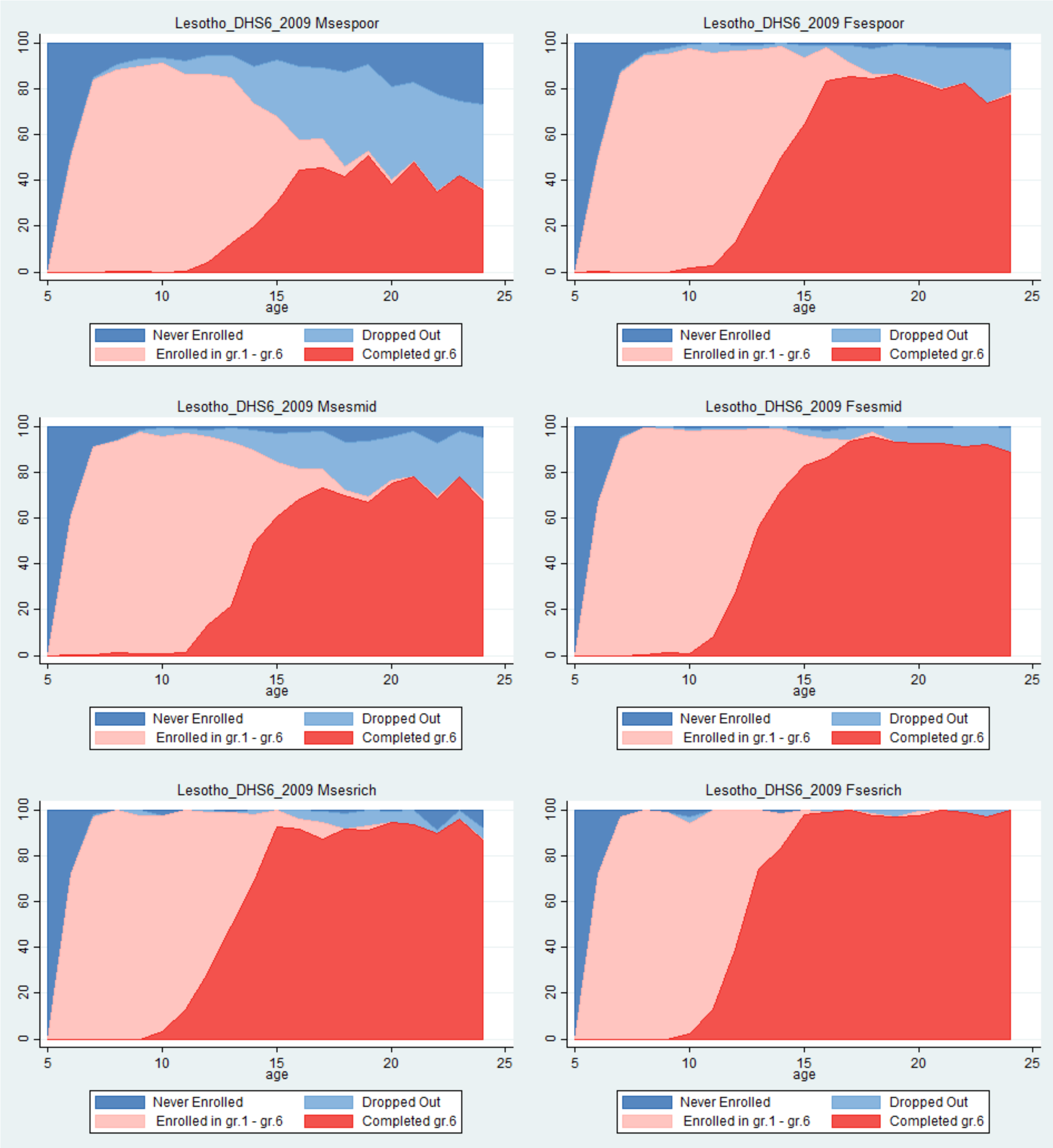
age
Never Enrolled
Dropped Out
Enrolled in gr.1 - gr.6
Completed gr.6

Lesotho 2009



Stellenbosch University https://scholar.sun.ac.za



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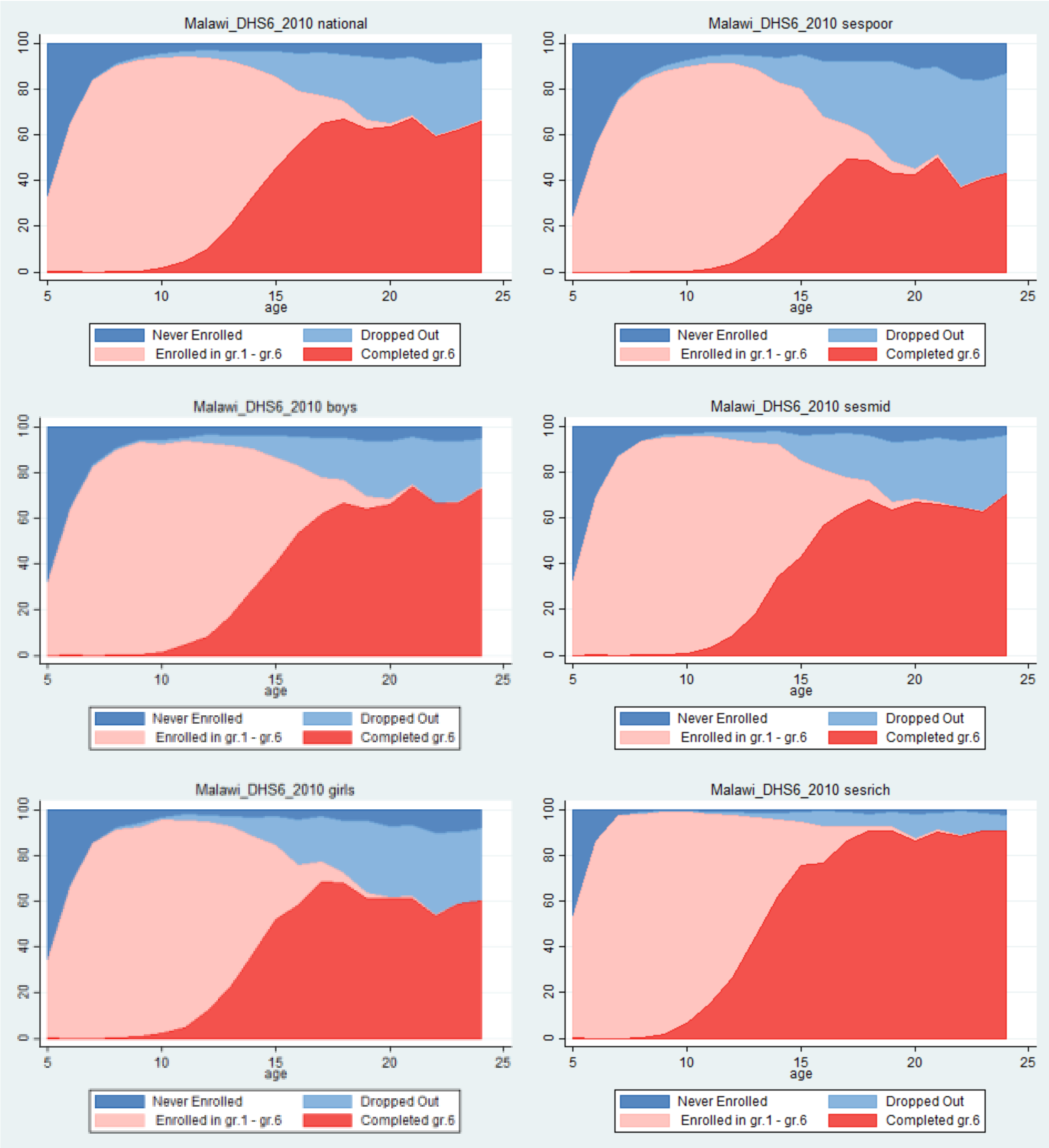
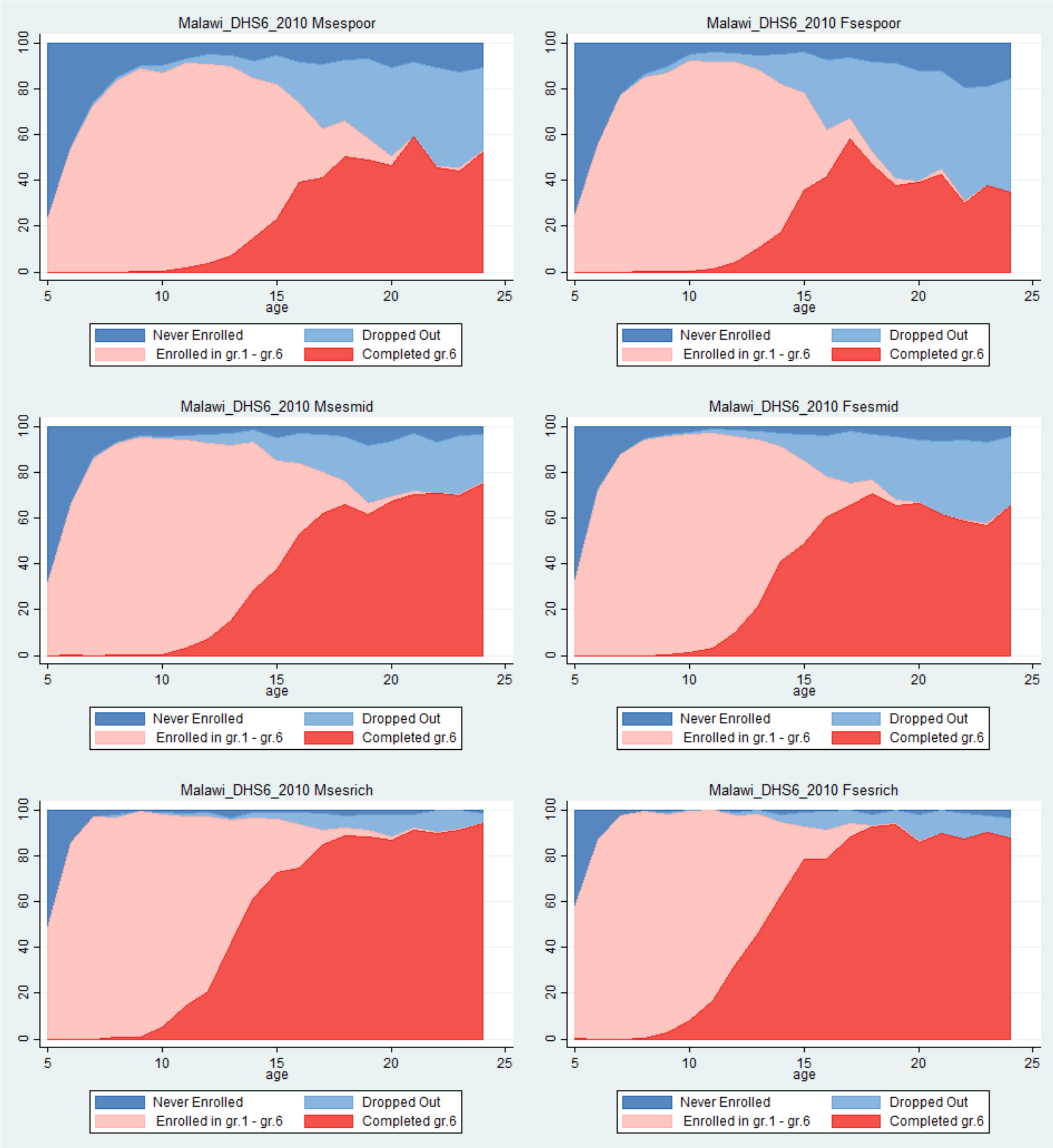
Malawi 2010




Malawi_DHS6_2010 Msespoor
Malawi_DHS6_2010 Fsespoor
Malawi_DHS6_2010 Msesmid
Malawi_DHS6_2010 Fsesmid
Malawi_DHS6_2010 Msesrich
Malawi_DHS6_2010 Fsesrich
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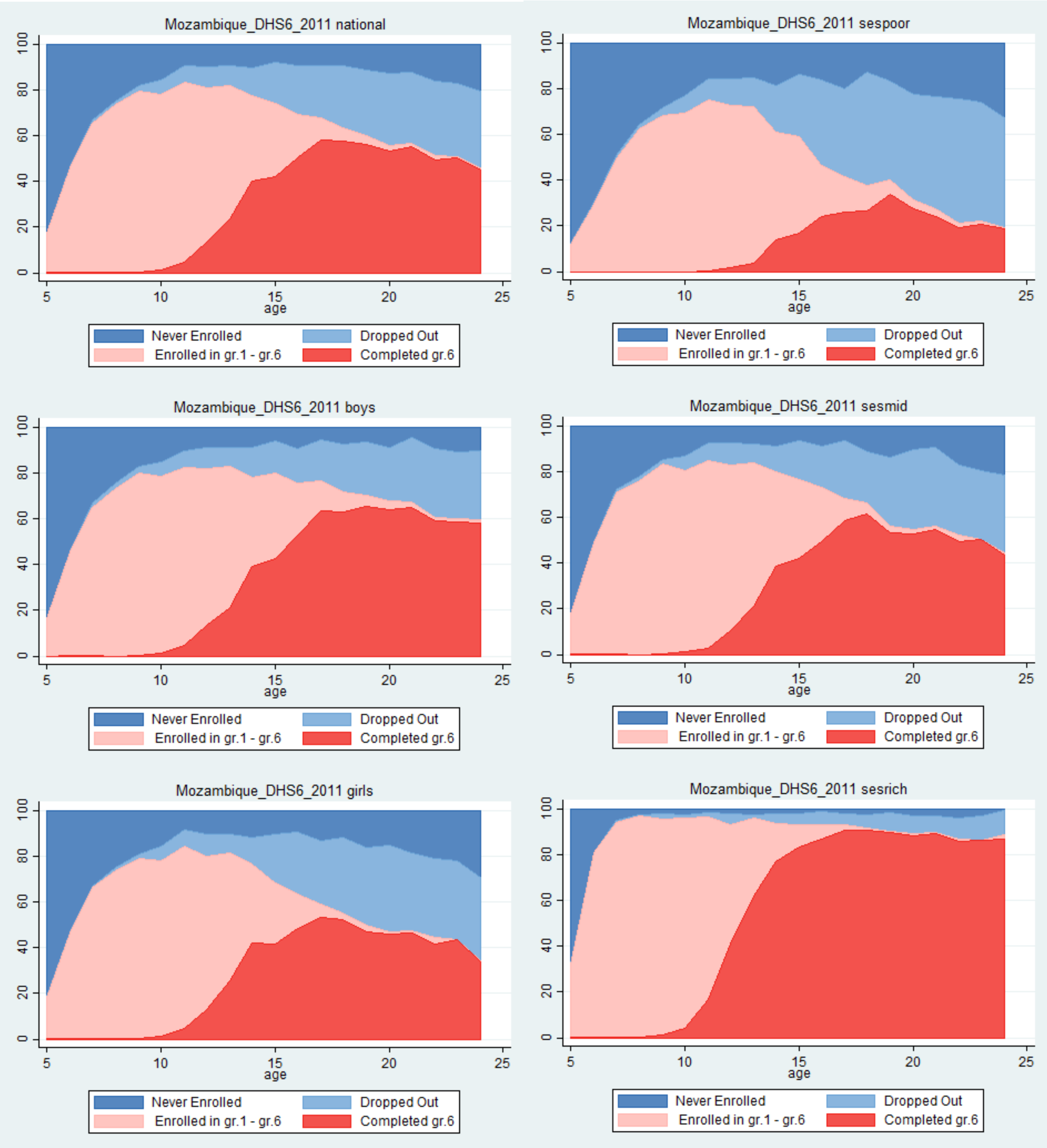
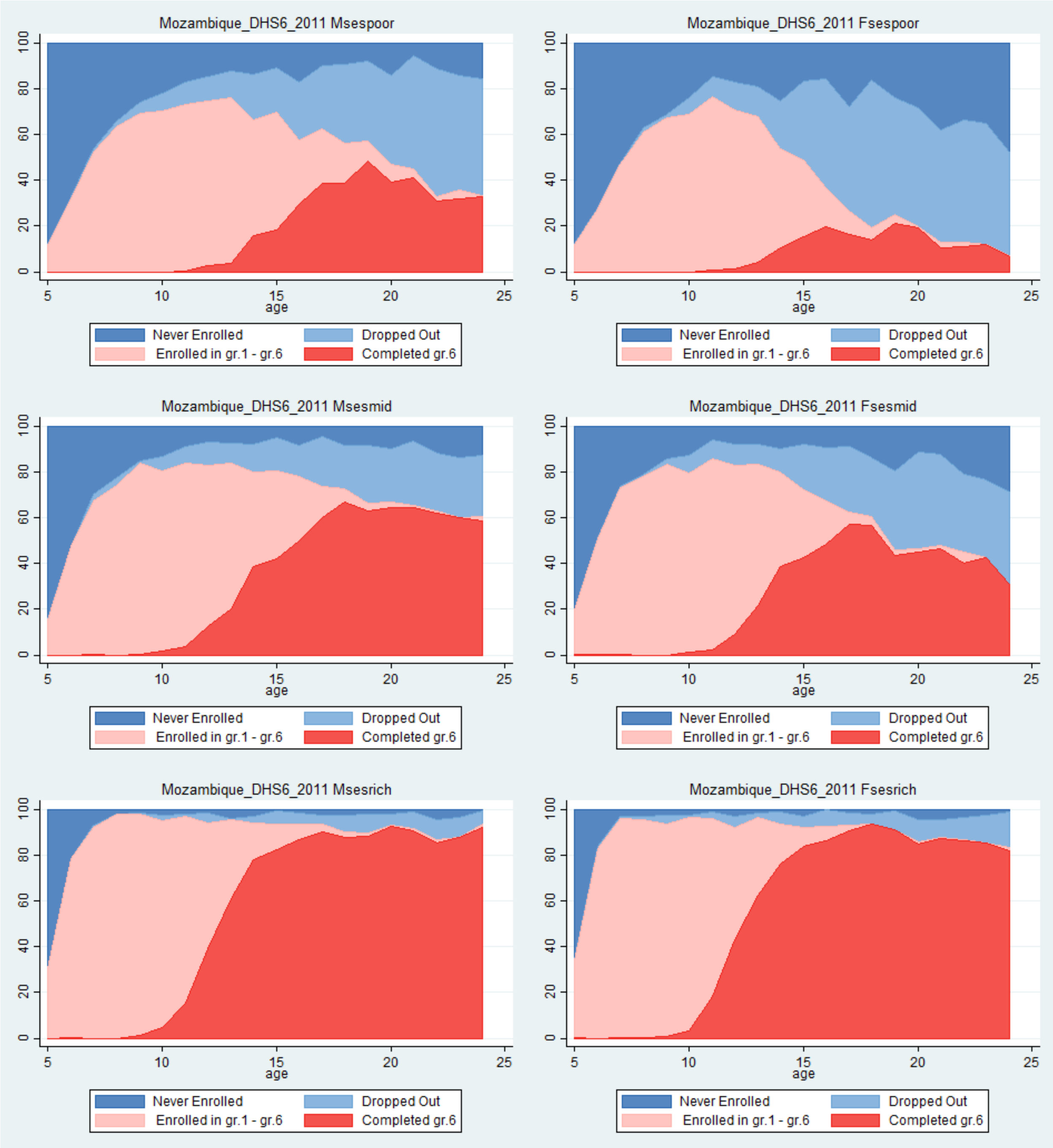
age
Never Enrolled
Dropped Out
Enrolled in gr.1 - gr.6
Completed gr.6

Stellenbosch University https://scholar.sun.ac.za

Mozambique 2011




Mozambique_DHS6_2011 Msespoor
Mozambique_DHS6_2011 Fsespoor
Mozambique_DHS6_2011 Msesmid
Mozambique_DHS6_2011 Fsesmid
Mozambique_DHS6_2011 Msesrich
Mozambique_DHS6_2011 Fsesrich
age
Never Enrolled
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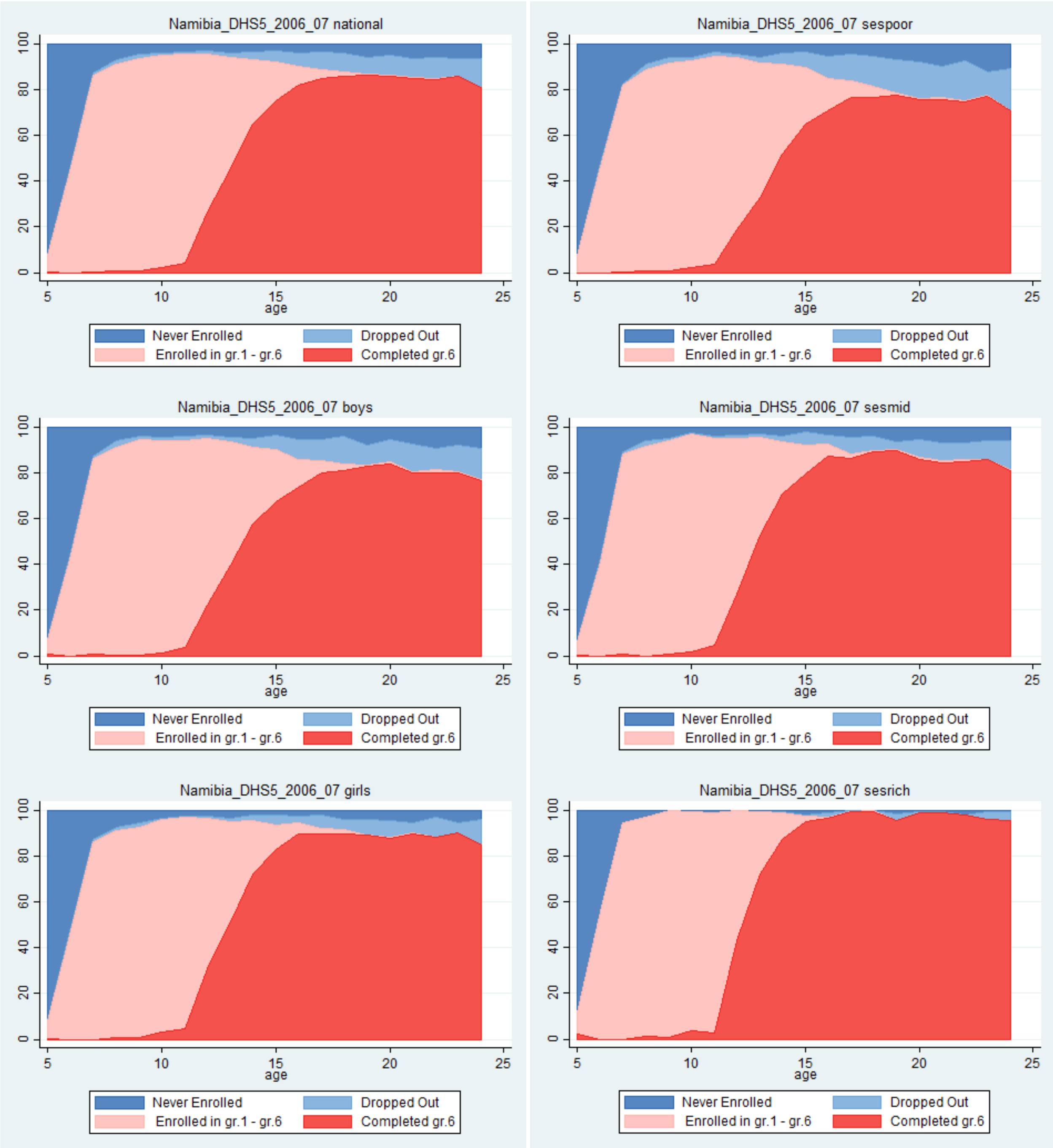
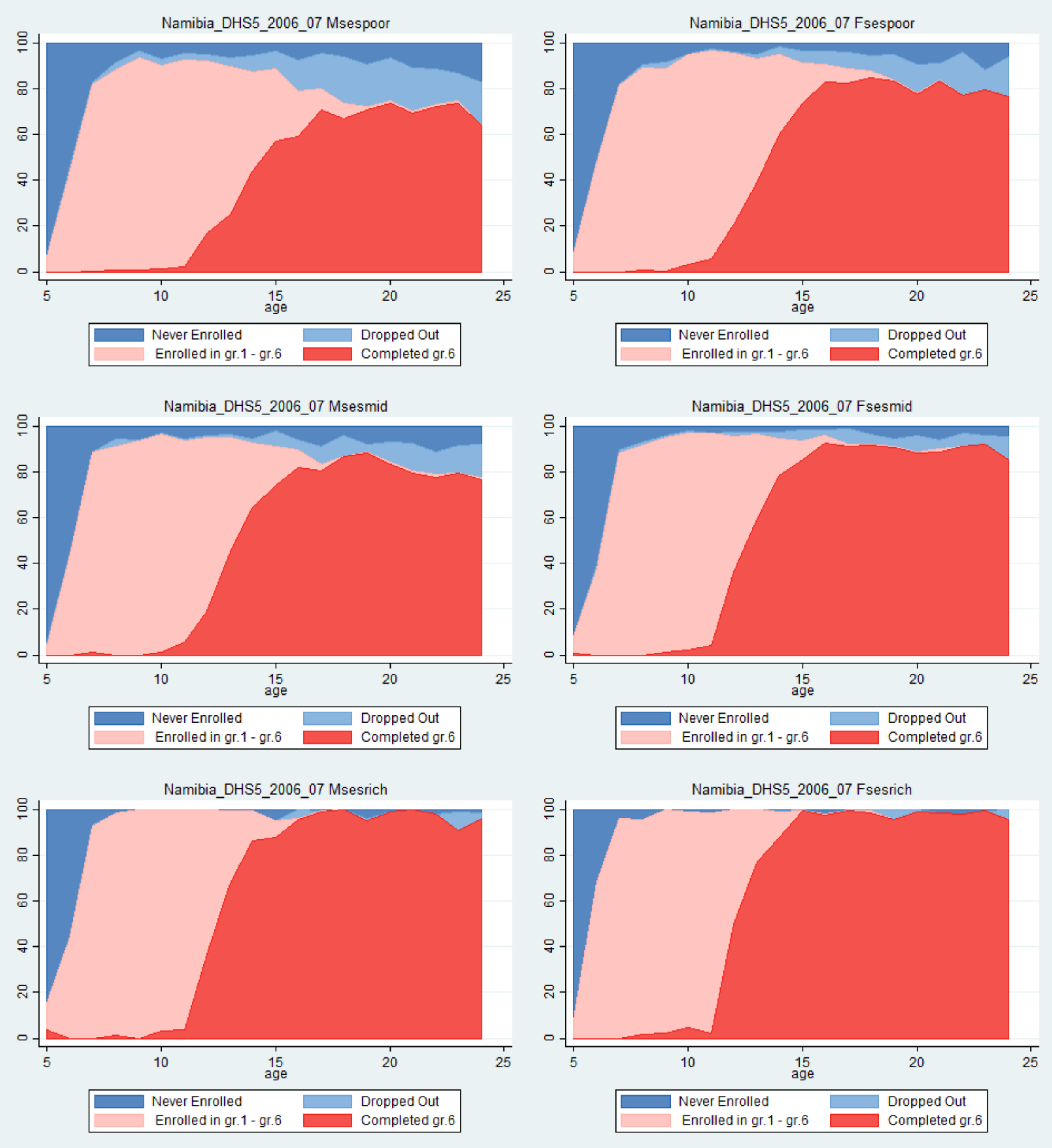
Enrolled in gr.1 - gr.6
Completed gr.6

Stellenbosch University https://scholar.sun.ac.za

Namibia 2006/7




Namibia_DHS5_2006_07 Msespoor
Namibia_DHS5_2006_07 Fsespoor
Namibia_DHS5_2006_07 Msesmid
Namibia_DHS5_2006_07 Fsesmid
Namibia_DHS5_2006_07 Msesrich
Namibia_DHS5_2006_07 Fsesrich
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Never Enrolled
Dropped Out
Enrolled in gr.1 - gr.6
Completed gr.6

