CLASSROOM OBSERVATION STUDY

A Report on the Quality of Teaching and Learning in Primary Schools in Kenya

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Acknowledgement

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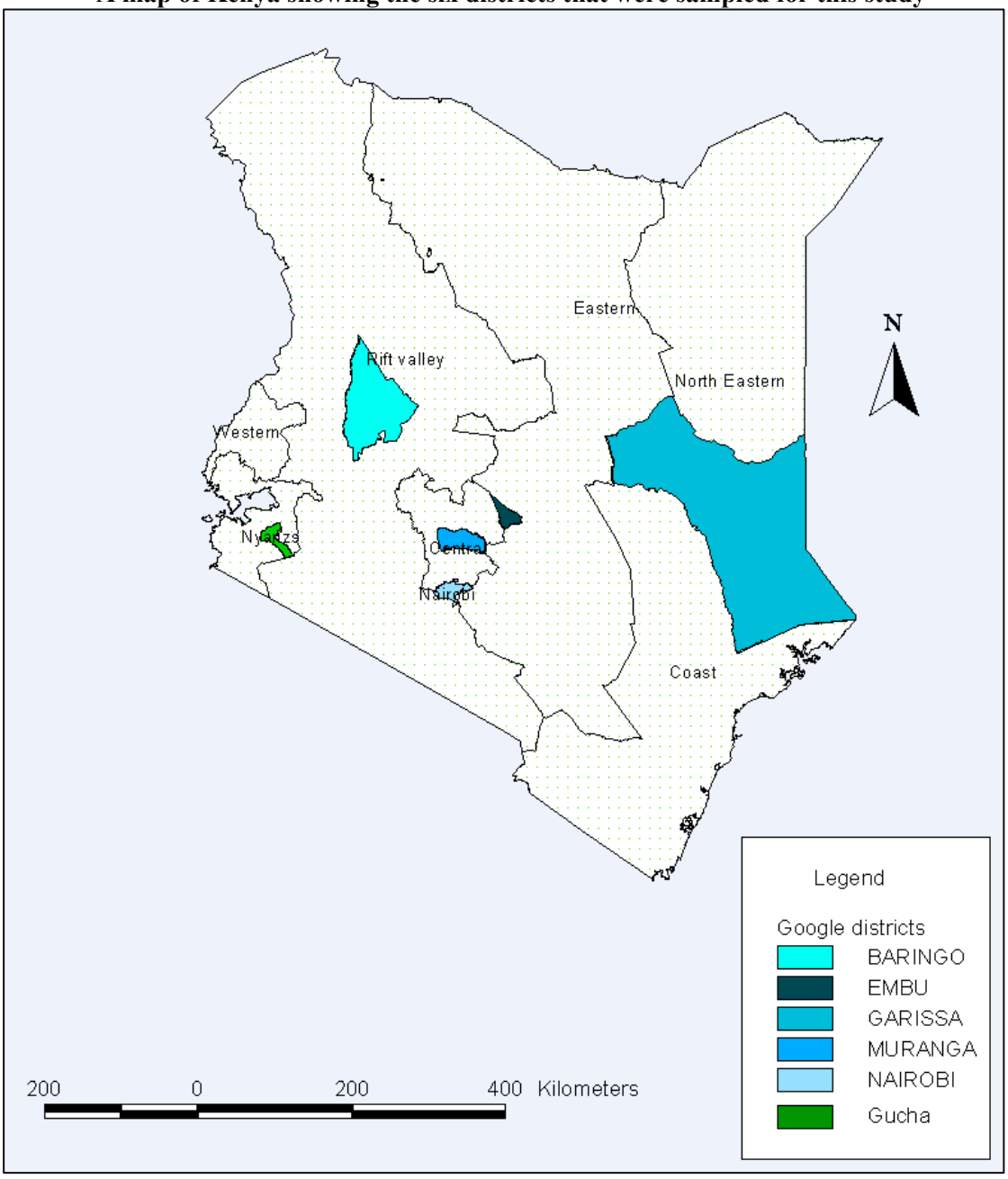
A map of Kenya showing the six districts that were sampled for this study



Executive summary

Anecdotal evidence indicates that there is growing interest and concern about what actually happens in the classrooms since Kenyan government successfully implemented free primary education policy in 2003. Teachers may be well trained and yet effective learning still fails to take place. This study provides the first opportunity in Kenya to understand whether classroom interactions, including aspects such as 'Opportunity to Learn' and teacher subject knowledge explain why some schools are consistently ranked at the top while others are dominating the bottom performance ranks in Kenya's KCPE[1]. Research evidence has shown that an important aspect of quality education is the teaching and learning processes that go on in the classrooms. For APHRC, this is ground breaking study that complements its other education research studies which have focused on assessing the impact of FPE on access for the poor residents of the slums of Nairobi.

The study uses cross-sectional data and involved several steps to obtain the sample. Firstly, using Kenya Certificate of Primary Education (KCPE) examination results for 2002 to 2005, districts which have consistently been ranked within the top 10%, middle 20% and bottom 10% were indentified. Secondly, from this pool of identified districts, two were randomly selected from each of the three categories. Thirdly, a pool of schools that have consistently been ranked in the top and bottom 20% categories respectively in the KCPE results between 2002 and 2005 in the selected districts were identified. These schools were selected taking into consideration stratification by type so as to include both public and private schools. Finally, 12 schools in each district were randomly selected for the study based on the following criteria: six schools that have consistently been ranked in the top 20% in the district and another six that have been ranked at the bottom 20% in the KCPE results. To ensure proportional representation of both public and private schools weighting was done according to the number of number of public and private schools in each of the selected districts. Using this step by step process, the following six districts were sampled for the study: Baringo, Embu, Garissa, Gucha, Murang'a and Nairobi. The selected districts represent Western, Central, Eastern, Rift-Valley and Nairobi regions of Kenya. It can therefore be said that the schools included in this study is nearly a nationally representative sample.

The instruments for data collection were developed in collaboration with researchers and practitioners with expertise in classroom observations, curriculum development, primary school teaching and assessment. The instruments were piloted in six primary schools, which enabled improvements to be made on various aspects of the questionnaires. Data collection included the use of video recording and a classroom checklist to capture classroom interactions during lesson teaching; survey instruments for the teachers, head teachers and students; teacher numeracy assessment tool; and a learner numeracy assessment tool. Sixteen field interviewers were trained

[1] KCPE refers to the Kenya Certificate of Primary Education exams which is taken at the end of the 8-year primary cycle of the Kenyan education system, and used to select entrants to the various tiers of Kenya secondary schools.

on how to administer the instruments and in the use of the video cameras. The first round of field work was carried out between the months of May and July 2009 in 72 primary schools. 211 teachers, 72 head teachers, and 2437 primary grade 6 pupils participated in the study. The second round of the field work was carried out during the months of February and March 2010. The video clips were analyzed by two experts using a video analysis rubric and the questionnaires were used to develop the analytical dataset on teaching practice and quality of learning in the visited schools. As is required of us by the Kenya Government, The National Council for Science and Technology and the Ministry of Education issued the requisite research authorization for the study, and the draft report has been shared with the Ministry of Education, Kenya

Summary of key findings and policy implications

- The mean pupil score in mathematics is 46.89% which is below 50% usually considered to be the pass mark.
- With the exception of Baringo district, girls in the other five districts have on average scored slightly higher (between 0.3 and 3.6 percentage points) than boys.
- The difference in maths mean scores is large (23.83 percentage points) between the top and bottom performing schools in Nairobi and smaller (4.9 percentage points) between top and bottom schools in Garissa.
- The maths mean score for teachers is 60.5% which is only slightly above the average pass mark of 50%
- Male teachers from top ranked schools scored higher than male teachers from bottom ranked schools by an average of 7 percentage points.
- There is a linear but weaker relationship between pupil mean score and teacher score in the bottom ranked schools- which is to say, teachers in the bootom ranked schools made some difference in the performance of their pupils in Mathematics wheras in the top ranked schools, this relationship is non existent. Individual seat work was a dominant teaching activity in maths lessons; recitation is the dominant activity in english lessons; andwhole class responses was the dominant activity in the science lessons. However, in the bottom schools, whole class responses was dominant in both english and science lessons.
- Use of relevant teaching aids such as a manila paper illustrating a concept and placed on a classroom was found to be important in teaching and learning.
- Learners exposed to more interactive classrooms, for instance recitation with question and answer activities, scored higher marks.
- High performing schools (and by implications students) had higher gain scores than low performing schools (students).

1. Background

1.1 Preamble

This study was funded by Google.org. The study began in 2008 and will end in 2011. Field work was done between May and July 2009 for the first round and February and March 2010 for the second round. The purpose of this field report is (1) to document how the data was collected; (2) to act as a reference to those who will be writing scientific papers, processing, and analyzing the data; and (30 consolidate the findings for purposes of sharing with key stakeholders including teachers and Ministry of Education. The report has five sections: Section 1 presents the study background. Section two presents data collection issues. Section three outlines the district and individual school reports. Section four captures the challenges experienced. Section five outlines the lessons learnt and recommendations for future classroom-based studies.

1.2 Purpose of the study

The purpose of this study was to examine the teaching process and generate information relevant to objective policy advice on the quality of teaching and learning. The intention is that by sharing the evidence generated by this study with policy makers, it is hoped that it will lead to the improvement of the quality of teaching in primary schools in Kenya. It sought to understand whether classroom interactions, including how aspects such as 'Opportunity to Learn' explain learning achievement.

1.3 Research questions guiding the study

The following are the main research questions guiding the study. However, the data collected is rich on teaching practice information and will make it possible to answer several other research questions.

a). What are the differences and similarities in teaching practice among teachers in high and low performance schools?

b). Does the observed teaching practice explain student achievement?

c). Do teacher attributes explain student's learning achievement?

d). What policy recommendations on teaching practices can improve the quality of teaching in primary education?

Based on the guiding research questions, the following research papers have been conceptualized

and are being finalized for publication as publicly available and accessible APHRC Working Papers.

- Do teachers who have a good understanding of maths demonstrate better teaching practice in the classrooms?
- Does teaching practice explain differences in learner achievement in low and high performing schools?
- Social relations as predictors of achievement in maths in Kenya primary schools.

Other questions that the data may help to answer

- Do opportunities to learn (measured by teacher absenteeism, curriculum completion, and bullying and class size) explain learning gains.
- To what extent do student characteristics, classroom sitting arrangements and classroom participation explain learning gains?
- Assess whether female and male teachers differ in mathematics teaching and content knowledge, and whether this is reflected in pupils' mathematics performance.

2. Literature on classroom interactions

Education has two main components—teaching and learning (Osakwe, 2009). One of the aims of education worldwide is the integration of individuals into their respective societies so that they can realize their potential, promote unity, and endeavor for cultural scientific, political, economic, social, and technological advancement. According to Osakwe (2009) teaching seeks to bring about change in behavior, both in formal and informal settings by communicating and imparting knowledge and skills to learners. Therefore, on the one hand, teaching is interactive in nature, involving an instructor and a learner (Osakwe, 2009), using communication to foster learning activities in the classroom (Osakwe, 2006, 2009). On the other hand, learning is a process of acquiring change (Okwo, 1995; Nweke, 1996). In addition learning involves the pursuit of goals, the discovery and construction of meaning from the various experiences received, moderated by the individual learners sole perception.

