



# Reading and numeracy skills after school leaving in southern Malawi: A longitudinal analysis

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## ABSTRACT

The extent to which skills acquired during schooling are retained after school-leaving in developing countries remains largely unknown. Using a longitudinal dataset of Malawian adolescents aged 14–17 attending school when first interviewed in 2007, we investigate whether literacy and numeracy skills at school leaving were retained several years after. We find a significant gender difference in skill level after school leaving for English skills, even after controlling for initial skill level and grade attainment, with females scoring lower than males. Although the gender difference in numeracy is not significant, females score lower than males after school leaving.

## 1. Introduction

Over the past two decades considerable attention has been placed, and progress made, on increasing access to schooling and narrowing the gender gap in primary school enrollment in developing countries (Lloyd and Hewett, 2009). More recently, focus has been shifting from expanding access to improving learning outcomes, particularly given concerns about school quality in many poor settings (UNESCO, 2005, 2006; van der Gaag and Adams, 2010; Perlman Robinson, 2011). Even if the gender difference in educational attainment closes, a gap in skill retention may persist if young men and women leave school with different skill levels or experience different opportunities to exercise those skills outside of school. Although the low levels of learning among students in developing countries have been widely documented (Hungu et al., 2010; Pritchett, 2013; Spaul and Taylor, 2015), very few studies have looked at the skills of young people who are out of school (Glick and Sahn, 2009; Asadullah and Chaudhury, 2015), and even fewer have compared skills before and after school leaving (Wagner et al., 1989). Thus, the extent to which young people retain skills that they had at school-leaving remains largely unknown.

If young women, in particular, are unable to retain the literacy and numeracy skills gained in school, then the beneficial demographic and health outcomes that are predicted to accompany expanded schooling attainment may be compromised. Literacy has emerged as an important

dimension of the mechanisms linking female education to maternal and child health. Based on data from Mexico, Zambia, Venezuela, and Nepal, LeVine et al. (2012: p.148) theorize that literacy skills acquired in school enable mothers to engage in ‘pedagogical mothering,’ described as responding to infants’ vocalizations by looking at and talking to them (p.132), as well as successfully navigate the healthcare system. The authors argue that these are key elements explaining the association between women’s schooling and child health and school performance. Recent work by Smith-Greenaway (2013) found that the association between mother’s educational attainment and child mortality in Nigeria was fully explained by reading skills. Analyzing data from Morocco, Glewwe (1999) found that a mother’s knowledge obtained outside of school, using literacy and numeracy skills learned in the classroom, played a more important role in improving child health than did information taught in class, or simply exposure to formal schooling.

Data from developing countries suggest that math, science, and reading skills – as distinct from years of schooling – also yield strong economic returns, both at the individual level and as a driver of growth (Hanushek and Woessman, 2008). In addition, adult literacy, particularly for females, has been linked to increased political engagement (Burchfield et al., 2002) and greater likelihood of sending children to school (Abadzi, 2003). Although literacy and numeracy skills can be developed outside the classroom, formal education represents the primary means for acquiring such skills. It is important to ensure,

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particularly in view of the resources devoted to supporting global education systems, that students acquire foundational skills while in school, and are able to retain those skills upon school leaving.

In this paper we investigate reading and numeracy skills after school leaving, while taking into account skills at school leaving, using data from the Malawi Schooling and Adolescent Study (MSAS), a longitudinal survey of young people in southern Malawi. The paper is structured as follows: first, we review the literature relevant to the present study, summarize pertinent characteristics of the local context, present our conceptual framework and describe the data and methods used to investigate our research questions. We then present the results and conclude by discussing our findings, the limitations of our study, and directions for future research.

## 2. Background

### 2.1. Literacy, numeracy, and skill loss

A minimum level of literacy and numeracy skills is likely needed for utilization and retention of those skills, as well as building other important cognitive skills, throughout life. [Chall et al. \(1990\)](#), who conceptualized literacy acquisition in U.S. students as a multi-stage process, argued that students who failed to transition from “learning to read” to “reading to learn” while in school were more likely to lose their literacy skills after leaving school than students who had successfully made that transition. They called this transition point the “fourth grade slump,” and demonstrated that at-risk readers (including those whose home environments did not support literacy development) faced particular challenges during this juncture. Building on this work, [Wagner \(1994: p.14\)](#) noted that “it is sometimes claimed for developing countries that at least four to six years of primary school is the intellectual human resources floor upon which national economic growth is built.” The activities in which young people engage after leaving school—whether employment, household work, or childbearing—may result in erosion, preservation, or strengthening of the skills learned in school. Knowing who is at risk of losing basic skills could help focus remedial literacy programs for students and those who recently left school, as well as improve the quality of instruction for children still in school.

Ideally, the study of skill loss requires longitudinal data, through which the capabilities of the same individuals can be followed over time ([Wagner et al., 1989](#); [Glewwe, 2000](#)). With few exceptions, due to a limited number of longitudinal datasets, the retention of skills among school leavers has largely been overlooked in the empirical literature. Indeed, [LeVine et al. \(2012\)](#), who analyzed cross-sectional literacy assessments for mothers, assumed that adult literacy reflected retention of skills acquired in school, despite the fact that assessments were conducted an average of fifteen years after mothers had left school. Their argument may be plausible for those interviewed between 1983 and 1998 (the dates of their study), when school participation was far from universal ([Grant and Behrman, 2010](#); [Lloyd and Hewett, 2009](#); [Bruns et al., 2003](#)) and those who attended were likely more selective.<sup>1</sup> Moreover, schools may not have been as overcrowded as they currently are in much of sub-Saharan Africa and thus students may have had stronger skills upon leaving school. LeVine and colleagues also assumed that, at school leaving, mothers were performing at grade level on average, and attributed poorer than expected performance in reading

comprehension to skill loss after school leaving, rather than failure to acquire those skills while in school. However, given the rapid influx of students into schools in recent decades, and the subsequent deterioration in school quality in many countries ([Kendall, 2007](#)), the assumption that students retain skills gained in school into adulthood—or attained mastery of the appropriate skill while in school—is increasingly unfounded.

A few researchers have used longitudinal data to examine skill retention, such as [Wagner et al. \(1989\)](#), who investigated whether 72 fifth grade school leavers in Morocco retained basic skills. They found that two years after leaving school these adolescents demonstrated a significant increase in performance in Arabic literacy (first language), modest gains in French literacy (second language), no change in cognitive skills, and a decrement in math skills. They also found that the literacy of urban leavers improved more than for rural leavers, and that girls retained more academic skills than boys even though they were less likely to be employed. Ethnographic interviews and observations in the home revealed that, compared to their male counterparts, adolescent females who were relatively secluded were also more likely to read books, apparently as a way to have access to the world beyond their homes.

[Hartley and Swanson \(1986\)](#) traced the skill trajectories of primary students and dropouts in Egypt over a two-year period and observed that school leavers from early grades, who had lower skills than their peers before leaving school, continued to acquire skills after dropout, but at a considerably slower rate than their peers who remained in school. However, school leavers from later grades experienced an erosion of both literacy and numeracy skills after school leaving, suggesting a possible convergence of skills for these groups, albeit below functional standards ([Hartley and Swanson, 1986](#)).

Using data from the INCAP study in Guatemala, [Gorman and Pollitt \(1997\)](#) found that students’ reading skills improved steadily until grade three, at which point all students were literate based on the study assessments. After leaving school, subjects’ reading skills continued to improve, with the largest improvements among those who had completed fewer (1–3) years of schooling, although reading performance remained highest among those with the most years of schooling (5–6), regardless of how long they had been out of school ([Gorman and Pollitt, 1997](#)).

