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WORKING PAPER

Inform: Using available data to optimize education investments in Africa

Synthesis of UNICEF Innocenti research on education in Africa

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UNICEF INNOCENTI – GLOBAL OFFICE OF RESEARCH AND FORESIGHT

Contents

Executive summary

Across Africa, ministries of education have made significant advances in broadening children's access to schooling. Education continues to be a high priority for governments across the continent. Of the 41 African countries that submitted a National Statement of Commitment at the Transforming Education Summit, 93 per cent committed to increasing domestic financing for education – a significantly higher proportion than the rest of the world (66 per cent).

To support governments with evidence-based insights to maximize the impact of increased investment, the results presented here synthesize research led by UNICEF Innocenti – Global Office of Research and Foresight together with UNICEF country offices and ministries of education in 33 countries. The significance of this synthesis is underpinned by the scale of its underlying research sources: UNICEF's Data Must Speak, Teachers for All and Time to Teach programmes rely on ministry-owned data from over 167,000 schools, supplemented by field research with over 5,500 teachers, across the continent.

This evidence synthesis is organized around three core investment and policy streams in education: workforce, curriculum and infrastructure. Transforming education systems in Africa necessitates these areas to work coherently in support of common goals. Each policy area plays an important role.

The education **workforce** takes up most of the education spending in the continent, and 85 per cent of African countries mentioned teachers in their national statements of commitment to Sustainable Development Goal 4 (SDG 4). Within this policy area, the key findings from UNICEF Innocenti research are as follows:

- The size of teaching groups in included countries has a consistently negative relationship with student outcomes, but the high cost of recruiting and deploying new teachers suggests that addressing the inequitable deployment of existing teachers between and within schools can be a more efficient starting point to support student learning.

- Teacher training should be of sufficient duration, intensity and relevance, and should come with ongoing support opportunities. In most countries, some form of professional training or academic qualification was associated with better student outcomes, while other qualifications – often of lesser duration – did not have an effect.

- Strong teacher management systems – particularly in terms of enabling timely salary payments, clear expectations for progression and monitoring for accountability and to create positive performance-based incentives – matter more than professional status and can explain the differing influence of employment types on outcomes.

- While students appear to benefit from being taught by same-gender teachers, many girls across the continent are missing out on this opportunity, particularly in rural areas.

Curriculum and pedagogy are front of mind among African governments, with all participating countries referring to this policy area in their national statements of commitment. Within this policy area, the key findings from UNICEF Innocenti research are as follows:

- Lesson time has some of the strongest relationship with education outcomes – more contact hours and fewer student absences were associated with better learning outcomes, while double shifts were associated with significantly lower promotion rates.

- Policies to support local language instruction can reduce the challenges faced by the mismatch between students' mother tongue and the official language of instruction. The availability of sufficient textbooks (and teacher guides) was consistently found to be associated with better student outcomes, but they need to be accessible to students – written in a language students read and stored where students can get to them.

- Multigrade classes can be a positive policy option for smaller communities and can support differentiation by student learning levels, if teachers are sufficiently supported.

Infrastructure is a significant component of public education expenditure globally. Although most governments in Africa spend less than 10 per cent of education budgets on capital items, education infrastructure is a key component of the Continental Education Strategy for Africa. Within this policy area, the key findings from UNICEF Innocenti research are as follows:

- While smaller distances to school are associated with better outcomes, new school construction is costly and can be time-consuming. Interventions to ease and support safer commutes to school should be considered in the shorter term.

- Capacity expansion – to create more space as well as to support effective teaching and learning approaches – could be considered as an alternative to constructing new schools. This could address overcrowding and improve access to schooling in a more cost-efficient manner.

Facility upgrades can help ameliorate the effect of adverse weather on school attendance and instruction quality. The availability of electricity, WASH facilities, libraries and canteens also support the creation of safe learning environments that attract and keep students and teachers in school.

The specific policies that would make the biggest difference would vary by country, informed among other factors by the local contexts, the policies and programmes already in place, and where the biggest gaps in resourcing exist. Overall, however, this synthesis shows that education policy decisions should be geared towards the goal of maximizing the quantity and quality of pedagogical experiences for all students. Specifically:

- **Maximizing instructional time:** This can be supported by setting clear and high expectations for minimum instruction hours within curricular standards, reducing reliance on double-shift systems, managing student and teacher absences, and providing safe and supportive learning environments.

- **Improving pedagogical quality:** This can be supported by providing teacher training pathways of sufficient duration, intensity and relevance, with ongoing support, strengthening teacher accountability and monitoring systems, and providing accessible teaching, learning materials and learning spaces that can enable effective good pedagogical practices.

- **Prioritizing equitable outcomes for all students:** This can be supported by, among other things, enabling mother tongue instruction, addressing rural school disadvantages – particularly in relation to access to electricity – and providing gender-responsive school environments and facilities, which may also help reduce the significant gap in female teachers.

Finally, findings across multiple policy areas highlight the importance of implementation and monitoring in achieving system transformation. These topics will be covered in more depth in subsequent papers of this series.[1]

Introduction

By the middle of this century, Africa will be home to a billion children and adolescents under 18 years of age, or almost 40 per cent of all children and adolescents worldwide.[1] This number of children and young people represents a powerful source of growth and progress in Africa. It also indicates the expected scale of growth in the demand for schooling and learning that the continent's education systems must prepare for.

Analysis of education spending by UNICEF and the African Union Commission found that COVID-19 caused a large drop in education expenditure across Africa.[2] The report called on African Union Member States to recommit to making education a budget priority, prioritizing several key actions, including: strengthening the credibility and execution of education budgets, especially for capital items, investing more in strengthening the education workforce and enhancing transparency, accountability and public participation in planning, budgeting and transforming the education system.

Governments across the continent have made public their intention to increase and improve spending on education. Of the 41 African countries that submitted a National Statement of Commitment at the Transforming Education Summit, analysis by UNESCO[3] found that 93 per cent committed to increasing financing for education – a significantly higher proportion than the rest of the world (66 per cent).

This working paper is part of a series synthesizing findings on research led by UNICEF Innocenti – Global Office of Research and Foresight (UNICEF Innocenti) in Africa. The education unit at UNICEF Innocenti has published 50 reports covering 33 African countries between 2019 and 2024,[4] in close collaboration with partner ministries of education as well as UNICEF country offices and regional offices. Most of the research considered in this working paper uses Education Management Information Systems (EMIS) datasets collected and owned by ministries of education, which covers the entirety of the respective countries' education systems.

The focus of this paper is on Investing for Outcomes. It synthesizes the findings of the research that relate to three main areas of education spending: the workforce, curriculum/pedagogy and infrastructure/facilities.

1 All papers in this series can be found here: https://www.unicef.org/innocenti/projects/education-africa

The figures presented in this paper are largely based on data from five UNICEF Innocenti research programmes:

Data Must Speak (DMS) positive deviance research: DMS has so far published reports on 11 sub-Saharan African countries and territories based on the programme's Stage 1 activities, which harmonized administrative data with learning outcomes data to identify the factors associated with school performance, and 16 reports from Stage 3 activities which examined the factors that distinguish positive deviant schools.

Longitudinal Assessment of School Dropout (ALDE/Mozambique): Where relevant and comparable, data from the Longitudinal Assessment of School Dropout (Avaliação Longitudinal da Desistência Escolar/ALDE) in Mozambique are also included. The ALDE is based on nationally representative data from around 5,400 primary school students in 60 schools across the country.

Teachers for All (T4A): This research initiative aims to generate robust evidence on teacher deployment. It is currently implemented in 13 African countries. Data analysis from ten countries – including five that were not part of the DMS group of countries – had been completed by the time of this paper's writing and are included here.

Time to Teach (TTT): This research programme surveyed over 5,500 teachers across 21 countries and territories in Africa to identify the factors associated with teacher attendance. It is predicated on the idea that teachers' presence and engagement is a prerequisite to learning within school.

Women in Learning Leadership (WiLL): The research stream of this joint initiative of UNICEF Innocenti with the UNESCO International Institute for Educational Planning (IIEP) in Dakar and the Gender at the Center Initiative seeks to examine the evidence on the role of female head teachers and the adoption of good school leadership practices.

Over 180 regression models with a total of almost 5,000 variables, based on data from over 167,000-schools across 15 countries, were used to examine the relationship between key areas of public expenditure in education to understand their relationship with outcomes. *See Box 1* for an explanation of how to interpret the relationships presented in this paper and an overview of the statistical methodology to estimate them.

Most of the UNICEF Innocenti research data cited were focused on primary schools, except for: Ghana (where only lower secondary schools were included), and Mali and Togo (where data from both primary and secondary schools were included). Data from secondary schools are denoted in the figures and significant differences between primary and secondary schools are referred to in text.

UNICEF Innocenti research programmes are co-created with partner governments. In most of the projects, the factors and outcomes of interest – as well as the schools included – were selected with local partners and chiefly intended support national priorities rather than cross-country purposes. Best efforts were made to make them comparable with each other for the purpose of this paper, and exceptions are noted throughout.

Box 1: Interpreting the relationship between resources and outcomes

This paper reports the relationship between different school resourcing factors with two main types of outcomes. These outcome measures were selected for this paper as they were the most used across the research, and by governments in monitoring their progress: learning outcomes (in the form of standardized assessment or examination scores) and promotion rates as a measure of student progression and system efficiency (where there is no automatic promotion system in place).

Regression models are used to estimate the extent of the relationship between several explanatory variables with an outcome variable of interest. A regression coefficient refers to the variation in average scores between groups of students that differ on one unit of the factor of interest, while holding the value of other factors included in the regression model constant. In other words, it shows how much of a change is expected in the outcome (e.g., average mathematics score or promotion rate) when one unit of the resource of interest is changed). It is important to note that these coefficient sizes do not assume cause and effect, but merely describes the strength of the association between the two.

The control variables used vary by country but were chosen to account for the context and other resourcing levels schools are operating in as precisely as possible, based on the available data. This includes a measure of the student-teacher ratio, school location, and the presence of specific facilities.

As countries have different examination scoring scales, the strength of the relationships between resources and learning outcomes are reported here as a proportion of a standard deviation. This shows the size of magnitude of an association compared with typical variations in scores. Based on a review of education intervention studies, Kraft[5] proposed updated benchmarks that an effect size with a standard deviation (SD) of less than 0.05 is small, 0.05 SD to (and less than) 0.20 SD is medium, and 0.20 SD or greater is large. Similarly, Evans and Yuan[6] found a median effect size of 0.10 SD across 130 education studies in low- and middle-income countries that reported on learning outcomes, with an effect size of 0.38 SD falling into the 90th percentile. These serve as useful benchmarks for interpreting the strength of the relationships reported in this paper.

In most countries, the analyses also looked at differences by groups of students, such as between boys and girls, or between students in urban, rural and remote areas. Where significant differences were observed, they are discussed through the paper and summarized in dedicated sections (*see Box 2*: Spotlight on student gender and *Box 3*: Spotlight on rural schools).

Workforce

The education workforce is a high priority among African Union Member States. African countries invest around 90 per cent of their budgets on current items, largely consisting of salaries.[7] Within African countries' national statements of commitment to SDG 4, 85 per cent mentioned teachers.[8] All included commitments to design and improve pedagogical training and continuous professional development. Also frequently mentioned were commitments to improve teacher working conditions (49 per cent), and teacher supply and deployment (46 per cent), while teacher certification and qualification were less frequently discussed (24 per cent).

The *Transforming Education in Africa* report highlighted a pressing need for qualified teachers in the region, recommending that teacher training be prioritized to include pedagogical skills and digital skills for learner-centred, inclusive quality education.[9] These align with the UN Secretary-General's recent statement that it is time to make sure that teachers have the support, recognition and resources they need to provide relevant, high-quality education and skills for all.[10]

Key findings: Workforce

- Larger student-teacher ratios are associated with worse student outcomes, but while this relationship is consistently found across studies the size of the relationship is usually very small.

- Teachers are often also inequitably distributed within schools, with more teachers and higher proportions of qualified, permanent, and male teachers being found in later grades compared with early grades. Addressing shortages in the early years can be one of the most cost-efficient policies to improve student outcomes.

- As teachers are inequitably distributed between schools, redeploying existing teachers to areas of greatest shortage can be a more cost-effective approach to addressing inequalities in student outcomes that are driven by inequitable access to teachers.

- Some form of professional training or academic qualification was associated with better student outcomes in most country contexts. However, not all forms of qualification had this relationship with outcomes, which appear to be due to differences in training duration, intensity, and relevance.

- Teacher employment status has a mixed relationship with student outcomes, with differences more likely to be driven by accountability and incentive structures across different contexts.

- Students appear to benefit from being taught by same-gender teachers, particularly in primary school. However, many girls across countries will miss out on the opportunity to have female teachers, particularly in rural areas.

- Having strong systems in place to monitor how teachers are being trained, deployed and supported – key to increasing the efficiency of instruction – can enable governments to ensure that investments in the workforce are achieving their intended outcomes. The role of implementation and monitoring will be discussed further in Paper 3 of this series.

