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Abstract

To achieve the overarching goal of "education for all," there is a growing interest in understanding school learning outcomes and disparities among school children from disadvantaged backgrounds in Africa. This study employs data from standardized reading skill tests conducted in 11 low-income and lower-middle-income African countries through the Multiple Indicator Cluster Surveys (MICS) to evaluate children's learning outcomes. Drawing from recent nationally representative data, this multi-country study investigates the impact of various factors, including a country's socio-economic development, rural-urban disparities, family background, and disability status, on children's reading skills acquisition.

Our study reveals that reading proficiency among children is generally low and exhibits significant variation across the 11 African countries under examination. Notably, reading skills proficiency rates are lower in countries with lower GDP per capita, smaller government education expenditure relative to GDP per capita, lower school enrolment, and higher pupil-teacher ratios. The study identifies notable learning gaps among children from disadvantaged backgrounds, including disabled children, those residing in rural areas, and those from poorer and less educated families.

We specifically investigate the reading skills disparities between disabled and non-disabled children across various social categories and countries. These reading skills disparities remain fairly constant across the different social backgrounds, indicating that disabled children benefit equally from improved conditions as other children do. These results underscore the critical role of macroeconomic development and social equity in enhancing reading skills for all. To effectively reduce this gap, further targeted research is essential to understand the dynamics and identify tailored interventions.

Highlights

- We explore the impacts of socio-economic development and micro-level factors on children's reading skills across 11 African countries
- Reading proficiency skills among African children is found to be generally low and exhibits significant variation
- Macroeconomic conditions and school policies contribute to the enhancement of children's reading skills
- Reading disparities are observed by location (rural and urban), family wealth (poor and rich), and parents' education (less or better-educated)
- Disabled children respond equally to improved socio-economic conditions, despite persistent disparities in diverse social backgrounds

Keywords

Socio-economic development, reading skills, urban-rural disparity, children with disabilities, poverty, educational inequality, Africa

JEL codes

I24: Education and Inequality

1. Introduction

The UN Sustainable Development Goal 4 underscores the importance of achieving inclusive and equitable quality education for all (UN, 2015; UNESCO, 2016). There is a growing interest in understanding the educational outcomes of children from disadvantaged backgrounds and identifying the factors that contribute to variations in these outcomes, which can inform the development of effective educational policies (Evans & Mendez Acosta, 2021; Bashir et al., 2018; Musau, 2018).

Previous research has emphasized the persistent disparities in skills acquisition among children from disadvantaged backgrounds (Hernandez, 2011; Heckman, Pinto & Savelyev, 2013). Efforts to improve learning outcomes for disadvantaged groups have traditionally focused on assessing socio-economic factors such as gender, education, income, and geographical location (Zhang, 2006; Clercq, 2020) within the context of developing countries.

With a focus on the correlation between socio-economic factors and children's school performance, relatively little attention of current literature has been given to understanding the role of country as the primary provider of education in shaping the educational disparities and social reproductive processes through education (Heyneman and Loxley, 1983). In the early 1980s, two important papers by Heyneman and Loxley (1982, 1983) provocatively argued that the impact of individual or socio-economic factors might be relatively limited in economically disadvantaged developing countries compared to their influence in developed countries. Their research examined the roles of family social status and school quality in children's academic achievement across 29 countries with varying levels of economic development. Their study revealed that the macro social environment and school quality often exerted more significant influence than individual or family social status in poor countries. By combining country-level indicators across 11 low-income and lower-middle-income African countries with nationally representative data for school children with variable socio-economic and disability status, our

paper aims to contribute to the growing body of evidence regarding the influence of national development and micro-level variation on children's reading skills and the disparities in children's reading skills proficiency between children from disadvantaged and advantaged backgrounds.

In this study, we evaluate the reading skills of children aged 10 to 14 years old and investigate variations in reading skills across rural versus urban areas, between children with versus without disabilities, as well as between children from economically disadvantaged backgrounds and less educated families versus better-off and more educated families. More specifically, we assess the relative performance of disabled children within various social groups as well as examine how these disparities also varies across different African countries.

The educational achievement gap of children with disabilities has only recently gained attention, particularly following the adoption of the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) in 2006 (UN, 2006). Recent studies have made efforts to understand the schooling challenges faced by children with disabilities, focusing on differences in school access, attendance and enrolment in developing countries (Filmer, 2008; Mizunoya et al., 2018; UNESCO, 2018). Most studies assessing variations in school skill learning achievement for children with disabilities as compared to non-disabled children, are either based on school attendance/ enrolment or based on the data from developed countries (ref to be added later). Studies on learning achievement for children with disabilities are scarce in the context of developing countries, with a few exceptions from individual studies in Asia (Bakhshi et al., 2018; Singal et al., 2020), and none in the African context.

Our research aims to address the following research questions: 1) To what extent do reading skills among school children vary across African countries, and to what extent are these variations correlated with national development indicators such as income level (measured as GDP per capita) and primary school investment policies (including government expenditure in

education, net enrolment rate, and teacher-pupil ratio)? 2) Whether and to what extent do children from disadvantaged backgrounds (e.g., children with disabilities, those from disadvantaged background families or rural areas) lag behind their peers in reading skills when compared to children without disabilities, urban children, or children from more affluent or more educated families? 3) To what extent do disparities in reading skills between children with and without disabilities vary across various social groups (urban vs. rural, poor vs. rich, less vs. more educated families), as well as among countries with differing levels of macroeconomic development and school policy indicators?

Notably, country comparative studies often encompass a wide range of countries. For instance, in Filmer's study (2008), only two out of 14 surveys, and in Mizunoya et al.'s study (2018), only two out of 15 countries qualify as low-income countries according to the World Bank's classification[1]. Our study uses unique data from the sixth round of Multiple Indicator Cluster Surveys (MICS) conducted in seven low-income and four lower-middle-income African countries between 2017 and 2020. The MICS survey data includes a standardized reading skills performance test, enabling a comprehensive multiple-country study. We assess children's reading skills by measuring the proportion of school children with minimum reading proficiency.

Our study aims to provide comprehensive insights into the roles of micro-level factors and a country's macroeconomic development on children's academic performance, specifically focusing on low-income and lower-middle-income African countries. It emphasizes that in very poor context, these factors play crucial roles in shaping the the reading skills development of children. Studies on learning disparities among disabled children in the context of low-income countries have been relatively understudied in recent literature, likel due to data limitations. Our study highlights the persistent gap in reading skills among disabled children across various social groups, signifying the unique challenges they face. However, disabled children from

more advantaged backgrounds or in countries with higher socio-economic development have experienced similar improvement in reading skills as non-disabled children. The insights from this study have the potential to inform and improve education policies while also offering directions for future research on educational performance disparities.

2. Conceptual framework

2.1 Children's reading skills related to country-level development and school policy

Based on data from the 1970s, Heyneman and Loxley (1983) argue that in low-income countries, economic development levels and school quality have a more critical impact on children's school achievement compared to developed countries. In this context, family characteristics contribute much less to children's school performance than in developed settings. In economically disadvantaged countries with limited teaching resources, disparities in educational achievement among children from different individual and family backgrounds may be constrained when there are insufficient additional teaching resources available, even for relatively affluent families. However, as more resources become available and are unevenly distributed to schools and regions where children from wealthier families are concentrated, the influence of micro-level factors tend to increase accordingly.

African countries have shown commitment and political motivation to adopt various development frameworks such as education for all (UNESCO, 2016) and the Millennium Development Goals (UN, 2015), leading to a rapid expansion of mass education. While there has been great success in achieving universal basic education, it remains unclear whether the quality of education has been improved as many countries committed to enhancing minimal levels of educational quality. Conversely, African countries with low school enrolment rates

might have limited resources or different political motivations. They may have prioritized allocating their resources to improving school quality. The school quality can vary, depending on countries' national educational policy, which may or may not align with their school enrolment rates when compared across African countries.

Studies conducted in developed contexts have produced mixed conclusions regarding the impact of education spending on children's reading performance (Lips et al., 2008). A study by Vegas and Coffin (2015) based on numerous countries worldwide [2] concluded that a statistically significant correlation between education spending and children's performance in mathematics exists when a country spends below an annual threshold of US$8,000 per student (PPP). They concluded that each additional US$1,000 spent on schools was associated with a higher mean school performance, equivalent to a 14-point increase on the PISA[3] scale.

In this paper, we employ several country-level indicators to assess different aspects related to economic development and educational landscape of countries studied. These indicators include GDP per capita (adjusted by purchasing power parity), to represent a country's economic development level; primary school net enrolment rate, to measure a country's school enrolment level; government expenditure per primary school student (expressed as percentage of GDP per capita), to measure the level government investment in education; and pupil-teacher ratio, to gauge the quality of education. We set up the first hypothesis related to the country-level indicators:

H1. The percentage of school children aged 10-14 with satisfactory reading skills is positively correlated with a) GDP per capita, b) government expenditure in education; c) primary school net enrolment; and negatively correlated with d) pupil-teacher ratio.