Teacher-classroom interactions that aid student learning are often complex processes that depend on interpersonal and pedagogical awareness. According to Morrison, Bachman, & Connor (2005) the teacher's pedagogy, classroom management strategies, and interactions with students at classroom level can determine how much is learned. Therefore, learning is contingent on the teachers' ability to create and sustain optimal learning environments. The authors assert that there are at least three important dimensions of teaching that influence students' literacy acquisition directly or indirectly: (1) the classroom environment teachers create, (2) teachers' warmth and responsiveness to their students, and (3) the amount and type of instruction they provide (Morrison, Bachman, & Connor, 2005).

Alexander (2001) argues that there are three elements of teaching: (i) frame, (ii) form and (iii) act. That the core acts of teaching (task, activity, interaction and judgment) are framed by classroom organization ('space'), pupil organization, time and curriculum, and by classroom routines, rules and rituals. They are given form in the lesson or teaching session. He further states that the national or local curriculum, school curriculum, class curriculum and timetable and the lesson plan are grouped under *frame*. The lesson itself then becomes the *form* and the *act* encompasses task, activity, interaction and assessment. In his earlier work, Alexander (2000) studied primary education in five cultures, schools and classrooms between 1994 and 1998. The study's context was England, France, India, Russia and the USA. He identified six important characteristics of teaching: teaching as transmission (the passing on of information and skill); teaching as disciplinary induction (providing access to a culture's established ways of enquiry and making sense); teaching as democracy in action (in which knowledge is reflexive rather than received, and teachers and students are joint enquirers); teaching as facilitation (respecting individual differences and responding to developmental readiness and need); teaching as acceleration (outpacing 'natural' development rather than following it); and teaching as technique (emphasizing structure, graduation, economy, conciseness and rapidity).

In the context of classroom interaction, the transmission, facilitation and acceleration are very important components for effective learning. For instance, learning in the classroom involves arranging and transferring of information from a source (teacher) to destination (learner) (Heinichi, Molender, & Russel 1999). In this respect effective communication on the part of the teacher is an integral part of effective classroom interaction. However, other variables have been identified by scholars as being important for the quality of instruction that is received in a classroom. These include, attitude of the teacher (Osakwe, 2009), knowledge base, and mastery of subject knowledge by the teacher (Osakwe, 2009; Darling-Hammond, 2000), and the socio cultural context (Osakwe, 2009). These scholars are in consensus that a substantial proportion of student achievement is attributable to the characteristics and performance of the teachers in their respective schools. According to Darling-Hammond (2000) differences in teacher effectiveness determines students' achievement over and above the effects of class size and heterogeneity in a classroom (also see Sanders & Rivers, 1996; Wright, Horn, & Sanders, 1997; Jordan, Mendro, & Weerasinghe, 1997).

Moreover, teachers' attitude has also been found to be associated with quality teaching and learning in the classroom. For example, possession of positive work attitude enhances teaching, thereby leading to the achievement of learning objectives and the overall educational objectives (Okorodudu, 2006). This implies that teachers who possess negative attitudes impair the ability of students to be able to receive messages from the subjects that they teach, leading to wrong interpretation of concepts. Research also shows that the teachers' knowledge is key to effective interaction in the classroom (Osakwe, 2009; Okorosaye-Orubite, 2005, Darling-Hammond, 2000). According to Osakwe, (2009) and Okorosaye-Orubite, (2005), teachers ought to have adequate knowledge about the learners for effective classroom interaction to take place. That teaching involves the transmission of what is to be learned by the teacher to the learner. Thereafter, the learners have to be able to use their skills to interpret the knowledge they receive from the teachers.

From the foregoing discussion, a teacher needs to have good mastery of the content for enhanced classroom interaction. For example, Moloi, Morobe, & Urwick (2008) in their study of Free Primary Education (FPE) in Lesotho found that teachers' poor knowledge of content and pedagogy surfaced in the teaching of Mathematics with the deficiencies attributed partly to their training, and partly to the situation in the schools. While teachers did keep pupils occupied throughout their lessons, the concept of a learner-centered method of teaching was lacking. These findings suggest that teachers need to have good content knowledge, knowledge of assessment strategies, including the design of activities and test items relevant to objectives and marking for effective mathematics teaching and learning. Content knowledge aside, it is only when a teacher can communicate effectively that he will be able to draw upon the various social cultural contexts of the learner to facilitate learning (Stoner, Freeman, & Gilbert, 1999). Effective classroom interaction can also be enhanced by individual attention of teachers to their students.

According to Brown (2004) effective classroom interaction for effective learning encompasses individualized attention by developing a personal relationship with each student. This involves taking time out of each day to communicate individually with students on non academic matters. That it is important to look at students beyond bodies to be educated, but as people who need to be nurtured. From his study, Brown, (2004) proposes that teachers use techniques such as, rarely raising their voices, treating students with respect, being friendly (not necessarily being their friend), welcoming students into the classroom and having mutual respect for students. The idea of individualized instruction is reinforced by Wenglinsky (2000) who explored how improving teachers' classroom practice could improve teacher quality. He argues that conveying higher-order thinking skills lead to improved student performance. He further asserts that the effectiveness of individualized instruction accommodates the differing knowledge and skills which different students bring to the classroom. This study showed that there were no benefits from working in small groups and students suffered academically from lack of point-in-time testing. Other scholars argue that professional development (Hardman, Abd-Kadir, & Smith, 2008; Akyeampong, Pryor, & Ampiah 2006), and cultural diversity and awareness can be linked to higher mathematics test scores. From their study, Hardman, Abd-Kadir, & Smith (2008) conclude that the quality of the teacher is essential in raising standards in primary schools and that professional development programs such as in-service could help improve teacher delivery methods. In South Africa, a study in 40 schools by the Human Science Research Council and Stanford University (2008) show that the school system is characterized by a low average level of pupil and teacher mathematical knowledge. In this study most of the math teachers who were observed demonstrated a good pedagogical practice in the way they handle their lessons, use of lesson time, and communication with the students. However, a lack of an adequate pool of teacher mathematics content and pedagogical content knowledge seemed to be a major factor in influencing how much mathematics the students learnt.

Some scholars have argued that for effective classroom interaction between teachers and pupils, to translate into outcomes, pupils should be nurtured well within their households (O-saki & Agu 2002). The authors found that appropriate training programs could help both parents and teachers realize their role in bringing up children in a modern world, and encourage learning and active participation by both boys and girls as well as help reduce the number of school drop-outs. This

implies that parents have a role to play in their children's upbringing if the children have to come to school prepared to receive instruction from the teachers.

In the context of Kenya, research shows that there is need for more powerful school-based teacher development programs incorporating classroom observation, coaching and feedback in the use of effective teaching behaviors, alongside improved classroom conditions and teaching resources (Ackers & Hardman, 2001). The authors suggest the need for more longitudinal studies to investigate the effects of such interventions on teachers' thinking, classroom practice and the attainment and motivational levels of pupils. On the contrary, other scholars raise issues with gender differences that arise in schools that are detrimental to the classroom interaction when boys and girls are in the same classes. For instance, Mensch, Lloyd and Clark (1998) established that school environments are discouraging to girls where boys are favored in class and provided with a more supportive environment in terms of advice. Class interaction is further reduced when teachers take the importance of girls' participation in math less seriously; where boys are left free to harass girls; and where girls' experience unequal treatment. The study concluded that there is more to school effectiveness than the development of academic competency, and there is more to the quality of the school environment and by extension classroom environment than time to learn, material resources for the basic curriculum, and pedagogical practices.

Hardman et al. (2009) used a mixed-method approach, 144 video-recorded lessons covering the teaching of English, Math and Science at Standards 3 and 6 to investigate whole-class teaching and group-based learning. The authors found that compared to the earlier studies in Kenya, teachers were more interactive with the pupils in their whole class teaching and greater use was being made of group work. Teachers demonstrated the use of lesson plans, teaching resources and flexible classroom layouts than was the case before. Teachers who had undergone a systematic in-service training and were serving as key resource teachers demonstrated the most improvement in classroom interactions. This work by Hardman et al (2009) demonstrates that in-service training is very important for teacher classroom effectiveness and justifies what Wanzare and Ward (2000) had called for in their study.

Wanzare and Ward (2000) had argued that Kenya needs to review the teacher in-service training programs to make them more relevant to the needs of teachers and head teachers, especially as they relate to classroom practices. The authors are of the idea that in any staff development strategy, instructional supervisory systems must be in place in schools with the objective of promoting professional growth of teachers. They propose a professional development agenda for Kenya where productive staff development for teachers lies in their maximum involvement and participation in designing the in-service programs which will provide school-based professional experiences relevant to the needs of teachers and to the needs of the schools in which they work. According to Wanzare (2002), centralized teacher in-service training programs are highly inadequate because of lack of comprehensive teacher in-service programs is in place to prepare serving teachers to cope with the changes and challenges in teaching. As a result, many school teachers in Kenya have numerous problems including: inadequate ability and commitment to motivate the children under their care towards developing a desire for lifelong learning; ineffective communication skills, especially in primary education; and, unpreparedness to cope with the demands of the 8–4–4 system of education, as the majority of them had failed in

mathematics and sciences, yet they are expected to teach the current curriculum which has a heavy component of these subjects (Wanzare, 2002).

Wanzare (2002) further suggests that there is need to enhance the competence of Kenyan teachers in the light of the rapid, intensive and fundamental nature of present-day technological, economic, cultural, societal and political changes. In light of Wanzare (2002) observations a lot needs to be done to improve the quality of the teachers. This is because recent research still shows that there is less interaction in the Kenyan primary schools with dominance of recitation (Pontefract & Hardman 2005). The authors found that teacher interest in student learning and teacher years of experience were both inverse predictors of exam scores. Teacher tone and behavior and teacher interest in student learning were both related to higher levels of off-task behavior. On the contrary, Kodzi, Oketch, Ngware, Mutisya, & Nderu (Forthcoming) argue that teachers who show commitment to teaching by going over students' work and keeping the students occupied in the lesson have their students perform better in Math. They found an inverse relationship between teacher lack of interest and absenteeism and Math performance.

