

Final report



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School performance

The role of early
stage learning
environments



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Executive Summary

In three appearances in the Trends in International Mathematics and Science Study (TIMSS) (2003, 2007 and 2011), Ghana has consistently been one of the bottom 3 ranking countries in both mathematics and science. TIMSS tests eight grade students (Junior High School 2 students in Ghana's education system). The results show that a year before completion of basic education, pupils are performing well below standard in core subjects and compared to their counterparts in other countries. This is troubling as low levels of literacy and numeracy skills are linked to low wages, greater risk of unemployment, lower standards of living, poorer health for adults, all factors that have a negative impact on labour force productivity and economic growth.

Further, the TIMSS reports indicate that Ghanaian students perform at the "facts and procedures" level but fail in the areas of problem solving, reasoning and using concepts. While the average underperformance speaks to scarcity of input such as teaching materials, the weakness in the more advanced areas is primarily a pedagogical issue. Developing critical thinking skills such as problem solving and reasoning are important, particularly for low-income economies because they promote innovation and enhance worker skills.

This study assesses the early grade classroom learning environment in Ghana and its influence on teaching and learning. The study focuses on the early grades because of the need to lay strong foundations in the schooling life course. Pre-school experience shapes long-term development and learning outcomes such as IQ, academic achievement, and grade retention. Data comes from the Classroom Learning Environments Ghana Study conducted by the Regional Institute for Population Studies, University of Ghana in 2016. The project analysed data on 4,720 pupils in 174 classrooms. Project funding was courtesy a grant from the International Growth Centre.

The study finds that class size and space limitations have a negative correlation with teacher motivation and likelihood of using child-centred teaching styles. In terms of classroom location and structural characteristics, KG classrooms are at a disadvantage compared to P1 while P1 classrooms were less likely to have learning aids and child-centred teaching activities. The multivariate findings also show that the influence of the classroom environment, particularly teaching and learning aids and teaching styles, is important for learning outcomes in KG2 and P1. For KG1, teacher experience and comfort level are the strongest influences on performance.

The study's policy recommendations are that the government needs to introduce and enforce early grade classroom limitations for pupils per caregiver and per square meter to support teaching and learning in early grade classrooms. Schools must also prioritize the state of the physical learning environment in the kindergarten, to provide safe and distraction-free spaces for learners, and incorporate ECD principles into the lower primary curriculum. Finally, teachers must be required to have training in early childhood development to provide them requisite skills to teach at that level.

BACKGROUND

Early Childhood Education in Ghana

In the past two decades, Ghanaian policy-makers have prioritized Early Childhood Development (ECD) starting with the Early Childhood Care and Development Policy which was developed in 2001. Next was the 2007 Education Reform which included a mandate to expand of basic education to include kindergarten. The existing Free Compulsory Universal Basic Education (FCUBE) policy meant that all children were entitled to two tuition-free years of pre-school education. The current government priorities for early childhood education are improving access and quality. They propose to achieve this by building more kindergarten classrooms to ensure that every child aged 4 – 6 years attends pre-school and by narrowing the focus of the early grade curriculum to focus on reading, math and creativity.

Despite the growing policy interest in early childhood education in Ghana, there has been limited research in that area, particularly relating to learning outcomes. The Early Grade Reading Assessments (EGRA) and Early Grade Mathematics Assessment (EGMA) were conducted in 2013 and 2015 to address this deficiency. Findings from these assessments revealed that reading performance was very low for P2 pupils in Ghana as was numeracy performance (Ghana Education Service, RTI International and Education Assessment and Research Centre 2016; Ministry of Education, Ghana Education Service and National Assessment Unit 2014). School factors influencing early grade performance on these assessments included regular attendance, access to learning materials such as textbooks, and teacher engagement. In light of these findings, extensive research investigating the constraints to learning in the early grades is very much needed in this context. The research team’s pre-fieldwork engagement with stakeholders in the Education sector indicated an interest in early childhood research particularly in the areas of early grade teacher training and experience, as well as early grade teaching and learning outcomes in private school classrooms.

Objectives of Study

The study seeks to examine the quality of the learning environment in the early grade Ghanaian classroom by answering the following research questions:

1) How conducive is the physical classroom environment for learning in early grades?

The study’s first objective requires that the learning environment of the classroom be measured. The study aims to assess the learning environment in the classrooms by identifying the presence of tangible and intangible characteristics that have been shown to improve learning outcomes in other settings.

2) To what extent do teacher characteristics, particularly training experiences, influence their ability to provide an engaging classroom environment for students?

To build on the first objective, the study focuses on the teacher and their role in shaping the learning environment in the classroom. The focus is on their teaching style, particularly teacher preparation, classroom communication and sensitivity to student needs.

3) *To what extent do learning environments explain between-school variations in student performance?*

Finally, the study aims to assess the influence of the classroom learning environment on learning outcomes, specifically emergent literacy, numeracy and reasoning skills.

Study Rationale

This project studies literacy and numeracy skill acquisition in early childhood because of the importance of these skills to economic development. Cross-national studies indicate that literacy and cognitive skills are a stronger predictor of economic development than educational attainment (Hanushek & Woessmann 2007; 2008, 2012; Heyneman 2004; OECD 2010; Somers 2005). Low levels of literacy and numeracy skills are both linked to low wages, greater risk of unemployment, lower standards of living, and poorer health for adults (OECD 2010; 2013) - all factors that have a negative impact on labour force productivity and economic growth. Since emphasis on quality of education over quantity is important, research that focuses on directly assessing literacy skills is needed in the developing country context.

An OECD (2010) study found that low academic performance is costly for countries and concludes that ensuring that all students meet a minimum standard can lead to substantial long-term gains in economic growth. The study uses simulations to project that if all countries participating in the Programme for International Student Assessment (PISA) had the minimal proficiency level, there would be Gross Domestic Product (GDP) increase of \$200 trillion. Countries having an average national test score of the top performing country would result in a \$260 trillion gain.

The economic growth benefits of raising skills are particularly relevant for developing countries such as Ghana. Total education spending in 2015 represented almost a quarter of Government of Ghana expenditure (Ministry of Education, 2016) and given the country's resource constraints, it is important that this sector maximize the development returns to the inputs invested especially in the area of early childhood education. A World Bank report (2015) indicates that properly investing in early childhood is one of the smartest strategies for poverty reduction and improvement of life course outcomes, yet many developing countries are investing less than the needed funds per capita in Early Childhood Development. As with overall education, the development benefits of early childhood education depend on the quality – the report states, based on empirical evidence from developed and developing countries that high quality preschool programs bring returns of \$6 - \$17 for each additional \$1 invested. Quality can be assessed using factors such as teaching and learning materials, space and safety, class sizes, and instructional and emotional support from care-givers (Neuman and Carter 2011; Pianta et al. 2005; Peisner-Feinberg et al. 2001; Weiland et al. 2013; Weiland 1979).

Investment in early childhood pays dividends because pre-school experience shapes development and learning outcomes (Barnett 1995, 1998; Campbell and Ramey 1994; Phillips & Shonkoff 2000) such as IQ, academic achievement, and grade retention. In addition, early conditions predict a variety of long-term outcomes such as educational attainment (Duncan, Ziol-Guest, & Kalil 2010; Maluccio et al. 2009; Nores & Barnett 2010), labour force productivity and

earnings (Heckman 2006; Gertler et al. 2014), health, wellbeing and mortality risk (Flaherty et al. 2013; Nores & Barnett 2010; Reynolds et al. 2007). Unfortunately, millions of children in developing countries are at risk of not reaching their development potential (Grantham-McGregor et al. 2007; Lake 2011).