2.2 Children's reading skills related to micro-level factors

Reading skills are crucial for the development of various other academic skills in school and can greatly impact children's likelihood of repeating grades or dropping out (Reschly, 2010). Several social, familial and individual factors influence children's learning, and the mechanisms through which these factors influence learning are multifaceted (Taylor & Yu, 2009).

Families with higher social status, including better income and higher education levels, tend to provide better support for their children's learning. Children from more advantaged backgrounds often begin their learning process earlier than their peers from disadvantaged families (Lee and Burkham, 2002). Additionally, they may indirectly benefit from residing in neighbourhoods with higher-quality schools (Anderson, Case and Lam, 2001). Parents with higher social status are also more likely to actively engage with the school community, thereby contributing to overall school quality.

The neighbourhood environment can influence children's learning outcomes. In the African context, although not extensively studied, there is evidence of urban-rural disparities in schooling (Zhang, 2006). Rural areas often face challenges related to school quality due to a lack of infrastructure, educational resources, and qualified teachers. Furthermore, in neighbourhood characterized by high levels of poverty in rural areas, various social issues affecting disadvantaged families can be exacerbated. Children are exposed to the influences of their peers in the same neighbourhood or school (Kahlenberg, 2001).

The challenges related to learning reading skills vary greatly across different disability types due to the diverse nature of functional difficulties (Premeaux, 2001; Anastasiou & Kauffman, 2011). Children with vision disabilities may have the same capability to develop reading skills as their peers, but the real challenges often stem from the availability of aids, such as corrective lenses, optical devices, glasses (Le Fanu et al., 2022), as well as access to consultative instructional services (Corn & Koenig, 2002). For children with hearing disabilities, the challenge in learning to read often arise from a lack of exposure to their first language before

the critical period (Kushalnagar et al., 2010). This puts them at high risk of linguistic deprivation (Mayberry, 1994, 1998). Children with physical disabilities may not face apparent functional challenges in learning reading skills, but they frequently experience high rates of school absenteeism due to factors like long distance to school, lack of infrastructure, materials, and support (Tanya et al., 2023). Children with intellectual disabilities struggle with developing reading skills due to challenges in various abilities, including information processing, cognitive abilities, and attentive behaviours (Tolar et al., 2016; Chan & Dally, 2001). Children with multiple disabilities are exposed to higher risks due to several different functional challenges. Moreover, the availability of appropriate teaching materials and pedagogical interventions for children with disabilities can limit their skill development.

We set up the second hypothesis related to micro-level factors, including disability status, urban/ rural residence, family income, and family educational level:

H2. The percentage of school children aged 10-14 with satisfactory reading skills among children with a) disabilities (vision, hearing, physical, intellectual, and multiple disabilities), b) rural residence, c) poor, and d) less-educated households is significantly lower than that among their peers without disadvantaged background. We assume that disabled children, as well as children with other disadvantaged backgrounds, face unique challenges arising from specific mechanisms related to their functional and other difficulties, which hinder their acquisition of reading skills.

In the African context, research on children's learning disparities in reading skills has primarily centered around gender disparities (Zuze, 2015; Kyei, 2021), disparities related to poverty (Gruijters & Behrman, 2020), and urban-rural disparities (Zhang, 2006). However, there is a shortage of empirical evidence concerning the disparities in reading skills associated with children's disabilities among various social groups. The fundamental question revolves

around whether children with disabilities, when raised in families with a more advantageous social background (urban residence, higher income, higher education), can successfully bridge the academic performance gap compared to their non-disabled counterparts. Can improvements in micro-level social factors mitigate the educational disparities linked to disability?

While there is limited empirical evidence regarding the correlation between the impact of disability on reading skills and a country's development and macroenvironment in the African context, several comparative studies have implicitly suggested such a correlation. For instance, Filmer (2008)[4] estimated larger differences in school attendance between children with and without disabilities in countries with higher overall enrolment rates and vice versa. Mizunoya et al. (2018)[5] confirmed this finding, noting a larger disability effect on dropout in countries with higher primary school enrolment rates. More recently, Lewis et al. (2022)[6] reported a larger disability effect related to educational attainment in countries with higher Human Development Index (HDI) across 40 countries. However, these studies have primarily estimated disability effects related to school enrolment and attendance, which are more readily available in extensive comparative studies involving many countries. None included school achievement indicators, and none specifically focused on African countries.

Understanding the impact of micro-level factors and macro development on the reading skills of disabled children in African countries is critical for addressing disparities among this group. While children generally achieve higher reading skills in households with better backgrounds and countries with stronger socio-economic development, it is essential to determine whether children with disabilities benefit equally. More empirical evidence is needed to assess how various factors contribute to reducing or widening disparities among children with disabilities.

We set up the third hypothesis related to the disparities in reading skills associated with children's disabilities:

H3a. Disparities in the percentage of school children with satisfactory reading skills between children with and without disabilities are smaller in a) urban; b) higher-income; c) more educated families.

H3b. Disparities in the percentage of school children with satisfactory reading skills between children with and without disabilities are larger in countries with stronger socio-economic development and improved school conditions.

Our hypotheses are based on the notion that families with advantageous conditions can better support children with disabilities in overcoming learning challenges. In contrast, prior research (Filmer, 2008; Mizunoya et al., 2018; Lewis et al., 2022) indicates larger disability effect on school enrolment and attendance in countries with higher school enrolment and better socio-economic development. This study aims to investigate whether the disability effect on school children's learning outcome varies in countries with different level of development. However, due to data limitations, our assessment is confined to children who were enrolled in school and participated in the reading tests during the survey period.

3. Data and estimation strategy

3.1 Data description

We use publicly available data from the sixth round of MICS surveys conducted by United Nations International Children's Emergency Fund (UNICEF). Our dataset comprises information collected from national representative surveys conducted between 2017 and 2020 in 11 African countries: Central Africa Republic, Chad, DRCongo, Ghana, Lesotho, Madagascar, Malawi, The Gambia, Togo, Tunisia, Zimbabwe. These surveys underwent review and received approvals from ethics committees in each respective country. Furthermore,

participants were provided with verbal information about the surveys and their consent was obtained[7].

The sixth round of MICS adopted the Washington Group Child Functioning Module (WG-CFM) to assess functional difficulties among children aged 6-17 (Groce & Mont, 2017; WG, 2020). from the 13 functional domains covered by WG-CFM, this paper focuses on eight domains that include four severity scales, categorized into five types of disabilities: vision, hearing, walking, intellectual and multiple[8] disabilities.

Our analysis primarily relies on the reading test designed for children aged 10-14 in the MICS survey. This reading test is highly standardized and consistently applied across countries. It consists of a brief story consisting of approximately 60-80 words[9], followed by a comprehensive test containing five questions related to the content of the text. From this test, we derive two key indicators: Q1, representing the proportion of correctly read words (ranging from 0 to 1), and Q2, indicating the proportion of correctly answered questions (with values of 0, 0.2, 0.4, 0.6, 0.8, 1). The reading test score is subsequently computed as the average of Q1 and Q2.

The distribution of these test scores shows a substantial number of extreme values, with children either facing reading difficulties or being proficient in reading. Therefore, instead of using the reading test score as a continuous measure, this study employs the indicator of the percentage of school children who surpass the threshold score of 0.85[10], which represents satisfactory reading ability.

Although the 0.85 threshold is somewhat arbitrary, it allows a maximum of one incorrect comprehensive question and a limited number of errors in reading the story (up to 10 percent of words). To ensure robustness, we conduct sensitivity analyses using alternative cutoff points (0.8, 0.9) to assess whether they would significantly change our primary findings. The results of these sensitivity analyses are provided in Appendix III.

In the MICS survey, one child aged between 6 and 17 is selected from the participating households to take the reading test. Table 1 provides an overview of the total sample size by countries and the size of non-response.