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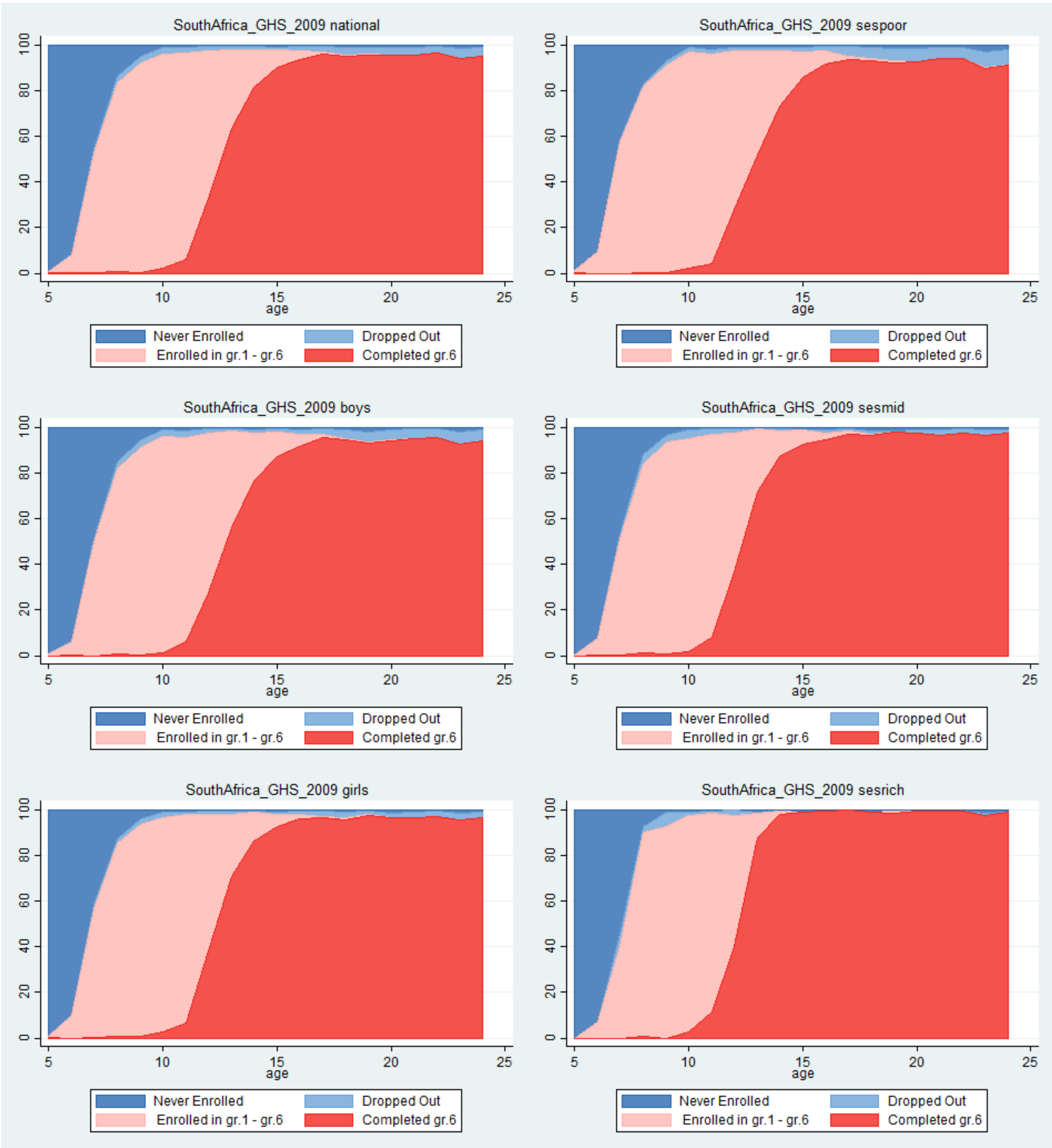
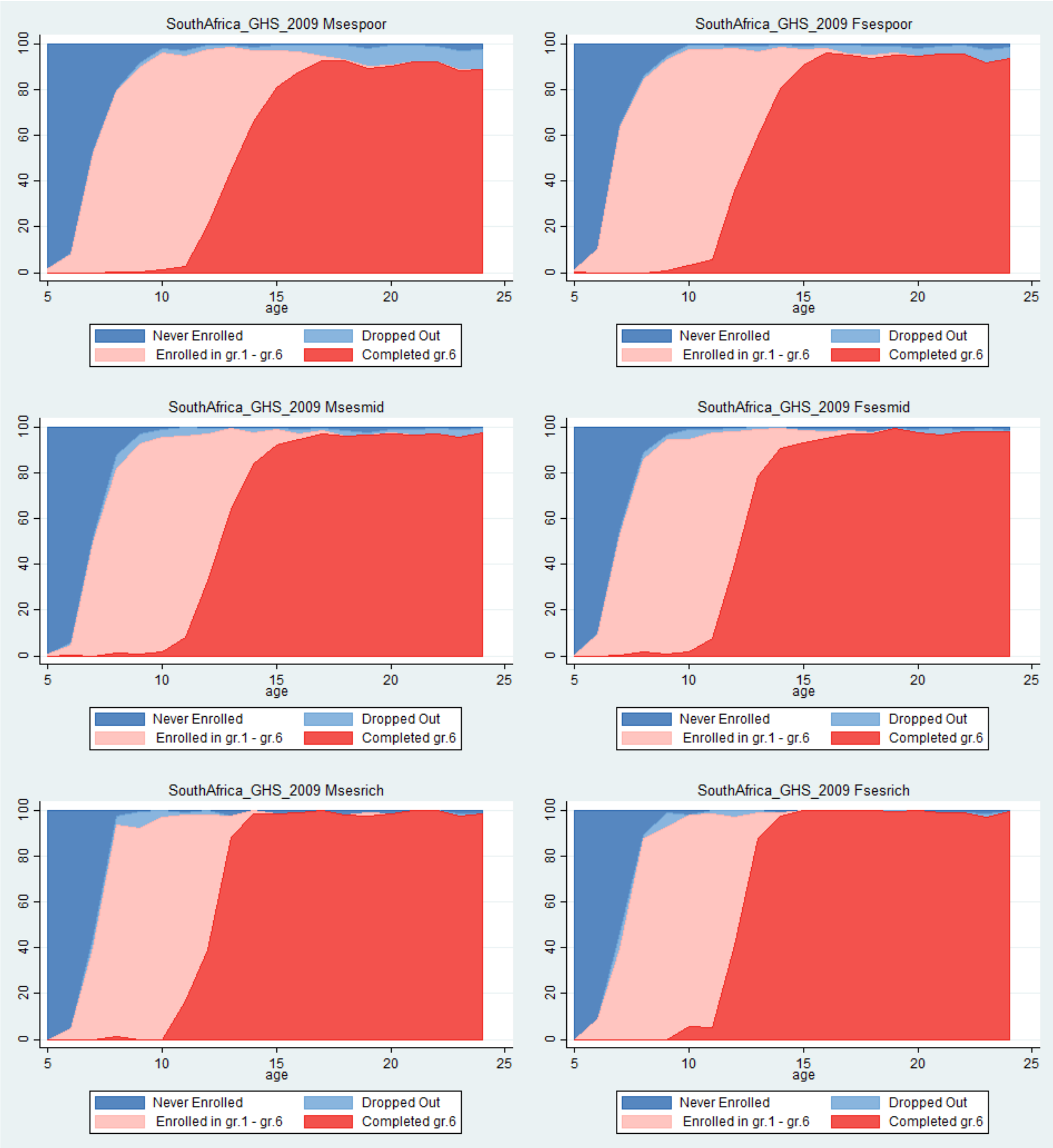
South Africa GHS 2009




SouthAfrica_GHS_2009 Msespoor
SouthAfrica_GHS_2009 Fsespoor
SouthAfrica_GHS_2009 Msesmid
SouthAfrica_GHS_2009 Fsesmid
SouthAfrica_GHS_2009 Msesrich
SouthAfrica_GHS_2009 Fsesrich
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age
Never Enrolled
Dropped Out
Enrolled in gr.1 - gr.6
Completed gr.6

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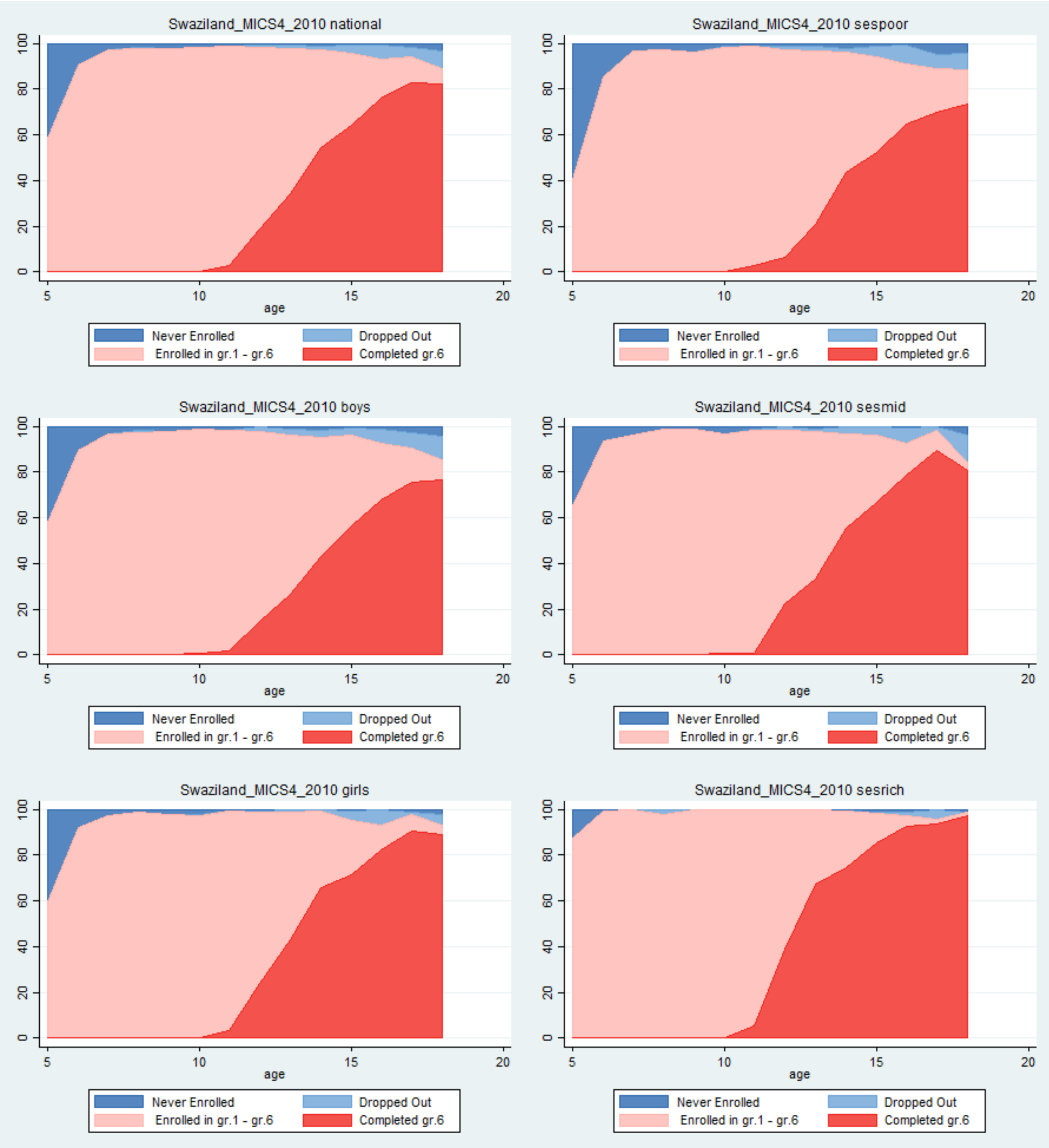
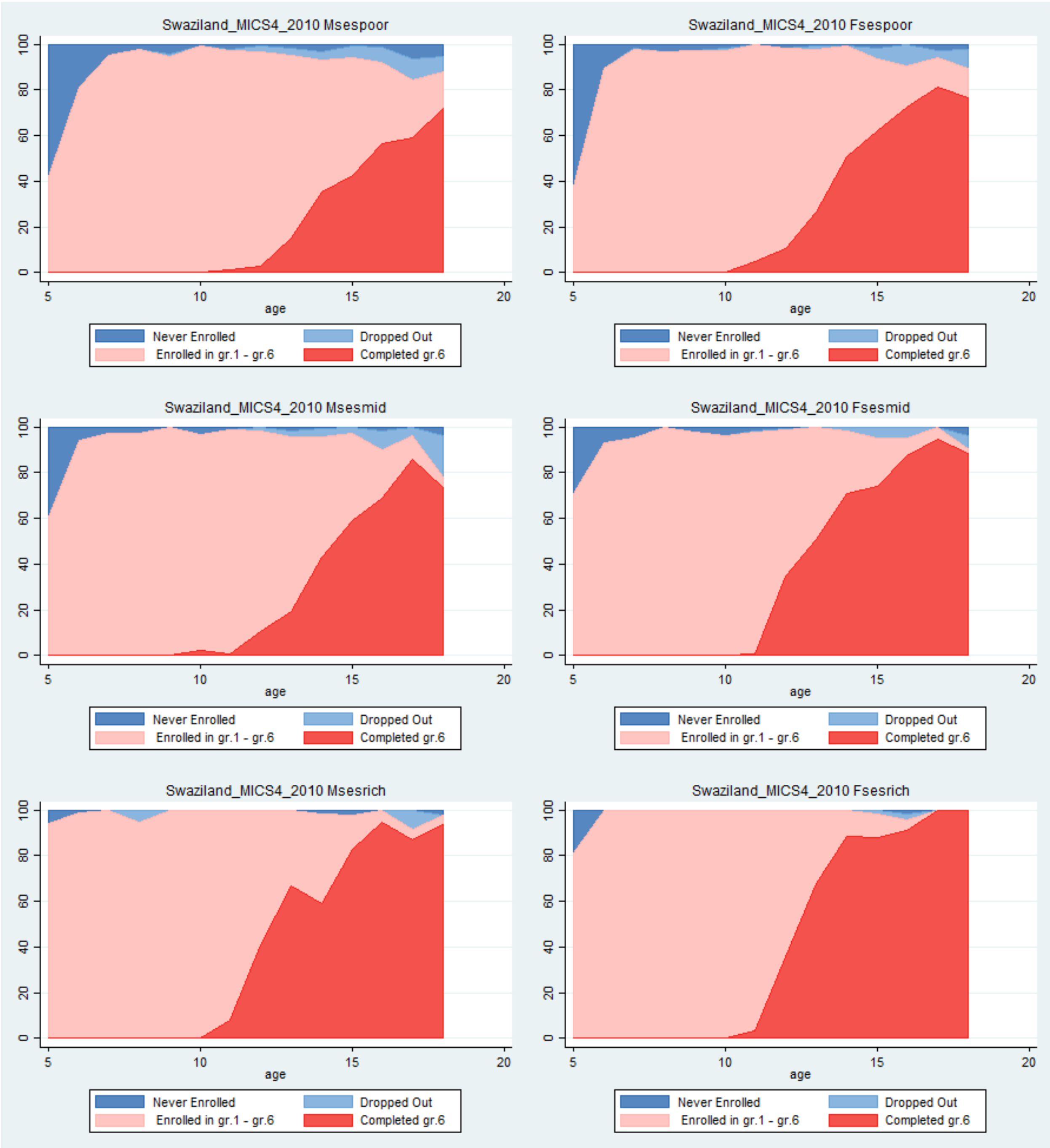
Swaziland 2010 (MICS)

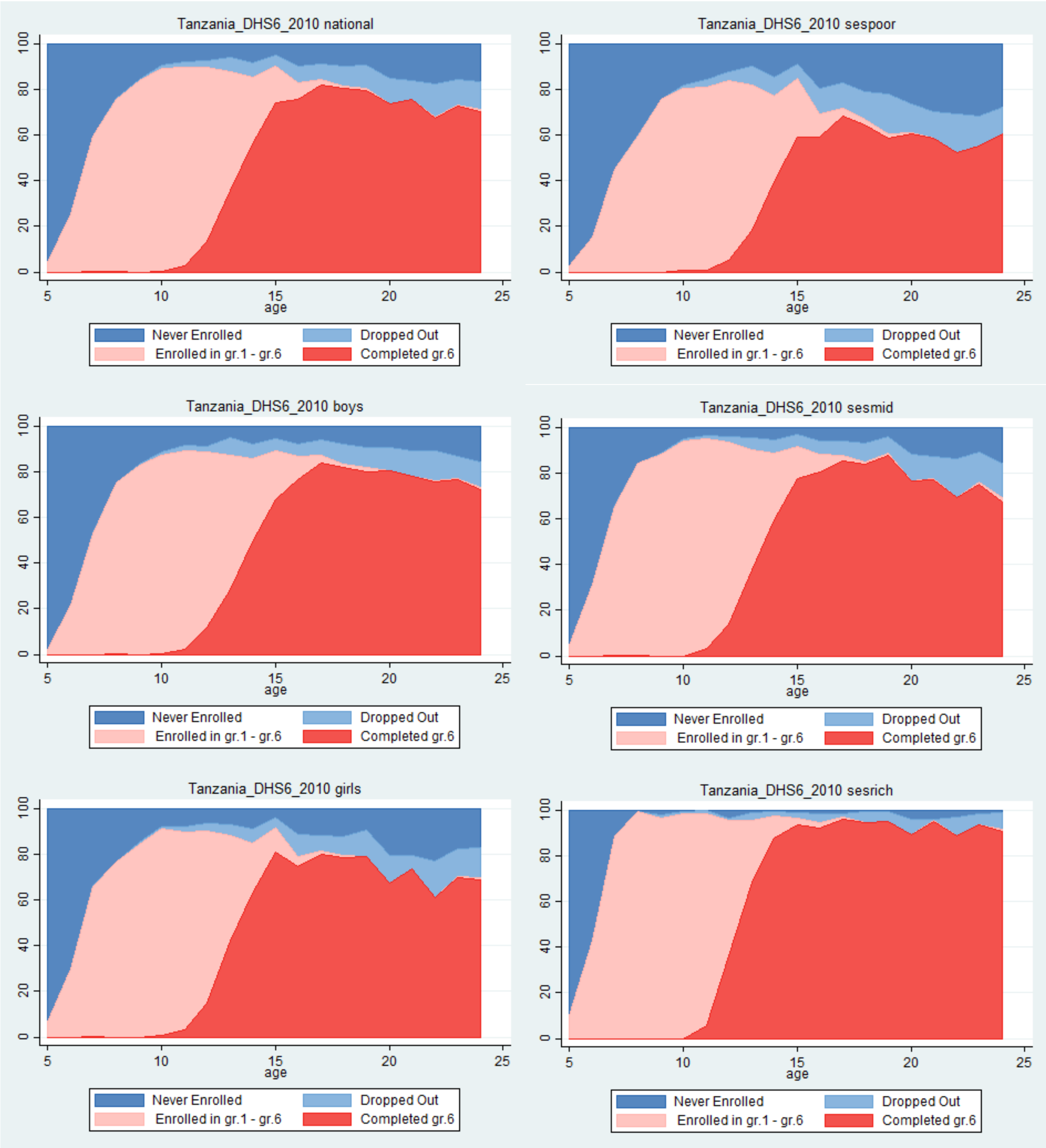


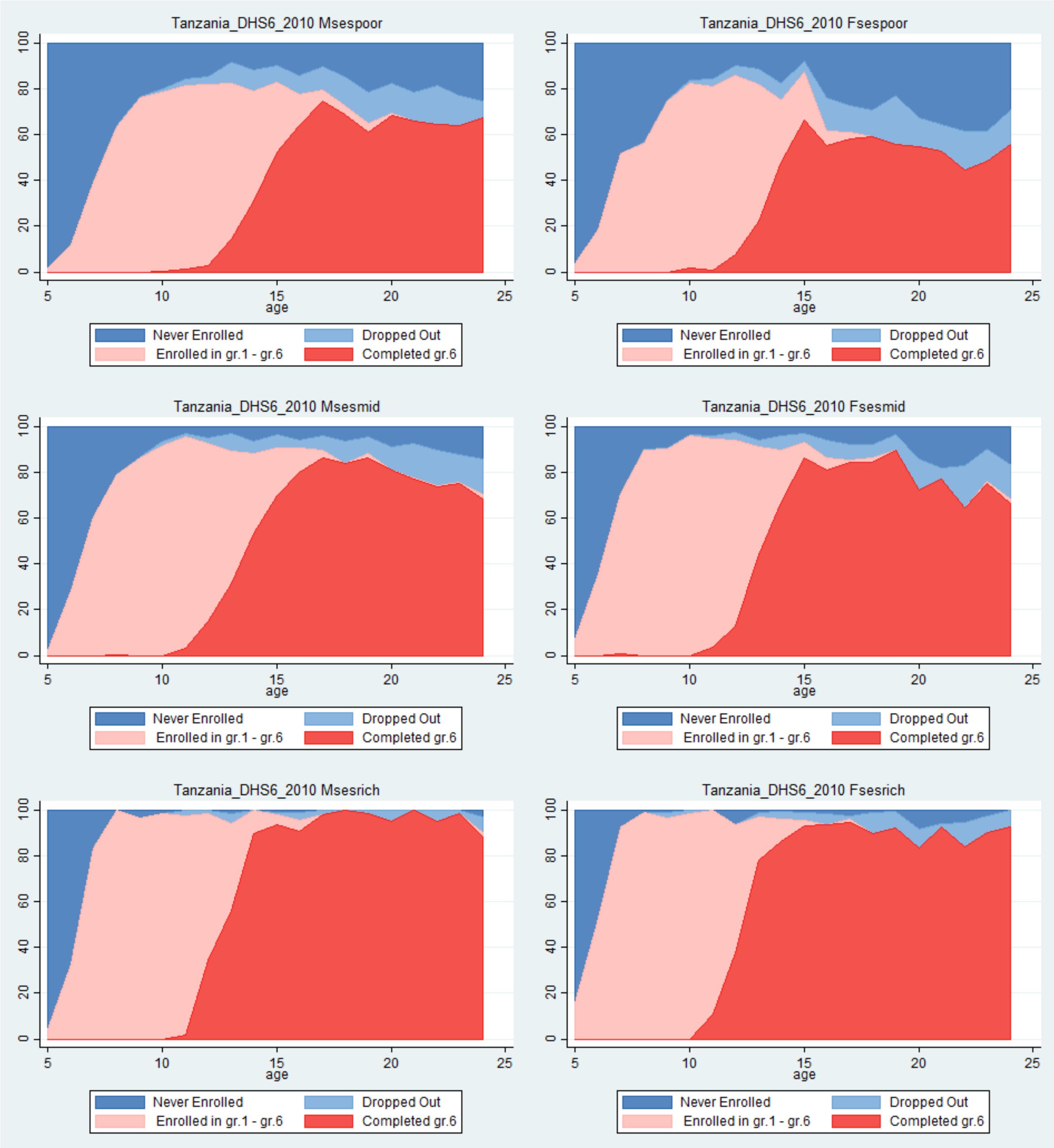
Stellenbosch University https://scholar.sun.ac.za



Stellenbosch University https://scholar.sun.ac.za

Tanzania 2010





Tanzania_DHS6_2010 Msespoor
Tanzania_DHS6_2010 Fsespoor
Tanzania_DHS6_2010 Msesmid
Tanzania_DHS6_2010 Fsesmid
Tanzania_DHS6_2010 Msesrich
Tanzania_DHS6_2010 Fsesrich
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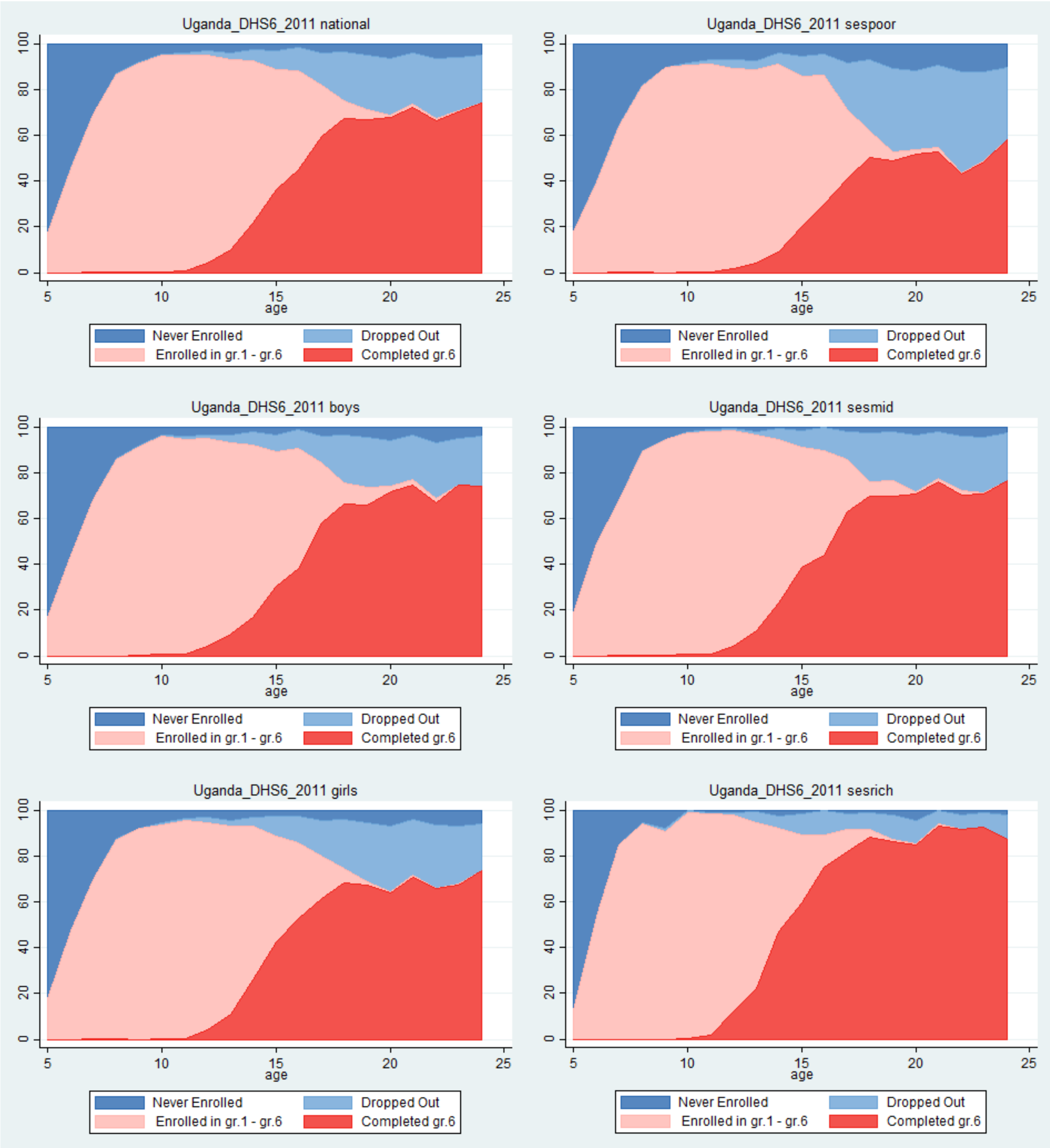
age
Never Enrolled
Dropped Out
Enrolled in gr.1 - gr.6
Completed gr.6