Considerable research has touched on the importance of the environment for learning at all stages, both at home and in school (Brooks 2012; Buckley, Schneider, and Shang 2005; Cleveland and Fisher 2014; Guo and Harris 2001; Temple 2008; Yang, Becerik-Gerber, and Mino 2013). Cognitive stimulation from learning materials such as educational toys and books promote learning (Bradley and Putnick 2012; Evans et al. 2010; Guo and Harris 2001; Retherford and Sewell 1991; Sandefur and Park 2006). The physical aspect of the environment such as poor infrastructure and sensory distractions that do not make conditions conducive negatively affect learning as well (Legros, Soler and Bakris 2003; Sen and Desai 2004; Smith and Barret 2011; Yair and Gazit 2006).

Over the past two decades, industrialized countries have invested in classroom learning environment research because of the positive association between the quality of the environment and student learning outcomes (Barret et al. 2015; Cheryan et al. 2014; Dart et al. 1999; Dorman, 2001; 2003; Fisher, 2005; Fraser, 1998; Fraser & Goh, 2003; Sanoff 1994; Spaul 2013). The environment plays a key role in learning, especially in early childhood. Environment shapes development through factors such as intellectual stimulation from learning aids (Hamadani et al. 2014; Nores & Barnett 2010; Tucker-Drob, Briley, & Harden 2013), socio-economic resources, caregiver-child interactions (Kiuri et al. 2012; Licata et al. 2012), safety and stress-free conditions (Cheryan et al. 2014; Guo and Harris 2000; Yair and Gazit 2006).

Substantially less research has been conducted on learning environments in sub-Saharan Africa where students consistently tend to be among the lowest scorers in international assessments (Mullis et al. 2004; 2008; 2012). Research on school quality in this context tends to focus on the more tangible infrastructural measures such as teacher training, pupil-teacher ratio, and seating places. These factors are undeniably important and continue to be significant predictors of student performance however; it is time to study the other dimensions of school quality that the conventional measures of school quality cannot explain to further understand the constraints to student performance.

Classroom Environments and Learning

Research on classroom environments is instrumental to understanding learning outcomes. The bulk of the existing research on early childhood classroom environments and learning outcomes are based on cross-sectional data that demonstrate correlations and not causality. Weiland et al. (2013) review the literature and find that causal research on the relationship between observational measures of classroom quality and short-term learning outcomes shows small to not significant effects, in contrast to the significant effects seen in studies of long-term outcomes. The relatively small effects on short-term outcomes compared to the larger long-term effects of the early stage learning environment underscores the importance of laying strong foundations in

early childhood for later life. The empirical evidence from their own paper finds similar results and they discuss the role of accurately assessing the quality of the environment in early childhood to this finding.

Indeed, measuring the quality of the environment and linking it to learning is a complex task. Other studies (Evans 2006; Cleveland and Fisher 2014; La Paro, Pianta, & Stuhlma 2004; Weinstein 1979) have also discussed the challenges in measuring the quality of the early classroom environments because of the complexity involved – there are a variety of elements, many intangible, that can influence pupil learning in the classroom – learning materials, interactions with peers and caregivers, space to engage in play and other activities, safety etc.

The learning environment has long been characterized using intellectual factors with a focus on socio-ecological and psychological factors that affect cognitive development. Relatively more recently, research has increasingly demonstrated the importance of the physical characteristics as well (Cheryan et al. 2014; Cleveland 2009; Cleveland and Fisher 2014; Temple 2008; Weinstein 1979). The physical space is particularly important because it not only influences learners but teachers as well. Poor quality physical classroom environment negatively affects teachers in areas such as motivation, engagement and job satisfaction, instructional support and interactions with children (Brooks 2012; Buckley et al. 2005; Hogland, Klinge and Hosan 2015; Pakarinen et al. 2010; Pianta et al. 2005).

A critical component of the physical learning environment is the structural aspect – the design, spacing, and layout. Structural classroom factors such as crowded spaces and poor building conditions are detrimental to student learning and by extension achievement (Barrett et al. 2015; Cheryan et al. 2014; Evans 2006; Spaul 2013). Cheryan et al. (2014) further find positive influence of physical symbolic features such as classroom décor on learning and achievement, explaining that it works through inspiring students and making them students feel valued. Sensory factors in the physical environment such as excessive noise, uncomfortable temperatures and poor lighting have a negative association with learning outcomes as well (Barrett et al. 2015; Cheryan et al. 2014; Marchand et al. 2014).

Caregivers and teachers (in the case of classrooms), play an important role in shaping the learning environment in a variety of ways. Teachers are particularly influential in the early stages where teachers can provide emotional and behavioural support in addition to instructional support. Teachers can influence the learning environment when they use child-centred and participatory instructional styles that promote engagement and learning (Araujo et al. 2016; Burchinal et al. 2008; 2012; Salminen et al. 2012; Xue and Meissels 2004). For instance, Lerkanen et al. (2015) find that child-centered teaching practices promote interest in reading and math for kindergarten pupils. Pakarinen et al. (2011) find that task avoidance in mathematics can be linked to instructional style.

Teacher interactions with children influence the learning environment through pupil engagement and motivation (Burchinal et al. 2008; Curby, Rimm-Kaufman and Ponitz 2009; Howes et al. 2008). Teacher characteristics such as training and beliefs can affect the learning environment by

influencing interactions, teacher awareness of pupil needs and the ability to adopt suitable teaching practices (Hu et al. 2016; Schachter et al. 2015; Williford et al. 2017). The evidence for teacher education and training is mixed - both pre-service and in-service training can be positively correlated with teaching practice and learning outcomes (Angrist and Lavy 2001; Neuman and Cunningham 2009; Pianta et al. 2005; Raver et al. 2008) while some studies find no significant effect of education and training (Early et al. 2006; Howes et al. 2008).

DATA

Survey Information

Data for this study comes from the Classroom Learning Environments Ghana Study (CLEGS) conducted by the Regional Institute for Population Studies, University of Ghana. The survey received ethical clearance for the research from the University of Ghana Ethics Committee for the Humanities. The study received approval to conduct research in schools from the Basic Education Division of the Ghana Education Service. In each district, the study received approval to conduct research in district schools from the District Directorate of Education. Funding for this project was available courtesy of a grant from the International Growth Centre (IGC).

The study design utilized a mixed method approach and conceptualized the learning environment using the following areas - layout and design, sensory distractions, teaching and learning aids, and teaching style. The instruments were meant to collect data in the areas measuring the learning environment, the learning outcomes of interest – emergent literacy and numeracy skills – and background information to be used as control variables in the analysis. The research team developed five instruments and used an existing scale as an additional instrument:

School Questionnaire (SQ)

This questionnaire collected information on school quality from the head teacher. In instances, where the kindergarten and primary school had different head teachers, both head teachers were interviewed. The questionnaire had four (4) sections: head teacher characteristics, school information, teaching staff and early childhood education.

Teacher Questionnaire (TQ)

This instrument was designed to assess the intellectual environment on the classroom by collecting information on teaching style in addition to other teacher and class characteristics. The questionnaire has five (5) sections – teacher characteristics, teacher experience and training, classroom management, working conditions and teaching style.

Classroom Observation Inventory (COI)

This instrument is designed to assess the environment through direct observation. In each school, three trained fieldworkers were assigned to observe each class, record their observations and take a photograph of the classroom. For the analysis, one out of the three recorded was randomly

selected from each classroom¹. The COI has three sections – cognitive stimulation, layout and design, and sensory. The cognitive stimulation questions assessed the presence of visual and learning aids. Layout and design focused on structural characteristics of the classroom and the building it was housed in, classroom space and safety. The sensory section focused on distractions to pupils and sources of discomfort.