In sum the debates surrounding classroom interaction and students outcomes are far from over. Scholars have made progress debating over those variables that positively or negatively affect students' outcomes. However, there still remains unresolved issues on what characteristics influence achievement in high performing and low performing schools in Kenya. From a policy standpoint, scholars argue that in order for quality teaching to take place in a classroom, policy makers must communicate these policies effectively to teachers. This should be accompanied by professional development at all levels (Darling-Hammond, 1990). Darling-Hammond (1990) further argues that policies about the way teachers teach do not land in a vacuum, rather there are cumulative effects of policy actions on teachers. Most importantly, the act of teaching is a direct effect of what the teacher knows. Therefore, for policy to change the way teachers teach in order to enhance quality of teaching, policy ought to pay attention to the knowledge base of the teachers. **In Kenya, the question remains: Why do some schools perform well, while others persistently perform poorly**? The study findings reported in this report attempts to address this question. For instance, initial analysis of data from this study show that the dominant teaching activity in a Math lesson (teaching practice), availability of relevant teaching aids and the interaction between teaching aids and teaching experience significantly explains learner test scores and is a source of the difference in performance between high and low performing schools (Ngware, Oketch, Mutisya & Kodzi, *forthcoming*). Another initial analysis of the data has shown that teacher subject knowledge explains some of the scores of the pupils in low performing schools, but does not at all explain the scores of pupils in high performing schools (Oketch, Ngware, Mutisya, *forthcoming*)

From this literature, classroom-based studies generate useful information on the quality of education, and in particular, the way teachers teach and how learners get exposed to learning opportunities. While the findings on teacher-pupil classroom interactions seem to be consistence across countries, fewer (in the reviewed literature, only the South African study) directly links teaching practice to test scores including teacher content knowledge. In the case of Kenya, there is only one comprehensive and recent post-FPE study (see Hardman, et al., 2009) that looks at the teaching practice, though it does not use test scores. By providing empirical evidence on the linkage between the teaching practice in low and high performing schools, and test scores, this

study not only closes the gap in literature but also contributes to the debate on the quality of education in the context of UPE policies.

3. Study design and methods

3.1 Sampling procedures and sample size

Selection of the best and poor performing districts and schools, the Kenya Certificate of Primary Education (KCPE) results of the last five years available were used to rank districts (nationally) and schools (at district level). School performance in national examinations (a proxy indicator for student achievement) in Kenya varies by geographical and ecological regions of the country. Based on the distribution of school mean scores in a district, schools were categorized as low performing and high performing schools in any given year.

Specifically, six districts in Kenya, two that have consistently been ranked in the bottom 10% of the KCPE examinations over the past 4 years, two that have been consistently ranked within the middle 20% and another two that have consistently been ranked in the top 10% over the same period were selected for the study. A total of 72 schools, 12 in each of the six districts were randomly selected for the study. The schools selected for the study included six that had consistently been ranked in the bottom 20%, and six that had consistently been ranked in the top 20%. A further selection criterion for the schools ensured a mix of rural, peri-urban and urban schools in the sample. While taking a national representation in to account, the sample size was influenced by resource availability.

3.2 Development of instruments

The study used mixed methods to collect data. These included interviews using structured questionnaires, classroom observations checklist and the use of video cameras (filming) for actual lesson observation. To assess grade six learner achievement in mathematics and teacher mathematical knowledge, two separate numeracy assessment tests were developed and used to collect data from 72 primary schools spread across six districts countrywide (Baringo, Embu, Garissa, Murang'a, Nairobi, and Gucha districts).

Two video analysis tools (rubrics) were developed to analyze classroom observation videos. The main objective of these instruments was to assist the video analyst in recording various activities and tasks performed by learners and the teacher in the classroom at regular intervals. This is referred as the time line analysis, and it was used to capture teachers' demonstration of mathematical proficiency and mathematical pedagogical knowledge. The objective of the filming and subsequent analyses of the films is to study teacher-pupil classroom interaction as well as opportunity to learn (OTL). In addition, a classroom checklist was developed and was

used together with the video recording to capture aspects of classroom environment that may not have been captured in the filming. These aspects included, wall charts, availability of teaching aids, availability of recommended textbooks, lesson plans among others.

Survey instruments:

- Head teacher questionnaire: This instrument solicited information on school management, staffing, enrolment and parental participation in school affairs, among others.
- Teacher questionnaire: This solicited for information on biodata, qualification and training, discipline and syllabus coverage. The questionnaire was administered to grade six Maths, English and Science teachers.
- Learner questionnaire: The questionnaire solicited information on social economic background of the grade six learners and the school environment. This questionnaire was administered to grade six pupils in the selected schools.

Assessment tools:

- Mathematics teacher assessment tool, for grade six math teachers.
- Learner mathematics assessment tool, for pupils in the selected grade six streams.

Classroom observation and checklist tools:

- Classroom observation checklist: The checklist solicited information on availability of relevant textbooks, teacher and student made teaching and learning materials, other teaching resources, enrolment, learner absenteeism and lesson preparation.
- Opportunity to Learn (OTL) form: This form collected information from grade six exercise books that a learner used between January and November 2009. The information collected included date when the lesson was taught, and the main topic and subtopic as defined in grade six subject syllabus. In the absence of a main topic or subtopic, some contents of the lesson were recorded. These were later to be matched with main topic and subtopic from the syllabus.

Sixteen field interviewers were recruited and trained on the administration of the instruments. After a five-day training workshop for field interviewers, they piloted the instruments in conjunction with APHRC's research staff. Alterations on the instruments were made based on the experiences in the field after the pilot. The aim of the pilot was to assess whether the test was measuring learners competency in numeracy skills at primary grade six. In order to ensure validity and reliability of the test instruments, APHRC researchers held a two-day workshop

with one curriculum developer from the Kenya Institute of Education, two teacher trainers from a public teacher training college and one standard six mathematics teacher.

Of the sixteen field interviewers recruited, five were selected, based on their experience and performance during training sessions, and trained on using video cameras in classroom observations. The five were further instructed on analysis of classroom observation on video and trained for extra 2 days on using the classroom observation checklist and video analysis. Training was conducted by APHRC research staff in conjunction with an external researcher with experience in video analysis from the Human Science Research Council in South Africa. Training on video camera observation and analysis was done in March 2009.

3.3 Recruitment and training of fieldworkers

To undertake this study, qualified Field Interviewers (FI) who understood the context of teaching and learning were recruited. The minimum qualification was a Bachelor's degree and preferably those with some experience in surveys to assure good understanding of the study requirements. The total number of FIs recruited was 20 from which the best 16 were selected after training. To ensure quality FIs were recruited, a second recruitment was carried out to replace the withdrawals. Therefore, the recruitment process was done twice in February and April 2009.

3.4 Data collection, coordination and quality assurance

To administer the instruments at school level, the research team arrived at school before the start of the school day (except in cases where logistics could not allow) and introduced themselves to the head teacher, deputy head teacher or school manager in the case of private schools. Prior to the data collection, a researcher visited the school to inform the management about the intended data collection exercise. During such visits, the head teachers and managers or their representative were briefed on the study. School heads or managers either consented or declined to give permission for the study to be conducted within their schools. Schools that declined were immediately replaced following the selection criteria that had been described above. Four private and one public school declined to participate in the study. Out of these schools that declined, three were private schools and a public school in Nairobi; the fourth private school was in Murang'a district.

Video recording was done during a normal lesson as stipulated in the school time table. Individual questionnaires were administered to headteachers and teachers while group questionnaires were administered to learners. For the learner numeracy assessment test, the field interviewer read the items to those who were not able to read on their own. Learners were given ample time to finish completing the questionnaire. The instrument captured both the test start and end times for each learner.

Data collection was done using four teams; each handling a school per day. The teams often consisted of two groups of four and two groups of three. Those with four members handled schools with high number of pupils. The composition of groups was done taking into consideration individual characteristics, abilities and background. It was also agreed that the teams remain temporary and hence regrouping was often done as a means of: 1) ensuring the FIs concentrate on the work, 2) improving the working relationship among all members and, 3) enhancing team building and teamwork. Such measures were taken to enhance the groups' productivity and maintain the quality of work done. These strategies proved to be very productive.

In the schools, the teams randomly selected one grade six class in cases where there was more than one stream. The numeracy test, learner questionnaire and maths lesson filming took place in this selected grade. The observations of English and Science lessons were done in the other grade 6 streams. This enabled interviewing to take place concurrently in different grade 6 streams. The interviews and assessment involved all the grade six pupils in the selected stream.

The mathematics teacher was observed while teaching a mathematics lesson and the lesson was captured on video for post-analysis. The teacher was also interviewed in order to establish his professional or teaching practices, and other attributes. The same was done for the English and Science teachers. Only the mathematics teacher sat for a numeracy assessment test. In addition,

the head teacher provided information about the school. However, it was not always possible to find the respondents (teachers) in school. The absence of teachers necessitated callbacks. Proper planning and scheduling of callbacks therefore was considered an essential element of the whole process of coordinating data collection. Callbacks were done concurrently with data collection, or the research groups reorganized themselves to facilitate them.

To ensure the accurateness and completeness in data collection, a Master Data Sheet was kept where all the data sheets and questionnaires collected were tracked for the entire project period. Regular back checks and cleaning-up of questionnaires was also done in the field to ensure all the required data are sufficiently captured before leaving a particular district. Daily meetings were also held with team leaders to share lessons and give feedback on the findings of the field supervisor and team leaders' regular back checks in the filled questionnaires and spot checks. Regular meetings were also held with all members of the research team to discuss the progress of the study as well as various issues affecting the whole group. Important decisions were made and lessons shared on the appropriate ways of maintaining the productivity and quality of work done.

Different education researchers from APHRC visited the field a day or two before the team broke camp to go to the next district for purposes of spot checks and to monitor the progress, replenish survey instruments and address any challenges facing the field staff. The field supervisor and team leaders on the other hand carried out quality assurance activities such as performing random back-checks and cleaning to validate and ensure the accurateness and completeness of data collected as is normally done in all education field activities.

Standard six learners were assessed twice. The first round was carried out in May to July 2009, while round two was done in January to February 2010. The purpose of round two was to enable us compute a gain score for each pupil. During the second round, information on grade six subject, that is Maths, English and Science content coverage was collected using the opportunity to learn (OTL) form. To complete the OTL form, the field interviewer selected exercise books from three learners in each subject who are known to attend school and lesson regularly. This was to ensure that we captured all that the teacher taught the learners for the entire school year. The information on the topics and key subject contents were recorded on the OTL form for further analysis of content coverage.

3.5 Ethical and administrative considerations

The study observed all the APHRC and internationally laid down ethical guidelines throughout the research process. Among the ethical issues considered included: confidentiality, protection of human subjects especially of minors, and the principle of distributive justice. Before interviewing the pupils, parental consent was obtained. There were two exceptions to the rule--Garissa district and one school in Embu district where the head teacher advised that such consent should be given by him as the parents had delegated such issues to him as long as the child was in school. All the information collected was kept confidential and was available only to APHRC

researchers and analysts. During data collection, the respondents were given equal chance of being selected and they were allowed to decide whether or not to take part in the study.

Prior to embarking on the field work, ERP applied and was granted both the research permit and authority to carry out research in the selected districts from the Kenya National Council for Science and Technology (NCST). The ERP team also requested for authority to visit schools from the Ministry of Education. The authority was granted by the Directorate of Quality Assurance and Standards. On arrival in each district, the teams and researchers reported to the District Education Officer who issued a letter of introduction to schools. Ethical approval for the study was given by the Kenya Medical Research Institute, which is mandated by the NCST to issue such approvals for studies that deal with human subjects.

Table 3.1 shows a summary of data collected in all districts, in the first round of data collection done in May to July 2009. In total, 72 Headteachers, 70 Mathematics teachers, 70 English teachers, 71 science teachers and 2443 pupils took part in the study. 2443 learners undertook the numeracy assessment, but only 2438 of them participated in the interview. This means more pupils took part in numeracy test than in the interviews. What is important to note is the fact that the difference was greater in schools and districts where pupils go home for lunch e.g. Garissa (Table 3.2).

