# Gender Differences in the Retention of Literacy and Numeracy in Malawi

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## 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 for children in developing countries. More recently, attention has been shifting from expanding access to improving learning outcomes (UNESCO 2005; UNESCO 2006; van der Gaag and Adams 2010; Perlman 2011). While there is an increasing literature on the determinants of learning (Glewwe 2002; Behrman et al 2006; Glick and Sahn 2009), the extent to which young people retain acquired skills upon school-leaving remains largely unknown.

A vast body of literature indicates that education is positively associated with a range of important outcomes. However, studies examining the pathways through which these relationships operate suggest that the acquisition and retention of such skills as literacy and numeracy are dominant factors. For example, using data from Morocco, Glewwe (1999) finds that a mother's health knowledge obtained outside of school, using literacy and numeracy skills learned in the classroom, plays a more important role in improving child health than does information taught in class, or exposure to modern society through formal schooling. In addition, evidence from developing countries suggests that cognitive skills – as distinct from years of schooling – yield strong economic returns, both at the individual level and as a driver of growth (Hanushek & Woessman 2008). Adult literacy, particularly for females, has also 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, particularly in view of the resources devoted to supporting global education systems, that school enrollment sufficiently equips students to retain foundational skills upon leaving.

Identifying the degree to which skills are retained and the determinants of retention has several key policy implications. A minimum number of completed grades are likely needed for students to become sufficiently literate or numerate to retain these basic skills for life. Wagner (1994, p.14) notes, for instance, 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." Furthermore, analysis of Demographic and Health Survey data from seven countries in sub-Saharan Africa found that on average less than half of women who dropped out of school before completing the fourth grade were able to read a simple sentence (Lloyd 2005). 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 which groups are at risk of losing basic skills could help better focus remedial literacy programs.

Study of skills retention requires longitudinal data, where the capabilities of the same individuals can be followed over time (Wagner et al 1989; Glewwe 2000). With few exceptions, probably due to the lack of adequate data, the retention of skills has largely been ignored in the empirical literature. Using unique longitudinal data from a sample of Malawian adolescents who were attending school when first interviewed in 2007 and were re-interviewed yearly until 2011, this paper will address the following questions: Are adolescent students in rural Malawian primary schools acquiring and retaining basic literacy and numeracy skills? Are there gender differences in the retention of these skills and in the determinants of retention?

Answering these questions is particularly relevant for a context such as Malawi. The Malawian education system includes eight years of primary schooling (standards 1-8), four years of secondary (forms 1-4), and four years of university-level education. In 1994, Malawi became one of the first countries in Sub-Saharan Africa to introduce free primary education. This 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). The internal efficiency of the system is weak, in particular due to very high repetition rates. It is estimated 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 have fallen between 1999 and 2004 (Chimombo et al 2005).

## 2. Data and Methods

The data for this analysis come from the Malawi Schooling and Adolescent Study (MSAS), a longitudinal survey with a baseline sample of 1764 students and 885 out-of-school Malawians aged 14–16 at the start of 2007. The adolescents were interviewed for the first time between May and July of 2007. Follow-up interviews were conducted annually between 2007 and 2011; the sixth round of data collection is currently ongoing. The study achieved a re-interview rate of 91% in 2008, 90% in 2009, and 88% in 2010 and 2011. This paper uses data from the sample of adolescents attending school at baseline.

The student sample was selected from fifty-nine primary schools in Balaka and Machinga, two southern districts of Malawi. The 30 schools visited in Machinga represent nearly 20 percent of the primary schools in the district, whereas those in Balaka represent nearly 25 percent of the primary schools in that district. The probability of a particular school being included in the sample was proportional to its enrollment in 2006.[1] At each school we interviewed approximately 30 students in standards 4-8, the last 4 years of primary school,

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[1] 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.

stratified by gender and age.[2] The students were randomly selected from registers recording enrollment at the beginning of the 2007 school year. Our student sample reflects the typical educational experience of young people in Malawi. According to the 2004 MDHS, of the 76 percent of 14-16 year olds who were enrolled in school, 92 percent were still enrolled at the primary level. Even among 16 year olds, 82 percent of current students were attending primary school (NSO and ORC Macro 2005). However, it is important to note that if a student entered standard 1 on time at age six and progressed through primary school without interruption, he/she should have completed primary by age 14. Therefore, by definition, our student sample is composed of students who have experienced some type of delay. We do not have data on adolescents in the same age group who were already in secondary school. Neither are we including data from adolescents who had not reached standard 4.