Table 1
Sample size and non-response by countries

Country	Missing due to Out of school[1]		Missing due to Language		Missing due to refusal[2]		Done reading test		**Total**
	Number	Percent (%)	Number	Percent (%)	Number	Percent (%)	Number	Percent (%)	
Central African Repub	361	17.8	145	7.1	444	21.9	1081	53.2	**2,031**
Chad	2,568	54.1	107	2.3	490	10.3	1582	33.3	**4,747**
DRCongo	769	16.6	305	6.6	754	16.2	2813	60.6	**4,641**
Ghana	176	5.0	112	3.2	267	7.6	2937	84.1	**3,492**
Lesotho	42	2.2	0	-	287	14.9	1598	82.9	**1,927**
Madagascar	958	22.3	1	0.0	656	15.3	2686	62.5	**4,301**
Malawi	204	3.0	69	1.0	1498	22.4	4930	73.6	**6,701**
The Gambia	366	18.7	190	9.7	179	9.2	1220	62.4	**1,955**
Togo	119	6.6	5	0.3	110	6.1	1576	87.1	**1,810**
Tunisia	20	1.1	0	-	77	4.4	1651	94.5	**1,748**
Zimbabwe	137	5.6	43	1.8	105	4.3	2156	88.3	**2,441**
Total	**5,720**	**16.0**	**977**	**2.7**	**4,867**	**13.6**	**24,230**	**67.7**	**35,794**

Note 1 including children never-in-school and dropouts
2 including family and child refusal

In many countries, the majority of children who have never attended school (99.6 percent) or have dropped out (78.5 percent) did not take the reading test, accounting for 16.0 percent of the sample. Additionally, 2.7 percent of children did not take the reading test because the test was not available in their primary teaching language. In most countries, the test is administered in an official foreign language, such as English or French[11]. Finally, 13.6 percent of non-responses were due to refusals, with 4.7 percent attributed to families refusing to involve their child, and 8.9 percent to children themselves refused to take the reading test.

Table 2 provides an overview of four country-level indicators for each country in our sample (The World Bank). These indicators include GDPP (Gross Domestic Product per capita), GEXE (% Government Expenditure on Education as a proportion to GDP per capita), SNE (School Net Enrolment), PTR (Pupil-Teacher Ratio). Based on the World Bank Atlas method, which is used for World Bank classifications, seven countries (Central Africa R., Chad, DRCongo, Madagascar, Malawi, The Gambia, Togo) are categorized as low-income economies,

while four countries (Ghana, Lesotho, Tunisia, Zimbabwe) are classified as low middle-income economies.

Table 2
Country-level factors and school policy indicators by countries

Country Name	GDPP (GDP per capita, PPP, current international, 2010-2021, $1000)	GEXE (Government Expenditure on Education per student in % of GDPP, primary, 2010-2018)	SNE (School Net Enrolment, primary, 2010-2019)	PTR (Pupil-Teacher Ratio, primary, 2010-2019)
Central Africa R.	0.841	4.10	65.35	82.27
Chad	1.667	6.40	72.65	59.51
DRCongo	0.876	4.73	57.41*	35.75
Ghana	5.026	11.84	84.77	29.83
Lesotho	2.531	20.71	89.10	33.36
Madagascar	1.540	6.59	95.60	41.17
Malawi	1.504	7.42	97.65	71.08
The Gambia	2.046	12.85	69.76	37.61
Togo	1.867	13.44	90.76	41.24
Tunisia	10.739	17.43	98.06	16.77
Zimbabwe	2.333	14.01	94.16	36.13

* SNE (School Net Enrolment) indicator for DRCongo is calculated based on data available between 1990 and 1999 due to the data availability constraints

3.2 Estimation strategy

In theory, the MICS data represents a national sample of children aged 6-17. However, the non-response rate in the MICS reading tests is as high as 32 percent. The majority of out-of-school children and all children taught in minority language are excluded from the reading tests. As a result, our analysis can only confidently speak about in-school children taught in the main language.

We are able to address one of the selection problems in the data, non-participation due to refusal. To address this potential selection issue due to refusals, we employ inverse probability weighting (IPW). IPW relies on estimating the probability of exposure (in this case, taking the reading test) for each person in the sample by using probit regression models.

We first use a probit model to evaluate the likelihood of children in the sample taking the reading test in each respective country in the following setting:

$$Selection_i^m = \alpha_0^m + \alpha_{1j}^m D_{ij}^m + \alpha_3^m UR_i^m + \alpha_{2k}^m EDU_i^m + \alpha_{2k}^m ASS_i^m + \alpha_4^m Age_i^m + \alpha_5^m Gender_i^m + \varepsilon_i \quad (1)$$

To address potential sample selection, we include variables that could be correlated with a child's probability of taking the reading tests. These variables encompass: 1) disability status (D_{ij}), represented by dummy variables indicating no disability, vision, hearing, physical, intellectual, and multiple disabilities; 2) location variable UR_i, indicating urban or rural residence; 3) asset index indicator quintiles (ASS_i), constructed using weighted assets owned by the household through the first principal component analysis (PCA) at the household level (Naveed et al., 2021); 4) highest completed educational level among the household members (EDU_i); and 5) children's age and gender. Here, subscript *i* represents each individual child, m represents countries, *j* represents different disability statuses.

If the coefficients for these variables are statistically significant, it indicates evidence of sample selection. The predicted probability of selection from full model (1) is $\widehat{Selection1}_i^m$. Next, we rerun a reduced probit model with covariates that are insignificant in (1) and the predicted probability from the reduced model is $\widehat{Selection2}_i^m$. The inverse probability weight is calculated as the ratio between the two predicted probabilities:

$$Weight_i^m = \widehat{Selection2}_i^m. \ / \ \widehat{Selection1}_i^m. \quad (2)$$

The inverse probability weight is used on the sample who have completed the reading test. The approach helps adjust for potential selection bias related to family and individual characteristics since children with similar characteristics to those who refused the reading test will receive higher weights[12].

In the second stage model, only school children with reading test scores will be included, weighted by IPW. We first test hypothesis H1, which states that the percentage of school children aged 10-14 with satisfactory reading skills is positively correlated with a) GDP per capita (GDPP) (adjusted by purchasing power parity, in 1000$ per capita per year); b) government expenditure in education (GEXE) (in % of GDPP); c) primary school net enrolment (SNE); and negatively correlated with d) pupil-teacher ratio (PTR).

We estimate the effects of these country-level factors on school children's reading skills by conducting inverse probability weighted least squares regressions. The regressions include country-level indicators that reflect country's macroeconomic development or school policy:

Second stage: $\text{Reading}_i = \gamma_0 + \gamma_1 GDPP_i + \gamma_2 GEXE_i + \gamma_3 SNE_i + \gamma_4 PTR_i + \gamma_5 PTT_i + u_i$ (3)

Here, subscript *i* represents each individual child.

In the second set of regressions, we will test hypothesis H2, which states that the percentage of school children aged 10-14 with satisfactory reading skills among children with a) disabilities, b) rural residence, c) pooor, and d) less-educated households is significantly lower than that among their peers without disadvantaged background.

We will include disability status (D_{ij}), urban/ rural residence (UR_i), Asset index quintile (ASS_i), Families' educational level (EDU_i), and other additional control variables such as age and gender in the following setting:

$$Reading_i = \beta_0 + \beta_{1j} D_{ij} + \beta_2 UR_i + \beta_3 ASS_i + \beta_4 EDU_i + \beta_5 Age_i + \beta_6 Gender_i + u_i \quad (4)$$

To test hypothesis H3a, which states that disparities in the percentage of school children with satisfactory reading skills between children with and without disabilities are smaller in households with advantageous conditions, we include interaction terms between disability status and other micro-level indicators. Due to the limitations in the size of samples for some disability types, we will not estimate the treatment effect of different disability types but include disability status D_i as a catch-all category.

$$Reading_i = \pi_{10} + \pi_{11} D_i + \pi_{12} UR_i + \pi_{13} ASS_i + \pi_{14} EDU_i + \pi_{15} D_i * UR_i + \pi_{16} D_i * ASS_i + \pi_{17} D_i * EDU_i + \pi_{18} Age_i + \pi_{19} Gender_i + u_{1i} \quad (5)$$

To test hypothesis H3b, which states that disparities in the percentage of school children with satisfactory reading skills between children with and without disabilities are larger in countries with stronger socio-economic development and improved school conditions, we

include interaction terms between disability status and country dummy variables, while using other micro-level variables as control variables.

$$Reading_i = \pi_{20} + \pi_{21}D_i + \pi_{22}COUNTRY_i + \pi_{23}D_i * COUNTRY_i + \pi_{24}UR_i + \pi_{25}ASS_i + \pi_{26}EDU_i + \pi_{27}Age_i + \pi_{28}Gender_i + u_{2i} \quad (6)$$

4. Results

4.1 Reading skills across country-level factors and school policy indicators

The percentage of school children aged 10-14 with satisfactory reading skills (reading score 0.85 or above) in each country is displayed in table 3, showing significant variation. This percentage ranges from a low of 17.8% in the Central Africa Republic to a high of 87.7% in Tunisia. Tunisia has a reading skill proficiency rate nearly five times that of the Central Africa Republic.

