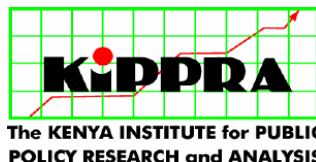


Impact of Primary School Education Inputs and Outputs in Kenya: Empirical Evidence

Moses Ngware
Eldah Onsomu
Damiano Manda

Social Sector Division
Kenya Institute for Public Policy
Research and Analysis

KIPPRA Discussion Paper No. 81
December 2007



KIPPRA IN BRIEF

The Kenya Institute for Public Policy Research and Analysis (KIPPRA) is an autonomous institute whose primary mission is to conduct public policy research leading to policy advice. KIPPRA's mission is to produce consistently high-quality analysis of key issues of public policy and to contribute to the achievement of national long-term development objectives by positively influencing the decision-making process. These goals are met through effective dissemination of recommendations resulting from analysis and by training policy analysts in the public sector. KIPPRA therefore produces a body of well-researched and documented information on public policy, and in the process assists in formulating long-term strategic perspectives. KIPPRA serves as a centralized source from which the Government and the private sector may obtain information and advice on public policy issues.

Published 2007

© Kenya Institute for Public Policy Research and Analysis

Bishops Garden Towers, Bishops Road

PO Box 56445, Nairobi, Kenya

tel: +254 20 2719933/4; fax: +254 20 2719951

email: admin@kippra.or.ke

website: <http://www.kippra.org>

ISBN 9966 777 29 6

The Discussion Paper Series disseminates results and reflections from ongoing research activities of the Institute's programmes. The papers are internally refereed and are disseminated to inform and invoke debate on policy issues. Opinions expressed in the papers are entirely those of the authors and do not necessarily reflect the views of the Institute.

KIPPRA acknowledges generous support from the European Union (EU), the African Capacity Building Foundation (ACBF), the United States Agency for International Development (USAID), the Department for International Development of the United Kingdom (DfID) and the Government of Kenya (GoK).

Abstract

This paper examines a range of factors that determine primary school output (proxied by examination performance) with an aim of identifying the main inputs that are of policy relevance in the improvement of quality of primary education. Cross-section data was used in the analysis. The data was collected from a sample of 448 primary schools spread over 39 districts using structured questionnaires and was supplemented by the 2006 KCPE examination data from the Kenya National Examination Council (KNEC). An education production function was estimated. The results show that students' socio-economic background, utilization of textbooks especially for homework, class-size, classroom environment as measured by pupil seating space, school management, availability of a meal in school, and school infrastructure have a significance effect on pupil performance in primary schools. A key finding is that utilization of textbooks rather than the pupil-textbook ratio is important in determining primary school performance. Therefore, in order to improve the quality of education, primary school management needs to ensure that pupils not only have books but that they use them effectively. The value of this study is in the identification of selected inputs that policy implementers need to focus on in order to enhance the quality of primary school education.

Abbreviations and Acronyms

CDF	Constituency Development Fund
CSES	Community Socio-Economic Status
EPF	Education Production Function
FPE	Free Primary Education
GER	Gross Enrolment Ratio
GoK	Government of Kenya
GDP	Gross Domestic Product
IMP	Instruction Materials Programme
INSET	In-Service Teacher Training
KCPE	Kenya Certificate of Primary Education
KCSE	Kenya Certificate of Secondary Education
KESSP	Kenya Education Sector Support Programme
KIPPRA	Kenya Institute for Public Policy Research and Analysis
KNEC	Kenya National Examination Council
KRT	Key Resource Teacher
MOE	Ministry of Education
NARC	National Rainbow Coalition
OLS	Ordinary Least Squares
QAO	Quality Assurance Officers
SbTD	School Based Teacher Development
UNESCO	United Nations Educational, Scientific and Cultural Organization

