

Changes in population literacy and numeracy in Ghana after three decades of free basic education

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Abstract

Motivation: Despite increases in school enrolment, the world is facing a global learning crisis that suggests a trade-off between the quantity and quality of education.

Purpose: This case study from Ghana examines whether there has been a long-term change in educational outcomes, measured by population literacy and numeracy rates, in the decades following the implementation of a national free compulsory basic education policy. It further determines whether there are variations by level of education in the changes over time.

Approach and methods: This study used nationally representative repeated cross-sectional data from two Ghana Living Standards Surveys (2006 and 2017) to estimate basic literacy and numeracy.

Findings: At the same level of education for the primary and lower secondary school levels, literacy and numeracy were lower in the latter period than a decade previously. These findings suggest that the expansion in gross enrolment at the primary and lower secondary school levels has been associated with a long-term decline in the quality of education.

Policy implications: Considering these findings, it is crucial to consider the long-term implications of expanding access to education on the quality of the education provided. These findings highlight the need for increased investment in quality education to complement the increase in access. This would ensure that children acquire foundational skills at the basic education level. Failure to maintain quality alongside expanded access could negatively impact workforce productivity, economic growth, and social equality.

KEYWORDS

education expansion, Ghana, learning outcomes, literacy and numeracy, quality education

1 | INTRODUCTION

Educational enrolment in Ghana, as in other sub-Saharan African countries, has increased substantially over the past few decades. The gross enrolment rate for primary schools in Ghana increased from 80% in 1994 when the Free Compulsory Universal Basic Education (FCUBE) programme was introduced to 105% in 2021 (UNESCO, [n.d.](#)). Capitulation grants were subsequently initiated in 2005 to further reduce barriers to education and increase access to education. The country has pursued expanding access to basic education due to the demographic and economic

benefits derived from the increasing educational attainment of the population. Free education policies have been shown to be positively associated with a variety of outcomes such as increases in school enrolment (Garlick, 2019; Kodila-Tedika & Otchia, 2022; Stenzel et al., 2024), higher completion rates (Earle et al., 2018), improvements in maternal health seeking behaviour and decision-making (Bose & Heymann, 2019; Bose et al., 2024), reductions in early marriage and childbearing for girls (Bhuwania et al., 2023), and reductions in child malnutrition and mortality (Makate & Makate, 2016; Martin et al., 2024; Qamruzzaman et al., 2014).

However, the impact of free education policies on long-term population skill levels is relatively understudied. This is an important area of study, as increases in school enrolment may not necessarily translate into increases in learning outcomes, such as literacy and numeracy, as evidenced by the global learning crisis (World Bank, 2017; World Bank et al., 2021), which persists despite expanded access to education. Increases in enrolment rates, while a positive indicator of improved access to education, can place considerable strain on existing educational resources and infrastructure if schools are ill-equipped to handle the influx of students. Therefore, increases in enrolment in resource-constrained settings have the risk of lowering the learning outcomes of enrolled students due to increased pressure on existing resources. When the available educational inputs (such as classrooms, trained teachers, textbooks, etc.) do not increase to meet the demands of increasing enrolment, the quality of education declines.

Theoretically, the expectation that increases in quantity typically require a trade-off with quality emanates from the negative correlation observed between the number of children and the level of investments per child and child outcomes due to competition for parental resources such as time and money (Becker & Tomes 1976; Blake 1981; Hanushek 1992). This micro-level theory can be applied at the macro level to examine the relationship between the number of students enrolled and learning outcomes where increases in student numbers would lead to increased competition for the existing resources. The quality–quantity trade-off may explain why an estimated nine in every 10 children in sub-Saharan African countries are unable to read and understand simple texts by the age of 10 despite the global increase in primary school enrolment (World Bank, 2022). Using cross-national data, Le Nestour et al. (2022) showed that the quality of education has declined over time, with the largest decreases observed in sub-Saharan African and South Asian countries.

Available research on the impact of educational expansion on student performance skills in sub-Saharan Africa is mixed, with complementary increases in educational inputs provided as an explanation for cases where there is a positive impact. Moshoeshe (2023), in Botswana, found that the implementation of free primary education (FPE) had a positive impact on pre-tertiary academic performance, noting that the FPE rollout was accompanied by increases in recruitment, construction of schools, and textbook ownership. Somasse (2022) found no negative effect of increased enrolment on primary school exit pass rates in Benin. Valente (2019) found that increases in enrolment in Tanzania led to increases in pupil–teacher ratios and a decrease in teacher quality, but a decrease in test scores was observed only in urban areas, with one explanation being a larger increase in student sizes in urban areas compared to rural areas for regions with higher increases in enrolment rates. Garlick (2019) found that although the elimination of fees in South Africa increased enrolment in early grades, pass rates on graduation examinations declined. Oketch and Somerset (2010) analysed the influence of the 2003 free education policy in 17 Kenyan schools, noting that the two schools that had substantial increases in enrolment without commensurate increases in inputs experienced declines in quality that were still evident in 2007. The findings from these studies indicate that educational expansion policies are less likely to be detrimental to learning outcomes when there are commensurate increases in inputs to match increases in enrolment.