Uganda 2011


Uganda_DHS6_2011 national
Uganda_DHS6_2011 sespoor
Uganda_DHS6_2011 boys
Uganda_DHS6_2011 sesmid
Uganda_DHS6_2011 girls
Uganda_DHS6_2011 sesrich
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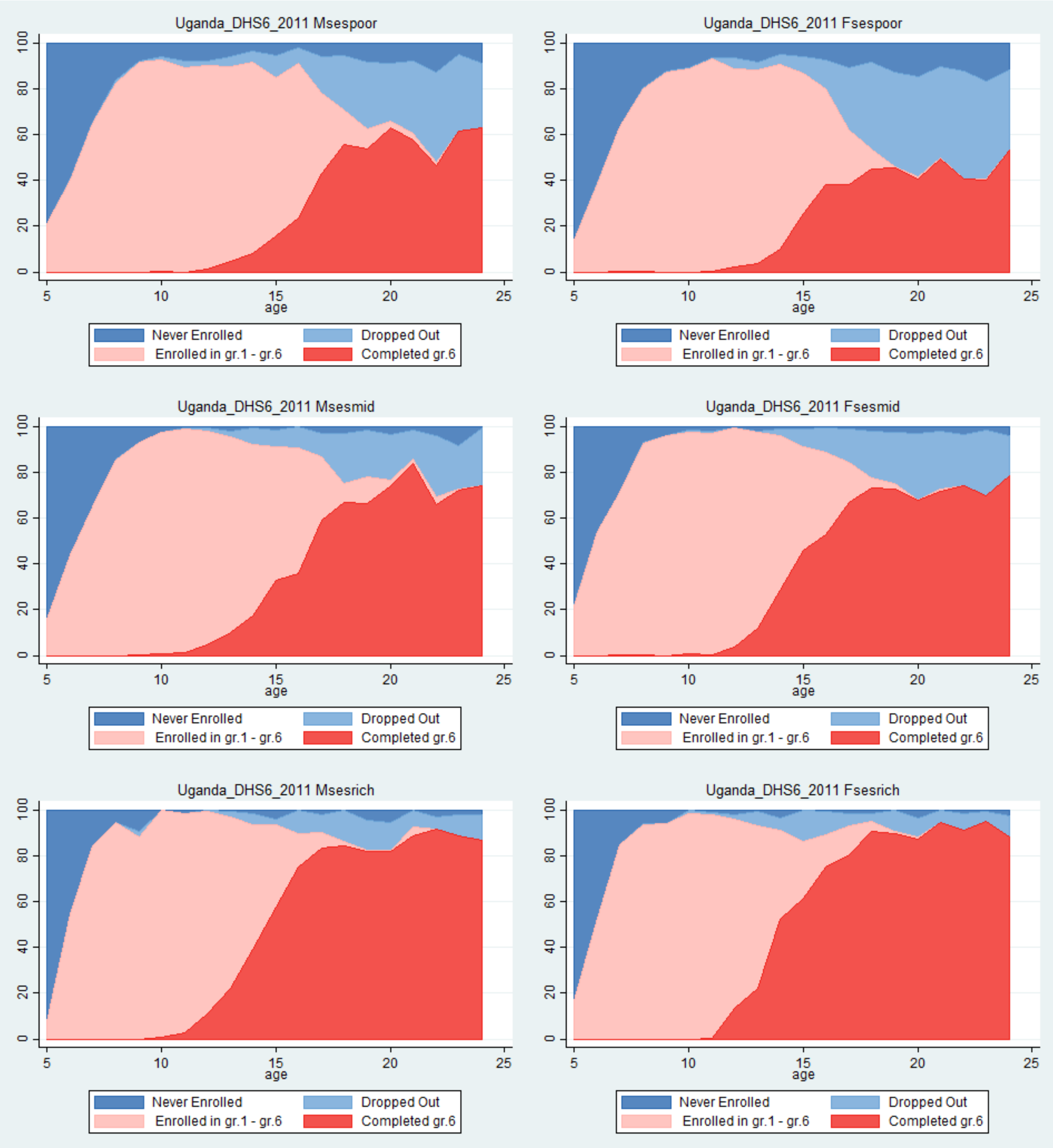
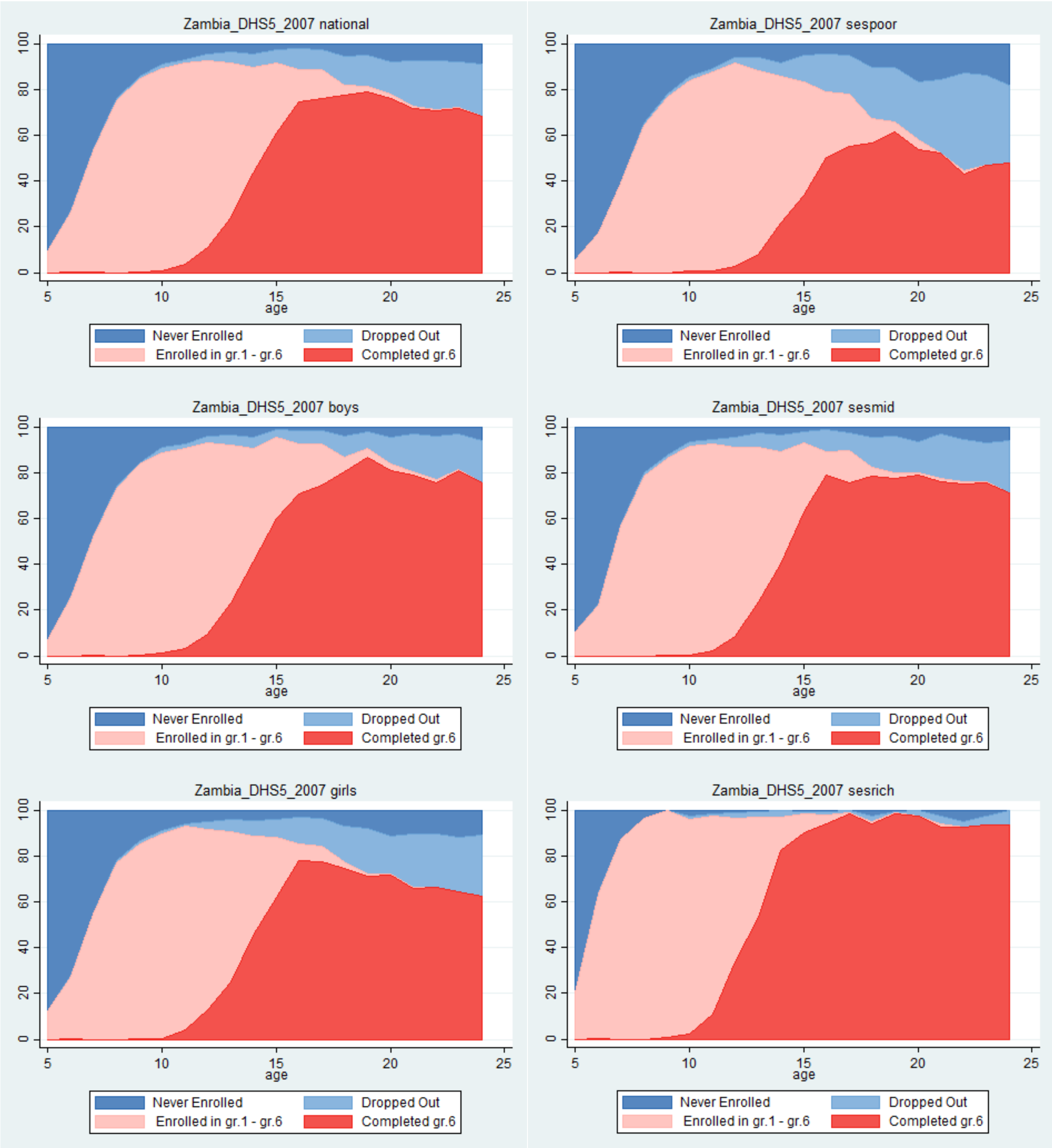
age
Never Enrolled
Dropped Out
Enrolled in gr.1 - gr.6
Completed gr.6

Stellenbosch University https://scholar.sun.ac.za



Zambia 2007


Zambia_DHS5_2007 national
Zambia_DHS5_2007 sespoor
Zambia_DHS5_2007 boys
Zambia_DHS5_2007 sesmid
Zambia_DHS5_2007 girls
Zambia_DHS5_2007 sesrich
0
20
40
60
80
100
5
10
15
20
25
age
Never Enrolled
Dropped Out
Enrolled in gr.1 - gr.6
Completed gr.6

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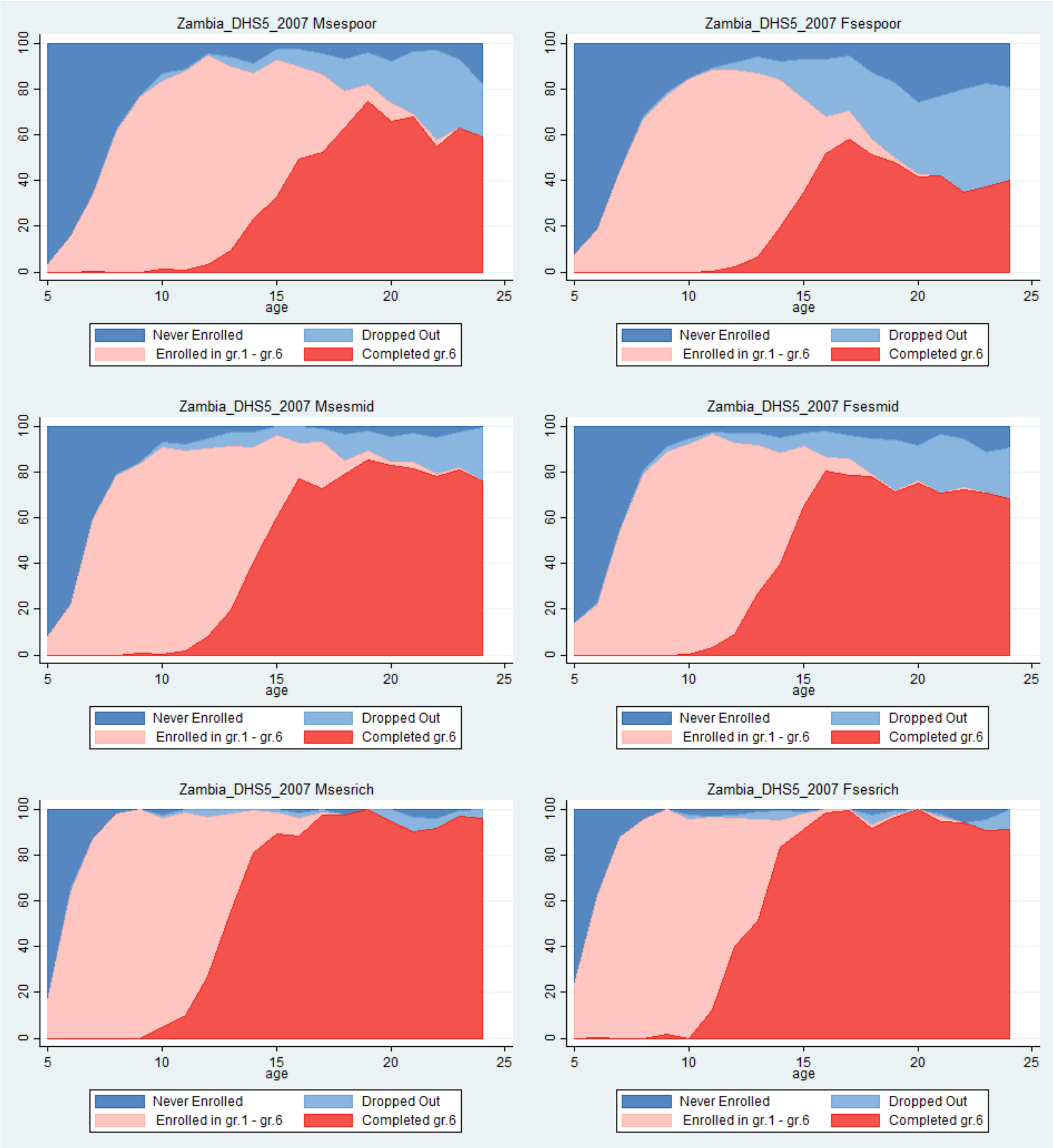
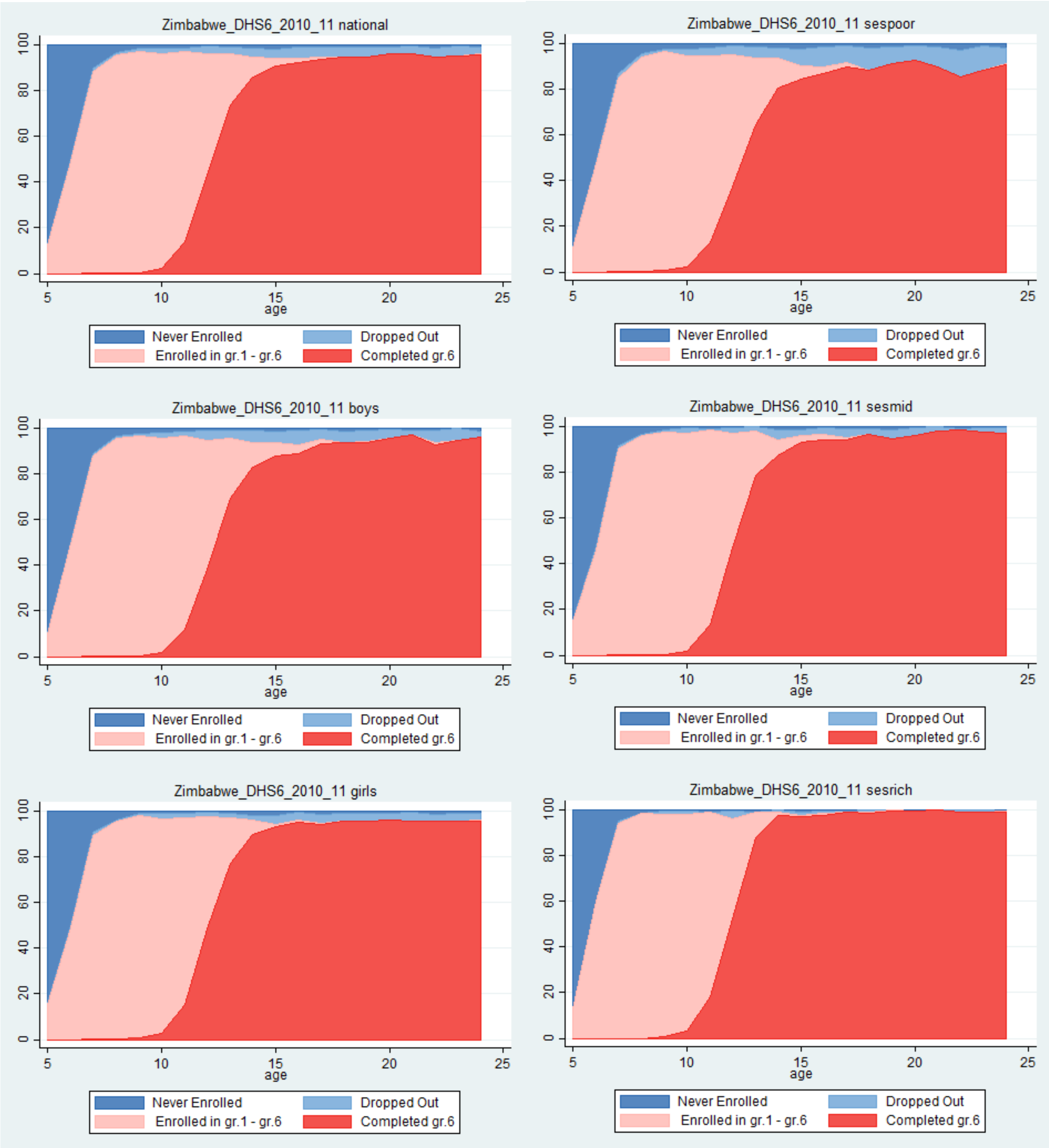
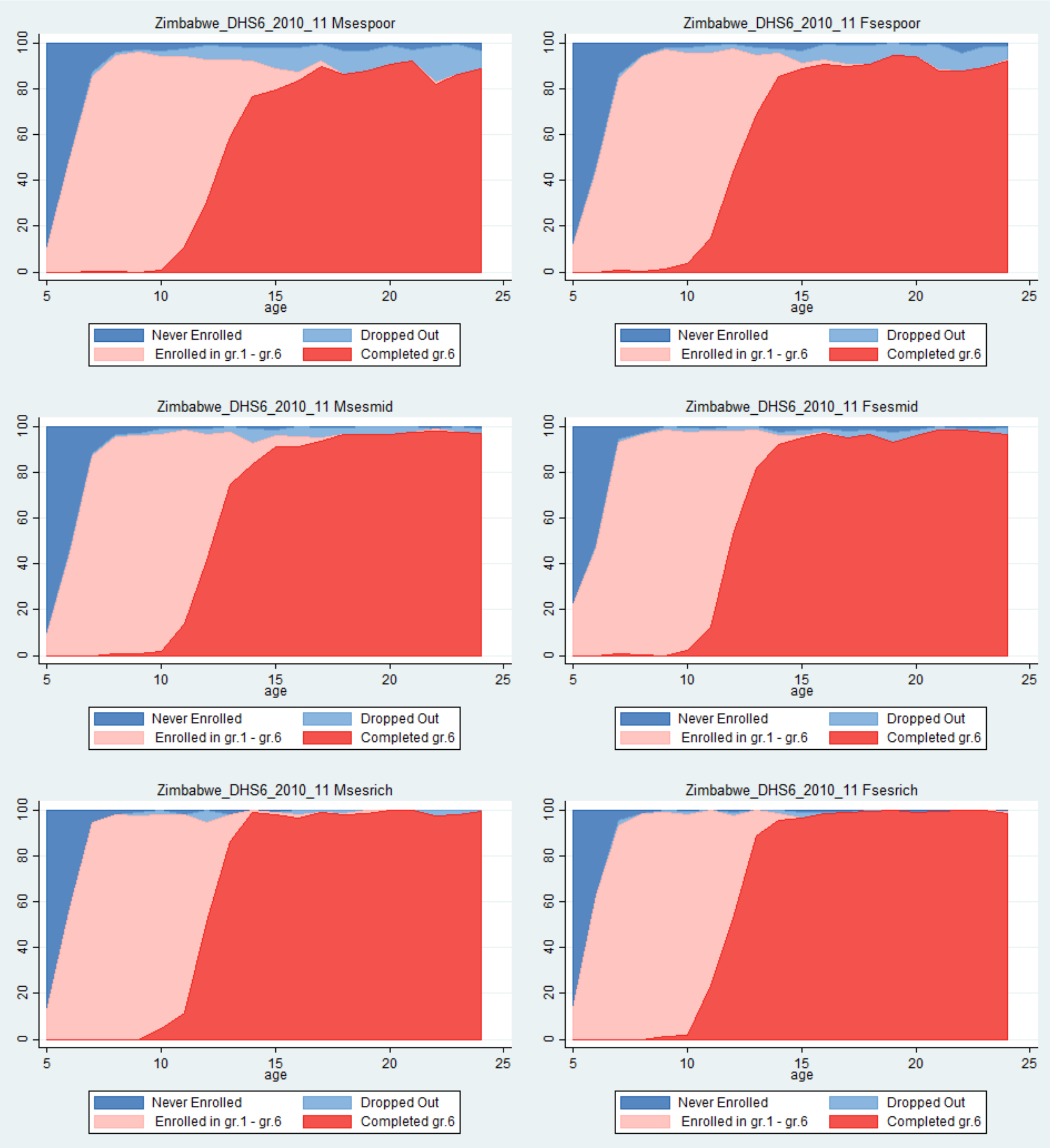


Zimbabwe 2010/11



Stellenbosch University https://scholar.sun.ac.za



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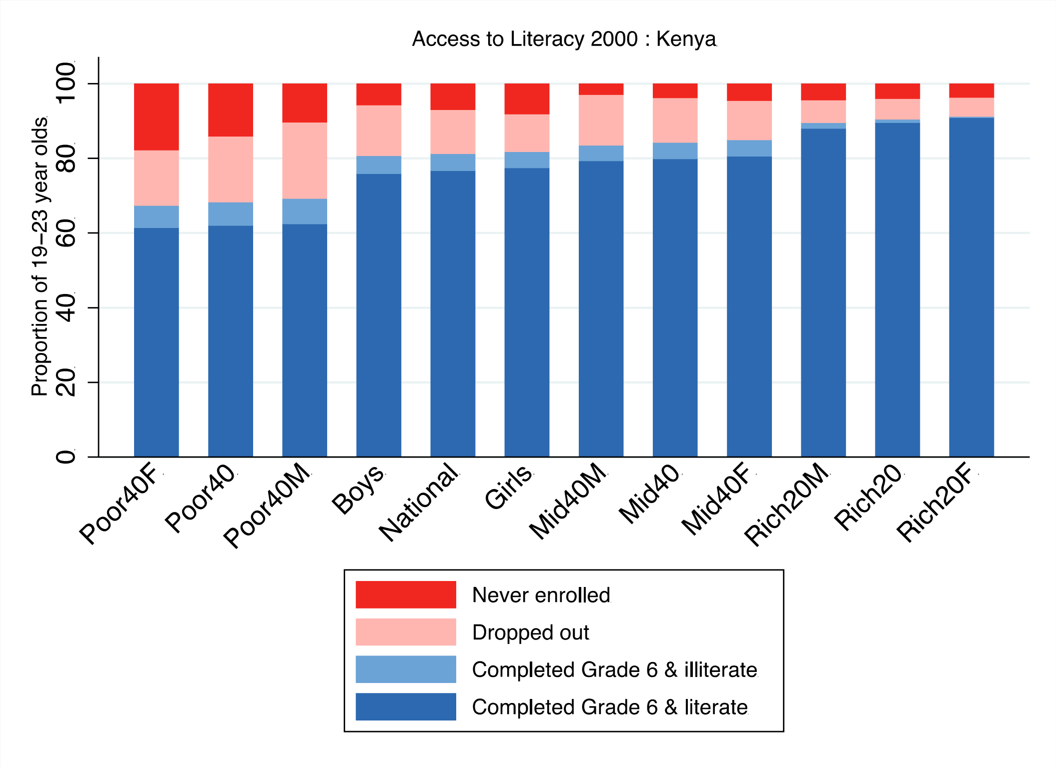
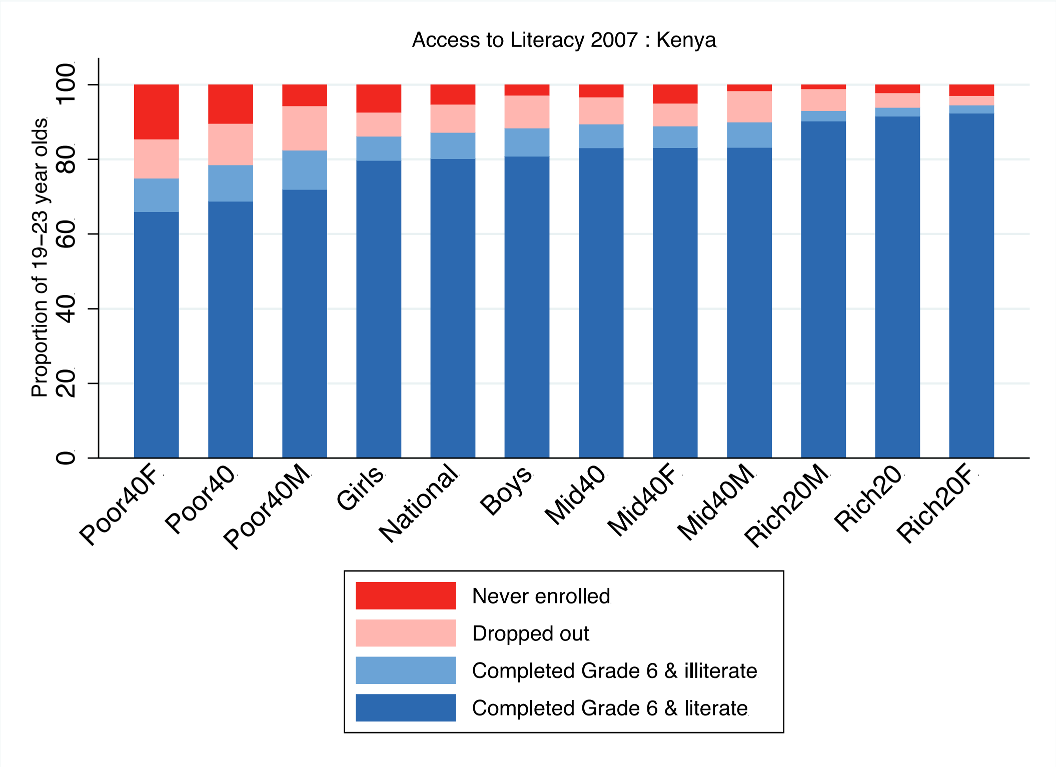
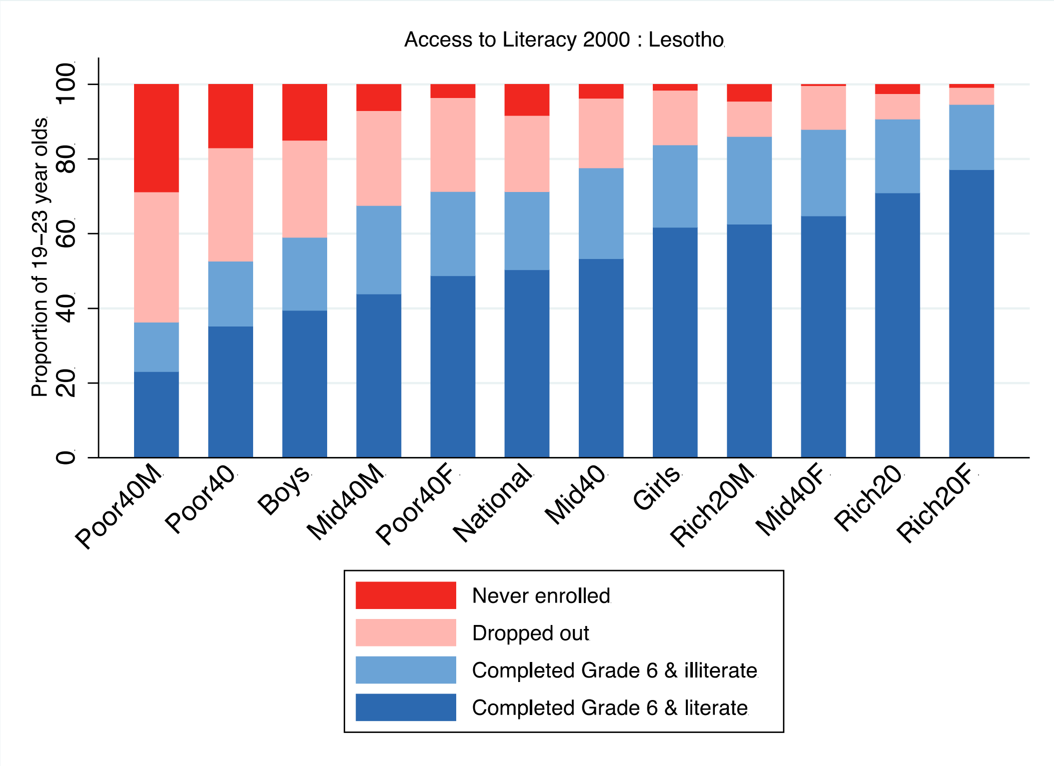
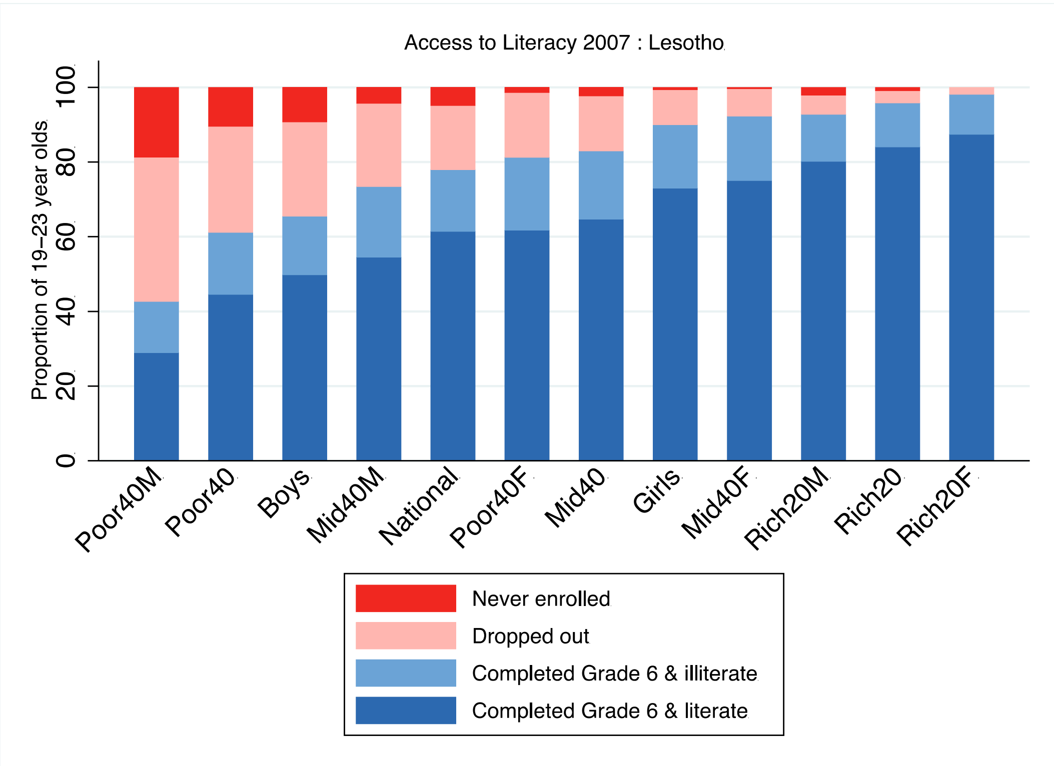
Appendix D3: Chapter 5 graph appendix