Evaluation of adult literacy programs provides further empirical evidence of skill attrition. In a World Bank review of the program implementation experience, [Abadzi \(2003\)](#) noted that, although data were somewhat sparse due to deficient monitoring and the difficulties of tracing course graduates, evidence from programs in India, Bangladesh, and Ghana suggested that a considerable proportion of beneficiaries of adult literacy programs subsequently relapsed into illiteracy. [Durgunoğlu et al. \(2003\)](#) found that, relative to a comparison group, initial literacy gains among 60 participants in a 90-hour adult literacy program in Turkey disappeared six months after course completion. The authors cited two factors associated with skill attrition: low proficiency levels at the start of the program, and limited use of literacy skills after the course concluded.

Researchers conducting a randomized controlled trial in Niger similarly found that extracurricular utilization of literacy skills enhanced retention ([Aker et al., 2011](#)). The RCT, implemented in 117 villages, compared literacy acquisition and retention among men and women enrolled in a classroom-based adult literacy program with those of participants exposed to the same basic program with an additional mobile phone component. The study showed that, although literacy and numeracy skills improved in both groups, average test scores were 20 percent higher for writing and 11 percent higher for math in the villages with the mobile phone component, compared to the basic program alone. Moreover, seven months after the intervention attrition of skills was lower in the villages with the added mobile phone component, which the authors attributed to mobile phone usage outside the classroom. The researchers also observed a gender difference in test

<sup>1</sup> LeVine et al. argued that selectivity was unlikely to explain their findings given historical and anthropological data indicating that, during the period when study respondents were school-aged, parents’ decisions about their children’s schooling were unrelated to student ability or level of achievement. However, they apparently did not consider that those who entered school might have been selective to begin with. For example, coming from a family with a higher socioeconomic status might not only increase the chances of entering or remaining enrolled in school, but it may also increase exposure to opportunities to exercise and maintain reading and numeracy skills outside of school.

scores at the end of the program, with scores of males exceeding females in both writing and math, but did not examine potential differences in skill retention by gender after the intervention.

## 2.2. The malawian context

Studying the retention of skills is particularly relevant in an environment such as Malawi. In 1994, the country became one of the first in sub-Saharan Africa to introduce free primary education. This policy change resulted in large increases in enrollment, but these were not accompanied by corresponding investments in school quality (Kendall, 2007). Access to the first grade of primary school is almost universal but the rate of dropout remains very high thereafter; according to the 2010 Malawi Demographic and Health Survey (MDHS), only 50.7% of males and 38.3% of females ages 20–24 had completed primary (NSO and ICF Macro, 2011).<sup>2</sup> The internal efficiency of the system is weak, due both to the large fraction who drop out before completing a level and very high repetition rates. The World Bank estimates that it takes 23 student years to produce one standard 8 graduate (World Bank, 2010). Further, there is evidence from the Southern and Eastern Africa Consortium on Monitoring Education Quality (SACMEQ) that learning outcomes deteriorated between 1999 and 2004 (Chimombo et al., 2005).

Complicating the process of skill acquisition is the multilingual structure of Malawi's education system. The first four standards of primary school are taught in the dominant language of a particular school's catchment area, which is commonly but not exclusively Chichewa, the country's national language, spoken by approximately 60% of the population. English is taught as a subject in all primary standards, and becomes the official language of instruction in standard 5. Proficiency in English is required for entry into secondary school. The interplay between languages, as well as exposure to written material, differs by setting.

Malawi is a predominantly rural country, with 85% of its population residing in rural areas (NSO, 2008). Literacy in any language is higher in urban areas than in rural ones: nearly 80% of the urban population aged 5 years and older are able to read and write in any language, compared to about half of the rural population. The difference between urban and rural areas is particularly stark with respect to English proficiency. Whereas, among the self-reported literate population, 98% of the urban population and 97% of the rural population claimed to be literate in Chichewa, 66% of the urban and 38% of the rural population self-reported being literate in English. Use of print media is considerably higher in urban areas. According to the 2010 MDHS, 45% of urban males and 23% of urban females aged 15–49 read a newspaper at least once a week, relative to 20% of males and 9% of females in rural areas. While the size of gender gaps in schooling outcomes varies across regions (Kalipeni, 1997; EMIS, 2013), gender gaps in educational attainment are noticeably higher in the Southern region, the location of the Malawi Schooling and Adolescent Study, as well as on the Central region by comparison to the Northern region.

## 3. Conceptual framework

In Fig. 1 we present a theoretical model for the determinants of academic skills after

school leaving. While academic skills at school leaving — which are a function of background circumstances such as parental education and socioeconomic status as well as grade attainment — clearly predict skill level after school leaving, a number of factors that facilitate or inhibit use of those skills are also key. For example, work may provide young

adults with an opportunity to use literacy and numeracy skills, whereas parenthood, particularly for women in high fertility resource poor settings who have limited access to books, magazines and newspapers, may provide few opportunities to read and perform arithmetic calculations. We also hypothesize that sex of the individual is an essential element, particularly in environments with traditional gender roles.

## 4. Data and methods

### 4.1. Data

The data for this analysis come from the Malawi Schooling and Adolescent Study (MSAS), a longitudinal survey (2007–2013) with a baseline sample of 1764 adolescent primary school students and 885 adolescents who were out-of-school. We restricted the present analysis to respondents from the baseline student sample, for whom we observed literacy and numeracy skills before school leaving.

The student sample was selected from fifty-nine primary schools in Balaka and Machinga, two predominantly rural southern districts of Malawi. The 30 schools visited in Machinga represented nearly 20% of primary schools in the district at baseline, and those in Balaka represented nearly 25% of primary schools in that district. The probability of a particular school being included in the sample was proportional to its enrollment in 2006.<sup>3</sup> At each school we interviewed approximately 30 students in standards 4–8, the last 5 years of primary school, stratified by gender and age. The students were randomly selected from all students aged 14–16 at the beginning of the 2007 school year who were recorded in the school registers. It is important to note that, as resources were limited, we did not collect data on adolescents in the same age group who were attending secondary school, nor did we collect data from adolescents who were attending primary school but had not reached standard 4. According to the 2004 MDHS data (NSO and ORC Macro, 2005), of the 75% of males and 71% of females aged 14–16 in the southern region who were enrolled in school, 11% of males and 17% of females were enrolled in secondary school, 73% of both males and females were enrolled in primary school in standards 4–8, and 16% of males and 10% of females were enrolled in standard 3 or lower. Therefore, although the student sample did not include the top and bottom tier students, it reflected the educational experience of the vast majority of young people in southern Malawi.

Respondents were aged 14–17 when first interviewed between May and July of 2007 and were re-interviewed annually until 2011 and subsequently in 2013. The baseline student sample included 889 males and 875 females. The study achieved a re-interview rate for of 94.9% for both males and females in 2008, 92.5% for males and 93.1% for females in 2009, 90.7% for males and 92.0% for females in 2010, 90.2% for males and 91.5% for females in 2011, and 79.5% for males and 88.9% for females in 2013.

The MSAS instrument included an extensive set of questions on household and family characteristics, educational attainment, schooling history and experiences, household labor and employment, sexual behavior, marriage, and health. The study also included short assessments of oral reading and reading comprehension in English and Chichewa, and written numeracy skills. For the oral assessment, respondents were asked to read aloud two sentences in Chichewa and two sentences in English.<sup>4</sup> The reading of each sentence was scored by the interviewer as: a) cannot read any part of the sentence, b) able to read only part, and c) able to read the whole sentence.