The Revised Child Caregiver Interaction Scale (CCIS-R)

The CCIS-R is an observation tool that assesses the quality of the interaction between teachers and pupils. The observation was conducted for the entirety of the school day. The scale assesses interactions in three domains – emotional (tone of voice/sensitivity, acceptance/respect for children, enjoys and appreciates children, and expectations for children), cognitive/physical, (health and safety, routines/time spent, physical attention, discipline, language development, learning opportunities, and involvement with children’s activities) and social (arrival, promotion of prosocial behavior/ social emotional learning, and relationships with families).

Pupil Questionnaire (PQ)

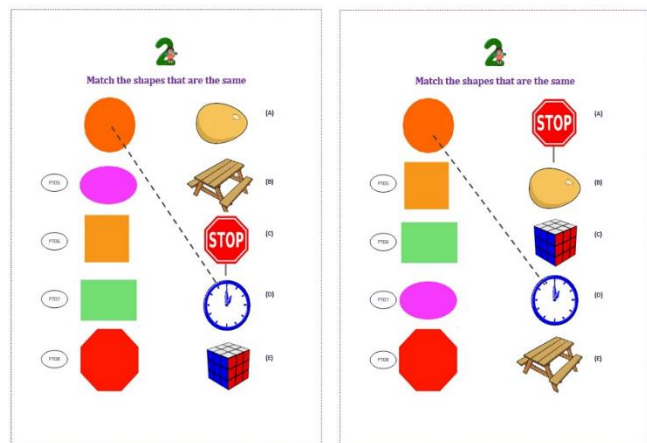
The pupil questionnaire had twelve questions asking about household assets; family characteristics and socioeconomic status; and educational support at home.

Pupil Workbook (PW)

The study developed a workbook for each grade after reviewing the GES curriculum for those grades. The study was conducted in the middle of the third term of the academic year so all questions in the workbook were from areas that should have been covered by the end of second term. The workbooks had questions testing literacy, numeracy and reasoning skills of pupils.

Photo 1: Snapshot comparing a page from an 'A' and a 'B' booklet

To minimize the bias of pupils copying responses from other pupils, each grade had two workbooks printed – ‘A’ and ‘B’ versions where the placement of the questions and/or answers differed but the example was the same. Pupils were assigned the workbooks based on their seating arrangements so that pupils sitting next to each other received different versions of the booklet. The figure below shows a comparison of a selected page from comparable booklets.



Each page had a set of questions targeting a specific skill e.g. counting and a pre-answered example. The fieldworker in charge of administering the test held up a A3 card of each test page in front of the class and went over the example to ensure that pupils understood what the questions on that page required. Once the pupils understood the example they were given some

¹ For the pilot study, questions from the observation inventory were compared for the three field workers and there were no significant differences in the answers provided.

time to answer the questions before moving on to the next. At least two field workers were involved in the administering of the test – one to explain the example to the pupils and the other(s) to invigilate. The pupil assessment was administered at the same time as the teacher questionnaire to ensure teachers did not get involved in the testing process.

Pilot Study

Before primary data collection commenced, there was a pilot study, which collected data on 470 pupils in 24 classrooms from eight (8) schools out of ten (10) randomly selected schools – two (private) schools did not consent to participate in the survey. The results from the pilot study were used to refine the instruments used for the main data collection and make minor modifications to the study design. The pilot study was particularly useful in highlighting the need to have assessments that include tests of reasoning skills in addition to reading and math. Performance on literacy and numeracy questions was significantly better than on reasoning ones, consistent with the trends observed in the TIMSS regarding performance in basic versus higher order skills.

After the pilot, two sets of questions were dropped – word search puzzle for all grades and a word problem set for first grade. Pupils had difficulty understanding the instructions and finding the words in the word search. They also had difficulty reading and understanding the word problems. A sub-sample of class teachers were given copies of the test booklet to review after the assessment and all the first-grade public school teachers indicated that the reading level of their pupils was not advanced enough to read, understand and solve the word problems. Some teachers also indicated that the pupils were yet to be taught some of the topics in the coming weeks and so the content of the assessment must be in sync with the curriculum. As a result, the study was limited to topics that were supposed to have been taught by the end of the previous term.

During the pilot study, there was a chance to have semi-structured interviews with the public-school head teachers on the challenges to Early Childhood Education. A summary of the challenges as follows: The Reform that mandated that kindergarten be a part of basic education posed a challenge for some schools because it was not necessarily accompanied with funds to build additional classrooms for schools without available spaces. Almost ten years later, many schools are still struggling to accommodate pre-school pupils. As a result, the kindergarten classrooms were at risk of being placed in multi-grade classrooms, temporary structures, converted classrooms, or under trees.

Schools also had difficulty providing the learning aids and toys for early childhood classrooms because they faced funding challenges and struggled to get basic supplies such as lesson planning books, textbooks etc. One strategy they used to counter this challenge is to encourage teachers to create handmade posters and toys for the classroom. Many classrooms observed during the pilot had hand-drawn posters on the walls but few had hand-made toys.

Head teachers also cited a lack of parental support for young children and early childhood development. They indicated factors detrimental to learning such as older siblings accompanying pupils in kindergarten and lower primary to and from school and as such not giving teachers and opportunity to interact with parents, parents not assisting pupils with schoolwork and ensuring that homework is done, parents refusal to contribute to per-pupil levies to improve classroom conditions and sending young children to school without breakfast and money to buy food.

Head teachers expressed their support for the project and discussed the importance of understanding the challenges facing learning in the early stages. Head teachers mentioned that with the new basic education structure, pupils were likely to stay in the same school from kindergarten to JHS3, and as such the blame for poor performance in the Basic Education Certificate Examination (B.E.C.E) rests fully on them and cannot be shifted to another pre-school or primary school. They noted that teachers in Upper Primary and Junior High School complained about the preparedness of students that came into their class and so strengthening the teaching and learning at the entry point into the school would eliminate the problem of promoting peoples without the requisite skills.

Primary Data Collection

Data collection took place from May to June 2016. Fieldworkers were divided into three (3) teams made up of two (2) supervisors and six (6) enumerators. Each team spent a full school day in a school. The jobs of the supervisors were to coordinate the data collection within the schools and ensure each instrument was administered properly. They were also responsible for paying a courtesy visit to the head teacher and the class teachers to introduce the team when they arrived at the school. Each team had three trained fieldworkers assigned a grade to observe the teacher-child interaction in each school visited. They also assisted in administering the assessment. The other three fieldworkers were to administer the teacher questionnaire and complete the classroom observation inventory. All team members were responsible for administering the pupil questionnaire during break times.

Sampling

The survey took place in three (3) districts selected based on public school kindergarten Pupil-Teacher ratios: one above-average, one average and one below-average. Pupil-teacher ratio (PTR) was selected as an indicator of district school quality (Barrow and Lee 1996; Eide and Showalter 1998; Welch 1996) and kindergarten ratios were used instead of primary school because of the focus on early childhood.

Public schools were randomly selected from the Education Management Information Systems (EMIS) school census listing. The private schools were a convenience sample of school located in the same locality as the selected public schools. For the main data collection exercise, all the sampled public schools consented to participate in the study. Three (3) private schools did not consent with the following reasons: no reason (1), survey would take too much time (1), head teacher was away and the assistant would not consent (1).

The study collected survey data at three levels – school, classroom and pupil. In each school, data was collected from one KG1, KG2 and P1 classroom. For schools with more than one stream, one class was randomly selected to participate in the study. In the selected classrooms, all pupils participated in the assessment. In classrooms where there was more than one teacher, the lead teacher was identified and interviewed. All pupils in the classroom were included in the assessment. Pupils who received parental consent were eligible for the pupil questionnaire and those who gave assent were interviewed.