Table 3.1: Summary of the data collected in all districts

Survey instrument	Expected Response	Response	Response Rate
Headteacher Questionnaire (HTQ)	72	72	100.0%
Mathematics Teacher Questionnaire (MTQ)	72	70	97.2%
English Teacher Questionnaire (ETQ)	72	70	97.2%
Science Teacher Questionnaire (STQ)	72	71	98.6%
Learner Questionnaire (LQ)	2443	2438	99.8%
Mathematics Teacher Test (MTT)	72	70	97.2%
Learner Test (LT)	2443	2443	100.0%
Mathematics Observation Checklist (MOC)	72	70	97.2%
English Observation Checklist (EOC)	72	70	97.2%
Science Observation Checklist (SOC)	72	71	98.6%
Parent Consent Form (PCF)	2443	2228*	91.2%
Headteacher Consent Form (HCF)	72	54*	75.0%
Totals	**7977**	**7727**	96.9%

Notes: * In case of the parent consent forms, the pupils either forgot to bring them back to the H/T and/or the H/T did not find it necessarily to send the form to the parent for consent. For instance, no school in Garissa asked for parental consent. In case of the H/Ts, the FI did not collect this form from the head teacher. However, in the H/T questionnaire, there is a question that asked the H/T to consent. The parental and headteacher consent forms were not data collection instruments but ethical and administrative procedures.

Table 3.2: Summary of the data collected by district

DISTRICT	HTQ	MTQ	ETQ	STQ	LQ	MTT	LT	MOC	EOC	SOC	PCF	HCF
EMBU	12	12	11	12	407	12	410	12	12	11	500	12
NAIROBI	12	12	12	12	536	12	537	12	12	12	527	4
GARISSA	12	11	12	12	411	11	414	11	12	12	0	9
GUCHA	12	11	12	12	315	11	315	11	12	12	278	11
BARING'O	12	12	12	12	361	12	361	12	12	12	408	11
MURANG'A	12	12	11	11	408	12	406	12	11	11	515	7
TOTAL	**72**	**70**	**70**	**71**	**2438**	**70**	**2443**	**70**	**71**	**70**	**2228**	**54**

HTQ= Head teacher questionnaire
MTQ = Maths teacher questionnaire
ETQ = English teacher questionnaire
STQ = Science teacher questionnaire
LQ = Learner questionnaire
MTT = Maths teacher test
LT = Learner test
MOC = Maths lesson observation checklist
EOC = English lesson observation checklist
SOC = Science lesson observation checklist
PCF = Parent consent form
HCF = Head teacher consent form

3.6 Data analysis

Data analysis was done using mixed methods in order to understand both the qualitative and quantitative aspects of the quality of teaching in primary schools in Kenya. Specifically, videos were analyzed for dominant teaching activities during lesson teaching, pupil-teacher interactions, mathematics proficiency and teachers pedagogical knowledge. Two primary school teacher training college tutors, each with more than 15 years of training teachers were trained on video analysis by an external expert who is experienced on lesson video analysis. The two carried out the video analysis using both the time line and math proficiency rubrics. Their analysis was externally validated by analysts who have been doing similar studies in Botswana, South Africa and Costa Rica. To ensure accurate and complete analysis of subject content coverage (OTL form) in Maths, English and Science, six grade six teachers (two in each subject) were inducted on the OTL form, and then coded all the main topics, subtopics and subject content covered by grade six learners in 2009. This information is used to generate the proportion of grade six syllabus coverage and hence the opportunity to learn based on subject content exposure.

Quantative analysis is done using descriptive statistics (means and percentages) and regression. Use of regression techniques enabled us to quantify the extent to which teaching practice and teachers' content and pedagogical knowledge influence math achievement, while controlling for other factors. The use of multi-level analysis in the regression enables us to identify both school and individual level effects on learner achievement. In this report, results from the descriptive analysis are reported. Other results based on regression and video analyses, and policy implications are reported in our various APHRC Working Papers.

3.7 Field experience challenges

Accessibility to schools

Most of the sampled schools in almost all districts except Nairobi are located in none motorable areas. Accessing these schools was therefore difficult and required four wheel vehicles, special "matatus" which are slightly raised or "Boda boda" (motor bikes). In a few cases, the teams experienced difficulties even when using four-wheel drive vehicles.

Teacher absenteeism and callbacks

Teacher absenteeism (including Headteachers) was a major problem cutting across most schools in all districts. Due to absences on the part of the head teachers, the teams were received in school by the deputy or senior teachers in most instances. This problem was common in schools which were located in far flang regions of the district. Callback were used to collect data in instances where the respondent was absent during the first visit.

Pupils participation in the study

There were a number of instances where some of the selected pupils missed to take part in the study. For instance, some pupils participated in numeracy assessment but disappeared during the interview session, and in other instances, some were simply late for the interview or assessment.

4. Findings

The classroom observation study sought to answer the following questions:

(i). What are the differences and similarities in teaching practice among teachers in high and low performance schools?

(ii). Does the observed teaching practice explain student achievement?

(iii). Do teacher attributes explain student's learning achievement?

(iv). What policy recommendations on teaching practices can improve the quality of teaching in primary education?

Three APHRC Working Papers have been finalized. The working papers interpret and discuss the results. The titles of the working papers are:

- Do teachers who have a good understanding of maths demonstrate better teaching practice in the classrooms?
- Does teaching practice explain differences in learner achievement in low and high performing schools?
- Social relations as predictors of achievement in maths in Kenya primary schools.

4.1 Student scores in Mathematics

Table 4.1 shows the mean percentage score in the six districts sampled. Nairobi and Baringo were in the high performing districts; Embu and Murang'a were middle performing districts and Garissa and Gucha were the bottom performing districts based on the KCPE results which was used to select the districts in the study.

Table 4.1: Pupils mathematics mean score (%) by district

District	No of Pupils	Mean % Mark	Std Dev	Lowest Mark	Highest Mark	No below mean	% below mean score
Nairobi	537	51.25	14.26	34.58	82.33	268	49.91
Muranga	406	48.46	10.08	35.87	64.38	220	54.19
Embu	408	42.06	8.88	33.00	60.90	211	51.72
Baringo	360	48.63	5.90	34.76	56.64	191	53.06
Gucha	315	46.22	9.53	32.50	63.84	152	48.25
Garissa	411	43.40	7.20	30.93	58.18	225	54.74
Overall	2437	46.89	10.56	30.93	82.33	**1267**	**51.99**

The mean score is 46.89% which is below 50% considered to be the pass mark. Although, the mean mark differs from one district to the other, the difference is not large—averaging 7

percentage points between the top and bottom districts. The results also show a high variation in score for pupils in Nairobi and Murang'a districts (standard deviations of 14.26 and 10.08 respectively) as compared to Baringo, where the variation is small (standard deviation of 5.90). Table 4.2 presents mathematics mean scores by gender.

Table 4.2: Pupils mathematics mean score (%) by district and gender

	Girls (G)			Boys (B)			
School code	**No of Girls**	**Mean Mark**	**Std Dev**	**No. of Boys**	**Mean Mark**	**Std Dev**	**Mean diff (G-B)**
Nairobi	276	51.40	14.31	261	51.09	14.23	0.31
Muranga	214	50.15	10.19	192	46.58	9.64	3.57
Embu	229	42.56	8.96	179	41.43	8.77	1.12
Baringo	176	48.51	5.80	184	48.75	6.01	-0.24
Gucha	161	46.38	9.61	154	46.06	9.48	0.32
Garissa	110	43.67	7.66	301	43.30	7.03	0.38
Overall	**1166**	**47.58**	**10.84**	**1271**	**46.25**	**10.25**	1.32

The last column of table 4.2 shows the difference in mean score between the two sexes. A positive difference means the girls mean score is high than that of boys. With the exception of Baringo, girls in the other five districts have on average scored slightly higher than boys. The difference ranges from 0.31 in Nairobi to 3.57 in Murang'a. When the results are disaggregated by gender, the standard deviations largely remain similar to those in the overall results shown in table 4.1. Table 4.3 shows the performance of districts by school category. There is a large difference in scores between the bottom and top schools. The difference is 13.1 percentage points.

Table 4.3: Mathematics mean score (%) by school category and district

Table 3: Mean score by district and school rankings

	Top schools (n=36)			Bottom schools (n=36)			
School code	**No of Pupils**	**Mean Mark**	**% Std Dev**	**No. of Pupils**	**Mean Mark**	**% Std Dev**	**Mean diff (Top-Bottom)**
Nairobi	280	62.65	10.13	257	38.82	4.08	23.83
Muranga	216	56.92	5.68	190	38.84	2.45	18.08
Embu	207	47.91	8.72	201	36.04	3.23	11.86
Baringo	222	50.82	4.66	138	45.12	5.99	5.70
Gucha	201	49.90	9.16	114	39.74	6.12	10.16
Garissa	262	45.17	3.52	149	40.28	10.30	4.90
Overall	**1388**	**52.52**	**9.66**	**1049**	**39.43**	**6.13**	13.10

The difference among schools in Nairobi is large (23.83 percentage points) and small (4.90 percentage points) among schools in Garissa.

Figure 1 shows the distribution of school mean scores by school category type. The schools mean score were sorted in ascending order (The horizontal axis ranging from 1 to 36 indicates school ranking within the top and bottom category). The graph shows a consistent difference in the mean score between the top and bottom schools where the top schools were outperforming the low performing schools even at grade six. The percentage mean score for the bottom performing schools is 39.43%; and almost corresponds with the mark for the lowest performing school ranked in the top category (39.25%).