Table of Contents

<i>Abstract</i>	<i>iii</i>
<i>Abbreviations and Acronyms</i>	<i>iv</i>
1. Introduction	1
2. Kenya's Education System	3
3. Theoretical and Empirical Literature	5
4. Conceptual Framework	9
5. Analytical Framework	11
5.1 Model Specification	12
5.2 Data and Definaion of Variable	12
6. Study Results	14
6.1 Descriptive Statistics	14
6.2 Regression Results	15
7. Conclusions and Recommendations	20
References	22
Annex	24

1. Introduction

Provision of quality basic education to all school-going children poses a fundamental challenge to education and training systems in most countries, Kenya included. Despite the major strides achieved particularly in access to primary education, major challenges still remain. Among the challenges are the issue of improving quality and increasing learning achievement. Quality education can be achieved partly by ensuring that education resources are efficiently utilized. Provision of quality education ensures a highly productive and competitive labour force. To this end, provision of quality primary education forms the basis of achieving high quality skills, which in turn improve the quality of human capital.

According to Government of Kenya (2003), education in Kenya is expected to improve peoples' ability to take advantage of opportunities that can improve their well-being as individuals and be able to participate more effectively in the community and labour markets. In this respect, improved education provision and learning achievements is a major contributing factor to exiting from poverty. The emphasis put on education (especially primary education) by the government is manifested in the huge budget allocated to the sector. In 2005, the education budget constituted 27 per cent of the total government budget and 7 per cent of GDP. A large proportion of these financial resources are allocated to primary education sub-sector, which takes up about 55 per cent of the total government expenditure to education (Government of Kenya, 2005a).

Despite the high government expenditure on primary education in Kenya, the sector is faced with various challenges. They include: increasing direct costs of schooling for government and rising indirect costs borne by households, and low levels of internal efficiency and learning achievements. For instance, in 2003, dropout and repetition rates were recorded at 2 per cent and 9.8 per cent, respectively (Government of Kenya, *undated*). In 2004, transition rate from primary to secondary was 50 per cent while net and gross enrolment rates were 82 per cent and 105 per cent, respectively, with a high variation across and within regions. Arid and semi-arid areas have particularly low enrolment, especially for girls. Quality assessment studies (Nzomo, Kariuki & Guantai, 2001; and Onsomu, Nzomo & Obiero, 2004) show that students in primary schools have not achieved desired levels of performance, reflecting problems of quality in teaching and learning.

This evidence poses a daunting challenge to the education sector with regard to how to link provision of education to the set objectives.

The link between provision of education and its objective can be partly identified through analyzing the impact of education inputs on outputs and outcomes. Unfortunately, in Kenya, there exists limited empirical work on the impact of education inputs on outputs and outcomes. Part of the reasons for limited studies on this link is lack of comprehensive data and measurement of outcome. Some of the studies (Bedi *et al.*, 2004) that have attempted to link inputs to outcome in Kenya focus on determinants of enrolment in primary education and use the results to determine how the government can achieve higher enrolment by influencing the factors. The two studies are based on data from the Kenya Welfare Monitoring Survey III of 1997. However, a lot has changed since 1997. In particular, the introduction of free primary education in 2003 has shifted focus from enrolment to quality of education.

Following the implementation of free primary education, introduction of constituency development fund, and the substantial levels of resources being devoted to primary education in the country, there is need to identify inputs that contribute more to performance in terms of educational outputs and outcomes. This study attempts to analyze the impact of education inputs on outputs as proxied by performance in primary school examinations. Such analysis will add to the existing information and help policy makers design policies that can help improve the quality of education in primary schools.

The study attempts to answer the following two research questions: (i) What factors influence the educational outputs?; and (ii) What is the relative importance of the impact of educational inputs on outputs in primary education? The paper is organized as follows: Section 2 provides an overview of the education system in Kenya followed by section three that focuses on theoretical and empirical literature. In the fourth and fifth sections, the paper presents the conceptual and analytical frameworks, respectively. In section six, the findings of the study are articulated while section seven is on conclusions and recommendations.