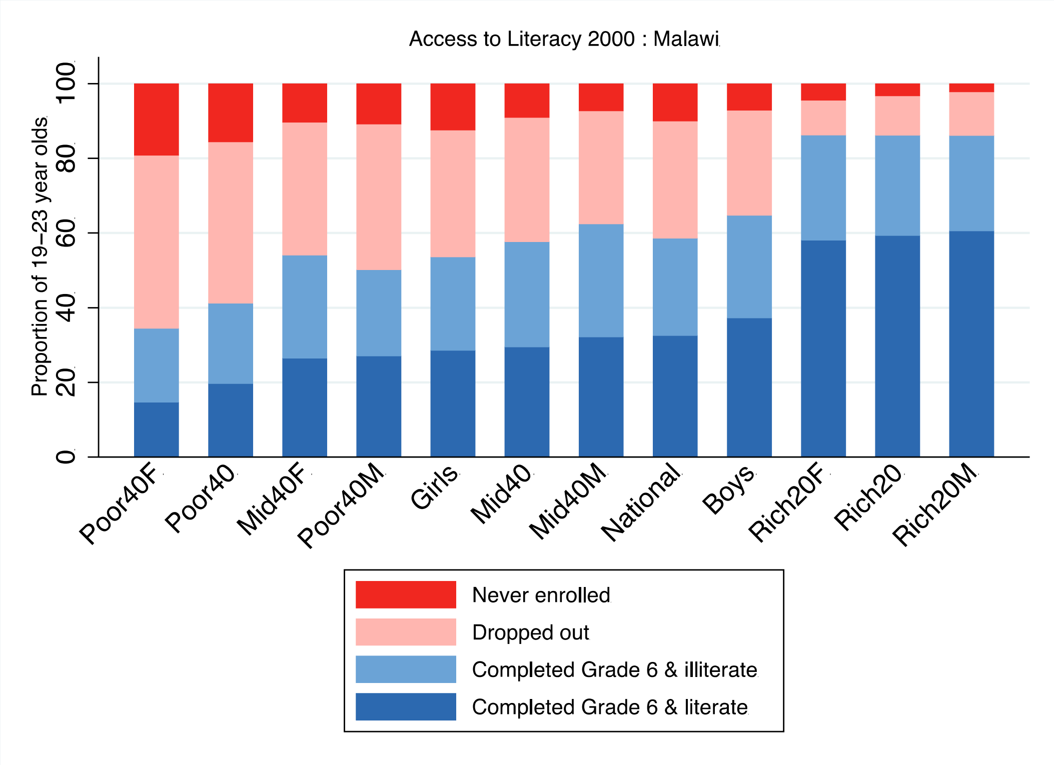
D3.1 Access to literacy graphs

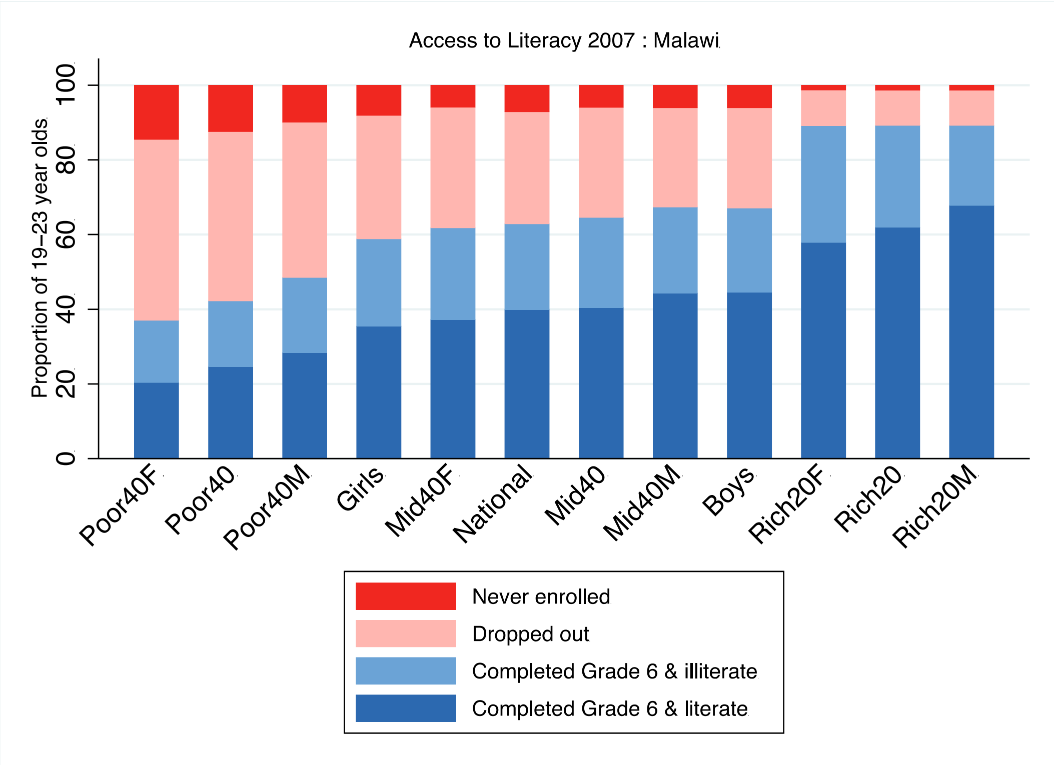


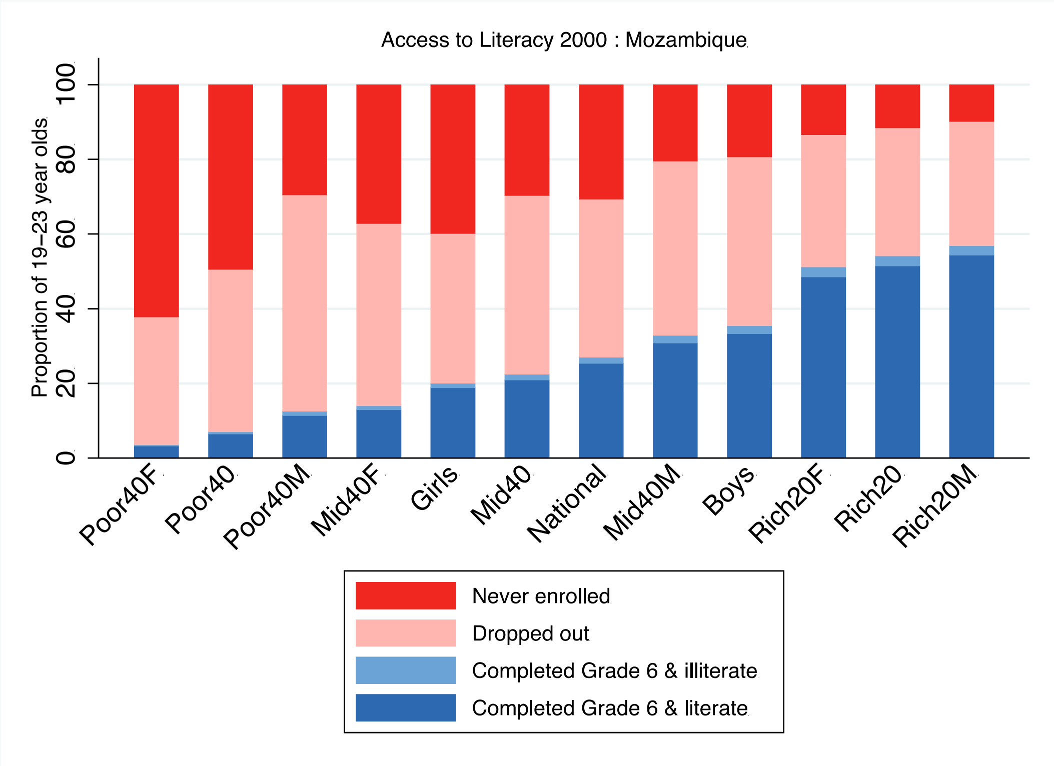


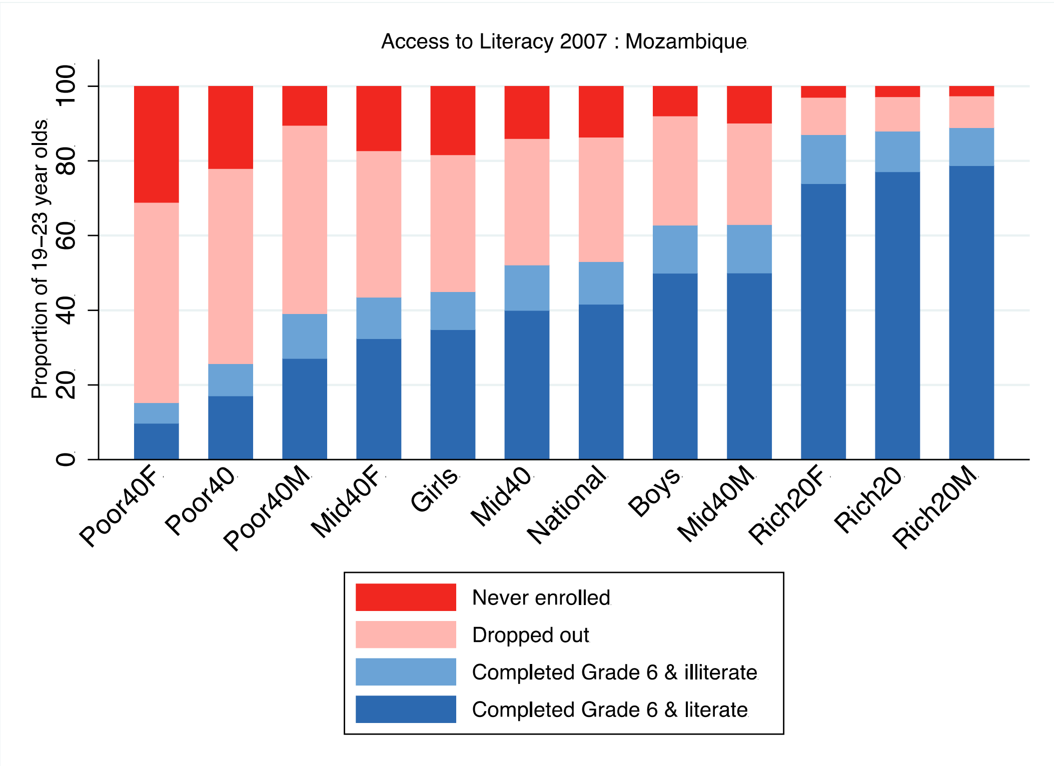

Access to Literacy 2000 : Lesotho
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40M
Poor40
Boys
Mid40M
Poor40F
National
Mid40
Girls
Rich20M
Mid40F
Rich20
Rich20F
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate

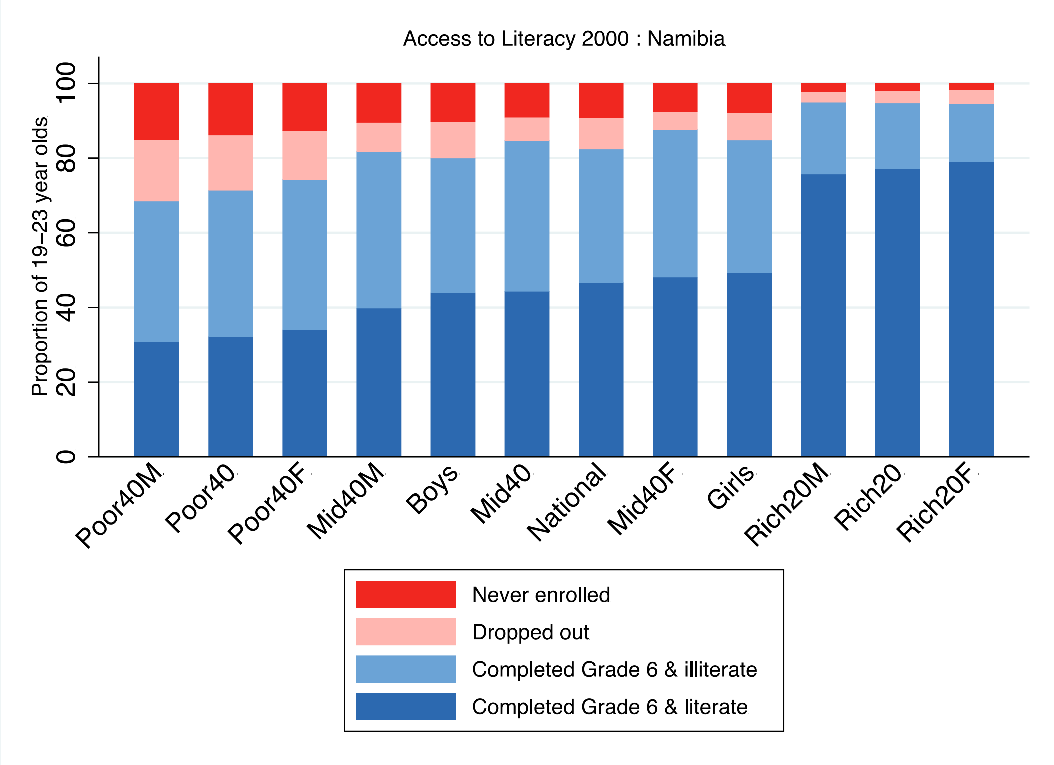

Access to Literacy 2007 : Lesotho
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40M
Poor40
Boys
Mid40M
National
Poor40F
Mid40
Girls
Mid40F
Rich20M
Rich20
Rich20F
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate

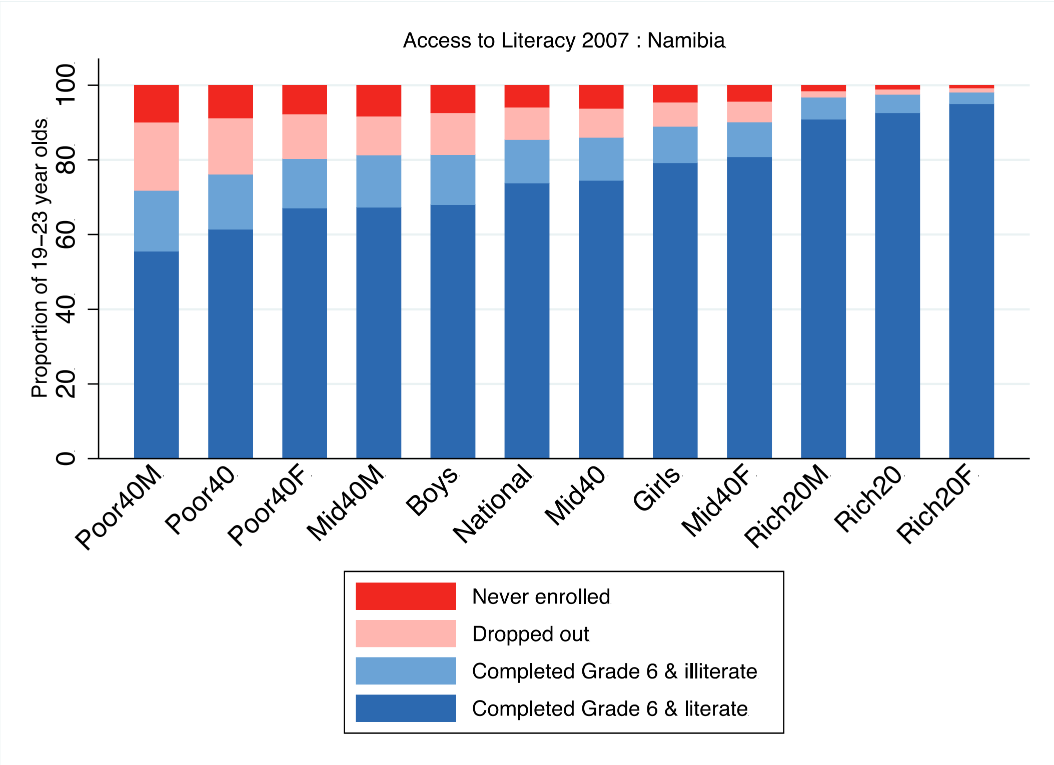

Access to Literacy 2000 : Malawi
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40F
Poor40
Mid40F
Poor40M
Girls
Mid40
Mid40M
National
Boys
Rich20F
Rich20
Rich20M
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate

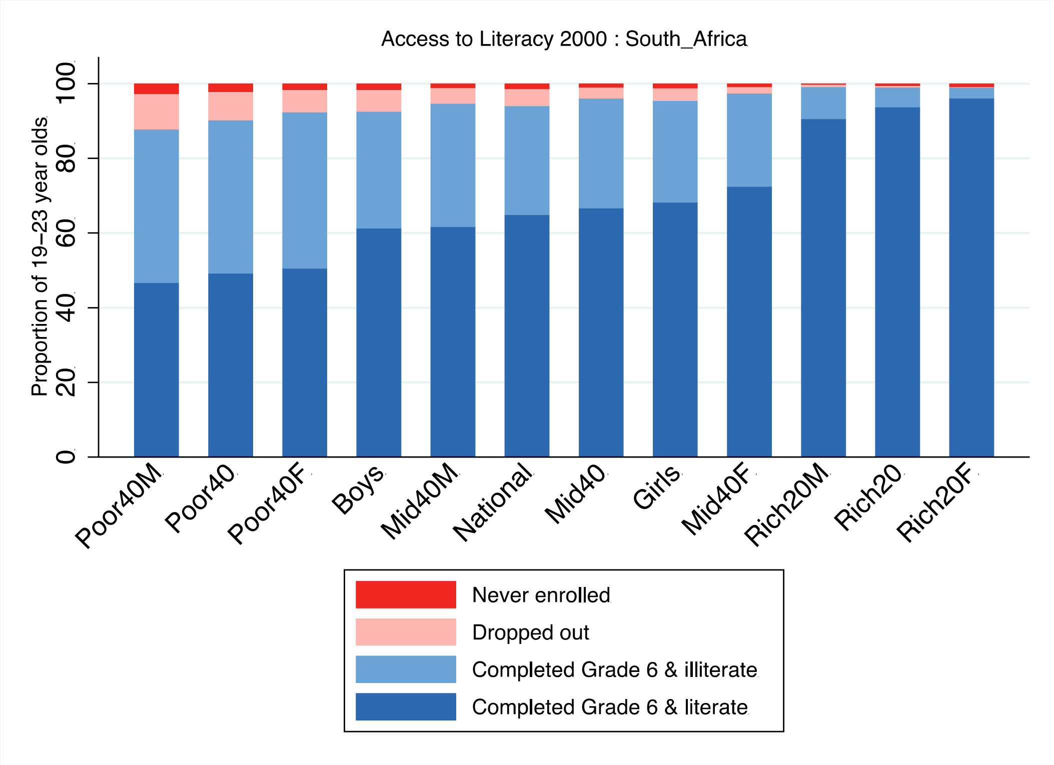

Access to Literacy 2007 : Malawi
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40F
Poor40
Poor40M
Girls
Mid40F
National
Mid40
Mid40M
Boys
Rich20F
Rich20
Rich20M
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate

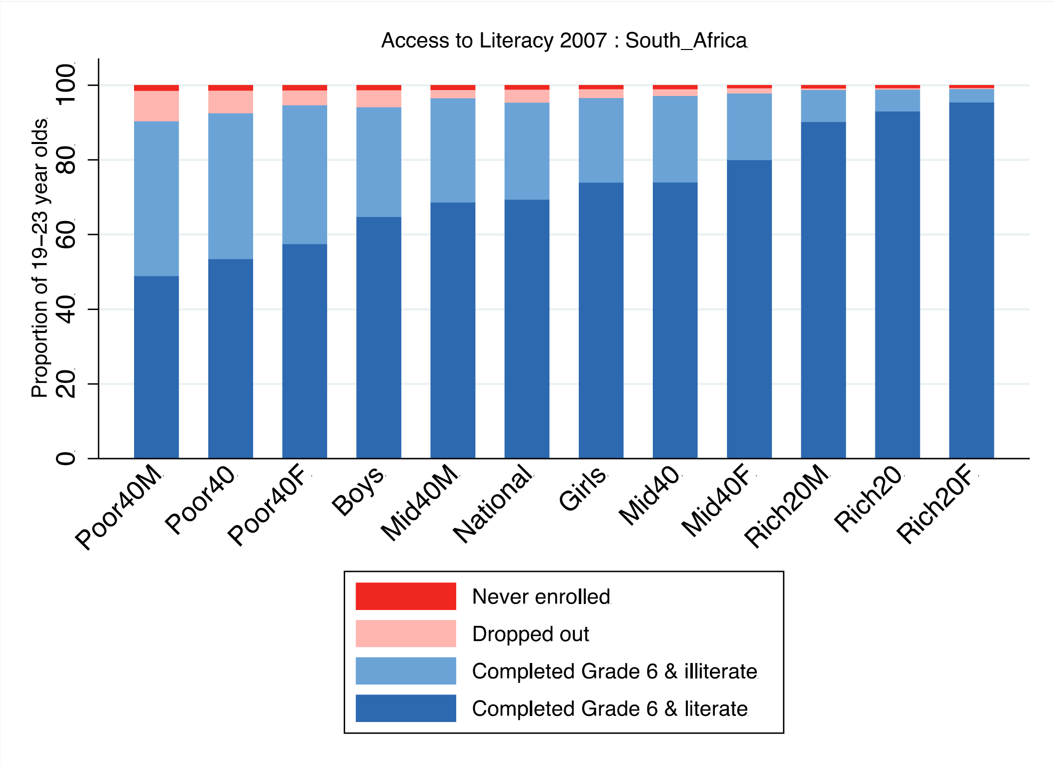

Access to Literacy 2000 : Mozambique
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40F
Poor40
Poor40M
Mid40F
Girls
Mid40
National
Mid40M
Boys
Rich20F
Rich20
Rich20M
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate

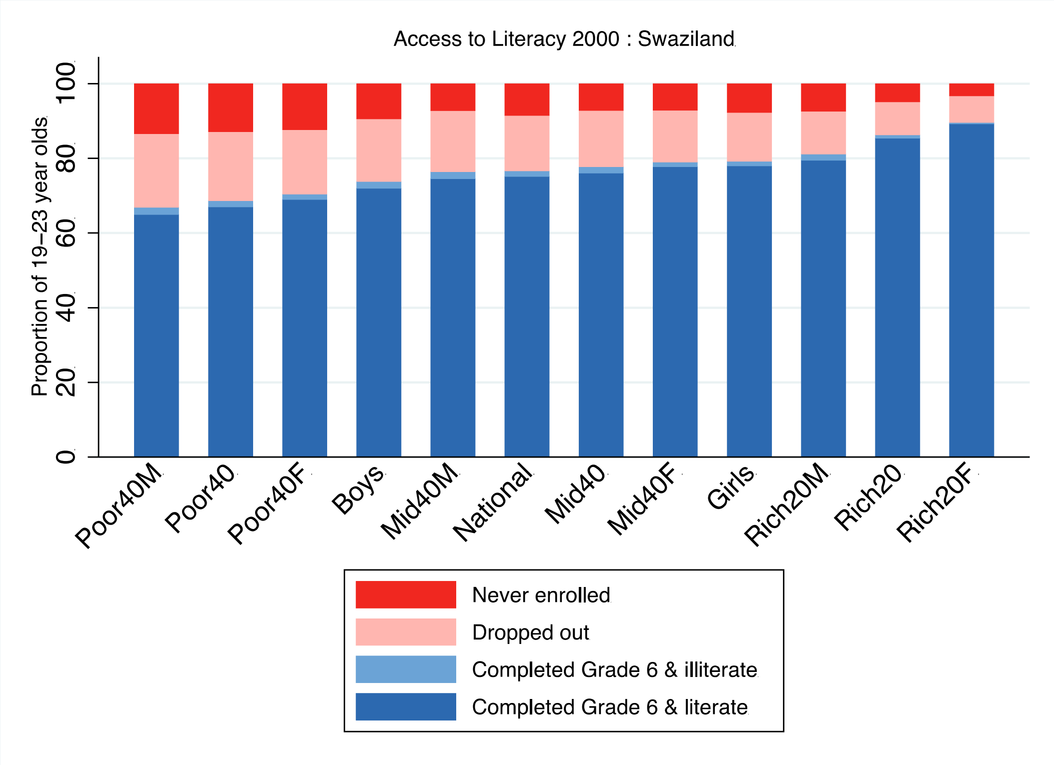

Access to Literacy 2007 : Mozambique
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40F
Poor40
Poor40M
Mid40F
Girls
Mid40
National
Boys
Mid40M
Rich20F
Rich20
Rich20M
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate


Access to Literacy 2000 : Namibia
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40M
Poor40
Poor40F
Mid40M
Boys
Mid40
National
Mid40F
Girls
Rich20M
Rich20
Rich20F
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate

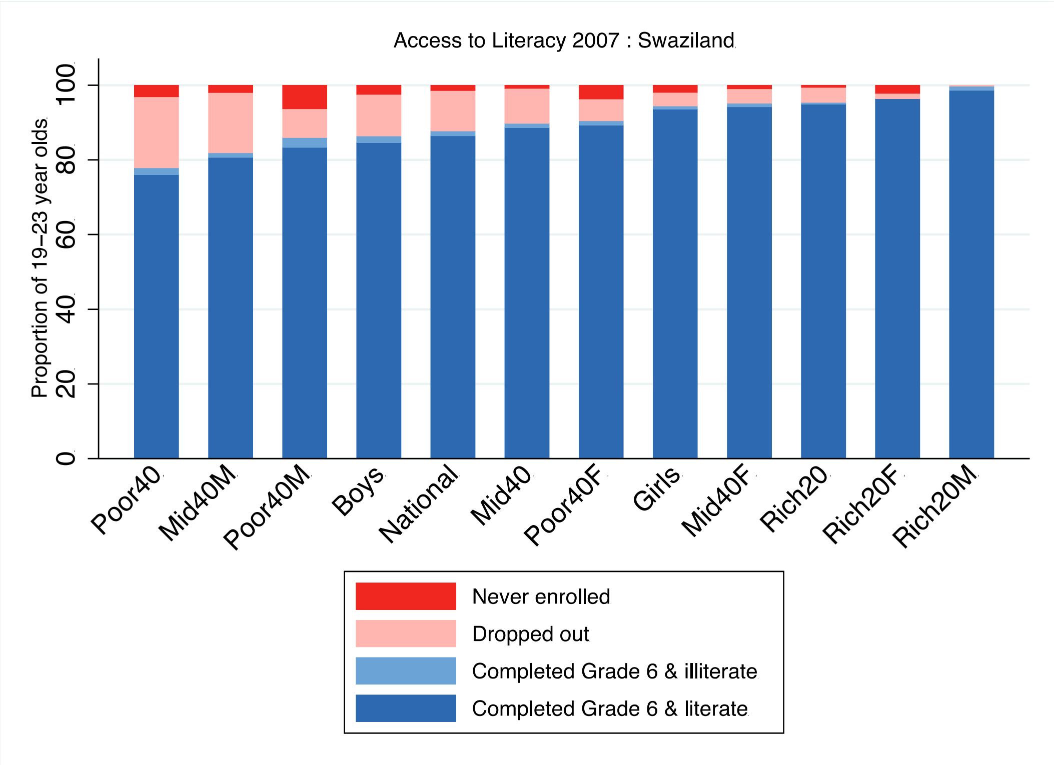

Access to Literacy 2007 : Namibia
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40M
Poor40
Poor40F
Mid40M
Boys
National
Mid40
Girls
Mid40F
Rich20M
Rich20
Rich20F
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate


Access to Literacy 2000 : South_Africa
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40M
Poor40
Poor40F
Boys
Mid40M
National
Mid40
Girls
Mid40F
Rich20M
Rich20
Rich20F
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate

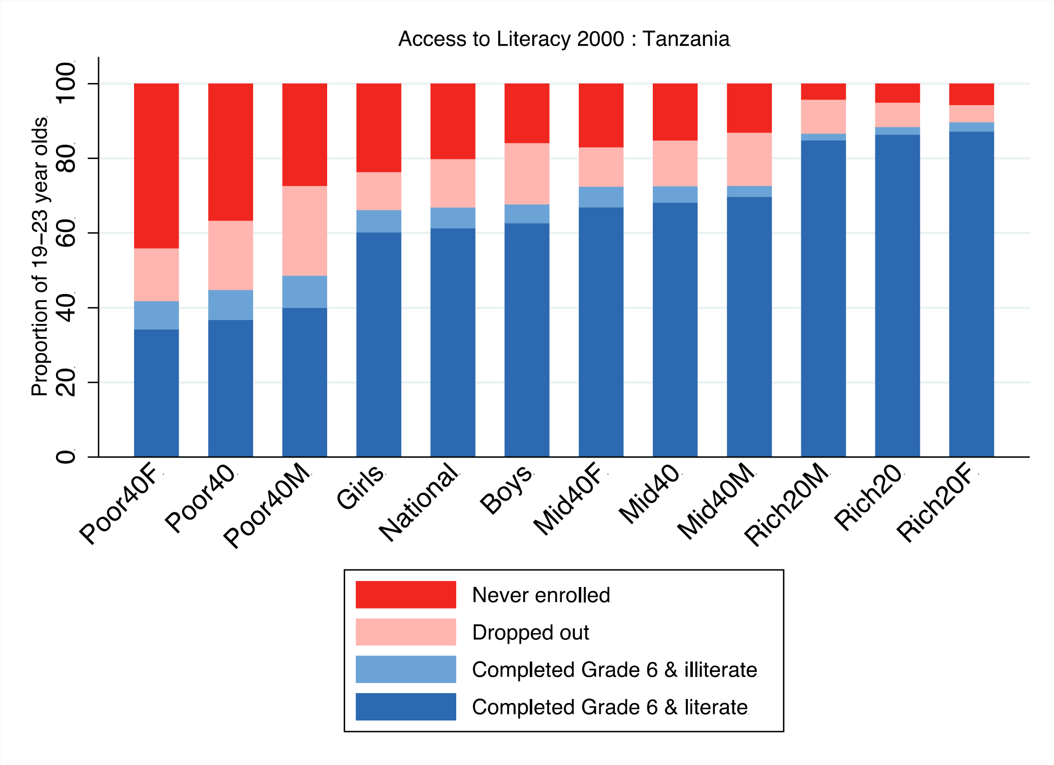

Access to Literacy 2007 : South_Africa
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40M
Poor40
Poor40F
Boys
Mid40M
National
Girls
Mid40
Mid40F
Rich20M
Rich20
Rich20F
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate



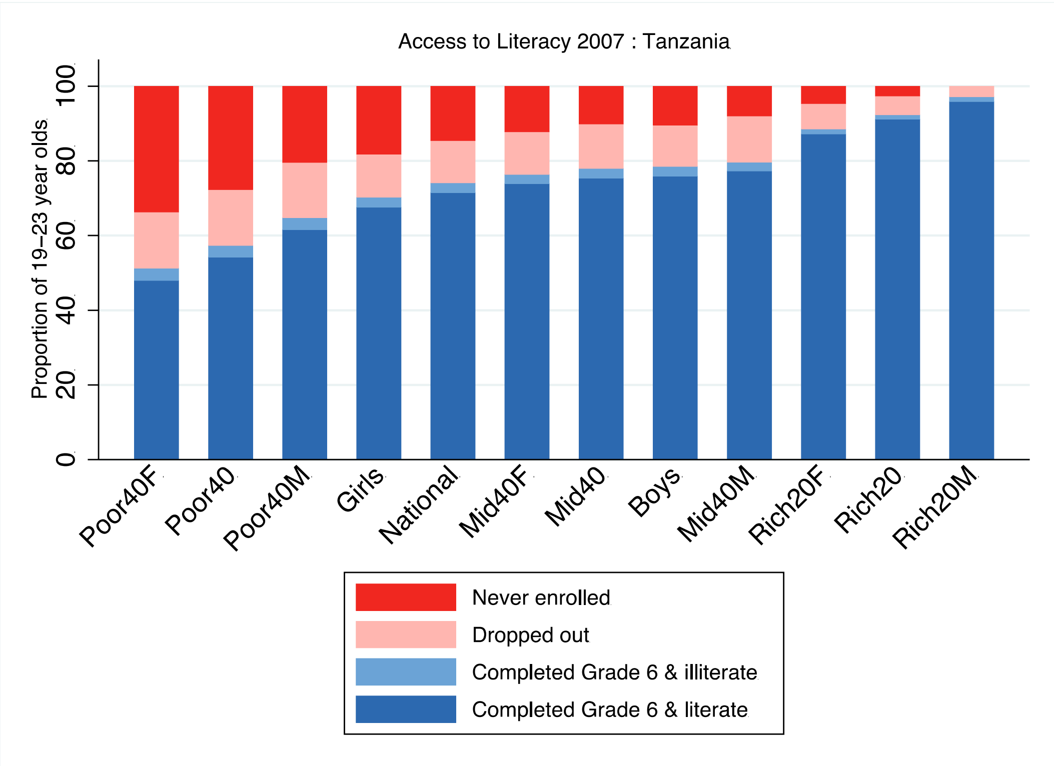
Access to Literacy 2000 : Swaziland
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40M
Poor40
Poor40F
Boys
Mid40M
National
Mid40
Mid40F
Girls
Rich20M
Rich20
Rich20F
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate



Access to Literacy 2007 : Swaziland
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40
Mid40M
Poor40M
Boys
National
Mid40
Poor40F
Girls
Mid40F
Rich20
Rich20F
Rich20M
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate



Access to Literacy 2000 : Tanzania
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40F
Poor40
Poor40M
Girls
National
Boys
Mid40F
Mid40
Mid40M
Rich20M
Rich20
Rich20F
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate



Access to Literacy 2007 : Tanzania
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40F
Poor40
Poor40M
Girls
National
Mid40F
Mid40
Boys
Mid40M
Rich20F
Rich20
Rich20M
Never enrolled
Dropped out
Completed Grade 6 & illiterate
Completed Grade 6 & literate

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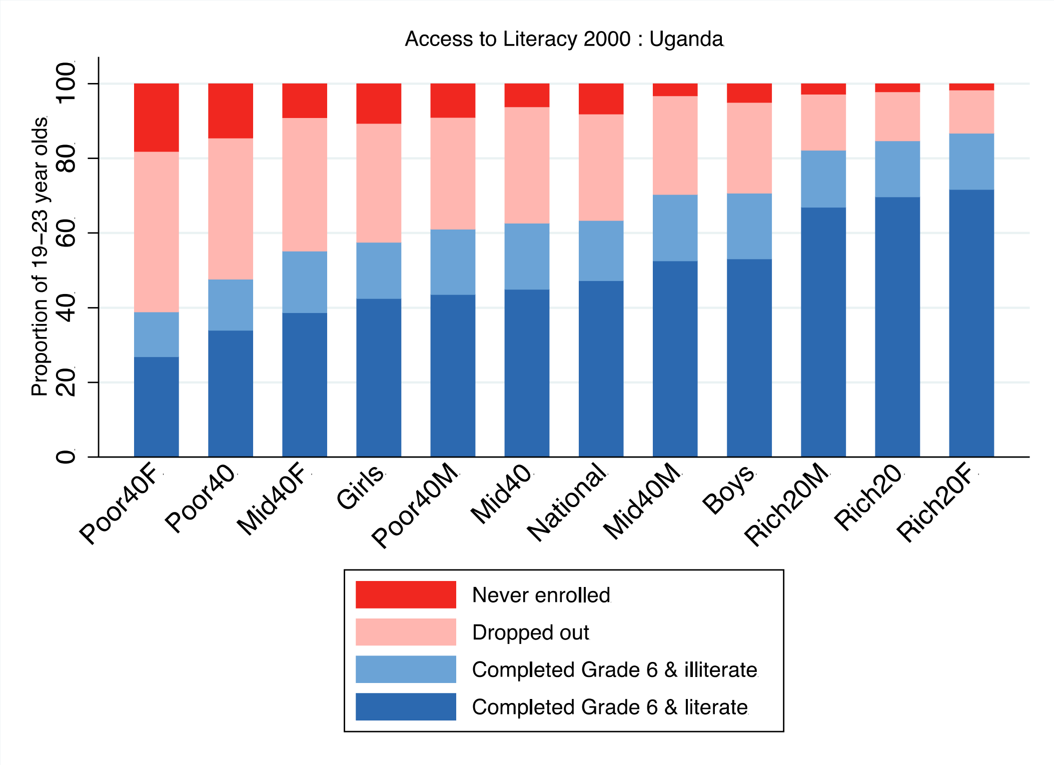

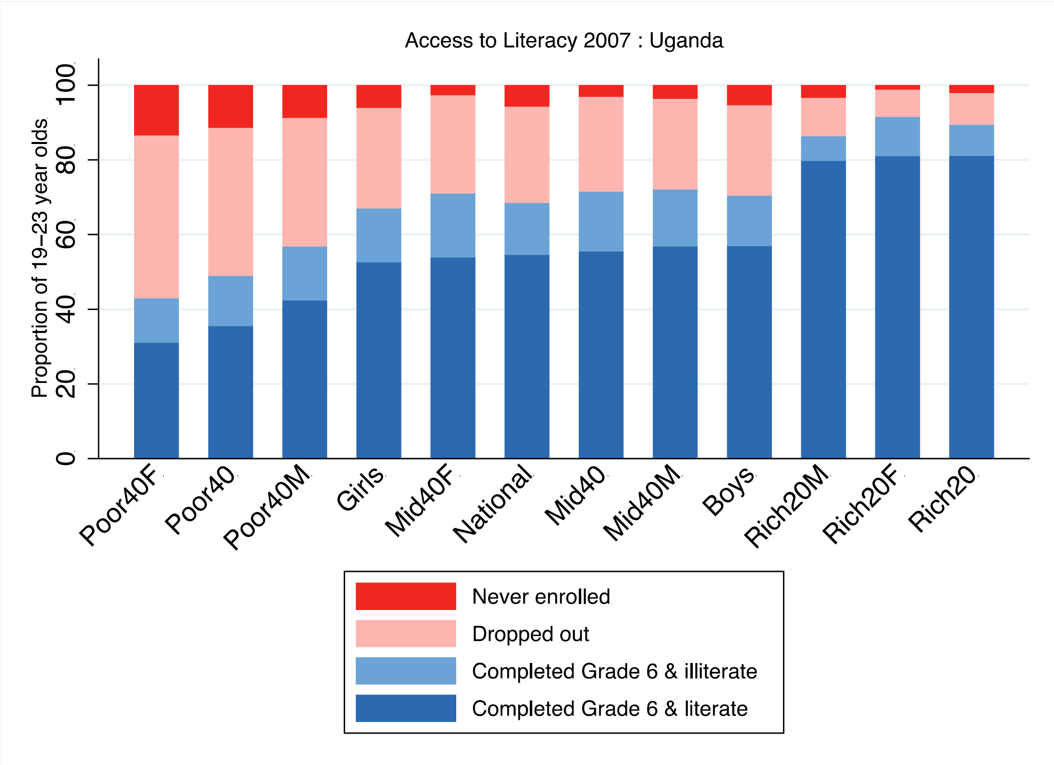

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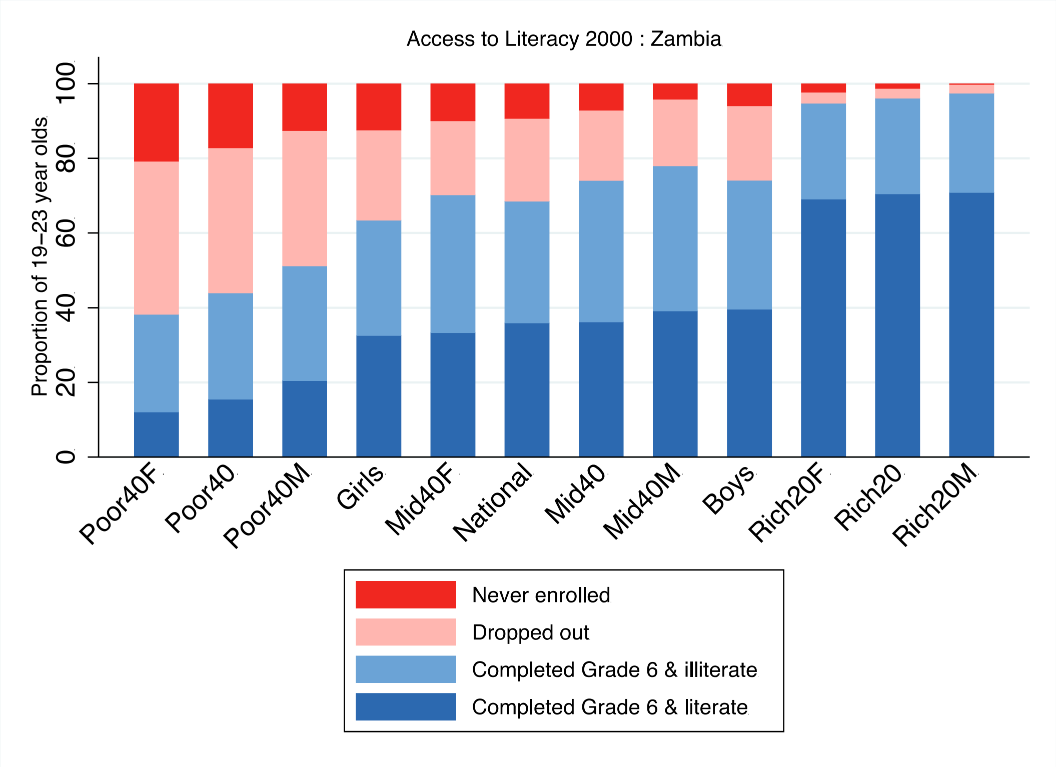
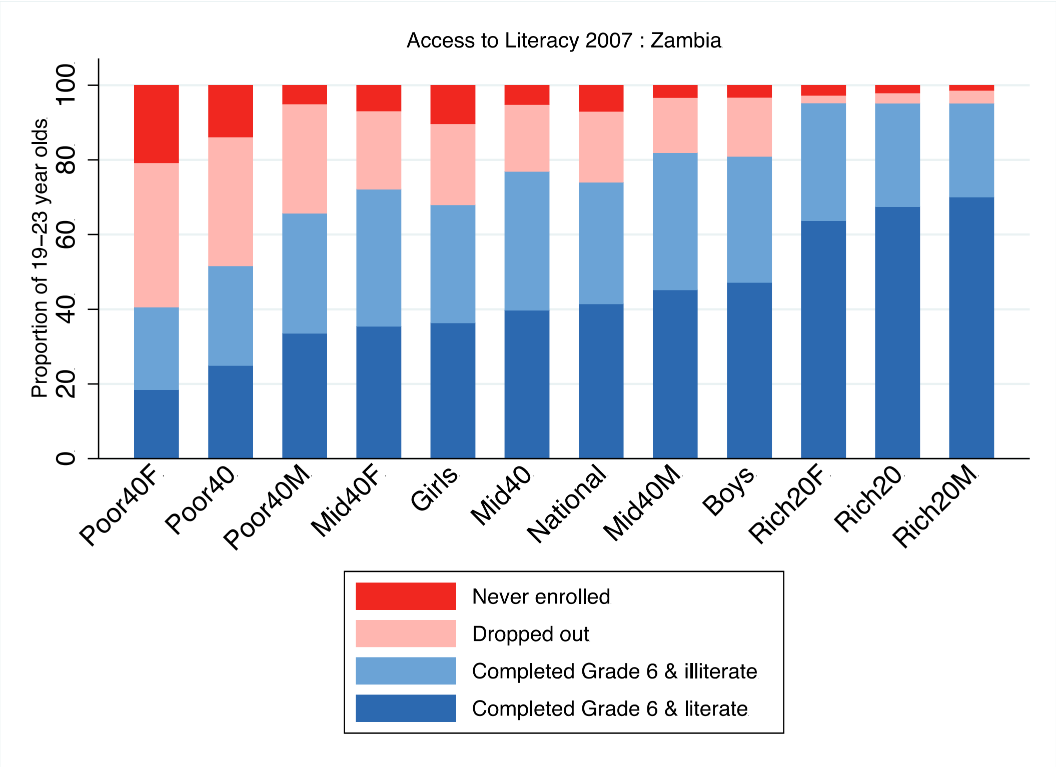
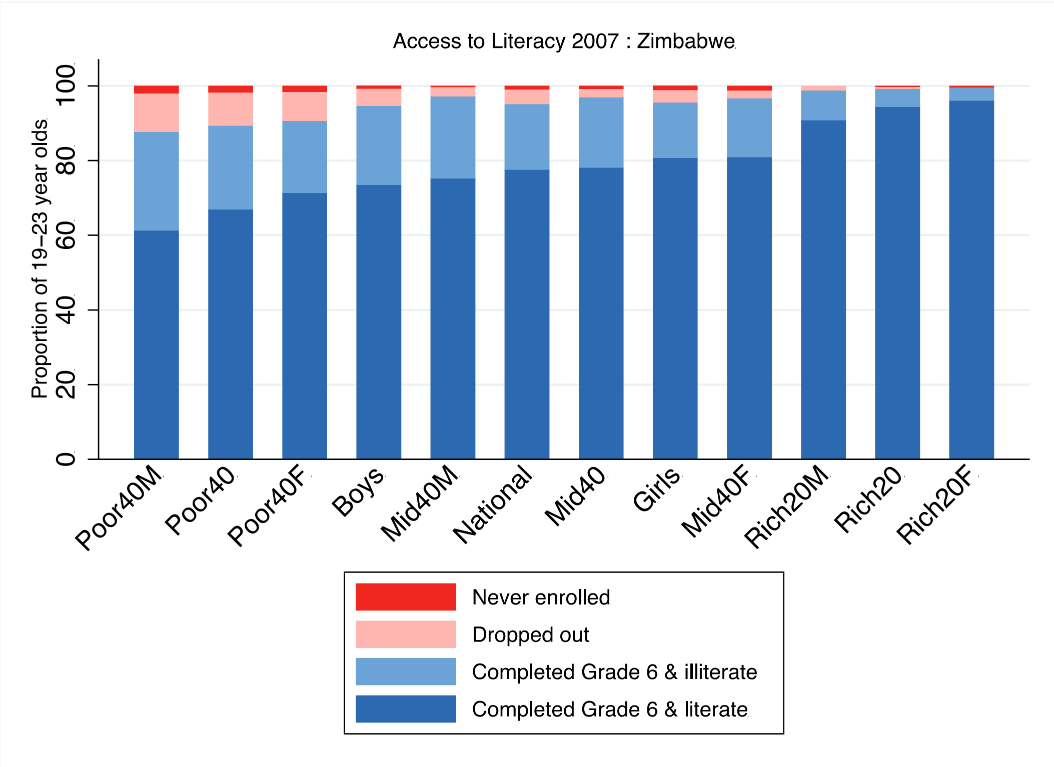




Stellenbosch University https://scholar.sun.ac.za

[Zimbabwe did not participate in SACMEQ 2000]



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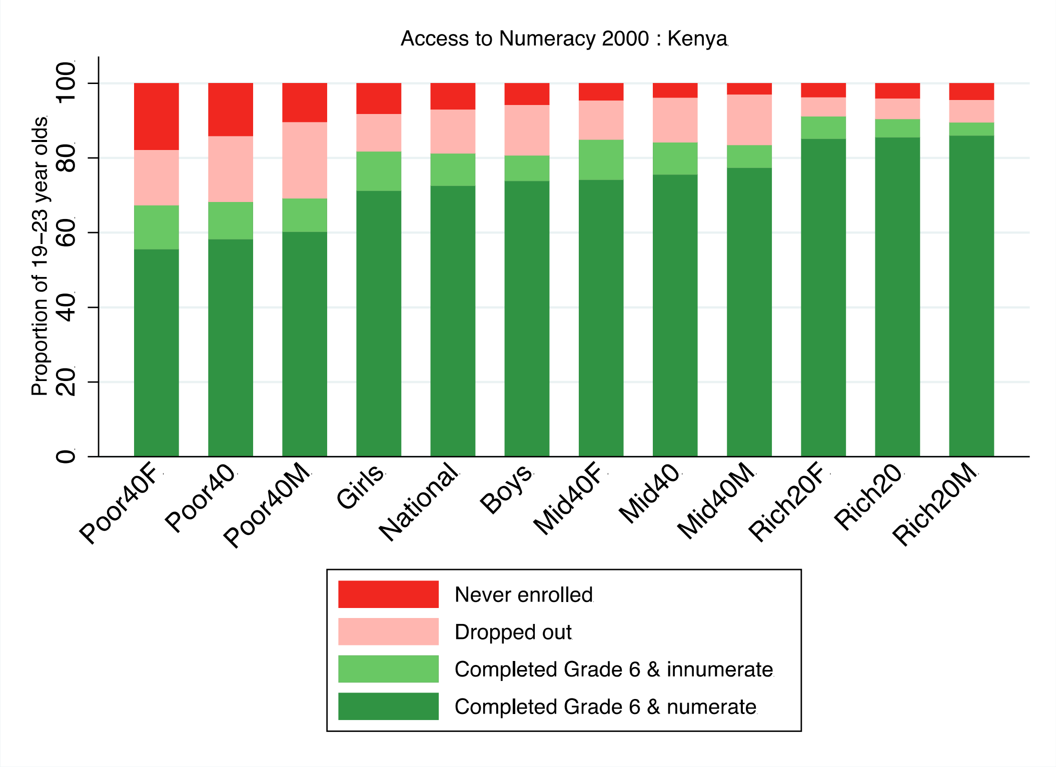
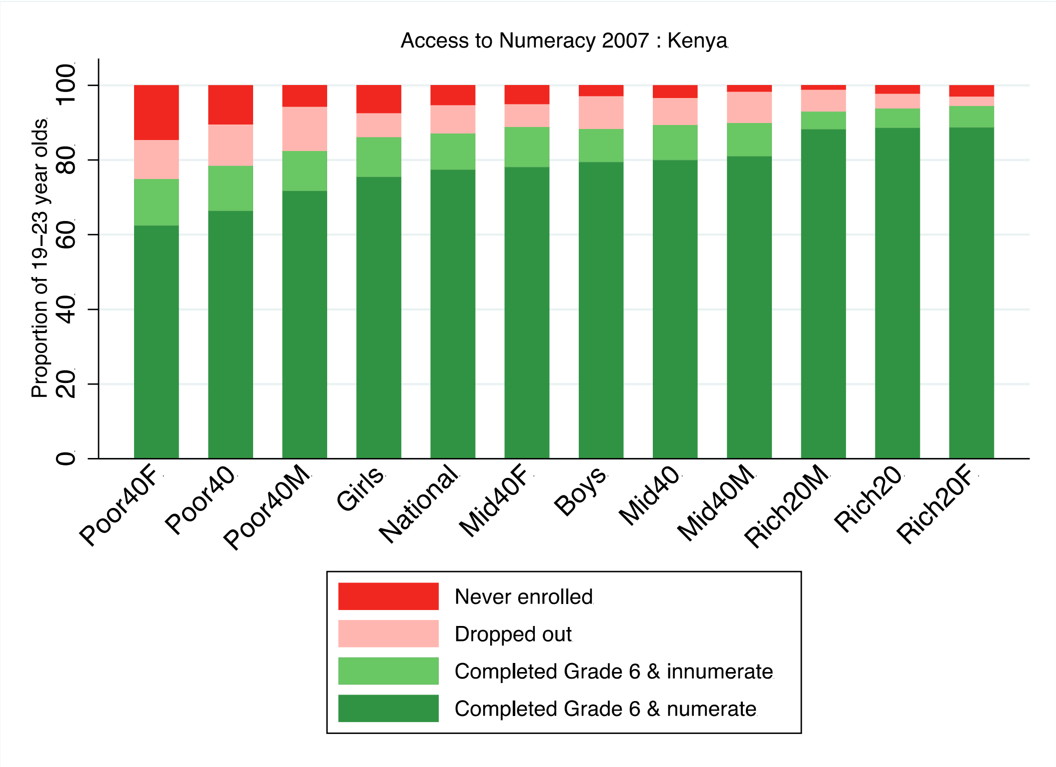
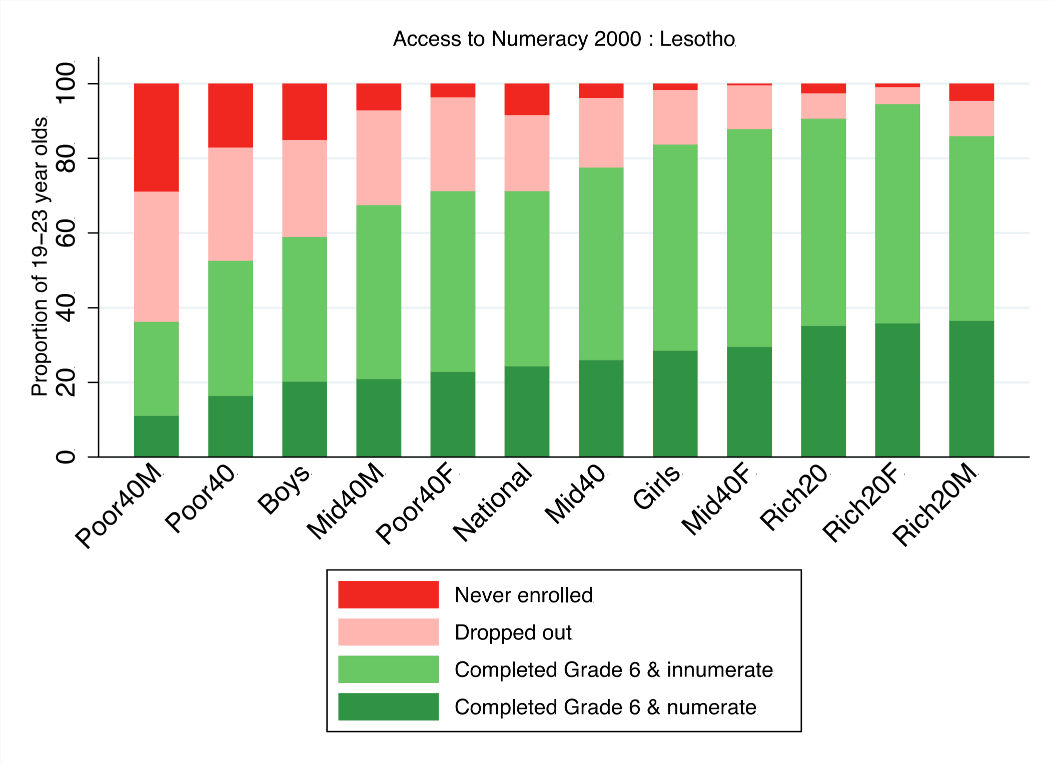
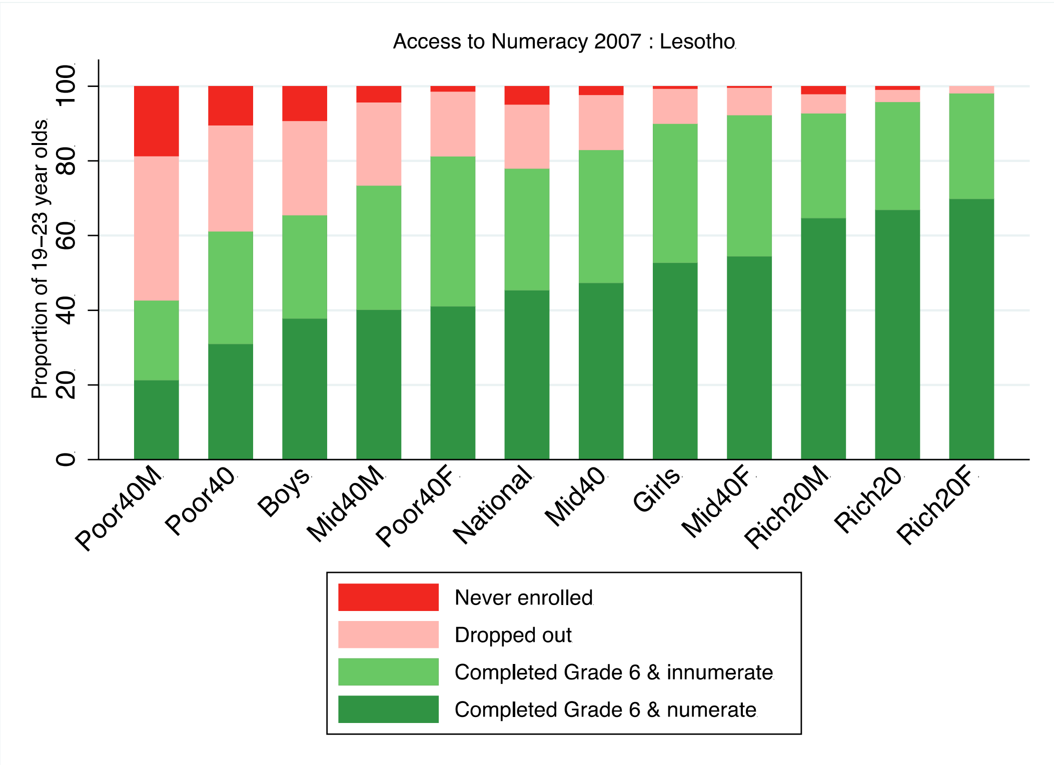
D3.2 Access to numeracy