Figure 1: School mathematics mean score (%) ranked from low to high scoring school

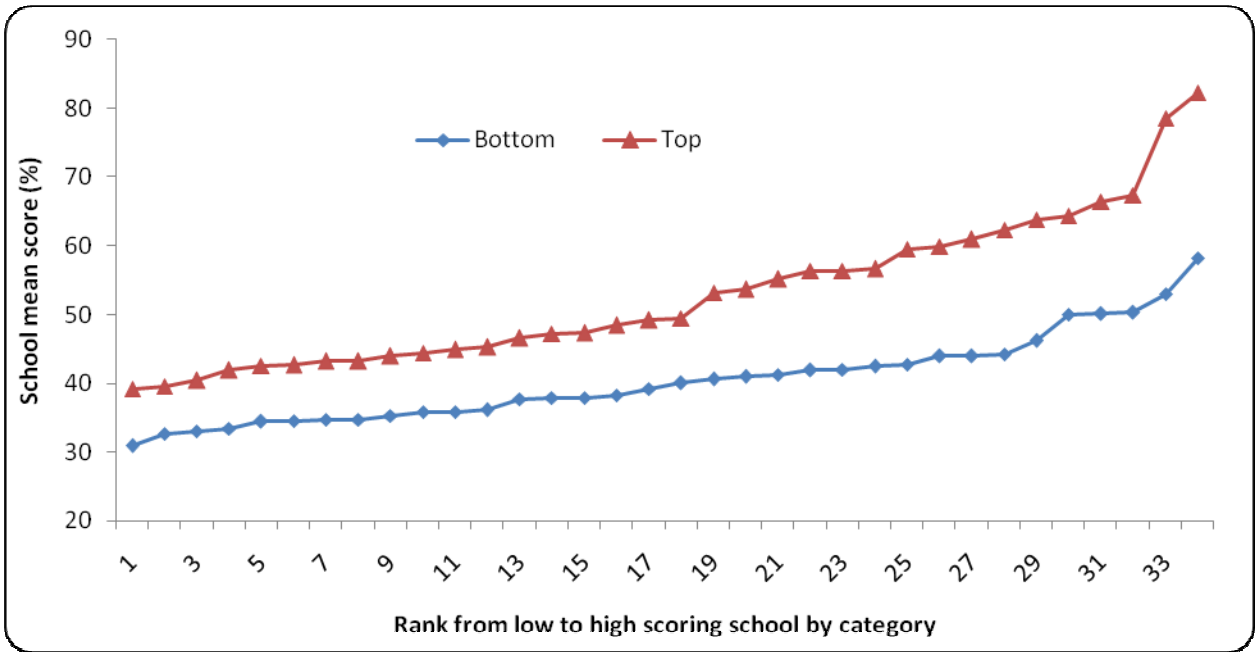
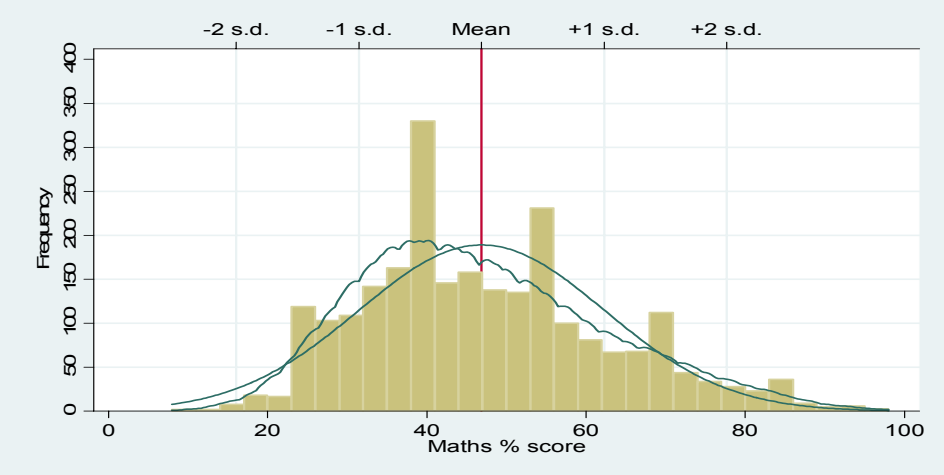


Figure 2 shows the distribution of the pupil scores in the mathematics test. The pupil scores are normally distributed.

Figure 2: Distribution of pupil mathematics score



4.2 Teacher scores in Mathematics

The classroom obsevation study also involved testing mathematics teachers on their knowledge of the subject. This was measured by giving the teachers a written mathematics assessment. The results are shown in table 4.4. Mean score for teachers scored was 60.5%. The difference in the mean score between the top and bottom performing schools is about 2 percentage points. There is no difference in score between male and female teachers. However, after controlling for gender and school category, male teachers from top schools scored higher than male teachers from bottom schools by a difference of 7 percentage points.

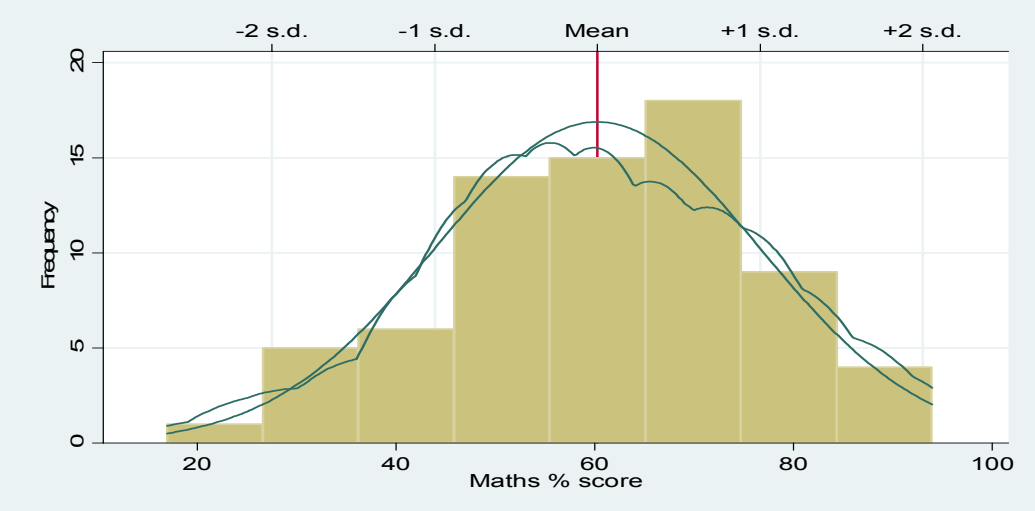
Table 4.4: Mathematics teacher score (%) by gender and school rank

Group	Number of teachers	Mean	Std. Dev.	Min	Max
Overall	70	60.50	16.22	17	94
Top Schools	36	62.83	15.48	28	94
Bottom Schools	34	58.03	16.84	17	94
Female	32	60.03	15.47	28	94
Male	38	60.89	17.02	17	94
Female-Top schools	15	61.07	17.83	28	94
Male - Top schools	21	64.10	13.89	33	89
Female-Bottom schools	17	59.12	13.54	33	83
Male - Bottom schools	17	56.94	19.98	17	94

Table 4.4 results also show a great variation of teacher score. The standard deviations are large and the lowest teacher score was 17, while the highest score was 94. The variation is larger in

bottom schools than it is in top schools. The teacher score in the mathematics test is normally distributed as can be seen in Figure 3.

Figure 3: Distribution of teacher mathematics score



We also plotted school mean score with that of mathamtics teacher in order to assess if there is a relationship between the two. The results are shown in figures 4, 5 and 6. Overall, there is a weak linear relationship between school mean score and teacher score. However, disagregating the analysis by school category, a moderate relatioship between (corr=0.49) the two is observed among low perfoming schools and a rather weak one (corr=0.03) among the high performing schools.

Figure 4: Scatter plot between school mean score and teacher score (n=72)

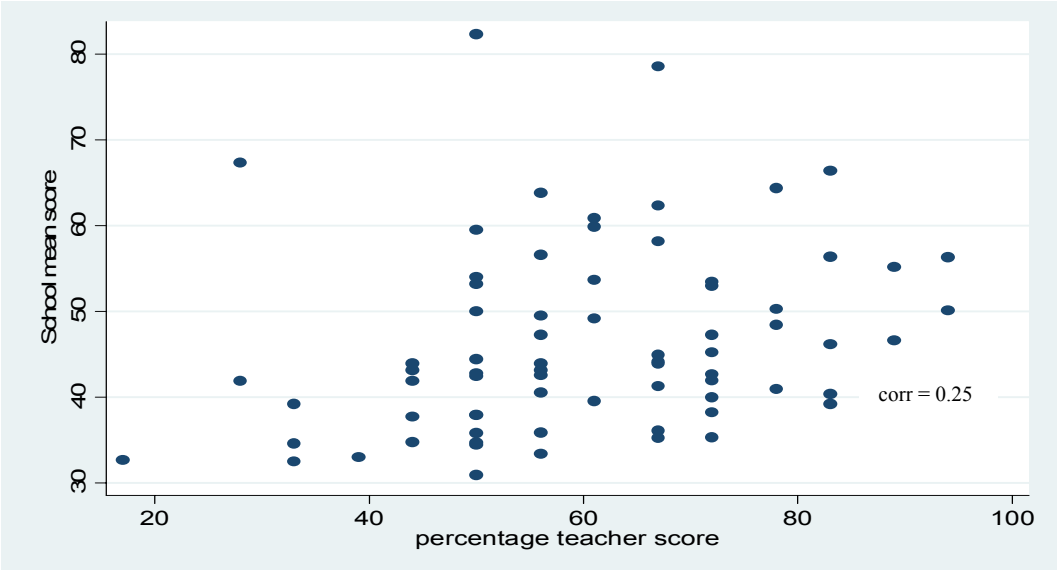


Figure 5: Scatter plot between school mean score and teacher score for bottom schools (n=36)

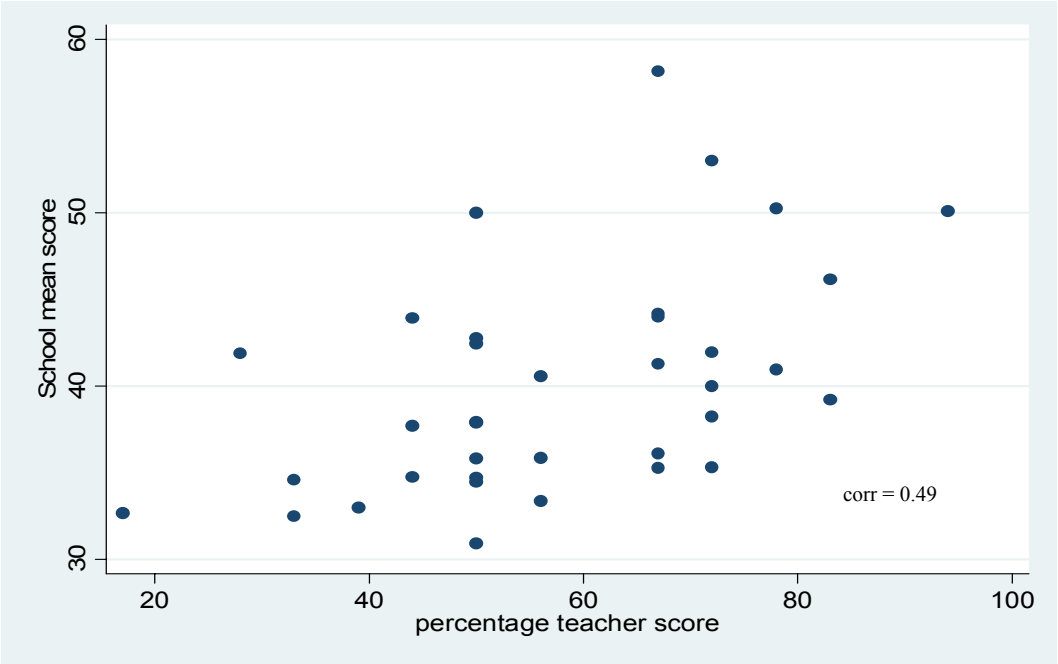
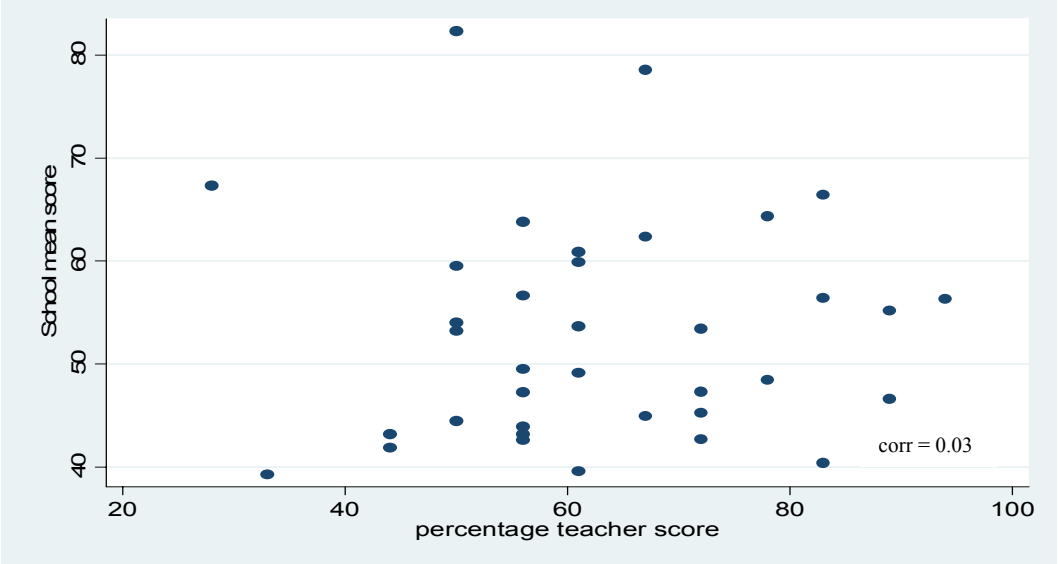


Figure 6: Scatter plot between school mean score and teacher score for top schools (n=36)



4.3 Methods of teaching

Methods of teaching: Dominant classroom interaction

We assessed the dominant teaching activity by using the time analysis technique. The classroom observation survey involved filming actual lessons. The videos were then analysed by experts.