The ability to read a sentence out loud is a skill that precedes reading comprehension in the literacy acquisition process (Chall et al.,

<sup>2</sup> The Malawian education system consists of eight years of primary schooling (standards 1–8), four years of secondary (forms 1–4), and four years of university-level education.

<sup>3</sup> The number of schools visited in each district was based on estimates of (1) the proportion of students in the age group attending primary school, (2) estimated attendance rates (3) estimated attrition rates, (4) estimates of transitions to secondary school and school dropout.

<sup>4</sup> The sentences used were drawn from the 2004 MDHS.

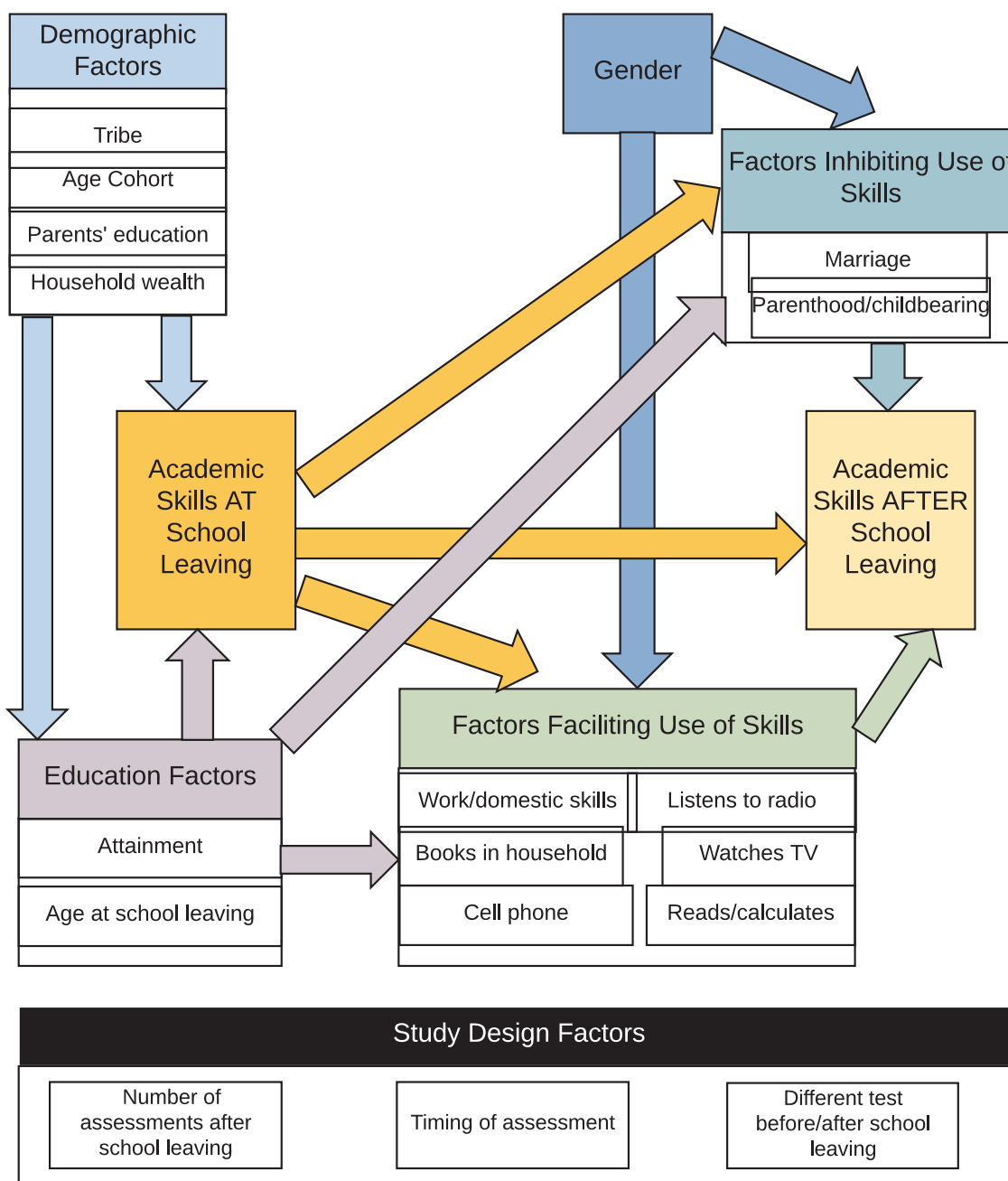


Fig. 1. Conceptual model of the determinants of academic skills after school leaving.

1990; LeVine et al., 2012). Starting in round 2 (2008), reading comprehension assessments in Chichewa and English were also conducted. For each language, respondents were given one minute to read a short passage out loud; the Chichewa passage had 73 words and the English passage had 86 words. Those who read at least the first 26 words (first three sentences) in Chichewa were then asked six questions about the content, and those who read at least the first 35 words (first three sentences) in English were asked five questions. Different passages and questions, but of similar length and complexity, were used in rounds 3 (2009) and 5 (2011), while the round 2 passages and questions were repeated in rounds 4 (2010) and 6 (2013). Scores ranged from 0 to 6 for reading comprehension in Chichewa, and 0–5 for reading comprehension in English, according to the number of questions answered correctly. If the respondent could not read at all, or could not read the first three sentences within one minute, or read the first three sentences but

did not correctly answer any of the questions, he/she was given a score of zero.

At round 1 in 2007, the numeracy assessment consisted of 12 questions drawn from the Malawi Institute of Education (MIE) achievement tests for standard 3.<sup>5</sup> The questions included sequencing and ordering numbers, addition, subtraction, multiplication, division, and two word problems involving simple monetary transactions. Respondents were given unlimited time to complete the numeracy assessment. A similar assessment, but with questions involving different numbers, was used in round 2 and repeated in rounds 4 and 6. The

<sup>5</sup> The Malawi Institute of Education is a para-statal organization that is charged by the Ministry of Education with curriculum development, assessment and teacher training programs.



**Table 1**  
Analytical sample.

	Total		Males		Females	
	N	% of baseline sample	N	% of baseline sample	N	% of baseline sample
Included in analytical sample						
Left school between 2nd term of 2007 school year and 2nd term 2011–12 school year	1118	63.4%	460	51.7%	658	75.2%
Not included in analytical sample						
In school after 2nd term 2011–12 school year	494	28.0%	323	36.3%	171	19.5%
In school last time interviewed, lost to follow up	114	6.5%	84	9.4%	30	3.4%
Missing relevant data	38	2.1%	22	2.5%	16	1.8%
Total baseline sample	1764	100.0%	889	100.0%	875	100.0%

round 1 numeracy assessment was repeated in rounds 3 and 5. The numeracy score is the total number of correct answers to the 12 problems in the assessment.

#### 4.2. Analytical sample

To investigate reading and numeracy skills after school leaving, we considered all baseline students who were known to have left school during the course of MSAS and for whom we had an assessment of skills close to the time of school leaving (one term before school leaving or up to two terms after school leaving), and at least one subsequent assessment of skills. The resulting analytical sample included 1118 respondents who left school between the second term of the 2007 school year and the second term of the 2011–2012 school year.<sup>6</sup> Note that of these 1118 respondents, those who left school during the 2007 school year—50 males and 166 females—were excluded from the reading comprehension analysis as a measure of their reading comprehension skills at school leaving was not available in the dataset. Not included in the analytical sample are 494 respondents who were still attending school past the second term of the 2011–2012 school year, 114 respondents who were attending school the last time they were interviewed and were lost to follow up in or before round 6, and 38 respondents who are known to have left school during the relevant time for this analysis but for whom we are missing relevant data (see Table 1).