2. Kenya's Education System

Since independence, the Kenyan education system has witnessed several changes in structure and curriculum design. In 1985, the education system was changed from the 7-6-3 to 8-4-4 system. In the prevailing system (8-4-4), primary education is supposed to start at the age of 6 years and it should last for 8 years. This is followed by 4 years of secondary education paving way for higher education, which is imparted through a variety of technical institutes, polytechnics and universities. University education consists of a minimum of a 4-year cycle of undergraduate studies.

Although the focus of our work is on primary school achievement after the year 2000, it is quite illuminating to begin our discussion by examining enrolment patterns over a longer time period. In 1970, the gross enrolment ratio (GER) in Kenya was 62 per cent and there was a gap of 20 percentage points between males and females (Bedi *et al.*, 2004). In the early 1970's, there was a rapid expansion of education due to the introduction of free education for grades I to IV in 1974. By 1980, the GER had reached a peak of 115 per cent, and the gender enrolment gap had narrowed to 10 percentage points. The first enrolment shock occurred between 1984 and 1985 and GER fell from 107 to 99 per cent. In 1989, there was a second shock and the GER declined from 98 to 92 per cent. Thereafter, there was a more gentle decline till the GER reached around 88 per cent in 1993. These shocks were explained by a decline in government financial support to schools occasioned by the structural adjustment policies. In the 1990s, the rate had stabilized between 86 and 88 per cent. Despite variations in the overall GER, the gender gap has narrowed considerably and since 1989 has ranged between 3 and 4 percentage points. There are substantial regional differences in enrolment rates. In 1990, the Central and Western provinces of Kenya had the highest enrolment rates of around 104 per cent. The North Eastern and Nairobi provinces had the lowest enrolment rates of around 24 and 66 per cent, respectively. In the 1990s, enrolment rates fell in nearly all the provinces. The sharpest declines were experienced in Nairobi and Central provinces.

The introduction of free primary education in 2003 by the National Rainbow Coalition (NARC) government improved both enrolment and access to primary education compared to the cost-sharing policy, which was introduced in mid-1980s. Through the free primary education

initiative, enrolment increased to 7.4 million in 2004. Of this 7.4 million, 272,358 pupils were enrolled in non-public schools, mainly private schools and non-formal schools—schools that give opportunity to vulnerable children to access basic education. The large increase in enrolment due to FPE and the resulting strain on school physical facilities and teaching resources has raised concerns on the quality of education provided. The concern about quality of primary education provided motivation for this study.

3. Theoretical and Empirical Literature

In this section, we review relevant literature on the effect of education inputs on output. Quality education is concerned with efficiency in meeting set goals, relevance to human and environmental conditions and needs, exploration of new ideas, pursuit of excellence and encouragement of creativity (Hawes and Stephens, 1990). The quality of education is mainly determined by the quality of teachers, provision and effective use of instructional materials and language proficiency, class size, health of children, decentralization of school management, length of learning time and curriculum implementation, among other factors (Throsby & Gannicott, 1990).

Prior to FPE, most primary schools in the country were poorly resourced with major inputs for improved provision of quality education at primary levels (Nzomo, Kariuki, and Guantai, 2001). In addition, the resources were inequitably distributed, with most primary schools having dilapidated physical infrastructure, and inadequate textbooks that constitute major inputs for quality learning and achievement. Most teachers hardly undertook in-service courses, inspection services were insufficient and the school environment, in some localities, was unattractive for quality learning. However, the situation could have changed due to the introduction of Free Primary Education (FPE) in 2003. Onsomu, Nzomo and Obiero (2005), indicate that 65 per cent of students in Kenya had achieved minimum levels of reading competency, while only 23 per cent had reached a desirable level for that age group. Onsomu, Nzomo and Obiero (2005) show that in 2000, there was generally poor availability of school inputs, including fewer text books and teaching-learning materials, low quality buildings, inadequate toilets, in-frequent in-service training for teachers and heads, and significant absenteeism of students and teachers. Input availability varied greatly across districts, with some provinces suffering severe shortages. There were also variations in teacher staffing, with some districts lacking teachers and others being over-staffed. While most teachers had some training, their academic backgrounds varied considerably.