Time analysis: In order to analyse the time distribution of the teaching and learning activities, the video rubric had a five-minute time segment interval. There were five broad activities: Individual work, Recitation, Group work, Whole class and others. These broad teaching and learning activities had a number of other smaller activities under them (See Appendix A). It is these smaller activities that the video analyst was meant to identify and mark for every minute in that lesson. During the time analysis, time spent on each of the smaller activities were tallied and summed up to get the total time spend on that broad activity in a given lesson. In order to have a standardized measure of comparison, the propoportion of time spent on each broad activity was calculated using the total minutes in that broad activity divided by the lesson duration and expressed as percentages. To check the coding, the analysts did individual coding and later a joint coding, which were used in this analysis. Using the calculated time spent in each lesson, the dominant teaching activity was identified to be that which took much of the lesson time (the one with the highest proportion). Tables 4.5, 4.6, 4.7 show the dominant teaching activity by school category and by subject.

Table 4.5: Dominant activity per lesson-overall (n=211)

	Mathematics	English	Science
	No (%)	No (%)	No (%)
Individual work	**31 (55.36)**	13 (23.21)	12 (21.43)
Recitation	16 (22.22)	**41 (56.94)**	15 (20.83)
Whole class	23 (27.71)	16 (19.28)	**44 (53.01)**

The dominant teaching activity varied across the 3 subjects. In Mathematics lessons, 55.36% of the dominant teaching method was individual seat work. Recitation, which was less used in mathematics which averaged 22.22%, was commonly use in English lessons (56.94%) while whole class was dominant in science lessons (53.01%). A similar pattern is also seen when the results are split into top and bottom performing schools (Tables 4.6 and 4.7).

Table 4.6: Dominant activity per lesson- top schools (n=106)

	Mathematics	English	Science
	No (%)	No (%)	No (%)
Individual work	**14 (56.00)**	6 (24.00)	5 (20.00)
Recitation	10 (24.39)	**24 (58.54)**	7 (17.07)
Whole class	12 (30.00)	5 (12.50)	**13 (57.5)**

Table 4.7: Dominant activity per lesson- bottom schools (n=105)

	Mathematics	English	Science
	No (%)	No (%)	No (%)
Individual work	**17 (54.84)**	7 (22.58)	7 (22.58)
Recitation	6 (19.35)	17 (54.84)	8 (25.81)
Whole class	11 (25.58)	**11 (25.58)**	**21 (48.84)**

We also related teaching method with the mathematics score of the teachers as well as school mean score (Figures 7 & 8). Teachers using recitation had high scores than those using whole class. The same is true for school mean score. If the classes were taught using recitation, then the schools' mean score also tended to be high.

Figure 7: Teacher subject knowledge by teaching practice

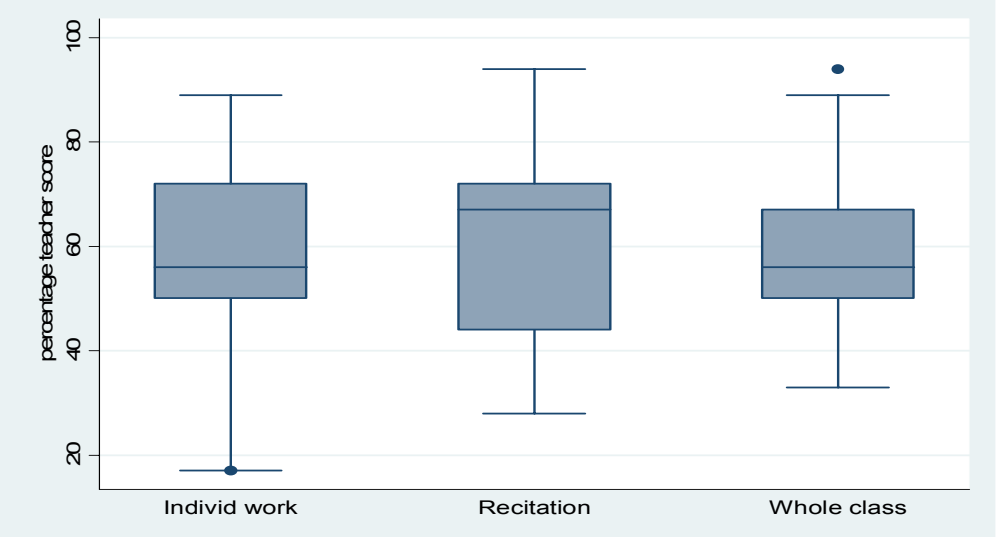
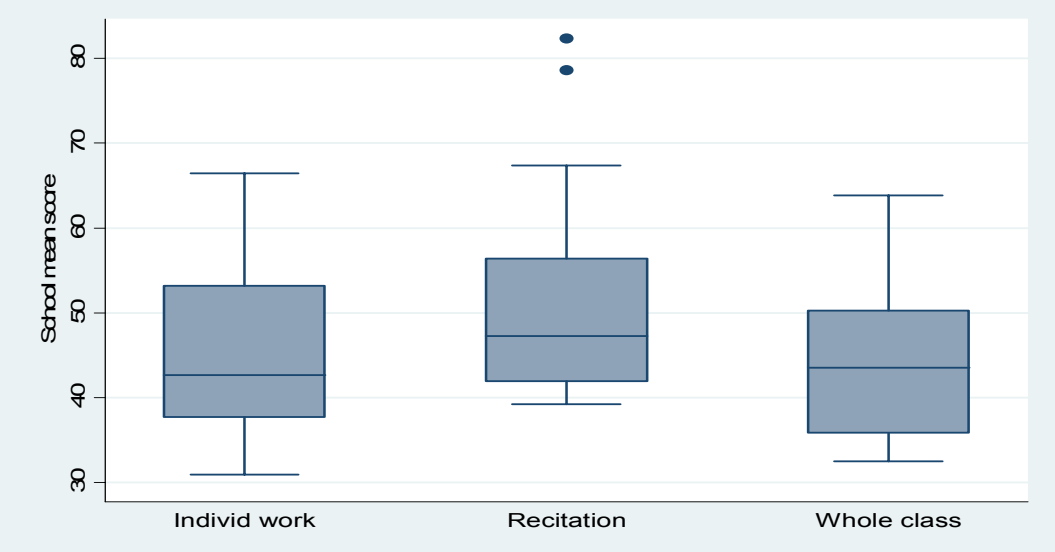


Figure 8: School means score by teaching practice



4.4 Gain score

During the first round of data collection, 2438 pupils were captured. During the follow up (round two), 530 of the pupils could not be traced. This attrition is mainly explained by transfers out of school and absenteeism on the date of interview. In addition, one private school in Gucha district closed down and we could not trace the pupils.

Gain score: - This is the change in mathematics test score (percentage) between round one and round two. The relative gain score is computed by calculating the proportion gain in a pupil's score relative to what the pupil was supposed to gain. The formula used in calculating the gain score for pupil *i* is as shown below:

$$Gain\ score\ (proportion) = \frac{Score_{R2} - Score_{R1}}{100 - Score_{R1}}$$

Where, $100 - Score_{R1}$ is the expected maximum gain for pupil *i*. The interpretation of the relative gain score is the proportion of actual gain relative to the expected maximum gain.

Table 4.8a shows the gain score by district. In the follow up round, unlike in round one, the mean score for each of the districts was above 50%. The maximum overall expected relative gain is 56.62 percentage points; while the overall actual relative gain score was 9.52 percentage points; this is translated to 18% on the expected gain score.

Table 4.8a: Overall gain score by district (n=1907)

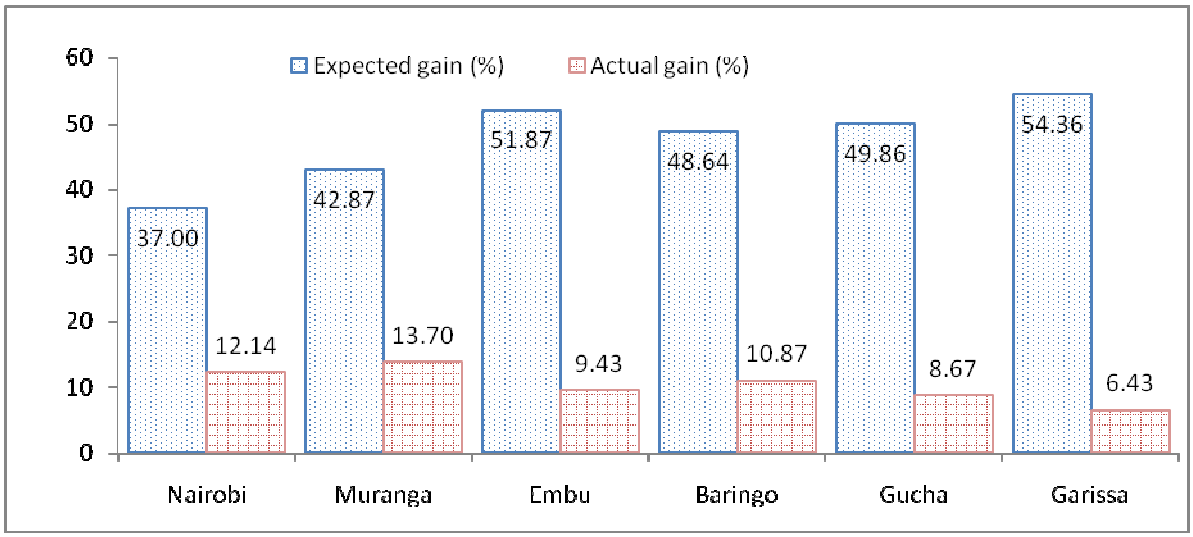
	Round 1 mathematics score				Round 2 mathematics score			
School code	**No of Pupils (1)**	**Mean % Mark (2)**	**Std Dev (3)**	**Maximum Expected Gain (4)=100-Col 2**	**Mean % Mark (5)**	**Std Dev (6)**	**Raw gain (7)=Col 6-col 2**	**Proportion Gain (8)=Col 7/Col 4**
Nairobi	424	52.83	18.33	47.17	62.56	20.33	9.74	0.21
Murang'a	344	48.95	14.41	51.05	60.68	17.69	11.73	0.23
Embu	325	42.81	13.53	57.19	51.53	16.23	8.72	0.15
Baringo	293	49.09	12.31	50.91	59.91	14.65	10.82	0.21
Gucha	225	46.97	13.71	53.03	56.11	15.99	9.14	0.17
Garissa	296	43.61	14.61	56.39	50.61	16.88	7.00	0.12
Overall	1907	47.38	15.32	52.62	56.90	17.94	9.52	0.18

The actual gain score was high in Murang'a (23%) and lowest in Garissa (12%). Tables 4.8b and 4.8c and Figures 9a and 9b disintegrate the gain score by school category-top and bottom respectively. The expected maximum gain among the top schools was 46.79 percentage points compared with 60.07 percentage points among the bottom schools. Among the top schools, there is a great variation in the gain score between the districts with the highest actual gain score being 33% and the lowest being 12%. In top schools, the relative proportion gain was 22%.