#### 4.3. Explanatory variables

The first set of variables included in our analyses includes constant sociodemographic characteristics: female (versus male), belongs to the Yao ethnic group (versus others), age at baseline, whether the respondent's biological parents completed primary school, and a time-varying count of household items.<sup>7</sup> It also includes respondent's grade attainment and age at school leaving.

The second set of variables includes respondents' skills—ability to read sentences, reading comprehension score, and numeracy score—measured near the time of school leaving. To assess respondents' ability to read sentences at school leaving, separately for each language, we defined three mutually exclusive categories: (i) “no skill” if the respondent could not read at all; (ii) “low skill” if the respondent could

read parts or one complete sentence but not both sentences; and (iii) “high skill” if the respondent could read both sentences in full.

We also included a set of binary indicator variables to control for whether the assessment near the time of school leaving was conducted one term before school leaving, the same term as school leaving, or one or two terms after school leaving. We do this to control for the imprecision in the timing of the assessment relative to school leaving. We also included the time since school leaving, measured as the number of years between the measurement of skills near school leaving and the measurement of skills after school leaving. For the purposes of these analyses, we assume that the skills measured closest to the time of school leaving (one term before school leaving or up to two terms after school leaving) represent skills at the time of school leaving, although skills might have improved or deteriorated between the assessment and the actual last day of school attendance. The assessment was conducted two terms after school leaving only for 43 respondents. We refer to the assessment conducted close to school leaving as skills “at school leaving,” and we refer to the assessment(s) conducted subsequently as “after school leaving” for the remainder of this paper. Given that the reading comprehension units and numeracy questions were repeated in alternate years, we also included a variable indicating whether the assessments measuring skills at and after school leaving were the same version of this tool.

Third, we include time-varying individual and household-level variables measured at the same time as each assessment after school leaving: whether the respondent was working, whether the respondent spent two hours or more doing domestic work the day before the survey, whether the respondent was married, whether the respondent had ever given birth, whether the household had any books, and whether the household had a cell phone.

Finally, we included a series of indicators on use of skills and exposure to mass media that were only measured at round 6 and are thus treated as constant in the models: reads anything at least once a week; calculates prices, costs, budgets, or uses fractions, decimals or percentages at least once a week; listens to the radio at least once a week; and watches television at least once a week.

#### 4.4. Statistical methods

The data are structured as observations nested within individuals sampled from schools, so we structure the analysis as a series of multi-level regressions with random intercepts at the school and individual level. To investigate the determinants of oral reading after school leaving we use multi-level logistic regression models where the outcome is equal to 1 if the respondent has a high skill level after school leaving and 0 otherwise. To investigate the determinants of reading comprehension and numeracy skills after school leaving we estimate multi-level linear regression models for the respective scores after school leaving. It should be noted that individuals may have more than one assessment after school leaving depending on the time when they

<sup>6</sup> Note that during the course of the MSAS, the school calendar in Malawi was changed from a January to a September start. In 2007–2009, the school year started in January and ended in November. The transition occurred with a compressed school year that started in December 2009 and ended in August 2010. The following school years started in September and ended in July.

<sup>7</sup> Respondents' were asked whether their household had any of the following 14 items: mattress, sofa, table, chairs, paraffin lamp, television, radio, mosquito net, bicycle, motorcycle, car, tin roof, electricity, boat/canoe. We include a simple count of these items, results do not change in any significant way if instead we use an index generated through principal components analysis.

left school and the number of rounds they were interviewed while no longer attending school.

Formally, we estimate the following model:

$$K_{it} = \beta_0 + \beta_1 S_i + \beta_2 T_{it} + \beta_3 X_i + \beta_4 Z_{it} + u_i + u_s + e_{sit}$$

where  $K_{it}$  is skill of respondent  $i$  measured at time  $t$  after school leaving [ $t = 1, \dots, 5$ ];  $S$  is a vector of school experience variables including grade attainment, age at school leaving, and skill level at school leaving ( $t = 0$ );  $T$  is time, measured in years, that has elapsed between the measurement of skills at school leaving and  $K$ ;  $X$  is a vector of time-constant variables including respondent sex, ethnicity, and parental education;  $Z$  is a vector of time-varying variables including work, domestic work, and household items;  $u_i$  is a random intercept at the individual level;  $u_s$  is a random intercept at the school level; and  $e$  is a random error.

The regressions were estimated as a series of nested models that sequentially added the independent variables. For all outcome variables, the first model included sex, ethnicity, age at baseline, parents' education, household wealth, grade attainment, and age at school leaving as covariates. The second model added skills at school leaving. The third model added the covariates identified in the conceptual model as facilitating or inhibiting skill retention, except those assessing skill use and exposure to mass media after school leaving (measured only at round 6), which were added in the fourth model. Because the numeracy assessment included word problems, we also control for respondents' reading comprehension scores in Chichewa, measured at the same time as the outcome, in the numeracy models. We are not formally modeling the causal pathways identified in the conceptual framework. Our sequence of nested models, however, allows us to examine whether the addition of variables that are more proximate to the outcome in our conceptual framework mediate the associations between the more distal variables and skill retention.

## 5. Results

### 5.1. Descriptive findings

As observed in Table 2, which compares respondents based on whether they are included in the analysis or not, there are significant differences in characteristics measured at baseline between respondents who left school and those that remained in school after the second term of the 2011–2012 school year. Those who remained in school after the second term of the 2011–12 school year were more likely to be male, to be younger, to score higher on literacy and numeracy assessments, to have parents who completed primary school and to reside in households with books, cellphones and a greater number of other assets.

Table 3 presents descriptive statistics for the explanatory variables for the analytic sample and by sex. In comparing the characteristics of males and females it is important to keep in mind that approximately half of male respondents were still enrolled in school when the sample was censored, as compared to only one-quarter of female respondents. This difference means that the male analytic sample is less representative of the full male sample than are females representative of the full female sample. These censoring issues mean that we are likely underestimating male skills at school leaving more than female skills at school leaving. For example, other than English reading comprehension, literacy and numeracy skills at school leaving were the same or slightly better for females included in the analytic sample as for males (Table 3). Were we able to follow the entire sample until they left school, however, the scores of males would be higher, if for no other reason than grade attainment at school leaving would exceed that of females. And, while parents of females included in the analytic sample were significantly better educated than parents of males, were those still attending school included, this gender difference would not remain.

Table 4 compares skills at school leaving with the skill level at the

**Table 2**  
Comparison of baseline characteristics by inclusion in analytical sample.

	Included in analytical sample: Left school between 2nd term of 2007 school year and 2nd term 2011–12 school year (N = 1118) Mean	Excluded from analytical sample			
		In school after 2nd term 2011–12 school year (N = 494) Mean	Diff ! = 0 p-val	Lost to follow up or missing relevant dat (N = 152) Mean	Diff ! = 0 p-val
Is female	0.589	0.346	***	0.303	***
Tribe is Yao	0.430	0.310	***	0.493	
Age	15.440	14.868	***	15.362	
Both parents completed primary	0.089	0.146	***	0.118	
Only mother completed primary	0.034	0.055	†	0.039	
Only father completed primary	0.205	0.227		0.230	
Neither parent completed primary	0.673	0.573	***	0.612	
Count of other household items	4.597	5.227	***	5.000	†
Grade attending	6.385	6.502	†	6.678	**
Reads two sentences in Chichewa	0.908	0.933	†	0.901	
Reads two sentences in English	0.678	0.763	***	0.709	
Numeracy score	9.098	9.668	***	9.133	
Works	0.335	0.342		0.375	
Domestic work 2 or more hours	0.368	0.259	***	0.283	*
Ever been married	0.002	0.000		0.000	
Ever given birth/had a child	0.014	0.008		0.000	
Household has any books	0.612	0.700	***	0.651	
Household has a cell phone	0.131	0.188	**	0.243	***

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

†  $p < 0.1$ .