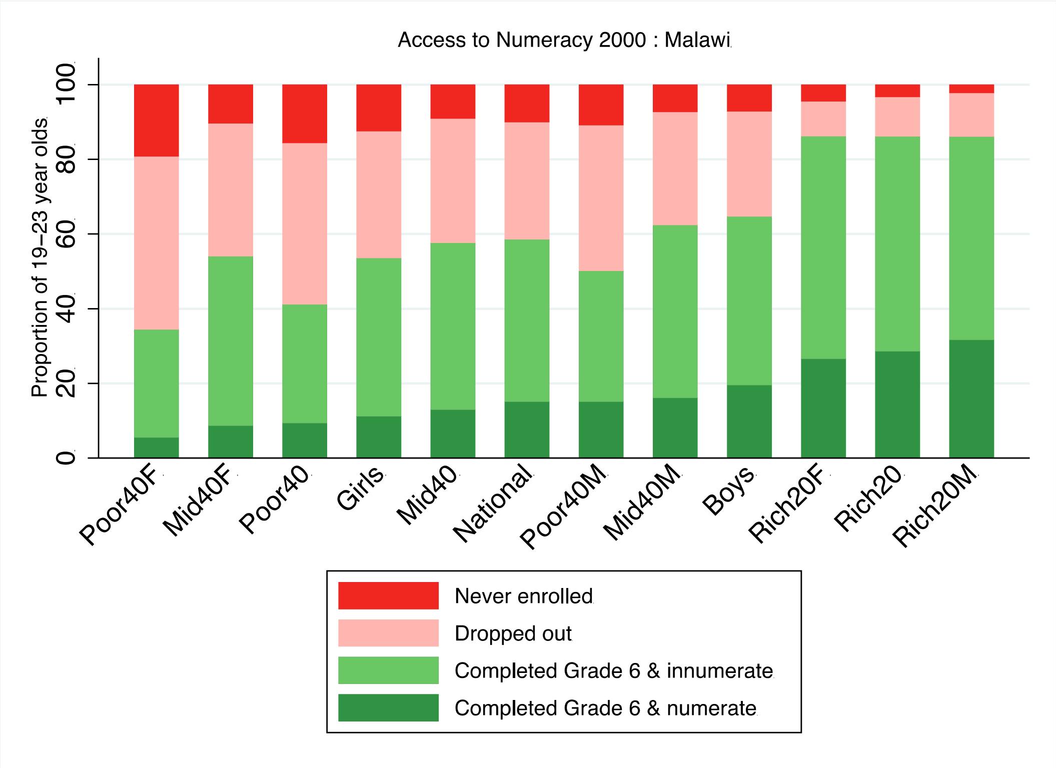


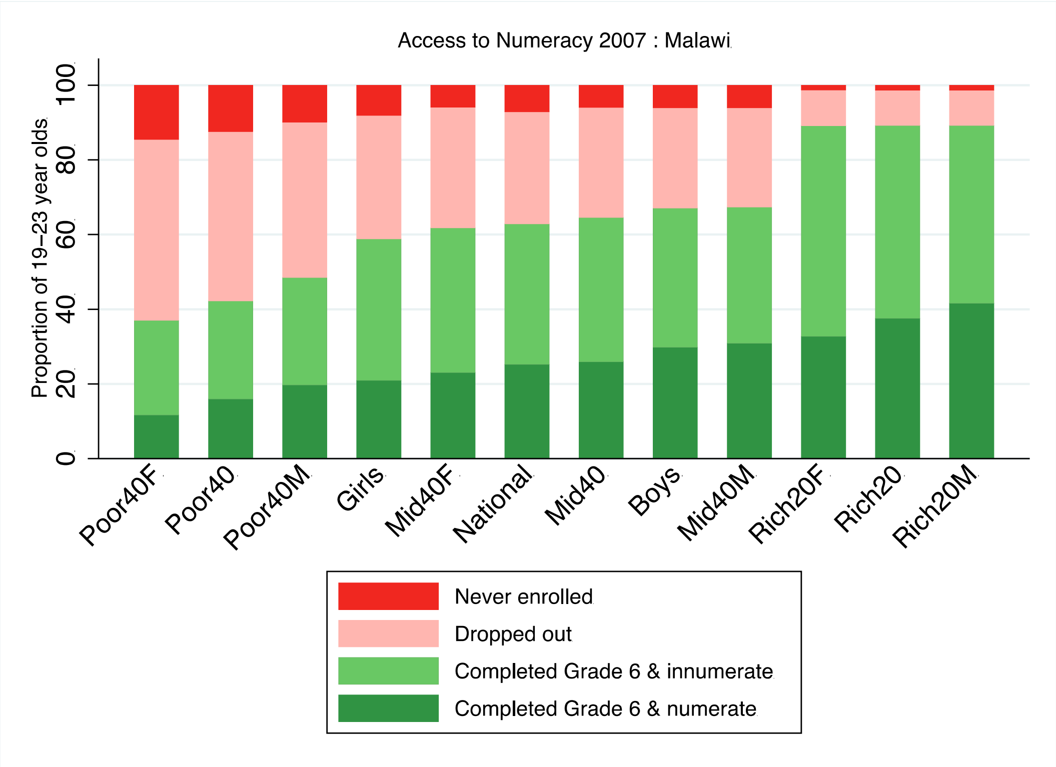


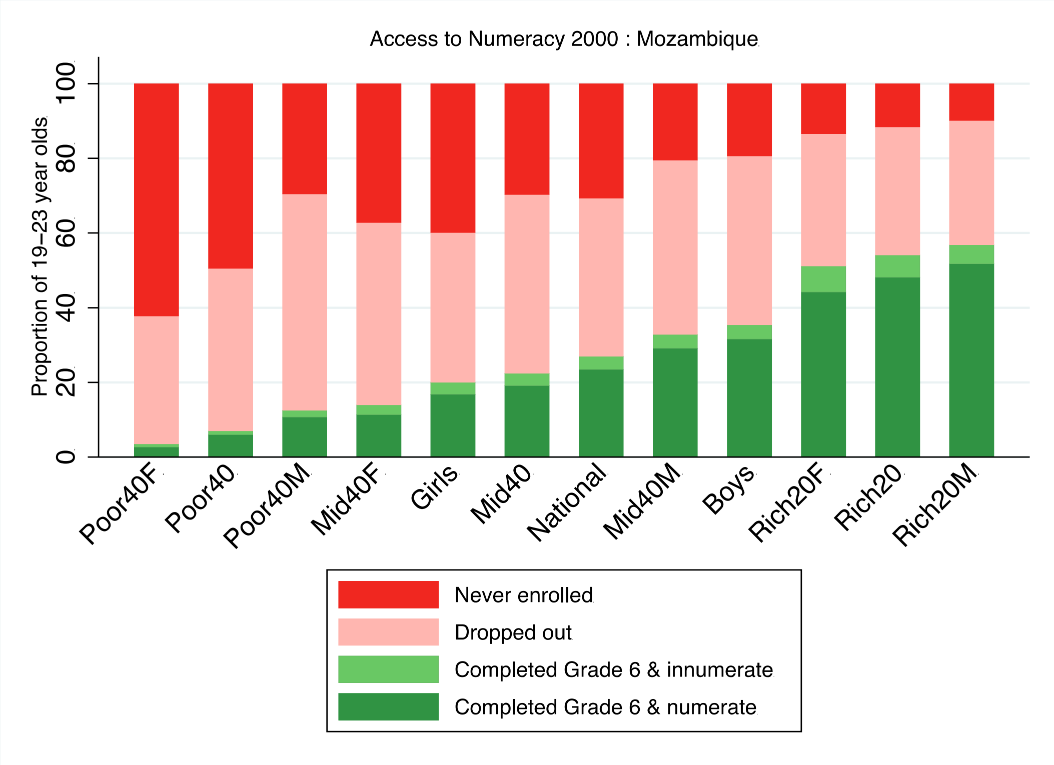
Stellenbosch University https://scholar.sun.ac.za

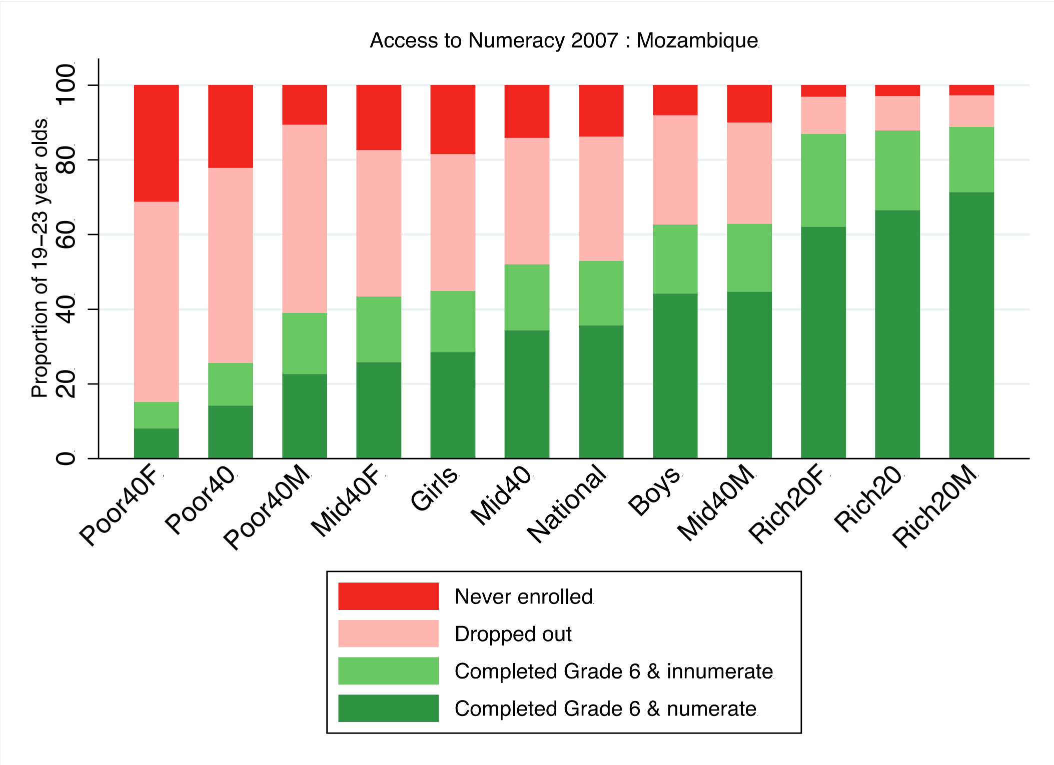





Access to Numeracy 2000 : Malawi
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40F
Mid40F
Poor40
Girls
Mid40
National
Poor40M
Mid40M
Boys
Rich20F
Rich20
Rich20M
Never enrolled
Dropped out
Completed Grade 6 & innumerate
Completed Grade 6 & numerate


Access to Numeracy 2007 : Malawi
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40F
Poor40
Poor40M
Girls
Mid40F
National
Mid40
Boys
Mid40M
Rich20F
Rich20
Rich20M
Never enrolled
Dropped out
Completed Grade 6 & innumerate
Completed Grade 6 & numerate


Access to Numeracy 2000 : Mozambique
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40F
Poor40
Poor40M
Mid40F
Girls
Mid40
National
Mid40M
Boys
Rich20F
Rich20
Rich20M
Never enrolled
Dropped out
Completed Grade 6 & innumerate
Completed Grade 6 & numerate


Access to Numeracy 2007 : Mozambique
Proportion of 19–23 year olds
0
20
40
60
80
100
Poor40F
Poor40
Poor40M
Mid40F
Girls
Mid40
National
Boys
Mid40M
Rich20F
Rich20
Rich20M
Never enrolled
Dropped out
Completed Grade 6 & innumerate
Completed Grade 6 & numerate

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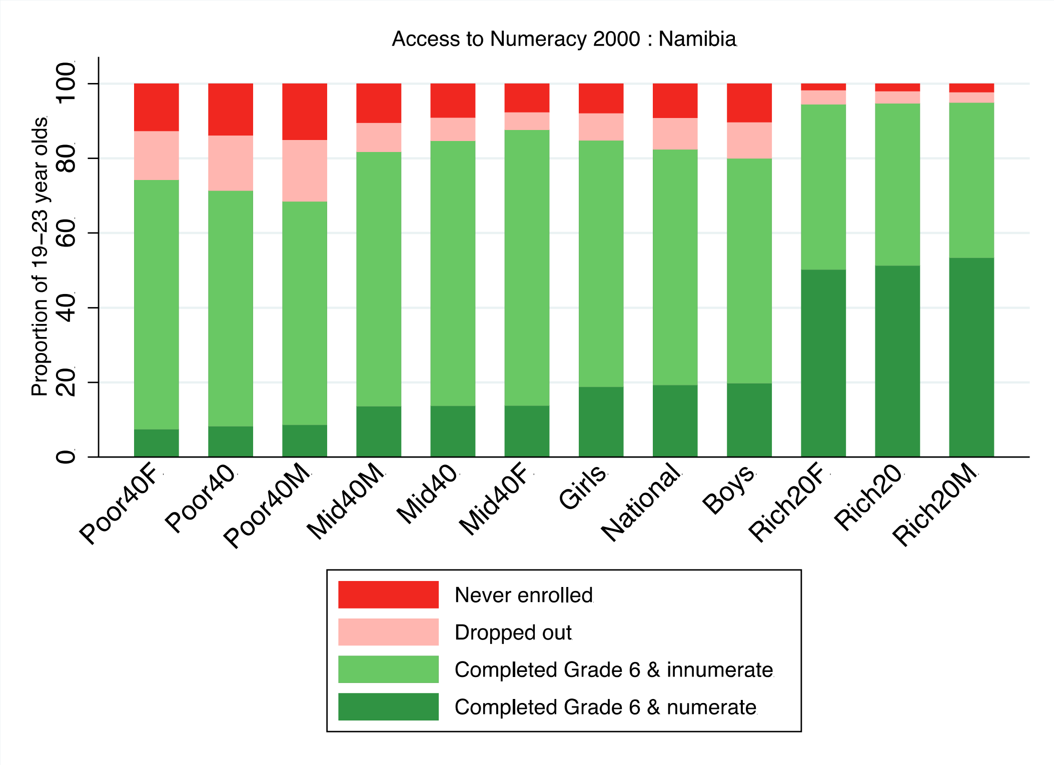
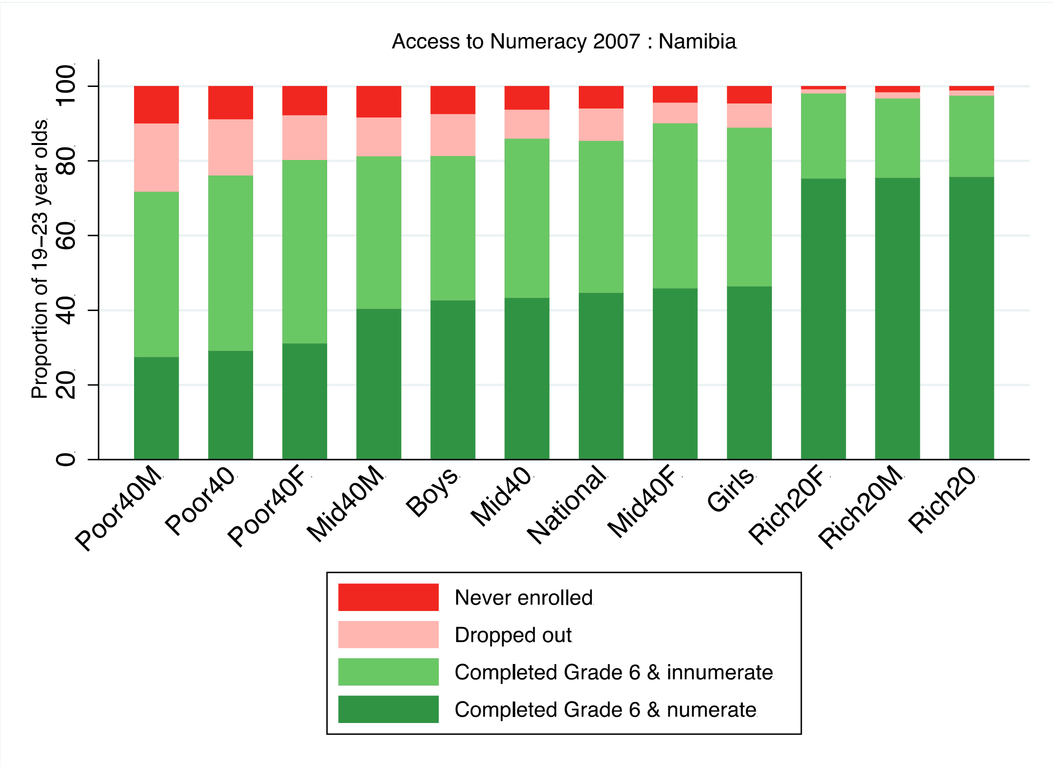
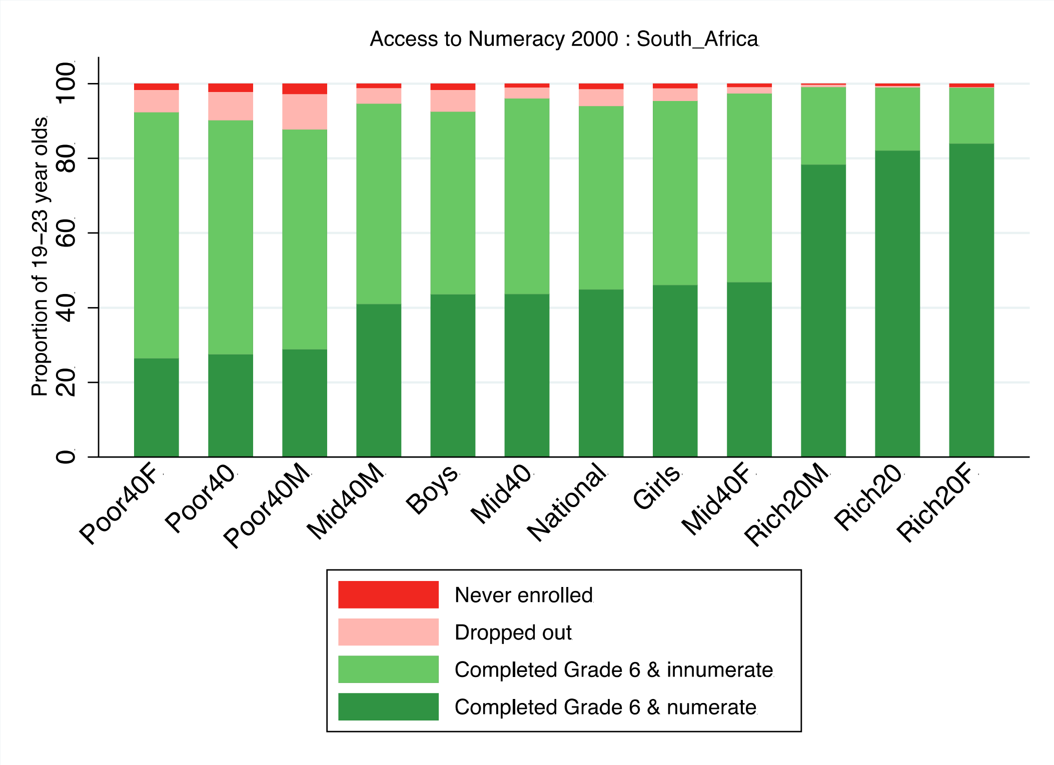
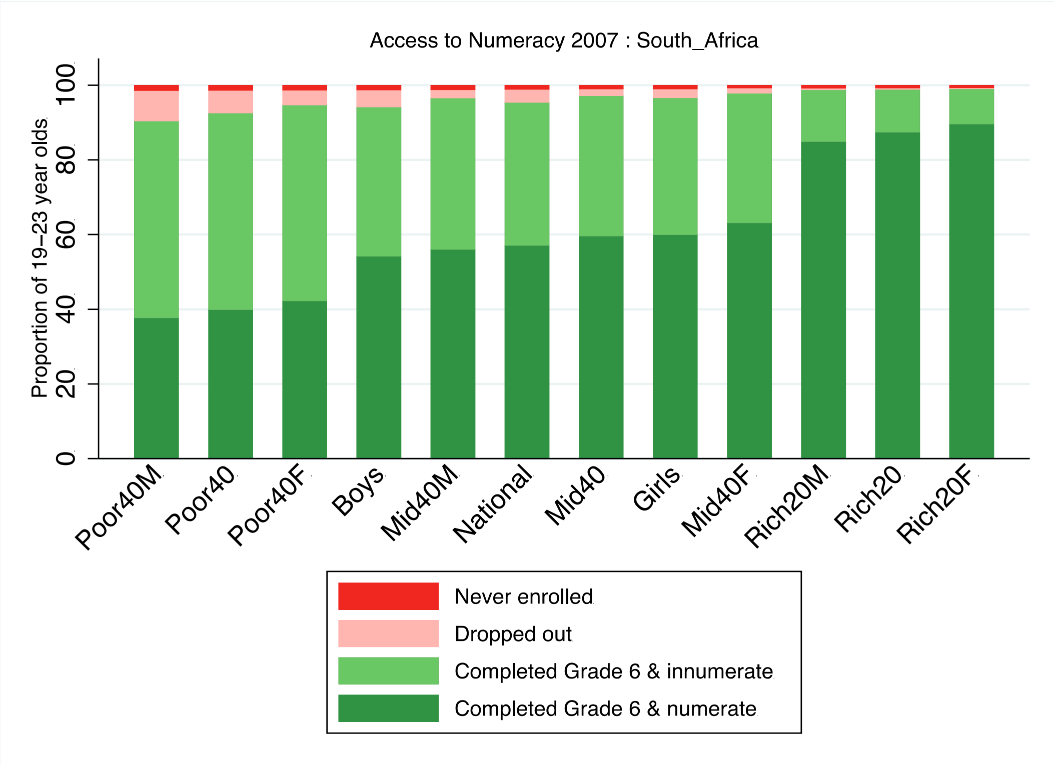


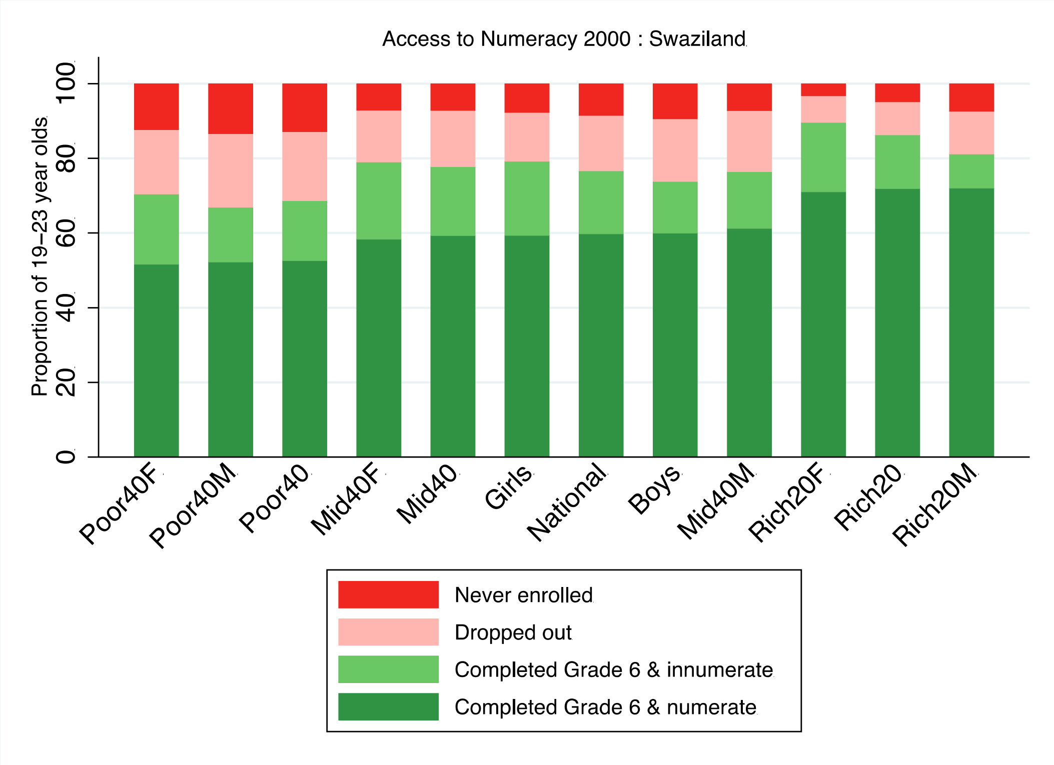


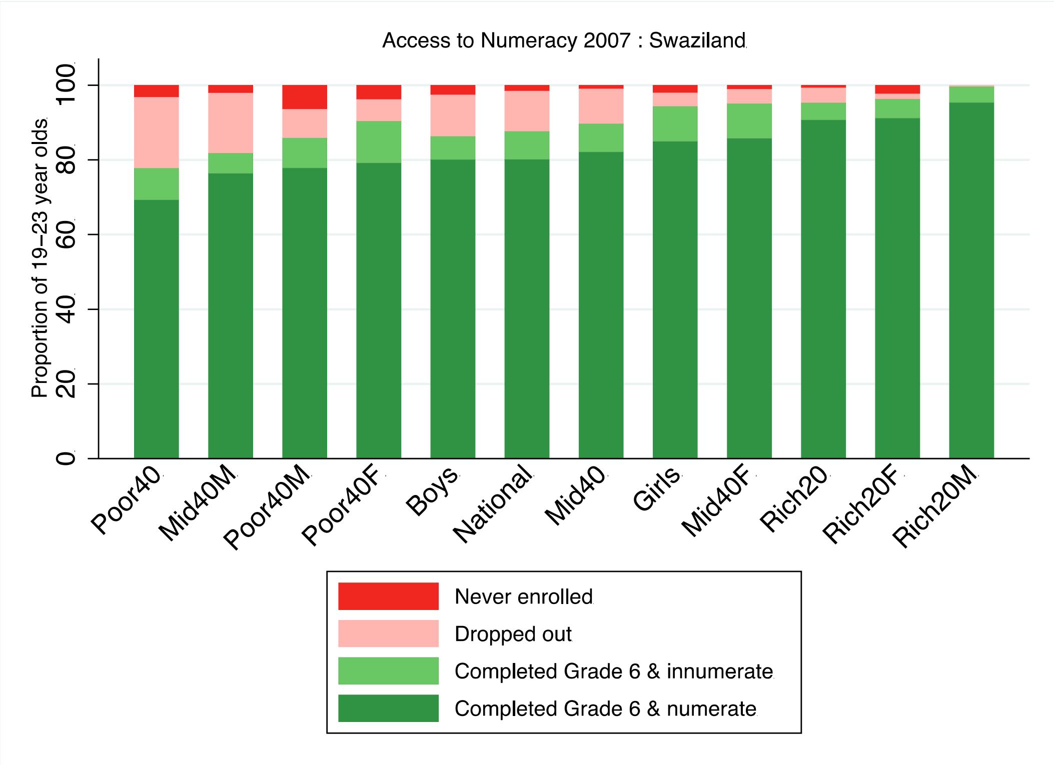
Stellenbosch University https://scholar.sun.ac.za