Outside the literature on universal primary education policies, there is substantial research on the impact of cash transfers, which can provide insight into the relationship between quantity and quality when represented using enrolment and learning outcomes. Cash transfers that reduce education costs have been linked to increases in school enrolment and educational attainment (Baird et al., 2019; Evans et al., 2023; Gazeaud & Ricard, 2024; Millán, Barham et al., 2019; Millán, Macours et al., 2020) but the impact on learning outcomes is substantially lower (Baird, Ferreira et al., 2013, 2014; Millán, Barham et al., 2019) with mixed findings. Findings related to learning outcomes range from positive (Barham et al., 2017; Mostert & Castello, 2020) to none (Ponce & Bedi, 2010) to negative (Gazeaud &

Ricard, 2024). Within the same setting, some studies found divergent directions for this relationship. For instance, Das and Sarkhel (2023) found in India that conditional cash transfers were positively correlated with enrolment and lower-order learning outcomes but had a negative association with higher-order learning outcomes.

This study examines whether basic literacy and numeracy skills of the population in Ghana have increased over time after decades of education expansion. Specifically, it assesses whether there has been a statistically significant change in the basic literacy and numeracy skills of the population by comparing groups with similar educational levels in two nationally representative repeated cross-sectional surveys conducted a decade apart. Understanding the long-term impacts of free education policies on literacy and numeracy is important for low- and middle-income countries. Several cross-national studies indicate that literacy and cognitive skills are strong predictors of economic development (Altinok & Aydemir, 2017; Hanushek et al., 2008; Hanushek & Woessmann, 2012). Global commitments to universal access to primary education, as outlined in the Millennium Development Goal 2 (achieving universal primary education), have thus evolved to include quality education in the Sustainable Development Goal 4 (ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all) because of the link between the quality of education and learning outcomes (Fomba et al., 2023; Gruijters & Behrman, 2020).

Ghana's age structure is evolving from young to youthful, where youth (15 to 35 years old) make up a predominant share of the population rather than children (under 15 years old) (Ghana Statistical Service, 2021). The changing age structure positions Ghana to reap a demographic dividend that could lead to sustainable development. However, the harnessing of the dividend depends on having a highly skilled labour force, which requires that increases in educational attainment correlate with commensurate increases in learning outcomes and skills. Ghana's results for the 2018 National Educational Assessments align with global findings on the high proportion of students who are not learning enough, with three-quarters of pupils in Primary 6 scoring below the proficiency level in English and mathematics (Ministry of Education, 2019).

The current indication that learning outcomes are lower than expected at the primary education level requires an in-depth understanding of how basic literacy and numeracy have changed for the population over time. This is particularly important given that Ghana has been implementing a free Senior High School policy since 2016 that has led to increased enrolment at that level (Stenzel et al., 2024). The expansion of free education to the upper secondary level requires a critical examination of lessons and the impact of the expansion in education at the primary and lower secondary levels. There is relatively little empirical evidence on the long-term impact of universal primary education policies in sub-Saharan Africa on the skills of the general population. The existing literature has largely focused on learning and other outcomes of students at the level of educational expansion. Thus, this study aims to augment the existing literature by providing insights into long-term changes in the literacy and numeracy skills of the population following the implementation of free education policies.

Furthermore, Ghana presents a unique case study for this research, studying the long-term changes in literacy and numeracy levels after the implementation of free education policies. Akyeampong (2009) argues that Ghana's educational expansion differed from that of other countries in the sub-region, as the increase in enrolment was relatively slow because the FCUBE programme did not eliminate costs for the poorest households. In addition, the FCUBE policy was preceded by the 1987 education reform, which shortened the years of primary and secondary education from 17 to 12, thus providing savings to be invested in doubling the number of primary and secondary schools between 1980 and 2000 (Akyeampong, 2009). This would suggest that the pressure on existing resources due to the increase in enrolment would be somewhat alleviated by increases in inputs. However, qualitative research on the implementation of expansion policies relating to basic education in Ghana points to challenges that negatively affected education quality and, by extension, learning outcomes. These include funding constraints for schools, a shortage of teaching and learning materials, inadequate instructional spaces, and increased pupil-to-teacher ratios (Alhassan, 2020; Mohammed & Apiung, 2024; Pajibo & Tamanja, 2017). Additionally, there is evidence that national teacher shortages were addressed by hiring untrained teachers (Akyeampong, 2009, 2012; Ankomah, 2012) which would also reduce education quality. These research findings suggest that there were

declines in education quality following the implementation of the free education policy that may have long-term impacts on learning outcomes.

2 | MATERIALS AND METHODS

The empirical analysis is based on the Ghana Living Standards Surveys (GLSS 5 and 7) collected in 2006 and 2017 (Ghana Statistical Service, 2008, 2018). These surveys are nationally representative, independent, and repeated cross-sectional survey datasets that aim to provide comparable estimates of population well-being and living standards over time. The GLSS was designed to provide indicators that are nationally and regionally representative and comparable to other GLSS rounds. This study used a two-stage stratified sampling design. GLSS 5 (2008) was carried out in 2006 and contains interviews with 8,687 households and 37,128 members, while GLSS 7 (2018) was carried out in 2017 and contains interviews with 14,009 households and 59,864 members. The analytical sample for this study consisted of respondents aged 11 years and older: 25,424 in 2006 and 42,376 in 2017.