**Table 3**  
Gender differences in explanatory variablesTable 3 continued.

	Total		Males		Females		Diff != 0
	N	Mean	N	Mean	N	Mean	p-val
Number of assessments after school leaving	1118	2.780	460	2.313	658	3.106	***
Is female	1118	0.589					
Tribe is Yao	1118	0.430	460	0.443	658	0.421	
Age at baseline	1118	15.440	460	15.498	658	15.400	†
Both parents completed primary	1118	0.089	460	0.074	658	0.099	
Only mother completed primary	1118	0.034	460	0.022	658	0.043	†
Only father completed primary	1118	0.205	460	0.170	658	0.229	*
Neither parent completed primary (ref)	1118	0.673	460	0.735	658	0.629	***
Completed standard 3–4	1118	0.086	460	0.104	658	0.073	†
Completed standard 5	1118	0.109	460	0.087	658	0.125	*
Completed standard 6	1118	0.141	460	0.137	658	0.144	
Completed standard 7	1118	0.181	460	0.159	658	0.196	
Completed standard 8	1118	0.231	460	0.222	658	0.237	
Completed form 9 or higher (ref)	1118	0.252	460	0.291	658	0.225	*
Age at school leaving	1118	17.247	460	17.652	658	16.964	***
Skills at or around school leaving:							
Chichewa reading no skill	1118	0.030	460	0.041	658	0.021	†
Chichewa reading low skill	1118	0.040	460	0.039	658	0.041	
Chichewa reading high skill (ref)	1118	0.930	460	0.920	658	0.938	
Chichewa reading comprehension score	902	4.198	410	4.083	492	4.295	†
English reading no skill	1118	0.064	460	0.091	658	0.046	**
English reading low skill	1118	0.176	460	0.152	658	0.193	†
English reading high skill (ref)	1118	0.759	460	0.757	658	0.761	
English reading comprehension score	902	1.432	410	1.651	492	1.250	***
Numeracy score	1118	9.130	460	9.050	658	9.185	
Assessment one term before school leaving	1118	0.155	460	0.137	658	0.167	
Assessment same term as school leaving (ref)	1118	0.461	460	0.515	658	0.422	**
Assessment one or two terms after school leaving	1118	0.385	460	0.348	658	0.410	*
Years between assessments	3108	2.654	1064	2.516	2044	2.726	***
Different test before/after school leaving	3108	0.601	1064	0.615	2044	0.594	
Works	3108	0.345	1064	0.607	2044	0.208	***
Domestic work 2 or more hours	3108	0.607	1064	0.277	2044	0.779	***
Is married	3108	0.606	1064	0.286	2044	0.773	***
Ever given birth/had a child	3108	0.582	1064	0.278	2044	0.740	***
Household has any books	3108	0.458	1064	0.495	2044	0.439	**
Household has a cell phone	3108	0.536	1064	0.537	2044	0.536	
Count of other household items	3108	4.321	1064	4.562	2044	4.195	***
Reads anything at least once a week (R6 only)	970	0.387	373	0.507	597	0.312	***
Calculates anything at least once a week (R6 only)	970	0.416	373	0.413	597	0.419	
Listens to radio at least once a week (R6 only)	970	0.665	373	0.724	597	0.628	**
Watches TV at least once a week (R6 only)	970	0.165	373	0.279	597	0.094	***

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

†  $p < 0.1$ .

first assessment after school leaving, as well as the final assessment after school leaving, for the total sample and separately by sex. Note that for 248 respondents (22% of the analytical sample), only one assessment is available after school leaving. There was no significant change in Chichewa oral reading skills over time for either the total sample or for males or females separately; over 90% of respondents were able to read both sentences each time they were assessed. In contrast, Chichewa comprehension skills increased between school leaving and the last assessment both for the total sample (an 8% increase) and, separately, for males (a 9% increase) and females (a 7% increase).

A different pattern was observed for English literacy skills. For both the total sample, and for males and females separately, there was a significant decline in English oral reading skills between school leaving

and the final assessment; while 76% of both male and female respondents were able to read English sentences aloud at school leaving, by the last assessment this proportion had declined significantly to 70% for males and 64% for females. As with Chichewa, English comprehension skills increased significantly for both males and females between the initial and final assessments; the average scores rose from 1.25 to 1.55 (out of 5—a 24% increase) among females and 1.65–1.97 among males (a 19% increase). The counter-intuitive finding, indicating declines in oral reading and increases in comprehension, is driven by the fact that the declines in the proportion of respondents who are able to read is offset by increases in the comprehension score for the larger proportion of the sample who are literate.

Numeracy skills declined significantly for both males and females between school leaving and the last assessments. Overall, the numeracy

**Table 4**

Skills nearest to school leaving and after school leaving by sex ( $t_0$  = Nearest assessment to time of school leaving;  $t_1$  = 1 st assessment after school leaving;  $t_{\max}$  = Last assessment after school leaving).

	N	Mean $t_0$	Mean $t_1$	Diff $t_1-t_0$	Diff ! = 0 p-val	Mean $t_{\max}$	Diff $t_{\max}-t_0$	Diff ! = 0 p-val
<b>ALL</b>								
Chichewa: Read 2 full sentences	1118	0.930	0.931	0.001		0.916	−0.014	
Chichewa: Reading comprehension score (0–6; 0 if did not read first 3 sentences)	902	4.198	4.387	0.188	***	4.521	0.323	***
English: Read 2 full sentences	1118	0.759	0.711	−0.048	**	0.664	−0.096	***
English: Reading comprehension score (0–5; 0 if did not read first 3 sentences)	902	1.432	1.512	0.080		1.742	0.309	***
Numeracy score – (0–12)	1118	9.130	8.643	−0.487	***	8.342	−0.788	***
<b>MALES</b>								
Chichewa: Read 2 full sentences	460	0.920	0.924	0.004		0.900	−0.020	
Chichewa: Reading comprehension score (0–6; 0 if did not read first 3 sentences)	410	4.083	4.373	0.290	***	4.454	0.371	***
English: Read 2 full sentences	460	0.757	0.702	−0.054	†	0.696	−0.061	*
English: Reading comprehension score (0–5; 0 if did not read first 3 sentences)	410	1.651	1.827	0.176	*	1.973	0.322	***
Numeracy score – (0–12)	460	9.050	8.767	−0.283	**	8.563	−0.487	***
<b>FEMALES</b>								
Chichewa: Read 2 full sentences	658	0.938	0.936	−0.002		0.927	−0.011	
Chichewa: Reading comprehension score (0–6; 0 if did not read first 3 sentences)	492	4.295	4.398	0.104		4.577	0.283	***
English: Read 2 full sentences	658	0.761	0.717	−0.044	†	0.641	−0.120	***
English: Reading comprehension score (0–5; 0 if did not read first 3 sentences)	492	1.250	1.250	0.000		1.549	0.299	***
Numeracy score – (0–12)	658	9.185	8.556	−0.629	***	8.187	−0.998	***

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

†  $p < 0.1$ .

score dropped by 9% from an average of 9.13 to 8.34, with a greater decline among females (11%) than among males (5%). All these changes are statistically significant ( $p < 0.001$ ).