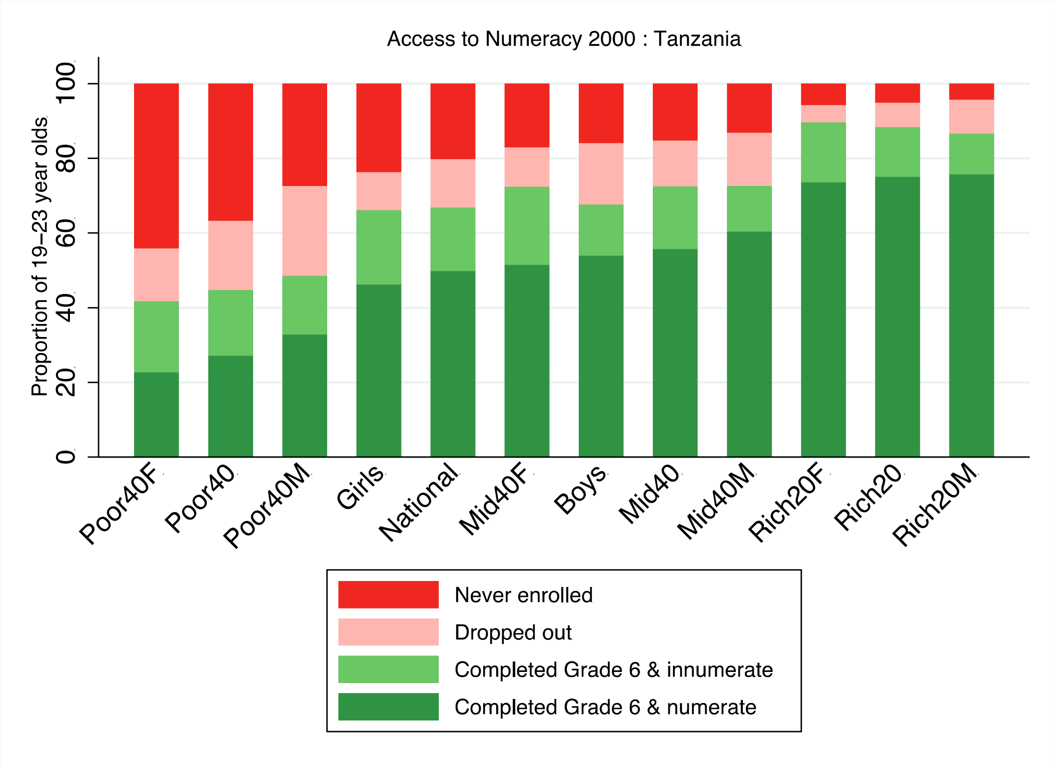


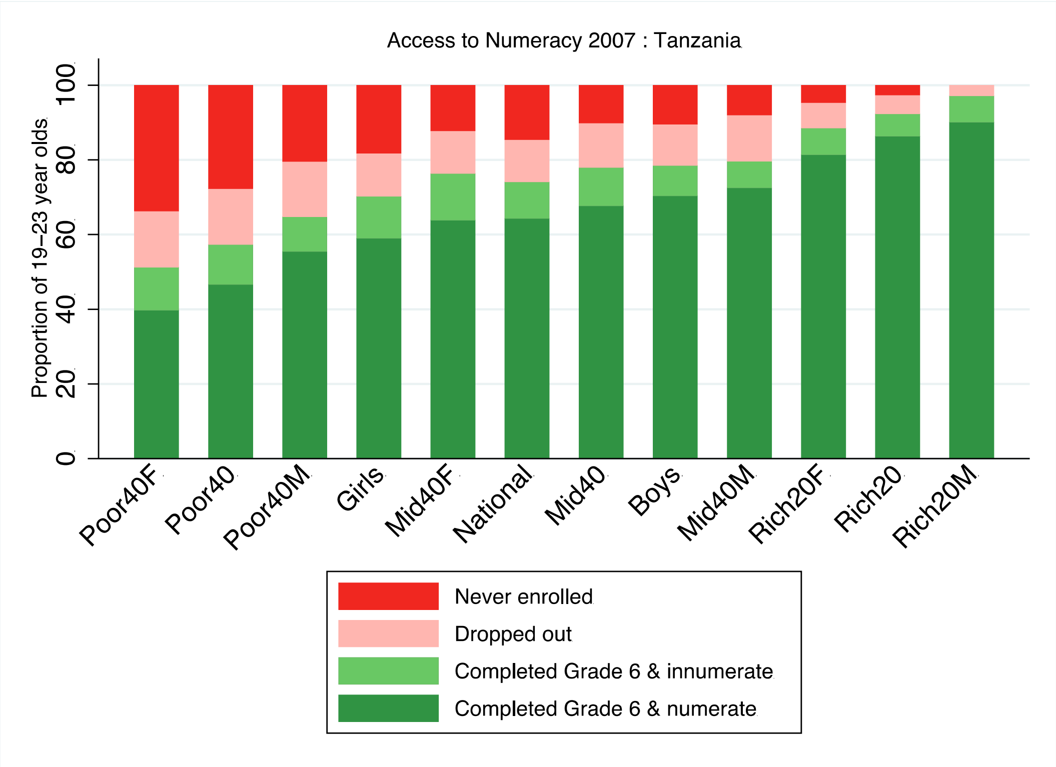
Stellenbosch University https://scholar.sun.ac.za



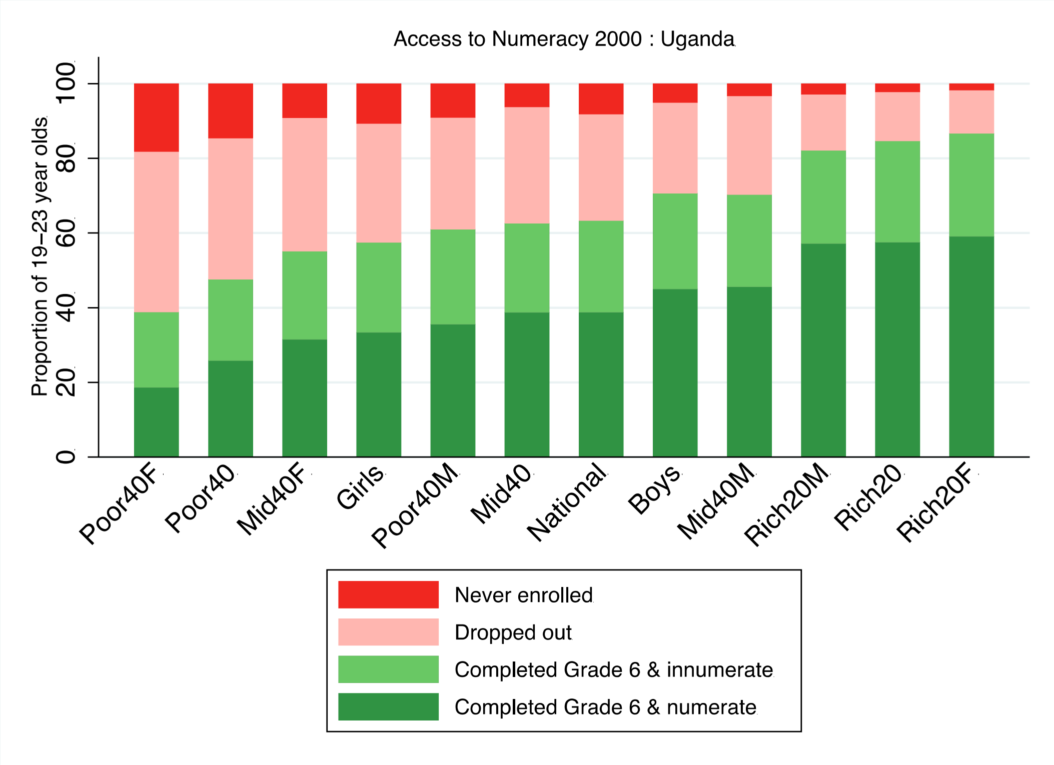


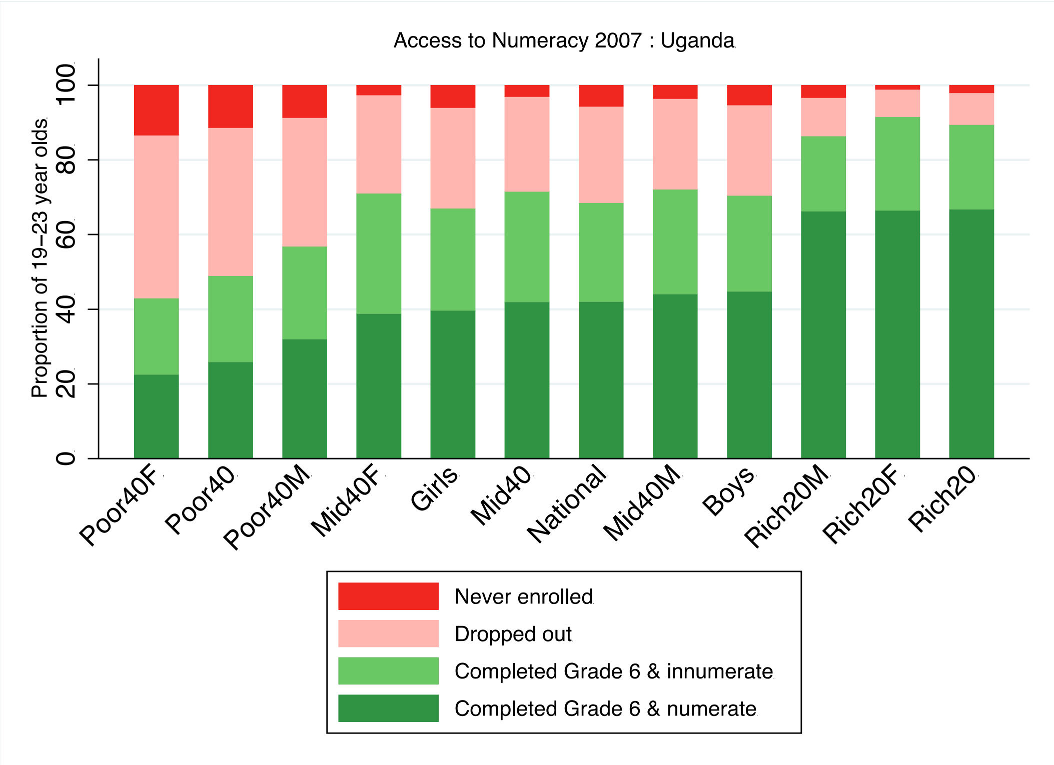
Stellenbosch University https://scholar.sun.ac.za



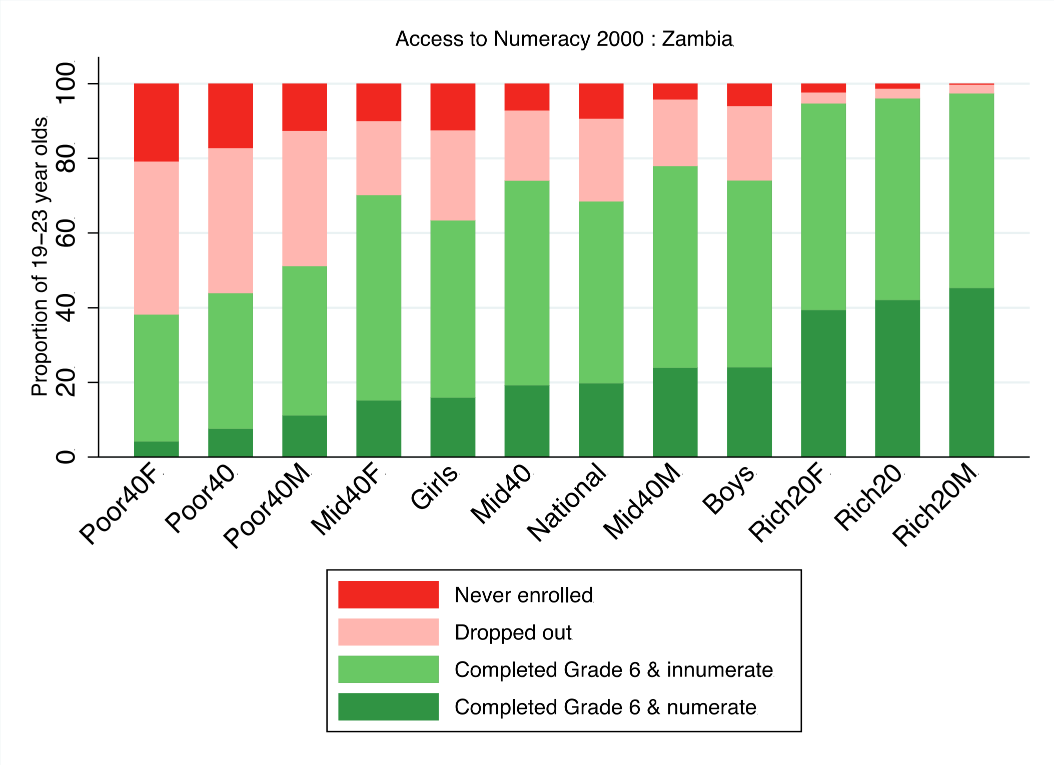


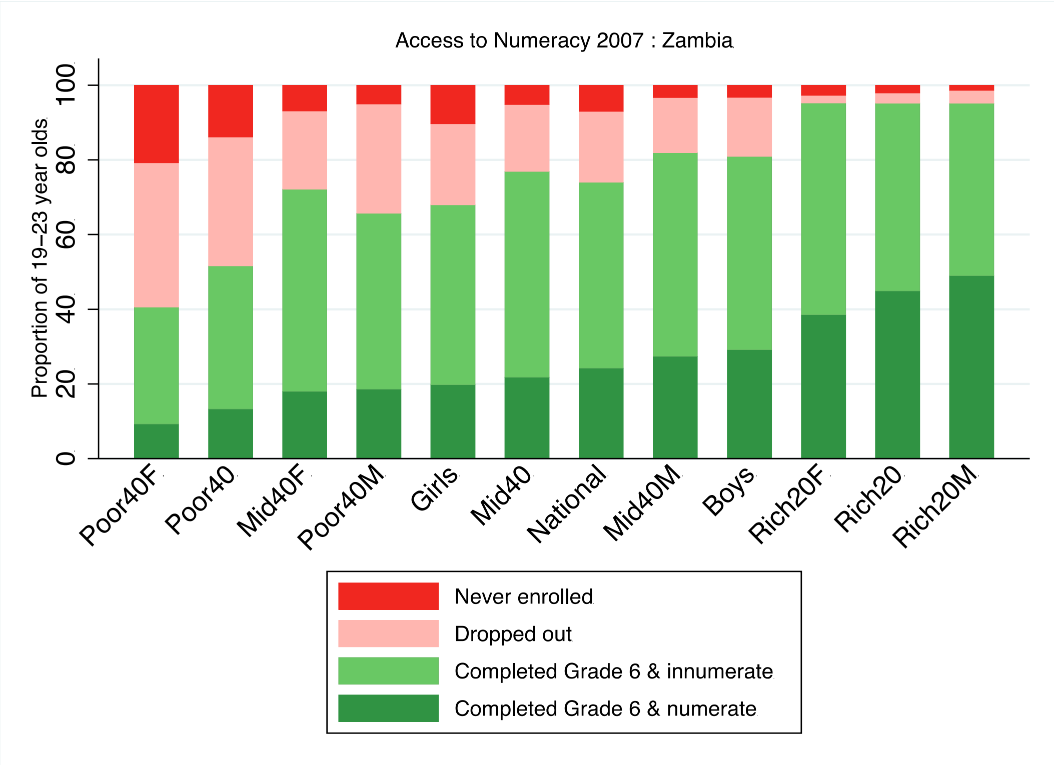
Stellenbosch University https://scholar.sun.ac.za





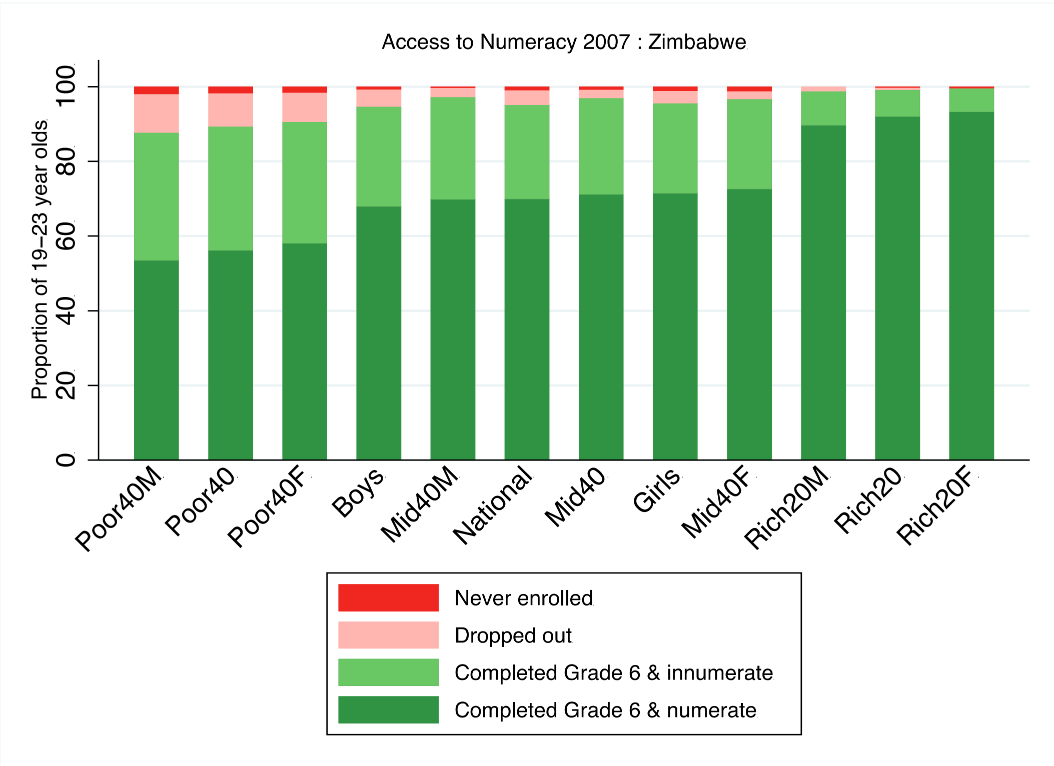
Stellenbosch University https://scholar.sun.ac.za





Stellenbosch University https://scholar.sun.ac.za

[Zimbabwe did not participate in SACMEQ 2000]



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APPENDIX D4: CHAPTER 5 SUPPLEMENTARY TABLES

Never enrolled (19-23) from DHS (circa 2000)

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	6,98	*0,73*	5,72	*0,79*	8,13	*0,94*	14,08	*1,86*	3,79	*0,65*	3,99	*0,98*	10,36	*1,90*	17,78	*2,45*	2,95	*0,77*	4,54	*0,93*	4,37	*1,23*	3,67	*1,10*
Lesotho	8,34	*0,58*	14,98	*1,05*	1,58	*0,27*	17,05	*1,21*	3,76	*0,49*	2,53	*0,64*	28,85	*2,03*	3,58	*0,63*	7,08	*0,95*	0,36	*0,19*	4,55	*1,24*	0,86	*0,59*
Malawi	10,01	*0,61*	7,09	*0,69*	12,41	*0,83*	15,58	*1,12*	9,02	*0,82*	3,27	*0,68*	10,79	*1,23*	19,18	*1,55*	7,30	*1,04*	10,33	*1,07*	2,17	*0,86*	4,43	*0,99*
Mozambique	30,62	*1,20*	19,34	*1,12*	39,88	*1,54*	49,44	*1,93*	29,70	*1,72*	11,55	*1,35*	29,53	*2,59*	62,25	*2,10*	20,47	*1,80*	37,18	*2,38*	9,85	*1,23*	13,37	*2,14*
Namibia	9,08	*0,99*	10,31	*1,41*	7,88	*1,05*	13,83	*1,71*	9,02	*1,34*	1,95	*0,59*	15,01	*2,47*	12,65	*2,25*	10,43	*1,72*	7,61	*1,37*	2,22	*1,00*	1,70	*0,87*
South Africa	1,39	*0,15*	1,62	*0,24*	1,17	*0,18*	2,12	*0,29*	0,97	*0,19*	0,52	*0,30*	2,71	*0,48*	1,60	*0,33*	1,09	*0,31*	0,85	*0,20*	0,21	*0,15*	0,85	*0,60*
Swaziland	8,52	*0,88*	9,43	*1,32*	7,72	*1,09*	12,85	*1,43*	7,16	*1,48*	4,89	*1,61*	13,38	*2,02*	12,30	*1,99*	7,20	*2,01*	7,11	*1,93*	7,38	*3,61*	3,26	*1,22*
Tanzania	20,16	*1,53*	15,83	*1,51*	23,63	*1,86*	36,68	*2,73*	15,18	*1,55*	5,05	*1,17*	27,35	*2,56*	44,05	*3,29*	13,06	*2,08*	16,97	*1,82*	4,20	*1,30*	5,70	*1,55*
Uganda	8,14	*0,70*	5,02	*0,68*	10,63	*1,01*	14,55	*1,52*	6,21	*0,83*	2,19	*0,51*	9,04	*1,60*	18,16	*1,93*	3,24	*0,89*	9,10	*1,42*	2,82	*0,82*	1,68	*0,67*
Zambia	9,33	*0,73*	5,96	*0,76*	12,41	*1,02*	17,17	*1,47*	7,10	*0,85*	1,25	*0,44*	12,56	*1,83*	20,81	*1,84*	4,19	*0,74*	9,94	*1,41*	0,23	*0,23*	2,32	*0,86*

Completed Gr6 (19-23) from DHS (circa 2000)

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	81,26	*1,07*	80,70	*1,31*	81,77	*1,31*	68,30	*2,44*	84,24	*1,38*	90,45	*1,25*	69,23	*2,89*	67,37	*3,10*	83,48	*1,88*	84,93	*1,76*	89,54	*1,67*	91,22	*1,43*
Lesotho	71,26	*1,01*	59,01	*1,48*	83,75	*1,00*	52,61	*1,56*	77,58	*1,27*	90,70	*1,13*	36,26	*2,08*	71,28	*1,84*	67,55	*1,87*	87,88	*1,34*	86,00	*2,03*	94,59	*1,25*
Malawi	58,61	*1,26*	64,73	*1,58*	53,57	*1,37*	41,18	*1,45*	57,69	*1,53*	86,18	*1,47*	50,14	*2,02*	34,43	*1,71*	62,42	*1,96*	54,07	*1,91*	86,14	*2,16*	86,23	*1,82*
Mozambique	26,99	*1,14*	35,44	*1,34*	20,05	*1,14*	7,03	*0,78*	22,42	*1,33*	54,12	*1,81*	12,52	*1,67*	3,51	*0,76*	32,83	*1,87*	13,98	*1,33*	56,87	*2,00*	51,16	*2,43*
Namibia	82,45	*1,43*	80,03	*1,87*	84,83	*1,51*	71,38	*2,60*	84,72	*1,84*	94,77	*1,07*	68,49	*2,88*	74,29	*3,15*	81,76	*2,30*	87,70	*2,02*	94,99	*1,78*	94,57	*1,77*
South Africa	94,04	*0,31*	92,55	*0,48*	95,46	*0,37*	90,23	*0,59*	96,07	*0,38*	99,08	*0,36*	87,81	*0,91*	92,40	*0,74*	94,69	*0,65*	97,45	*0,37*	99,15	*0,39*	98,99	*0,62*
Swaziland	76,66	*1,51*	73,81	*2,19*	79,19	*1,80*	68,63	*2,14*	77,76	*2,71*	86,27	*2,70*	66,86	*2,79*	70,43	*2,78*	76,42	*3,81*	79,01	*3,31*	81,15	*5,76*	89,62	*2,19*
Tanzania	66,89	*1,67*	67,76	*1,87*	66,19	*2,00*	44,82	*2,48*	72,55	*1,85*	88,42	*1,56*	48,62	*2,78*	41,81	*2,97*	72,66	*2,59*	72,47	*2,15*	86,69	*2,38*	89,73	*1,94*
Uganda	63,36	*1,29*	70,67	*1,72*	57,52	*1,55*	47,62	*1,91*	62,64	*2,00*	84,68	*1,34*	61,05	*2,84*	38,84	*2,14*	70,31	*2,67*	55,16	*2,45*	82,18	*2,21*	86,71	*1,49*
Zambia	68,56	*1,33*	74,13	*1,47*	63,46	*1,62*	43,95	*2,03*	74,04	*1,51*	96,16	*0,74*	51,20	*2,52*	38,23	*2,24*	77,97	*1,80*	70,22	*2,03*	97,51	*0,92*	94,77	*1,14*

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Proportion literate from SACMEQ 2000

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	94,39	0,75	94,06	0,85	94,72	0,90	90,82	1,55	94,81	1,04	99,02	0,34	90,16	1,74	91,17	1,56	95,01	1,05	94,87	1,15	98,29	0,66	99,67	0,25
Lesotho	70,64	1,96	66,86	2,18	73,66	2,19	66,94	3,05	68,74	2,43	78,17	2,27	63,54	3,79	68,37	3,53	64,89	2,64	73,68	2,59	72,73	3,19	81,58	2,40
Malawi	55,51	2,18	57,50	2,37	53,33	2,58	47,79	3,19	51,04	2,70	68,84	2,70	53,96	4,18	42,57	3,65	51,48	2,79	48,94	3,40	70,31	3,34	67,39	3,18
Mozambique	93,84	0,63	93,94	0,65	93,70	0,99	91,35	1,47	93,14	0,83	95,07	0,82	90,66	1,80	91,29	2,76	93,78	0,85	92,25	1,59	95,57	0,95	94,82	1,06
Namibia	56,55	1,49	54,86	1,66	58,12	1,71	45,04	1,82	52,32	1,78	81,44	1,95	44,98	2,29	45,73	2,35	48,70	2,13	54,87	2,17	79,70	2,35	83,58	2,00
South Africa	68,99	2,11	66,24	2,19	71,48	2,38	54,52	2,73	69,37	2,43	94,59	1,23	53,12	3,24	54,72	3,15	65,19	2,78	74,34	2,76	91,37	2,10	97,13	0,91
Swaziland	98,01	0,47	97,49	0,71	98,50	0,38	97,63	0,55	97,78	0,77	99,04	0,38	97,16	1,03	97,91	0,65	97,54	0,72	98,41	0,61	97,95	0,90	99,57	0,30
Tanzania	91,70	0,90	92,47	1,10	90,98	1,09	82,06	2,10	93,97	0,80	97,72	0,64	82,33	2,82	81,93	2,11	95,99	0,99	92,37	1,28	97,94	0,84	97,16	0,99
Uganda	74,48	2,18	75,08	2,34	73,75	2,60	71,22	3,27	71,68	2,32	82,29	2,71	71,29	3,58	69,05	3,93	74,69	2,64	70,02	2,97	81,36	3,02	82,62	3,59
Zambia	52,33	2,22	53,41	2,51	51,26	2,40	35,27	3,06	48,85	2,25	73,28	2,73	39,97	3,98	31,53	3,88	50,15	2,42	47,41	2,66	72,67	3,26	72,90	3,38