Our interest is in two educational outcomes, y_j (i.e., English literacy and numeracy), for individual i drawn independently from the population at each time t . The main explanatory variable of interest is $educ_j$, which is the years of schooling or the level of education attained by individual i in year t . For this kind of dataset, we can fit a regression of y_{ji} on $educ_{ji}$ and a vector of other covariates \mathbf{x}_i for each round of the survey:

$$y_{ji} = \alpha_{ji} + \beta_j educ_{ji} + \mathbf{x}_i \theta_j + \varepsilon_{ji} \quad (1)$$

Since formal education is the primary channel of literacy (particularly English literacy) and numeracy in Ghana, one would expect the “population averaged” estimate of the marginal effect of schooling on literacy and numeracy, β_j , to be strongly positive and precise. However, the core argument of this article is that although high levels of enrolment and retention—particularly at the primary school level—are necessary to increase literacy and numeracy rates, if increased enrolment is not adequately matched with both hard and soft infrastructure (e.g., properly trained teachers, optimum class size, pupil–teacher ratio, and availability of textbooks), the quality of education will decrease over time. To see how this can be observed over time, we can write the general form of a repeated cross-sectional model with a time-fixed effect (t) after dropping the subscript j without loss of generality as follows:

$$y_{it} = \alpha_i + \beta_0 t + \beta_1 educ_{it} + \mathbf{x}_{it} \theta + \varepsilon_{it}, t = 2006, 2017 \quad (2)$$

where α , β_0 , β_1 , and θ are estimable parameters, and ε_{it} is the random error term. To allow the formulation of testable hypotheses on the “population averaged” association between ‘functional’ education outcomes or basic skills (y_{it}) and schooling ($educ_{it}$) over time, we rewrite equation (2) by interacting $educ_{it}$ with the time-fixed effect:

$$y_{it} = \alpha + \beta_0 t + \beta_1 educ_{it} + \delta(t \times educ_{it}) + \mathbf{x}_{it} \theta + \varepsilon_{it} \quad (3)$$

Equation (3) can be considered a model that measures returns to schooling, where returns are measured in terms of basic skills (i.e., literacy and numeracy). There are two key hypotheses. The first hypothesis (H1) states that the return on schooling (in terms of basic skills) is constant over time. In other words, the average literacy and numeracy rates were the same for 2006 and 2017. In this test, a $\delta = 0$. The second hypothesis (H2) is that the average literacy and numeracy rates are the same in 2006 and 2017 for the same level of education. H2 is the test in which $\beta_1 = 0$ and $\delta = 0$. H2 is, in fact, at the core of this paper. We argue that if education quality remained the same over time, for example, then population average literacy and numeracy rates would be similar in 2017 and 2006 for individuals who attained the same level of education, such as primary school. However, if the average quality of education has declined over time due to expansion of education without commensurate expansion of infrastructure, literacy and numeracy rates will be lower in 2017 than in 2006 at the same level of education.

The GLSS provides direct measures of basic literacy and numeracy skills by presenting flashcards to respondents asking them to read short phrases or perform written calculations. Flashcards were presented to respondents aged 11 years or older. Respondents had to read all the words in the sentence and provide an exact answer to the calculation for the response to be yes to the questions posed on whether they could read or perform written calculations. Thus, basic literacy is defined in this study as the ability to read a short sentence in English, and basic numeracy is the ability to correctly answer a simple written calculation. The use of flashcards provides a more accurate assessment of literacy and numeracy than self- or third-party reports. However, the use of flashcards means that household members would have to be present for the module to be administered.

The main covariates of interest in this analysis were formal education (measured using both education level and years of education) and year of the survey. The regressions also adjusted for other demographic variables, including age, sex, current school attendance, level of education of the father, level of education of the mother, and mean years of schooling of the household. We also include geographic fixed effects in the regressions to account for contextual heterogeneity across the country.

3 | RESULTS

3.1 | Descriptive statistics

[Table 1](#) presents the descriptive statistics of the sample in the two survey rounds. As expected, there was a general increase in educational attainment over the 10 years. For example, the mean number of years of schooling in the sample increased by approximately 30% between 2006 and 2017 (about 2.7% per year). Over the past decade, the sample that attained a secondary school level of education and above almost doubled from 12% in 2006 to 21% in 2017.

Turning to our key outcome variables of interest, the proportion of the sample that could read a short sentence in English increased by nearly 11 percentage points (from 52% in 2006 to 63%) or by approximately 20% in a decade. Similarly, the proportion that correctly answered a written calculation increased over the decade, but by a lower magnitude (\approx 5 percentage points or 7%). The difference in proportions over time was statistically significant for both literacy and numeracy ([Table 1](#)). This overall increase in literacy and numeracy could be due to the general expansion in enrolment.

[Figure 1](#) provides descriptive evidence regarding the main question of this article, that is, whether and in what direction education outcomes (measured by literacy and numeracy rate) have changed over time for the same level of educational attainment. The descriptive results are striking, showing what could be interpreted as a decrease in the quality of education, mainly at primary school level and, to a much lesser extent, at pre-secondary school level. The highest magnitude of the decline in literacy rate was at the upper primary (years 4–6) level, with a decline of 19 percentage points, or approximately 34% in a decade. Those who attained lower primary education (years 1–3) recorded the highest drop (29 percentage points or \approx 42%) in the numeracy rate over the period. The descriptive results suggest that while the gross enrolment rates in primary schools in Ghana were high and increasing over the survey period (approximately 92% and 99% in 2006 and 2017, respectively), outcomes in terms of literacy and numeracy did not improve.

3.2 | Changes in basic literacy and numeracy over time

[Tables 2](#) and [3](#) present the results of the regression model specified in [equation \(1\)](#). They showed the average marginal effects (from logistic regressions) of the respective covariates on the probability of acquiring basic literacy and numeracy skills. As expected, the findings indicate a positive and statistically significant association between years of schooling and basic literacy and numeracy in both survey rounds.