## 5.2. Regression models

While the descriptive results presented in Table 4 are illuminating, they raise several questions:

- 1 Controlling for grade attainment and skill level at school leaving, is there a gender difference in skill level after school leaving?
- 2 What effect do background characteristics and time-varying individual and household variables have on skill level after school leaving?
- 3 To the extent that skill level after school leaving differs for males and females, does the opportunity to apply skills gained in school, measured by exposure to media and time spent reading, partially explain the gender gap?

Tables 5–9 present the regression results for each of the five skills included in Table 4. Note that for oral reading skills — for which logistic models were estimated (Tables 5 and 7) — the results are presented as odds ratios with a value less than one for “female” indicating that females performed worse than males whereas for reading comprehension and numeracy (Tables 6, 8 and 9) — for which linear models were estimated — the results are presented as coefficients with a negative sign for “female” indicating that females performed worse.

In answer to our first question, we find a significant gender difference in skill level after school leaving for English oral reading ( $p < 0.10$ ) and reading comprehension skills ( $p < 0.001$ ), even after controlling for initial skill level and grade attainment, with females scoring lower than males. For instance, females had approximately a 36% lower odds of being able to read than their male counterparts and had a 0.42 lower average on reading comprehension. While the gender difference in numeracy is not statistically significant in all the models, it is worth noting that the mean numeracy scores were consistently lower for females than for males after school leaving.

As for the second question regarding the influence of other factors on skill level after school leaving, only four variables were consistently associated with skills across outcomes. As expected, those who had attended secondary school had a significantly higher skill level for all outcomes. Age at school leaving was negatively and significantly associated with skill level after school leaving for all outcomes except English reading comprehension; the older the respondent when leaving school — which after controlling for grade attainment primarily reflects the effect of grade repetition, late entry, and temporary withdrawals — the lower the subsequent skill level. Also, as expected, skill level after school leaving was positively and significantly associated with skill level at school leaving for all outcomes. Two other variables, timing of the initial skill assessment and years between assessments, were significantly associated with skill level after school leaving. For four of the five outcomes — Chichewa oral reading being the exception — respondents who were initially assessed 1–2 terms after school leaving compared to the same term as school leaving had lower scores. Notably,



**Table 5**  
Mixed-effects logistic regression models for reading in Chichewa after school leaving.

	Model 1		Model 2		Model 3		Model 4	
	OR	p-val	OR	p-val	OR	p-val	OR	p-val
Is female	1.174		0.621		0.572		0.746	
Tribe is Yao	1.210		1.063		1.112		1.061	
Age at baseline	1.254		1.665	**	1.627	*	1.507	*
Both parents completed primary	0.302	†	0.589		0.622		0.806	
Only mother completed primary	0.482		0.988		0.990		0.916	
Only father completed primary	0.586		0.620		0.620		0.573	
Neither parent completed primary (ref)								
Count of household items	1.083		1.043		1.080		1.068	
Completed standard 3–4	0.001	***	0.016	***	0.015	***	0.027	***
Completed standard 5	0.011	**	0.074	***	0.071	***	0.098	**
Completed standard 6	0.038	*	0.130	**	0.126	**	0.193	*
Completed standard 7	0.071		0.218	*	0.218	*	0.277	*
Completed standard 8	0.098		0.487		0.471		0.468	
Completed form 9 or higher (ref)								
Age at school leaving	0.780		0.541	**	0.559	**	0.638	*
Chichewa reading no skill at school leaving			0.000	***	0.000	***	0.000	***
Chichewa reading low skill at school leaving			0.041	***	0.039	***	0.055	***
Chichewa reading high skill at school leaving (ref)								
Assessment one term before school leaving			2.067		2.134		2.151	
Assessment one or two terms after school leaving			0.424	*	0.427	*	0.618	
Assessment same term as school leaving (ref)								
Years between assessments			0.872	*	0.917		0.896	
Works					0.731		0.762	
Domestic work 2 or more hours					1.128		1.057	
Is married					0.863		0.808	
Ever given birth/had a child					0.974		1.054	
Household has any books					1.106		1.118	
Household has a cell phone					0.569	*	0.538	*
Reads anything at least once a week (R6 only)							1.243	
Listens to radio at least once a week (R6 only)							1.107	
Watches TV at least once a week (R6 only)							1.753	
Constant	13061.4	*	21084.6	**	21140.5	**	3780.9	**
Variance in random intercepts								
School-level	0.000		0.000		0.000		0.000	
Individual-level	16.854		4.869		4.931		4.777	
Obs	3108		3108		3108		2836	
Schools	59		59		59		59	
Respondents	1118		1118		1118		970	
Wald chi2	66.85		123.47		123.25		115.17	
Prob > chi2	0.000		0.000		0.000		0.000	
Log likelihood	−633.9		−537.1		−533.5		−492.6	
LR test vs. logistic regression chi2	(a)		106.07	***	105.03	***	97.96	***

(a) Convergence not achieved after 100 iterations.

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

†  $p < 0.1$ .

aside from age at baseline, which was positively correlated with skill level for Chichewa oral reading, Chichewa reading comprehension and numeracy, none of the socioeconomic or demographic variables was consistently associated with skill level after school leaving across the five outcomes when controlling for grade attainment, age at school leaving, and skill level at school leaving. Finally, it is worth noting that we do not find substantive between-school variance in literacy, reading comprehension, or numeracy.

A comparison of Models 3 and 4 addresses our third question regarding differential opportunities to apply skills after leaving school,

which we hypothesized might explain why females scored significantly lower in English reading and comprehension after school leaving than males. As Table 3 indicates, females were significantly and substantially less likely than males to read, listen to the radio and watch television after school leaving. For example, 51% of males compared to 31% of females reported reading something in the week prior to the round 6 survey in 2013. Our hypothesis was that young women, the majority of whom were married and had children by round 6 (see Table 3), were more likely to be confined to home or engaged in household-related tasks, whereas young men were more likely to frequent venues where

**Table 6**  
Mixed-effects ML regression models for reading comprehension score in Chichewa after school leaving.

	Model 1		Model 2		Model 3		Model 4	
	Coef	p-val	Coef	p-val	Coef	p-val	Coef	p-val
Is female	−0.038		−0.150	†	−0.146		−0.106	
Tribe is Yao	0.034		0.097		0.104		0.133	
Age at baseline	0.106	†	0.174	**	0.171	**	0.165	**
Both parents completed primary	−0.015		−0.023		−0.027		0.031	
Only mother completed primary	0.093		0.032		0.026		0.031	
Only father completed primary	0.010		0.014		0.013		0.055	
Neither parent completed primary (ref)								
Count of household items	−0.028	*	−0.014		−0.021		−0.012	
Completed standard 3–4	−2.730	***	−1.950	***	−1.932	***	−1.776	***
Completed standard 5	−1.739	***	−1.366	***	−1.349	***	−1.241	***
Completed standard 6	−1.414	***	−1.042	***	−1.017	***	−1.038	***
Completed standard 7	−0.739	***	−0.513	***	−0.498	***	−0.435	**
Completed standard 8	−0.574	***	−0.395	**	−0.385	**	−0.348	**
Completed form 9 or higher (ref)								
Age at school leaving	−0.164	**	−0.243	***	−0.238	***	−0.235	***
Chichewa reading comprehension score at school leaving			0.413	***	0.412	***	0.418	***
Assessment one term before school leaving			0.092		0.097		0.035	
Assessment one or two terms after school leaving			−0.288	**	−0.286	**	−0.293	**
Assessment same term as school leaving (ref)								
Years between assessments			0.084	***	0.093	***	0.099	***
Different assessments			0.084		0.077		0.066	
Works					−0.023		−0.009	
Domestic work 2 or more hours					0.053		0.061	
Is married					−0.052		−0.071	
Ever given birth/had a child					−0.021		−0.048	
Household has any books					0.104	†	0.093	
Household has a cell phone					0.014		−0.017	
Reads anything at least once a week (R6 only)							0.275	**
Listens to radio at least once a week (R6 only)							0.013	
Watches TV at least once a week (R6 only)							−0.117	
Constant	6.569	***	4.765	***	4.693	***	4.531	***
Variance in random intercepts								
School-level	0.003		0.000		0.000		0.000	
Individual-level	1.065		0.647		0.641		0.616	
Obs	2187		2187		2187		1987	
Schools	59		59		59		59	
Respondents	902		902		902		784	
Wald chi2	245.34		645.07		652.93		582.01	
Prob > chi2	0.000		0.000		0.000		0.000	
Log likelihood	−3877.7		−3742.6		−3740.3		−3391.3	
LR test vs. linear regression chi2	365.91	***	193.34	***	191.07	***	171.90	***