Table 3
Percentage of tested children with satisfactory reading skills (score > 85%) by countries, ages 10-14

	Mean (%)	Std. Err.	[95% Conf.	Interval]	Sample size	Year of survey
Central Africa R.	17.8	0.012	0.155	0.201	1,080	2019
Chad	21.2	0.010	0.192	0.232	1,548	2019
DRCongo	18.9	0.008	0.175	0.204	2,730	2017
Ghana	47.0	0.009	0.452	0.488	2,916	2017
Lesotho	58.4	0.012	0.559	0.608	1,568	2018
Madagascar	51.2	0.010	0.492	0.531	2,477	2018
Malawi	49.4	0.007	0.480	0.508	4,883	2020
The Gambia	34.6	0.014	0.319	0.373	1,213	2018
Togo	37.9	0.012	0.355	0.403	1,574	2017
Tunisia	87.7	0.008	0.861	0.893	1,607	2018
Zimbabwe	56.3	0.011	0.542	0.585	2,056	2019
Total	**44.7**	**0.003**	**0.441**	**0.454**	**23,652**	

To test Hypothesis H1, we run inverse probability weighted[13] least squares regressions by including different combinations of macroeconomic development and school policy indicators. The results are presented in Table 4.

Table 4
IPW least squares regressions by country-level factors and school policy indicators (ages 10-14) with outcome as proportion of children with satisfactory reading skills (score > 85%)

Variable	Model1	Model2	Model3	Model4	Model5
GDPP	0.027***		0.028***	0.030***	0.044***
	(0.002)		(0.002)	(0.002)	(0.002)
GEXE	0.005***	0.008***		0.007***	0.019***
	(0.001)	(0.001)		(0.001)	(0.001)
PTR	-0.001***	-0.003***	-0.002***		0.003***
	(0.000)	(0.000)	(0.000)		(0.000)
SNE	0.008***	0.010***	0.009***	0.008***	
	(0.000)	(0.000)	(0.000)	(0.000)	
Constant	-0.354	-0.338***	-0.329***	-0.382***	-0.01
	(0.025)	(0.024)	(0.024)	(0.022)	(0.022)
Sample size	23591	23591	23591	23591	23591
R2	0.115	0.107	0.114	0.115	0.081

Note: GDPP: GDP per capita (adjusted by purchasing power parity); GEXE: Government Expenditure in Education (as percentage of GDP per capita); SNE: School Net Enrolment; PTR: Pupil-Teacher Ratio

The first set of regressions shows that a $1000 increase in GDP per capita (GDPP)[14] is associated with an average increase of 3 percentage points in the proportion of school children with satisfactory reading skills. Additionally, for every 1 percentage point increase in government expenditure on education (GEXE), there is a corresponding 0.5-0.8 percentage point increase in the proportion of school children with satisfactory reading skills. A reduction of one student per teacher in the pupil-teacher ratio (PTR) leads to a 0.1-0.3 percantage point increase in children's reading skills proficiency rate.

Furthermore, a 1 percentage point increase in school net enrolment (SNE) results in approximately a 1 percentage point increase in the share of children with satisfactory reading skills. However, when SNE is excluded from the analysis, the estimated effects of both GDPP and GEXE increase, and the coefficient estimated for PTR becomes positive. These changes in parameters indicate a correlation between SNE and the other country-level indicators.

4.2 Reading skills across micro-level factors

In the second set of regressions, we initially include only one of the four micro factors: disability status, location (rural vs. urban), asset index quintile, or highest educational level in the household together with additional control variables such as age and gender, in each

regression. The final regression, labelled as Model5, includes all the micro-level factor variables, along with the control variables, as displayed in Table 5[15].

Table 5
IPW least squares regressions by three micro factors (ages 10-14) with outcome as proportion of children with satisfactory reading skills (score > 85%)

	Model1	Model2	Model3	Model4	Model5
Disability status (base category: non-disabled)					
Vision disability	0.128***				0.118**
	(0.039)				(0.039)
Hearing disability	-0.124*				-0.082
	(0.052)				(0.051)
Physical disability	0.015				0.054
	(0.041)				(0.042)
Intellectual disability	-0.148***				-0.147***
	(0.016)				(0.016)
Multiple disabilities	-0.188***				-0.147**
	(0.054)				(0.054)
Location (base category: urban)		-0.215***			-0.110***
		(0.009)			(0.010)
Wealth index (base category=Poorest)					
Second quintile			0.056***		0.038***
			(0.010)		(0.010)
Middle			0.109***		0.070***
			(0.011)		(0.011)
Fourth quintile			0.201***		0.131***
			(0.011)		(0.012)
Richest			0.351***		0.237***
			(0.011)		(0.013)
Highest Educational level in the household (base category=No school)					
Primary				0.123***	0.106***
				(0.009)	(0.008)
Junior secondary				0.234***	0.134***
				(0.010)	(0.010)
Senior secondary or higher				0.194***	0.085***
				(0.011)	(0.011)
Gender (Base category: Boys)	0.044***	0.042***	0.038***	0.044***	0.037***
	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
Age (Base category=10)					
age11	0.078***	0.069***	0.070***	0.072***	0.068***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
age12	0.116***	0.112***	0.114***	0.117***	0.111***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)
age13	0.178***	0.173***	0.174***	0.179***	0.173***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
age14	0.224***	0.217***	0.212***	0.223***	0.211***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Constant	0.268***	0.413***	0.131***	0.128***	0.173***
	(0.012)	(0.013)	(0.013)	(0.013)	(0.017)
Sample size	23591	23591	23591	23572	23572
R2	0.032	0.069	0.088	0.055	0.108

Table 5 indicates large differences in the share of school children with satisfactory reading skills among various groups. Compared to non-disabled children, children with hearing disabilities (12 percentage points lower), intellectual disability (15 percentage points lower) and multiple disabilities (19 percentage points lower) exhibit lower proficiency rate (Model 1).

Additionally, children from the wealthiest quintile of the asset index perform 24 to 35 percentage points better than those from the poorest quintile (Model 3). Children in families

with primary education outperform those in families without any schooling by 12 percentage points, while those in families with at least one family member who has completed junior secondary education achieve approximately a 20 percentage points advantage over children from families without any schooling (Model 4). In the full model with all micro-level covariates included, children in households with various levels of parental education are approximately 10 percentage points ahead of those in families without any schooling. Once parents have received some level of schooling, the differences between families with primary schooling and those with higher education do not appear to be substantial (Model 5). The reduction in coefficients from models 3 and 4 to 5 for wealth and education also indicate that these effects are correlated.

Finally, urban children outperform their rural counterparts by a 22-percentage point difference in satisfactory reading skills compared to their rural counterparts before wealth and education of parents is controlled for(Model 2) and by 11 percentage points after these are controlled for (Model 5).

4.3 Disparities in reading skills related to disabilities

To test hypothesis H3a, we include all micro-level indicators, as well as the interaction terms between disability status and other micro-level indicators (urban/rural residence, wealth index, and family's highest educational level). The regression results at various cutoff points are presented in Appendix III.

Figures 1 displays the predicted proportion of 14-year-old children with satisfactory reading skills. These predictions are made with covariates set at their means for both disabled and non-disabled children in different social groups (urban vs. rural, high vs. low socio-economic status, more vs. less educated families). These disparities in reading skills between school children with and without disabilities are visually represented as lines connecting two estimated reading skill proficiency rates in various social groups. A steeper incline in the line

indicates a higher disparity between disabled and non-disabled children, while a flatter line suggests a smaller disparity.