A master file linking all instruments was created giving an analytic sample of 61 schools, 174 classrooms, and 4,720 pupils. Each classroom had to have recorded information for all six instruments to be in the analytic sample. Twelve classrooms were dropped from the final sample because the head teacher or class teacher was on leave due to illness, or the teacher was away attending a training course or conducting B.E.C.E invigilation.

District Characteristics

Table 1 presents district education characteristics of the districts from the Education Management Information Systems (EMIS) census data for the 2014/2015 academic year. There are the expected differences between public and private schools with public schools having higher pupil teacher ratios, substantially so in the case of District C for kindergarten. District C, with the highest public PTR and lowest private school PTR had the greatest kindergarten public/private disparity while District A had the lowest disparity. Public schools also had lower ratios for seating and writing spaces per pupil compared to private schools. On the other hand, the private schools had substantially higher pupil to trained teacher ratios. Trained teacher refers to professional teachers who have completed an accredited teacher training programme.

Table 1: Profile of Participating Districts

School Characteristics

Table 2 presents the characteristics of the schools in the sample based on information from the head teacher. 43 (70.5%) out of the 61 schools were public. There were the expected differences between public and private schools with public schools being significantly more likely to be under-staffed and under-resourced. The most significant disparity was in terms of space – more than half of public school head teachers reported that inadequacy of instructional space was a problem compared to about 5% of private schools.

Public schools had the advantage in the ratio of trained teachers. The pupil-teacher ratios stated here are based on enrolment and staffing information reported by head teachers. The mean ratios reported are lower than expected based on the district averages. This may likely be due to discrepancies between class sizes on paper and on the ground. Fieldworkers consistently found

larger class sizes on the day of data collection than expected based on the reported enrolment figures provided by head teachers during reconnaissance visits to schools.

Although the current policy states that Language of Instruction (LOI) in kindergarten and lower primary must be a local language, 40% of schools reported English as the LOI. Private schools were significantly more likely to select English – more than a third of the sampled private schools. Head teachers reported a high percentage of their teaching staff with ECD training – almost a third in both public and private schools. However, private school head teachers were significantly more likely to report having had any ECD training. The in-service training (INSET) reported was less than the recommended number from the Ghana Education Service (GES) Teacher Education Division (TED) – 2 school-based and 1 cluster-based per term. Public schools had significantly more school-based trainings but there was no significant difference in number of cluster-based trainings.

Table 2: Profile of Schools in Sample

Teacher Characteristics

Table 3 presents the profile of teachers in early grades within the sample². The most interesting pattern observed in the teacher sample is that KG2 teachers appear to be positively selected when compared to KG1 and for certain characteristics, even P1 teachers. The rationale for assigning stronger teachers in kindergarten to KG2 is possibly to ensure that pupils are prepared to start primary school. With respect to language of instruction (LOI) KG2 teachers are most likely to say they are trained in and are fluent in their school's LOI, comfortable teaching in the LOI and least likely to say they have difficulty communicating with students who are not fluent in the LOI. KG2 teachers are most likely to say they chose they love working with children, least likely to say they would prefer to be teaching at another level and have poor working conditions. They are also most likely both to report having had in-service training and in-service training related to ECD. This pattern is observed in both public and private schools.

P1 teachers had the highest level of education and the greatest proportion of trained teachers and teachers trained in local languages. However, they had the lowest proportion of teachers with both pre-service and in-service training related to early childhood. P1 classes also had the lowest likelihood of having teaching assistants. The data indicates a declining investment of schools in ECD once pupils leave kindergarten. This is unfortunate as early childhood spans ages 3 – 8, i.e. pupils in kindergarten to P3, and as such teachers in lower primary should have equivalent ECD training as their peers teaching kindergarten as well as teaching support.

The other statistic of note is that about two-thirds of the sampled stated that they would prefer to be teaching another level (higher classes). This may be indicative of inadequate training to equip them to teach in early grade and inadequate support for them in the classrooms. For

² Five (5) schools had one kindergarten classroom and did not differentiate between KG1 and KG2 and so classrooms were coded as KG1.

instance, teachers in the sample are less likely to say they prefer to teach other levels if they have had ECD pre-service training (significant difference), or have access to teaching and learning materials (difference not significant) or have a teaching assistant (difference not significant).

Table 3: Profile of Teachers in Sample

Pupil Characteristics

Table 4 below presents descriptive characteristics of the pupils in the sample. The sample age is indicative of delayed enrolment as pupils are on average slightly older than the recommended grade for age. The recommended ages of entry for KG1, KG2 and P1 pupils are 4, 5 and 6 respectively and the observed means here indicate that the differences between actual and recommended age increases with grade.

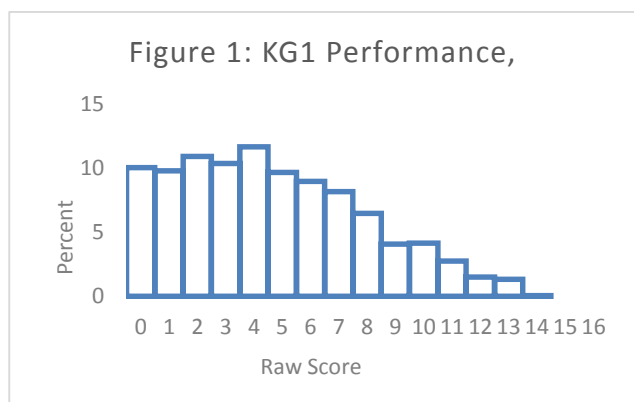
More than 80% of the pupils live in two-parent households; the likelihood of residing with parents reduced with grade. The pupils report high level of educational support at home – about 70% of the sample report having someone at home help them with their homework and the likelihood increases with grade. There is a lower likelihood of reporting that someone at home was reading to pupils – 61% of the sample report being read to. A little over half of the sample reported having books and toys at home; the likelihood of having toys decreases with grade while that for having books increases with grade.

Table 4: Descriptive Statistics of Pupil Sample

Workbook Performance

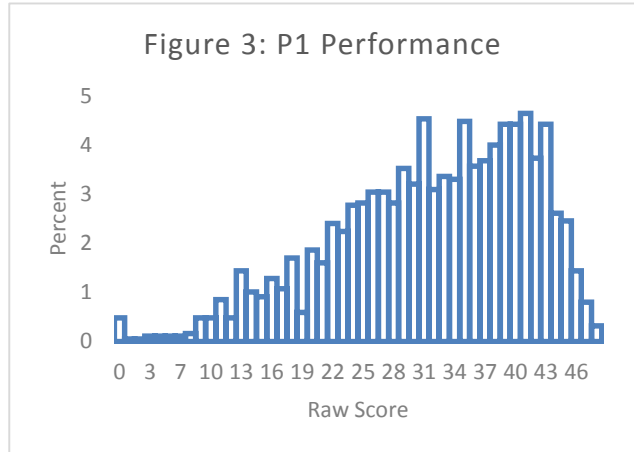
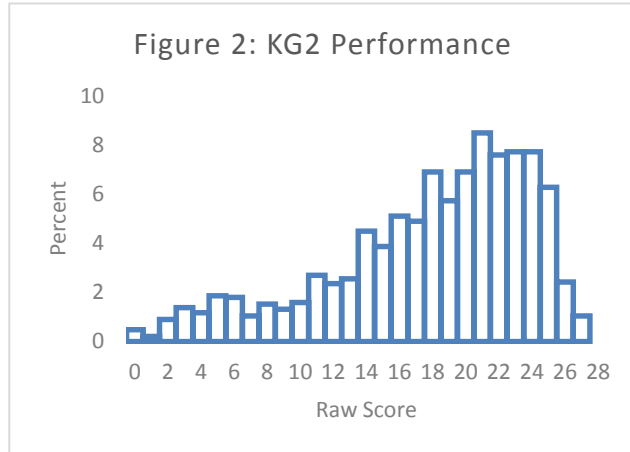
Figures 1 – 3 present the raw test score performance on the assessment. Performance on the assessment increased by grade.

