DATA MUST SPEAK

Ghana

Unpacking Factors Influencing School Performance
UNICEF Innocenti – Global Office of Research and Foresight

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Unpacking Factors Influencing School Performance in Ghana
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Data Must Speak research coalition of donors:
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Executive summary
Executive summary

The Government of Ghana is dedicated to providing every Ghanaian child with the opportunity to succeed, firmly aligning itself with achieving the Sustainable Development Goal on education (SDG 4). To this end, the Ghana Ministry of Education (MoE) has developed the Education Sector Plan 2018–2030 (ESP) that establishes the vision for achieving equitable access to quality education and effectively managing education service delivery.

Beyond traditional sector analysis, MoE is invested in deepening its use of existing data to enhance education quality. The Data Must Speak (DMS) positive deviance research is a collaboration between MoE and the United Nations Children’s Fund (UNICEF) in service of these ambitious goals. The research aims to identify and scale local solutions already working in Ghanaian schools. The first step of this multi-stage research is to analyse administrative and examination data sets to understand the determinants of student exam performance. This report summarizes the results of this analysis, which leveraged the Education Management Information System (EMIS) and Basic Education Certification Examination (BECE) data sets over four years (2017/18 to 2020/21).

The education sector in Ghana faces many challenges, the key among which is low student learning levels. For example, a nationally representative survey showed that in 2018, only 19 per cent of grade 4 students met the proficiency cut point for mathematics, and nearly half failed to achieve the minimum competency level. Results were similarly low for grade 6 pupils – only 22 per cent met the proficiency threshold in mathematics, and over a third failed to achieve minimum competency.

Stage 1 of the research aims to understand what influences student learning, a first step in identifying ways to improve it. It leverages multivariate regression analysis to model various factors influencing BECE exam performance in Ghanaian schools.

Key findings from this analysis include:

**Student characteristics influencing exam performance**

Higher student attendance is associated with better exam performance, signalling the importance of appropriate instructional time for student learning.

Encouragingly, and in line with Ghana’s commitment to equality in educational outcomes, boys’ and girls’ exam performances are comparable across subjects. While boys outperformed girls in mathematics in the past, this gap has vanished over time. In English and Ghanaian languages, there are no gender performance gaps.

**Teacher characteristics influencing exam performance**

Teacher academic and professional qualifications are positively associated with student exam performance. All other things equal, students are expected to perform better when taught by teachers with at least a diploma, compared to those with lower official qualifications.

Student exam performance in the BECE exams is associated with teacher gender in different ways. For instance, an increase in the proportion of male teachers in a school is positively
associated with boys’ performance. For girls, this relationship varies by subject. While further research is needed to understand how and why teacher gender interacts with student learning, these trends suggest that gender norms and expectations may influence the interactions.

**Headteacher characteristics influencing exam performance**

Female headteacher-led schools outperform their male-led counterparts in BECE exams, particularly in English. Understanding what these female leaders are doing differently could unearth scalable behaviours and practices for improving learning.

**School characteristics influencing exam performance**

Various infrastructural inputs such as libraries, sufficient seats for students, access to sanitation facilities, access to drinking water and functional electricity, are all positively associated with exam performance.

**Other characteristics influencing exam performance**

Urban schools outperform their rural counterparts, and private schools consistently outperform public schools. For instance, after controlling for various school, teacher and student characteristics, there is a 14 raw BECE point performance gap between private urban schools (the best performers) and rural public schools (the worst performers) in English. Persisting gaps in performance between different types of schools underscore the importance of embedding equity-focused policies and programmes in education planning.

There are significant fluctuations in exam performance across the years. For instance, all other things equal, there was a 13-point difference in average student performance between 2018/19 and 2019/20 in mathematics. This trend suggests differences in exam difficulty year to year, which has additional implications for equity.

This first stage of the DMS positive deviance research surfaced important insights that offer avenues for further research and implications for education policy in Ghana. Future stages will complement this analysis with primary data, both quantitative and qualitative, to identify ‘positive deviant’ schools and learn from their behaviours and practices.

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1. Academic qualifications are degrees or certificates that are non-teaching related. Professional qualifications are teaching credentials obtained from an accredited teacher training institute. Specifically, a professional diploma for a basic schooling teacher is usually a three-year degree called the Diploma of Basic Education, obtained from accredited institutions called Colleges of Education.
1. Introduction
The Government of Ghana is committed to giving every Ghanaian child the opportunity to succeed and contribute to national development. It recognizes that education is critical to achieving this goal, and has made improving the quality of education a national priority. Although Ghana has made rapid strides in expanding access to education since independence, there is still work to be done to enhance its quality. Learning assessments indicate that many Ghanaian students are not learning in schools, starting from foundational learning all the way up to more advanced skills. Thus, improving learning outcomes is an important goal identified by the Ghana Ministry of Education (MoE) in its most recent Education Sector Plan (ESP).

MoE is interested in producing evidence to identify effective strategies for improving education in the country. The Data Must Speak (DMS) positive deviance research is an innovative collaboration between MoE and the United Nations Children’s Fund (UNICEF) aiming to identify and scale local solutions already working in Ghanaian schools.\(^2\)

The ‘positive deviance’ methodology is rooted in the premise that there are individuals in every community whose behaviours and practices help them find better solutions to the same problems their peers face, despite operating in similar circumstances (Herington and Van De Fliert 2018, as cited in Lézano et al. 2022). This research extends the positive deviance methodology to the education sector in Ghana, and aims to understand why some schools are performing better than their peers even when operating in similar conditions and with equivalent access to resources.

The research is a multi-stage, mixed-methods exercise, which compares schools with similar characteristics but different performance outcomes to identify differences in stakeholder behaviours and practices. There are four in-country stages which leverage both quantitative and qualitative methods. In Stage 1, secondary data are analysed to understand what factors correlate with Ghana’s school performance. Stage 2 builds on Stage 1 to identify which schools are positive deviants, i.e., obtaining higher results despite operating with similar resources and contexts to their peers. In Stage 3, the research team will visit the positive deviant schools and a control group of average-performing schools and collect primary data to understand how positive deviant schools differ from their peers and what behaviours and practices they use to achieve higher performance. Finally, Stage 4 will identify concrete levers and incentives at the system, policy, school and community levels to scale the identified positive deviant behaviours and practices in other schools.

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\(^2\) For more information on DMS, see <www.unicef.org/education/data-must-speak>.
This report summarizes key findings from Stage 1 of the research, and is divided into five sections. Section 1 introduces the report, section 2 provides a brief overview of the education context in Ghana, section 3 details the methodology and data use, section 4 discusses the key results from this analysis, and section 5 proposes emerging policy areas for further exploration.
2. Ghanaian education context
Education in Ghana is overseen by the MoE at the centre and supported by various national agencies. The Ghana Education Service implements policies formulated at the centre via an extensive network of regional and district-level offices for pre-tertiary education. Private education coexists with the public system, accounting for 30 per cent of enrolment in 2020 (World Bank 2022).

The education system follows a 2-6-3-3-4 structure with five levels of education: two years of kindergarten, six years of primary school, three years of junior high school (JHS), three years of senior high school (SHS) and four years of tertiary education. Basic education, composed of kindergarten, primary and JHS, is free and compulsory for all. At the senior secondary level, students can opt for an academic track via SHS or follow a technical or vocational track. In September 2017, SHS was also made free for all. However, while the Government covers school fees, there are other additional costs (school uniforms, books, meals etc.) that must still be covered by households.

Ghana typically runs a two-term education system from September to June. The two terms are bridged by a 10–12 week-long end-of-year break. MoE changed the academic calendar to a three-term system during the COVID-19 pandemic, but is expected to revert to the two-term system in 2023. Overall, Ghanaian students engage in a 48 week-long academic year, consistent with other countries in the region.

The Government of Ghana finances the majority of its education sector, more so than any other west African country (Ghana, MoE 2019b). Worryingly, however, the allocation to MoE has recently seen a significant drop, particularly for basic education. Ghana spent 14 per cent of its national budget on education in 2020, a decrease from the 17–23 per cent expenditure in the preceding years. Of the education spending in 2021, 74 per cent was funded by the Government (Ghana, MoE and UNICEF 2021). Primary education accounts for the largest share of education spending, although recently expenditure on JHS and SHS has been rising. A significant proportion of the budget is spent on staff compensation, with little money allocated to purchasing goods and services.

2.1. Current education challenges

Ghana has made massive progress in increasing access to education for all children (World Bank 2019). Gross enrolment rates at the primary level are over 100 per cent, and over 85 per cent for JHS. Access to secondary education has also increased over time, particularly since the launch of free SHS for all. However, regional-, income- and gender-based inequities in access remain (Ghana, MoE 2019a). While Ghana has achieved national gender parity at all basic education levels, regional disparities proliferate.

There remain various challenges with basic education, key among which is low learning outcomes across all levels. The Ghana National Education Assessment showed that in 2018, only 19 per cent of grade 4 pupils met the proficiency cut point for mathematics, and 48 per cent of pupils failed to achieve the minimum competency level. Results were similarly low for grade 6 pupils – only 22 per cent met the proficiency threshold in mathematics, and 35 per cent failed to achieve minimum competency (Ghana, MoE 2019c). Early Grade Reading Assessment results show low reading proficiency, and Early Grade Mathematics Assessment results reveal difficulties with conceptual knowledge classes. Similarly, Basic Education

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3 From the school year 2019/20 to 2022/23, MoE changed the school calendar to three terms from January to December, which were bridged by three- to four-week-long holidays due to COVID-19-related disruptions.
Certification Examination (BECE) results also vary by region and gender (see section 4).

In its Education Sector Analysis (Ghana, MoE 2019a), MoE identified various reasons for the persisting low learning levels, including inadequate teacher knowledge and ineffective teacher management. Teacher absenteeism and low time-on-task directly affect instructional time, and are recognized as critical hurdles to learning. Teacher deployment is inequitable, with high variance in pupil-teacher ratios (PTRs) and teachers frequently placed in schools where they are not proficient in the language of instruction (Akseer and Játiva 2021). While various decentralized education management structures exist, they are often under-resourced and lack coordination, resulting in inefficient education management and weak accountability systems (World Bank 2019).

The Government recognizes these myriad challenges, many of which are shared by other countries in the region, and has taken various steps to improve education quality in the country. For instance, in 2017, MoE launched the World Bank/IDA-supported Ghana Accountability Outcomes Project to improve the quality of education in low-performing schools and strengthen equity and accountability in the sector. In addition, in 2018 MoE also initiated education reforms to enhance learning, which straddled 12 critical areas, including teacher education, curriculum reform, decentralization, information and communication technology in education, and reforms to secondary education and technical and vocational education and training.

**Box 1**

**Examinations and large-scale assessments in Ghana**

In Ghana, the West African Examinations Council (WAEC) leads the design, implementation, and analysis of two critical standardized national examinations: BECE held at the end of JHS, and the West African Senior Secondary Certificate Examination (WASSCE) held at the end of SHS.

BECE and WASSCE are used for certification and selection into later stages of education. Specifically, BECE moderates selection into SHS and technical institutes in Ghana, and WASSCE does the same into tertiary education. BECE exams are taken by students in the third year of JHS, and WASSCE for students in the third and final year of SHS. They both involve external examinations that are nationally implemented and assessed.