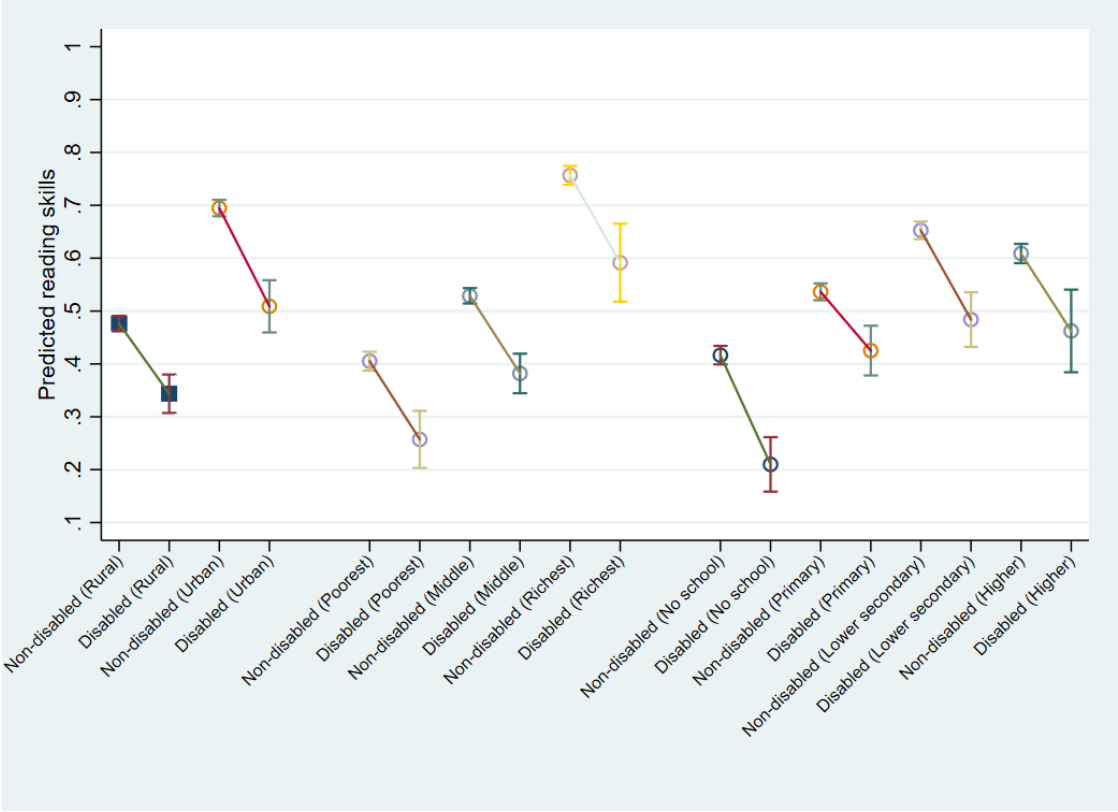

Figure 1
Predicted proportion of 14-year-old children with satisfactory reading skills for disabled vs. non-disabled children in various social groups, with 95% confidence intervals.
Note: The predictions are calculated at the means of covariates across all countries, with separate predictions for various social groups related to rural and urban residences, family wealth index, and the highest educational level among household members.

Figure 1 suggests that disparities in reading skills proficiency between disabled and non-disabled children do not vary significantly across different social groups. These disparities remain relatively constant at around 15 percentage points in various groups. The most significant disparities are observed in urban areas (19 percentage points) and among families without any schooling (21 percentage points).

Furthermore, it is noteworthy that children with disabilities in social groups with advantaged background (urban, rich and more-educated families) have achieved similar levels of reading skill proficiency as their non-disabled peers in social groups with disadvantaged background (rural, economically disadvantaged, and less-educated families).

To test hypothesis H3b, we incorporate all country dummies and include the interaction terms between disability status and individual countries. Additionally, the regression results at various cutoff points can be found in Appendix III. In figure 2, we present the predicted proportion of 14-year-old children with satisfactory reading skills for both disabled and non-disabled children in each respective country.

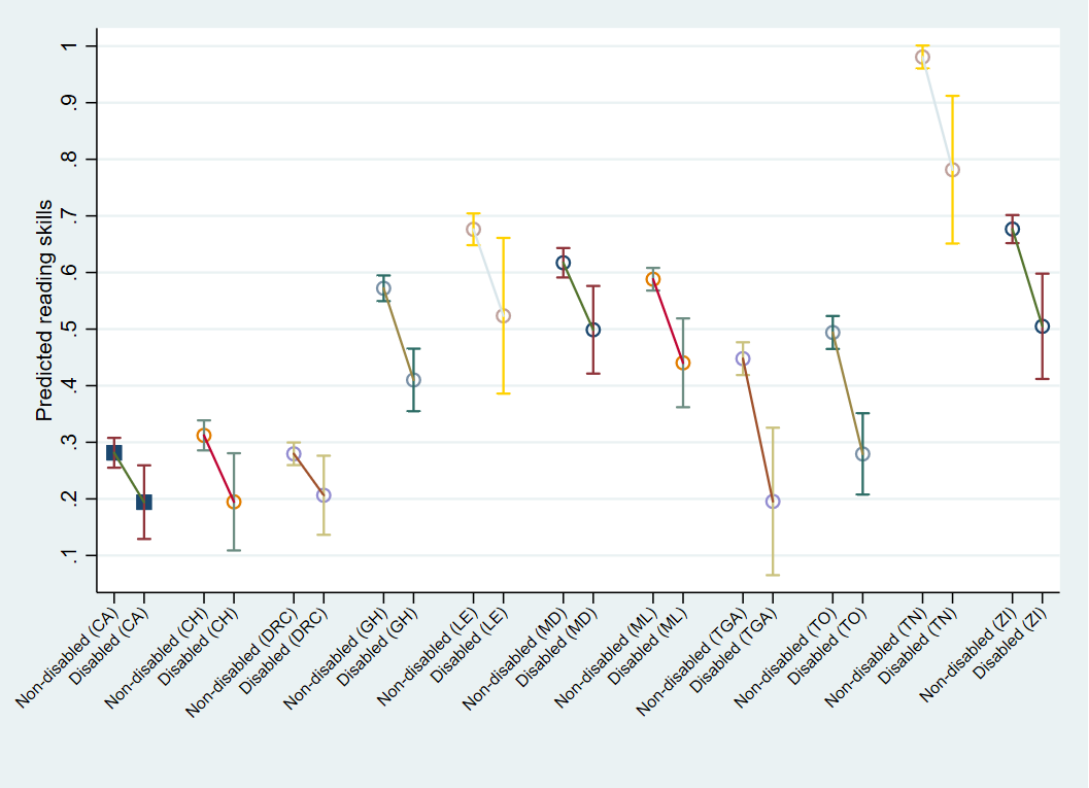

Figure 2
Predicted proportion of 14-year-old children with satisfactory reading skills for disabled vs. non-disabled children in each country, with 95% confidence intervals
Note: The predictions are calculated at the means of covariates, with separate predictions for various social groups related to rural and urban residences, family wealth index, and the highest educational level among household members.
CA: Cenral Africa Republic; CH: Chad; DRC:DRCongo; GH: Ghana; LE: Lesotho; MD: Madagascar; ML: Malawi; TGA: The Gambia; TO: Togo; TN: Tunisia; ZI: Zimbabwe

Disparities in reading skills between disabled and non-disabled children are lowest in the Central Africa Republic, Chad, and DRCongo, where the gap range is 7-12 percentage points. It is worth noting that these countries generally exhibit the lowest overall reading skills proficiency rates for the entire children's population in these countries, which fall within the range of 18-21 percent (as shown in Table 3).

Conversely, the largest gaps are observed in The Gambia (25 percentage points), Togo (21 percentage points), and Tunisia (20 percentage points). Notably, Tunisia has the highest overall reading skills proficiency rate at 88 percent, while The Gambia and Togo have relatively lower reading skills proficiency rates at 35 percent and 38 percent, respectively.

5. Discussion and study limitations

5.1. Discussion

In this section, we will discuss the findings related to the key hypotheses. We will also discuss important limitations of our study and provide some suggestions for future research.

Our analysis shows considerable variations in overall reading skills among school children across the 11 African countries where the MICS survey has been conducted in recent years. The proportion of school children attaining satisfactory reading skills ranges widely, from 18 percent in the Central Africa Republic to 88 percent in Tunisia. In our combined sample from these 11 countries, less than half (45 percent) of the school children have reached a satisfactory reading level. We should expect a much lower reading skill level for children not in school. It is important to note that there is substantial variation in the level of school attendance across these countries, with rates ranging from 43% in Chad to 69% in Madagascar, and reaching as high as 95% in Lesotho, Malawi, and Tunisia.

The first regression analysis supports hypothesis H1, demonstrating a positive correlation between the percentage of school children with satisfactory reading skills and country-level indicators, including GDP per capita; government expenditure in education, and primary school net enrolment. Furthermore, children's reading skills improve when pupil-teacher ratio is reduced. However, this result does not remain robust when the primary school net enrolment indicator is excluded from the regression analysis.

In developed countries, the pupil-teacher ratio typically ranges from 10 to 15 and even falls below 10 in some countries (The World Bank, 2020a). Within our sample, pupil-teacher ratios in the low-ratio group mainly fall between 30 and 40, while in the high ratio group, they span between 50 and 80. Although the pupil-teacher ratio is not identical to class size, they are closely correlated. Many studies argue that reducing class size can impact school performance, especially for younger children and those from economically disenfranchised backgrounds (Zyngier, 2014; Schanzenbach, 2014). However, most of these studies are based on developed contexts. The effect of class size in developing contexts, where it can be initially much higher, remains unclear. Our findings suggest that by reducing the pupil-teacher ratio by 10 students per teacher, children's average reading skills proficiency will increase by 1-3 percentage points. For countries with very high pupil-teacher ratios, there is much room for improvement in children's reading skills.

The second set of models partly support hypothesis H2a), indicating that the percentage of school children with satisfactory reading skills among those with hearing, intellectual, and multiple disabilities[16] is significantly lower than their non-disabled peers. However, it is important to note that children with vision or physical disabilities do not significantly lag behind and the conclusion regarding children with hearing disability does not remain statistically significant when all control variables are included in the analysis. Additionally, children residing in 2b) rural areas, 2c) impoverished background, and 2d) less-educated households exhibit significantly lower reading skills than children in urban areas, affluent families, or higher-educated households.