TABLE 1 Mean characteristics of the sample.

Variables	2006 (GLSS 5)	2017 (GLSS 7)	p-value of diff
English literacy	0.524	0.627	0.000
Numeracy	0.690	0.739	0.000
Years of schooling	5.610	7.287	0.000
No formal education	0.281	0.163	0.000
Lower primary education	0.094	0.077	0.000
Upper primary education	0.164	0.138	0.000
Lower secondary school education	0.341	0.411	0.000
Upper secondary education	0.083	0.114	0.000
Tertiary education	0.037	0.097	0.000
Still in school	0.261	0.274	0.024
Mean education of household members	5.610	7.287	0.000
Father had no formal education	0.593	0.518	0.000
Father completed primary school	0.044	0.054	0.007
Father completed lower secondary school	0.264	0.317	0.000
Father completed upper secondary school or higher	0.099	0.110	0.063
Mother had no formal education	0.724	0.630	0.000
Mother completed primary school	0.064	0.094	0.000
Mother completed lower secondary school	0.172	0.231	0.000
Mother completed upper secondary school or higher	0.040	0.045	0.179
Female individual	0.523	0.527	0.398
Age of individual	32.428	32.981	0.005
Sample size	25,424	42,376	

On average, an extra year of schooling was associated with an approximately 5 and 3 percentage points increase in literacy and numeracy rates, respectively, in the 2006 sample. For the 2017 sample, the associated increases in literacy and numeracy for an extra year of schooling averaged 5.7 and 3.8 percentage points, respectively. Taken at face value, this suggests an improvement in basic skills for an extra year of schooling in the 2006 sample relative to the 2017 sample. However, this conclusion would be erroneous because the results could be due to sampling variability and external factors underlying these relationships. In fact, the *F* statistic for testing the difference in the relationship between the waves was 0.323 (p -value=0.570) for literacy and 1.228 (p -value=0.268) for numeracy.

Before presenting the results from [equation \(3\)](#), which concretely tests the hypotheses of this study, one more covariate (“still in school”) needs commentary. Beyond the “population averaged” basic skills analysis, comparing the marginal effects of this variable over the two waves could tell us something about the difference in basic skills acquisition between those who were in the educational system and those who were not over time. In 2006, those in the educational system had a “basic skill premium” of approximately 25 and 16 percentage points for literacy and numeracy, respectively. By 2017, this premium had dropped to approximately 15 and 8 percentage points, respectively, for the two basic skill indicators. Are these differences real or due to sampling variability? The *F*-statistics for testing the difference in the coefficients between the waves were 96.23 and 62.29, respectively, for literacy and numeracy, with p -values equal to zero to four decimal places. This result suggests a significant decrease in educational quality between the two samples.

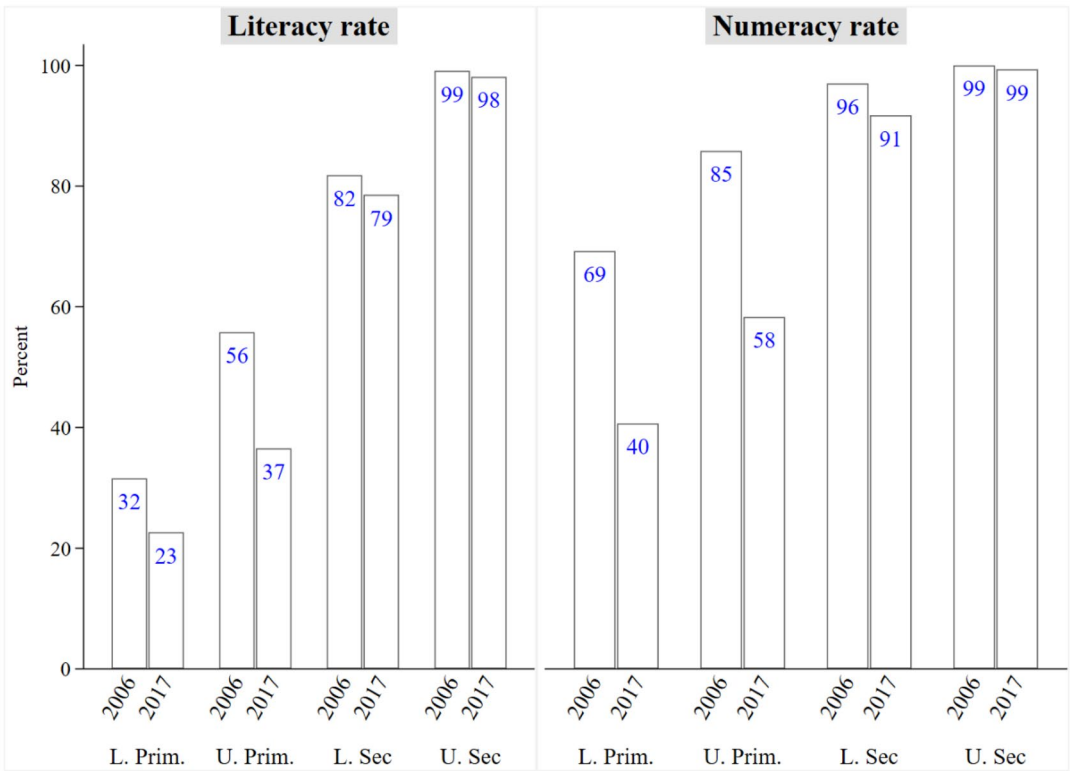


FIGURE 1 Change in English literacy and numeracy rate for the same levels of education.