Table 4.8b: Gain score by district- top schools (n=1119)

	Round 1 mathematics score				Round 2 mathematics score			
School code	**No of Pupils (1)**	**Mean % Mark (2)**	**Std Dev (3)**	**Maximum Expected Gain (4)=100-Col 2**	**Mean % Mark (5)**	**Std Dev (6)**	**Raw gain (7)=Col 6-col 2**	**Proportion Gain (8)=Col 7/Col 4**
Nairobi	240	63.00	15.98	37.00	75.13	14.29	12.14	0.33
Murang'a	186	57.13	11.94	42.87	70.84	13.39	13.70	0.32
Embu	173	48.13	14.32	51.87	57.57	17.60	9.43	0.18
Baringo	187	51.36	11.91	48.64	62.22	14.02	10.87	0.22
Gucha	149	50.14	13.69	49.86	58.81	16.58	8.67	0.17
Garissa	184	45.64	14.16	54.36	52.07	15.61	6.43	0.12
Overall	1119	53.21	15.14	46.79	63.58	17.27	10.37	0.22

Figure 9a: Expected gain and actual gain score by district- top schools

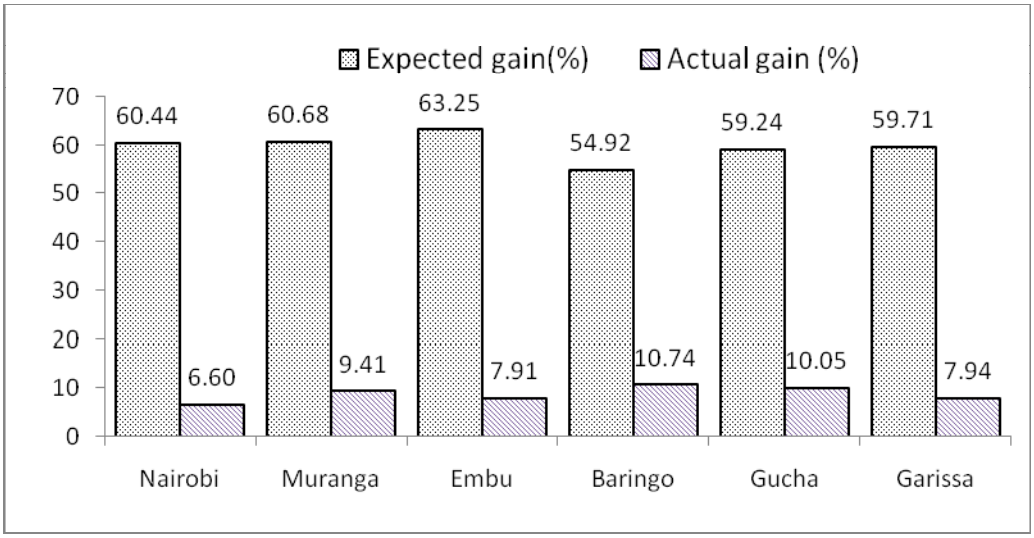


The gain score among the bottom schools is much lower than that of the top schools despite the fact that in round one, the bottom schools had a mean score of 40%, hence expected to gain about 60 percentage points compared to the top performing schools. The actual gain score in bottom schools is 8.49 percentage points which translates to 14% of the expected gain score. Nairobi had the lowest actual gain score among the bottom schools (11%) and Baringo had the largest actual gain score (20%) in this category of bottom schools.

Table 4.8c: Gain score by district- bottom schools (n=788)

		Round 1 mathematics score			Round 2 mathematics score			
School code	**No of Pupils (1)**	**Mean % Mark (2)**	**Std Dev (3)**	**Maximum Expected Gain (4)=100-Col 2**	**Mean % Mark (5)**	**Std Dev (6)**	**Raw gain (7)=Col 6-col 2**	**Proportion Gain (8)=Col 7/Col 4**
Nairobi	184	39.56	11.44	60.44	46.16	14.52	6.60	0.11
Murang'a	158	39.32	10.62	60.68	48.73	14.35	9.41	0.16
Embu	152	36.75	9.48	63.25	44.66	11.09	7.91	0.13
Baringo	106	45.08	12.03	54.92	55.82	14.90	10.74	0.20
Gucha	76	40.76	11.51	59.24	50.82	13.35	10.05	0.17
Garissa	112	40.29	14.79	59.71	48.22	18.60	7.94	0.13
Overall	788	39.93	11.77	60.07	48.43	14.86	8.49	0.14

Figure 9b: Expected gain and actual gain score by district- bottom schools



There were no significant differences in the proportion of gain score between the top and bottom performing schools in Baringo, Garissa and Gucha districts. Top performing schools in Nairobi gained 33% of the maximum expected gain while the bottom performing schools gained only 11% of the maximum expected gain.

4.5 Summary of key findings and lessons learnt

- The average pupil score is 46.89% which is below 50% that can be considered to be the pass mark.
- With the exception of Baringo district, girls in the other five districts have on average scored slightly higher than boys.
- The difference in pupil scores is large among schools in Nairobi (23.83 percentage points) and smaller among schools in Garissa.
- Teachers scored on average 60.5%.
- Male teachers from top schools scored higher than male teachers from bottom schools by an average of 7 percentage points.
- There is a linear but weak relationship between school mean score and teacher score.
- On dominant teaching activities in the top schools, individual seat work was dominant in Maths lessons; recitation in English lessons while in Science lessons whole class responses was the dominant activity. In the bottom schools, whole class responses were dominant in both English and Science lessons.
- Use of relevant teaching aids was found to be critical in teaching and learning.
- Teacher knowledge of mathematics is critical in low performing schools.

- Learners exposed to more interactive classrooms scored higher marks.
- Head teacher observation of mathematics lesson to provide feedback is important.
- High performing schools had higher gain scores than low performing schools

4.6 Conclusions and Policy Implications

The purpose of this study was to examine what happens in classrooms of low and high performing schools. From the reviewed classroom-based studies' literature, we find that the way teachers teach and how learners get exposed to learning opportunities contributes to learner achievement. The use of different classroom interaction and teaching approaches (for instance, recitation, whole class, group work, co-operative learning among others) produce different learning outcomes (see e.g. Hardman et al. 2009). Our findings on teacher-pupil classroom interactions are consistent with this literature. However, our study directly linked teaching practice to test scores, gain score and also teacher content knowledge – this is missing in most of the available literature. By providing empirical evidence on the linkages between the teaching practices and test scores, gain scores, teacher pedagogical and content knowledge, this study not only closes the gap in literature but also expands our understanding of the more underlying classroom based factors that influence learning.

The empirical evidence presented in this report suggests that dominant methods of teaching, teacher's knowledge, non-basic teaching aids, head teacher supervision of lessons and social relations within school communities contribute to learner achievement. It is evident from the gain score results (Tables 4.8a, b, c) that students and schools with low initial (entry) performance levels continue to perform poorly while those with high initial performance levels continue to do better in the curriculum based tests. In other wards, low performing schools continue to add less value to students' achievement throughout the year. Based on these findings, our study has the following policy implications.

- Provision of non-basic teaching aids: Teaching aids (non-basic materials) significantly contribute to learner achievement. Learners who are taught using effective teaching aids score higher marks. Developing effective teaching aids requires a teacher who is creative, proactive and appreciates the power of teaching aids in improving students' achievement.

In addition, school management need to devote adequate resources to the production of teaching aids including the use of locally available materials. One way of increasing the availability of non-basic teaching materials is through working in subject teams so that the developed materials can be shared across streams and that their effectiveness is evaluated by the subject team. Having a clear school policy on the development and utilization of teaching aid will go along way in ensuring the availability of effective aids in the classrooms.

- Head teacher supervision of lessons: What gets measured gets done. Head teachers are the immediate quality assurance officers at school level and they have a responsibility of making lesson observations. In addition, they have a professional obligation to coach and mentor teachers, and guide them professionally. The practice of lesson observation was more common in high than in low performing schools. As part of monitoring curriculum implementation and giving feedback, head teachers should intensify lesson observations, mentoring, coaching and professional guidance with a view to improving the teaching practice of classroom teachers. Since head teachers are also charged with many other school management responsibilities, they need the support of deputy head teachers and senior teachers in carrying out lesson observation. Peer evaluation from subject team members is also a strategy that can be used to improve the effectiveness of teaching practice. Therefore, there needs to be a policy that encourages the institutionalization of lesson observation at school level.

- Teachers subject knowledge: For a teacher to competently impart knowledge, he or she must have requisite levels of competency in the subject for them to be able to manipulate the cognitive demands of a task as required in the curriculum. Lessons taught by teachers with low subject knowledge are more likely to focus on low level cognitive tasks. Such low level tasks fail to develop adaptive reasoning and critical thinking among learners and make learning routine and uninteresting to learners. In the study the mean score on a teacher maths test was 60.5%, with the scores ranging from 17% to 94%. Given this reality, there is need to periodically assess teachers level of competency in the subjects they teach. While the policy that a primary school teacher is a master of all subjects ensures that teachers can be allocated to any class to teach any subject, it may compromise quality of subject content delivered – the policy may need to be reviewed in away that teachers teach subjects they are competent in.

- Social relations: School principal's good interpersonal interactions with parents had positive effects on learners. In addition, parental provision of materials and financial support was associated with better grades, while absence of parental involvement in the classroom had negative effects on grades. In view of this, more parental and

teacher/headteacher interactions should be encouraged, including parental involvement with what happens in the classroom.

- In low performing schools, teachers may require more pedagogical skill-upgrading with a view to enabling them shift their lessons to more learner-centered approaches. Periodic teacher in-service training, which was rare in most of the sampled schools, is one way of rejuvenating teacher's pedagogical knowledge so that they can be re-empowered to adapt best teaching practices. This should be reinforced by school-based teacher support programs mentioned earlier (mentoring, coaching, peer evaluation and professional guidance).