As demonstrated by numerous studies in developed context (Pace, etc., 2017), children from disadvantaged backgrounds tend to lag behind in reading abilities. Notably, our analysis shows that family poverty has the strongest correlation with children's reading skills. The

proportion of school children in the richest quintile group who have achieved satisfactory reading skills is 24-35 percentage points higher than those in the poorest quintile group.

What is particularly notable in our study is the observation that a substantial proportion of school children obtain extreme values in their reading test scores, either very low or very high scores. The concern here is primarily for school children who at their current age continue to achieve very low scores in basic reading tests. This underscores the substantial challenges they may have encountered in developing proficient reading skills in the long future. Among them, children from disadvantaged background are particularly representative.

Furthermore, our study indicates that school children with vision and physical disabilities do not exhibit significant disparities in their reading skills. It is plausible that they have managed adequately with basic reading skills. However, if more comprehensive reading tests were to be introduced, these children might also encounter challenges and potential difficulties in meeting advanced reading skill requirements.

Our findings do not support Hypothesis H3a that disparities in the percentage of school children with satisfactory reading skills between children with and without disabilities would be less pronounced in households with more advantaged background. Instead, these disparities have remained relatively constant across different social groups. It is worth emphasizing that these results are based on children who are currently enrolled in school. When we consider out-of-school children, recorgnizing the overrepresentation of disabled children in this group, it becomes apparent that disparities in social groups with disadvantaged backgrounds may have been underestimated. However, as long as children are enrolled in school, a consistent gap between disabled and non-disabled children appears to persist.

Our findings do not support Hypothesis H3b, which suggests that disparities in reading skills proficiency rates between children with and without disabilities would be more pronounced in countries with stronger socio-economic development and improved school

conditions. Tunisia, characterized by the highest socio-economic development and the highest children's reading skills proficiency level among the 11 countries (88 percent), does exhibit relatively high disparities in reading skills between disabled and non-disabled children. However, when we consider the gap of 20 percentage points in proportion to the overall reading skills proficiency level of 88 percent, it does not appear higher compared to the gaps of 7 to 12 percentage points observed in countries with lower reading skills proficiency (ranging from 18 to 21 percentage points).

Furthermore, it is noteworthy that the countries with the highest disparities in reading skills proficiency rates are The Gambia and Togo, both of which have lower-middle-level reading skills proficiency rates among the 11 countries in our sample. When we examine country-level indicators, we observe that government expenditure as a proportion of GDP per capita in The Gambia greatly increased between 2008 and 2012 (The World Bank, 2020b). This may have contributed to explain the 10-percentage-point increase in school enrolment between 2013 and 2018 (The World Bank, 2020c). In the case of Togo, GDP per capita and government expenditure in education as a proportion of GDP per capita also experienced rapid growth from the early to mid-2010s (The World Bank, 2020b). While the rapid growth and significant investment in education may have positively impacted children's overall school performance, the influence of this growth on the disparities between disabled and non-disabled children in reading skills remains unclear. This aspect warrants further research.

5.2. Study limitations

Several limitations should be considered when interpreting the findings of this study.

First, the reading test used in the MICS survey is relatively basic. Given the age range of children tested (10-14 years), it may not comprehensively assess more advanced reading skills. However, even with the basic test, the prevalence of satisfactory reading skills among

children aged 10-14 in most of these countries is notably low, indicating limited reading abilities across many African countries. The introduction of a more comprehensive reading test could potentially reveal even greater difficulties, particularly among children from disadvantaged backgrounds.

Second, it is crucial to recognize that this study exclusively focuses on children currently enrolled in school. Many children who are not attending school and therefore not taking the reading test are disproportionately from disadvantaged background. It is highly likely that these children may have much lower reading skills. As a result, the disparities estimated in this group may have been underestimated.

Moreover, there is substantial variation in school attendance rates across the countries studied. Careful consideration is needed when analyzing countries with low school enrolment. It is important to emphasize that the conclusions drawn in this paper are applicable exclusively to children enrolled in school and cannot be generalized to encompass all children in these countries.

Third, the selection of countries in this study was not guided by strict predefined criteria but was rather constrained by data availability. It is essential to interpret the estimated disparities cautiously due to the inherent randomness associated with the selection of countries in this paper.

6. Conclusion

Drawing from nationally representative samples of 10-14 years old school children across 11 African countries surveyed in the MICS survey, our study aims to empirically explore the connections between a country's socio-economic development, school quality, and various regional, family, and individual factors affecting children's acquisition of reading skills. We assess the reading proficiency of school children aged 10-14 years through standardized reading tests conducted as part of the MICS survey.

In our analysis, focusing specifically on low-income and lower-middle-income African countries, we observe substantial variation in reading skill proficiency rates across these countries and various social groups. The study establishes a strong correlation between a country's macroeconomic development, measured by GDP per capita, and the reading skills of school children. Additionally, key country-level indicators, such as higher education expenditure per primary student as a percentage of GDP per capita, higher net primary school enrolment rates, and lower pupil-teacher ratios contribute to improved reading skills among school children. Our study unveils lower reading skills among children from disadvantaged backgrounds, including disabled children, those residing in rural areas, and those from poor, and less educated families. Family income exhibits the strongest correlation with children's reading skills among these factors.

Despite the existing gaps in reading skills between disabled and non-disabled children, our study reveals that disabled children attain higher reading skills to a similar extent as non-disabled children when living under improved conditions. The share of children with adequate reading skills increases in a manner similar to non-disabled children in response to improved conditions. These results underscore the critical role of macroeconomic development and social equity in addressing the challenges faced by vulnerable populations and enhancing reading skills for all. Finally, it is crucial to acknowledge the complexity of mechanisms contributing

to disparities in children's school performance related to micro-level and country-level factors. To effectively reduce this gap, further targeted and in-depth research is essential to understand the dynamics and identify tailored interventions, which extends beyond the scope of this paper.

Acknowledgements

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7. Appendix

Appendix I

Regression results from first stage of selection model for each country

Variable	Central Africa R.	Chad	DRCongo	Ghana	Lesotho	Madagascar	Malawi	The Gambia	Togo	Tunisia	Zimbabwe
Disabled	-0.292*	-0.07	-0.592***	-0.440***	-0.389*	-0.16	-0.309***	-0.714**	0.045	-0.305	0.078
Location (base category: urban)											
	-0.280**	-0.253**	-0.197**	-0.290***	-0.169	0.038	-0.130*	-0.212	-0.24	0.189	0.378
Wealth index (base category=Poorest)											
Second quintile	0.12	0.239*	0.033	0.014	0.251*	0.268**	0.156**	-0.184	0.09	-0.166	0.155
Middle	0.102	0.354**	0.253***	0.208	0.353**	0.367***	0.272***	-0.231	0.068	0.169	0.167
Fourth quintile	0.300*	0.323**	0.490***	0.304*	0.282*	0.455***	0.383***	-0.28	0.117	0.288	0.747**
Richest	0.343*	0.507***	0.811***	0.256	0.573***	0.334**	0.539***	0.096	0.14	0.233	0.664*
Highest Educational level in the household (base category=No school)											
Primary	-0.08	0.007	-0.055	-0.104	0.227*	0.105	0.155**	0.148	0.061	-0.109	0.244
Junior secondary	0.066	0.138	0.066	0.023	0.074	0.11	0.366***	0.159	-0.094	-0.128	0.28
Senior secondary or higher	0.047	0.085	0.066	0.185	-0.148	0.047	0.568***	-0.038	-0.001	-0.119	0.795
Age (Base category=10)											
age11	-0.018	0.021	0.053	0.098	0.202	0.12	0.196***	0.172	0.137	-0.175	0.111
age12	-0.057	0.094	0.166*	0.273**	0.134	0.125	0.303***	0.254	-0.086	-0.045	0.085
age13	0.056	0.077	0.323***	0.349***	0.157	0.261**	0.430***	0.492**	0.034	-0.167	0.117
age14	0.116	0.203	0.495***	0.631***	0.176	0.336***	0.571***	0.512***	0.241	-0.223	0.222
Gender (Base category: Boys)	-0.167*	0.063	-0.091	-0.099	0.290***	0.058	0.258***	0.222*	-0.066	-0.019	0.371***
Constant	1.133***	0.790***	0.889***	1.704***	0.458	0.29	-0.131	1.068**	1.934***	1.681***	-0.08
Sample size	1458	1910	3468	3159	1823	2972	6332	1355	1663	1669	2144

Appendix II

IPW least squares regressions by three micro-level factors (ages 10-14) including country fixed effect