Turning to results from estimating equation (3) in Section 3, we simply first test that $\delta = 0$, implying that average literacy and numeracy rates were the same in 2006 and 2017. This test returns *F*-statistic values of 9.27 (0.002) and 6.29 (0.012) for literacy and numeracy, respectively, so hypothesis H1 is rejected at conventional levels. To test hypothesis H2 that average literacy and numeracy rates were the same in 2006 and 2017 for the same level of education, we estimated equation (3) and then graphed the relationships in Figure 2 for literacy and in Figure 3 for numeracy.

Figure 2 indicates that hypothesis H2 is rejected for all years of schooling below 12 years and that the probability of being able to read a short sentence is statistically significantly lower for those with less than 12 years of education in 2017 than in 2006. Among people with at least 12 years of education, the probability of being literate did not change between the two periods. The largest difference in the probability of being literate is observed for those with four to six years of education.

The results of the test for H2 concerning the basic numeracy are presented in Figure 3. Here, the hypothesis was rejected for 18 years of schooling and below, meaning that the probability of being able to correctly answer the written calculation was lower in 2017 than in 2006 across almost all years of schooling. Similar to literacy, the difference in basic numeracy skills between the two surveys was more pronounced among people with fewer years of education. In this case, the largest differences were observed for those with two to four years of schooling.

To align years of schooling with levels of education, the logistic regression was rerun by substituting years of schooling for the highest levels of education attained. Figures 4 and 5 present the differences in the average marginal effects of the level of education on basic skills between 2006 and 2017.

The difference in the probability of being literate is largest for those with upper primary education. For this group, the probability of being able to read a short sentence was about 14 percentage points lower in 2017 than in 2006—in 2006, the estimated probability of being literate for those who attained upper primary education

TABLE 2 Average marginal effects of years of schooling on English literacy rate.

Variables	(1)	(2)	(3)	(4)
	GLSS 5 (2006)	GLSS 5 (2006)	GLSS 7 (2017)	GLSS 7 (2017)
Years of schooling	0.057*** (0.001)	0.050*** (0.001)	0.057*** (0.001)	0.057*** (0.001)
Still in school		0.254*** (0.009)		0.151*** (0.006)
Mean education of household members		0.005*** (0.001)		0.002** (0.001)
Father completed primary school		0.005 (0.009)		0.017* (0.009)
Father completed lower secondary school		0.011* (0.006)		0.017*** (0.006)
Father completed upper secondary school or higher		0.027*** (0.010)		0.023*** (0.008)
Mother completed primary school		0.002 (0.008)		0.017** (0.007)
Mother completed lower school		0.024*** (0.007)		0.024*** (0.006)
Mother completed upper secondary school or higher		0.063*** (0.016)		0.018 (0.015)
Female individual		-0.057*** (0.004)		-0.059*** (0.004)
Age of individual		0.000 (0.000)		-0.003*** (0.000)
Living in a rural area		-0.037*** (0.008)		-0.033*** (0.007)
Observations	25,424	25,424	42,376	42,376
Region FE	YES	YES	YES	YES

Note: Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

(after adjusting for other covariates) was about 44%, but this dropped to about 30% by 2017. The second largest difference was observed for those with lower primary education, where the probability of being literate was about six percentage points lower in 2017 (one in every four in 2006 relative to one in every five in 2017). We also find a non-trivial decline in quality at the lower secondary level, with a decline of about 5 percentage points in literacy rate over the decade (dropping from 77% to 72% over the period). There were no statistically significant differences in the probability of being literate between the two surveys for individuals with other levels of education.

Finally, Figure 5 shows the results of the numeracy skill outcome regression, in which the level of education interacts with the time variable. Similar to the literacy outcome, we found significant declines in basic numeracy skills over time at the primary and pre-secondary school levels. The difference in the probability of being able to answer a written calculation between 2006 and 2017 was lowest for people with primary education (about 26 and 25 per centage points at the lower and upper primary levels, respectively). The decline is statistically different

TABLE 3 Average marginal effects of years of schooling on numeracy rate.

	(1)	(2)	(3)	(4)
	GLSS 5	GLSS 5	GLSS 7	GLSS 7
Variables	(2006)	(2006)	(2017)	(2017)
Years of schooling	0.051*** (0.001)	0.032*** (0.001)	0.045*** (0.001)	0.038*** (0.001)
Still in school		0.159*** (0.010)		0.077*** (0.006)
Mean education of household members		0.005*** (0.001)		0.002 (0.001)
Father completed primary school		-0.011 (0.011)		0.020** (0.009)
Father completed lower secondary school		0.012* (0.007)		0.028*** (0.006)
Father completed upper secondary school or higher		0.014 (0.011)		0.034*** (0.009)
Mother completed primary school		-0.016 (0.011)		0.007 (0.007)
Mother completed lower secondary school		0.005 (0.009)		0.023*** (0.007)
Mother completed upper secondary school or higher		0.012 (0.017)		0.012 (0.015)
Female individual		-0.052*** (0.004)		-0.049*** (0.004)
Age of individual		-0.001*** (0.000)		-0.001*** (0.000)
Living in a rural area		-0.038*** (0.009)		-0.040*** (0.009)
Observations	25,424	25,424	42,376	42,376
Region FE	YES	YES	YES	YES

Note: Standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

from zero by the lowest at the lower secondary or level, with a gap of approximately eight percentage points. There were no differences in the probability of correctly answering a written calculation between 2006 and 2017 for people with no education or other levels of education.