Figure 1: Relationship between student-teacher ratio on learning

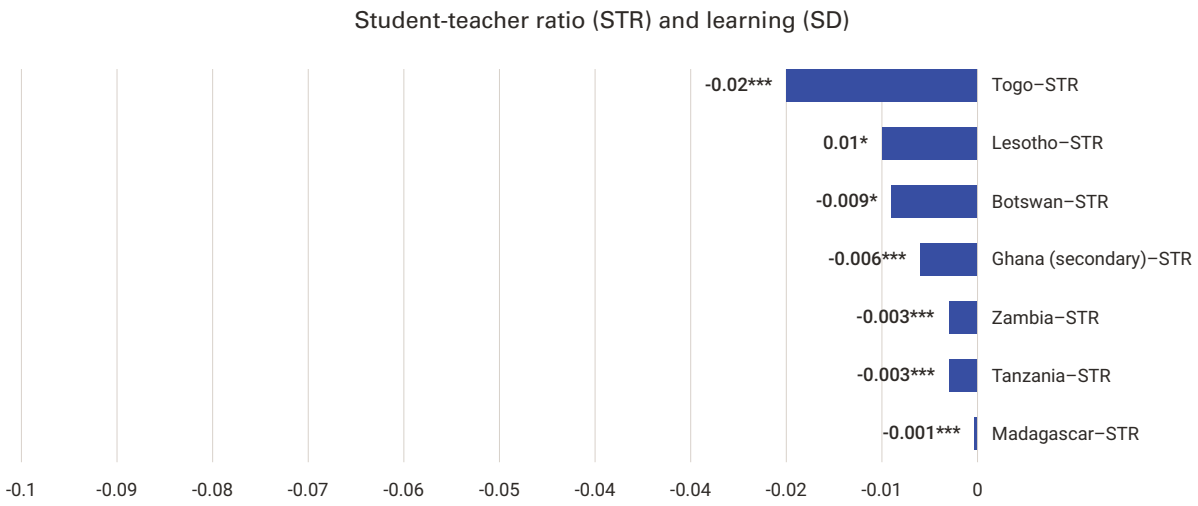


Figure 2: Relationship between teacher qualifications on learning outcomes

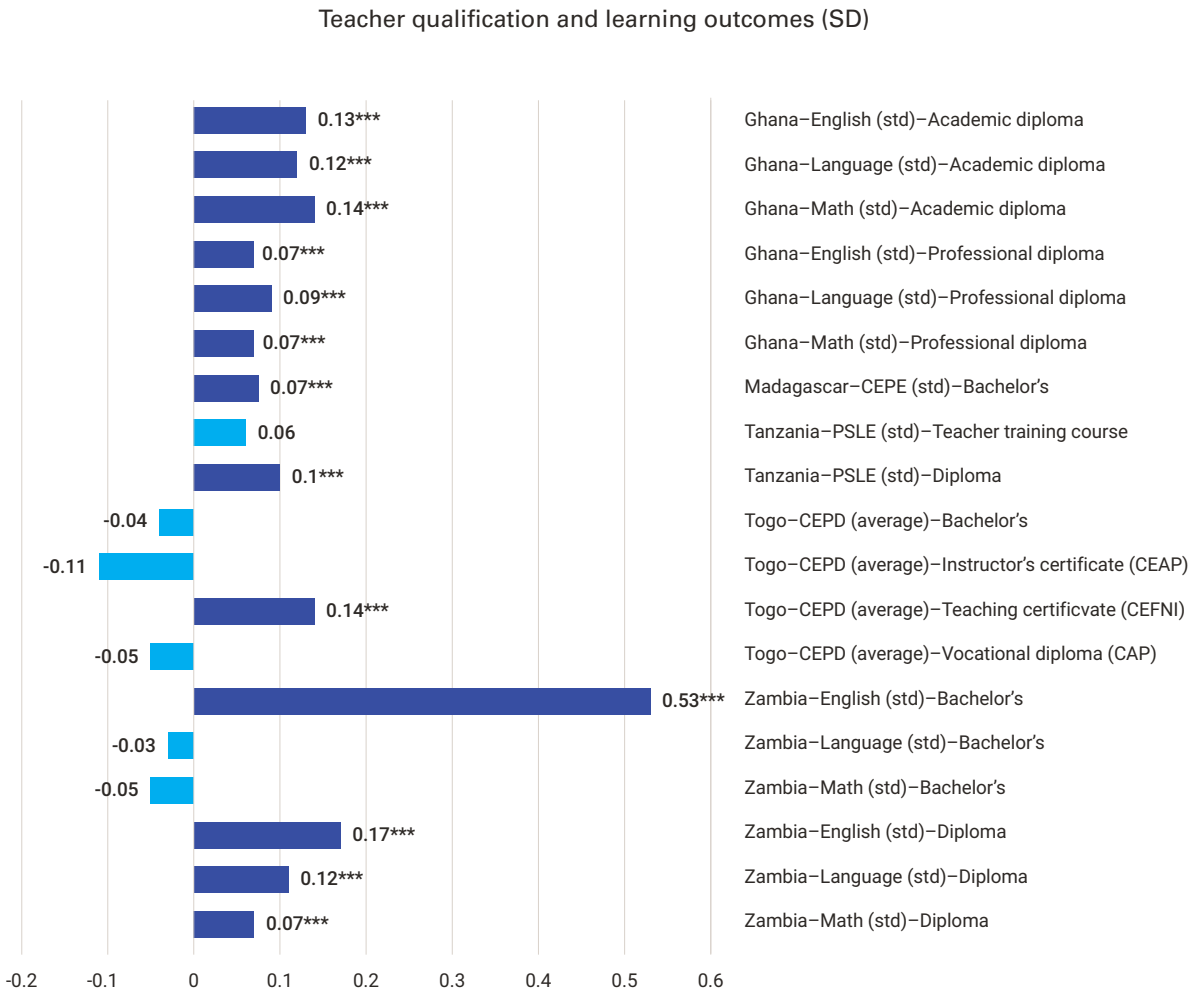
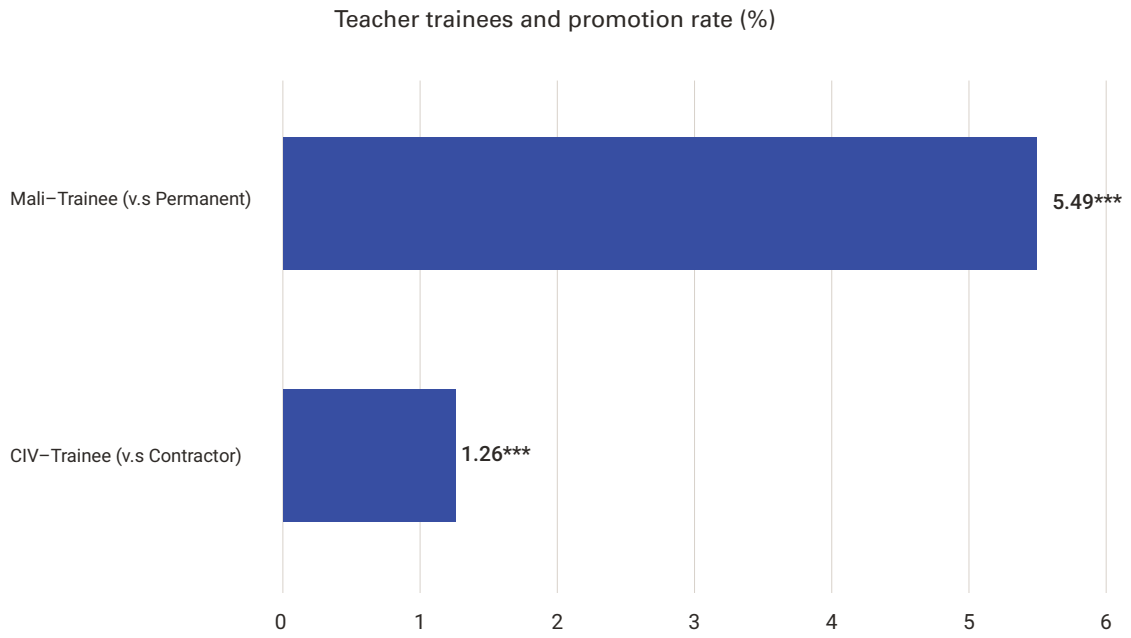


Figure 3: Relationship between teacher trainees on promotions



Source: EMIS and learning outcomes data analysed as part of Data Must Speak and Teachers for All Stage 1 reports. Links to reports provided in Annex 1. Values reported refer to the difference of average scores between groups of students that differ on one unit of the factor of interest, while holding the value of other factors included in the regression model constant (see Box 1).

Student-teacher ratio is consistently but weakly linked to outcomes

On average, there are 37 primary school students per teacher in Africa.[11] The size of teaching groups[12] based on country EMIS data vary significantly between and within countries, with greater variation in countries with larger ratios (*see Table A2*). In Côte d'Ivoire, Niger and Togo, there were an average of 44 students per teacher (regardless of qualification), while in Chad, Mali, Tanzania and Zambia, there were 60 or more student per teaching group on average.

Teaching group size (class size or student-teacher ratio) is negatively associated with learning and progression (*see Figure 1*). This relationship is consistently observed across different locations, school sectors and subject areas. In most countries, however, the magnitude of the relationship is very small, ranging from 0.0001 to 0.02 standard deviations (SD) on examination scores or between 0.001 and 0.006 percentage points on promotion rates for each additional student. In some instances, the association becomes smaller with larger teaching groups.

Teaching group size can influence education outcomes through teacher behaviours, including their attendance at school and in the classroom, and their engagement in teaching and learning. A high student-teacher ratio can increase teachers' classroom preparation workload, and teachers who report having too many classroom preparation tasks were 1.8 times more likely to report frequent reduced instruction time in West and Central Africa and 1.5 times in Eastern and Southern Africa.[13] High student-teacher ratio can also lead to higher administrative workloads, which more than doubled reported classroom absences across the region.[14]

The overall weakness of the relationship between teaching group size and student outcomes, however, suggests that it is not enough to improve learning and efficiency. This is also consistent with analyses of regional assessments such as the Program for the Analysis of Educational Systems of the CONFEMEN (PASEC) and Southern and Eastern Africa Consortium for Monitoring Educational Quality (SAQMEC), which found an insignificant relationship with class sizes below 60 students per teacher.[15] Rather, manageable teaching group sizes should be considered an enabling condition to effective teaching and learning.

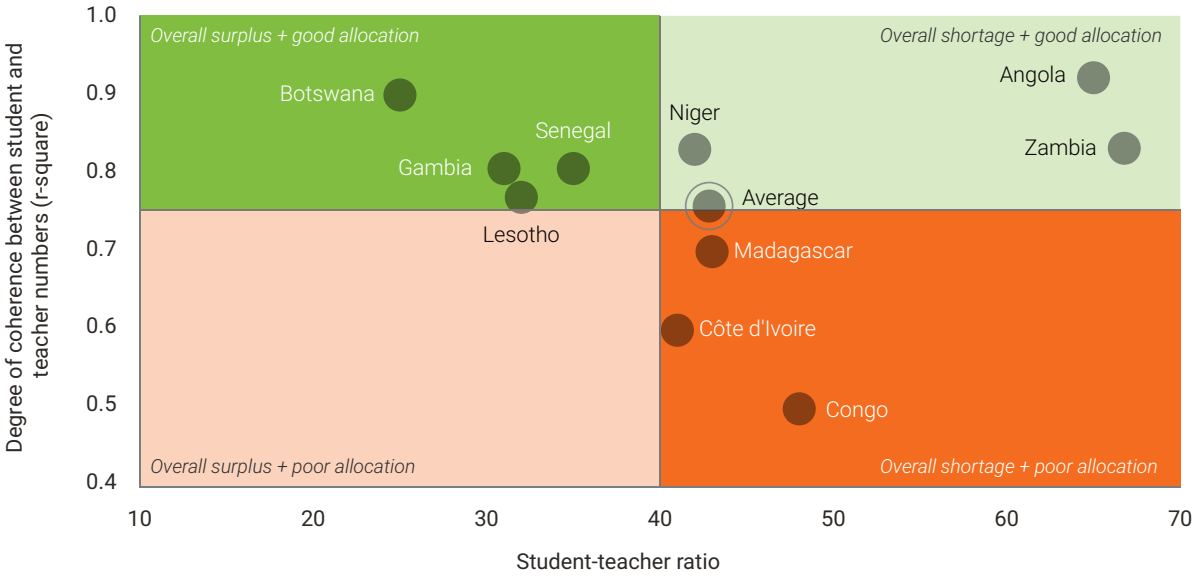
One mechanism to demonstrate how class sizes indirectly affect learning is by influencing how teachers adjust instruction to meet the needs of different students. Rigorous reviews of impact evaluation evidence from Africa has found that the greatest learning impacts come from programmes that focus on improving pedagogy or classroom instructional techniques – particularly to meet student ability levels – which have the greatest impact on learning outcomes.[16] The most evidence exists for structured pedagogy support that combine teaching and learning materials with ongoing teacher training and support, and for targeting teaching instruction to student learning level rather than grade level.[17] Large class sizes, however, have been found to impede teachers' ability to differentiate instruction.[18]

Equitable teacher deployment, including within districts and within schools, can help address localized shortages

The small size of the relationship between teaching group sizes and student outcomes can be partially influenced by increasing teacher numbers. Across the continent, governments have made concerted efforts to recruit teachers to meet the demands of increased enrolments. There was, for example, a 50 per cent increase in the number of primary teachers between 2011 and 2021 (based on 25 African Union countries with data for both years).[19] UNICEF's Teachers for All research is finding that national ratios often mask the inequitable distribution of teachers between and within districts. In addition to ensuring there are sufficient teachers for the number of students, therefore, it is also important that teachers are deployed where they are needed.

The coefficient of coherence is one way of measuring how well teachers are distributed across schools, based on need. It ranges from 0 to 1, with 1 demonstrating a perfect correlation between the number of teachers and the number of students in schools, and 0 reflecting completely random allocation. Some countries with high national student-teacher ratios also have a low degree of coherence, indicating that teachers are poorly allocated within the national system. Based on analyses of national EMIS data, Congo, Côte d'Ivoire and Madagascar fall into this category (*see Figure 4*). In these instances, what appears to be an overall national teacher shortage may at least be partially addressed by more equitable teacher deployment.

Figure 4: Student-teacher ratio and degree of coherence in teacher distribution



Source: EMIS data analysed in Teachers for All Stage 1 reports. Reference lines are based on Global Partnership for Education benchmarks.

These national figures show that teachers are not equitably deployed between schools, and that they are frequently also inequitably deployed within schools. This uneven deployment means that frequent localized teacher shortages and surpluses are masked by the overall student-teacher ratio and degree of coherence numbers, implying that while some schools benefit from small class sizes, others struggle with large class sizes and difficult learning conditions. For example, a third of districts in Zambia require additional teachers while another one-third of districts have more teachers than they require to meet the target ratio of students to teachers.[20] The variation of student-teacher ratios within districts is even greater – almost double the size of the variation between districts. Moving teachers to the most overcrowded districts and schools can improve overall student-teacher ratios more efficiently than hiring new teachers.

In some contexts, urban schools face larger class sizes. Among countries with available data in this research, this was the case, for example, in Botswana, Côte d'Ivoire, Lesotho, Mali and Niger (*see Table A2*). More rapid population growth in urban areas have placed increased pressure on schools. Despite lower STRs in rural areas, however, teacher shortages tend to be more pronounced, such as in Chad, Tanzania and Zambia. In many instances this reflects the difficulty of recruiting teachers to rural and remote areas due to the challenges of working and living in these settings.

Governments have made efforts to address these challenges to incentivize and support relocation to hard-to-staff schools or areas. In Madagascar, the Ministry of Education established an allowance based on distance, to compensate teachers who take up a position in rural areas, and allocated newly recruited teachers to rural and understaffed areas.[21] However, due to the scattering of many small schools and an insufficiently developed road network, rural and isolated areas remain particularly deprived.

A systematic review found that most programmes that offer financial incentives to teachers were able to increase teacher placement or reduce turnover in hard-to-staff schools.[22] In the Gambia and Zambia, rural hardship allowances which increased salaries by 20–40 per cent were able to increase the number of teachers in target areas and in some instances also the length of their tenure.[23] The review noted that financial incentive programmes are subject to the limitations of the administrative system, with teachers in Tanzania, South Africa, Ghana and Zambia reporting delays to payment, which reduced the effectiveness of such programmes.

Finally, teachers are also inequitably distributed within schools. Evidence from the ongoing Teachers for All research shows that school leaders in Africa tend to allocate more and better-qualified teachers to higher grades. The gap in class size between first and last primary school grades is consistent across partner countries. This ranges from substantial differences across the primary cycle in Madagascar where the student-teacher ratio falls from 49:1 in the first grade to 17:1 in the last grade of primary, to Botswana, where the gap is smaller (32:1 compared with 28:1). Teachers in the earlier primary grades are also less likely to be permanently employed and less likely to be qualified.

The focus on allocating more – and better-qualified – teachers to higher grades is often done with the intention of boosting school performance in high-stakes national examinations. Students who fail to acquire foundational skills in the early grades, however, will be unable to engage with more advanced curricula as they progress through the education cycle. Focusing resources away from the early years can therefore worsen teaching and learning challenges and widen inequities. The importance of education in the early years will be discussed in more detail in Paper 2 of this series.

Effective teachers, regardless of status, need strong training, support and accountability

In almost all countries, some form of higher academic qualification or professional training levels were associated with either higher levels of student learning outcomes or progression through the school system. The typical association between teacher qualifications and learning outcomes is moderate. A percentage point increase in diploma-qualified teachers is associated with a 0.07–0.17 SD increase in performance in Zambia, 0.12–0.14 SD in Ghana and 0.1 SD in Tanzania (*see Figure 2*). The relationship between higher teaching qualifications and learning outcomes was more consistent, compared with its relationship with promotion rates. This may be partly explained by the more objective nature of learning outcome measures. Promotion decisions often rely on teacher judgement, which could be influenced by their training.

Requirements to be a teacher, regarding the minimum level of academic qualification and types of teacher training, vary by country. In the process of developing internationally comparable teacher training indicators, the UNESCO Institute of Statistics[24] observed that in most countries, becoming a teacher requires at least a short-cycle tertiary education programme following upper-secondary education (ISCED 5) to teach in primary schools. In all the included countries, the proportion of trained and qualified teachers[25] vary considerably (*see Table A2*). For example, while 88 per cent of teachers in Ghana hold a professional diploma, only 51 per cent of teachers in Zambia do. In most countries schools in urban areas have a higher proportion of qualified teachers than rural schools.

Not all forms of academic qualifications and professional training were associated with improved outcomes. In Togo, the teaching certificate awarded by dedicated teacher training institutions were associated with higher learning outcomes. However, students who were taught by teachers with a general bachelor's degree or with certifications or diplomas awarded only through examinations did not perform better than students whose teachers hold no qualification. Similarly, in Chad, holding a more intensive teacher training qualification – either a two-year teacher training institution certificate or training programme for community teachers – is associated with increased learning outcomes, but not the shorter-term training (45 days) for community teacher progression. These within-country differences in relationship indicate that the content, duration and rigour of teacher training matter.

Teachers' qualifications can influence students' learning through different pathways. In a more direct path, teachers learn subject and pedagogical skills which they utilize in the classroom. Data from PASEC found that teachers' knowledge and skills in francophone sub-Saharan Africa vary according to their qualification level.[26] The EMIS data reviewed in this paper also largely supports this direct pathway, in that teacher qualifications are more closely linked to test-based measures of student learning than with promotion that are subject to teacher judgement.

Education and training levels may also influence learning indirectly, through teacher attitudes and behaviours. For example, in Eastern and Southern Africa, absenteeism rates differed according to the highest level of education a teacher has received.[27] Interview data suggest that lack of specific pedagogical skills – such as engaging appropriately with learners, classroom management, time management, and developing effective schemes of work – affects teacher classroom attendance and time on task. In Western and Central Africa, when teachers feel confident about their knowledge and skills, they were 2.6 times less likely to be absent from the classroom.[28] Teachers who believe their colleagues have the knowledge and skills to teach well were also less likely to be unpunctual and to be absent from the classroom. The content of teacher training course, therefore, matters as much as the qualifications themselves.