	Model1	Model2	Model3	Model4	Model5
Disability status (base category: non-disabled)					
Vision disability	0.05				0.039
	(0.036)				(0.035)
Hearing disability	-0.145**				-0.105*
	(0.049)				(0.047)
Physical disability	0.037				0.073*
	(0.035)				(0.036)
Intellectual disability	-0.157***				-0.150***
	(0.016)				(0.015)
Multiple disabilities	-0.174***				-0.128*
	(0.051)				(0.050)
Location (base category: urban)		-0.225***			-0.090***
		(0.008)			(0.009)
Wealth index (base category=Poorest)					
Second quintile			0.059***		0.044***
			(0.009)		(0.009)
Middle			0.109***		0.076***
			(0.009)		(0.010)
Fourth quintile			0.209***		0.145***
			(0.010)		(0.011)
Richest			0.367***		0.257***
			(0.010)		(0.013)
Highest Educational level in the household (base category=No school)					
Primary			0.059***	0.033***	
			(0.009)	(0.009)	
Junior secondary			0.210***	0.098***	
			(0.010)	(0.010)	
Senior secondary or higher			0.211***	0.085***	
			(0.011)	(0.011)	
Gender (Base category: Boys)	0.043***	0.040***	0.037***	0.042***	0.035***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)

Age (Base category=10)					
age11	0.074***	0.065***	0.065***	0.068***	0.063***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
age12	0.115***	0.111***	0.112***	0.116***	0.110***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
age13	0.166***	0.162***	0.161***	0.166***	0.161***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
age14	0.218***	0.211***	0.205***	0.216***	0.204***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Country (Base category=Central Africa R.)					
Chad	0.026	0.075***	0.032*	0.071***	0.059***
	(0.017)	(0.017)	(0.016)	(0.017)	(0.017)
DRCongo	-0.006	0.036*	0.082***	-0.029	0.054***
	(0.016)	(0.015)	(0.014)	(0.015)	(0.014)
Ghana	0.283***	0.293***	0.331***	0.276***	0.320***
	(0.019)	(0.016)	(0.015)	(0.017)	(0.015)
Lesotho	0.388***	0.448***	0.467***	0.418***	0.470***
	(0.019)	(0.018)	(0.017)	(0.018)	(0.017)
Madagascar	0.331***	0.381***	0.372***	0.357***	0.387***
	(0.018)	(0.017)	(0.016)	(0.017)	(0.016)
Malawi	0.300***	0.391***	0.343***	0.335***	0.373***
	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)
The Gambia	0.155***	0.164***	0.229***	0.218***	0.228***
	(0.020)	(0.018)	(0.017)	(0.019)	(0.018)
Togo	0.205***	0.248***	0.265***	0.232***	0.273***
	(0.019)	(0.018)	(0.017)	(0.018)	(0.017)
Tunisia	0.692***	0.662***	0.748***	0.693***	0.711***
	(0.015)	(0.015)	(0.013)	(0.014)	(0.014)
Zimbabwe	0.389***	0.444***	0.443***	0.372***	0.434***
	(0.018)	(0.016)	(0.015)	(0.017)	(0.015)
Constant	0.011	0.117***	-0.181***	-0.114***	-0.120***
	(0.015)	(0.016)	(0.016)	(0.016)	(0.019)
Sample size	23591	23591	23591	23572	23572
R2	0.153	0.19	0.214	0.176	0.226

Appendix III

Regression results with various cutoffs for the outcome variable

IPW least squares regressions by country-level factors and school policy indicators (outcome variable cutoff at 80%)

Variable	Model1	Model2	Model3	Model4	Model5
GDPP	0.027***		0.028***	0.031***	0.046***
	(0.002)		(0.002)	(0.002)	(0.002)
GEXE	0.003***	0.006***		0.006***	0.019***
	(0.001)	(0.001)		(0.001)	(0.001)
PTR	-0.001***	-0.003***	-0.002***		0.003***
	(0.000)	(0.000)	(0.000)		(0.000)
SNE	0.009***	0.011***	0.010***	0.009***	
	(0.000)	(0.000)	(0.000)	(0.000)	
Constant	-0.374	-0.358***	-0.358***	-0.406***	0.005
	(0.025)	(0.025)	(0.025)	(0.023)	(0.022)
Sample size	23591	23591	23591	23591	23591
R2	0.122	0.113	0.121	0.121	0.081

Note: GDPP: GDP per capita (adjusted by purchasing power parity); GEXE: Government Expenditure in Education (as percentage of GDP per capita); SNE: School Net Enrolment; PTR: Pupil-Teacher Ratio

IPW least squares regressions by country-level factors and school policy indicators (outcome variable cutoff at 90%)

Variable	Model1	Model2	Model3	Model4	Model5
GDPP	0.028***		0.030***	0.032***	0.042***
	(0.002)		(0.002)	(0.002)	(0.002)
GEXE	0.004***	0.007***		0.007***	0.015***
	(0.001)	(0.001)		(0.001)	(0.001)
PTR	-0.001***	-0.003***	-0.002***		0.002***
	(0.000)	(0.000)	(0.000)		(0.000)
SNE	0.007***	0.008***	0.007***	0.006***	

	(0.000)	(0.000)	(0.000)	(0.000)	
Constant	-0.262***	-0.244***	-0.242***	-0.293***	0.004
	(0.023)	(0.023)	(0.022)	(0.020)	(0.020)
Sample size	23591	23591	23591	23591	23591
R2	0.096	0.085	0.095	0.095	0.074

Note: GDPP: GDP per capita (adjusted by purchasing power parity); GEXE: Government Expenditure in Education (as percentage of GDP per capita); SNE: School Net Enrolment; PTR: Pupil-Teacher Ratio

IPW least squares regressions by micro-level factors (outcome variable cutoff at 80%)

	Model1	Model2	Model3	Model4	Model5
Disability status (base category: non-disabled)					
Vision disability	0.112**				0.103**
	(0.038)				(0.039)
Hearing disability	-0.117*				-0.075
	(0.053)				(0.051)
Physical disability	0.009				0.048
	(0.041)				(0.042)
Intellectual disability	-0.156***				-0.154***
	(0.017)				(0.016)
Multiple disabilities	-0.180**				-0.138*
	(0.056)				(0.056)
Location (base category: urban)		-0.211***			-0.103***
		(0.009)			(0.010)
Wealth index (base category=Poorest)					
Second quintile			0.055***		0.037***
			(0.011)		(0.010)
Middle			0.114***		0.077***
			(0.011)		(0.011)
Fourth quintile			0.203***		0.137***
			(0.011)		(0.012)
Richest			0.356***		0.251***
			(0.011)		(0.013)
Highest Educational level in the household (base category=No school)					
Primary				0.128***	0.110***
				(0.009)	(0.008)
Junior secondary				0.230***	0.127***
				(0.010)	(0.010)
Senior secondary or higher				0.194***	0.083***
				(0.011)	(0.011)
Gender (Base category: Boys)	0.044***	0.042***	0.039***	0.045***	0.037***
	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)
Age (Base category=10)					
age11	0.077***	0.068***	0.069***	0.071***	0.067***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
age12	0.121***	0.117***	0.118***	0.123***	0.117***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
age13	0.187***	0.183***	0.184***	0.189***	0.183***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
age14	0.235***	0.228***	0.223***	0.234***	0.222***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Constant	0.293***	0.435***	0.153***	0.152***	0.189***
	(0.012)	(0.013)	(0.013)	(0.013)	(0.017)
Sample size	23591	23591	23591	23572	23572
R2	0.034	0.07	0.092	0.056	0.111

IPW least squares regressions by micro-level factors (outcome variable cutoff at 90%)

	Model1	Model2	Model3	Model4	Model5
Disability status (base category: non-disabled)					
Vision disability	0.086*				0.077*
	(0.039)				(0.039)
Hearing disability	-0.109*				-0.072
	(0.048)				(0.047)
Physical disability	0.014				0.05
	(0.040)				(0.041)
Intellectual disability	-0.140***				-0.139***
	(0.015)				(0.015)
Multiple disabilities	-0.154**				-0.117*
	(0.050)				(0.051)

Location (base category: urban)		-0.205***			-0.110***
		(0.009)			(0.010)
Wealth index (base category=Poorest)					
Second quintile			0.052***		0.035***
			(0.009)		(0.009)
Middle			0.100***		0.063***
			(0.010)		(0.010)
Fourth quintile			0.178***		0.109***
			(0.010)		(0.011)
Richest			0.323***		0.209***
			(0.011)		(0.013)
Highest Educational level in the household (base category=No school)					
Primary				0.095***	0.081***
				(0.008)	(0.008)
Junior secondary				0.214***	0.123***
				(0.010)	(0.010)
Senior secondary or higher				0.179***	0.081***
				(0.011)	(0.011)
Gender (Base category: Boys)	0.039***	0.036***	0.034***	0.039***	0.032***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Age (Base category=10)					
age11	0.067***	0.059***	0.060***	0.061***	0.057***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
age12	0.096***	0.092***	0.094***	0.097***	0.092***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
age13	0.149***	0.144***	0.145***	0.149***	0.144***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
age14	0.189***	0.182***	0.178***	0.188***	0.178***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Constant	0.208***	0.347***	0.084***	0.088***	0.138***
	(0.011)	(0.013)	(0.012)	(0.012)	(0.016)
Sample size	23591	23591	23591	23572	23572
R2	0.025	0.062	0.076	0.047	0.095