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

†  $p < 0.1$ .

there were newspapers, television and radio. This differential exposure, however, does not appear to explain the gender gap in English oral reading and reading comprehension, as the association between sex and reading skills changed little after the addition of these variables to the models.

## 6. Discussion

In this paper we have investigated whether, among a sample of Malawian adolescents attending school at ages 14–17, literacy and numeracy skills measured at school leaving were retained several years after school leaving. The descriptive findings presented here indicate

that, on average, English oral reading and numeracy skills deteriorated after school leaving, while Chichewa oral reading skills remained about the same, and reading comprehension skills in both languages improved. That Chichewa oral reading skills remained the same and English oral reading skills deteriorated, while comprehension increased in both languages, likely reflects a threshold such that those who had an initial grasp of the skill were able to use it in their daily lives, thereby strengthening their skills, whereas those who had a tenuous hold on the skills fell further behind. Moreover, the number of years between assessments was significantly associated with scores after school leaving, positively for Chichewa and English comprehension, and negatively for English reading and numeracy, which is likely a reflection of the same

**Table 7**  
Mixed-effects logistic regression models for reading in English after school leaving.

	Model 1		Model 2		Model 3		Model 4	
	OR	p-val	OR	p-val	OR	p-val	OR	p-val
Is female	0.634	*	0.511	***	0.581	*	0.641	†
Tribe is Yao	0.990		0.885		0.909		0.898	
Age at baseline	1.203	†	1.193		1.173		1.159	
Both parents completed primary	0.904		0.929		0.925		0.766	
Only mother completed primary	1.027		1.109		1.071		0.909	
Only father completed primary	0.773		0.835		0.851		0.816	
Neither parent completed primary (ref)								
Count of household items	1.022		1.009		1.001		1.007	
Completed standard 3–4	0.001	***	0.006	***	0.006	***	0.004	***
Completed standard 5	0.008	***	0.022	***	0.023	***	0.020	***
Completed standard 6	0.027	***	0.047	***	0.048	***	0.048	***
Completed standard 7	0.142	***	0.176	***	0.180	***	0.150	***
Completed standard 8	0.273	***	0.381	**	0.388	**	0.449	*
Completed form 9 or higher (ref)								
Age at school leaving	0.708	***	0.630	***	0.639	***	0.628	***
English reading no skill at school leaving			0.009	***	0.009	***	0.009	***
English reading low skill at school leaving			0.130	***	0.131	***	0.132	***
English reading high skill at school leaving (ref)								
Assessment one term before school leaving			1.546	†	1.544	†	1.775	*
Assessment one or two terms after school leaving			0.524	**	0.522	**	0.540	**
Assessment same term as school leaving (ref)								
Years between assessments			0.841	***	0.850	***	0.847	**
Works					1.282	†	1.368	*
Domestic work 2 or more hours					1.002		1.025	
Is married					1.024		0.965	
Ever given birth/had a child					0.934		0.917	
Household has any books					1.255	†	1.226	
Household has a cell phone					0.962		0.994	
Reads anything at least once a week (R6 only)							0.775	
Listens to radio at least once a week (R6 only)							0.730	†
Watches TV at least once a week (R6 only)							2.002	*
Constant	1316.6	***	27178.8	***	21117.8	***	42107.3	***
Variance in random intercepts								
School-level	0.227		0.036		0.043		0.184	
Individual-level	3.724		2.379		2.385		2.173	
Obs	3108		3108		3108		2836	
Schools	59		59		59		59	
Respondents	1118		1118		1118		970	
Wald chi2	262.36		336.54		337.23		318.31	
Prob > chi2	0.000		0.000		0.000		0.000	
Log likelihood	–1422.1		–1298.5		–1295.5		–1162.4	
LR test vs. logistic regression chi2	302.41	***	158.96	***	158.77	***	146.52	***

\* p < 0.05.

\*\* p < 0.01.

\*\*\* p < 0.001.

† p < 0.1.

threshold effects.

Multivariable analyses reveal that, controlling for initial skill level and grade attainment, females score significantly lower than males on English oral reading and reading comprehension skills. While the gender difference in numeracy is not always significant, females have inferior numeracy skills after school leaving. Notably, although young women are significantly less likely to read, listen to radio or watch TV, these variables are not consistently associated with reading skills and do not appear to explain the gender difference.

Our models indicate that grade attainment – not media exposure, life experience (marriage, becoming a parent, work status), parental

education, household economic status, or unobserved school characteristics – is the critical factor explaining variability in skill level after school leaving. That those with lower grade attainment have inferior skills after school leaving, controlling for skill level at school leaving, suggests that students who progressed farther in school were more likely to regularly apply and reinforce their skills after leaving school, whereas those who left school earlier, particularly females, may not have had the same opportunities. This difference in the opportunity to apply skills after leaving school may reflect a different value placed on education, especially for girls, which both supports (or undermines) higher grade attainment and contributes to the use of skills after leaving