In addition to its sprawling examinations infrastructure, Ghana has conducted various large-scale assessments: the Early Grade Mathematics Assessment and Early Grade Reading Assessment for grade 2, the National Education Assessment for grades 4 and 6, and the Trends in International Mathematics and Science Study (TIMMS) for grade 8 (Raudonytė 2021). These are sample-based assessments funded by various international organizations, contextualized for Ghana and implemented by national bodies. These learning assessments have informed the curriculum framework, teaching and learning materials, and various active education programmes.

Finally, MoE has ambitious plans for implementing new national standardized tests for grade 2 (introduced in 2022), grade 4 (introduced in 2021), and grade 6 (proposed and yet to be launched).
2.2. Government policy priorities

ESP 2018–2030 sets the vision for the education sector in Ghana and strategies for achieving this vision over a 12-year period. ESP intentionally aligns the country with a path for achieving SDG 4, African Union Agenda 2063 and the overall National Development Plan, and establishes both long-term vision and medium-term visions. It represents strategies to realize three guiding policy objectives of the Government:

**Policy 1**

Improved equitable access to and participation in inclusive quality education at all levels.

**Policy 2**

Improved quality of teaching and learning and science, technology, engineering and mathematics (STEM) at all levels.

**Policy 3**

Sustainable and efficient management, financing and accountability of education service delivery (Ghana, MoE 2019c).

Various programmes and policies exist within all levels of education to achieve these key MoE priorities. The DMS positive deviance research was conceptualized to contribute to the evidence base required by MoE to deliver on its ambitious mandate.
3. Methodology and data
Methodology and data

3.1. Methodology and research question

Across its stages, the DMS positive deviance research uses mixed methods to answer a series of research questions, detailed in Appendix G. Stage 1 – results from which are presented in this report – seeks to answer the following research question:

What resources and contextual factors are associated with school performance in Ghana?

In Stage 1, this research question was tackled by conducting secondary data analyses of existing administrative and examination data sets collected and maintained by MoE and WAEC.  

Multivariate regression analysis was used to understand the relationships between school performance, available resources, and prevailing contexts in Ghana. The following regression model was estimated:

\[ Y_{i,j,k} = \beta_0 + \beta_1 \text{Student}_{i,j,k} + \beta_2 \text{Teacher}_{i,k} + \beta_3 \text{School}_{i,k} + \beta_4 \text{Other}_{i,k} + \beta_5 \text{District}_{i} + \beta_6 \text{Year}_{k} + \epsilon \]

Where,

- \( Y_{i,j,k} \) represents performance in school \( i \), for students of gender \( j \) (male or female), in year \( k \) as measured by the average scores in BECE examinations in mathematics, English and Ghanaian languages.
- \( \text{Student}_{i,j,k} \) represents a set of independent variables depicting averaged student characteristics in school \( i \), for students of gender \( j \) (male or female), in year \( k \).
- \( \text{Teacher}_{i,k} \) are a set of variables representing averaged teacher characteristics in school \( i \) for year \( k \).
- \( \text{School}_{i,k} \) are a set of variables representing school-level characteristics for school \( i \) in year \( k \).
- \( \text{Other}_{i,k} \) are a set of variables representing other contextual information for school \( i \) in year \( k \).
- \( \text{District}_{i} \) are unobserved time-invariant heterogeneities across each district \( l \) in which school \( i \) is located (district fixed effects).
- \( \text{Year}_{k} \) are unobserved time-invariant heterogeneities across each year \( k \), four years ranging from 2017/18 to 2020/21 (year fixed effects).
- \( \epsilon \) is the stochastic error term.

For more information on WAEC, see <www.waecgh.org>.
In close collaboration with MoE and various education stakeholders, student learning outcomes were identified as an important indicator to represent school performance in Ghana.

Indicators depicting internal efficiency of the school system, such as promotion, repetition and dropout rates, were also considered, but ultimately discarded for different reasons. Promotion rates are not as meaningful in the Ghanaian context due to the recent enactment of automatic promotions. Repetitions and dropouts could not be analysed due to inconsistent data and lower prevalence in basic education.

Hence, the dependent variable representing school performance was defined as the average BECE exam score – conducted after the final JHS year – in mathematics, English and Ghanaian languages. This analysis used BECE exams because JHS years are some of the most critical years of schooling in Ghana, determining an essential milestone in the academic lifecycle of a student.

Both the raw and standardized BECE exam scores were used to facilitate a more complete understanding. Maths, English and Ghanaian languages were chosen to understand foundational literacy skills, which is an area of focus for the Government and for the DMS research. As such, the BECE scores represent grade 9 student performance (J3, the final year of JHS) and is a grade-level metric. However, as in most countries, exams at the end of a schooling cycle are a means to measure learning throughout that school cycle. Ultimately, this analysis draws conclusions about JHS-level learning for all schools in the country.

All independent or explanatory variables included in the analysis were calculated at JHS level and refer to the characteristics of either students (gender, age, etc.), teachers (age, qualification, etc.) or schools (size, governance, etc.). Independent variables were chosen based on their relevance to the research question (as determined by underlying education theory and the extensive education and policy experience of the research team), their variability and important data considerations.

District and year fixed effects were included in the regression models to account for inherent differences between various Ghanaian districts and across years. For instance, by adding year fixed effects, the analysis can account for 2020 being an atypical school year due to the COVID-19 pandemic, and yet extract meaningful correlations between school performance and selected independent variables.

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5 The automatic promotion policy systematically promotes all children to the next grade, regardless of exam performance or learning levels at the end of the school year.
6 Examination scores from earlier grades (earlier than grade 9) are desirable for investigating foundational learning. However, the BECE exam is Ghana’s earliest consistent, annual and standardized exam. Hence, this was the earliest grade of multi-year data available. MoE recently (in 2022) launched a National Standardized Test for grade 4 students; however, only one year of this data is available. It was decided to use BECE data to investigate trends over time.
7 Variables with low variation were not included in the models because they contribute little to the results and may introduce multicollinearities. For example, the proportion of repeaters in J3 was considered but dropped due to limited variation (less than 2 per cent).
8 Variables that were missing many observations or had a high number of obvious errors were discarded to avoid biasing the analysis. For example, data on water, sanitation and hygiene facilities were missing information for 37 per cent of schools, and were discarded to avoid dropping these schools from the regression analysis sample.
Various other robustness checks were conducted to ensure results are consistent across different models. These robustness checks are discussed in Appendix C.

This analysis offers a unique opportunity to use existing secondary data to understand the state of the education system in Ghana. Since it leverages administrative data sets, it includes thousands of observations over time. This makes it one of the biggest samples in education research in Ghana in recent years, offering high internal validity to make meaningful and contextualized recommendations for education policy in Ghana.

### 3.2. Data and sample

This analysis leverages four years of Education Management Information System (EMIS) data from 2017/18–2020/21, and the four corresponding years of WAEC data containing student BECE examination scores in mathematics, English and Ghanaian languages.

Ghana’s EMIS contains information across a comprehensive set of variables, including school location and context, teacher characteristics, learning resources, school infrastructure and resources, and student characteristics. In addition, the WAEC data contained student-level examination scores across subjects linked to student gender and school.

In order to run the analysis, the EMIS data was combined with the BECE examination data, a complex process as each data set uses a different unique code (ID) to identify schools. Furthermore, there is no key linking these unique IDs with each other. For instance, a hypothetical school X may have code 123 in the EMIS data and code 876 in the BECE data. Hence, as a first step, the data sets had to be merged (by using other information such as school name, location, etc.), such that the EMIS characteristics of school X could be combined with the BECE exam performance of school X.

The two data sets were linked using a technique called ‘fuzzy merging’.

While this process merged many schools between the BECE and EMIS data sets, it was not possible to link all schools. Additionally, even within the EMIS data set, school IDs were inconsistent across years (e.g., IDs were different in the year 2017/18 compared to other years). Hence, even within the EMIS data set, school data had to be connected across years using fuzzy merging to follow schools over time. For example, school X may have code 123 in 2017/18 but code 245 in the other three years, requiring fuzzy merging to combine these years.

Across the four years included in this analysis, 80–88 per cent of schools were successfully linked between the BECE and EMIS databases. However, despite connecting over 80 per cent of schools in a given year, many schools are not consistently followed across all four years in the regression analysis. This was due to missing information on independent variables included in the regression analysis.

The final analysis sample included two observations for a given school per year, disaggregated by gender. Schools were followed for one to four years, depending on successful linking across years and based on missing information on variables. The final regression sample had 74,661 observations, representing data on 14,124 unique schools, some followed across all four years, some over three years, some over two years and some for just a single year. Appendix F provides more details on the merging process and the final regression sample.

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9 Fuzzy merging is the process of matching two variables based on comparing strings, generally across multiple variables. In this analysis, for example, schools in the EMIS and BECE data sets were matched based on school name, region and district where they are based.
3.3. Limitations of the research

Like all studies using similar methodologies, Stage 1 of the DMS positive deviance research has limitations that are important to consider while interpreting the results.

First, the associations between school, teacher and learner characteristics and school performance represent correlations, and do not necessarily signal the existence of a causal link. For example, the data show that exam performance in Ghanaian languages is marginally higher when teachers are younger. However, this does not necessarily mean that hiring or retaining younger teachers will improve exam performance. Instead, it could be that schools with younger teachers have more consistent trainings and other teacher collaboration policies, all of which could contribute to higher exam performance. Hence, the presented results are not necessarily causal, and must be considered in tandem with other similar research and available analyses. Future stages of this research will also aim to bolster the findings of this first phase.

Secondly, the available data capture information on some, but not all, factors that influence learner performance. Other observed or unobserved factors, such as the family or socioeconomic characteristics of the learners or the different behaviours and practices of school stakeholders, may also influence exam performance but are not captured in the data. Hence, while the data models used provide valuable insights, they do not fully explain the determinants of learner performance. In Stage 3 of this research, additional primary data will be collected to complement this analysis and obtain deeper insights into the determinants of learner performance.
4. Discussion of findings
Discussion of findings

This section first discusses the profile and exam performance of schools in the analysis database, and then presents results from six main econometric models which used the raw and standardized BECE results for JHS students in three subjects: mathematics, English and Ghanaian languages.

4.1. Descriptive statistics – school types and exam performance

The analysis was conducted at the JHS level. Therefore, the descriptive statistics in this section describe the JHS schooling experience in Ghana, and are based on the sample of schools that were successfully merged between the EMIS and BECE databases across four years (80–88 per cent of schools merged each year).10

In 2018, Ghana held a referendum to create new regions in the country, shifting from 10 regions to 16 regions as a result. As this analysis uses data from before and after the 2018 referendum, the older regional classification (10 regions) is used for consistency. However, since the data comes from most Ghanaian schools nationwide, it is possible to extrapolate the findings to the new regions (including the additional six that were carved out in 2018).

4.4.1. School type and location

Most JHS schools in Ghana are public and rural. A total of 69 per cent of all JHS schools are public schools, and a little over half (53 per cent) are in rural locations. Private schools are largely located in urban areas – over 70 per cent of private schools are urban. Figure 2 shows the regional variation in school location.