The study instrument used 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 a short literacy and numeracy test. Respondents were asked to read two sentences in Chichewa (the national language) and two sentences in English, tasks at which they should have been proficient by standard 4.[3] The tests were scored as a) cannot read any part of the sentence, b) able to read only part, and c) able to read whole sentence. Starting in 2008 (round 2), a reading comprehension section in Chichewa and in English was added. Respondents also completed a short mathematical evaluation. In 2007, the math assessment consisted of 12 questions drawn from the Malawi Institute of Education (MIE) achievement tests for standard 3.[4] The literacy and numeracy tests were repeated in each follow-up round for comparability.

*Dependent variables*

Literate: we consider a respondent to be literate in Chichewa or English if he/she could read both whole sentences in each respective language.[5] We look at literacy in both languages, as although Chichewa is the national language, English is required to successfully progress to higher schooling levels.

Numerate: we consider a respondent to be numerate if he/she could solve at least two-thirds of the math test (8 out of 12 problems). We also look separately at the word problems involving simple monetary transactions and consider a respondent to be numerate if he/she could solve the two money word problems in the math assessment.

*Explanatory variables*

The key explanatory variables in this analysis are the respondent's gender, school attendance status, and schooling attainment. Gender is measured with an indicator variable that

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[2] The overwhelming majority (93%) of 14-16 year olds attend standards 4-8 (NSO and ORC Macro 2005).
[3] These sentences used were drawn from the 2004 MDHS.
[4] 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.
[5] Note that our definition differs from that used by the DHS and UNESCO, which considers a person to be literate if he/she can read parts of a sentence.

takes the value of 1 if the respondent is a female and 0 if the respondent is a male. School attendance and attainment are time varying. School attendance is measured with an indicator variable that takes the value of 1 if the respondent was attending school at round $t$, and 0 if not. Schooling attainment is measured as the highest grade that the respondent had attended by round $t$.

*Methods*

First, we describe the literacy and numeracy skills of male and female students in the MSAS sample at baseline. Next, we conduct nonparametric analysis and estimate survivor functions where survival is considered remaining in each of the literate and numerate states. We also compare the literacy and numeracy survival experience between males and females. Finally, we use Cox proportional models to estimate the impact of gender, school attendance, and grade attainment on the hazard of losing literacy and numeracy skills, while controlling for other individual and household level characteristics. The time of analysis is from 2007-2011 (baseline-round 5).

## 3. Preliminary Results

Table 1 shows the percentage of male and female respondents who were literate in Chichewa and in English, and numerate at baseline. For both languages, a significantly higher proportion of females than of males were able to read the two sentences: 89.4% of males and 93.7% of females (p=0.001) could read the two sentences in Chichewa, while 67.2% of males and 73.6% of females (p=0.003) could read the two sentences in English. For numeracy, there are no gender differences at baseline: 80.0% of males and 79.4% of females (p=0.765) could solve at least two-thirds of the math test; 59.6% of males and 60.3% of females could solve the two worded money problems (p=0.770).

[Table 1]

Tables 2 and 3 show the survivor functions for literacy and numeracy by gender. Throughout this paper we assume that the onset of risk for losing skills is when we first observe respondents as being literate or numerate. That is, respondents enter the analysis the first round when we observe them to be literate or numerate. Respondents could experience more than one "failure"; for example, a respondent could have been literate at baseline, have lost his/her literacy skills by round 2 and then regained these skills by round 3 but lost them again by round 5. In order to test whether the survivor functions for literacy and numeracy differ by gender we conducted two tests for equality of survivor functions: the log-rank test and the Wilcoxon test. Results from both tests indicate that the survivor functions are statistically significantly different for both languages and for both measures of numeracy, with females facing higher hazards of loss of skills than males.

[Tables 2 and 3]

Why are females at a higher risk of losing their skills than males, at least through the time that we are able to observe them? School attendance and attainment might explain this gender

difference as a much larger proportion of females than of males left school during the course of the study. To investigate whether the observed gender difference in the retention of skills is explained by gender differences in the time of school leaving and attainment, we estimated Cox proportional hazard models. Results from these models are presented in Tables 4 and 5. As with the survivor functions, a respondent enters the analysis the first round when we observe him/her to be literate or numerate, and exits the analysis the last round for which we have information. A respondent fails in literacy the first follow-up round that he/she is unable to read both sentences in full; similarly, a respondent fails in numeracy the first follow-up round that he/she could not solve at least two-thirds of the math exam or could not solve the two money problems. A respondent who has failed reenters the analysis if he/she becomes literate or numerate again in a later round. In each table, model (1) includes only gender as a covariate; and model (2) adds two time-varying covariates: school attendance and grade attainment. Results show that females are more likely than males to lose their literacy and numeracy skills. Even when controlling for grade attainment and school attendance, the female coefficient is marginally significant in the case of literacy in both Chichewa and in English, and highly significant for solving the worded money problems.