References

Ackers, J., & Hardman, F. (2001). Classroom Interaction in Kenyan Primary Schools. *Compare*, 31(2), 245-261.

Akyeampong, K., Pryor, J., & Ampiah, J.G. (2006). A vision of successful schooling: Ghanaian teachers' understandings of learning, teaching and assessment. *Comparative Education*, 42(2), 155-176.

Alexander, R.J. (2000). *Culture and pedagogy: International comparisons in primary education*. Oxford: Blackwell

Alexander, R.J. (2001). Border Crossings: Towards a Comparative Pedagogy. *Comparative Education*, 37(4), 507-523.

Brown, F.D. (2004). Urban Teachers' Professed Classroom Management Strategies: Reflections of Culturally Responsive Teaching. *Urban Education, 39*(3), 266-289.

Darling-Hammond, L. (1990). Instructional policy into practice: The power of the bottom over the top. Educational Evaluation and Policy Analysis, 12 (3), 339-347.

Hardman, F. Abd-Kadir, J., Agg, C., Migwi, J., Ndambuku, J. & Smith, F. (2009), changing pedagogical practice in Kenyan primary schools: the impact of school-based training. *Comparative Education*, 45(1), 65-86.

Hardman, F., Abd-Kadir, J., & Smith, F. (2008). Pedagogical renewal: Improving the quality of classroom interaction in Nigerian primary schools. *International Journal of Educational Development*, 28, 55-69.

Heininchi, R., Molendar, M., & Russel, J. D. (1999*). Instructional Medial and New Technologies of Instructions*. 2nd Edition, New York: Macmillan Publication & Company.

HSRC & Stanford University (2008), Towards understanding student academic performance in South Africa: A pilot study of grade 6 mathematics lessons in Gauteng Province. A report prepared by The Human Sciences Research Council (HSRC) with Stanford University (in partnership with a consortium of South African Universities and Jet Education Services).

Kodzi, I., Oketch, M. Ngware, M., Mutisya, M., & Nderu, E. (*forthcoming*). Does social capital matter for academic achievement in Kenya? Examining students, teachers and parental involvement. APHRC Working Paper.

Mensch, B.S., Lloyd, C.B., & Clark, W.H. (1998). The Effects of Primary School Quality on School Dropout among Kenyan Girls and Boys. *Comparative Education Review*, 44(2), 113-147.

Morrison, F.J., Bachman, H.J., & Connor, C.M. (2005). Improving literacy in America: Guidelines from research. New Haven, CT7 Yale University Press

Ngware, M., Oketch, M., Mutisya, M. & Kodzi, I. (*forthcoming*). Does teaching practice explain differences in learner achievement in low and high performing schools in Kenya? APHRC Working Paper.

Oketch, M., Ngware, M., Mutisya, M.. (forthcoming). Improving the quality of education in Kenya: Do teachers who have a good understanding of maths demonstrate better teaching practice in the classrooms? APHRC Working Paper.

Okorodudu, R. I. (2006). Refocusing teachers' personality dimensions as correlate of work attitude: *Implications for counseling teacher education in Nigeria. Journal of Education in Developing Areas (JEDA)*, 15: 1-10.

Okorosaye-Orubite, A. K. (2005). The role of the teacher in the development of the Nigerian nation. *Journal of Research in Education, 2*(1): 41-45.

Okwo, F.A. (1995). Instructional communication. In F.A. Okwo, G.A. Ike (Eds): *Educational technology: Basic concepts and issues*. Nsukka: Nsukka University Trust Publisher.

O-saki, K.M., & Agu, A.O. (2002). A Study of Classroom Interaction in Primary Schools in the United Republic of Tanzania. *Prospects*, 32(1), 103-116.

Osakwe, R. N. (2006). *Understanding teaching profession*. Osasu Series in Education. Benin City: University of Benin.

Osakwe, R. N. (1999). Dimensions of communication as predictors of effective classroom interaction. *Studies Home Communication Science, 3*(1): 57-61.

Stoner, J. A. F., Freeman, R. E., Gilbert, D. R., (1999). *Management*. *India*. New Delhi: Prentce-Hall.

Wanzare, O.Z. (2002). Rethinking Teacher Evaluation in the Third World: The Case of Kenya. *Educational Management Administration Leadership*, 30(2), 213–229.

Wanzare, Z., & Ward, K.L. (2000). Rethinking staff development in Kenya: agenda for the twenty-first century. *The International Journal of Educational Management*, 14(6), 265-275.

Wenglinsky, H. (2000). *How teaching matters: Bringing the classroom back into discussions of teacher quality*. Princeton: Educational Testing Service

Appendices

Appendix A

Broad activity - (n=5)	Specific activity- (n=33)
Individual work	Copying instructions/Problems
Individual work	Solving problems individually- Teacher circulating
Individual work	Solving problems individually- Teacher on other tasks
Individual work	Teacher checking work Individual (working)
Individual work	Teacher checking work Individual (stopped)
Recitation	Q_A: Individual learner (Teacher asks)
Recitation	Q_A: Individual learner (Verbal answer)
Recitation	Q_A: Individual learner (Non-verbal answer)
Recitation	Q_A: Individual learner (Learner asks)
Recitation	Q_A: Whole class chorus
Recitation	Q_A: Whole class-Groups reporting
Recitation	Individual learner- Read orally
Recitation	Whole class- Read orally
Recitation	Solve at blackboard (Learner)
Recitation	Learner gives instruction
Recitation	Individual demonstrates (Verbal)
Recitation	Individual demonstrates (non-verbal)
Group work	Individual solving (Quiet)- Teacher circulating
Group work	Individual solving (Quiet)- Teacher on other tasks
Group work	Individual solving (Talking)- Teacher circulating
Group work	Individual solving (Talking)- Teacher on other tasks
Group work	Group discussion (Oral)
Group work	Group solving (Multi-tasks)
Group work	Teacher checking -work group (working)
Group work	Teacher checking -work group (stopped)
Whole class	Whole class task instructions (Teacher only)
Whole class	Whole class demonstrations (Teacher only)
Whole class	Whole class lecture (Teacher only)
Whole class	Whole class review/Recap (Teacher only)
Whole class	Whole class evaluate lesson (Teacher only)
Other	Transition (to other tasks e.t.c)
Other	Interruption (from within)
Other	Interruption (from outside)

Appendix B. Details of sampled schools

School Name		District	School type	School Name		District	School type
1	A.I.C VISA OSHWAL EMBO-RUTOO PRIMARY	Baringo	Public	37	EGETUKI GOLDEN ACADEMY	Gucha	Private
2	SCHOOL	Baringo	Public	38	ENSOKO DOK PRIMARY	Gucha	Public
3	KAPKIAI PRIMARY SCHOOL	Baringo	Public	39	GETARE DEB PRIMARY	Gucha	Public
4	KAPKOMOI PRIMARY SCHOOL	Baringo	Public	40	GETENGA DEB PRIMARY	Gucha	Public
5	KAPSOO PRIMARY SCHOOL	Baringo	Public	41	GETUMO AIC PRIMARY	Gucha	Public
6	KIPKUTUNY PRIMARY SCHOOL	Baringo	Public	42	KEORE COG PRIMARY	Gucha	Public
7	KITUMBEI PRIMARY SCHOOL	Baringo	Public	43	NYABIOTO MIXED PRIMARY	Gucha	Public
8	KOROTO PRIMARY SCHOOL	Baringo	Public	44	NYABISIA DEB PRIMARY	Gucha	Public
9	LOBOI PRIMARY SCHOOL	Baringo	Public	45	NYAMASEGE PRIMARY SCHOOL	Gucha	Public
10	LOGUMGUM PRIMARY SCHOOL	Baringo	Public	46	OLYMPIC JUNIOR ACADEMY	Gucha	Private
11	MONDOI PRIMARY SCHOOL	Baringo	Public	47	ST JAMES NYAMBUNDE ACADEMY	Gucha	Private
12	MUMOL PRIMARY SCHOOL	Baringo	Public	48	TENDERE PRIMARY SCHOOL	Gucha	Public
13	C.C.M KATHUNIRI	Embu	Public	49	GAICANGERE PRIMARY	Muranga	Public
14	D.E.B GICHERA	Embu	Public	50	GATUNDU INI PRIMARY	Muranga	Public
15	D.E.B IVECHE	Embu	Public	51	GATUNDU PRIMARY	Muranga	Public
16	EMBU COUNTY	Embu	Public	52	GIKANDU PRIMARY	Muranga	Public
17	KARIRU PRIMARY	Embu	Public	53	GITHUGUYA PRIMARY	Muranga	Public
18	KATHURIRI PRIMARY	Embu	Public	54	KARUNGE PRIMARY	Muranga	Public
19	KINTHITHE PRIMARY	Embu	Public	55	KIGORO PRIMARY	Muranga	Public
20	KIVURIA PRIMARY	Embu	Public	56	MBARI YA HITI PRIMARY	Muranga	Public
21	N.I.C.A GACIIGI	Embu	Private	57	MUMBI KIANO PRIMARY	Muranga	Public
22	NGENIARI D.E.B	Embu	Public	58	ST JAMES PRIMARY	Muranga	Private
23	ST JOSEPH NDUNDA	Embu	Private	59	THIRIKWA PRIMARY	Muranga	Public
24	ST MARYS PAROCHIAL	Embu	Private	60	WILL POWER ACADEMY	Muranga	Private
25	ABU-UBAYDA ACADEMY	Garissa	Private	61	GARDEN ESTATE PRIMARY	Nairobi	Public
26	ALINJUGUR PRIMARY	Garissa	Public	62	HOSPITAL HILL PRIMARY	Nairobi	Public
27	AMA PRIMARY SCHOOL	Garissa	Public	63	KARIOBANGI NORTH PRIMARY	Nairobi	Public
28	BOREHOLE 5 PRIMARY SCHOOL	Garissa	Public	64	LANGATA WEST PRIMARY	Nairobi	Public
29	BOUR ALGY PRIMARY	Garissa	Public	65	MASHIMONI SQUATERS	Nairobi	Private
30	BOYSTOWN PRIMARY	Garissa	Public	66	NGEI PRIMARY SCHOOL	Nairobi	Public
31	BURA BOARDING PRIMARY	Garissa	Public	67	NJATHAINI PRIMARY SCHOOL	Nairobi	Public
32	MODOGASHE PRIMARY SCHOOL	Garissa	Public	68	OLYMPIC PRIMARY	Nairobi	Public

33	NAJAH PRIMARY SCHOOL	Garissa	Public
34	SAKA PRIMARY SCHOOL	Garissa	Public
35	SANKURI BOARDING PRIMARY	Garissa	Public
36	YOUNG MUSLIM ACADEMY	Garissa	Private
69	RIVERSIDE ACADEMY	Nairobi	Private
70	RUARAKA ACADEMY	Nairobi	Private
71	ST BRIGIDS PRIMARY	Nairobi	Private
72	ST NICHOLAS PRIMARY ANNEX	Nairobi	Private