Figure 2: School type and location by region in 2020/21

Source: EMIS 2020/21

10 The descriptive statistics in this section are computed from the entire sample of schools that were successfully merged between the EMIS and BECE databases over four years. These statistics are not restricted to only the schools that were included in the multivariate regression analysis sample.
JHS enrolment varies across schools. In 2020/21, the average JHS had 107 students. A quarter of schools had less than 52 students enrolled in JHS, and half the schools had 52–136 students. Most schools in the largest quarter by enrolment had 137–438 students. As expected, JHS schools in urban areas are larger (122 versus 93 students in rural areas); and public schools are almost twice as large as private schools (126 versus 65 students). There is also regional variation in enrolment.\(^{11}\)

There is no gender gap at the national level in student enrolment, showing encouraging progress by Ghana along SDG 4.2 on ensuring girls and boys have equal access to education. However, disaggregating this national metric reveals gender differences. For instance, in rural areas, there are more boys enrolled in JHS (49 boys versus 44 girls), and in urban areas, there are more girls enrolled in JHS (63 girls versus 60 boys).

Not all enrolled students sit for the BECE exam. In 2020/21, roughly 82 per cent of students in J3 sat for the BECE exam. There was no gender difference in student participation. Public and private schools also had comparable exam turnouts – 82 per cent of public school J3 students versus 81 per cent of private school J3 students sat for the exam. There were also some regional variations: Eastern had the lowest BECE participation rate (79 per cent), and Upper East had the highest (85 per cent).

4.1.2. Basic Education Certification Examination performance in Ghana\(^{12}\)

Nationally, the average BECE exam performance is low, particularly in English. In 2020/21, the average JHS student scored 49 per cent in mathematics, with a quarter of the students scoring below 34 per cent. Students did better in Ghanaian language exams, where the average score was 59 per cent. However, student performance in English was also poor – average scores were 37 per cent, with three quarters of students scoring below 44 per cent.

Exam performance varies over time and across regions. Maths and English scores vary over the years, whereas performance in Ghanaian languages is relatively stable. Figure 3 shows national BECE trends across the academic years 2017/18 to 2020/21.

Significant regional variation in exam scores highlights inequities across the country. For instance, in 2020/21, the highest-scoring region scored almost twice the lowest-scoring in maths – 63 per cent in Brong-Ahafo versus 31 per cent in Upper West. In addition, Upper West, Upper East and Volta perform poorly across subjects, indicating a need for additional attention and support.

Additional summary statistics on all other variables used in the multivariate analysis are included in Appendix B.

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\(^{11}\) Northern has the largest schools (149 students), followed by Upper East (121 students), Ashanti (119 students) and Greater Accra (111 students). On the other hand, Eastern and Central have the smallest schools (93 students). This variation is partly explained by the proportion of urban and public schools (the latter of which tend to be larger) in a region.

\(^{12}\) All summary statistics in this sub-section are weighted by size of JHS by enrolment (number of students enrolled at JHS). This was done to reflect the average student experience in JHS and to ensure that smaller schools do not disproportionately influence the estimates.
Figure 3: BECE exam scores over time

Source: BECE scores from 2017/18–2020/21. Calculations made by authors, representing an average of averages (average computed from school-level average exam scores). All point estimates weighted by size of JHS (number of students enrolled in JHS).

Figure 4: Regional variation in BECE exam scores in 2020/21

Source: BECE scores from 2017/18–2020/21. Calculations made by authors, representing an average of averages (average computed from school-level average exam scores). All point estimates weighted by size of JHS (number of students enrolled in JHS).

Note: The vertical red line in each panel indicates the national average score.
4.2. Determinants of exam performance in Ghana

In this section, results from the econometric models are grouped and presented by student, teacher, school level and other miscellaneous characteristics. The regression output table is included in Appendix A.

4.2.1. Student characteristics

A large and global body of research shows that student characteristics are associated with education outcomes (World Bank 2018). For this analysis, the available data allowed an exploration of relationships between exam performance and student characteristics, such as attendance and gender.

Across countries, evidence reinforces the importance for learning of student attendance. Higher attendance contributes to higher instructional time, which is critical for student learning (Cattaneo et al. 2016; Rodrigues-Segura and Mbiti 2022). In Ghana, in 2020/21, average student attendance, as captured in the EMIS, was 76 per cent. In other words, the average JHS student attended 76 per cent of school days in an average month. At the national level, girls and boys had similar attendance (boys were more likely to attend by only 1 percentage point). Attendance was also similar across private and public schools, and urban and rural schools.

Figure 5: Regional variation in student attendance in 2020/21

Source: EMIS 2020/21. Calculations made by authors, representing an average of averages (average computed from school-level averages). All point estimates weighted by size of JHS (number of students enrolled in JHS).

Note: The vertical red line indicates the national average attendance in 2020/21.

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13 While the EMIS questionnaire asks about the preschool experiences of students entering grade 1; this cannot be tied to the experiences of grade 7 students. There are no questions collecting information about students’ socioeconomic backgrounds.

14 In the EMIS data set, attendance is captured for one ‘usual’ month (the month of February). It represents the average attendance – the percentage of school days attended by a student – for all students in JHS in each school in this ‘usual’ month. This figure is used as a proxy to understand average attendance during the regular school year.
The association between two variables (in this instance exam performance and student gender) is often standardized to facilitate comparability across different studies and samples. Comparison is possible because standardized values are unitless. For instance, it may be possible to compare results from this study to a similar study in a different country, if they both report results in SDs, and have samples with similar distributions. Each variable in the regression analysis (such as exam scores, student characteristics, teacher characteristics and school characteristics, etc.) is standardized by subtracting the variable’s mean from the observed value and then dividing by the variable’s SD (spread of data). Regression analysis is then run on these standardized values.

T-tests to test the equality of means show a statistically significant difference (at the 5 per cent level of significance) in girls’ and boys’ performance from 2017/18 to 2019/20, and no significant difference in 2020/21.

Boys outperformed girls in mathematics in the past; however, this gap has narrowed over time. Boys’ mathematics performance was higher than that of girls from 2017/18 to 2019/20, but by 2020/21 there were no significant differences in their BECE exam scores (see Figure 6).

Students that do not attend school are exposed to lower instructional time, affecting their learning.

Student attendance varies across regions. For example, students in Upper East attend school the least regularly, with girls missing school more than boys. Northern has the largest gender gap in attendance (with girls’ attendance higher than boys), followed by Greater Accra (with boys’ attendance higher than girls). Figure 5 shows regional trends in student attendance for boys and girls in 2020/21.

Higher student attendance is associated with better exam performance. Increasing student attendance from the prevailing 76 per cent to 100 per cent is associated with a corresponding improvement of 0.93 raw BECE points (0.05 standard deviations [SD]) in mathematics, 0.83 raw points (0.07 SD) in English and 0.87 raw points (0.06 SD) in Ghanaian languages.

While attendance has improved over the four years tracked in this research (from 65 per cent in 2017/18 to 76 per cent in 2020/21), there remains scope for further improvement, particularly in certain regions. Students that do not attend school are exposed to lower instructional time, affecting their learning.

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Figure 6: National BECE trends over time by gender

Source: BECE scores from 2017/18–2020/21. Calculations made by authors, representing an average of averages (average computed from school-level average exam scores). All point estimates weighted by size of JHS (number of students enrolled in JHS).

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15 The association between two variables (in this instance exam performance and student gender) is often standardized to facilitate comparability across different studies and samples. Comparison is possible because standardized values are unitless. For instance, it may be possible to compare results from this study to a similar study in a different country, if they both report results in SDs, and have samples with similar distributions. Each variable in the regression analysis (such as exam scores, student characteristics, teacher characteristics and school characteristics, etc.) is standardized by subtracting the variable’s mean from the observed value and then dividing by the variable’s SD (spread of data). Regression analysis is then run on these standardized values.

16 T-tests to test the equality of means show a statistically significant difference (at the 5 per cent level of significance) in girls’ and boys’ performance from 2017/18 to 2019/20, and no significant difference in 2020/21.
For instance, in 2017/18, the average BECE score for boys was 2 percentage points higher than for girls (46 versus 44), whereas in 2020/21 the difference was negligible (49.4 versus 49.2).

**Boys’ and girls’ exam performance is comparable in English and Ghanaian languages.** Across both subjects, BECE exam performance has been similar over the years.\(^{17}\)

**While nationally there were limited gender differences in exam performance across subjects, there were some regional variations.** For instance, in Upper West, notably the lowest-performing region in the country, boys significantly outperform girls across subjects. **Figure 7** depicts regional gender gaps across subjects in 2020/21.

Lower female performance in mathematics in certain regions may be related to harmful norms around STEM subjects and girls (Salikutluk and Heyne 2017; United Nations Educational, Scientific and Cultural Organization [UNESCO] 2020) or differential time to study at home (Björkman-Nyqvist 2013). Further investigation is needed to understand why these trends persist.

**Figure 7:** Gender differences in student performance in 2020/21

![Graph showing gender differences in exam performance across regions in 2020/21](image)

**Source:** EMIS 2020/21. Calculations made by authors, representing an average of averages (average computed from school-level average exam scores). All point estimates weighted by the size of JHS (number of students enrolled in JHS).

**Note:** The gap in exam performance was calculated as boys score - girls score. A positive gap signifies that boys outperform girls.

\(^{17}\) Similarly to mathematics, T-tests were conducted to test the equality of means in girls’ and boys’ exam performance. In English, there is no statistically significant difference (at the 5 per cent significance level) across all years. In Ghanaian languages, there is a statistically significant difference (at the 5 per cent significance level) in 2017/18 and 2018/19, but it is of limited practical magnitude (0.3 raw point difference). There is no statistically significant difference in performance between 2019/20 and 2020/21.
4.2.2. Teacher characteristics

The analysis modelled various teacher characteristics to understand which dimensions are related to student exam performance. Specifically, teachers’ gender and their academic and professional qualifications, and PTRs in JHS classrooms, were analysed.

**Teacher gender**

The teacher workforce in JHS schools is largely male, particularly in rural areas. Only a quarter of the JHS teachers are women (24 per cent). This is a substantial decrease from the primary levels, where almost 45 per cent of teachers are women (UNESCO Institute for Statistics 2022). Female teachers in Ghana are more likely to work in urban (see Figure 9) and public schools (see Figure 11).

Student exam performance varies with teacher gender, including differences between girls and boys. Figure 8 shows how boys’ and girls’ BECE exam performance varies with teacher composition by gender.

**Figure 8: Variation in average examination scores by teacher gender ratio**

![Graph showing variation in average examination scores by teacher gender ratio](image)

**Source:** EMIS and BECE scores 2017/18–2020/21. Calculations made by authors, representing an average of averages (average computed from school-level averages).

**Note:** The width of line represents the 95 per cent confidence interval for estimates, meaning we can be 95 per cent confident that the true population mean is contained within this interval. The x-axis represents increasing proportion of female teachers in JHS (ranging from 0 female teachers to 100 per cent female teachers.) The y-axis represents the predicted BECE scores. The three panels represent trends by subject. In each panel, moving from left to right, the graph indicates predicted BECE performance as the proportion of female teachers in JHS increases.
The proportion of female teachers in a school is negatively associated with boys’ exam performance. For girls, exam performance is negatively associated or unassociated with the proportion of female teachers. As the proportion of female teachers increases, boys are predicted to perform worse across subjects. However, for girls, this trend varies. For instance, in mathematics and Ghanaian languages, girls’ exam performance is negatively associated with the proportion of female teachers in the school. However, their exam performance in English is relatively consistent, regardless of teacher gender.

These national-level trends could be driven by various underlying characteristics or differences in how female and male teachers interact with the education system. They are unrelated to teacher qualifications, which are similar across male and female teachers (see Table 1). Further research is needed to unpack the causes behind these trends.

There are subject-specific variations in how teacher gender influences girls’ and boys’ exam performances differently.