3.3 | Exploring sources of heterogeneity in changing education quality

It is important to explore the sources of the differences in the results reported in the previous section; for example, one relevant question is whether changes in basic skills over time at each level of educational attainment differ according to gender and location. This is based on the expanded access to education, disproportionately benefiting children who are less likely to attend school due to household income constraints, such as girls and those in

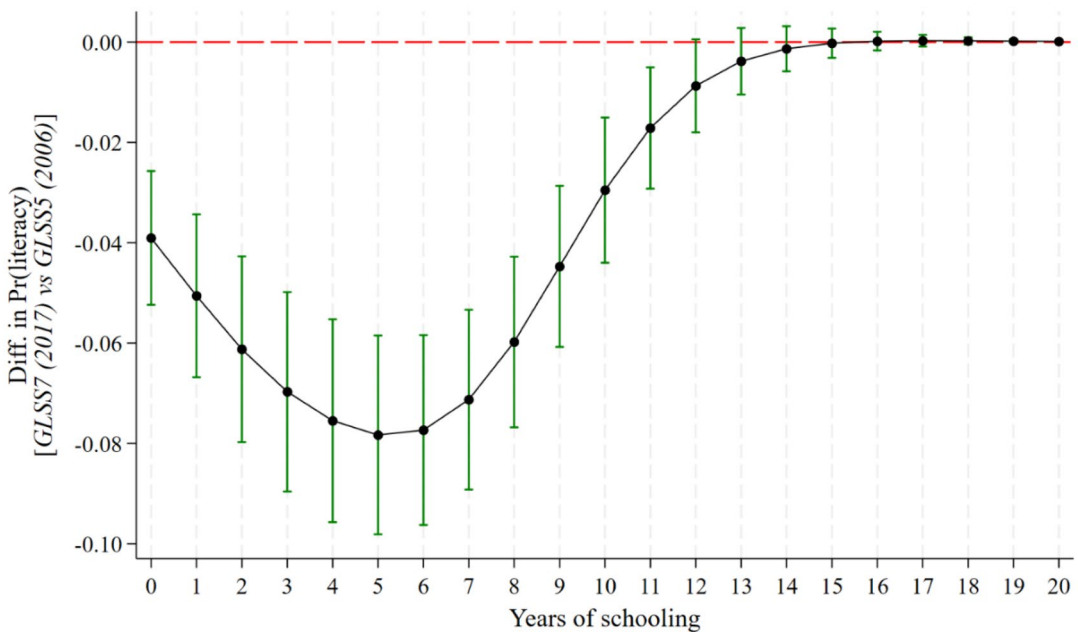


FIGURE 2 Difference in the probability of correctly reading a short sentence between 2006 and 2017, by years of schooling. The line spikes represent 95% confidence intervals.

rural areas, making the population that attends schooling less selective over time for these groups. Furthermore, gender differences in parental investment in education may be a source of heterogeneity. In addition, educational infrastructure (both hard and soft) differs markedly between rural and urban locations in Ghana, all of which could lead to differences in the outcomes of the hypotheses tested. To examine these issues, equation (3) was re-estimated, including an additional interaction to explore whether the differences over time in literacy are the same for females and males and for persons in rural compared to urban areas (see the Appendix for figures presenting these results).

The results show that, while the pattern of change over time among both females and males largely reflect the overall results reported earlier, there is no evidence of a significant decline in basic literacy skills at lower primary school level among females. Although the conclusions from the hypothesis tests for numeracy are generally similar to the overall results, the largest difference in the decreasing probability of numeracy between 2006 and 2017 occurred at the lower primary level for males but at the upper primary level for females.

The general pattern by locality is similar to that observed at the national level, with the exception that a significant decline in literacy is observed for persons with secondary education in urban areas. When comparing the two locations, the decline observed at the lower and upper primary levels in urban areas was greater than that observed in rural areas. Changes in basic numeracy skills over time and by location largely reflect the pattern of significant declines for persons with less than upper secondary education observed for the general population. In urban areas, the decline was greater for those with lower primary education than for those with upper primary education, while the opposite was observed in rural areas.

4 | DISCUSSION

This study assesses whether literacy and numeracy in Ghana have increased over time due to increases in school enrolment following the implementation of the FCUBE programme in 1994. The analysis involved a comparison of