While none of the EMIS data shared with UNICEF Innocenti researchers monitored teachers' participation in professional development or in-service training, it is important to acknowledge that this form of training is crucial in improving the knowledge and skills of the existing teacher workforce. Previous studies into the components that make teacher training effective support the findings from UNICEF Innocenti studies concluding that how teacher qualifications are earned is what matters, and can shed more light onto the design considerations of such training.[29]

UNESCO and the Teacher Task Force[30] estimated that 15 million additional teachers are needed to achieve universal primary and secondary education by 2030 in sub-Saharan Africa alone. While efforts to train new teachers continue, countries across the continent employ various strategies to address their more immediate teacher shortages, including the engagement of contract teachers, volunteers, teachers paid by communities and untrained teachers. Several countries are looking to move away from reliance on non-permanent teachers. In Madagascar and Togo, the Ministry of Education is seeking to integrate community teachers into public service.[31] In some countries, while the use of community or volunteer teachers are no longer sanctioned, in practice schools still rely on them to meet shortages.

The relationship between para-professional teaching status and student outcomes is mixed. In some countries, for some subjects, UNICEF Innocenti research found that having a higher proportion of non-

permanent or non-civil service teachers has a negative association with learning and efficiency, while in other contexts they have a positive association, without a clear trend to explain these differences (*see Table A3*).

While to some extent this could be due to the difficulty of disentangling the relationship between status and qualification, these mixed results also capture the complexity of the accountability and incentive structures behind different forms of teacher contracts. Some ministries may have a stronger mechanism to monitor and support permanent or civil service teachers than others. Similarly, in some contexts, communities may be more able and motivated to monitor and support the teachers they have recruited.

For example, in Eastern and Southern Africa, teacher absenteeism was significantly higher among volunteer teachers than civil service or contracted teachers.[32] Across the region, volunteer teachers were paid less than their civil service counterparts and were less likely to receive their salary on time. In Guinea-Bissau, however, where delayed salary payments and frequent teacher strikes were driving low teacher attendance rates, some public schools transitioned to become self-managed schools, where the local communities raise money to supplement teacher salaries and provide financial incentives, thus strengthening the community's involvement in monitoring teachers. In this context, teachers in self-managed schools were significantly less likely to report all forms of absenteeism than their public or private school colleagues.[33]

The importance of monitoring and accountability is also supported by other studies. A review of reviews into education interventions in low- and middle-income countries found that boosting teacher accountability – through performance incentives or contract teachers – have among the largest impacts on student outcomes.[34] In one experimental study in Kenya, for example, hiring contract teachers improved outcomes only for students who were assigned to the contract teachers and not those who remained with civil service teachers,[35] whereas in another study contract teachers only had a positive impact when managed by an NGO but not by the government. This was partly explained by differences in monitoring and implementation.[36] These topics will be discussed further in Paper 3.

An emerging finding from UNICEF Innocenti research is on the positive influence of teacher trainees, who are enrolled in initial teacher education programmes. While only Côte d'Ivoire and Mali collected data on trainees in their EMIS, in both countries they have a significant and positive relationship with promotions (*see Figure 3*). This may at least be partly due to the role of teacher judgement in promotion decisions in some contexts. Another possible explanation, however, is the greater accountability and monitoring trainees are subject to. In both countries, some evidence suggests that trainees have a positive relationship with outcomes in contexts where they have more access to experienced teachers who can provide them with guidance. In Côte d'Ivoire, the relationship between the proportion of trainees and promotions are significant in public schools (which have lower student-teacher ratios and a lower proportion of trainee teachers than private schools). In Mali, trainee teachers have a positive relationship with promotion rates in public and private schools, but not in community and madrasa schools where there are fewer qualified teachers. When teacher trainees have better access to ongoing support, they are likely to have a positive influence on students, in addition to contributing to a higher quality future teaching workforce.

Students can benefit from having teachers of the same gender, but girls in rural areas are missing out on this opportunity

Across several countries, teacher gender has a significant association with educational outcomes. EMIS data showed that boys and girls benefit from being taught by a teacher of the same gender in Chad, Côte d'Ivoire, Mali and Togo (*see Table A3*). The difference of magnitude in the relationship between teacher gender (having a female teacher) and learning outcomes for girls and boys is greater than 0.15 SD in Côte d'Ivoire, Niger and Zambia. At the secondary level in Togo, having a female teacher has a large and significantly positive relationship with learning outcomes for girls and boys, although in Ghana and Mali the association is negative for girls and boys (with smaller magnitudes).

These findings from UNICEF Innocenti research are consistent with the existing evidence linking teacher gender to student outcomes, which in many cases found that girls performed better when their teacher is a woman. Jieun Lee and colleagues[37] found a positive effect on mathematics and reading test scores of female teachers for primary school girls in 10 French-speaking African countries. In other low- and middle-income countries outside the continent, other studies have also found that female students have greater aspirations and higher performance when assigned to female teachers.[38]

While the data suggest that boys and girls can benefit from the experience of being taught by a teacher of the same gender at the primary level, not all children are afforded this opportunity. Across the continent, there are approximately equal numbers of female and male teachers, but this gender makeup varies significantly between countries. The proportion of female teachers in primary schools ranges from 19 per cent in Togo to 88 per cent in the Seychelles. This figure varies by region and by income level, with 40 per cent of teachers among low-income countries in the region being women, compared with 52 per cent in lower middle income countries and 66 per cent among upper middle income countries (all based on the latest available figures from.[39] Where the teacher gender gap is high, girls may lose out on the chance to have a female role model outside the home. In Togo, for example, 52.6 per cent of students attend a lower secondary school with no female teachers.[40]

The differences within countries are also significant. Female teachers are much more likely to be found in urban areas. In the partner countries with sufficiently disaggregated EMIS data, the proportion of female teachers in urban areas is double that in rural areas (46 vs 22 per cent respectively) (*see Table A3*). Similarly, the proportion of female head teachers was three times larger in urban than in rural areas (25 vs 8 per cent respectively). These large urban–rural gaps can be due to a range of reasons, from the difficulty for married female teachers to relocate their spouse and family to rural areas, to challenges in settling in rural areas where a lack of security and the more conservative attitudes of the local population might be a barrier for women.

In the aforementioned systematic review on recruiting teachers for hard-to-staff schools, it was found that financial incentives which were effective in increasing the overall number of teachers did not result in the recruitment female teachers.[41] A study in Ghana reported that female teachers preferred other incentives such as study leave with pay, expedited promotion and the provision of housing over a rural incentive allowance,[42] while in Kenya, female teachers reported support for both provision of housing and hardship allowance.[43]

The association between female head teachers and outcomes in some countries are similar to the ones for female teachers, with smaller magnitudes. Being enrolled in a school led by a female head teacher has a positive relationship with overall promotion rates in primary schools in Côte d'Ivoire, Madagascar, Mali, and Togo, but negative relationship in secondary schools in Mali and Togo (*see Table A3*). There is a strong same-gender effect in primary schools on promotion rates in Mali and on learning outcomes in Togo and Niger. In secondary schools, however, the relationship between of female head teachers and outcomes is negative in Mali and Togo.

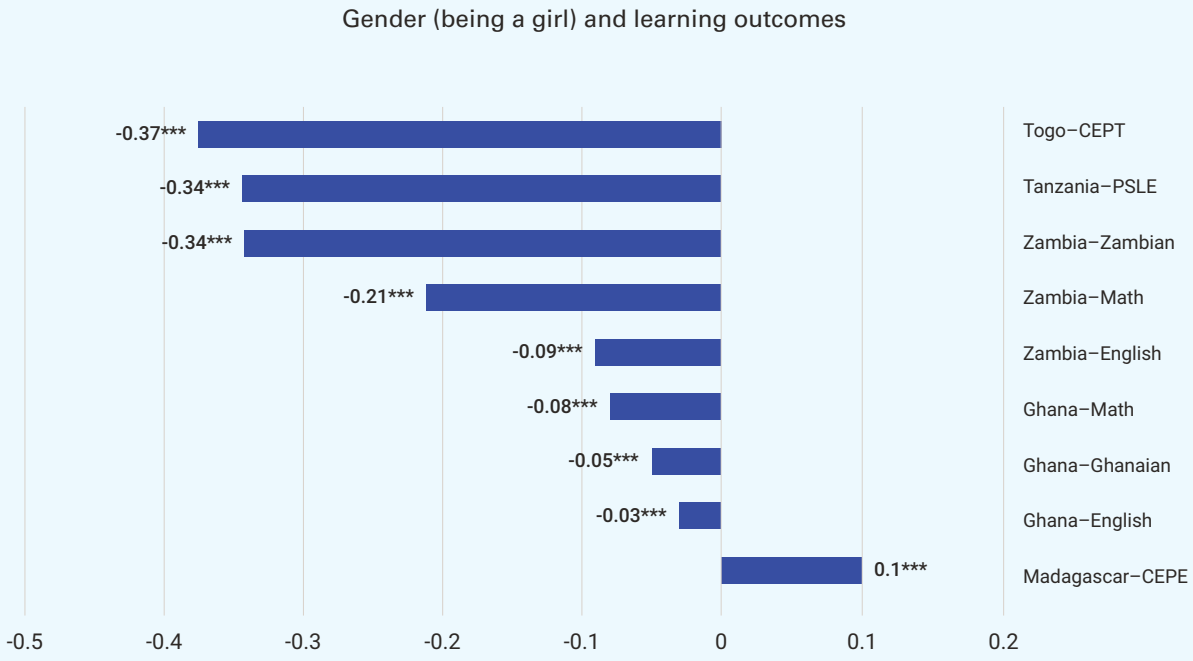
Examining the complexity of the influence of female head teachers on children's education is an emerging research area currently being led by UNICEF Innocenti and UNESCO under the WiLL partnership. Early evidence suggests that female head teachers may adopt a range of effective practices and behaviours that could contribute to improved outcomes.[44] Time to Teach studies also found that female school leaders are more likely than male school leaders to actively encourage teacher attendance and use sensitization strategies to make teachers aware of how their attendance affects student outcomes.[45] Analysis of PASEC data undertaken as part of the WiLL initiative found that in some countries, female-led schools are more likely to hold meetings with parents and offer support classes to pupils.[46]

It is notable that in every country the proportion of head teachers who are female is smaller than the proportion of teachers who are female (*see Table A3*). This shows a glass-ceiling effect for female teachers who are not nominated to be female directors as often as male teachers. In most countries and contexts, this glass ceiling is low: EMIS data showed that the proportion of female directors is less than half of the proportion of female teachers. For example, half of all primary teachers in Niger are female, but only 15 per cent of head teachers are. The gap is also considerably larger in rural areas: 9 per cent of rural primary head teachers in Niger are female, compared with 37 per cent of rural teachers, and less than 5 per cent of rural primary head teachers in Chad and Côte d'Ivoire are female. The challenges of increasing female representation among the school leadership workforce is another focus area of the WiLL initiative.

Box 2: Spotlight on student gender

Learning outcomes were worse for girls in almost all partner countries with data available at the time of writing (*see Figure 5*). The size of this gender difference is large in some contexts – greater than 0.3 SD in Tanzania, Togo and Zambia. In Ghana the relationship is smaller while in Madagascar it is reversed, with the same increase being associated with 0.1 SD higher scores on average.

Figure 5: Relationship between gender (being a girl) and learning outcomes



The relationship between gender and promotion rates is more mixed. In Chad, Mali and Togo girls experienced lower promotion rates, while in Côte d'Ivoire and Tanzania the reverse is true. One possible explanation for this distinction is the role of teacher judgement in promotion decisions, including teachers' perceptions of students' behaviours and maturity, which may be influenced by gender. Another explanation is that gender composition influences boys and girls differently.

This paper shows that several school inputs influence boys and girls differently. These provide some policy directions to address the continent's gender gap in learning: recruiting more female teachers and head teachers – particularly to rural schools – and providing safe learning environments in and on the way to/from school, including canteens and WASH facilities. Furthermore, the next paper in this series will discuss the potential of early childhood education in tackling gender inequities and successes in providing targeted supports to the most vulnerable girls.

Curriculum

In their SDG 4 national statements, almost all African countries (98 per cent) made commitments about teaching and learning content and methods.[47] The most frequently discussed topics included curricular content (61 per cent) and pedagogical approaches (51 per cent). This priority aligns with the available evidence. A review of rigorous studies in Africa found that pedagogical interventions including mother tongue interventions hold promising impacts on learning.[48] Data from the few African countries with comparable spending data on teaching and learning materials, however, show that only 4.4 per cent of the education budget was spent on this, comparing unfavourably against the 6.5 per cent spent on average by countries outside the continent.[49]

Key findings: Curriculum

- Multiple data points suggest that increasing and protecting lesson time is likely to produce the highest improvements in student outcomes: more contact hours and higher student attendance were associated with better learning outcomes, while double shifts were found to be associated with lower promotion rates. These were the largest associations seen across different factors reported here.

- A mismatch between students' mother tongue and the language of instruction is frequently reported as causing a challenge in students' ability to comprehend lessons and teachers' ability to meet students at their level. Few countries monitor this systematically but where data were available, policies to support mother tongue instruction were associated with higher promotion rates.

- The availability of sufficient textbooks (and teacher guides) was consistently found to be associated with better student outcomes. This is consistent with other observational studies, but experimental study results point to the importance of ensuring that textbooks are accessible to students.

- Multigrade classes often result in larger class sizes, but it was difficult to disentangle the effects of multigrade and large classes. Where this was possible, it showed that multigrade classes can lead to better students outcomes than very large classes (mono or multigrade. Multigrade classes can therefore be a policy option for small communities if teachers, schools and communities are sufficiently prepared.