A study by Fuller (1987) shows that some of the inputs with positive effects on school achievement are length of the instructional programme, pupil feeding programmes, school library activity, years of teacher training, textbooks and instructional materials. Other factors include pupil grade repetition, class size, teachers' salaries, and science

laboratories. The study further notes that in most instances, lowering class size with the intent of raising achievement is not a cost effective strategy, particularly where enrolments are already low and given the optimal resource use levels.¹

A study done in Kenya on staffing norms (Government of Kenya, 2005b) established that the optimal class size ranges from 40 to 45 pupils, beyond which national examinations mean scores start declining significantly.

In the area of teaching and learning materials, textbooks or writing materials have more influence on learning achievements in the low-income countries than in industrialized countries (Fuller, 1987). The influence of textbooks appears to be stronger within rural schools and among students from lower income families, but little research has been conducted on how and the conditions under which textbooks shape achievement. These findings are consistent with those of an earlier review by Schiefelbein and Simmons (1981). They argued that there is a small number of main determinants of school achievement. Schiefelbein and Simmons (1981) emphasized the need to experiment with any suggested changes before policies are endorsed and implemented on a national scale.

In Papua New Guinea, for instance, quality of teaching, style of school administration, extra assistance for weak students, levels of staff morale, and the provision of basic facilities (such as water and electricity) were major factors affecting learning achievements (Vulliamy, 1987). Other important education inputs with major effects on school outputs and outcomes were head teachers' characteristics and school environment.

¹ See Hanushek (1998), who reviews a large range of international evidence as well as evidence in the United States of America (including a wide range of studies done on each) and finds that "the extensive investigation of the effects of class size on student performance has produced a very consistent picture...here appears to be little systematic gain from general reductions in class size"... [the story] also comes through from international data, where extraordinarily large differences in class size are found without commensurate differences in student performance".

Hanushek (1998) says that "... even if we were confident of positive effects [of reducing class sizes], the case for general policies to reduce class size would not yet be made. Class size reduction is one of the most expensive policies that can be considered...variations in teacher quality have been shown to be extraordinarily important for student achievement, and the econometric studies providing such results indicate that these variations completely dominate any effects of altered class size."

Vulliamy (1987) suggests that such effects are related not to resource-based school input factors, but rather to school-process factors that are more elusively categorized as features of school climate or school culture in their study based on secondary schools in Zimbabwe using multi-level analysis.

Student achievement is higher when schools have a greater availability of textbooks, and a larger proportion of trained and experienced teachers (Riddell & Nyagura, 1991). Thus, raising the proportion of trained teachers and, more importantly, improving the provision of textbooks and provision of incentives for teachers to remain in the same schools for a reasonable period of time, were promising investment options to boost student achievement but limited in terms of coverage. In a more wide study that included case studies of effective schools in eight countries, Levin and Lockheed (1991) argue that flexibility appears to affect school effectiveness, and point out the importance of material inputs on achievement in economically impoverished countries. Resources sufficient to provide even the most rudimentary conditions for success are often lacking. They argue that creating effective schools in developing countries requires three elements, *inter alia*, basic inputs, facilitating conditions and the will to change. The necessary inputs are a well-developed curriculum, in terms of scope, sequence and consequences; sufficient instructional materials for students; adequate time for teaching and learning; and, teaching practices that encourage active student learning. The facilitating conditions are community involvement; school-based professionalism (which includes the crucial role of the principal in school effectiveness, teacher commitment, and autonomy balanced with accountability); flexibility in curriculum and organization and the will to implement projects that enhance vision and decentralization.