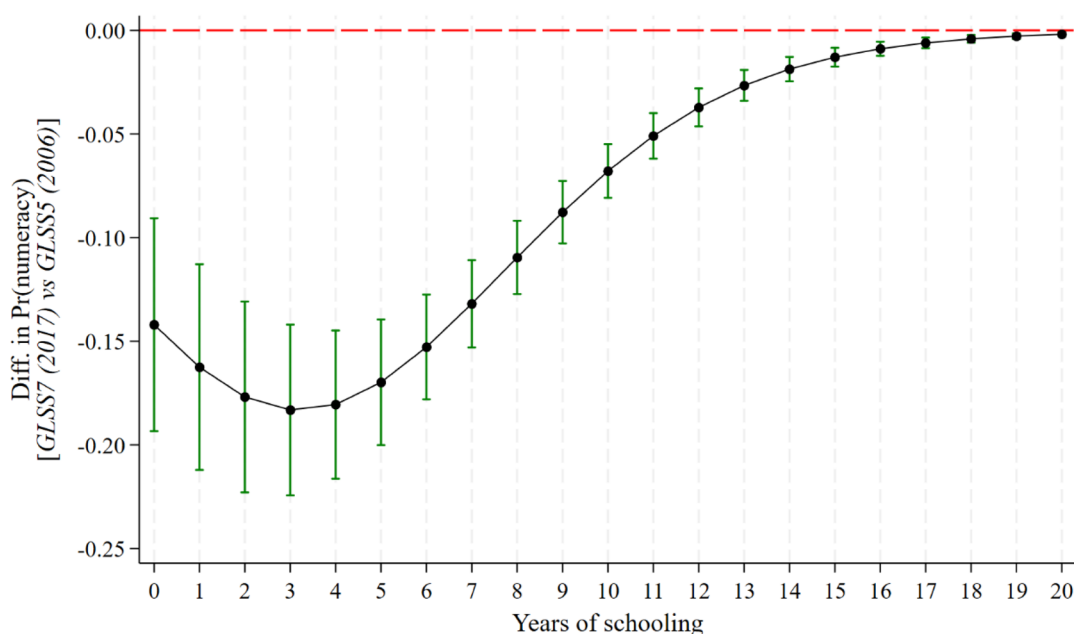


FIGURE 3 Difference in the probability of correctly answering a written calculation between 2006 and 2017, by years of schooling. The line spikes represent 95% confidence intervals.

literacy and numeracy in two nationally representative surveys conducted approximately a decade apart in 2006 and 2017. Although the proportion of the numerate and literate population has increased over time, this increase is largely due to changes in the educational composition of the population. An assessment of the differences in literacy and numeracy by level of education indicated that literacy and numeracy rates declined when comparing people with the same level of education in the two surveys. Both the probability of being able to read a short sentence and answer a written calculation have generally declined over time, with the largest differences observed among people with primary education. The observed decline between the two survey years was substantially larger for numeracy than for literacy, which could be partly explained by research showing that reading ability is significantly associated with mathematics performance (Ding & Homer, 2020). A plausible explanation for this is that the decline in educational quality has both direct and indirect effects (through the added effect of the decline in literacy) on numeracy, leading to larger differences.

The decline in population-level literacy and numeracy despite increases in educational attainment may be indicative of reductions in the quality of education due to inadequate adjustment of educational inputs to match the increased educational enrolment. There are limited data on direct measurements of education quality over time that can be used to properly analyse the ratio of inputs to enrolment. Statistics on the number of teachers at the primary level indicate that there has been a steady increase over the past three decades (UNESCO, n.d.). However, Akyeampong (2009) found that the number of untrained primary and lower secondary education teachers in Ghana doubled in the years following the introduction of the FCUBE programme. Similarly, Filmer (2023) found that teachers hired after FPE reforms in six sub-Saharan African countries (not including Ghana) performed worse on tests than those hired before reforms, suggesting that even in instances where there are attempts to increase requisite inputs other constraints may limit their quality. Le Nestour et al. (2022) found a correlation between the size of the educational expansion and the speed of the decline in education quality in their analysis of FPE reforms in 27 low- and middle-income countries—noting, however, that factors such as selection into schooling can partly account for the patterns observed. Adding to the complexity of the influence of free education policies is their effects on the composition and distribution of students in the educational system, with the share of children from

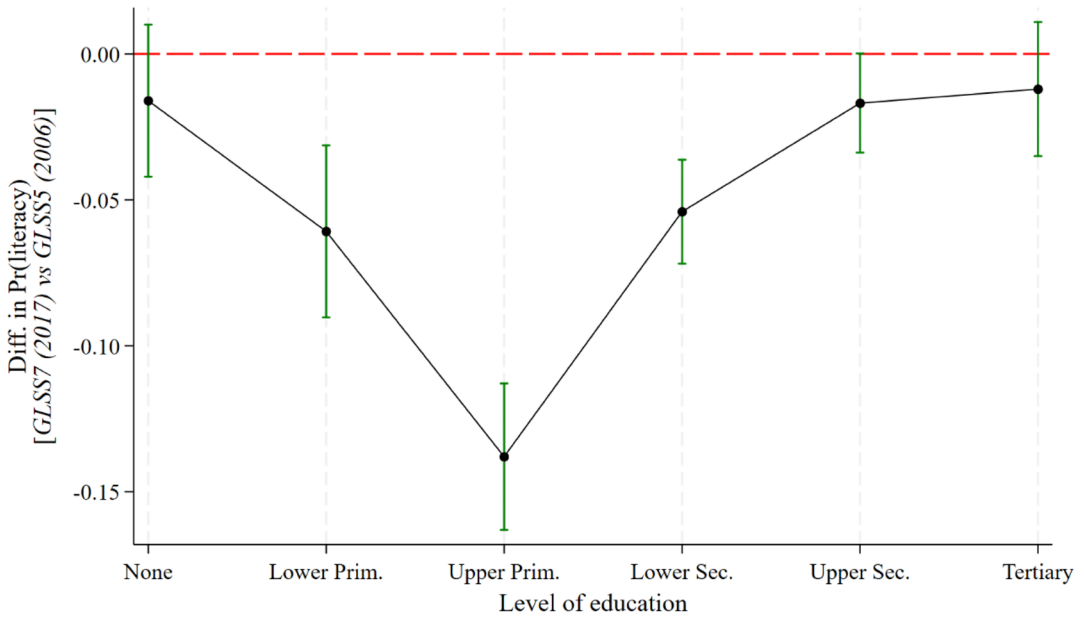


FIGURE 4 Difference in the probability of correctly reading a short sentence between 2006 and 2017 based on the level of education. The line spikes represent 95% confidence intervals.