- **Mathematics**: In mathematics, there is no difference in how girls’ and boys’ scores are influenced by teacher gender. In both cases, students are predicted to perform almost 3 raw points (0.18 SD) higher in schools with all male teachers compared to all female teachers.

- **English**: In English, girls are unaffected by teacher gender, yet the proportion of female teachers negatively influences boys. For instance, boys are predicted to perform 1 raw point (0.1 SD) higher in a school with all male teachers as compared to all female teachers. For girls, the scores remain largely the same.

- **Ghanaian languages**: Both boys’ and girls’ scores are negatively associated with the proportion of female teachers in the school. However, this is true to a greater extent for boys. For instance, boys are predicted to perform 2.2 raw points (0.15 SD) higher with all male versus all female teachers, whereas for girls, this difference is only 0.8 raw points (0.06 SD).

The trend of scores decreasing as the proportion of female teachers in a school increases exists in urban schools but not rural ones. In rural schools, student exam performance is either unassociated or positively associated with teacher gender. Figure 10 depicts the urban versus rural trends for English, but the same is true across subjects (see graphs in Appendix E). Similarly, the negative association between student scores and the female teacher composition of a school workforce is stronger in private schools than in public schools. Since most private schools (70 per cent) are in urban areas, this is likely directly related to the urban-rural differences discussed above.

Why does student performance vary by teacher gender? There could be various reasons for these trends. For example, prevailing gender norms may influence how girls and boys interact with their teachers based on teacher gender. Alternately, these trends may reflect different levels of preparation of teachers in urban versus in rural schools. Some of these findings may also be driven by the low proportion of female subject teachers in JHS, or the types of schools with a higher proportion of female teachers. In general, the proportion of female teachers working at the JHS level is relatively low in Ghana – only 24 per cent nationally – and this number is likely lower for specific subjects. Further research is needed to unpack these gender dynamics.
Figure 9: Urban and rural teacher profiles in JHS in 2020/21

Teachers that... (%)

- have a permanent contract: 96.8 (Urban), 96.1 (Rural)
- are women: 19.3 (Urban), 29.1 (Rural)
- have a professional diploma: 81.3 (Urban), 57.6 (Rural)
- have an academic diploma: 69.9 (Urban), 57.3 (Rural)

Source: EMIS 2020/21. Calculations made by authors, representing an average of averages (average computed from school-level averages).
Figure 10: Urban versus rural schools’ English exam scores by teacher gender ratio

Source: EMIS and BECE scores from 2017/18–2020/21. Calculations made by authors, representing an average of averages (average computed from school-level averages).

Note: The width of line represents the 95 per cent confidence interval for estimates, meaning we can be 95 per cent confident that the true population mean is contained within this interval. The x-axis represents increasing proportion of female teachers in JHS (ranging from 0 female teachers to 100 per cent female teachers). The y-axis represents the predicted BECE scores. The three panels represent trends by subject. In each panel, moving from left to right, the graph indicates predicted BECE performance as the proportion of female teachers in JHS increases.

Teacher professional and academic qualifications

To become a professional teacher for basic schooling in Ghana, the minimum qualification required is a Diploma in Basic Education obtained from an accredited higher educational institution for training teachers.18 In addition to professional teachers, there are non-professional teachers who are individuals with either just a senior secondary leaving certificate or diplomas from accredited technical universities (Buabeng et al. 2020). Nationally, 64 per cent of teachers have at least an academic diploma, and 70 per cent have at least a professional diploma.

Public school teachers have higher official qualifications than private school teachers. On the other hand, male and female teachers have comparable qualifications. For instance, 92 per cent of public teachers have a professional diploma compared to 19 per cent of private school teachers. This is consistent with the trend in many low- and middle-income countries, where public teacher roles require higher qualifications than private sector teaching roles. There are marginal differences in qualifications between female and male teachers (Table 1) and substantial differences between urban and rural teachers (Figure 9).

18 There are many pathways for individuals to become professional teachers. In addition to the three-year DBE from accredited institutions, there are options such as a two-year post-DBE for teachers who already have a DBE, a four-year bachelor’s degree, a two-year DBE (sandwich) programme and a distance education programme.
Table 1: JHS teacher qualifications profile by gender in 2020/21

<table>
<thead>
<tr>
<th>Teacher has...</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Academic qualifications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Senior Secondary Leaving Certificate or lower</td>
<td>30%</td>
<td>31%</td>
</tr>
<tr>
<td>At least a diploma</td>
<td>67%</td>
<td>64%</td>
</tr>
<tr>
<td>Other qualifications (technical/vocational)</td>
<td>3%</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Professional qualifications</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education certificate or other</td>
<td>23%</td>
<td>30%</td>
</tr>
<tr>
<td>At least a diploma</td>
<td>77%</td>
<td>70%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figure 11: Teacher profile in public and private schools in 2020/21

Source: EMIS 2020/21. Calculations made by authors, representing an average of averages (average computed from school-level averages).
Teacher academic and professional qualifications are associated with improved student performance. Across subjects, there is a positive association between the proportion of JHS teachers with at least a diploma and student exam performance (this is true for both academic and professional qualifications). The higher the proportion of JHS teachers with at least a diploma compared to a school leaving certificate (or lower), the better the student’s performance in BECE exams.

Increasing the proportion of teachers with a professional diploma from the prevailing 70 per cent to 100 per cent is associated with a slight improvement of 0.2–0.4 raw points (0.02–0.03 SD) in exam performance across subjects. Similar improvements are associated with increasing teacher academic qualifications.

Teacher qualifications are particularly strongly associated with student performance in urban and private schools. This is likely driven by the low number of teachers with professional qualifications higher than a diploma in private schools (19 per cent) versus in public schools (92 per cent). Similarly, urban schools contain fewer officially qualified teachers compared to rural schools – 57 versus 81 per cent.

Pupil-teacher ratio

PTR in JHS is negatively associated with exam performance; however, the practical magnitude of this association is almost negligible. PTR is an important metric, often used for resource allocation and policy decisions. Lower PTRs are considered better as they ensure sufficient instructional time and attention for all students in a classroom. According to the EMIS data in Ghana, the average PTR in JHS classrooms is not very high at 15, and is consistent across rural and urban schools.

Precisely calculating PTR in Ghana

The average PTR computed using the EMIS data provides a representative sense of resources in a school but does not fully capture the class sizes faced by Ghanaian students. This is because the EMIS collects data on the total number of students enrolled in each grade and the total number of teachers in JHS, but does not connect specific teachers to classrooms. For example, an average PTR of 20 may mask a J1 classroom with a PTR of 35, a J2 classroom with a PTR of 15, and a J3 classroom with a PTR of 10. PTRs may also vary by subject. For instance, if there are fewer mathematics teachers in the school, then these students face a larger class size for that subject.

Additionally, class sizes faced by students also depend on the number of hours taught (contact hours) and the average teaching hours of a teacher. Contact hours and teaching hours are expected to vary by subject in JHS classrooms; however, this information is also not included in the EMIS.

To gain a more precise picture, additional details about teachers, classroom-level student enrolment and how they are connected to each other need to be collected. Some countries (e.g., Togo) collect such information in their EMIS, and can offer a roadmap for Ghana.

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19 Academic qualifications refer to education in any subject area (unrelated to teaching), whereas a professional teacher qualification is a teaching degree that aims to transfer both subject matter and pedagogical skills.

20 A total of 70 percent of private schools are in urban locations.
Figure 12: Distribution of PTR in 2020/21

Note: The red line in this figure depicts the average PTR of 15. The orange part of the distribution represents the proportion of JHS schools with PTR less than 15 and the yellow part represents the proportion of schools with PTR higher than 15.

Source: EMIS 2020/21. PTR computed by dividing total enrolment in JHS by total number of teachers in JHS (see Box 2).

PTR is negatively associated with exam performance, signifying that exam performance in a smaller classroom is expected to be better; however, the magnitude of this association is negligible. For instance, reducing the average PTR from 15 to 10 may improve BECE exam performance by only 0.12 raw points in mathematics.

PTR varies across schools. As depicted in Figure 12, while the average PTR in 2020/21 was 15, a quarter of JHS schools had PTR higher than 18, and 10 per cent were higher than 24. Similarly, a quarter of JHS schools had PTR of less than 9.

The PTR also varies across regions and districts. For instance, Northern and Western have the highest PTR (19 and 18 respectively) and Ashanti has the lowest at 13. Even within regions, there is variation across districts – for instance, within Eastern, the PTR ranges from an average of 11 in Asuogyaman district to 19 in Kwahu Afram Plains district. These variations in PTR within regions and schools suggest that teacher redistribution could be a possible solution to addressing higher PTRs in certain areas.

Finally, other variables, such as teacher experience and attendance, would have been enlightening to include, and were considered for inclusion. Ultimately, however, they were discarded due to inconsistent or missing data.

Furthermore, accounting for school size while examining PTR (i.e., weighting the average by the number of JHS schools enrolled in a school) reveals that an average JHS student experiences a PTR of 18. This jump from 15 to 18 represents an unequal teacher allocation: larger schools have higherPTRs.
4.2.3. School characteristics

Next, the analysis explored relationships between student performance and various school-level characteristics. These included factors related to school leadership and supervision, teaching and learning environment and resources, and school infrastructure.

To understand what types of leaders enable better exam performance, various characteristics of school headteachers were examined.22

Female headteacher-led schools perform marginally better in exams, particularly in English. Compared to male headteacher-led schools, such schools performed 0.3–0.4 raw points (0.02–0.03 SD) higher in BECE exams across subjects. This trend is strongest in rural schools, where only 11 per cent of headteachers are female. For example, in mathematics, schools with female headteachers score 0.7 raw points higher than school with male headteachers in rural schools, but in urban schools, there is no difference based on headteacher gender.

Differences between rural and urban schools may arise due to various reasons. Fewer headteachers in rural schools are female – only 11 per cent, versus 25 per cent in urban schools. It could be that these are exceptional leaders who have risen to head status despite facing barriers, or it could be that they leverage different management practices. Overall, a similar trend of better exam performance with female heads is seen in other countries, including many participating in the DMS positive deviance research (Bergmann et al. 2022).23

The analysis also sought to understand which key infrastructural inputs influence exam performance in Ghanaian schools. Evidence substantiates what is intuitively apparent – fully functioning schools with appropriate infrastructure and resources are conducive to student learning (Glewwe et al. 2011; Shotland, Komaragiri and Sharma 2021).

Access to drinking water and functional electricity are positively associated with exam performance.

In 2020/21, 87 per cent of schools had access to drinking water, which was stable across rural and urban parts of the country. Expanding access to drinking water in a school is associated with a modest improvement in exam performance of 0.4–0.6 raw points (0.03–0.05 SD).

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22 Other characteristics of headteachers, such as their academic qualifications and age, were considered for the primary models, but discarded due to high amounts of missing information. A secondary model which included these variables revealed that these headteacher qualifications were unassociated with exam performance. This model was the same as the primary model, with additional explanatory variables describing headteachers’ profiles. It had a smaller sample, as many schools were missing information on headteacher characteristics. However, the overall results in the secondary model were consistent with the primary model results. As a robustness check, schools that were excluded were compared to included schools, and they were not systematically different (based on running T-tests on key characteristics of these schools).