[Tables 4 and 5]

Future analyses will explore the effect of other respondent and household level covariates that might affect retention of skills and explain the remaining gender difference, such as participation in the labor market; participation in social groups or clubs; education of parents; household assets; books in the household; access to cellular phone.

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Table 1. Percentage of MSAS respondents who are literate and numerate at baseline, 14-17 year old attending standards 4-8

|  | Males | Females | (a) |
|---|---|---|---|
| Literacy |  |  |  |
| % Read two sentences in Chichewa | 89.4 | 93.7 | ** |
| % Read two sentences in English | 67.2 | 73.6 | ** |
| Numeracy |  |  |  |
| % Solve 2/3 of math test | 80.0 | 79.4 |  |
| % Solve two worded problems | 59.6 | 60.3 |  |
| Sample size | 884 | 869 |  |

(a) Two-sided p values from tests of proportions comparing males and females.
*** $p<.001$; ** $p<.01$; * $p<.05$; †$p<.1$


Table 2. Survivor functions for literacy, 2007-2011

|  | Chichewa | | English | |
|---|---|---|---|---|
|  | Males | Females | Males | Females |
| 2007-08 | 0.984 | 0.982 | 0.931 | 0.912 |
| 2008-09 | 0.968 | 0.958 | 0.871 | 0.836 |
| 2009-10 | 0.955 | 0.928 | 0.845 | 0.737 |
| 2010-11 | 0.937 | 0.905 | 0.818 | 0.704 |
| Log-rank[a] | 5.11* | | 19.00*** | |
| Wilcoxon[b] | 5.00* | | 17.38*** | |

a. Chi2 from log-rank test for equality of survivor functions.
b. Chi2 from Wilcoxon (Breslow) test for equality of survivor functions.
*** $p<.001$; ** $p<.01$; * $p<.05$; †$p<.1$


Table 3. Survivor functions for numeracy, 2007-2011

|  | Solve 2/3 of math assessment | | Solve two worded problems | |
|---|---|---|---|---|
|  | Males | Females | Males | Females |
| 2007-08 | 0.894 | 0.880 | 0.666 | 0.595 |
| 2008-09 | 0.822 | 0.793 | 0.569 | 0.409 |
| 2009-10 | 0.738 | 0.694 | 0.425 | 0.270 |
| 2010-11 | 0.700 | 0.652 | 0.353 | 0.232 |
| Log-rank[a] | 3.39† | | 21.92*** | |
| Wilcoxon[b] | 3.25† | | 19.05*** | |

a. Chi2 from log-rank test for equality of survivor functions.
b. Chi2 from Wilcoxon (Breslow) test for equality of survivor functions.
*** $p<.001$; ** $p<.01$; * $p<.05$; †$p<.1$

Table 4. Hazard ratios from Cox proportional models for loss of literacy, 2007-2011

| | Chichewa | | English | |
|---|---|---|---|---|
| | (1) | (2) | (1) | (2) |
| Explanatory variables | | | | |
| Female | 1.53* | 1.39† | 1.71*** | 1.25† |
| Highest grade attended | | 0.97 | | 0.59*** |
| Attends school | | 0.73*** | | 0.61*** |
| Subjects | 1,598 | 1,598 | 1,228 | 1,228 |
| LR chi2 | 5.2* | 38.9*** | 19.3*** | 229.7*** |

Note: Highest grade attended and attends school are time-varying.
\*\*\* p<.001; \*\* p<.01; \* p<.05; †p<.1


Table 5. Hazard ratios from Cox proportional models for loss of numeracy, 2007-2011

| | Solve 2/3 of math assessment | | Solve two worded problems | |
|---|---|---|---|---|
| | (1) | (1) | (1) | (2) |
| Explanatory variables | | | | |
| Female | 1.19† | 1.04 | 1.42*** | 1.34*** |
| Highest grade attended | | 0.81† | | 0.90 |
| Attends school | | 0.70*** | | 0.83*** |
| Subjects | 1,392 | 1,392 | 1,048 | 1,048 |
| LR chi2 | 3.4† | 146.7*** | 21.2*** | 67.7*** |

Note: Highest grade attended and attends school are time-varying.
\*\*\* p<.001; \*\* p<.01; \* p<.05; †p<.1