**Table 8**  
Mixed-effects ML regression models for reading comprehension score in English after school leaving.

	Model 1		Model 2		Model 3		Model 4	
	Coef	p-val	Coef	p-val	Coef	p-val	Coef	p-val
Is female	−0.533	***	−0.406	***	−0.466	***	−0.420	***
Tribe is Yao	0.025		0.048		0.060		0.042	
Age at baseline	−0.074		−0.071		−0.080	†	−0.083	
Both parents completed primary	0.245	†	0.139		0.148		0.191	
Only mother completed primary	0.072		−0.020		0.014		0.048	
Only father completed primary	0.117		0.101		0.112		0.135	
Neither parent completed primary (ref)								
Count of household items	−0.005		0.002		−0.001		−0.005	
Completed standard 3–4	−2.376	***	−1.845	***	−1.811	***	−1.737	***
Completed standard 5	−2.032	***	−1.641	***	−1.615	***	−1.582	***
Completed standard 6	−1.916	***	−1.483	***	−1.454	***	−1.478	***
Completed standard 7	−1.230	***	−0.969	***	−0.956	***	−0.940	***
Completed standard 8	−0.860	***	−0.637	***	−0.630	***	−0.581	***
Completed form 9 or higher (ref)								
Age at school leaving	−0.024		−0.018		−0.010		−0.013	
English reading comprehension score at school leaving			0.351	***	0.351	***	0.353	***
Assessment one term before school leaving			−0.017		−0.012		−0.065	
Assessment one or two terms after school leaving			−0.183	*	−0.178	*	−0.205	*
Assessment same term as school leaving (ref)								
Years between assessments			0.129	***	0.141	***	0.150	***
Different assessments			0.070		0.064		0.092	†
Works					−0.109	†	−0.125	*
Domestic work 2 or more hours					0.038		0.049	
Is married					0.118	†	0.113	
Ever given birth/had a child					−0.099		−0.102	
Household has any books					0.163	**	0.150	*
Household has a cell phone					−0.061		−0.075	
Reads anything at least once a week (R6 only)							0.062	
Listens to radio at least once a week (R6 only)							0.074	
Watches TV at least once a week (R6 only)							0.166	†
Constant	4.333	***	3.083	***	3.050	***	3.019	***
Variance in random intercepts								
School-level	0.036		0.013		0.010		0.015	
Individual-level	0.557		0.358		0.356		0.341	
Obs	2187		2187		2187		1987	
Schools	59		59		59		59	
Respondents	902		902		902		784	
Wald chi2	511.48		910.49		936.93		904.75	
Prob > chi2	0.000		0.000		0.000		0.000	
Log likelihood	−3654.6		−3532.6		−3524.0		−3175.7	
LR test vs. linear regression chi2	153.11	***	81.91	***	81.85	***	78.02	***

\*  $p < 0.05$ .

\*\*  $p < 0.01$ .

\*\*\*  $p < 0.001$ .

†  $p < 0.1$ .

school. The effect of grade attainment, regardless of skill level at school leaving, may also be a consequence of the socializing effect of attending school at higher levels, because of the selectivity of those who remain in school, as well as a consequence of better quality schooling at higher grades because of the lower student teacher ratio. This finding warrants further exploration in future research.

These results should be viewed in light of several important limitations. First, a substantial proportion of respondents, more male than female, were still enrolled in school when our last assessment was administered. In addition, among respondents who had left school, we lack multiple assessments after school leaving for those who remained in school longer, a larger proportion of which is male. This means that

we have censoring primarily among respondents who may be more academically inclined or who have greater family support for education, factors that may make those students less likely to lose and more likely to gain skills. Moreover, the fact that Malawian boys remain in school during adolescence longer than girls indicates that the gender differences we observe in skill level after school leaving, in which boys outperform girls, are likely to be accentuated once the full cohort has left school (either dropping out or completing secondary or higher education). Second, the literacy and numeracy assessments administered in this survey were developed to provide valuable information while limiting the burden on field data collectors. We were not able to capture nuances in different levels of learning and skill loss, or different

**Table 9**

Mixed-effects ML regression models for numeracy after school leaving.

	Model 1		Model 2		Model 3		Model 4	
	Coef	p-val	Coef	p-val	Coef	p-val	Coef	p-val
Is female	−0.271	*	−0.274	**	−0.189		−0.191	
Tribe is Yao	0.040		0.052		0.068		0.027	
Age at baseline	0.263	***	0.188	**	0.176	**	0.179	**
Both parents completed primary	−0.392	†	−0.253		−0.241		−0.261	
Only mother completed primary	−0.234		−0.181		−0.184		−0.165	
Only father completed primary	−0.185		−0.262	*	−0.252	*	−0.259	*
Neither parent completed primary (ref)								
Count of household items	−0.013		−0.016		−0.019		−0.030	
Completed standard 3–4	−5.099	***	−3.109	***	−3.078	***	−2.505	***
Completed standard 5	−3.258	***	−2.076	***	−2.046	***	−1.828	***
Completed standard 6	−2.051	***	−1.343	***	−1.304	***	−1.068	***
Completed standard 7	−1.306	***	−0.820	***	−0.790	***	−0.701	***
Completed standard 8	−0.766	***	−0.385	*	−0.362	*	−0.338	*
Completed form 9 or higher (ref)								
Age at school leaving	−0.279	***	−0.208	***	−0.187	**	−0.207	**
Numeracy score at school leaving			0.511	***	0.512	***	0.476	***
Assessment one term before school leaving			0.311	*	0.330	*	0.310	*
Assessment one or two terms after school leaving			−0.381	**	−0.386	**	−0.368	**
Assessment same term as school leaving (ref)								
Years between assessments			−0.112	***	−0.074	**	−0.100	***
Different assessments			−0.073		−0.099		−0.080	
Works					0.029		0.053	
Domestic work 2 or more hours					0.089		0.087	
Is married					0.014		−0.011	
Ever given birth/had a child					−0.262	**	−0.220	*
Household has any books					0.132	†	0.076	
Household has a cell phone					−0.064		−0.040	
Reads anything at least once a week (R6 only)							0.087	
Listens to radio at least once a week (R6 only)							0.116	
Watches TV at least once a week (R6 only)							0.126	
Chichewa reading comprehension score							0.221	***
Constant	11.048	***	6.193	***	5.914	***	5.454	***
Variance in random intercepts								
School-level	0.105		0.025		0.024		0.003	
Individual-level	2.454		1.126		1.124		0.976	
Obs	3108		3108		3108		2677	
Schools	59		59		59		59	
Respondents	1118		1118		1118		970	
Wald chi2	516.97		1579.28		1597.85		1598.2	
Prob > chi2	0.0000		0.0000		0.0000		0.0000	
Log likelihood	−6748.2		−6470.4		−6464.0		−5512.7	
LR test vs. linear regression chi2	674.81	***	256.93	***	256.74	***	172.93	***

\* p &lt; 0.05.

\*\* p &lt; 0.01.

\*\*\* p &lt; 0.001.

† p &lt; 0.1.

learning processes, which might be relevant to our research questions. Third, we only measured use of skills at round 6, thus we lack measures of skill use between the time of school leaving and the assessments following school leaving. Our treatment of this variable as time invariant is one of the reasons why we believe gender remains significant in the English literacy models. Moreover, we are unable to differentiate between respondents who read and/or watch television in English or Chichewa, which may be a reason for the weak and inconsistent associations with outcomes. Fourth, our measure of labor force participation does not distinguish between skilled and unskilled work, which could explain why work does not appear to be a relevant predictor of skills after school leaving and also why gender remains significant. Fifth, there are some important factors that we did not measure, such as innate ability or cognitive development, likely related to both predictors and outcomes that may have affected our results.

## 7. Conclusion

These findings have important implications for education policy and programs. Expectations about the potential demographic and public health benefits of education, particularly the education of women, are based on an assumption that these relationships will remain consistent across generations of school-goers. However, many policy-makers and practitioners have speculated that the quality of school, and perhaps learning as a result, have deteriorated as enrollment has increased in some settings. Further, assuming that the lifelong benefits of schooling accrue from the academic skills learned while in school (LeVine et al., 2012), future intervention research should identify those factors that determine grade progression and completion, which our research has identified as the key factors promoting skill retention after school leaving. At the same time, higher quality education may also result in the acquisition of stronger literacy and numeracy skills at lower levels of grade attainment, and a greater capacity of students to reinforce



those skills after they leave school. In addition, a clear understanding of the factors that not only influence skill acquisition but also support skill retention throughout the life course, particularly for young women, whose English language skills are weaker than males even controlling for grade attainment, will inform more effective education interventions for school-aged children, adolescents, and adults. Education practitioners and researchers should not assume that students' academic skills on the day they leave formal schooling will last throughout their lives. Rather, our findings reaffirm that the skills young people develop in school provide an essential foundation that can either be reinforced or crumble depending on the strength of the foundation, and opportunities after leaving school.

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