23 Specifically, in Côte d’Ivoire female headteachers are positively associated to promotion rates in public primary schools. In Togo and Mali, female headteachers are positively associated with promotion rates in primary schools for girls-only schools. In Madagascar, female headteachers are positively associated with promotion rates for girls-only schools, and positively associated with exam success for all students.
Functional electricity was less widely available in schools, particularly rural schools. In 2020, only 68 per cent of schools had functional electricity, ranging from 58 per cent of rural schools to 77 per cent of urban schools. The presence of functional electricity is associated with a 0.3–1 raw point improvement in exam performance across subjects (corresponding to 0.02 SD–0.07 SD, respectively).

**Libraries are important for student learning.** The presence of a school library is associated with a 1-point improvement in mathematics and English, and 0.6 points in Ghanaian languages (0.05–0.08 SD). Unfortunately, only 26 per cent of Ghanaian schools had a library in 2020/21, with rural schools particularly poorly off (only 18 per cent had libraries). Given this low penetration, increasing library access could be a promising lever for improving student learning.

**Access to sanitation facilities contributes to student learning.**

Menstrual hygiene changing rooms are positively associated with student performance. The presence of a changing room is associated with a small improvement in exam scores for both boys and girls. However, only 21 per cent of schools across Ghana reported having a menstrual changing room in 2020/21, providing scope to initiate greater access to this facility.

This analysis also sought to explore whether sufficient toilets are associated with exam performance. Unfortunately, due to a large amount of missing information on toilets across the years, this variable could not be included in the primary regressions to avoid dropping many schools from the analysis. However, the toilet-pupil ratio was included in a secondary model, which revealed a positive association between the presence of toilets and BECE exam performance across subjects.

Sufficient seating for students in a classroom and the state of the classroom are positively associated with learning outcomes. However, the practical magnitude of these associations is marginal. Schools with sufficient seats for students are associated with higher exam performance across subjects, whereas schools with more classrooms needing major repairs are associated with lower performance.

In 2020/21, Ghana’s average seat to pupil ratio was 0.7, indicating two seats available for three pupils in a school. This was the situation across schools in urban and rural regions. Providing a seat for every student in a school is associated with a marginal improvement of 0.2–0.3 raw points (0.01–0.02 SD) in exam performance across subjects.

Almost 16 per cent of Ghanaian classrooms need permanent repairs. Public schools, in particular, report high rates of physical defects in classrooms (19 per cent versus 3 per cent in private schools). Moreover, schools in rural areas are worse off, with 19 per cent requiring repairs versus 13 per cent in urban schools. These infrastructural issues are negatively, albeit marginally, associated with exam performance, likely via their influence on the class environment and student engagement.

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24 Changing rooms are specially designated spaces providing access to clean and safe sanitation facilities (including sanitary pads, hygiene supplies, toilet paper, pad disposal bins and washing facilities) to support girls during menstruation.

25 Interestingly, the result was not different between girls and boys, as might be expected. An interaction between the presence of menstrual changing rooms and student gender was included in the analysis and was non-statistically significant, indicating that girls’ and boys’ exam scores are not affected differently by the presence of changing rooms for girls. It could be that menstrual changing rooms influence girls’ access to school (more than exam performance), and that keeping girls in schools is good for both sexes. It could also be the case that schools with menstrual hygiene rooms have better sanitation facilities in general, which may influence student performance. While the channel of association is not entirely clear, the positive association with exam performance merits a closer examination.

26 Seat to pupil ratio was constructed by dividing the total number of available seats in JHS classrooms by the total pupils enrolled in JHS. Total seats were calculated as: number of single-seater desks in school + 2 * number of double-seater desks in the school.
Other infrastructural facilities investigated in this analysis include the presence of a staff room and an administrator’s office in a school.

**Teacher staff rooms are associated with higher exam performance, whereas administrator offices have the opposite association.** A total of 57 per cent of Ghanaian schools have a teacher staff room, whereas 87 per cent have an administrator office. The presence of a teacher staff room is associated with a modest 0.7–0.9 raw point (0.05–0.06 SD) improvement in student exam performance, whereas the presence of an administrator’s office is associated with a 0.7–0.9 raw point (0.05 SD) drop in exam performance.

There may be different mechanisms through which these infrastructural structures for teachers and headteachers (who are most likely users of the administrator office) influence students. Staff rooms provide a dedicated space for teachers to collaborate and share ideas, which may directly influence teaching in the classroom. They may also function as a space for teachers to rest and recharge between classes, helping them remain motivated and more satisfied in their day-to-day activities. Administrator offices may wall off collaboration and engagement between headteachers and teachers, possibly influencing student performance through limited ability by the school leader to support and supervise their staff.

Stage 3 of this research will aim to dig deeper into these hypotheses to better understand the prevailing dynamics.

Finally, various factors were examined to understand the influence of the supervision and support received by schools. These included variables related to School Improvement Support Officers (SISOs), School Management Committees (SMCs) and distances of schools from District Education Board Secretary (DEBS) offices. Results on the distance of schools from DEBS offices and the frequency of SMC meetings were not clear-cut – they were inconsistent across subjects and of marginal practical magnitude. Similarly, more visits by SISOs were associated with lower exam performance across subjects, a counter-intuitive association that needs to be further explored. These are included in Appendix A for completeness; however, it is hard to draw conclusive interpretations based on these trends.

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27 The variables used are related to quantities of certain practices (e.g., number of SISO visits or number of SMC meetings), but not directly about the content or quality of these practices. Quality-related metrics are harder to collect in a country EMIS database, and are typically not included. The choice of variables to include in this analysis was constrained by variables on which EMIS collects information. Quality-related information will be investigated in future stages of the research.

28 SISOs are frontline officers within MoE responsible for monitoring and supervising education quality in their respective districts.

29 SMCs are governing agencies for basic schools in Ghana. They work to improve the functioning of the school. By law, every basic public school in the country is required to have a SMC.
4.2.4. Other school characteristics

Urban schools outperform rural schools, with private urban schools performing best across subjects. This trend has remained consistent over time.

Throughout the four years included in this analysis, there is a significant performance gap between the best performers – **private schools located in urban areas** – and the worst performers – **public schools located in rural areas**. This gap has remained consistent across years and subjects. Figure 13 details BECE performance across time and subjects for different types of schools.

Rural public schools are consistently the worst off in English and Ghanaian languages. For example, in 2020/21, with all other things equal, they were 14 and 11 raw points (1.1 and 0.8 SD) behind the best performers (urban private schools). In mathematics, however, rural and urban public schools have closely tracked each other in BECE outcomes, although they are still significantly behind urban private schools (13 raw points or 0.7 SD behind).

**More generally, private schools consistently outperform public schools in BECE examinations.** In Ghana, 31 per cent of schools are private, and most are located in urban areas (70 per cent urban). Private schools outperform public schools across subjects. For example, all other things equal, rural public schools are 11 points (0.6 SD) behind rural private schools in mathematics. Many of the private schools are low-income establishments that sprung up to cater to parental demand. There is a general perception among parents that these institutions offer better education opportunities, and hence parents are often willing to pay a school fee to enrol their students in private schools (Akyeampong et al. 2007).

**Basic schools outperform JHS-only schools.** This analysis included two types of schools: those that offer full basic education for grades 1–9, and those that offer only JHS (grades 6–9). All other things equal, basic schools score on average 2.5 raw points higher in mathematics, 2 points higher in English and 1.8 points higher in Ghanaian languages.

4.2.5. Basic Education Certification Examination variation

**Significant fluctuations in exam performance across years, particularly in mathematics and English, suggest differences in exam difficulty year to year, which has implications for equity.**

High-stakes examinations like the BECE, that determine if students move on to further schooling, aim to maintain fixed and consistent competency standards over time. This ensures fairness and equity to all students, regardless of which year they sit for the exam. WAEC also aims to adhere to these ideals. Large yearly fluctuations in such examinations – which mark a critical landmark in a student’s academic and life journeys – are problematic, as they unfairly penalize certain students and have potential long-term implications.

In Ghana, with all other things equal, there is significant variation in exam performance across the four years of data analysed. For instance, student performance in mathematics was 4 points (0.2 SD) lower in 2018/19, and 9 points (0.5 SD) higher in 2019/20, compared to 2017/18. In other words, there was a 13-point (0.7 SD) difference in exam performance between 2018/19 and 2019/20 in mathematics – equivalent to over three years of regular schooling (Evans and Yuan 2017).
There could be various reasons for such fluctuations – year-specific shocks (e.g., economic recessions, food shocks, COVID-19), impacts of policy reforms, improper implementation of the exams, or cheating by exam takers. These are valid reasons and should be investigated. However, fluctuations every year, over four years, also suggest a deeper, more persistent issue – differences in the standardization of tests across the years. Indeed, another study in Ghana which leveraged robust psychometric techniques to test standardization across years for WASSCE exams, concluded that differences in test difficulty explained more than 80 per cent of the variance in pass rates (Rossiter et al. 2021).

Further research is needed to understand the reasons for this trend and to support the robust efforts of the WAEC team in further standardizing examination difficulty across the years. WAEC leverages gold-standard techniques for developing and implementing national examinations, and has a strong history of high-quality examinations. Investigating such trends could further strengthen and bolster these examinations.

Figure 13: BECE mathematics, English and Ghanaian language exam performance over time by school type and location

Source: BECE scores 2017/18–2020/21. Calculations made by authors, representing an average of averages (average computed from school-level average exam scores). All point estimates weighted by size of JHS (number of students enrolled in JHS).
5. Policy implications and areas for further exploration
Policy implications and areas for further exploration

This report presents results from Stage 1 of the multi-stage DMS positive deviance research. The presented insights can serve as inputs in ongoing policy planning, conversations and other education research. If interpreted with caution (i.e., treating estimated coefficients as correlations and not as causal effects), these results can be a valuable tool for policymakers, practitioners and researchers. This section presents policy implications and areas for further exploration based on the results of this analysis.

Gender norms and expectations may influence how teachers teach, how learners learn, and how they interact with each other.

Results show a negative association between student performance and the proportion of female teachers in urban JHS schools; schools with a higher proportion of female teachers seem to have lower exam performance. This teacher gender trend is especially true for boys, and less stark or non-existent for girls. Student gender also intersects with exam performance differently by subject. For instance, boys are better at certain subjects (e.g., mathematics), whereas girls are better at others (e.g., English).

These differences by gender (of both teachers and students) suggest the prevalence of gender-specific norms, which may influence how teachers and learners interact with each other and behave in classrooms. Stage 3 of the DMS research will investigate what school-level behaviours and practices may underlie these differences.

However, some policy implications already emerge, including efforts to dispel gender stereotypes, incorporate gender-inclusive curricula, and strengthen gender-sensitive teaching methods and techniques in schools.

There is scope to learn from female headteachers, whose schools outperform male-led schools.

Across subjects, but especially in English, female-led schools perform marginally better, particularly in rural areas. However, less than a third of the headteachers in Ghana are female. Moreover, female headteachers are particularly rare in rural schools (10 per cent). Learning from the behaviours and practices of existing female heads, and identifying ways to replicate these across all schools, could benefit all Ghanaian students. Future stages of this research will explore these trends further, contributing to initiatives such as Women in Learning Leadership (WiLL) to expand the evidence base on female leaders.30

In Ghana, at a national average of 15 pupils per teacher, PTR is reasonable. However, this PTR varies widely by region and location (urban or rural), suggesting areas for improvement in terms of equity of teacher distribution across schools and regions. Inequitable distribution of teachers influences both the learning conditions in classrooms and teacher workloads, further compounding already busy schedules.