Performance was lowest in KG1 with 10% of the sample scoring 0 out of 16 on the test. An additional 20% scored 1 or 2 on the test. About 20% of KG1 pupils could answer at least half of the questions.



The low performance on the KG1 test was not surprising as there was wide variation in KG1 classrooms ranging from pupils learning how to write to being taught three-letter words.

Performance was much better for KG2 and P1 where there was less variance across schools with



respect to the curriculum. The distribution for these grades are both right skewed with 80% of the sample scored greater than 50% on the test and less than 1% scored 0 of 28 and 48 respectively.

METHODS AND RESULTS

How conducive is the physical classroom environments for learning?

Table 4 presents the summary of selected variables from the Classroom Observatory Inventory which assesses the structural characteristics, sensory distractions, and learning aids. The inventory had about a 100 items and so exploratory factor analysis was used to reduce the dimension of the variables (Tables A-C in Appendix 1 presents the components that the variables loaded in the factor analysis). We run bivariate frequencies and use chi-squared tests to first compare KG classes with P1 then KG1 and KG2.

The bivariate analyses reveal that kindergarten classes are at a significant disadvantage compared to P1 classroom, with respect to many structural characteristics and sensory distractions but had an advantage with learning aids. When comparing KG1 to KG2 classrooms, the KG1 classrooms were better off in all three areas. In line with what head teachers noted during the pilot study regarding difficulty finding instructional space for kindergarten classrooms, both KG1 and KG2 classrooms were in less conducive spaces than P1.

Kindergarten pupils were significantly less likely to be in an enclosed space and in a completed structure. They are more likely to be in cluttered spaces and rooms without windows. Their classes were more likely to be situated where unpleasant odours from outside permeated the classrooms and where classroom temperatures were rated uncomfortable. Kindergarten classes had less space for movement, interactive learning and other activities besides listening. They were less likely to have seating and writing spaces for each pupil as well. Most concerning, is that KG pupils were less likely to be in classrooms where they could exit safely in an emergency.

Fieldworker observations on spacing and safety concerns mainly noted that doorways were too narrow, the position of the teacher's desk partially blocking the doorways and desks arranged too close together to allow easy movement.

Fieldworkers were significantly less likely to report that kindergarten classrooms were free of unnecessary distractions. The main distractions they noted were domestic animals entering the classroom, noise from other classes and passers-by, and the classroom doubling as a storage room and being distracted by people coming to look for items.

Kindergarten classrooms were significantly more likely to have visual aids and educational toys while P1 classrooms had the highest proportion with books. Hardly any classrooms had ICT or musical instruments. The presence of visual aids in early grade classrooms in many early grade classrooms is a positive finding as they enhance the learning environment. However, there are two issues of concern – first is that the visual aids, toys and books were not always accessible to children in almost 20% of the classrooms that had them; they were locked away in cupboards, teacher's desk and even the head teacher's office.

Secondly, the proportion of classrooms with visual aids is significantly lower for P1 suggesting again that schools pay less attention to ECD once pupils start primary school. The likelihood of pupils seating in traditional rows as opposed to clusters, that encourage interactive learning, increases significantly by grade. Less than half of KG1 classrooms are arranged in traditional rows compared to almost 100% of P1 classrooms again suggesting that ECD concerns are not prioritized in P1 classrooms.

Table 5: Classroom Characteristics

To what extent do teacher characteristics influence their ability to provide an engaging classroom environment?

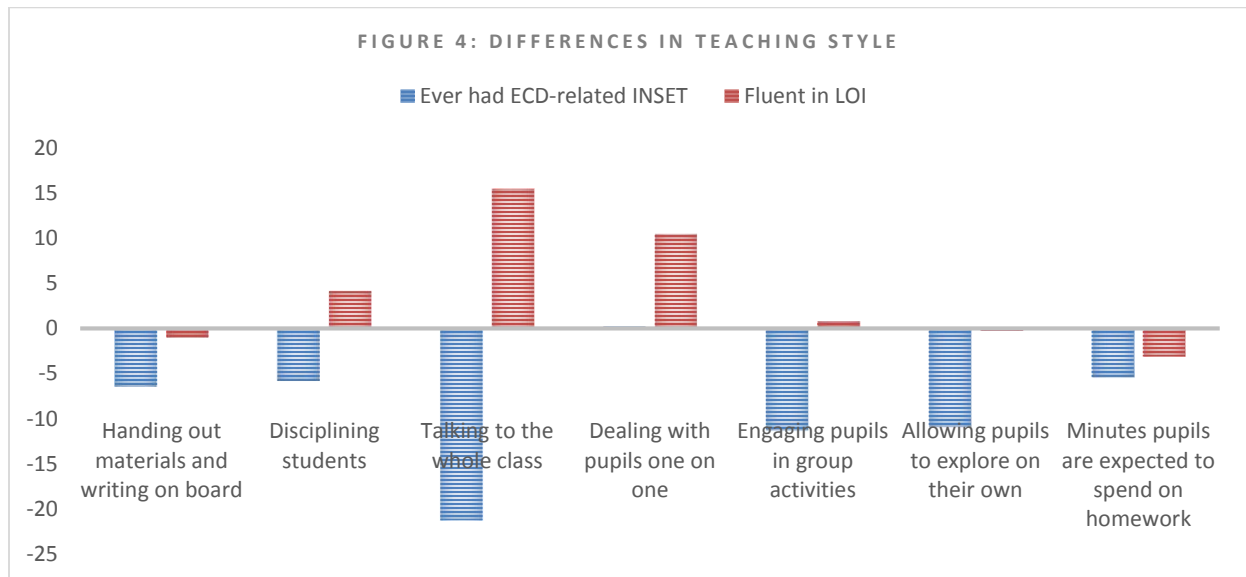
Table 6 presents cross-tabulations of teacher-reported mode of instruction and classroom management. Again, we see some differences between characteristics of KG2 teachers and others in the sample – notably preparation time, time use during instructional hours in class, mode of assessment, and reporting on student indiscipline and ability to cope with ability.

Table 6: Description of Teaching Styles

We focus on two teacher characteristics to study patterns in mode of instruction – in-service training related to early childhood and fluency in the language of instruction (LOI). We focus on these two factors over other teacher characteristics for policy reasons – requiring INSET ECD training and assignation on teachers based on fluency can be modifications to the existing system at minimal cost. For mode of instruction, we use reported time spent on specific tasks during a normal school day and expected time to complete homework.

Figure 4 estimates the differences between teachers who have had some ECD INSET versus others (controlling for grade, class size, public school, teacher training and experience and ECD-related/local language pre-service training, space for movement and other activities in the classroom and teaching assistants). The differences are not statistically significant apart from homework (for ECD INSET) and one on one interactions (for fluency in LOI). Teachers with ECD INSET expected their pupils to spend fewer minutes on their homework while teachers fluent in the LOI spent more time dealing with students one on one.

Figure 4: Differences in Teaching Styles



The conclusion from this analysis is that teacher characteristics, represented by ECD INSET and fluency in LOI has minimal influences on teaching style. This is consistent with the mixed findings from the existing literature. Notably, the largest (in size and significance) influences on time spent on child-centred and participatory activities such as group work and exploration is class size and space for movement and other activities besides listening to the teacher, and space to rearrange furniture. This is to be expected as such activities would require room for both teachers and pupils to move about.