IPW least squares regressions with interaction terms (outcome variable cutoff at 85%, 80%, and 90%)

	Interaction terms with micro-level factors			Interaction terms with country dummies		
Cut point	0.85	0.8	0.9	0.85	0.8	0.9
Disabled (base category: non-disabled)	-0.249***	-0.268***	-0.249***	-0.087*	-0.097**	-0.052
	(0.045)	(0.047)	(0.040)	(0.034)	(0.034)	(0.033)
Location (base category: urban)	-0.117***	-0.114***	-0.103***	-0.114***	-0.112***	-0.099***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Disabled # Location						
Disabled # Rural	0.055	0.054	0.092**			
	(0.035)	(0.035)	(0.032)			
Wealth index (base category=Poorest)						
Middle	0.081***	0.081***	0.076***	0.081***	0.082***	0.075***
	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)
Richest	0.232***	0.238***	0.218***	0.232***	0.240***	0.219***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Disabled # Wealth Index						
Disabled#Middle	0.000	0.02	-0.003			
	(0.034)	(0.035)	(0.031)			
Disabled#Richest	0.01	0.039	0.013			
	(0.057)	(0.056)	(0.053)			
Highest educational level in the household (base category=No school)						
Primary	0.034***	0.032***	0.024**	0.038***	0.036***	0.026**
	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.008)
Junior secondary	0.109***	0.105***	0.092***	0.110***	0.106***	0.093***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)
Senior secondary or higher	0.096***	0.095***	0.084***	0.099***	0.097***	0.087***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Disabled # Highest Education level in the household						
Disabled#1	0.094**	0.086*	0.058			
	(0.036)	(0.037)	(0.031)			
Disabled#2	0.049	0.056	0.041			
	(0.039)	(0.041)	(0.034)			
Disabled#3	0.073	0.048	0.098*			
	(0.050)	(0.051)	(0.046)			
Age (Base category=10)						

age11	0.064***	0.063***	0.054***	0.063***	0.063***	0.053***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
age12	0.111***	0.116***	0.092***	0.111***	0.116***	0.092***
	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.008)
age13	0.162***	0.172***	0.136***	0.162***	0.171***	0.135***
	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.008)
age14	0.206***	0.217***	0.174***	0.206***	0.217***	0.174***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
Gender (Base category: Boys)	0.036***	0.036***	0.032***	0.036***	0.036***	0.033***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Country						
Chad	0.065***	0.070***	0.068***	0.069***	0.074***	0.074***
	(0.017)	(0.017)	(0.015)	(0.017)	(0.018)	(0.016)
DRCongo	0.043**	0.053***	0.037**	0.046**	0.056***	0.042**
	(0.014)	(0.014)	(0.013)	(0.015)	(0.015)	(0.014)
Ghana	0.315***	0.332***	0.268***	0.320***	0.336***	0.273***
	(0.015)	(0.015)	(0.014)	(0.016)	(0.016)	(0.014)
Lesotho	0.466***	0.487***	0.360***	0.470***	0.491***	0.363***
	(0.017)	(0.017)	(0.017)	(0.018)	(0.017)	(0.018)
Madagascar	0.388***	0.431***	0.304***	0.390***	0.432***	0.307***
	(0.016)	(0.016)	(0.015)	(0.017)	(0.016)	(0.016)
Malawi	0.379***	0.413***	0.289***	0.383***	0.417***	0.295***
	(0.014)	(0.015)	(0.014)	(0.015)	(0.015)	(0.014)
The Gambia	0.221***	0.231***	0.187***	0.229***	0.237***	0.195***
	(0.018)	(0.018)	(0.016)	(0.018)	(0.019)	(0.017)
Togo	0.270***	0.280***	0.208***	0.278***	0.288***	0.217***
	(0.017)	(0.017)	(0.015)	(0.018)	(0.018)	(0.016)
Tunisia	0.698***	0.723***	0.636***	0.705***	0.729***	0.648***
	(0.014)	(0.014)	(0.015)	(0.014)	(0.014)	(0.015)
Zimbabwe	0.427***	0.424***	0.414***	0.433***	0.429***	0.424***
	(0.015)	(0.015)	(0.015)	(0.016)	(0.016)	(0.016)
Disabled # Country						
Chad				-0.03	-0.037	-0.086
				(0.055)	(0.055)	(0.050)
DRCongo				0.014	0.005	-0.02
				(0.049)	(0.050)	(0.044)
Ghana				-0.075	-0.069	-0.085*
				(0.045)	(0.046)	(0.043)
Lesotho				-0.066	-0.059	-0.012
				(0.080)	(0.083)	(0.077)
Madagascar				-0.031	-0.015	-0.037
				(0.051)	(0.052)	(0.048)
Malawi				-0.06	-0.072	-0.09
				(0.050)	(0.049)	(0.048)
The Gambia				-0.165*	-0.132	-0.133
				(0.074)	(0.073)	(0.072)
Togo				-0.127*	-0.126*	-0.132**
				(0.052)	(0.055)	(0.047)
Tunisia				-0.112	-0.096	-0.257**
				(0.077)	(0.071)	(0.084)
Zimbabwe				-0.085	-0.069	-0.157**
				(0.061)	(0.057)	(0.057)
_cons	-0.097***	-0.093***	-0.100***	-0.105***	-0.101***	-0.110***
	(0.019)	(0.019)	(0.018)	(0.019)	(0.019)	(0.018)
Sample size	23572	23572	23572	23572	23572	23572
R2	0.222	0.233	0.19	0.222	0.233	0.19

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[1] There are 28 countries classified as low-income countries by the World Bank, with 2021 GNI per capita of up to $1,085

[2] All the countries with available data for PISA assessment and education expenditure per secondary school around year 2010.

[3] the OECD's Programme for International Student Assessment

[4] He estimated school participation gap associated with disability, based on survey data from 14 household surveys in 13 developing countries between 1992 and 2004.

[5] They assessed disability gap in school enrolment in both primary and secondary education, based on nationally representative household surveys and census conducted in 15 low- and middle-income countries between 2005 and 2013.

[6] They examined disability inequalities related to education, employment and multidimensional poverty across countries 40 countries with different development levels in Asia, Europe, Africa, Latin America, and Middle East between 2009 and 2018

[7] Detailed information is provided in section 2.4 in the survey report for each country.

[8] Five functional domains for behavioural and psychological disabilities: accepting change, controlling behaviour, making friends, anxiety, and depression, are not included since their prevalence rates across the countries vary greatly. It might indicate a large disparity in interpreting these functional domains in the local context. We classify vision disability as severe difficulty (cannot at all or a lot of difficulty) in vision even with glasses or contact lenses, hearing disability as severe difficulty in hearing even with a hearing aid, physical disability as severe difficulty in self-care or walking 500 meters on level ground without equipment or assistance, and intellectual disability as severe difficulties in communication, learning, remembering, or concentrating on activities that the child enjoys doing. Finally, those who reported more than one co-occurring severe functional difficulty are categorized as having multiple disabilities.

[9] MICS survey reading tests mainly use same text with primary official teaching languages in these countries, which are English in The Gambia, Ghana, Lesotho, Malawi, and Zimbabwe; French in Central African Republic, Chad, DRCongo, Madagascar, Togo, and Tunisia. The story is same across all countries but total number of words vary depending on the language used.

[10] The threshold at 0.9 might be little bit too strict, because if the child did not answer one of the questions correctly, the child will have to read all the words 100% correctly, or the child has to answer all the 5 questions correctly.

[11] In Malawi and Zimbabwe, some children whose main teaching language is local language only did a reading test for local language.

[12] Note that IPW cannot adjust the bias if the bias is related with other characteristics that we do not have information on.

[13] The outputs for the first stage of selection model are presented in Appendix I.

[14] It is essential to note that a $1000 increase in GDP per capita represents a substantial change, especially when considering that the GDP per capita of the lowest-income countries in our sample, such as Central Africa R. and DRCongo, is below $1000. Even for the country with the highest GDP per capita in our sample, Tunisia, a $1000 increase represents approximately 10% of its GDP per capita.

[15] As a robustness check, we conduct the same regressions while including country fixed effects. The outcomes from both sets of models, with and without country fixed effects, are quite similar. The detailed results can be found in appendix II.

[16] The coefficient for multiple disabled children become insignificant when more control variables included. The sample size for multiple disabled children is quite limited due to the very low school attendance in this group of children, which may lead to high standard error.