Understanding why these inequities persist and how to better allocate teachers can be beneficial for both learners and teachers.31

30 For more information on the WiLL initiative, visit <www.unicef-irc.org/research/women-in-learning-leadership>.
31 Initiatives such as UNICEF Innocenti’s Teachers for All workstream are seeking to expand the evidence base on teacher deployment in Africa to identify how the deployment of qualified teachers can be optimized to improve learning outcomes. For more information, visit <www.unicef-irc.org/research/teachers-for-all>. 
While the PTR is only mildly associated with exam performance in this analysis, it is an important planning factor that not only influences exam performance, but also learner retention and teacher workloads. However, given the very small associations we see between performance and PTR or class size, simply allocating more teachers will likely not be enough to improve performance – other improvements need to accompany this deployment.

Libraries could be a low-cost policy lever to improve student performance.

According to the analysis, the presence of a library in the school is associated with higher exam performance in English and mathematics. There are various creative, low-cost ways to establish school libraries that create intellectual spaces for learners to learn and grow. Schools could consider donation drives to build a repertoire of books, and even consider having small ‘library corners’ in classrooms to provide some of the benefits of a library while mitigating costs.

Persisting gaps in performance between different types of schools underscore the importance of equity-focused policies and programmes.

Performance differences exist in Ghanaian schools based on location (rural or urban) and ownership (public or private). Private schools consistently outperform public schools, and urban schools outperform rural ones. There are also variations in performance by districts. While not entirely surprising, these variations further highlight the types of schools requiring more support and attention. Policies targeting equity of outcomes across schools are especially significant, since most Ghanaian students attend rural primary schools – the worst performers in the country.

Private schools have achieved equal or higher BECE outcomes than public schools. As Ghana works to improve learning for all students, private schools can play an important role in the Government’s strategy. Evidence from other countries shows that public-private school partnerships have been successful in improving student learning and cognitive development in various other countries. By providing some resources and support to private schools, the Ghanaian Government can increase access to more and poorer students (Hossain 2007 as cited in World Bank 2015; Patrinos et al. 2009; Pal and Kingdon 2010). Furthermore, promoting sharing and cross pollination of ideas between public and private schools could unearth new practices, benefiting both groups.

Stage 1 of the research raised important insights and new questions. Going forward, this analysis will be bolstered by primary data collection, both quantitative and qualitative. Specifically, in Stage 3 of this research, primary data will be collected from positive deviant schools (i.e., exceptional schools) and control schools to investigate the concrete behaviours and practices that help them perform better than their peers. This data will also unpack the trends uncovered in this stage (such as the gender-based trends, the dynamics between SISO support and schools, etc.) The ultimate goal of the research is to produce concrete recommendations and sustainable implementation plans that the Government and other education stakeholders can carry forward to improve learning in the country.
6. Appendices
### Appendix A: Regression output table

#### Table 2: Primary regression output table

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Student characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage student attendance for 1 month</td>
<td>3.844***</td>
<td>3.454***</td>
<td>3.605***</td>
<td>0.2155***</td>
<td>0.28518***</td>
<td>0.26764***</td>
</tr>
<tr>
<td>Student gender (1 = girl; 0 = boy)</td>
<td>-1.504***</td>
<td>-0.342***</td>
<td>-0.632***</td>
<td>-0.0843***</td>
<td>-0.02828***</td>
<td>-0.04689***</td>
</tr>
<tr>
<td><strong>Teacher characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% female teachers in JHS</td>
<td>-3.112***</td>
<td>-1.255***</td>
<td>-2.022***</td>
<td>-0.1745***</td>
<td>-0.10365***</td>
<td>-0.15013***</td>
</tr>
<tr>
<td>Interaction: student gender X JHS teacher gender</td>
<td>-0.234</td>
<td>1.292***</td>
<td>1.216**</td>
<td>-0.01314</td>
<td>0.10666***</td>
<td>0.09030**</td>
</tr>
<tr>
<td>% JHS teachers with professional diploma or higher</td>
<td>1.201***</td>
<td>0.816***</td>
<td>1.227***</td>
<td>0.0674***</td>
<td>0.06742***</td>
<td>0.09107***</td>
</tr>
<tr>
<td>% JHS teachers with academic diploma or higher</td>
<td>2.452***</td>
<td>1.528***</td>
<td>1.634***</td>
<td>0.13746***</td>
<td>0.12614***</td>
<td>0.12128***</td>
</tr>
<tr>
<td>% JHS teacher who are full time/ permanent</td>
<td>-0.250</td>
<td>-0.0130</td>
<td>1.582***</td>
<td>-0.01401</td>
<td>-0.00108</td>
<td>0.11747***</td>
</tr>
<tr>
<td>PTR in JHS</td>
<td>-0.0235**</td>
<td>-0.022***</td>
<td>-0.0759***</td>
<td>-0.00132</td>
<td>-0.00181***</td>
<td>-0.00564***</td>
</tr>
<tr>
<td>Average age of JHS teachers</td>
<td>0.0137</td>
<td>0.0550***</td>
<td>0.0122</td>
<td>0.00077</td>
<td>0.00454***</td>
<td>0.00091</td>
</tr>
<tr>
<td>Variables</td>
<td>Raw maths score</td>
<td>Raw English score</td>
<td>Raw Zambian languages score</td>
<td>Standardized maths score</td>
<td>Standardized English score</td>
<td>Standardized Zambian languages score</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------</td>
<td>------------------</td>
<td>-----------------------------</td>
<td>--------------------------</td>
<td>---------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>School characteristics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of students enrolled in JHS</td>
<td>0.0220***</td>
<td>0.0308***</td>
<td>0.0263***</td>
<td>0.0012***</td>
<td>0.00254***</td>
<td>0.00195***</td>
</tr>
<tr>
<td>Classroom per 100 students in JHS</td>
<td>-0.295***</td>
<td>-0.0999***</td>
<td>-0.316***</td>
<td>-0.0165***</td>
<td>-0.00825***</td>
<td>-0.02346***</td>
</tr>
<tr>
<td>Road material: tar or gravel</td>
<td>0.228*</td>
<td>0.263***</td>
<td>0.279***</td>
<td>0.01276*</td>
<td>0.02174***</td>
<td>0.02070***</td>
</tr>
<tr>
<td>Gender of headteacher (1 = female; 0 = male)</td>
<td>0.321*</td>
<td>0.386***</td>
<td>0.283***</td>
<td>0.01800*</td>
<td>0.03191***</td>
<td>0.02099**</td>
</tr>
<tr>
<td>Distance of school from DEBS (1 = &lt;10 km; 0 = &gt;10 km)</td>
<td>-0.274**</td>
<td>0.395***</td>
<td>0.301***</td>
<td>-0.01537**</td>
<td>0.03258***</td>
<td>0.02232***</td>
</tr>
<tr>
<td>School is less than 1 km from neighbouring school</td>
<td>-0.0134</td>
<td>0.275**</td>
<td>0.561***</td>
<td>-0.00075</td>
<td>0.02267**</td>
<td>0.04166***</td>
</tr>
<tr>
<td>Library (1 = yes; 0 = no)</td>
<td>1.105***</td>
<td>1.024***</td>
<td>0.630***</td>
<td>0.062***</td>
<td>0.08456***</td>
<td>0.04676***</td>
</tr>
<tr>
<td>Staff room (1 = yes; 0 = no)</td>
<td>0.867***</td>
<td>0.707***</td>
<td>0.740***</td>
<td>0.049***</td>
<td>0.05842***</td>
<td>0.05491***</td>
</tr>
<tr>
<td>Administrator office (1 = yes; 0 = no)</td>
<td>-0.899***</td>
<td>-0.658***</td>
<td>0.106</td>
<td>-0.0504***</td>
<td>-0.05432***</td>
<td>0.00789</td>
</tr>
<tr>
<td>% JHS classrooms requiring major repairs</td>
<td>-0.00484***</td>
<td>-0.004***</td>
<td>-0.0043***</td>
<td>-0.0003***</td>
<td>-0.00030***</td>
<td>-0.00032***</td>
</tr>
<tr>
<td>Sitting places per student</td>
<td>0.911***</td>
<td>0.784***</td>
<td>0.998***</td>
<td>0.05108***</td>
<td>0.06476***</td>
<td>0.07408***</td>
</tr>
<tr>
<td>Drinking water (1 = yes; 0 = no)</td>
<td>0.527***</td>
<td>0.552***</td>
<td>0.364***</td>
<td>0.0295***</td>
<td>0.04556***</td>
<td>0.02703***</td>
</tr>
<tr>
<td>Electricity (1 = yes; 0 = no)</td>
<td>0.344**</td>
<td>0.800***</td>
<td>1.001***</td>
<td>0.01930**</td>
<td>0.06609***</td>
<td>0.07428***</td>
</tr>
<tr>
<td>SMC meetings/year</td>
<td>-0.0633**</td>
<td>-0.0170</td>
<td>-0.0493**</td>
<td>-0.00355**</td>
<td>-0.00141</td>
<td>-0.00366**</td>
</tr>
<tr>
<td>SISO visit/year</td>
<td>-0.287***</td>
<td>-0.233***</td>
<td>-0.264***</td>
<td>-0.0161**</td>
<td>-0.01923***</td>
<td>-0.01963***</td>
</tr>
<tr>
<td>Menstrual changing room (1= yes; 0 = no)</td>
<td>1.023***</td>
<td>0.685***</td>
<td>0.506***</td>
<td>0.0574***</td>
<td>0.05660***</td>
<td>0.03757***</td>
</tr>
<tr>
<td>Interaction term: girl student X menstrual changing room present</td>
<td>0.130</td>
<td>0.310</td>
<td>0.392</td>
<td>0.00730</td>
<td>0.02561</td>
<td>0.02912</td>
</tr>
</tbody>
</table>
### Variables

<table>
<thead>
<tr>
<th></th>
<th>(1) Raw maths score</th>
<th>(2) Raw English score</th>
<th>(3) Raw Zambian languages score</th>
<th>(4) Standardized maths score</th>
<th>(5) Standardized English score</th>
<th>(6) Standardized Zambian languages score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.077***</td>
</tr>
<tr>
<td>Year: 2018</td>
<td>-4.212***</td>
<td>-1.839***</td>
<td>-1.790***</td>
<td>-0.2361***</td>
<td>-0.15184***</td>
<td>-0.13286***</td>
</tr>
<tr>
<td>Year: 2019</td>
<td>8.695***</td>
<td>4.277***</td>
<td>-2.286***</td>
<td>0.4874***</td>
<td>0.35317***</td>
<td>-0.16972***</td>
</tr>
<tr>
<td>Year: 2020</td>
<td>3.837***</td>
<td>1.344***</td>
<td>-2.800***</td>
<td>0.2151***</td>
<td>0.11102***</td>
<td>-0.20790***</td>
</tr>
<tr>
<td>District fixed effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Constant</td>
<td>53.82***</td>
<td>38.51***</td>
<td>63.98***</td>
<td>0.3194***</td>
<td>0.16638***</td>
<td>0.35443***</td>
</tr>
<tr>
<td>Observations</td>
<td>74,661</td>
<td>74,660</td>
<td>63,738</td>
<td>74,661</td>
<td>74,660</td>
<td>63,738</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.488</td>
<td>0.507</td>
<td>0.443</td>
<td>0.48823</td>
<td>0.50672</td>
<td>0.44332</td>
</tr>
</tbody>
</table>

**Robust standard errors in parentheses**

*** p<0.01, ** p<0.05, * p<0.1

Certain results were inconclusive and/or inconsistent, but are explained below for completeness. Additionally, certain variables were used as controls and not for interpretation. For instance, teacher age and employment status (full time versus not) were used as controls in the model, and not interpreted for policy.