Figure 6: **Relationship between double shifts and promotion rates**

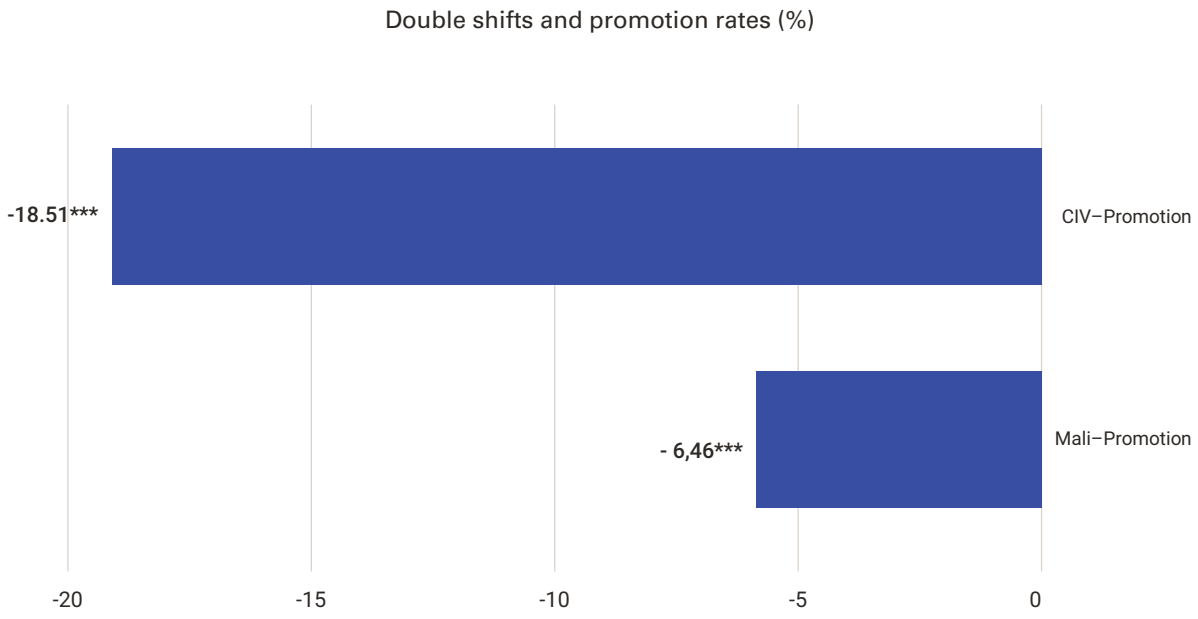


Figure 7: **Relationship between mother tongue policies and promotion rates**

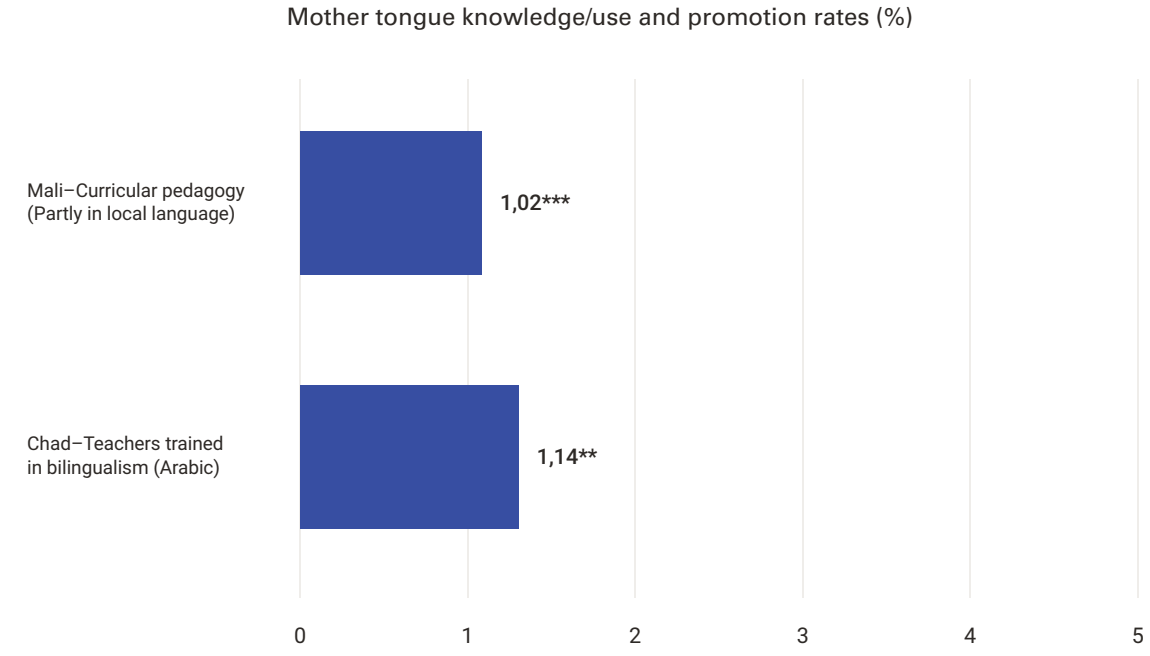


Figure 8: Relationship between a 1:1 textbook-to-student ratio and outcomes

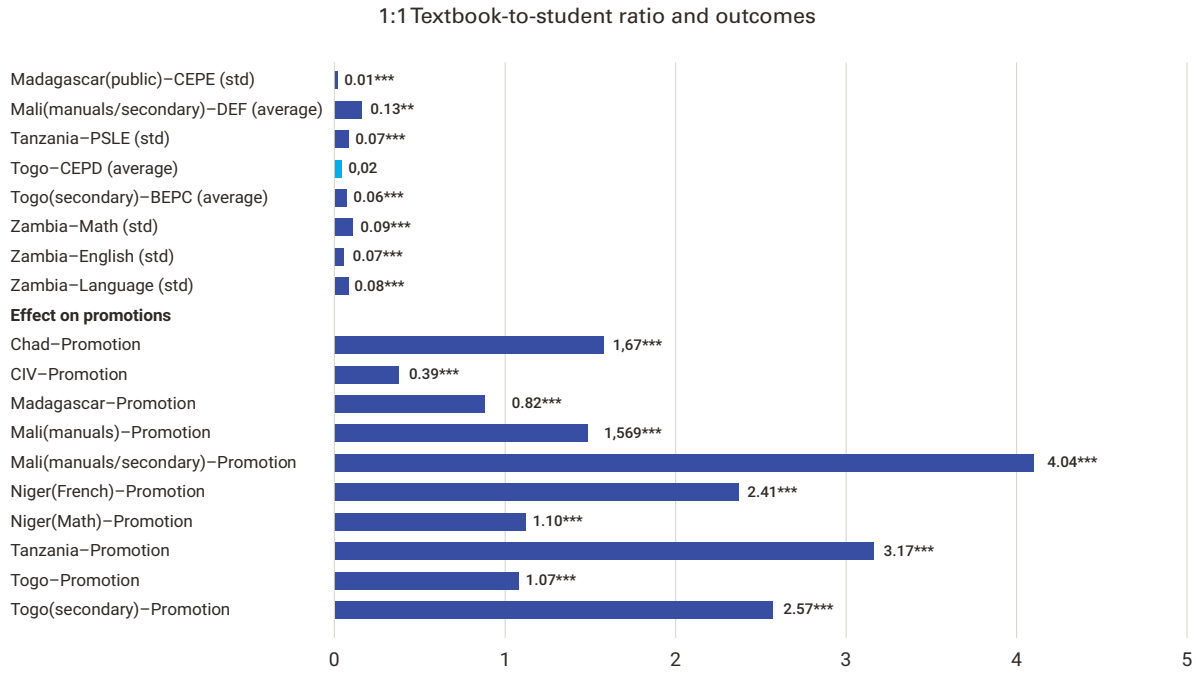
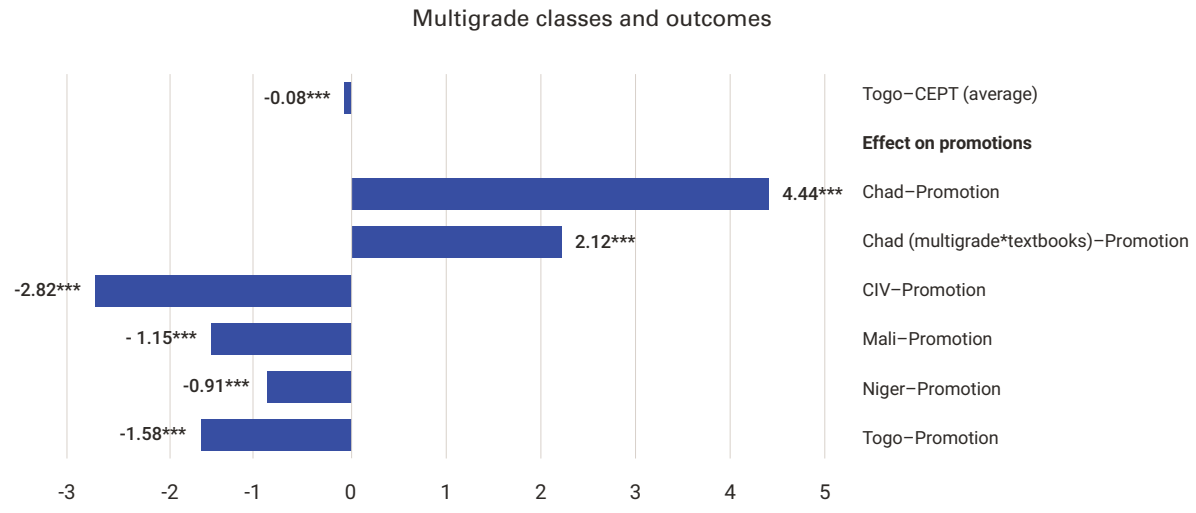


Figure 9: Relationship between multigrade classes on outcomes



Source(6-9): EMIS and learning outcomes data analysed as part of Data Must Speak and Teachers for All Stage 1 reports. Links to reports provided in Annex 1. Values reported refer to the difference of average scores between groups of students (see Box 1).

The amount of instructional time students receive consistently influences outcomes

Several findings from UNICEF Innocenti studies highlight the importance of instructional time. In Zambia, an additional contact hour per day was associated with 0.008–0.01 SD learning outcomes across subjects.[50] Higher student attendance was also associated with better outcomes in Ghana,[51] and in Mozambique, higher student attendance was associated with lower dropout rates.[52]

One policy decision that can significantly reduce total learning time for individual students is the use of double shifts. Around 4–5 per cent of students were sharing double-shift classrooms in Côte d'Ivoire and Mali, two countries that tracked this prevalence in their EMIS. The practice was more commonly found in urban areas and in public schools. In both countries, being in a double-shift classroom had a significant and large negative relationship with promotion rates. In Mali, students in double-shift classrooms had a 6.5 percentage point lower promotion rate than those in single shift, while in Côte d'Ivoire this difference is 18.5 percentage points (*see Figure 6*). The direction of this relationship is consistent across different school types and locations, but largest among urban schools in Côte d'Ivoire and private schools in Mali. Earlier analyses of regional assessment programme data from SAQMEC and PASEC also revealed negative effects of double-shift teaching, which was only partly explained by the selection of poor performers in double-shift classes,[53] although analysis of more recent – PASEC 2014 – data found that it does not play a significant role.[54]

Despite these findings, double shifts play a significant role in extending access to school for more children in some contexts while minimizing budget implications.[55] Several policy options have been proposed to mitigate the potential negative influence that the double-shift model can have on student learning, largely focusing on making up for the reduced instructional time. They include designing overlapping shifts, increasing the number of school days per year, increasing out-of-school learning through homework, assignments, good textbooks and parental guidance, and using extra rooms in schools or the community for remediation.[56]

Qualitative research findings from UNICEF Innocenti studies further support the importance of protecting instructional time. In Madagascar, Togo and Zambia, positive deviant schools were found to be more systematic in ensuring that actual learning time is respected by using different strategies to ensure that teachers and students are present in school and in the classroom.[57] In Zambia, teachers in positive deviant schools place greater importance on ensuring every student is learning than on adhering to the pace of curriculum. In Madagascar, principals of the positive model schools reported more frequent measures to make up for lost hours, and more schools reported that students do not have to self-manage in the absence of a teacher.

Another enabler of instructional time relates to teachers' attendance and engagement in the classroom. In Eastern and Southern Africa, 18 per cent of surveyed teachers reported reduced time on task while in the classroom occurring at least once a week,[58] while in West and Central Africa, the corresponding regional average is 15 per cent.[59] Health, monitoring by the head teacher and the availability of sufficient teaching and learning materials were factors frequently associated with teachers' time on task in the classroom.[60]

Mother tongue instruction policies are associated with better outcomes, especially where they are needed most

Few countries were monitoring the languages of instruction used at the school level through EMIS. Where data were available, the use of students' mother tongues was associated with better outcomes. The effect appears to be concentrated in schools where the need may be greatest. In Chad and Mali, students with teachers who use – or are able to use – students' mother tongue have around 1 percentage point higher promotion rates nationally (*see Figure 7*), with the relationship being stronger among non-public schools. In Mali, this relationship is also stronger in remote schools (1.9 percentage points). These differences are likely to be at least partly explained by the concentration of students within these groupings who do not speak the official language of instruction and are most likely to benefit from policies that encourage mother tongue use.

These findings were supported by qualitative interviews and observations from Madagascar and Togo. In Madagascar, teachers were more likely to be observed using positive pedagogical practices (presenting lesson objectives, providing clear instructions, asking questions, encouraging students to help each other, explaining the vocabulary they are using, and making connections to everyday life) when they spoke Malagasy compared with those who were using French as the language of instruction.[61] Similarly, in Togo, teachers in positive deviant schools indicated that they more consistently used the local language to explain to students what they did not understand, by translating the unclear word or concept.[62] These schools were also found to have better communication between teachers and parents of students.

Even when the policy on language of instruction has changed, teachers often report that they still feel underprepared to teach in the children's mother tongues. Analysis commissioned by the UNICEF Eastern and Southern Regional Office found that most national language policies in the region support the use of local languages in early primary grades, but classroom practices do not generally conform to these policies.[63] Communication challenges in the classroom was more recently reported by teachers who participated in the Time to Teach studies in the Comoros, the Gambia, Mauritania and Rwanda, who perceived that they have received insufficient language training and ongoing support.[64] Survey data from the Eastern and Southern Africa region also illustrated the link between language mismatch and learning challenges, with teachers who cited language of instruction as a reason for absence being almost 1.5 times more likely to also report that their students frequently struggled to follow the content of lessons than those who did not view this as a reason.[65]

The findings here are consistent with a review of impact evaluations from Africa, which found that mother tongue instruction consistently provides learning gains, improving reading ability in the native language as well as children's ability to subsequently learn a second language.[66]

Sufficient textbooks and learning materials matter, but they need to be used

Where countries monitor textbooks and learning materials in national datasets, the data indicate that textbook availability is not yet universal. For example, around two to three learners share a mathematics textbook in Zambia, Chad and Côte d'Ivoire (*see Table A2*). Inequitable distribution of

textbooks is also an issue. In Côte d'Ivoire, for example, students attending urban public schools were 22 per cent more likely to have a mathematics textbook than those attending rural public schools.[67] In Chad, the province of Tibesti has one mathematics textbook for over 20 students while Mayo-Kebbi Oest province has one mathematics textbooks for three students.[68] The disparity of distribution of an already limited number of textbooks puts some schools behind in terms of resources.

The availability of textbooks is consistently associated with outcomes (*see Figure 8*), with the coefficient of the relationship falling between 0.01 and 0.09 SD for learning outcomes, and between 0.4 and 3.2 percentage points for promotion rates. In Mali and Togo, the influence of textbooks is greater in secondary schools than in primary schools. These results are consistent with earlier studies that found a positive correlation between textbook availability and student outcomes.[69] It is not enough to just make textbooks available; they also need to be accessible to students. Limited impact of textbook provision found in earlier experimental studies could be attributable to the textbooks being inaccessible. In Kenya, for example, providing textbooks increased results only for the best students,[70] but the books were written in English and most students were unable to read them. Meanwhile, in Sierra Leone, textbooks improved outcomes only for students with high socioeconomic status,[71] which the authors attributed to many of the schools in the study storing books rather than distributing them to students. Studies have also found that the availability of textbooks can complement teacher-based incentives. In Uganda and in Tanzania, a teacher performance pay programme found no impact on learning in schools that had no textbooks, but significant positive impacts in schools with textbooks.[72]

In Zambia, where the availability of teacher guides is monitored within EMIS, they were also found to be positively correlated with student outcomes.[73] There were approximately five teachers per resource book on average, with the ratio being higher among rural schools. A higher resource book to teacher ratio was associated with higher mathematics outcomes (0.03 SD nationally), although this relationship was not significant for English or Zambian language. This aligns with a recent study in 13 countries, including 8 in Africa, which found that the use of teachers' guides led to significant impacts on learning outcomes, associated with approximately half a year's worth of learning.[74] These guides can be simple, providing specific guidance to teachers without the need for word-for-word scripted lessons, as overly scripted guides were found to be somewhat less effective.

Several strategies can address systematic challenges in the provision of teaching/learning materials. They include reducing textbook costs by shifting non-core materials to teacher guides (a potential saving of approximately 12.5 per cent in paper and printing), reducing waste in printing and distribution, or producing textbook management and storage guidelines for schools to extend their lifespan and use.[75] Stronger evaluation processes can also better align textbooks with curricular guidelines and the language used in schools. Finally, incentives to use textbooks can increase their impact. A recent experiment in the Democratic Republic of Congo found that providing a mix of financial and non-financial incentives (including simple star charts for taking and returning textbooks) for using textbooks for home study significantly improved national examination outcomes.[76] This supports UNICEF Innocenti findings from Côte d'Ivoire and Niger that the receipt of school kits, which usually contain notebooks and pencils and other learning materials for children, was associated with higher promotion rates (0.3–1.4 percentage points).

Multigrade classes can have positive outcomes with sufficient resources and support for teachers

Multigrade teaching largely arises through necessity, often in areas of low population density or population decline.[77] Among included countries, multigrade classes were predominantly found in rural areas, and more commonly among community schools (*see Table A2*). Their prevalence varies across the region, with very few schools in Togo and Zambia, and 30 per cent of students in Chad being in schools that have multigrade classes.

A teacher in a multigrade class is responsible for teaching children from at least two grades within one class. The total number of students in these two teaching groups make up the resulting larger class size. Owing to the way data are captured in Togo, Mali, Niger and Côte d'Ivoire, it was not possible to disentangle the influence of being in a multigrade class and the effect of being a larger class size. In all cases except for in Côte d'Ivoire (for promotion rates), the coefficient associated with being in a multigrade class is smaller than the potential negative influence of doubling the size of the teaching group. This suggests that, for a given number of students, organizing a multigrade class made up of two smaller groups leads to better outcomes than one large class teaching a monograde group. In Chad, where the data did allow for measuring the total combined class size, the relationship between multigrade classes and outcomes was positive. Children in schools with multigrade classes had 4.4 percentage point higher promotion rates, and this relationship is even stronger in schools that had more textbooks per student (*see Figure 9*).

One possible explanation is that the by having distinct groups of students supported by different curricular materials, having multigrade classes can support teachers in differentiating their teaching, with the association being strongest when compared with the challenges of teaching many students the same material in one class. This is supported by a recent qualitative study of multigrade pre-primary classes in Kenya, which found that all teachers differentiated instruction to some extent.[78] The authors concluded that grade-based differentiation can allow teachers to feel comfortable with the idea of ability-based differentiation, which was considered by teachers to be unfair and detrimental to the sense of classroom togetherness in another study in Tanzania.[79]

Finally, a review based on experiences in three sub-Saharan African countries also concluded that multigrade teaching is a promising policy option for small communities, but that its effective implementation is dependent on schools, teachers and communities being sufficiently prepared.[80] Teachers require training, sufficient learning materials, and the buy-in and support from parents and communities to successfully deliver effective teaching in a multigrade environment.

Infrastructure

Several priorities expressed by African governments in their national statements of commitment to SDG 4 are dependent on the availability and conditions of certain school infrastructure and facilities. These include commitments to digital learning (expressed by 80 per cent of African governments), connectivity (59 per cent) and school meals (27 per cent).[81] Most governments, however, were investing extremely limited resources on infrastructure, with only 14 of the 40 countries with recent

data spending at least 10 per cent of their education budgets on capital items.[82] Budget credibility and execution were frequently a challenge – approved budgets were frequently not transformed into improved infrastructure or commitment, and poor planning, late disbursements, weak procurement and project management causing low budget execution.