To what extent do learning environments explain between-school variations in student performance?

Finally, we assess the correlation between the classroom environment and learning outcomes using multilevel regression analyses. The analyses are run separately by grade to assess whether the relationship between the classroom environment and learning outcomes differed by grade and the results indicate that it does. The dependent variable in the regressions is the pupil test score. Due to the skewness of the distribution, the logged raw score is used as the dependent variable. Our focal independent variable is the classroom learning environment. We utilize

Multiple Correspondence Analysis (MCA) to construct separate indices to represent structural (layout and design), sensory, learning aids, and teaching style.

The performance on learning outcomes (summarized in percent scores) are presented for the total, literacy, numeracy (excluding KG1 which had no numeracy questions) and reasoning in Table 7. The descriptive summary presents differences by grade and school type in test score performance. Overall pupils in private school performed better on the test than public schools. Within grades, scores were higher in KG1 and P1 private schools. KG2 pupils in public schools were scoring higher on average than their private school counterparts.

The table also presents test scores separately for reasoning questions. The pattern of note is that while overall performance increased by grade, performance on reasoning questions declined by grade. KG pupils perform relatively better on reasoning questions while P1 pupils performed relatively worse. The decline in the reasoning scores is most pronounced for public school P1 pupils. One possible explanation based on the summary statistics so far, is the observed differences in the learning environment between kindergarten and P1 classes – more teaching and learning aids, better spacing, and more child-centred teaching practices.

Table 7: Pupil Performance on Assessment

Table 8 presents selected coefficients results of the regression results. The logged raw score allows for interpretation of the predictors of percentage changes in scores. For the first three indices, the direction of the association is consistent across all grades in the expected direction but varies in significance. Teaching style is the only index that has mixed findings.

Teaching and learning aids have a significant positive association with performance for KG2 and P1. For KG1 the association is also positive but not significant. For KG1, one of the observations made during the classroom inventory is that the content of the visual aids in some of the classrooms were not necessarily grade-appropriate – e.g. posters with parts of the body, wildlife, Ebola awareness where posters such as numbers and ABCs would be more suited for that level. That may explain the lack of significance of the learning aids index in KG1.

Layout and design also has a positive association with scores but the index is only statistically significant for KG2. The influence of layout and design works through teaching style and so once teaching style is included in the model, the size and significance of the index declines for all grades. Sensory bombardment had a negative, but not statistically significant association with test performance across all grades.

The final index, teaching style which aims to assess how child-centred and participatory the teaching in the class is, provides mixed findings. The index is positive but not significant for KG1. For KG2, it is negative and significant, indicating that the child-centred teaching styles have a negative influence on test performance which is contrary to expectation. The association is observed for models predicting reasoning performance but not literacy. For P1, child-centred

teaching styles have a significant positive association with overall performance. The influence of teaching style is more pronounced in models predicting reasoning but not significant for models predicting literacy.

One finding of note is the influence of teacher ECD training on performance – statistically significant for KG2 and P1. This finding underscores the importance of ensuring that P1 classrooms have an ECD focus so that ECD is not only incorporated into the KG curriculum. Teaching training by itself does not have positive influence on performance in the early grades. In the case of KG1, it exerts a significant negative influence on performance. The limitation of the study is that there is no information on the content and the quality of trainings – where and when training was received. Future research examining the differences in content between the general training and the ECD-focused training will be important to determine which aspects influence learning in the early grades.

Teacher comfort with the grade level is most important for KG1. When the teacher is not comfortable with another level, it has significant negative influence on performance. It is not significant for KG2 and positive for P1. Teaching experience at the grade level also has a significant positive influence on performance in KG but not in P1.

The conclusions from this analysis are that the influence of the classroom environment, particularly teaching and learning aids and teaching styles, is important for learning outcomes in KG2 and P1. For KG1, teacher experience and comfort level with the grade are the strongest influences on performance.

*Table 8: Results of Multilevel Regression Analysis Predicting Overall Test Performance**

CONCLUSIONS

The study recommends improving the location and structural quality of existing KG classrooms and increasing the availability of visual aids in P1 classrooms. Such improvements can be encouraged by educating head teachers and class teachers on the importance of early childhood education for later academic outcomes. Such sensitization will ensure schools pay attention to the environment in the early grades, particularly to location, layout, and learning aids. We recommend policies requiring that the environment in kindergarten classrooms be of the same level of P1 classrooms while P1 classrooms be equipped with more visual aids.

Class sizes must be reduced to encourage more participatory learning (group activities, collaborations, exploring etc.) in early grade classrooms. This can be done by building more kindergarten classrooms over time to accommodate the demand and ensuring that all classrooms have the space required for these activities. We also recommend introducing space restrictions for early grade classrooms by instituting a classroom density limit in addition to the existing class size limits. These restrictions are necessary to support teaching in early grade classrooms, particularly those that encourage development of critical thinking skills. Further, all

classrooms must be assigned teaching assistants who can be National Service Personnel or teacher trainees to reduce the pupil-caregiver ratio in the classroom making it easier for children to be engaged in child-centred learning activities.

ECD training (either pre-service or in-service) should be a requirement for teachers in the early grades to equip teachers with the requisite skills to teach at this level particularly in the nurturing of critical thinking skills and creativity. ECD training can be extended to head teachers, circuit supervisors and parents as well. Such training can help with the assignment of teachers to early grade classrooms by identifying the teachers with the necessary training or ensuring teachers receive the training once assigned.

Finally, we recommend incorporating Early Childhood Development (ECD) principles into the P1 – P3 curriculum. The proportion of classrooms with visual aids is significantly lower for P1 suggesting again that schools pay less attention to ECD once pupils start primary school. The likelihood of pupils seating in traditional rows as opposed to clusters, that encourage interactive learning, increases significantly by grade. Less than half of KG1 classrooms are arranged in traditional rows compared to almost 100% of P1 classrooms again suggesting that ECD-friendly environments are not being prioritized in P1 classrooms. While the survey did not include P2 and P3, we assume the classroom environments are like that of P1. The developmental stages for children runs up to 8 years, or P3 for pupils progressing at the recommended ages, and as such curriculum content, classroom design and teacher training in pre-school, kindergarten and early primary must all be guided by ECD research.

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TABLES

Table 1: Selected Education Management Information Statistics for 2014-15 Academic Year				
<i>Statistic</i>	<i>District A</i>	<i>District B</i>	<i>District C</i>	<i>Country</i>
Public School Pupil-Teacher Ratio (KG)	19	30	63	29
Private School Pupil-Teacher Ratio (KG)	21	23	17	24
Public School Pupil-Trained Teacher Ratio (KG)	20	33	72	70
Private School Pupil-Trained Teacher Ratio (KG)	606	1,077	427	608
Public School Pupil-Teacher Ratio (Primary)	32	29	38	35
Private School Pupil-Teacher Ratio (Primary)	21	17	19	32
Public School Pupil-Trained Teacher Ratio (Primary)	33	31	38	56
Private School Pupil-Trained Teacher Ratio (Primary)	404	600	198	638
Public school seating places per pupil (KG)	0.6	0.6	0.4	0.6
Private school seating places per pupil (KG)	1.1	1.1	1.1	0.8
Private school writing places per pupil (KG)	0.5	0.7	0.4	0.5
Private school writing places per pupil (KG)	0.9	0.9	1.0	0.7
Public school seating places per pupil (Primary)	0.6	0.8	0.9	0.7
Private school seating places per pupil (Primary)	1.0	1.2	1.1	0.9
Private school writing places per pupil (Primary)	0.6	0.8	0.9	0.7
Private school writing places per pupil (Primary)	0.9	1.2	1.1	0.8
Number of public schools (KG)	18	50	15	13,828
Number of registered private schools (KG)	119	13	97	5,328
Number of unregistered private schools (KG)	38	12	14	1,804
Number of public schools (Primary)	22	51	17	14,405
Number of registered private schools (Primary)	119	13	88	5,223
Number of unregistered private schools (Primary)	94	12	13	1,681