### School governance-related characteristics

**Distance of schools from the DEBS office was differentially associated with student exam performance based on subjects.** Distance could be considered as a proxy to quantify the level of support received by schools, with the assumption that schools that are closer are perhaps visited more frequently and receive more support.

In mathematics, there is a marginal negative association between exam performance and distance (a school that is greater than 10 km from the DEBS office performs 0.018 SD lower in BECE); meaning schools that are further away from the DEBS office have lower exam performance. This relationship is prevalent in urban schools only, and disappears in rural schools. In English and Ghanian languages this relationship does not exist, and instead, schools that are further away are seemingly performing better.

The underlying mechanisms at play that result in these associations and why they differ by subject are unclear, and further investigation is needed.

The frequency of SMC meetings was either negatively associated or unassociated with exam performance across subjects (with marginal magnitudes of association).

---

34 Fuzzy merging is the process of matching two variables based on comparing strings, generally across multiple variables. For example, in this analysis, the comparison was conducted on school name, region name and district name.
Appendix B: Descriptive statistics on key variables

Table 3 below presents weighted descriptive statistics[^1] for key variables at the national level and for various subpopulations (e.g., rural, urban, public and private). All estimates have been weighted by JHS size (number of students enrolled in JHS) to represent the environment faced by an average student.

### Table 3: Descriptive statistics

<table>
<thead>
<tr>
<th>Variables</th>
<th>National</th>
<th>Rural</th>
<th>Urban</th>
<th>Private</th>
<th>Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average maths score (50–150 scale)</td>
<td>49.3</td>
<td>48.9</td>
<td>49.6</td>
<td>58.8</td>
<td>47.1</td>
</tr>
<tr>
<td>Average English score (50–150 scale)</td>
<td>36.9</td>
<td>33.1</td>
<td>40.2</td>
<td>47.9</td>
<td>34.3</td>
</tr>
<tr>
<td>Average Ghanaian languages score (50–150 scale)</td>
<td>59.1</td>
<td>57.1</td>
<td>60.7</td>
<td>65.9</td>
<td>57.5</td>
</tr>
</tbody>
</table>

### Student characteristics

| % student attendance for 1 month | 76.4 | 76.1 | 76.8 | 77 | 76.3 |
| % female students | 49.4 | 47.7 | 51 | 51 | 49 |

### Teacher characteristics

| % JHS teachers with professional diploma or higher | 79.4 | 86.8 | 73.1 | 23.6 | 92.1 |
| % JHS teachers with academic diploma or higher | 70 | 73.9 | 66.6 | 38.2 | 77.2 |
| % JHS full time teachers | 96.1 | 96.7 | 95.6 | 94.5 | 96.5 |
| % JHS female teachers | 28.9 | 21.4 | 35.4 | 17.7 | 31.5 |
| PTR | 18 | 17.8 | 18.2 | 16.1 | 18.4 |
| JHS average teacher age | 37.6 | 36.3 | 38.6 | 34.6 | 38.3 |

### School characteristics

| School size (primary and JHS) | 316 | 230.2 | 389.2 | 353.5 | 307.3 |
| % road material is tar or gravel | 46.5 | 37.8 | 54 | 46.7 | 46.5 |
| JHS classrooms per 100 students | 3.4 | 3.7 | 3.2 | 5.1 | 3 |
| % female headteacher | 22.6 | 12.5 | 31.1 | 13.9 | 24.6 |
| % distance from DEBS <10 km | 64 | 49.2 | 77 | 72.6 | 62.1 |
| % distance from neighbouring school <1 km | 82 | 80.5 | 83.2 | 79.4 | 82.6 |

[^1]: All summary statistics included in this table are weighted by the size of JHS based on enrolment, and hence may differ from the unweighted statistics presented in certain sections of the report. Weighted statistics are presented to provide a sense of resources and environment faced by an average Ghanaian student in JHS.
### Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>National</th>
<th>Rural</th>
<th>Urban</th>
<th>Private</th>
<th>Public</th>
</tr>
</thead>
<tbody>
<tr>
<td>% schools have library</td>
<td>25.5</td>
<td>18</td>
<td>32</td>
<td>43.7</td>
<td>21.3</td>
</tr>
<tr>
<td>% schools have staff room</td>
<td>57.2</td>
<td>48.6</td>
<td>64.5</td>
<td>58.2</td>
<td>56.9</td>
</tr>
<tr>
<td>% schools have administrative office</td>
<td>86.7</td>
<td>83.1</td>
<td>89.8</td>
<td>87.5</td>
<td>86.5</td>
</tr>
<tr>
<td>% schools have menstrual hygiene changing rooms</td>
<td>21.5</td>
<td>16</td>
<td>26.3</td>
<td>38.1</td>
<td>17.8</td>
</tr>
<tr>
<td>% classrooms in a school needing major repairs (in school)</td>
<td>15.7</td>
<td>18.5</td>
<td>13.2</td>
<td>2.8</td>
<td>18.6</td>
</tr>
<tr>
<td>Sitting places per student</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>% access to drinking water</td>
<td>86.7</td>
<td>85.9</td>
<td>87.3</td>
<td>93.7</td>
<td>85.1</td>
</tr>
<tr>
<td>% schools with functional electricity</td>
<td>67.9</td>
<td>57.8</td>
<td>76.4</td>
<td>75.9</td>
<td>66</td>
</tr>
<tr>
<td>Frequency SMC meeting (per year)</td>
<td>3.5</td>
<td>3.6</td>
<td>3.5</td>
<td>3.7</td>
<td>3.5</td>
</tr>
<tr>
<td>Frequency SISO visit (per year)</td>
<td>5.2</td>
<td>5.5</td>
<td>5</td>
<td>3.7</td>
<td>5.6</td>
</tr>
<tr>
<td>% part of the population</td>
<td>100</td>
<td>52.9</td>
<td>47.1</td>
<td>31.2</td>
<td>68.8</td>
</tr>
</tbody>
</table>

### Appendix C: Robustness checks

To check if the results obtained are robust to different specification choices for the estimated models, regressions based on alternative specifications were also estimated. The following specifications were estimated.

While there are variations in some results, by and large these alternative models provide very similar results to the primary models estimated in the main section of this report.

<table>
<thead>
<tr>
<th>Primary model</th>
<th>Sampling weights were used to account for the relative importance of schools and give more weight to larger schools, size being defined by the number of students. This was intended to address the fact that smaller schools have averages calculated on the basis of a limited number of pupils, which can lead to significant fluctuations from one year to the next and influence the results. As a robustness check, an alternate model without sampling weights was estimated.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subgroup analysis</td>
<td>Models were also estimated for various subgroups (see Appendix C) to understand if a certain subgroup was particularly important for certain associations, and to ensure that these results were consistent.</td>
</tr>
<tr>
<td>Fixed effects</td>
<td>Models without fixed effects and with regional fixed effects were also estimated.</td>
</tr>
</tbody>
</table>
Appendix D: Subgroup analysis

As an additional robustness check and to understand which subgroup of schools may be driving certain associations seen in the data model, the analysis was also run on various subgroups: rural, urban, public and private. Table 4 shows these results for raw BECE scores. Results for standard BECE scores are available on request from the authors. For all models included in the table below, the model included in section 3.1 was estimated.

**Table 4: Subgroup analysis regression output**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mathematics</th>
<th>English</th>
<th>Ghanaian languages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(1a)</td>
<td>(1b)</td>
</tr>
<tr>
<td>% student attendance for 1 month</td>
<td>3.844***</td>
<td>5.133***</td>
<td>2.627***</td>
</tr>
<tr>
<td>Student gender (1 = girl; 0 = boy)</td>
<td>-1.504***</td>
<td>-1.414***</td>
<td>-1.490***</td>
</tr>
</tbody>
</table>

**Teacher characteristics**

<p>| % female teachers in JHS | -3.112*** | -4.456*** | -0.874 | -1.568*** | -2.644*** | -1.255*** | -2.537*** | 0.479 | -0.226 | -1.195* | -2.022*** | -4.009*** | 0.798* | -0.812* | -1.943*** |
| Interaction: student gender X JHS teacher gender | -0.234 | -0.147 | -0.372 | -0.0947 | -0.296 | 1.292*** | 0.486 | 1.651*** | 1.852*** | 0.491 | 1.216** | 0.437 | 1.655*** | 2.158*** | -0.0321 |
| % JHS teachers with professional diploma or higher | 1.201*** | 0.967** | 1.513*** | 0.240 | -1.336** | 0.816*** | 1.078*** | 0.798** | -0.512* | 0.141 | 1.227*** | 1.460*** | 1.149*** | 0.886** | 0.351 |
| % JHS teachers with academic diploma or higher | 2.452*** | 3.421*** | 0.937*** | 0.699*** | 5.636*** | 1.528*** | 1.959*** | 0.842*** | 0.426*** | 3.996*** | 1.634*** | 2.224*** | 0.684*** | 0.419* | 2.371*** |</p>
<table>
<thead>
<tr>
<th>Variables</th>
<th>Mathematics</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>% JHS teachers who are full time/permanent</td>
<td>-0.250</td>
<td>-1.018</td>
<td>0.309</td>
<td>0.739</td>
<td>0.611</td>
<td>-0.0130</td>
<td>0.454</td>
<td>-0.395</td>
<td>0.865**</td>
<td>1.207***</td>
<td>1.582***</td>
<td>1.337**</td>
<td>1.997***</td>
<td>2.541***</td>
</tr>
<tr>
<td>PTR in JHS</td>
<td>0.032***</td>
<td>0.035*</td>
<td>0.027*</td>
<td>0.008</td>
<td>-0.004</td>
<td>0.008</td>
<td>0.003</td>
<td>0.012</td>
<td>0.002</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average age of JHS teachers</td>
<td>0.0137</td>
<td>0.0573***</td>
<td>-0.0877***</td>
<td>-0.106***</td>
<td>0.101***</td>
<td>0.0137</td>
<td>0.0573***</td>
<td>-0.0877***</td>
<td>-0.106***</td>
<td>0.101***</td>
<td>0.0122</td>
<td>0.00367</td>
<td>0.00466</td>
<td>-0.0422**</td>
</tr>
</tbody>
</table>

| School characteristics                        |             |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |
| No. of students enrolled in JHS               | 0.0220***   | 0.0217***        | 0.0295***        | 0.0243***        | 0.0309***        | 0.0308***        | 0.0305***        | 0.0321***        | 0.0326***        | 0.0314***        | 0.0263***        | 0.0272***        | 0.0230***        |
| Classrooms per 100 students in JHS            | -0.295**    | -0.342***        | -0.226***        | -0.157***        | -0.299***        | -0.0989***       | -0.117***        | -0.0329          | -0.124***        | -0.0150           | -0.316***        | -0.380***        | -0.210***        |
| Road material: tar or gravel                  | 0.228*      | 0.844***         | -0.327**         | 0.139            | 0.353            | 0.263***         | 0.529***         | -0.0710          | 0.0960           | 0.747***          | 0.279***         | 0.605***         | -0.00600         |
| Gender of headteacher (1 = female; 0 = male)  | 0.321*      | 0.0566           | 0.666***         | 0.275            | 0.913**          | 0.386***         | 0.243*           | 0.599***         | 0.354***         | 0.600**           | 0.283**          | 0.121            | 0.495**          |
| Distance of school from DEBS (1 <10 km; 0 >10 km) | -0.274**    | -0.632***        | -0.166           | -0.279*          | 0.0344           | 0.395***         | 0.172            | 0.313***         | 0.321***         | 0.644***         | 0.301***         | -0.0126          | 0.0258           |
| School is less than 1 km from neighbouring school | -0.0134    | -0.490           | 0.334*           | -0.144           | 0.611*           | 0.275**          | -0.120           | 0.479***         | 0.210            | 0.267            | 0.561***         | 0.137            | 0.734***         |
| Library (1 = yes; 0 = no)                     | 1.105***    | 1.405***         | 0.482**          | 0.0653           | 3.241***         | 1.024***         | 1.220***         | 0.692***         | 0.287**          | 2.524***         | 0.630***         | 0.935***         | -0.00554         |
| Staff room (1 = yes; 0 = no)                  | 0.867***    | 1.171***         | 0.552***         | 0.669***         | 0.811***         | 0.707***         | 0.852**          | 0.562***         | 0.603**          | 0.668***         | 0.740***         | 1.074***         | 0.437***         |
| Administrator office (1 = yes; 0 = no)        | -0.899***   | -0.745**         | -0.845***        | -0.966***        | -0.849**         | -0.658**         | -0.518***        | -0.631***        | -0.822***        | -0.196           | 0.106            | 0.00595          | 0.139            |