Key findings: Infrastructure

- Greater distance between students' homes and school is associated with worse outcomes, particularly for girls, although in some countries this disparity is driven by urban–rural differences. School construction, however, is costly, and the proliferation of smaller schools can mean that they are unable to offer all grades, a structure that is also associated with worse outcomes. These implications should be carefully considered prior to new school construction.

- Having sufficient student seats and desk space for students is associated with better outcomes, with similar magnitudes to the relationship between reduced distance to school and outcomes. Upgrading school infrastructure and facilities to expand classroom capacity is therefore another cost-effective investment option to accommodate more students and create spaces that are more conducive to learning.

- Better classroom conditions are associated with better outcomes, but the magnitudes are very small. Beyond the influence on student outcomes, however, another consideration for maintenance of school infrastructure conditions is for its effect on system resilience, for the role that classroom conditions can play in mitigating the adverse effects of weather conditions.

- The availability of electricity, WASH facilities, libraries and canteens were frequently associated with better outcomes. The influence of better facilities on outcomes can be attributed to their role in creating safe learning environments that encourages students to spend more time at school and attract more qualified teachers.

Figure 10: Relationship between distance to school and learning

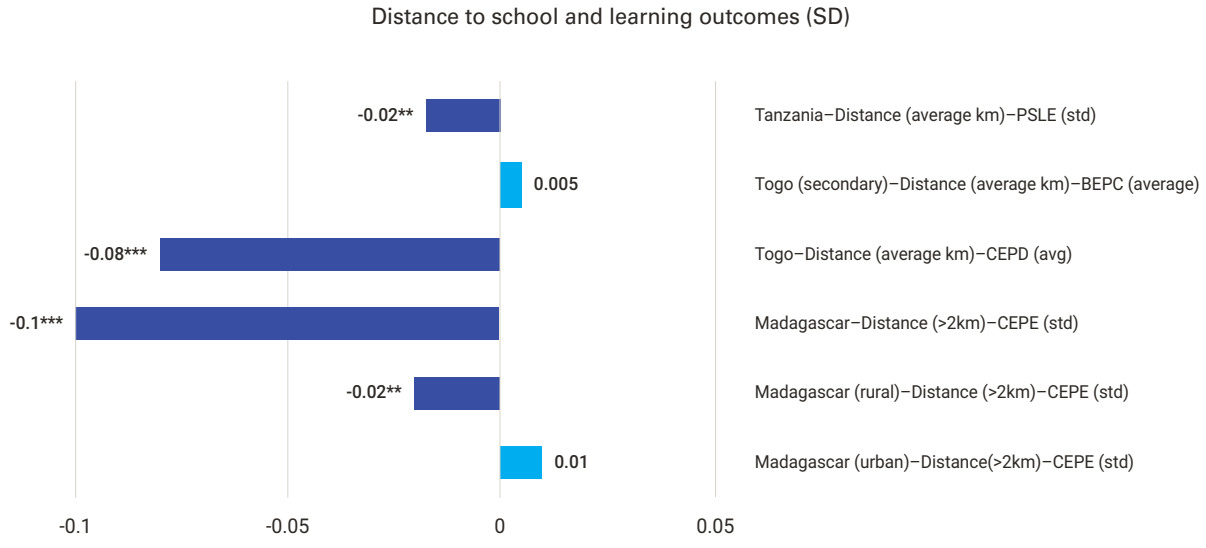


Figure 11: Relationship between 1:1 student-to-seat ratio and learning outcomes

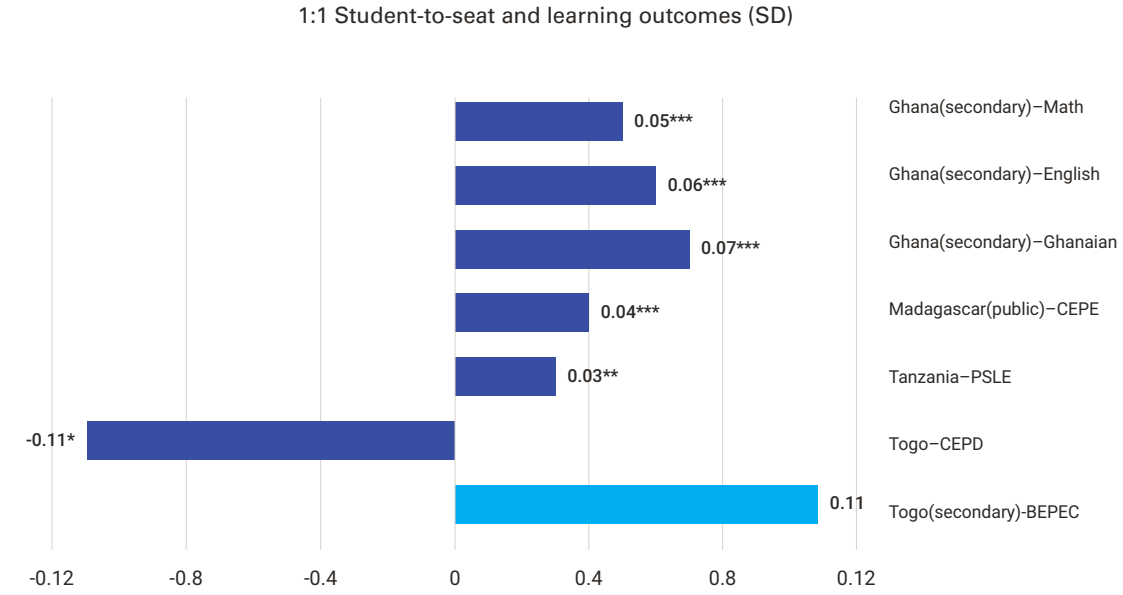
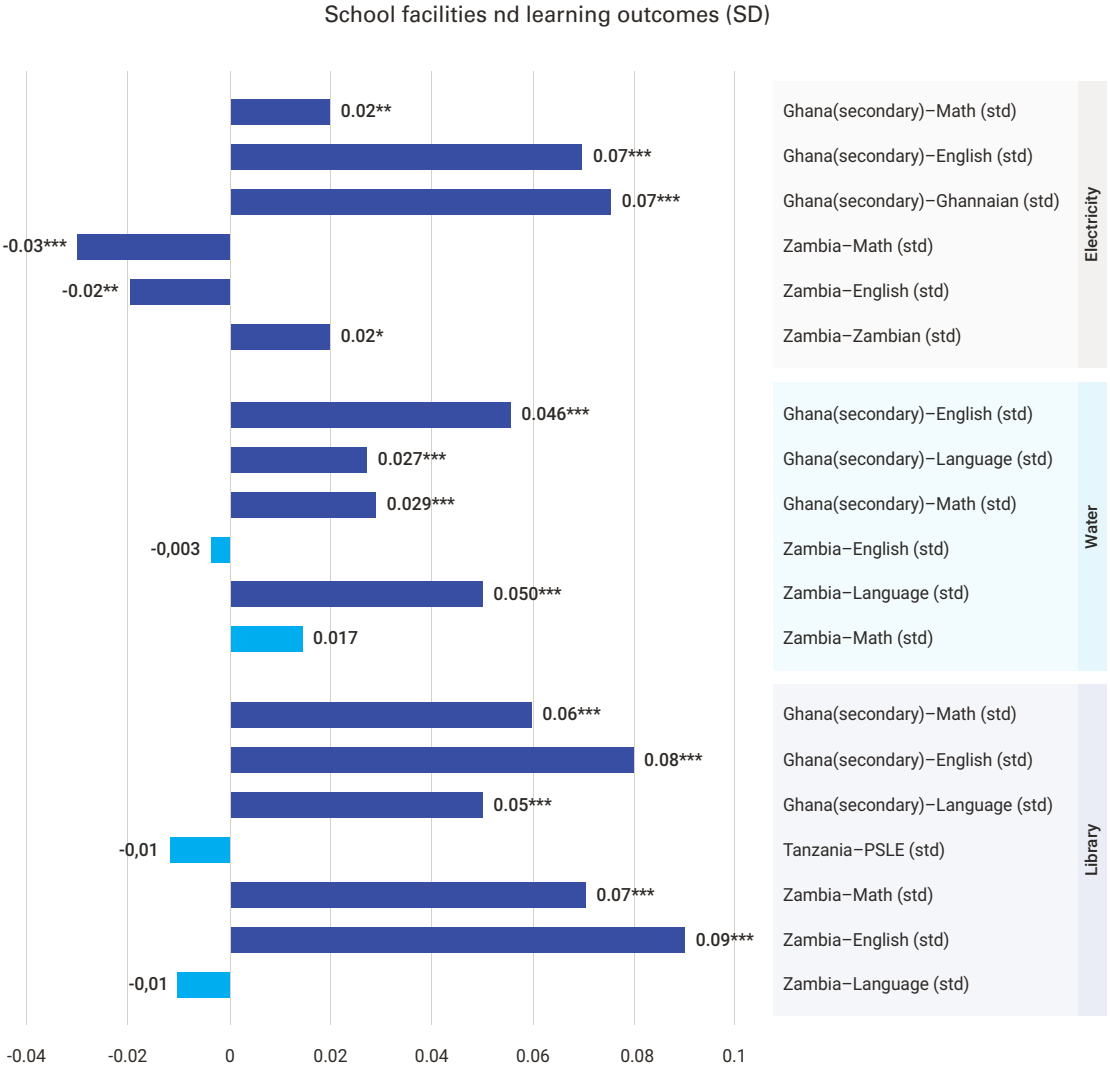


Figure 12: Relationship between school facilities and learning outcomes



Source(10-12): EMIS and learning outcomes data analysed as part of Data Must Speak and Teachers for All Stage 1 reports. Links to reports provided in Annex 1. Values reported refer to the difference of average scores between groups of students (see Box 1).

Distance to school is linked to outcomes in some contexts but expanding classroom capacity can be a more efficient way of increasing access

The relationship between the distance from students' homes to their school with outcomes was observed more consistently on learning than on promotions, although the magnitude tends to be small (*see Figure 10*). It is also seen for primary school students – but not for secondary school students – in Togo. It is important to note that the influence of distance reported here is likely to be an underestimate because this paper relies on school-based data. Children who live far away but were still attending school may already be particularly motivated to remain in school.

In some countries, the relationship between distance and outcomes appeared to be driven by the differences between urban and rural schools, although the direction of this relationship was not consistent: in Côte d'Ivoire and Niger distance had a positive relationship with outcomes in rural areas and a negative relationship in urban areas, while in Tanzania the opposite was true. These findings suggest that investing in the construction of new schools may be beneficial in some contexts but may have limited effects in others.

Considering the significant costs associated with school construction, therefore, its likely impact on student outcomes should be carefully considered. A recent review concluded that school construction interventions to reduce travel times to school are effective in absolute terms, but as they are expensive, they are only moderately cost-effective in improving outcomes – to the effect of around 1.5 learning-adjusted years of schooling per $100 spent.[83] A shorter (or easier) commute to school can be associated with a greater sense of safety, and in turn influence students' engagement and outcomes. In Mozambique, for example, having a safe commute was found to be associated with 0.04 percentage points lower rates of dropout from primary school.[84]

Girls were often more affected by greater distance to school. For example, among secondary students in Togo, for example, an additional average 1 km distance between home and school was associated with 0.5 percentage point lower promotion rates for boys and 1.3 percentage point lower for girls.[85] This aligns with previous research that distributing bicycles to girls in Zambia reduced commute time, increased punctuality and reduced the number of days absent.[86]

Increasing the number of schools reduces their catchment areas, with each school being smaller as they are serving a smaller population of children. Smaller schools may also mean that they are not all able to offer all grade levels. However, UNICEF Innocenti research found that attending a full-cycle school was found to be associated with better outcomes (*see Table A3*). This is the trade-off that should also be considered in school construction decisions. Creating too many small schools that do not offer all grades may be both less cost-effective and have detrimental effects on student outcomes.

One way countries have addressed this is shortcoming is through school clustering. In Mauritania, where more than two-thirds of schools do not offer all primary levels, the government introduced a school clustering policy to allocate teachers by grouping together schools without full primary grades that are located near each other, a process widely considered effective in reducing teacher absenteeism.[87]

In six countries that track classroom capacity – indicated by number of seats or desks available – in EMIS, the student-per-seat figure is above 1 (*see Table A2*). This indicates that enrolments are exceeding classroom capacity, with students sharing seats or engaged in some form of turn taking such as double shifts. For most countries, there were around three students per two seats. This increases in some contexts, with 13 students per seat in rural areas. In all countries but one, having more capacity or seats to accommodate students is associated with better outcomes (*see Figure 11*). These findings provide support for investing in the expansion of school capacity. Compared with constructing new schools, renovating existing school infrastructure to increase school capacity can be a more cost-effective approach to increase access to school and support school environments that are more conducive to learning.

Good classroom conditions can help students and teachers spend more time in school

Classroom conditions are defined differently within country EMIS, and as they are based on different guidelines cross-country comparisons should be made with caution. Rather, the focus should be on differences within countries. For example, in Côte d'Ivoire, while 93 per cent of private primary school students were in classrooms deemed to be in good condition, only one in four students in community primary schools were (*see Table A2*). Classroom conditions have a positive association with outcomes across all countries, in that schools with a higher proportion of classrooms that were permanent structures or were in good condition had higher exam scores or promotion rates compared with schools with worse classroom conditions (*see Table A3*).

As with the other associations presented in this paper, the relationship here is not necessarily causal. It is possible that other underlying factors, such as student demographics, level of community resources or local government support, influenced both the conditions of the school infrastructure as well as student outcomes. Rather than directly contributing to student outcomes, classroom conditions may instead be a precondition to providing an environment that is conducive to teaching and learning.

One way infrastructure can influence outcomes is by mitigating the adverse effects of bad weather that can otherwise disturb learning – such as the loud noise of rain hitting iron roofs preventing students and teachers from hearing each other – or halt teaching and learning completely. It was common across different projects and countries for schools to report that they had to close schools during rainy seasons, and for teachers and students to be unable to travel to schools. In this way, functional infrastructure also supports the resilience of school systems – a topic which will be discussed in greater detail in Paper 2.

Climate change increases the intensity and frequency of extreme weather events, such as droughts and severe floods, that can close schools. According to the Children's Climate Risk Index (CCRI), 9 in 10 school-aged children in Africa face a high, or extremely high, risk of climate and environmental shocks.[88] Almost all children in Central, Eastern and Western Africa are in this situation, with children in the Central African Republic, Chad and Nigeria facing the highest degree of risk. The continent needs resilient education systems that can provide continued learning during climate shocks.

Teachers and other school stakeholders reported that adverse weather, including heavy rain and excessive heat, is a common factor leading to teacher absences.[89] Across the continent, teachers in rural areas were more likely to mention weather as a reason for absenteeism than their urban colleagues. School infrastructure is critical for understanding weather-induced absenteeism. Classrooms are commonly affected by poor ventilation, lack of lighting, and weak and/or non-soundproofed roofs, making it difficult to protect teachers and their students from heavy winds, rain and high temperatures. Teachers interviewed in Puntland and northern Kenya explained that they often miss lessons when it becomes too hot for teaching and learning to take place in open-air classrooms.[90] In Uganda and Rwanda, where schools often have iron-sheet roofs, classroom absenteeism due to heavy rainfall was justified on the basis that the noise is so loud that it is impossible for teachers to continue teaching.[91]

Schools' ability to weatherproof their infrastructure was found to be one of the key distinguishing factors between positive deviant and average schools in Togo.[92] Two schools operating in the same context and with similar resources both faced a roof collapse problem that caused rain to seep into classrooms and interrupt student learning. In the positive model school, good community mobilization, initiated by the principal, made it possible to repair the roof through parents' financial contributions, but structural damage and instructional time loss persisted in the control school.

Access to electricity, WASH, canteens and libraries creates an enabling environment

Schools' access to electricity varies significantly among countries, from only 6 per cent of students in Chad being in schools with electricity to 68 per cent in Ghana (*see Table A2*). Fewer public schools had access to electricity than private schools, and fewer rural schools had electricity access than urban schools.

Electricity access has a consistently positive relationship with learning outcomes in Ghana, with moderate to large coefficients between 0.2 and 0.7 SD across all subjects (*see Figure 12*). In Zambia, while there is a significant and positive relationship with Zambian language scores, the relationship of electricity access with mathematics and English scores was significant and negative. While this is worth exploring further, the urban–rural and private–public gaps in electricity access among Zambian schools were significantly larger than in Ghana, so it is possible that the electricity effect there is in fact capturing differences between school types. Meanwhile, in Chad and Mali there was no association between electricity access and promotion rates.