Proportion numerate from SACMEQ 2000

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	89,29	0,94	91,48	0,92	87,13	1,29	85,30	1,75	89,70	1,30	94,56	0,96	87,02	1,77	82,53	2,00	92,72	1,15	87,42	1,85	96,06	1,17	93,39	1,38
Lesotho	34,13	2,08	34,25	2,28	34,04	2,30	31,11	2,37	33,47	2,34	38,77	3,15	30,59	3,17	32,04	2,99	30,93	2,69	33,58	2,68	42,50	4,03	37,92	3,58
Malawi	25,77	1,52	30,24	1,97	20,87	1,56	22,71	2,63	22,41	1,84	33,17	2,52	30,15	3,49	16,00	2,74	25,80	2,35	15,98	2,13	36,77	3,25	30,84	2,91
Mozambique	87,01	0,90	89,12	0,89	83,84	1,42	84,76	2,01	85,36	1,35	88,98	1,03	85,61	1,98	76,24	4,77	88,80	1,26	81,14	2,25	91,06	1,26	86,40	1,36
Namibia	23,38	1,35	24,73	1,58	22,13	1,38	11,51	1,01	16,18	1,12	54,14	3,17	12,57	1,45	10,00	1,11	16,66	1,58	15,67	1,43	56,21	3,45	53,07	3,35
South Africa	47,74	2,63	47,14	2,45	48,29	3,20	30,51	2,41	45,48	2,77	82,87	3,10	32,88	3,16	28,65	2,97	43,29	3,07	48,05	3,81	79,03	3,71	84,85	2,85
Swaziland	77,97	1,38	81,26	1,27	74,88	2,24	76,58	1,58	76,24	1,95	83,29	2,20	78,08	1,94	73,29	2,60	80,05	1,71	73,83	2,82	88,75	1,99	79,23	2,99
Tanzania	74,53	1,54	79,64	1,71	69,85	1,93	60,57	2,32	76,79	1,77	84,95	1,84	67,50	3,04	54,50	2,94	83,11	1,93	71,08	2,50	87,42	2,23	82,10	2,70
Uganda	61,18	2,58	63,70	2,63	58,05	3,48	54,23	3,51	61,83	2,82	67,99	3,68	58,26	3,65	47,94	4,97	64,92	3,33	57,15	3,88	69,57	3,95	68,15	5,11
Zambia	28,82	1,73	32,45	2,32	25,04	1,85	17,27	1,76	25,99	1,93	43,72	3,19	21,78	2,97	10,84	1,89	30,74	3,51	21,58	1,93	46,46	3,71	41,53	3,95

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Access-to-literacy (circa 2000)

	National (%)	*SE (%)*	Boys (%)	*SE (%)*	Girls (%)	*SE (%)*	Poor40 (%)	*SE (%)*	Mid40 (%)	*SE (%)*	Rich20 (%)	*SE (%)*	Poor40M (%)	*SE (%)*	Poor40F (%)	*SE (%)*	Mid40M (%)	*SE (%)*	Mid40F (%)	*SE (%)*	Rich20M (%)	*SE (%)*	Rich20F (%)	*SE (%)*
Kenya	76,70	*1,31*	75,91	*1,56*	77,45	*1,59*	62,03	*2,89*	79,86	*1,73*	89,56	*1,30*	62,42	*3,38*	61,42	*3,47*	79,31	*2,16*	80,57	*2,10*	88,01	*1,80*	90,92	*1,45*
Lesotho	50,34	*2,20*	39,45	*2,63*	61,69	*2,41*	35,22	*3,42*	53,32	*2,74*	70,91	*2,54*	23,04	*4,32*	48,73	*3,98*	43,83	*3,24*	64,75	*2,92*	62,54	*3,78*	77,17	*2,70*
Malawi	32,53	*2,52*	37,22	*2,85*	28,57	*2,92*	19,68	*3,50*	29,45	*3,10*	59,33	*3,07*	27,06	*4,64*	14,66	*4,03*	32,13	*3,41*	26,46	*3,90*	60,56	*3,97*	58,11	*3,67*
Mozambique	25,33	*1,31*	33,30	*1,49*	18,79	*1,51*	6,42	*1,67*	20,88	*1,57*	51,46	*1,99*	11,35	*2,46*	3,20	*2,86*	30,79	*2,05*	12,90	*2,07*	54,35	*2,21*	48,51	*2,65*
Namibia	46,63	*2,06*	43,90	*2,50*	49,31	*2,28*	32,15	*3,17*	44,32	*2,56*	77,18	*2,22*	30,81	*3,68*	33,97	*3,93*	39,82	*3,13*	48,12	*2,97*	75,71	*2,95*	79,04	*2,67*
South Africa	64,88	*2,13*	61,30	*2,24*	68,24	*2,41*	49,19	*2,79*	66,65	*2,46*	93,72	*1,28*	46,65	*3,37*	50,56	*3,24*	61,73	*2,86*	72,44	*2,79*	90,59	*2,14*	96,15	*1,10*
Swaziland	75,14	*1,58*	71,96	*2,31*	78,00	*1,83*	67,00	*2,21*	76,03	*2,82*	85,45	*2,72*	64,97	*2,97*	68,96	*2,86*	74,54	*3,88*	77,75	*3,37*	79,49	*5,83*	89,23	*2,21*
Tanzania	61,33	*1,89*	62,66	*2,17*	60,22	*2,27*	36,78	*3,25*	68,17	*2,02*	86,41	*1,69*	40,03	*3,96*	34,25	*3,65*	69,74	*2,77*	66,94	*2,50*	84,90	*2,52*	87,17	*2,18*
Uganda	47,20	*2,54*	53,06	*2,90*	42,42	*3,02*	33,92	*3,79*	44,90	*3,06*	69,69	*3,02*	43,52	*4,57*	26,82	*4,48*	52,51	*3,75*	38,62	*3,85*	66,86	*3,75*	71,64	*3,89*
Zambia	35,88	*2,59*	39,59	*2,91*	32,53	*2,90*	15,50	*3,67*	36,17	*2,71*	70,47	*2,83*	20,46	*4,71*	12,05	*4,48*	39,10	*3,02*	33,29	*3,35*	70,86	*3,39*	69,08	*3,57*

Access-to-numeracy (circa 2000)

	National (%)	*SE (%)*	Boys (%)	*SE (%)*	Girls (%)	*SE (%)*	Poor40 (%)	*SE (%)*	Mid40 (%)	*SE (%)*	Rich20 (%)	*SE (%)*	Poor40M (%)	*SE (%)*	Poor40F (%)	*SE (%)*	Mid40M (%)	*SE (%)*	Mid40F (%)	*SE (%)*	Rich20M (%)	*SE (%)*	Rich20F (%)	*SE (%)*
Kenya	72,56	*1,42*	73,83	*1,60*	71,25	*1,84*	58,26	*3,00*	75,56	*1,90*	85,53	*1,58*	60,25	*3,39*	55,60	*3,69*	77,40	*2,21*	74,24	*2,56*	86,01	*2,04*	85,19	*1,98*
Lesotho	24,32	*2,31*	20,21	*2,72*	28,51	*2,51*	16,37	*2,84*	25,97	*2,66*	35,17	*3,35*	11,09	*3,79*	22,84	*3,50*	20,89	*3,27*	29,51	*3,00*	36,55	*4,52*	35,87	*3,79*
Malawi	15,10	*1,97*	19,58	*2,52*	11,18	*2,08*	9,35	*3,00*	12,93	*2,39*	28,59	*2,92*	15,12	*4,03*	5,51	*3,23*	16,10	*3,06*	8,64	*2,86*	31,67	*3,90*	26,60	*3,44*
Mozambique	23,48	*1,46*	31,59	*1,61*	16,81	*1,82*	5,96	*2,16*	19,14	*1,90*	48,16	*2,08*	10,71	*2,59*	2,67	*4,83*	29,15	*2,25*	11,35	*2,61*	51,79	*2,36*	44,20	*2,78*
Namibia	19,27	*1,96*	19,79	*2,45*	18,78	*2,05*	8,22	*2,79*	13,71	*2,15*	51,31	*3,34*	8,61	*3,23*	7,43	*3,34*	13,63	*2,79*	13,74	*2,48*	53,39	*3,88*	50,19	*3,79*
South Africa	44,90	*2,65*	43,63	*2,50*	46,09	*3,23*	27,53	*2,48*	43,70	*2,80*	82,10	*3,12*	28,87	*3,29*	26,48	*3,06*	40,99	*3,14*	46,83	*3,83*	78,36	*3,73*	83,99	*2,91*
Swaziland	59,77	*2,05*	59,97	*2,54*	59,30	*2,87*	52,56	*2,66*	59,28	*3,34*	71,86	*3,48*	52,21	*3,39*	51,62	*3,81*	61,18	*4,18*	58,33	*4,35*	72,02	*6,09*	71,01	*3,71*
Tanzania	49,85	*2,27*	53,97	*2,54*	46,24	*2,78*	27,15	*3,40*	55,72	*2,56*	75,11	*2,41*	32,82	*4,12*	22,79	*4,18*	60,39	*3,23*	51,51	*3,30*	75,78	*3,26*	73,67	*3,33*
Uganda	38,77	*2,89*	45,02	*3,15*	33,39	*3,81*	25,82	*4,00*	38,73	*3,46*	57,57	*3,92*	35,57	*4,63*	18,62	*5,41*	45,64	*4,27*	31,52	*4,59*	57,17	*4,52*	59,09	*5,33*
Zambia	19,76	*2,18*	24,06	*2,75*	15,89	*2,46*	7,59	*2,69*	19,25	*2,46*	42,04	*3,28*	11,15	*3,89*	4,15	*2,93*	23,97	*3,94*	15,15	*2,80*	45,30	*3,82*	39,36	*4,11*

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Never enrolled (19-23) from DHS (circa 2007)

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	5,26	*0,72*	2,81	*0,54*	7,40	*1,20*	10,41	*1,67*	3,32	*0,91*	2,20	*0,79*	5,70	*1,35*	14,56	*2,59*	1,66	*0,62*	4,96	*1,71*	1,14	*0,70*	2,96	*1,19*
Lesotho	4,87	*0,46*	9,26	*0,87*	0,63	*0,19*	10,42	*1,01*	2,32	*0,38*	0,90	*0,39*	18,72	*1,77*	1,40	*0,48*	4,29	*0,71*	0,39	*0,21*	2,08	*0,88*	0,00	*0,00*
Malawi	7,09	*0,45*	6,03	*0,55*	8,09	*0,61*	12,43	*0,94*	5,96	*0,60*	1,32	*0,35*	9,88	*1,11*	14,52	*1,29*	6,04	*0,96*	5,88	*0,68*	1,34	*0,46*	1,29	*0,54*
Mozambique	13,67	*0,84*	7,95	*0,85*	18,39	*1,21*	22,10	*1,60*	14,03	*1,31*	2,81	*0,50*	10,48	*1,67*	31,12	*2,47*	9,89	*1,55*	17,31	*1,65*	2,59	*0,55*	3,00	*0,76*
Namibia	5,89	*0,46*	7,41	*0,66*	4,53	*0,54*	8,80	*0,96*	6,20	*0,67*	1,08	*0,49*	9,93	*1,31*	7,70	*1,15*	8,31	*0,98*	4,32	*0,79*	1,52	*0,84*	0,74	*0,41*
South Africa	1,13	*0,21*	1,29	*0,26*	0,98	*0,23*	1,38	*0,45*	0,99	*0,18*	0,74	*0,27*	1,46	*0,49*	1,32	*0,48*	1,25	*0,29*	0,74	*0,19*	0,80	*0,42*	0,69	*0,35*
Swaziland	1,42	*0,32*	2,44	*1,09*	1,89	*0,94*	3,08	*1,02*	0,82	*0,23*	0,57	*0,25*	6,29	*4,48*	3,66	*3,18*	1,98	*0,96*	0,95	*0,80*	0,00	*0,00*	2,17	*1,97*
Tanzania	14,56	*1,16*	10,44	*1,19*	18,20	*1,49*	27,71	*2,34*	10,10	*0,98*	2,61	*0,68*	20,39	*2,38*	33,71	*2,96*	8,00	*1,26*	12,21	*1,55*	0,00	*0,00*	4,65	*1,21*
Uganda	5,68	*0,61*	5,29	*0,74*	5,97	*0,71*	11,33	*1,47*	3,03	*0,56*	2,03	*0,49*	8,65	*1,65*	13,36	*1,75*	3,55	*0,96*	2,61	*0,67*	3,33	*0,94*	1,12	*0,49*
Zambia	7,03	*0,56*	3,28	*0,54*	10,33	*0,95*	13,87	*1,31*	5,18	*0,69*	2,09	*0,75*	5,03	*1,21*	20,78	*2,11*	3,32	*0,78*	6,92	*1,14*	1,40	*0,95*	2,72	*1,22*

Completed Gr6 (19-23) from DHS (circa 2007)

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	87,21	*1,00*	88,36	*1,13*	86,20	*1,43*	78,49	*2,07*	89,44	*1,36*	93,92	*1,35*	82,49	*2,21*	74,96	*2,97*	89,97	*1,57*	88,93	*2,12*	93,03	*2,00*	94,57	*1,53*
Lesotho	77,97	*1,00*	65,48	*1,52*	90,00	*0,84*	61,13	*1,70*	82,95	*1,14*	95,82	*0,81*	42,63	*2,09*	81,26	*1,88*	73,40	*1,85*	92,29	*1,05*	92,77	*1,60*	98,14	*0,62*
Malawi	62,86	*0,99*	67,10	*1,26*	58,85	*1,11*	42,21	*1,32*	64,57	*1,36*	89,23	*0,89*	48,50	*1,90*	37,03	*1,50*	67,39	*1,89*	61,80	*1,67*	89,25	*1,18*	89,20	*1,28*
Mozambique	53,01	*1,37*	62,79	*1,57*	44,93	*1,62*	25,64	*1,72*	52,07	*1,94*	87,94	*0,96*	39,05	*2,68*	15,22	*1,90*	62,93	*2,45*	43,45	*2,24*	88,92	*1,14*	87,03	*1,33*
Namibia	85,42	*0,84*	81,42	*1,25*	88,98	*0,88*	76,18	*1,59*	85,99	*1,07*	97,57	*0,71*	71,82	*2,24*	80,37	*1,95*	81,33	*1,66*	90,15	*1,07*	96,84	*1,28*	98,15	*0,75*
South Africa	95,42	*0,33*	94,16	*0,48*	96,64	*0,37*	92,58	*0,67*	97,24	*0,30*	98,90	*0,33*	90,42	*0,94*	94,69	*0,76*	96,59	*0,50*	97,87	*0,34*	98,76	*0,52*	99,03	*0,41*
Swaziland	87,73	*2,41*	86,39	*6,98*	94,43	*2,10*	77,90	*5,53*	89,78	*2,67*	95,38	*2,47*	85,99	*6,53*	90,49	*7,09*	81,88	*11,09*	95,19	*2,57*	99,75	*0,26*	96,41	*2,84*
Tanzania	74,12	*1,41*	78,50	*1,45*	70,24	*1,79*	57,37	*2,43*	78,00	*1,36*	92,36	*1,19*	64,78	*2,71*	51,29	*2,85*	79,62	*1,82*	76,36	*2,17*	97,19	*1,09*	88,56	*1,79*
Uganda	68,53	*1,34*	70,49	*1,54*	67,05	*1,72*	48,98	*2,19*	71,56	*2,09*	89,46	*1,20*	56,85	*2,92*	43,00	*2,72*	72,13	*2,37*	71,09	*2,64*	86,39	*2,32*	91,60	*1,24*
Zambia	74,03	*1,22*	80,91	*1,36*	67,98	*1,60*	51,58	*2,26*	76,89	*1,56*	95,21	*1,11*	65,71	*3,08*	40,54	*2,69*	81,92	*1,68*	72,20	*2,34*	95,21	*1,63*	95,21	*1,40*

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Proportion literate from SACMEQ 2007

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	91,96	*1,00*	91,45	*0,97*	92,48	*1,39*	87,58	*1,97*	92,88	*0,75*	97,51	*0,55*	87,18	*1,57*	87,97	*2,68*	92,48	*1,08*	93,50	*1,18*	97,03	*0,93*	97,68	*0,79*
Lesotho	78,80	*1,30*	76,06	*1,71*	81,09	*1,31*	72,89	*1,90*	78,00	*1,48*	87,73	*1,68*	67,88	*2,83*	75,97	*1,99*	74,24	*1,98*	81,32	*1,70*	86,44	*1,89*	89,10	*1,93*
Malawi	63,40	*1,77*	66,40	*2,04*	60,31	*1,95*	58,29	*2,77*	62,56	*2,04*	69,45	*2,26*	58,48	*3,27*	54,93	*3,30*	65,77	*2,67*	60,20	*2,57*	75,95	*2,70*	64,91	*2,53*
Mozambique	78,49	*1,13*	79,46	*1,25*	77,34	*1,42*	66,48	*3,07*	76,66	*1,48*	87,65	*1,22*	69,26	*3,34*	63,69	*4,60*	79,36	*1,67*	74,54	*2,07*	88,56	*1,36*	84,90	*1,66*
Namibia	86,37	*0,76*	83,50	*0,99*	89,01	*0,81*	80,61	*1,28*	86,60	*0,90*	94,94	*0,76*	77,35	*1,75*	83,49	*1,46*	82,76	*1,30*	89,66	*0,98*	93,88	*1,08*	96,83	*0,71*
South Africa	72,74	*1,19*	68,83	*1,32*	76,52	*1,25*	57,76	*1,60*	76,13	*1,17*	94,08	*0,85*	54,14	*1,77*	60,71	*1,92*	71,08	*1,57*	81,74	*1,18*	91,32	*1,28*	96,39	*0,85*
Swaziland	98,52	*0,40*	97,96	*0,53*	99,09	*0,33*	97,65	*0,79*	98,76	*0,33*	99,50	*0,26*	96,93	*0,99*	98,68	*0,55*	98,48	*0,49*	99,01	*0,38*	98,87	*0,59*	100,00	
Tanzania	96,50	*0,52*	96,77	*0,65*	96,24	*0,62*	94,54	*0,98*	96,64	*0,70*	98,71	*0,39*	95,05	*1,42*	93,53	*1,37*	97,03	*0,74*	96,78	*0,91*	98,64	*0,53*	98,46	*0,63*
Uganda	79,65	*1,30*	80,82	*1,39*	78,50	*1,51*	72,53	*2,09*	77,62	*1,45*	90,67	*1,16*	74,59	*2,30*	72,26	*2,30*	78,79	*1,76*	75,85	*1,83*	92,37	*1,43*	88,46	*1,51*
Zambia	55,91	*1,68*	58,25	*1,88*	53,45	*2,15*	48,34	*2,41*	51,72	*2,00*	70,85	*2,41*	51,02	*2,87*	45,43	*3,56*	55,14	*2,38*	49,05	*2,69*	73,57	*2,64*	66,92	*3,37*

Proportion numerate from SACMEQ 2007

	National (%)	SE (%)	Boys (%)	SE (%)	Girls (%)	SE (%)	Poor40 (%)	SE (%)	Mid40 (%)	SE (%)	Rich20 (%)	SE (%)	Poor40M (%)	SE (%)	Poor40F (%)	SE (%)	Mid40M (%)	SE (%)	Mid40F (%)	SE (%)	Rich20M (%)	SE (%)	Rich20F (%)	SE (%)
Kenya	88,77	*1,04*	89,92	*1,07*	87,59	*1,47*	84,65	*1,89*	89,44	*0,97*	94,40	*1,04*	86,98	*1,74*	83,34	*2,40*	90,06	*1,15*	87,85	*1,59*	94,86	*1,56*	93,83	*1,40*
Lesotho	58,19	*1,59*	57,72	*1,93*	58,59	*1,74*	50,64	*2,03*	57,05	*1,82*	69,79	*2,40*	49,85	*2,90*	50,51	*2,24*	54,70	*2,42*	59,00	*2,36*	69,71	*2,92*	71,17	*2,91*
Malawi	40,12	*1,80*	44,50	*2,07*	35,61	*2,18*	37,87	*2,86*	40,22	*1,97*	42,10	*2,36*	40,61	*3,11*	31,45	*4,11*	45,86	*2,73*	37,29	*2,50*	46,63	*3,21*	36,71	*3,08*
Mozambique	67,27	*1,26*	70,38	*1,42*	63,58	*1,69*	55,41	*2,27*	65,97	*1,77*	75,69	*1,59*	58,08	*2,79*	52,99	*3,79*	70,98	*2,03*	59,43	*2,44*	80,25	*1,94*	71,37	*2,12*
Namibia	52,31	*1,35*	52,39	*1,56*	52,24	*1,48*	38,28	*1,82*	50,38	*1,53*	77,60	*1,71*	38,24	*2,17*	38,70	*2,09*	49,65	*2,04*	50,95	*1,77*	77,95	*2,05*	76,73	*2,00*
South Africa	59,83	*1,38*	57,53	*1,55*	62,05	*1,46*	43,08	*1,74*	61,30	*1,37*	88,40	*1,13*	41,66	*2,12*	44,58	*1,99*	57,97	*1,68*	64,51	*1,49*	85,97	*1,56*	90,49	*1,28*
Swaziland	91,41	*0,93*	92,76	*0,92*	90,07	*1,17*	89,00	*1,34*	91,53	*1,10*	95,13	*0,86*	90,56	*1,60*	87,55	*1,65*	93,33	*0,96*	90,14	*1,67*	95,63	*0,98*	94,62	*1,29*
Tanzania	86,76	*1,07*	89,67	*1,05*	83,96	*1,45*	81,30	*1,92*	86,80	*1,21*	93,49	*0,88*	85,60	*2,03*	77,51	*2,82*	91,10	*1,13*	83,66	*1,55*	92,72	*1,33*	91,94	*1,33*
Uganda	61,26	*1,58*	63,45	*1,76*	59,14	*1,81*	52,86	*2,25*	58,64	*1,74*	74,62	*1,89*	56,31	*2,60*	52,30	*2,66*	61,08	*1,93*	54,61	*2,30*	76,71	*2,27*	72,56	*2,23*
Zambia	32,68	*1,42*	36,09	*1,75*	29,08	*1,73*	25,73	*2,03*	28,34	*1,50*	47,16	*2,89*	28,31	*2,74*	22,89	*2,20*	33,44	*2,10*	24,94	*1,95*	51,42	*3,34*	40,48	*3,67*

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Access-to-literacy (circa 2007)

	National (%)	*SE (%)*	Boys (%)	*SE (%)*	Girls (%)	*SE (%)*	Poor40 (%)	*SE (%)*	Mid40 (%)	*SE (%)*	Rich20 (%)	*SE (%)*	Poor40M (%)	*SE (%)*	Poor40F (%)	*SE (%)*	Mid40M (%)	*SE (%)*	Mid40F (%)	*SE (%)*	Rich20M (%)	*SE (%)*	Rich20F (%)	*SE (%)*
Kenya	80,19	*1,42*	80,80	*1,49*	79,71	*2,00*	68,74	*2,86*	83,08	*1,55*	91,59	*1,46*	71,92	*2,71*	65,95	*4,00*	83,20	*1,90*	83,14	*2,42*	90,27	*2,20*	92,38	*1,72*
Lesotho	61,44	*1,64*	49,80	*2,29*	72,98	*1,55*	44,56	*2,55*	64,70	*1,86*	84,06	*1,87*	28,94	*3,52*	61,74	*2,74*	54,49	*2,71*	75,05	*2,00*	80,19	*2,48*	87,44	*2,03*
Malawi	39,86	*2,03*	44,56	*2,39*	35,49	*2,24*	24,60	*3,07*	40,40	*2,45*	61,97	*2,43*	28,36	*3,78*	20,34	*3,63*	44,32	*3,27*	37,20	*3,07*	67,79	*2,94*	57,89	*2,84*
Mozambique	41,61	*1,77*	49,90	*2,01*	34,75	*2,15*	17,05	*3,52*	39,92	*2,44*	77,08	*1,55*	27,05	*4,29*	9,69	*4,98*	49,94	*2,97*	32,39	*3,05*	78,74	*1,77*	73,89	*2,13*
Namibia	73,77	*1,13*	67,99	*1,60*	79,20	*1,19*	61,41	*2,04*	74,47	*1,40*	92,63	*1,04*	55,55	*2,84*	67,10	*2,44*	67,31	*2,11*	80,83	*1,45*	90,91	*1,67*	95,04	*1,03*
South Africa	69,41	*1,23*	64,81	*1,40*	73,95	*1,31*	53,47	*1,74*	74,03	*1,21*	93,05	*0,91*	48,95	*2,00*	57,49	*2,06*	68,65	*1,65*	79,99	*1,23*	90,20	*1,38*	95,46	*0,94*
Swaziland	86,44	*2,44*	84,63	*7,00*	93,56	*2,12*	76,07	*5,59*	88,66	*2,69*	94,90	*2,48*	83,35	*6,60*	89,30	*7,11*	80,64	*11,10*	94,24	*2,60*	98,62	*0,65*	96,41	*2,84*
Tanzania	71,52	*1,50*	75,96	*1,59*	67,60	*1,89*	54,24	*2,62*	75,37	*1,52*	91,17	*1,25*	61,57	*3,06*	47,97	*3,16*	77,26	*1,97*	73,90	*2,35*	95,88	*1,21*	87,20	*1,90*
Uganda	54,58	*1,87*	56,97	*2,07*	52,64	*2,29*	35,52	*3,03*	55,54	*2,55*	81,12	*1,67*	42,41	*3,71*	31,07	*3,56*	56,83	*2,96*	53,93	*3,21*	79,79	*2,73*	81,03	*1,96*
Zambia	41,39	*2,08*	47,13	*2,32*	36,33	*2,68*	24,94	*3,30*	39,77	*2,54*	67,46	*2,65*	33,52	*4,21*	18,42	*4,46*	45,17	*2,92*	35,42	*3,57*	70,05	*3,10*	63,71	*3,65*

Access-to-numeracy (circa 2007)

	National (%)	*SE (%)*	Boys (%)	*SE (%)*	Girls (%)	*SE (%)*	Poor40 (%)	*SE (%)*	Mid40 (%)	*SE (%)*	Rich20 (%)	*SE (%)*	Poor40M (%)	*SE (%)*	Poor40F (%)	*SE (%)*	Mid40M (%)	*SE (%)*	Mid40F (%)	*SE (%)*	Rich20M (%)	*SE (%)*	Rich20F (%)	*SE (%)*
Kenya	77,42	*1,44*	79,45	*1,56*	75,50	*2,05*	66,44	*2,80*	80,00	*1,67*	88,66	*1,70*	71,75	*2,82*	62,47	*3,81*	81,03	*1,94*	78,12	*2,65*	88,26	*2,53*	88,74	*2,08*
Lesotho	45,37	*1,88*	37,79	*2,46*	52,73	*1,93*	30,96	*2,65*	47,32	*2,14*	66,88	*2,53*	21,25	*3,58*	41,05	*2,92*	40,15	*3,05*	54,45	*2,58*	64,67	*3,33*	69,85	*2,98*
Malawi	25,22	*2,05*	29,86	*2,42*	20,96	*2,44*	15,99	*3,15*	25,97	*2,39*	37,56	*2,52*	19,69	*3,65*	11,65	*4,37*	30,91	*3,32*	23,05	*3,01*	41,62	*3,41*	32,75	*3,34*
Mozambique	35,66	*1,86*	44,19	*2,12*	28,57	*2,34*	14,21	*2,85*	34,35	*2,63*	66,57	*1,85*	22,68	*3,87*	8,07	*4,24*	44,67	*3,19*	25,82	*3,32*	71,36	*2,25*	62,11	*2,50*
Namibia	44,68	*1,59*	42,65	*2,00*	46,48	*1,73*	29,16	*2,42*	43,33	*1,87*	75,71	*1,85*	27,47	*3,11*	31,10	*2,86*	40,38	*2,63*	45,93	*2,06*	75,49	*2,42*	75,31	*2,14*
South Africa	57,09	*1,42*	54,18	*1,62*	59,96	*1,51*	39,88	*1,87*	59,61	*1,40*	87,43	*1,17*	37,67	*2,32*	42,21	*2,13*	55,99	*1,75*	63,14	*1,53*	84,91	*1,65*	89,62	*1,35*
Swaziland	80,20	*2,58*	80,14	*7,04*	85,05	*2,40*	69,33	*5,69*	82,18	*2,89*	90,73	*2,62*	77,86	*6,72*	79,23	*7,28*	76,42	*11,13*	85,80	*3,06*	95,39	*1,01*	91,22	*3,12*
Tanzania	64,31	*1,77*	70,39	*1,79*	58,98	*2,30*	46,64	*3,10*	67,70	*1,81*	86,34	*1,48*	55,45	*3,39*	39,76	*4,01*	72,54	*2,15*	63,89	*2,66*	90,12	*1,72*	81,42	*2,23*
Uganda	41,98	*2,07*	44,72	*2,34*	39,65	*2,49*	25,89	*3,14*	41,96	*2,72*	66,76	*2,24*	32,01	*3,91*	22,49	*3,80*	44,06	*3,06*	38,82	*3,50*	66,27	*3,24*	66,47	*2,55*
Zambia	24,19	*1,88*	29,20	*2,22*	19,77	*2,36*	13,27	*3,04*	21,79	*2,16*	44,90	*3,10*	18,60	*4,12*	9,28	*3,47*	27,39	*2,69*	18,01	*3,04*	48,96	*3,72*	38,55	*3,92*

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