Table 2: Characteristics of Schools in Sample

Variable	Total	Private	Public
Head teacher female	60.2	46.3	66.7
Head teacher age	52.1	55.1	50.7
<i>Language of instruction in KG and P1</i>			
English	42.7	29.9	70.4
Ga	3.5	2.6	5.6
Dangbe	23.4	25.6	18.5
Akuapim Twi	3.5	5.1	0.0
Fante Twi	19.9	26.5	5.6
Asante Twi	7.0	10.3	0.0
School has a library	31.6	44.4	25.6
Library has books for early grades	64.8	75.0	56.8
School has an ICT laboratory	39.8	68.5	26.5
School has a staff common room	36.3	57.4	26.5
Teacher pupil ratio	15.7	12.3	16.3
Trained teacher pupil ratio	21.7	53.2	17.8
Teachers with any ECD training	62.9	63.2	62.8
Head teacher has received ECD training	40.3	47.4	37.2
Head teacher familiar with KG curriculum	83.9	79.0	86.1
School has copy of KG curriculum	87.1	84.2	88.4
School has NALAP materials for early grades	79.0	63.2	86.1
Are NALAP materials adequate for instruction	34.7	33.3	35.1
School-based INSET in current academic year	3.6	2.9	3.9
Cluster-based INSET in current academic year	1.5	1.6	1.4
Number of PTA meetings per term	1.6	1.5	1.7
Lack of instructional materials a problem	43.6	26.3	51.2
Inadequate budget for supplies a problem	43.7	10.5	58.1
Inadequacy of instructional space a problem	54.8	5.3	53.5
Shortage of teaching and learning materials a problem	58.1	52.6	60.5
Student indiscipline is a problem	21.0	15.8	23.3
Students unable to cope with materials a problem	19.5	15.8	20.9
Low teacher morale a problem	46.8	47.4	46.5
Weak school management a problem	29.0	31.6	27.9
Sample Size	62	19	43

Table 3: Descriptive Characteristics of Teachers in Sample				
Variable	Total	KG1	KG2	P1
Female	96.5	100.0	100.0	89.8
Age	37.2	39.3	35.6	36.8
Chose teaching because they love working with children	63.5	62.7	70.6	57.6
Secondary education	30.6	32.2	35.3	25.4
Vocational/technical	10.6	15.3	5.9	10.2
Tertiary	58.8	52.5	58.8	64.4
Trained teacher	66.5	64.4	64.7	71.2
Pre-service training related to early childhood	49.4	57.6	58.8	32.2
Training for local language instruction	42.4	35.6	39.2	52.5
Trained in local language of instruction of school	70.8	66.7	80.0	67.7
Years teaching	13.0	14.3	11.6	12.9
Years teaching this level	5.0	5.7	6.1	3.4
Class size	33.1	34.9	29.2	35.2
Class has a teaching assistant	24.1	33.9	25.5	13.6
Assistants have training related to teaching	63.4	60.0	69.2	62.5
Assistants have training related to early childhood	40.0	55.0	29.4	25.0
Assistants have received in-service training in past year	57.8	75.0	41.2	50.0
Fluent in the language of instruction	88.2	81.4	96.1	88.1
Comfortable teaching in language	90.6	91.5	92.2	88.1
Proportion of students fluent in language of instruction	67.8	64.4	70.9	67.9
Difficulty communicating with students not fluent	32.9	35.6	23.5	39.0
Chose to teach at this level	31.2	27.1	45.1	22.1
Prefers to be teaching at another level	65.9	64.4	56.9	74.6
Overall enjoys working as a teacher	95.3	93.2	96.1	96.6
Describes working conditions as poor	18.8	23.7	13.7	18.6
Very comfortable teaching children this young	68.8	57.6	72.6	76.3
Currently enrolled in a degree or certificate programme	20.6	17.0	23.5	20.3
In the field of education	85.3	100.0	91.7	66.7
In the field of early childhood education	0.0	0.0	0.0	0.0
In-service training in the past 12 months	75.6	74.1	78.4	74.6
Number of trainings	3.0	2.6	2.8	3.5
In-service training related to early childhood	60.7	65.5	80.4	39.0
If yes, was training was beneficial	96.1	97.4	95.1	95.7
If no, would training be beneficial	100.0	100.0	100.0	100.0
Familiar with learning objectives of the curriculum	90.0	83.1	92.2	94.3
Has a copy of the curriculum	81.8	76.3	88.2	83.1
Sample Size	174	59	56	59

Table 4 : Socio-Demographic Characteristics of Pupils in Early Grade Sample				
Variable	Total	KG1	KG2	P1
Age	6.7	5.3	6.7	7.9
Female	48.5	44.3	51.4	50.0
Mother resident in household	93.3	95.8	93.1	91.3
Father resident in household	84.4	88.2	85.8	80.1
Mother/Father owns a bicycle/motorcycle	31.2	23.1	29.8	26.0
Mother/Father owns a computer/tablet	26.2	23.1	29.8	26.0
Household has a television	85.0	83.7	84.8	86.1
Household has a radio	75.3	75.1	74.1	76.5
Household has newspapers/magazines	48.7	46.1	49.8	50.2
Household has books for the child to read	59.2	54.8	56.4	65.1
Household has toys for the child to play with	52.6	56.0	52.6	49.5
Household has a table for the child to write	80.7	80.1	82.5	79.7
Language at home				
Ga	6.2	5.2	7.3	6.3
Twi	30.4	32.1	28.8	30.3
Ewe	16.7	15.2	16.5	18.2
English	6.4	6.4	8.2	5.2
Dangbe	21.0	18.1	19.8	24.4
Other	19.3	23.1	19.6	15.7
Does anyone help with homework	69.6	59.1	65.4	82.0
Does anyone read to you	61.2	57.8	55.5	68.4
N	5,014	1,639	1,471	1,904

Table 5: Profile of Classrooms in Sample, Summary of Classroom Observation Inventory				
Variable	Total	KG1	KG2	P1
Classroom has visual aids	77.78	81.67	80.00	71.67
Are the visual aids accessible to children	83.67	81.25	81.40	82.14
Classroom has educational toys	13.33	18.33	18.33	3.33
Are the toys accessible to children	83.33	81.82	81.82	100.00
Classroom has books	86.11	76.67	86.67	95.00
Are the books accessible to children	83.23	89.13	84.62	77.19
Classroom has a computer/laptop/tablet	3.89	5.00	3.33	3.33
Is computer/laptop/tablet accessible to children	100.00	100.00	100.00	100.00
Classroom has musical instruments	2.22	3.33	1.67	1.67
Are the instruments accessible to children	75.00	50.00	100.00	100.00
Classroom is located outside	3.89	3.33	5.00	3.33
Classroom is located in an enclosed space	78.98	75.00	78.33	83.33
Classroom is housed in a completed structure	88.89	86.67	86.67	93.33
Classroom interior unpainted	16.96	18.97	16.36	15.52
Classroom walls dingy/dirty	70.76	70.69	65.45	75.86
Classroom has windows	77.78	75.86	74.55	82.76
Classroom appears cluttered	23.89	29.31	23.64	17.24
Classroom is clean	82.46	86.21	80.00	81.03
Classroom has space for pupil movement	79.53	74.14	80.00	84.48
Classroom doorways located to minimize distractions	83.04	82.76	80.00	86.21
Pupils can exit classroom safely in emergency	88.89	86.21	85.45	94.83
Classroom has space for teacher movement and interaction	85.38	77.59	89.09	89.66
Classroom has space to rearrange furniture for other activities	66.08	68.97	67.00	62.07
Classroom has room for other activities beside listening	59.06	60.34	54.55	62.07
Classroom has space for movement of physically challenged	46.20	50.00	44.45	43.10
Writing space for each pupil	92.98	89.66	94.55	94.83
Seating space for each pupil	93.33	93.33	90.00	96.97
Seating arranged in traditional rows	69.44	48.33	63.33	96.67
Seating appears comfortable	74.44	73.33	70.00	80.00
Classroom has lighting to see all relevant materials	93.89	93.33	93.33	95.00
External noise is audible	40.56	41.67	35.00	40.00
Unpleasant odours within classroom	11.11	10.00	11.67	11.67
Unpleasant odours from outside smelt in classroom	12.22	10.00	18.33	8.33
Classroom temperature uncomfortable	8.89	13.33	10.00	3.33
Classroom is free of unnecessary distractions	86.55	77.59	85.45	96.55
Sample Size	174	59	56	59