The findings on electricity is largely consistent with other reviews on the topic, which found that electrification largely improved student performance, although in some instances it may have the opposite effect by enabling distractions from learning.[93] The authors of one review concluded that electricity could enable success but it was not in itself sufficient to guarantee education improvements.[94]

In terms of mechanisms to achieve impact, the Teachers for All research observed that schools with electricity have more teachers (compared with other schools without electricity with similar enrolment size) in Lesotho, Niger and Senegal.[95] In Zambia, the availability of electricity was associated with both better teacher ratios and longer teacher tenures at the school.[96] This finding on the positive effect of

electrification on attracting teachers to school is aligned with previous studies that reported electricity as an important consideration for new teachers in selecting their initial teaching positions in Ghana and Zimbabwe,[97] suggesting that schools with electricity may be able to attract higher qualified teachers. Finally, electricity also enables schools to leverage digital learning technologies to support teaching and learning. This is an issue of recent priority among governments across the continent and will be discussed further in Paper 2.

Schools' access to water, sanitation and hygiene (WASH) facilities varies significantly among countries, with subnational variations being largest in countries where overall access rates were lower (*see Table A2*). No country had latrines available at all schools. Two countries monitored whether schools provided menstrual hygiene support: more than one in five Ghanaian schools have menstrual hygiene changing rooms while 0.5 per cent of Zambian schools provide menstrual hygiene towels.

The presence of WASH facilities was, in most instances, associated with higher learning outcomes (between 0.02 and 0.07 SD) and promotion rates (between 0.3 and 1.5 percentage points) (*see Figure 12*). Girls tend to be more positively affected by the presence of latrines than boys. In one instance (Mali), boys were negatively affected but the net effect of latrines is still positive because the magnitude of the positive relationship for girls was considerably greater. The presence of menstrual hygiene support is also positively associated with the performance of girls and boys, although again, the positive effect on girls is greater. This finding provides context to evaluations of menstrual health interventions in Kenya and Uganda, which found that involvement of boys is critical in supporting effectiveness (although its support may be best delivered to single-sex groups).[98]

There were significant differences, particularly within countries, in which schools have a school library (*see Table A2*). Libraries are considerably more frequently found in urban schools than rural schools, and in private schools than public schools. The presence of a school library was associated with higher learning in Ghana and Zambia, with coefficient sizes between 0.06 and 0.09 SD (*see Figure 12*). In Côte d'Ivoire, school libraries were associated with a 0.3 percentage point increase in promotion rates. In Tanzania, however, the presence of a school library is not associated with learning nationally.

These findings are consistent with other studies, that largely found a significant positive relationship between school libraries and outcomes, with one review linking this to studies that have found the presence of a school library to be linked to students spending more time at school.[99] Studies that have looked more deeply into the role of school libraries in the region have highlighted the importance of ensuring that they are adequately resourced with engaging and relevant materials.[100] This aligns with the positive association between teaching and learning materials and student outcomes as described in the Curriculum section of this report.

Primary schools with canteens tend to have better outcomes than those without (*see Table A3*). The relationship appears to be stronger with learning outcomes (between 3.4 and 4.4 percentage point pass rates nationally in Côte d'Ivoire and Madagascar) than with promotion rates (between 0.8 and 1.9 percentage points in Chad, Madagascar and Mali. Notably, in Côte d'Ivoire and Niger the relationship with promotion rates was positive among urban schools but negative among rural schools (in that rural schools that did not have a canteen had higher promotion rates than those that did). This may be attributed to the original selection criteria, demonstrating that the rural schools with canteens were socioeconomically worse off than those without, and that the presence of a school canteen was insufficient to overcome the disadvantage.

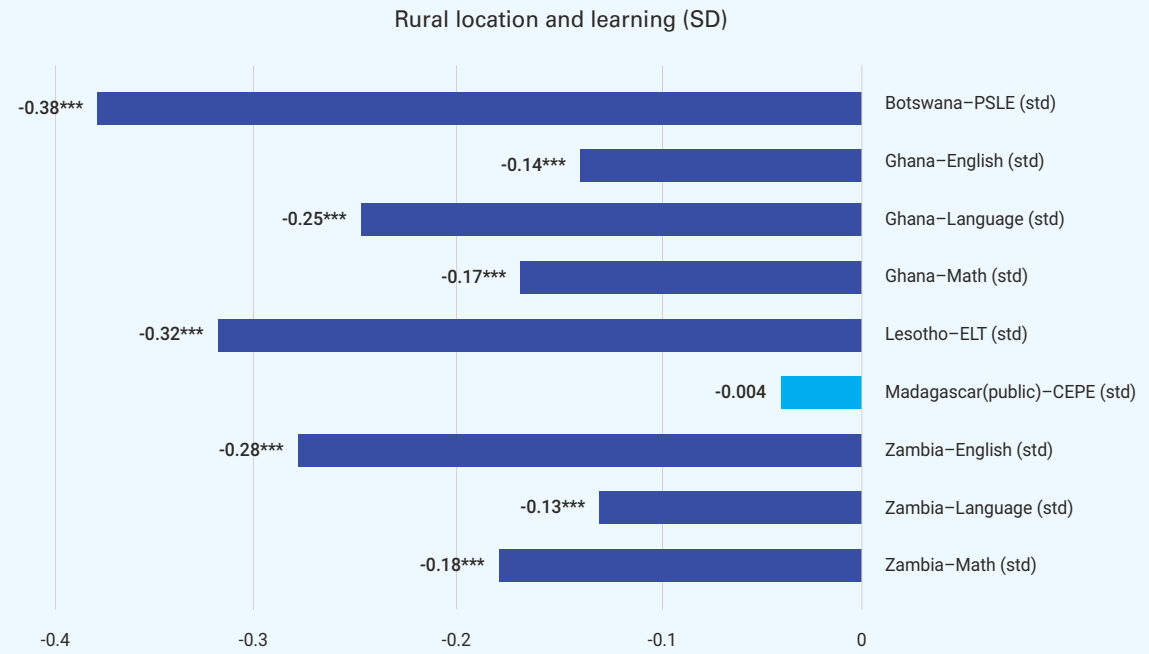
These findings are consistent with previous studies, which can also shed light into the likely mechanism on how such facilities influence student outcomes. In Côte d'Ivoire, the availability of a school canteen increases the probability of enrolment and reduces children's employment.[101] In this study, the effect was greater for girls, as canteens reduce the need for children to leave the school at lunch time and therefore increases the feeling of security. In Togo, stakeholders reported seeing the positive influence of having a school canteen on student attendance, which may also explain the effect on learning and promotions.[102] Finally, the availability of a school canteen enables the provision of school meals and support vulnerable students, which will be discussed further in Paper 2. Findings from school meal programme evaluations have found positive effects on students' food consumption and micronutrient.[103]

The pattern of school canteen availability differs from other facilities: schools in rural areas were more likely to have a canteen than urban schools (*see Table A2*). This is likely due to the selection criteria for the construction of school canteens, which usually targets schools serving more vulnerable communities with high levels of food insecurity, and at times limited to those in rural or peri-urban areas.[104]

Box 3: Spotlight on rural schools

In almost all participating countries, attending a rural school was associated with lower learning outcomes (*see Figure 13*). Several characteristics could be driving this rural disadvantage. Among the most significant difference in school characteristics between urban and rural areas were structures to manage population challenges: multigrade and double-shift classes. Students in rural areas were two to nine times more likely than those in urban areas to be in a multigrade class. The negative relationship between being in a multigrade class and outcomes also tends to be greater among rural students than among urban students. Meanwhile, although students in urban areas were considerably more likely to be in a double-shift school than those in rural areas, the negative relationship between double shifts and outcomes was greater for rural students in Mali and Congo compared with their urban counterparts.

Figure 13: Relationship between rural location and learning



As this paper summarized in earlier sections, schools in rural areas were considerably less likely to have access to complete school facilities, particularly electricity and WASH facilities, and to female teachers and head teachers. UNICEF Innocenti research findings reported here support existing research to indicate that these are related factors – schools with more complete and better functioning infrastructure can more easily attract and retain teachers, including, and at times especially, female teachers and head teachers. Altogether, the findings support the importance of prioritizing resourcing to rural schools. This aligns with the recommendations from the African Union Commission and UNICEF, based on the observation that in many countries across the continent, education spending was disproportionately concentrated in urban and peri-urban areas.[105]

Implications on education policy

The continent's ministries of education have made significant achievements in broadening access to schooling. Focus has shifted to how governments can best support students to achieve the goal of school enrolment: learning.

This paper recognizes as a starting point the commitments that African governments have made to continue increasing investments in education. To support them in this important goal, the results presented here point to how three key areas of investment – workforce, curriculum and infrastructure – can be more efficiently directed to achieve the outcomes for students. The return on this investment also comes in the form of a more efficient system – fewer students falling behind, needing to repeat, or needing additional supports to return to school.

Transforming education systems in Africa necessitates a focus on the quality and intensity of children's pedagogical experiences. The findings in this paper show that education investments in the continent should be geared towards ensuring the quantity and quality of pedagogical experiences for all students.

Maximizing lesson time: Students who experience more instruction time achieve better outcomes, and several policy components have significant influence on the amount of lesson time students experience at school.

- *Curricular standards* and guidelines should set clear and high expectations on the minimum number of effective instruction hours students need to receive.

- *Student and teacher absences* reduce instructional time experienced by students. Monitoring by teachers and head teachers, as well as engagement of parents and the community, can help manage and reduce absenteeism. See UNICEF Innocenti's Time to Teach research.

- *Double-shift systems* can also reduce the learning time experienced by students and affect the outcomes they achieve. Other policy interventions to tackle overcrowding should be considered, including the expansion of school infrastructure capacity. When double shifts are used, efforts could be made to ameliorate the negative effects through alternative programme design, making up for lost learning time, and guidance and support for out-of-school learning. This will also require sufficient teaching and learning materials, including self-instructional material that students can take home.

- *Safe and supportive learning facilities* can influence the amount of time students and teachers spend in school. The presence of school canteens and school libraries have been linked to more time in school, and the provision of safe school transport (such as bicycles) has been found to reduce student absences.

Improving pedagogical quality: Several rigorous reviews of impact evaluations in Africa have established that interventions that address pedagogy and classroom instruction have the greatest impact on student learning. Workforce, curriculum and – to a lesser extent – infrastructure policies are important enablers of quality pedagogy.

- *Teacher qualification and training* can increase teacher knowledge and skills, support their ability to deliver higher-quality instruction, and improve their attitude and behaviours. Teachers who have more confidence in their (and their colleagues') knowledge and skills were less likely to be absent and lose time on task. Notably, not all forms of qualifications were associated with better outcomes, so it is important to pay attention to the duration, intensity, content and support provided by teacher training programmes – including monitoring the practices and outcomes of their graduates.

- *Teacher accountability and incentives* are greatly influenced by administrative and management practices including supporting their salary payments, promotion decisions, and monitoring. There is evidence to support that these aspects – unlike the status of the civil servant, contractor or volunteer – drive the influence that different forms of teacher employment have on student outcomes.

- *Teaching and learning materials* play an important role in guiding and supporting classroom instruction as well as out-of-school learning (such as through homework assignments), and there is evidence that the provision of student textbooks and teacher guides can influence student outcomes. However, it is important that the resources are accessible to students – that they are in a language students understand, and that they are physically accessible, ideally to be used at school and home.

- *Classroom learning spaces and school facilities* can also enable effective pedagogical practices such as cooperative group activities among students, the use of digital learning tools (which is a high priority for almost all African governments) and providing access to reading materials. The evidence presented in this paper shows that the availability of seat and desk spaces for students is associated with student outcomes as are – albeit to a lesser extent – school access to electricity and the availability of a library.

Including all students: In an equitable education system, immutable characteristics such as student gender or where they live should have little to no influence on the outcomes they are able to achieve, but in almost all countries included here, student outcomes vary significantly by gender and location. Several policy options have been highlighted as playing particularly important roles in being able to ameliorate these differences.

- *Mother tongue instruction* is associated with improved outcomes particularly among students who do not fluently speak the official language(s) of instruction. Mismatch between mother tongue and language of instruction is particularly detrimental to teachers' ability to clarify concepts that students do not understand and schools' ability to engage parents and community. Consistent with this, evaluation of textbook provision interventions have found that they may benefit only the most advantaged students as the materials may be inaccessible to students who are not fluent in the language used or whose schools have difficulty in distributing, managing and/or storing textbooks.

- *Safe school environment is particularly important for girls*, with factors that influence outcomes including minimal distance or safe commute between home and school, the presence of school canteens since they reduce the need for students to leave the school at lunch time, and the availability of water, sanitary and hygiene facilities including menstrual support.

- *Rural schools face particular disadvantages with infrastructure and staff*, particularly in recruiting female teachers and head teachers, which deprives girls of the presence of female role models in positions of authority at school. Evidence suggests these factors are related, with the availability of electricity – where there is a significant urban–rural gap – influencing teacher deployment decisions.

This paper also illustrates a way forward for governments to make **informed policy choices** for their context, with coherent workforce, curriculum and infrastructure policies that could most likely achieve greater outcomes than if they were implemented individually. Infrastructure and workforce investments can work together to produce manageable class sizes that support learning. This paper points to strategic teacher redeployments to achieve more equitable teacher distribution and capacity expansions in existing schools as a cost-effective way forward to achieving this goal. A growing body of research, supported by this paper's findings, point to the use of structured teaching and learning materials, accompanied by ongoing teacher training and support, as the most cost-effective interventions to improve learning outcomes.

The main body of this paper focused on the association between a change in unit of each factor and student outcomes. Taken together, these can provide an indication of where workforce, curriculum and infrastructure policy should be prioritized in the continent. What makes the biggest difference to student learning would vary between, and at times within, countries. Prioritizing resources will require a consideration of the potential scale, cost and equity. The first of these – potential scale – can be simulated by combining the magnitude of the relationship between the resource and outcomes with the scale of the challenge faced in each country, illustrated in *Figure 14* and *Figure 15* below.

For example, the Global Partnership for Education recommends a ratio of 40 or fewer students to trained teachers. The estimated effect of meeting this benchmark nationally ranges from 0.1 to 0.36 SD higher on learning outcomes, or 17–36 percentage points higher promotion rates in most included countries. In Botswana and Ghana, however, the national student to trained teacher ratios were already below the recommended benchmark. Instead, the most meaningful effect found in Botswana would be to expand electricity access from 72 per cent of schools to all schools, which was associated with 0.15 SD higher learning outcomes. In Ghana, on the other hand, infrastructure upgrades (expanding classroom capacity to fit seats for all enrolled students, providing electricity, water and menstrual changing rooms in all schools) were found to have meaningful effects. Meanwhile, gender parity in the teaching workforce should be prioritized in Chad and among secondary schools in Togo, where having a female teacher was associated with higher learning outcomes, although fewer than one in five teachers are female.