Data Must Speak Research | Ghana
<table>
<thead>
<tr>
<th>Variables</th>
<th>Mathematics</th>
<th>English</th>
<th>Ghanaian languages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(1a)</td>
<td>(1b)</td>
</tr>
<tr>
<td>% JHS classrooms requiring major repairs</td>
<td>-0.00484***</td>
<td>-0.0108***</td>
<td>-0.000127</td>
</tr>
<tr>
<td>Sitting places per student</td>
<td>0.911***</td>
<td>1.578***</td>
<td>0.325</td>
</tr>
<tr>
<td>Drinking water (1 = yes; 0 = no)</td>
<td>0.527***</td>
<td>0.337</td>
<td>0.635***</td>
</tr>
<tr>
<td>Electricity (1 = yes; 0 = no)</td>
<td>0.344**</td>
<td>0.418</td>
<td>0.272*</td>
</tr>
<tr>
<td>SMC meetings/ year</td>
<td>-0.0633**</td>
<td>-0.0807*</td>
<td>-0.0177</td>
</tr>
<tr>
<td>SISO visits/ year</td>
<td>-0.287***</td>
<td>-0.363***</td>
<td>-0.0927</td>
</tr>
<tr>
<td>Menstrual changing room (1 = yes; 0 = no)</td>
<td>1.023***</td>
<td>0.995***</td>
<td>1.055***</td>
</tr>
<tr>
<td>Interaction term: girl student X menstrual changing room present</td>
<td>0.130</td>
<td>0.140</td>
<td>0.0513</td>
</tr>
</tbody>
</table>

Other characteristics

<p>| Rural                      | -2.354***                  | -       | -       | -0.549*** | 0.748* | -2.503*** | -       | -1.832*** | -0.573** | -3.069*** | -       | -1.281*** | -0.386 |</p>
<table>
<thead>
<tr>
<th>Variables</th>
<th>Mathematics</th>
<th>English</th>
<th>Ghanaian languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interaction term: rural schools X public schools</td>
<td>2.489***</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>JHS-only school</td>
<td>-2.467***</td>
<td>-3.185***</td>
<td>-1.917***</td>
</tr>
<tr>
<td>% JHS students sat BECE exam</td>
<td>-1.005***</td>
<td>-0.831***</td>
<td>-1.194***</td>
</tr>
</tbody>
</table>

**Other controls**

<table>
<thead>
<tr>
<th>Year</th>
<th>Mathematics</th>
<th>English</th>
<th>Ghanaian languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>-4.212***</td>
<td>-3.610***</td>
<td>-4.778***</td>
</tr>
<tr>
<td>2019</td>
<td>8.695***</td>
<td>9.001***</td>
<td>8.398***</td>
</tr>
<tr>
<td>2020</td>
<td>3.837***</td>
<td>2.728***</td>
<td>4.969***</td>
</tr>
</tbody>
</table>

**District fixed effects**

<table>
<thead>
<tr>
<th></th>
<th>Mathematics</th>
<th>English</th>
<th>Ghanaian languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2.086***</td>
<td>2.470***</td>
<td>1.710***</td>
</tr>
<tr>
<td>Observations</td>
<td>74,661</td>
<td>31,735</td>
<td>42,926</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Appendix E: Rural versus urban trends in exam performance based on teacher gender

In addition to the national-level models, additional analysis was conducted on the urban schools-only and rural schools-only samples (see results in Appendix D). Comparisons of the teacher gender and student performance results (discussed in section 4.2.2) between the urban-only (47 per cent of the population) and rural-only (53 per cent of the population) samples reveal interesting divergences.

Across subjects, exam performance of boys and girls is negatively associated with the proportion of female teachers in a school in urban schools. In rural schools, this relationship is either non-existent (see mathematics results in Figure 14) or positive (see Ghanaian language results in Figure 15).

Figure 14: Student and teacher gender interaction (urban versus rural) – mathematics

![Graph showing the relationship between female teachers in junior high schools and predicted BECE exam scores in urban and rural schools](image-url)
Appendix F: Creating a data set with EMIS and BECE data

This analysis required linking EMIS with BECE data sets at the school level for four years. The research team faced various challenges to doing so in Ghana. Firstly, not all schools have a stable unique code between years (specifically in the 2017 and 2018 EMIS data sets). Secondly, many schools have different school codes among years in the BECE data sets (specifically, there were differences in 2018, 2019 and 2020). Finally, school codes between EMIS and BECE data sets do not match. For these reasons, to harmonize school codes, three types of fuzzy merging were done: (1) within EMIS years, (2) within BECE years and (3) a bridge between EMIS and BECE.

Table 4 below summarizes by year the number of JHS schools available in the EMIS data set and in the BECE data set, and how many were harmonized with at least one other year and across data sources.

Within the BECE merging (2), 14,668 schools that existed in 2018 had all three years of school codes harmonized (representing 91 per cent of schools existing in 2018). Within the EMIS years (1), 15,306 JHS school codes were harmonized, representing 90 per cent of schools existing in 2017. Finally, 15,654 schools were bridged between EMIS and BECE data sets.

Fuzzy merging is a process of matching two variables based on comparing strings, generally across multiple variables. For example, in this analysis the comparison was conducted on school name, region name and district name.
(3), using 2020 as the basis for the bridge (representing 86 per cent of schools in BECE and 82 per cent of schools in EMIS 2020). When bridging these two data sources, an additional harmonization was done as WAEC and EMIS district codes and names classification were sometimes not the same.

When these three pieces are pulled together, the final harmonized data set has 15,604 unique schools of which 12,796 have all three parts fully harmonized. Once all codes were harmonized, yearly EMIS and BECE data sets were merged (the 2018 BECE with the 2018 EMIS data set, the 2019 BECE with the 2019 EMIS, etc.) and then appended into one common data set.

Table 5 below describes number of unique schools in each yearly data set of BECE and EMIS as well as how many schools had harmonized codes from each yearly data set of each source. The sixth column indicates how many schools each year had WAEC and EMIS linked.

Despite linking 85 per cent of school codes across the EMIS and BECE databases, because of frequent missing information on school characteristics throughout the years, the team was able to consistently follow 3,957 schools over all four years. Overall, the analysis is able to follow 3,599 schools throughout any three years, 4,003 schools for any two years and 2,565 schools for any single year (a total of 14,124 unique schools). The last column in Table 5 refers to the number of schools that had no missing information and could be used in the regression.

Table 5: Summary of the merging process

<table>
<thead>
<tr>
<th>Year (1)</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of JHS schools in the BECE data set (2)</td>
<td>15,042</td>
<td>16,032</td>
<td>16,384</td>
<td>18,023</td>
</tr>
<tr>
<td>Number of schools in EMIS data (3)</td>
<td>16,853</td>
<td>17,616</td>
<td>18,265</td>
<td>19,002</td>
</tr>
<tr>
<td>BECE data set with harmonized (4)</td>
<td>13,533</td>
<td>14,549</td>
<td>15,331</td>
<td>17,426</td>
</tr>
<tr>
<td>EMIS data set with harmonized codes (5)</td>
<td>12,903</td>
<td>14,543</td>
<td>14,558</td>
<td>14,659</td>
</tr>
<tr>
<td>Data set with EMIS and BECE using harmonized codes (6)</td>
<td>12,882</td>
<td>13,539</td>
<td>14,414</td>
<td>14,455</td>
</tr>
<tr>
<td>Number of schools in the final regression sample (7)</td>
<td>7,343</td>
<td>8,431</td>
<td>11,036</td>
<td>10,806</td>
</tr>
</tbody>
</table>

Appendix G: Research questions and stages of the research

The DMS research employs mixed methods and a staged approach to answer four main research questions. It draws extensively on the positive deviance research approach, as well as insights from behavioural science, implementation research and scaling science. The methodology employed includes both secondary data analysis and quantitative and qualitative data collection.
The four main research questions are:

<table>
<thead>
<tr>
<th>Research question 1</th>
<th>What are the human and material resources and contextual factors that are most associated with school performance in Ghana?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research question 2</td>
<td>Which schools are outperforming their peers in the same context and with the same level of operating resources?</td>
</tr>
<tr>
<td>Research question 3</td>
<td>What are the behaviours and practices of stakeholders at district, school, classroom and community levels that are making a difference in positive deviant schools, in comparison to the behaviours and practices in the other less well-performing schools?</td>
</tr>
<tr>
<td>Research question 4</td>
<td>What policy, system and community levers can incentivize the scaling of the positive deviant behaviours and practices in low-performing schools, addressing the ‘know-do’ gap?</td>
</tr>
</tbody>
</table>

At country level, the research design is implemented through the following four stages.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Research focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 1</td>
<td>Quantitative research</td>
</tr>
<tr>
<td>Stage 2</td>
<td>School typology</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Identifying behaviours and practices</td>
</tr>
<tr>
<td>Stage 4</td>
<td>Scaling science and implementation research</td>
</tr>
</tbody>
</table>

This first stage (the findings shared in this report) employs statistical analysis using existing education data sets to identify resources and contextual factors driving school performance in Ghana.

This stage will categorize schools according to their contexts and will identify positive deviant schools in each contextual and resource environment.

The third stage will investigate why positive deviant schools perform better using mixed-methods primary data. Behaviours and practices in the high-performing positive deviant schools and average-performing ‘control schools’ will be compared using data-collection instruments such as interviews, surveys and classroom/school observations. Other data-collection instruments will include questionnaires and interviews with key stakeholders at all levels – country, province, district, school and community. The data collected will help identify positive deviant behaviours and practices in different contexts.

This stage will use participatory action research to identify concrete levers and incentives at the system, school and community levels to scale up positive deviant behaviours and practices to other Ghanaian schools. This stage involves conversations with various stakeholders to identify practical, scalable and feasible policy levers to incentivize low-performing schools to adopt the behaviours and practices of the positive deviant schools and, in turn, become high-performing themselves.

The country-level stages of the research are also informed by a global DMS methodological review (Lévano et al. 2022) that was conducted in the research inception stage. National, regional and global dissemination of the research findings will be ongoing throughout the research.

7. References
References


for every child, answers