Table 6: Descriptive Characteristics of Teaching Styles and Classroom Management				
Variable	Total	KG1	KG2	P1
<i>Access to Teaching and Learning Aids</i>				
Permanently Displayed	40.0	32.2	43.1	44.1
Available for access when needed during class	37.7	42.4	39.2	32.2
Not available	22.4	25.4	17.6	23.7
Minutes spent preparing for next day's lessons	35.0	35.5	22.9	42.8
<i>Time Use during instructional hours (minutes)</i>				
Handing out materials and writing on board	34.0	33.2	25.9	41.7
Disciplining students	11.8	17.9	4.9	12.0
Talking to the whole class	54.6	47.7	40.0	67.0
Dealing with pupils one on one	17.4	19.9	16.0	16.2
Engaging pupils in group activities	28.5	33.9	27.1	24.4
Inspecting pupil work	22.8	26.9	19.3	21.6
Allowing pupils to explore on their own	21.9	30.2	17.1	17.9
Going over previously covered material	12.7	12.6	11.7	13.8
Parents required to sign their child's homework	32.9	33.9	33.3	30.5
Days a week teacher assigns homework	3.9	3.6	3.9	4.2
Minutes pupils are expected to spend on homework	19.7	17.4	18.9	22.6
Student indiscipline a problem	30.0	33.9	27.5	30.5
Students unable to cope with course material	12.9	15.2	5.9	17.0
<i>Assessment used most frequently for homework</i>				
Multiple choice questions	36.5	22.0	43.1	45.8
Open-ended questions	27.7	20.3	27.5	33.9
Puzzles	3.5	6.8	2.0	1.7
Searching for patterns	7.7	10.2	9.8	3.4
Questions requiring explanations	6.5	11.9	2.0	5.1
Other	18.2	28.8	15.7	10.2
Proportion of students fluent in language of instruction	67.8	64.4	70.9	67.9
Use both English and language to teach	62.9	54.2	68.6	67.8
Call on other teachers to help	6.5	8.5	7.8	3.4
Use local language they are familiar with	14.7	18.6	11.8	11.9
Do nothing	2.9	5.1	2.0	0.0
Other	12.9	13.6	9.8	17.0
<i>Does the following more than half the time</i>				
Coach positive behaviours	67.7	72.9	64.7	64.4
Reward targeted social behaviour with incentives	42.9	47.5	31.4	30.5
Punish negative behaviour with caning	15.9	10.2	15.7	22.0
Punish children for poor performance in school work	3.5	5.1	0.0	5.1

Inform parents of bad behaviour	30.6	35.6	25.5	30.5
Ignore misbehaviour that is non-disruptive to class	21.2	25.4	13.7	22.0
Extra parent conferences for students with learning problems	19.4	23.7	23.5	11.1
Sample Size	174	59	56	59

Table 7: Descriptive Summary of Pupil Test Scores

Variable	Total	Private	Public
<i>Total</i>			
Sample Size	4,404	1,115	3,289
Percent Score (Total)	53.4	56.4	52.3
<i>KG1</i>			
Sample Size	1,473	375	1,098
Percent Score (Total)	29.1	30.9	28.4
Percent Score (Literacy)	18.6	20.4	17.9
Percent Score (Reasoning)	32.2	34.0	31.6
<i>KG2</i>			
Sample Size	1,210	367	843
Percent Score (Total)	63.5	59.7	65.2
Percent Score (Literacy)	53.8	50.8	55.1
Percent Score (Numeracy)	59.4	54.4	61.5
Percent Score (Reasoning)	60.7	57.3	62.1
<i>P1</i>			
Sample Size	1,721	373	1,348
Percent Score	65.6	72.9	63.6
Percent Score (Literacy)	68.8	78.9	66.0
Percent Score (Numeracy)	67.9	76.8	65.5
Percent Score (Science)	74.0	65.9	73.2
Percent Score (Reasoning)	59.5	77.0	57.7

Table 7: Multilevel Regression Results									
Variable	KG1			KG2			P1		
	β		Z-score	β		Z-score	β		Z-score
<i>Classroom Environment Indices</i>									
Teaching and learning materials	0.0		0.1	0.2	**	2.6	0.1		1.7
Layout and design	0.0		1.2	0.1	*	2.1	0.0		0.9
Sensory bombardment	0.0		-1.3	0.0		-0.3	0.0		-1.4
Teaching style	0.0		1.6	0.0	**	-2.4	0.0	**	3.0
<i>Teacher Characteristics</i>									
Class teacher trained	-0.4	**	-2.9	0.0		0.3	-0.1		-1.5
Teacher experience (years)	0.0	**	2.5	0.0	**	2.6	0.0		-0.6
Teacher has had ECD training	0.1		0.6	0.1		0.7	0.1	**	2.1
Teacher uncomfortable teaching grade	-0.2	**	-2.3	-0.1		-0.8	0.1	**	2.1
<i>Pupil Characteristics</i>									
Asset-based SES score	0.0		0.5	0.0		1.7	0.0		-0.9
Books and toys at home	0.1	*	2.1	0.0		-0.6	0.0		1.6
Someone at home assists with homework	0.0		-0.3	-0.1		-1.6	0.0		-0.5
Someone at home reads to child	0.1		1.4	0.1	**	3.1	0.0		0.4
Language spoken at home same as LOI	0.1	**	2.3	0.0		-0.5	0.1	**	3.6
<i>School Characteristics</i>									
Public School	0.1		0.7	-0.4	**	-3.1	-0.1		-0.9
Pupil-teacher ratio	-0.1	**	-3.0	0.0		-0.8	0.0		-1.3
School climate index	0.0		-0.5	0.1	**	2.6	0.0		-0.7
Constant	0.4	*	2.1	1.9	**	8.1	2.7	**	11.1
Random Effects (Standard Deviation)	0.3		0.0	0.2		0.0	0.0		0.0
Log-likelihood	-1260			-478			-759		

The multilevel regression models control for pupil gender and age, asset-based household socioeconomic status score, co-residence with parents, public school, head teacher experience and training, district, school and classroom resources, teaching assistants and classroom size, and teacher beliefs.

^a Components: availability of and pupil access to visual aids, toys, activity books, textbooks, ICT and musical instruments; teacher access to teaching and learning materials.

^b Components: location and layout of classroom; building characteristics; spacing and safety; cleanliness and clutter; and arrangement of furniture.

^c Components: lighting; temperature; background noises; unpleasant odours; and seating discomfort.

^d Components: time use; mode of assessment; classroom management; and teacher attitudes.

* The result is significant at $p < 0.05$

** The result is significant at $p < 0.01$

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