Figure 14: Simulated effects of meeting policy benchmarks on learning outcomes (SD)

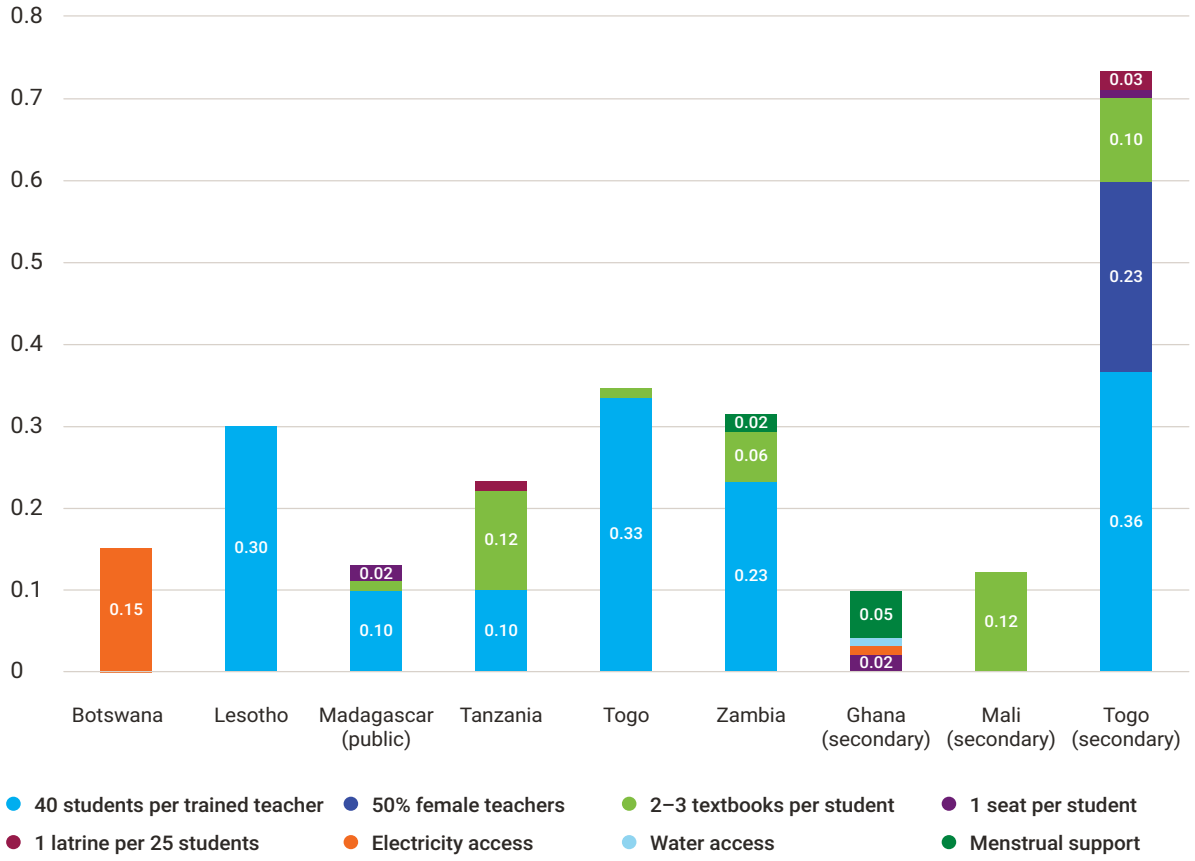
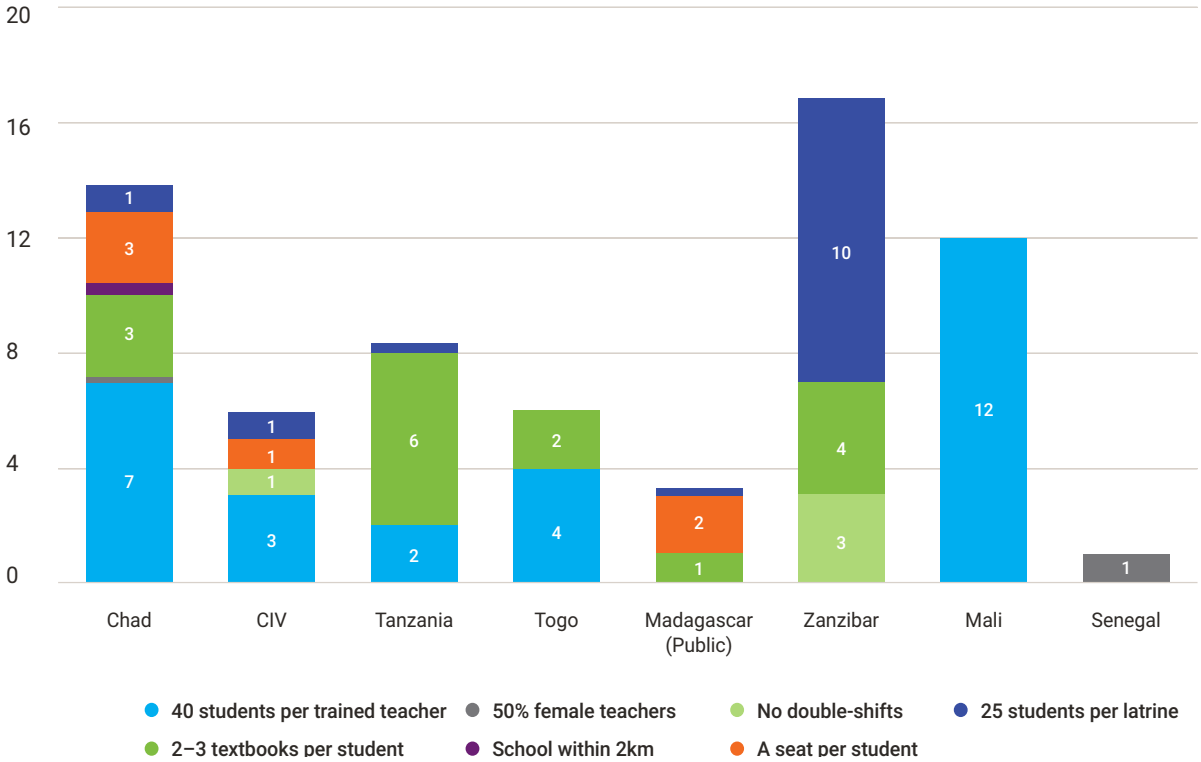


Figure 15: Simulated effect of meeting policy benchmarks on promotion rates (percentage points)



Source : EMIS and learning outcomes data analysed as part of Data Must Speak and Teachers for All Stage 1 reports. Links to reports provided in Annex 1. Values reported refer to the difference of projected effect of moving from current to ideal policy rates, based on the coefficient sizes of the relationship between the resource level and outcomes (see Box 1).

Cost considerations will also come into play in prioritizing or sequencing reforms. In Tanzania, for example, providing at least three textbooks (for each of the core examination subjects of mathematics, English and Kiswahili) for each student is associated with a similar effect to reducing national student to trained teacher ratio from 74 to 40, at significantly smaller potential cost.

The illustrative simulations presented here use national figures. The effects can vary, however, for different groups of schools and students within countries, creating important equity considerations. For example, increasing the proportion of female teacher is likely to have a stronger positive effect on girls, and was also found to have a stronger positive association with outcomes in rural schools, where the recruitment challenge is greater, than in urban schools. In most instances, however, policies that target the schools and students that benefit from them the most will result in better outcomes overall.

Finally, this paper also highlights the importance of implementation in achieving system transformation. The effectiveness of interventions from teacher performance pay, pedagogical change, to textbook provision, have been curtailed by weaknesses in systems to implement them – such as administering payments and the strength of incentive structures for those who deliver them. Monitoring implementation fidelity and outcomes plays a particularly important role in ensuring that investments in education are having their intended impact. These can be done at relatively low cost, including leveraging widespread low-tech approaches such as mobile phones.

The next two working papers in this series will delve further into these topics. Paper 2 will focus on emerging national education priorities in the continent, including the role of digital learning, early childhood education, and support for the most marginalized learners. Meanwhile, Paper 3 will focus on the role of different levels of education governance in the successful implementation of education policy priorities to achieve transformational change.

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Annex 1: UNICEF Innocenti partner countries included in this paper

Table A1: Countries with EMIS data analyses included in this pape

COUNTRY	TIME TO TEACH	DATA MUST SPEAK	TEACHERS FOR ALL
Angola			Yes
Botswana			Yes
Burkina Faso		Yes	
Comoros	Yes		
Congo			Yes
Côte d'Ivoire	Yes	Yes	Yes
Democratic Republic of the Congo		Yes	
Equatorial Guinea			Yes
Ethiopia	Yes		
Gabon	Yes		
Gambia	Yes		
Ghana	Yes		
Guinea	Yes		
Guinea-Bissau	Yes		
Kenya	Yes		
Lesotho			Yes
Liberia	Yes		Yes
Madagascar	Yes	Yes	Yes
Mali	Yes	Yes	
Mauritania	Yes		Yes
Morocco	Yes		
Mozambique	Yes		
Niger	Yes	Yes	
Nigeria	Yes		

COUNTRY	TIME TO TEACH	DATA MUST SPEAK	TEACHERS FOR ALL
Rwanda			Yes
Senegal			Yes
Sierra Leone			Yes
Somalia	Yes		
South Sudan	Yes		
Togo	Yes	Yes	
Uganda	Yes		
United Republic of Tanzania	Yes		
Tanzania–Zanzibar	Yes		
Zambia		Yes	Yes

Annex 2: Data tables

Table A2: Descriptive statistics (average values) of EMIS variables used in this paper

COUNTRY	VARIABLE	NATIONAL	URBAN	RURAL	PUBLIC	PRIVATE	COMMUNITY
Class size / student–teacher ratio							
Chad	Class size	81	81	82	90	58	78
Chad	Student-teacher ratio	71	64	75	77	48	72
Côte d'Ivoire	Class size	44	49	40	44	47	25
Ghana	Student-teacher ratio	18	18	18	18	16	
Madagascar	Student-teacher ratio	.	.	.	41	.	.
Mali	Class size	64	75	61	72	45	39
Niger	Class size	44	51	42	.	.	.
Tanzania	Class size	111	122	108	.	.	.
Tanzania	Student-teacher ratio	73	61	77	.	.	.
Teacher qualifications (%)							
Chad	Trained	63	85	50	69	76	41
Côte d'Ivoire	Bachelor's or higher	75	76	73	83	41	29

COUNTRY	VARIABLE	NATIONAL	URBAN	RURAL	PUBLIC	PRIVATE	COMMUNITY
Ghana	Professional diploma or higher	79	73	87	92	24	.
Madagascar	Bachelor's or higher	.	.	.	30	.	.
Mali	DEF/ISCED 2 or higher	88	91	88	89	94	88
Niger	CFEEN/teaching certificate	61	66	59	.	.	.
Tanzania	Teacher training course	99	100	99	.	.	.
Togo	Vocational diploma	77	.	.	.	.	.
Zambia	Professional diploma	51	52	51	51	58	.
Teacher status (%)							
Côte d'Ivoire	Regular teachers	49	51	47	59	9	0.6
Côte d'Ivoire	School assistants	28	24	31	31	18	0.5
Mali	Contract teachers	90	135	51	48	186	166
Mali	Trainee teachers	9	13	3	11	3	3
Niger	Teachers	8	12	7	.	.	.
Niger	Assistant teachers	85	84	85	.	.	.
Niger	Teacher-monitors	7	4	8	.	.	.
Niger	Head teachers	52	56	55	.	.	.
Niger	Teachers who are civil servants	22	32	19	.	.	.
Niger	Teachers on contracts	74	54	81	.	.	.
Tanzania	Teachers with permanent contracts	98	99	98	.	.	.
Togo	Volunteer	0.2	.	.	.	.	.
Teacher status (%)							
Côte d'Ivoire	Regular teachers	49	51	47	59	9	0.6
Côte d'Ivoire	School assistants	28	24	31	31	18	0.5
Mali	Contract teachers	90	135	51	48	186	166
Mali	Trainee teachers	9	13	3	11	3	3
Niger	Teachers	8	12	7	.	.	.
Niger	Assistant teachers	85	84	85	.	.	.
Niger	Teacher-monitors	7	4	8	.	.	.
Niger	Head teachers	52	56	55	.	.	.
Niger	Teachers who are civil servants	22	32	19	.	.	.
Niger	Teachers on contracts	74	54	81	.	.	.

COUNTRY	VARIABLE	NATIONAL	URBAN	RURAL	PUBLIC	PRIVATE	COMMUNITY
Tanzania	Teachers with permanent contracts	98	99	98	.	.	.
Togo	Volunteer	0.2	.	.	.	.	.
Female teachers (%)							
Chad	Female teachers	19	36	9	20	26	12
Chad	Female head teachers	8	16	3	9	11	4
Congo	Female teachers	58	.	.	36	71	0
Côte d'Ivoire	Female teachers	36	47	26	36	36	18
Côte d'Ivoire	Female head teachers	12	20	5	11	19	10
Ghana	Female teachers	29	35	21	32	18	.
Ghana	Female head teachers	23	31	13	25	14	.
Madagascar	Female teachers	.	.	.	41	.	.
Madagascar	Female head teachers	.	.	.	35	.	.
Mali	Female teachers	48	80	31	53	45	37
Niger	Female head teachers	15	49	9	.	.	.
Niger	Female teachers	50	84	37	.	.	.
Tanzania	Female teachers	42	61	38	.	.	.
Zambia	Female teachers	53	78	43	53	56	.
Zambia	Female head teachers	.	1	..	.	.	.
Double-shifts							
Côte d'Ivoire	Double-shift systems (%)	5	9	2	6	1	0
Mali	Double-shift systems (%)	4	6	3	5	0	3
Ghana	Student attendance for 1 month (%)	76	77	76	76	77	0
Zambia	Contact hours in Grade 7	5	5	5	5	6	0
Mother tongue instruction							
Chad	Teachers trained in bilingualism (%)	9	15	5	8	10	11
Mali	Curricular pedagogy (%)	15	13	17	21	1	20
Students per textbook							
Chad	Students per maths textbook	4.8	4.8	4.8	4.0	5.6	6.7
Chad	Students per textbook	2.0	2.0	2.0	1.8	2.3	2.6
Côte d'Ivoire	Students per textbook	1.1	0.8	1.4	1.1	0.8	3.3
Madagascar	Students per textbook	.	.	.	0.7	.	.
Mali	Students per textbook	1.0	1.4	0.9	0.8	2.0	0.8

COUNTRY	VARIABLE	NATIONAL	URBAN	RURAL	PUBLIC	PRIVATE	COMMUNITY
Niger	Students per French textbook	2.6	3.0	2.5	.	.	.
Niger	Students per maths textbook	2.9	3.0	2.9	.	.	.
Tanzania	Students per textbook	0.9	0.8	0.9	.	.	.
Togo	Students per textbook	0.4	.	.	.	.	.
Zambia	Students per English textbook	2.5	.	.	.	.	.
Zambia	Students per maths textbook	2.5	.	.	.	.	.
Zambia	Students per Zambian textbook	4.0	.	.	.	.	.
Multigrade classes							
Chad	Multigrade classes (%)	11	12	45	30	10	52
Côte d'Ivoire	Multigrade classes (%)	14	3	19	11	10	64
Mali	Multigrade classes (%)	17	2	15	14	2	32
Niger	Multigrade classes (%)	22				0	0
Togo	Multigrade classes (%)	2					
Zambia	Multigrade classes (%)	2.6	1	2		3	0
Distance between home and school							
Chad	Average distance (km)	1.5	1.6	1.4	1.5	1.7	1.4
Côte d'Ivoire	Average distance (km)	2.2	2.2	2.2	2.2	2.2	2.1
Madagascar	Students living more than 2 km away (%)	.	.	.	10.0	.	.
Tanzania	Average distance (km)	1.9	1.7	2.0	.	.	.
Togo	Average distance (km)	3.2	.	.	.	.	.
Niger	Average distance (km)	0.7	0.8	0.7	.	.	.
Grade availability / school size							
Chad	Full cycle (%)	81	94	73	91	89	54
Madagascar	Full cycle (%)	.	.	.	25	.	.
Mali	Full cycle (%)	22	37	16	9	60	10
Ghana	Number of students in school	316	389	230	307	354	.
Madagascar	Number of students in school	.	.	.	163	.	.
Students per classroom desk/seat							
Chad	Students per seat	7.7	4.8	12.5	7.7	3.8	16.7
Côte d'Ivoire	Students per seat	1.3	1.3	1.3	1.3	1.1	1.4
Ghana	Students per seat	1.4	1.4	1.4	1.4	1.3	.

COUNTRY	VARIABLE	NATIONAL	URBAN	RURAL	PUBLIC	PRIVATE	COMMUNITY
Madagascar	Students per seat	.	.	.	2.0	.	.
Tanzania	Students per seat	1.2	1.2	1.2	.	.	.
Togo	Students per seat	1.3	.	.	.	.	.
Zambia	Students per desk	3.3	2.5	3.3	3.3	1.3	.
Classroom conditions							
Chad	Permanent classrooms (%)	37	54	27	47	40	13
Côte d'Ivoire	Classrooms in good condition (%)	78	88	70	76	93	25
Ghana	Classrooms not needing major repairs (%)	16	13	19	19	3	.
Madagascar	Classrooms in good condition (%)	.	.	.	42	.	.
Niger	Permanent classrooms (%)	48	67	42	.	.	.
Togo	Permanent classrooms (%)	65	.	.	.	.	.
Electricity							
Chad	Access to electricity (%)	6	13	2	3	22	3
Ghana	Access to functional electricity (%)	68	76	58	66	76	.
Mali	Access to electricity (%)	24	55	12	16	65	10
Zambia	Access to electricity (%)	62	94	48	60	99	.
Water, sanitation and hygiene (WASH)							
Chad	Water points (%)	46	72	30	47	71	26
Ghana	Access to drinking water (%)	87	87	86	85	94	.
Mali	Water supply (%)	67	84	63	69	83	40
Zambia	Water access (%)	93	97	91	93	98	.
Chad	Functional latrine (%)	47	75	29	49	74	23
Mali	Presence of latrines (%)	164	260	78	165	186	141
Niger	Latrines (%)	59	87	48	.	.	.
Madagascar	Boys' or mixed latrines in good condition (%)	.	.	.	26	.	.
Madagascar	Girls' latrines in good condition (%)	.	.	.	15	.	.
Côte d'Ivoire	Latrines (per 100 students)	1	1	1	1	2	0
Tanzania	Pit latrines (per 100 students)	2	2	2	.	.	.
Zambia	Latrine–learner ratio	1	1	1	1	3	.

COUNTRY	VARIABLE	NATIONAL	URBAN	RURAL	PUBLIC	PRIVATE	COMMUNITY
Ghana	Menstrual changing rooms (%)	22	26	16	18	38	.
Zambia	Menstrual hygiene towels available (%)	1	1	0	1	1	.
School library							
Côte d'Ivoire	School has a library (%)	12	14	11	11.5	18	1
Ghana	School has a library (%)	26	32	18	21	44	0
Tanzania	School has a library (%)	12	13	11	0	0	0
Zambia	School has a library (%)	0.1	0.2	0.1	0	0.6	0
Canteen							
Côte d'Ivoire	School has a canteen (%)	37	32	42	42	17	.
Madagascar	School has a canteen (%)	.	.	.	6	.	.
Mali	School has a canteen (%)	12	9	12	15	10	11
Niger	School has a canteen (%)	8	2	10	.	.	.