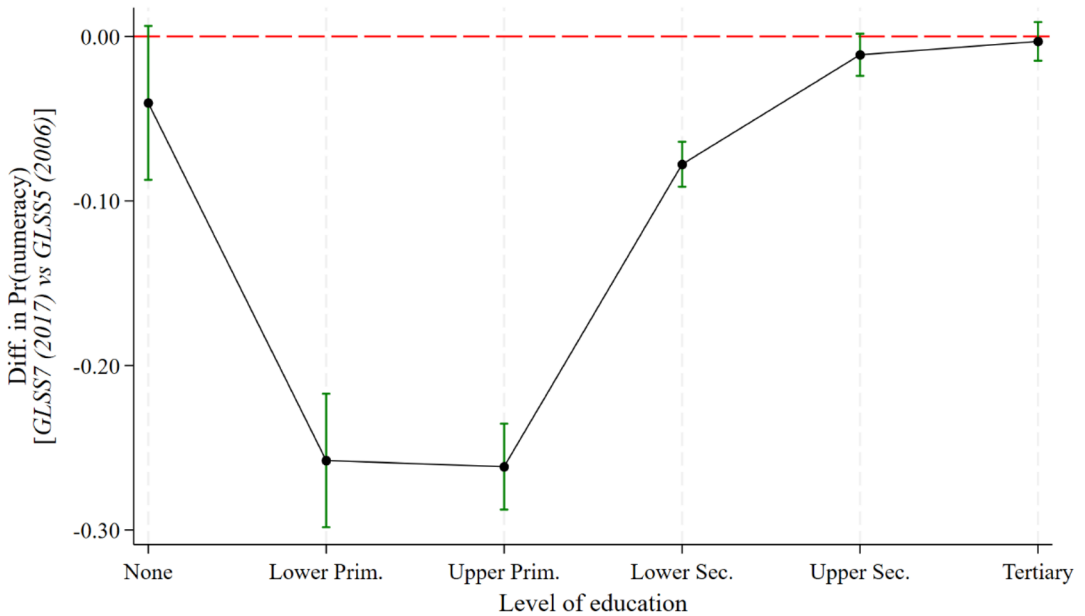


FIGURE 5 Difference in the probability of correctly answering a written calculation between 2006 and 2017, by level of education. The line spikes represent 95% confidence intervals.

lower socioeconomic backgrounds increasing, and the increment being mainly concentrated in public schools (Bold et al., 2015).

The finding that the decrease in the probability of having basic literacy and numeracy skills is largest for people with primary education lends additional support to the explanation that there has been a trade-off between

quantity and quality at the basic level due to educational expansion. Although the FCUBE policy was applied to both primary and lower secondary education, enrolment levels were substantially higher at the primary level. Five years after the policy was introduced, the gross enrolment rate for lower secondary school was 59.3% compared to 78.3% for primary level (UNESCO, n.d.). Thus, it is reasonable to assume that the pressure on the inputs is highest at the primary level. For those with secondary education and above, we make no inferences about the quality of education as basic literacy and numeracy skills are not an appropriate indicator of learning outcomes at this level.

The decline in basic literacy and numeracy at the primary and lower secondary levels has implications for the ongoing expansion of upper secondary education—which qualitative studies indicate have the same challenges related to increased enrolment, insufficient teaching and learning materials, and shortage of qualified teaching staff (Adarkwah, 2022; Chanimbe & Dankwah, 2021; Matey, 2020; Mohammed & Kuyini, 2021). Failure to address these issues and learn from previous free education policies may counter the long-term objectives of expanding access to secondary education. Although expanding access to secondary education is intended to create a more skilled workforce and drive economic development, the persistent problems in educational quality may hinder the achievement of these objectives. Without adequate resources, qualified teachers, and effective learning environments, students may graduate from secondary schools without the necessary skills and knowledge to contribute effectively to the workforce or pursue higher education. This situation could lead to a mismatch between the skills possessed by graduates and the needs of the job market, ultimately impacting the country's economic growth and development potential. A comprehensive and systemic approach to educational reform is necessary to address these challenges. This approach should focus not only on expanding access to education, but also on improving quality.

This study's findings on the long-term influence of universal primary education policies in Ghana on population-wide literacy and numeracy skills throughout the population provide valuable insights into the effectiveness of free education initiatives beyond immediate school-level outcomes. It adds to the existing literature on the consequences of declining school quality and highlights the need to ensure that free education initiatives translate into long-term increases in the basic skills of the general population that are needed for national development. Furthermore, the findings reveal potential disparities between demographic groups that point to a need for additional support or tailored interventions to ensure that everyone fully benefits from free education policies. The study's findings could also have broader implications for other countries implementing free education policies by providing empirical evidence on the risk of long-term declines in learning outcomes if education expansion policies are not implemented with prioritisation on maintaining education quality such as with investments in hiring additional training teachers and increasing the supply of funds and teaching and learning materials to schools.

DATA AVAILABILITY STATEMENT

The data used in this study are openly available in the Ghana Statistical Service Microdata Catalogue at <https://microdata.statsghana.gov.gh/index.php/home>.

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