Source: EMIS data analysed as part of Data Must Speak and Teachers for All Stage 1 reports. Links to reports provided in Annex 1. Values reported refer to proportion of student enrolments.

Table A3: Coefficient of school factors on learning outcomes or promotions

CATEGORY	VARIABLE	COUNTRY	OUTCOME	COEFFICIENT
student-teacher ratio	str	ghana	maths (std)	-0.00132**
student-teacher ratio	str	ghana	english (std)	-0.00181***
student-teacher ratio	str	ghana	language (std)	-0.00564***
student-teacher ratio	str	tanzania	psle (std)	-0.003***
student-teacher ratio	str	tanzania	psle (std)	-0.000*
class size	class size	togo	cepd (average)	-0.0195***
class size	class size squared	togo	cepd (average)	0.000104***
student-teacher ratio	str	zambia	maths (std)	-0.001**
student-teacher ratio	str squared	zambia	maths (std)	0
student-teacher ratio	str	zambia	english (std)	-0.003***
student-teacher ratio	str squared	zambia	english (std)	0.000***
student-teacher ratio	str	zambia	language (std)	-0.003***
student-teacher ratio	str squared	zambia	language (std)	0.000***
student-teacher ratio	str	lesotho	elt (scores)	-0.004*
student-teacher ratio	str squared	lesotho	elt (scores)	0
student-teacher ratio	str	botswana	psle (score)	-0.052*

CATEGORY	VARIABLE	COUNTRY	OUTCOME	COEFFICIENT
student-teacher ratio	str	ghana	maths (std)	-0.00132**
student-teacher ratio	str	ghana	english (std)	-0.00181***
student-teacher ratio	str	ghana	language (std)	-0.00564***
class size	class size	chad	promotion	-0,159***
class size	class size squared	chad	promotion	0,00026***
class size	teaching group size	civ	promotion	-0.656***
class size	teaching group size sq	civ	promotion	0.00245***
class size	class size	mali	promotion	- 0,503***
class size	class size squared	mali	promotion	0,00106***
class size	class size	niger	promotion	-0.348***
student-teacher ratio	str	tanzania	promotion	-0.072***
student-teacher ratio	str	tanzania	promotion	-0.008***
class size	str	togo	promotion	-0.989***
class size	str squared	togo	promotion	0.00439***
student-teacher ratio	str	senegal	promotion	-0,17***
teacher gender	% female teachers	botswana	english (std)	0.93**
teacher gender	% female teachers	ghana (boys)	math (std)	-0.17**
teacher gender	% female teachers	ghana(girls)	math (std)	-0.19
teacher gender	% female teachers	ghana (boys)	english (std)	-0.1*
teacher gender	% female teachers	ghana (girls)	english (std)	0**
teacher gender	% female teachers	ghana (boys)	language (std)	-0.15*
teacher gender	% female teachers	ghana (girls)	language (std)	-0.06**
teacher gender	% female teachers	lesotho	elt (std)	0.11
teacher gender	% female teachers	mali (boys)	def (std)	-0.04
teacher gender	% female teachers	mali (girls)	def (std)	-0.06
teacher gender	% female teachers	tanzania (boys)	psle (std)	-0.39***
teacher gender	% female teachers	tanzania (girls)	psle (std)	0***
teacher gender	% female teachers	togo (boys)	cepd (std)	-0.04*
teacher gender	% female teachers	togo (girls)	cepd (std)	0.04**
teacher gender	% female teachers	togo (boys)	bepc (std)	0.38*
teacher gender	% female teachers	togo (girls)	bepc (std)	0.67**
teacher gender	% female teachers	zambia (girls)	math (std)	-0.03***
teacher gender	% female teachers	zambia (boys)	math (std)	-0.21***
teacher gender	% female teachers	zambia (girls)	english (std)	0.12***

CATEGORY	VARIABLE	COUNTRY	OUTCOME	COEFFICIENT
teacher gender	% female teachers	zambia (boys)	english (std)	-0.14***
teacher gender	% female teachers	zambia (girls)	language (std)	0.36***
teacher gender	% female teachers	zambia (boys)	language (std)	-0.11***
teacher status	contract	civ	promotion	0.95***
teacher status	monitor	niger	promotion	-0.08
teacher status	contract	mali	promotion	-0.12
teacher status	community	madagascar	promotion	-0.18
teacher status	volunteer	togo	promotion	-0.47***
teacher status	contract	tanzania	promotion	-3.02***
teacher status	trainee (vs contractor)	civ	promotion	1.26***
teacher status	trainee (vs permanent)	mali	promotion	5.49***
teacher status	contract	ghana	english (std)	0
teacher status	contract	ghana	ghanaian (std)	-0.12***
teacher status	contract	ghana	maths (std)	0.01
teacher status	contract	tanzania	psle (std)	0.07
teacher status	volunteer	togo	cepd (std)	-0.06
teacher status	contract	zambia	english (std)	0.16***
teacher status	contract	zambia	zambian (std)	-0.05
teacher status	contract	zambia	maths (std)	0.23***
teacher qualifications	diploma	zambia	maths (std)	0.07***
teacher qualifications	diploma	zambia	language (std)	0.12***
teacher qualifications	diploma	zambia	english (std)	0.17***
teacher qualifications	bachelor's	zambia	maths (std)	-0.05
teacher qualifications	bachelor's	zambia	language (std)	-0.03
teacher qualifications	bachelor's	zambia	english (std)	0.53***
teacher qualifications	vocational diploma (CAP)	togo	cepd (average)	-0.05
teacher qualifications	teaching certificate (CEFNI)	togo	cepd (average)	0.14***
teacher qualifications	instructor's certificate (CEAP)	togo	cepd (average)	-0.11
teacher qualifications	bachelor's	togo	cepd (average)	-0.04
teacher qualifications	diploma	tanzania	psle (std)	0.1***
teacher qualifications	teacher training course	tanzania	psle (std)	0.06
teacher qualifications	bachelor's	madagascar	cepe (std)	0.07***
teacher qualifications	professional diploma	ghana	maths (std)	0.07***
teacher qualifications	professional diploma	ghana	language (std)	0.09***
teacher qualifications	professional diploma	ghana	english (std)	0.07***

CATEGORY	VARIABLE	COUNTRY	OUTCOME	COEFFICIENT
teacher qualifications	academic diploma	ghana	maths (std)	0.14***
teacher qualifications	academic diploma	ghana	language (std)	0.12***
teacher qualifications	academic diploma	ghana	english (std)	0.13***
teacher qualifications	teaching certificate	tanzania	promotion	-0.03
teacher qualifications	bachelor's	zambia	language (std)	-0.03
teacher qualifications	diploma	tanzania	promotion	-0.17
teacher qualifications	upper secondary	niger	promotion	-0.71
teacher qualifications	teaching certificate	niger	promotion	-0.92
teacher qualifications	bachelor's	niger	promotion	-1.02
teacher qualifications	upper secondary	mali	promotion	0.49
teacher qualifications	bachelor's	civ	promotion	1.22***
teacher qualifications	trained teachers (2 years)	chad	promotion	2.49***
teacher qualifications	trainee (vs contractor)	civ	promotion	1.26***
teacher qualifications	trainee (vs permanent)	mali	promotion	5.49***
textbooks	textbooks per student	madagascar (public)	cepe (std)	0.01***
textbooks	textbooks per student	tanzania	psle (std)	0.07***
textbooks	textbooks per student	togo	cepd (average)	0.02
textbooks	textbooks per student	zambia	maths (std)	0.09***
textbooks	textbooks per student	zambia	english (std)	0.07***
textbooks	textbooks per student	zambia	language (std)	0.08***
textbooks	textbooks per student	chad	promotion	1,67***
textbooks	textbooks per student	civ	promotion	0.39***
textbooks	textbooks per student	madagascar	promotion	0.82***
textbooks	manuals per student	mali (manuals)	promotion	1,569***
textbooks	French textbooks per student	niger (French)	promotion	2.41***
textbooks	maths textbooks per student	niger (maths)	promotion	1.10***
textbooks	textbooks per student	tanzania	promotion	3.17***
textbooks	textbooks per student	togo	promotion	1.07***
multigrade	multigrade	togo	cepd (average)	-0.08***
multigrade	multigrade	chad	promotion	4,44***
multigrade	multigrade x textbooks	chad (multigrade*textbooks)	promotion	2,12***
multigrade	multigrade	civ	promotion	-2.82***
multigrade	multigrade	mali	promotion	- 1,15***
multigrade	multigrade	niger	promotion	-0.91***

CATEGORY	VARIABLE	COUNTRY	OUTCOME	COEFFICIENT
multigrade	multigrade	togo	promotion	-1.58***
double-shifts	double-shifts	civ	promotion	-18.51***
double-shifts	double-shifts	mali	promotion	- 6,46***
mother tongue	teachers trained in bilingualism (Arabic)	chad	promotion	1,14**
mother tongue	curricular pedagogy (partly in local language)	mali	promotion	1,02***
distance	distance (>2km)	madagascar (urban)	cepe (std)	0.01
distance	distance (>2km)	madagascar (rural)	cepe (std)	-0.02**
distance	distance (>2km)	madagascar	cepe (std)	-0.1***
distance	average km	togo	cepd (avg)	-0.08***
distance	average km	tanzania	psle (std)	-0.02**
distance	distance (average km)	chad	promotion	-1.13***
distance	distance (average km)	chad (rural)	promotion	-0,778***
distance	distance (average km)	chad (urban)	promotion	-1,24***
distance	distance (average km)	civ	promotion	-1,04***
distance	distance (average km)	civ (public/rural)	promotion	0.462*
distance	distance (average km)	civ (public/urban)	promotion	-0.296
distance	distance (>2km)	madagascar (public)	promotion	-0.62***
distance	distance (average km)	niger	promotion	0.04
distance	distance (average km)	niger (rural)	promotion	0.765**
distance	distance (average km)	tanzania	promotion	0.12
distance	distance (average km)	tanzania (rural)	promotion	-0.745***
distance	distance (average km)	tanzania (urban)	promotion	0.603**
distance	distance (average km)	togo	promotion	0.17
size/coverage	full-cycle	ghana	english (raw)	2.02***
size/coverage	full-cycle	ghana	language (raw)	1.88***
size/coverage	full-cycle	ghana	maths (raw)	2.47***
size/coverage	full-cycle	chad	promotion	0.01***
size/coverage	full-cycle	madagascar	promotion	0.87***
size/coverage	school size	madagascar	promotion	0.03***
size/coverage	school size	senegal	promotion	-0,01
size/coverage	school size	congo	promotion	-0.08***
seats/desks	seats per student	ghana	maths (std)	0.05***
seats/desks	seats per student	ghana	english (std)	0.06***
seats/desks	seats per student	ghana	ghanaian (std)	0.07***

CATEGORY	VARIABLE	COUNTRY	OUTCOME	COEFFICIENT
seats/desks	seats per student	madagascar (public)	cepe (std)	0.04***
seats/desks	seats per student	tanzania	psle (std)	0.03**
seats/desks	seats per student	togo	cepd (std)	-0.11*
seats/desks	seats per student	chad	promotion	3,59***
seats/desks	seats per student	civ	promotion	4.01***
seats/desks	seats per student	madagascar (public)	promotion	3.29***
seats/desks	seats per student	tanzania	promotion	0.90***
seats/desks	seats per student	togo	promotion	1.63***
conditions	in good condition (%)	ghana	maths (std)	0.0003***
conditions	in good condition (%)	ghana	english (std)	0.00030***
conditions	in good condition (%)	ghana	language (std)	0.00032***
conditions	in good condition (%)	madagascar	cepe (std)	0.021*
conditions	permanent classrooms (%)	togo	cepd (std)	0.00113*
conditions	permanent classrooms (%)	chad	promotion	0,346
conditions	in good condition (%)	civ	promotion	0.00047
conditions	in good condition (%)	madagascar	promotion	0.338***
conditions	permanent classrooms (%)	niger	promotion	0.404
conditions	permanent classrooms (%)	togo	promotion	0.00901***
electricity	functional electricity (%)	ghana	maths (std)	0.02**
electricity	functional electricity (%)	ghana	english (std)	0.07***
electricity	functional electricity (%)	ghana	ghanaian (std)	0.07***
electricity	access to electricity (%)	zambia	maths (std)	-0.03***
electricity	access to electricity (%)	zambia	english (std)	-0.02**
electricity	access to electricity (%)	zambia	zambian (std)	0.02*
electricity	access to electricity (%)	chad	promotion	0.64
WASH	water points (%)	chad	promotion	0.809***
WASH	functional latrines (%)	chad	promotion	0.02
WASH	latrines per 100 students	civ	promotion	0.462***
WASH	functional girls' latrines (%)	madagascar	promotion	0.892***
WASH	functional girls' latrines (%)	madagascar (girls)	promotion	0.790***
WASH	functional girls' latrines (%)	madagascar (boys)	promotion	0.857***
WASH	latrines (%)	mali (boys)	promotion	- 0,901***
WASH	latrines (%) x girl	mali (girls)	promotion	1,536***
WASH	latrines (%)	niger (boys)	promotion	0.039
WASH	latrines (%) x girl	niger (girls)	promotion	0.459**
WASH	pits per 100 pupils	tanzania	promotion	0.274***

CATEGORY	VARIABLE	COUNTRY	OUTCOME	COEFFICIENT
WASH	pits per 100 pupils	tanzania	promotion	0.277***
WASH	latrines (%)	tanzania (boys)	promotion	-0.189
WASH	latrines (%) x girl	tanzania (girls)	promotion	0.404**
WASH	access to drinking water	ghana	english (std)	0.046***
WASH	access to drinking water	ghana	language (std)	0.027***
WASH	access to drinking water	ghana	maths (std)	0.029***
WASH	access to water	zambia	english (std)	-0.003
WASH	access to water	zambia	language (std)	0.050***
WASH	access to water	zambia	maths (std)	0.017
WASH	menstrual changing room	ghana (boys)	english (std)	0.057***
WASH	menstrual changing room	ghana (boys)	language (std)	0.038***
WASH	menstrual changing room	ghana (boys)	maths (std)	0.057***
WASH	menstrual changing room x girl	ghana (girls)	english (std)	0.026
WASH	menstrual changing room x girl	ghana (girls)	language (std)	0.029
WASH	menstrual changing room x girl	ghana (girls)	maths (std)	0.007
WASH	provide sanitary towels	zambia (boys)	english (std)	0.032***
WASH	provide sanitary towels	zambia (boys)	language (std)	-0.023**
WASH	provide sanitary towels	zambia (boys)	maths (std)	0.026**
WASH	provide sanitary towels x girl	zambia (girls)	english (std)	0.019
WASH	provide sanitary towels x girl	zambia (girls)	language (std)	0.067***
WASH	provide sanitary towels x girl	zambia (girls)	maths (std)	0.025
WASH	functional girls' latrines (%)	madagascar	cepe (std)	0.023**
WASH	pits per 100 pupils	tanzania	psle (std)	0.005
WASH	latrines (%)	togo (boys)	cepd (average)	-0.013
WASH	latrines (%) x girl	togo (girls)	cepd (average)	-0.039
WASH	latrines per 100 students	zambia	english (std)	0.046***
WASH	latrines per 100 students	zambia	language (std)	0.017***
WASH	latrines per 100 students	zambia	maths (std)	0.045***
library	presence of library (%)	ghana	maths (std)	0.06***
library	presence of library (%)	ghana	english (std)	0.08***
library	presence of library (%)	ghana	language (std)	0.05***
library	presence of library (%)	tanzania	psle (std)	-0.01
library	presence of library (%)	zambia	maths (std)	0.07***
library	presence of library (%)	zambia	english (std)	0.09***
library	presence of library (%)	zambia	language (std)	-0.01
library	presence of library (%)	civ	promotion	0.311*

CATEGORY	VARIABLE	COUNTRY	OUTCOME	COEFFICIENT
library	presence of library (%)	tanzania	promotion	-0.222
canteen	presence of canteen (%)	civ	cepe (pass)	3.41***
canteen	presence of canteen (%)	madagascar	cepe (pass)	4.37***
canteen	presence of canteen (%)	chad	promotion	1,94***
canteen	presence of canteen (%)	civ	promotion	-0.60*
canteen	presence of canteen (%)	madagascar	promotion	1.48***
canteen	presence of canteen (%)	mali	promotion	0.83**
canteen	presence of canteen (%)	niger	promotion	-0.32

Source: EMIS and learning outcomes data analysed as part of Data Must Speak and Teachers for All Stage 1 reports. Links to reports provided in Annex 1. Values reported refer to the difference of average scores between groups of students (see Box 1).

Note: * p<0.1, ** p<0.05, *** p<0.01

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