Pennyquick (1998) gives an extensive summary of empirical research findings on education process variables. A particularly interesting aspect of process factors is school management. He confirmed that well-managed, effective schools are characterized by an orderly environment, academic achievement, set high expectations for student achievement, and are run by teachers or principals who expend an enormous amount of effort to produce effective teaching and encourage pupils to learn despite their family background or gender. The most important factor governing how well pupils do in school, both in developing and developed countries, is school management supported with headmaster's education and experience.

Dearth literature on educational production function studies accurately show which school inputs have larger and smaller effects on achievement and which inputs are more cost-effective than others. Although “size” effects of the inputs are often a product of such studies, they rarely measure costs of inputs. Only a few educational investments have been subjected to analysis containing both effectiveness indicators and cost indicators (Lockheed & Hanushek, 1988), and these studies only provide examples of how decisions could be informed by such evidence. They conclude that most cost-effective materials could include such inputs as textbooks, post-secondary teacher education, education infrastructure and software inputs, particularly interactive radio programmes.

The empirical evidence reported in this section is based on studies of primary schools in developed and developing countries. There are many differences between these countries in terms of resource levels, socio-cultural factors, educational background of the teachers, and patterns of organization that affect education outputs in most schools. Nevertheless, there are lessons to be learnt. One striking feature is that the findings relate much more to process than to inputs, thus education researchers and policy makers should not only focus on the effects of material inputs, such as textbook availability or overall school expenditure levels, but ask how material ingredients are effectively utilized, mobilized and organized within schools and classrooms. This paper attempts to establish the impact of educational inputs and processes on outputs captured through performance in Kenya Certificate of Primary Education.

4. Conceptual Framework

More often than not, assessment of impact of education inputs on outputs² is based on traditional approaches such as the production function. These analyses precisely determine the relative importance of such factors as characteristics of school in terms of teachers, class size and curriculum on student achievements. But inputs are not systematically related to student performance since schools differ considerably in terms of quality. This points to the need to shift emphasis from policies based on inputs to those based on outputs. On the other hand, output policies imply the constant need for performance incentives and repeated testing.

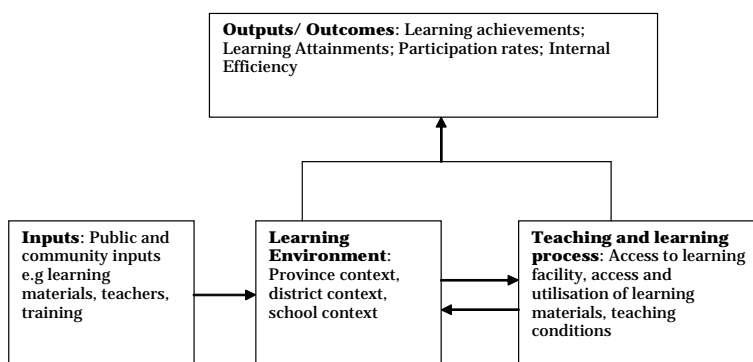
Within this framework, input measures include such quantifiable indicators as pupil teacher ratio, class size, pupil textbook ratio, parental involvement in student learning such as marking homework, pupil absenteeism/participation, teacher qualification, school feeding and student characteristics, among others. Learning processes are affected by regional, schooling and school/classroom environment, that enable quality interaction between school inputs and student attributes, for the outputs to be realized. Outputs and outcomes, therefore, comprise of levels of learning achievements (competence levels), attainment (national examinations), student attitude and satisfaction. The benefits

² Education inputs are human or financial resources of critical prerequisite for effective learning process. They include such resources as teachers, books, instructional materials, physical facilities, computers and students interested in learning. The processes variables include activities such as school management, developing curriculum, teaching, training, demonstrating procedures and students using computers, completing projects and writing reports. Hence, education processes use resources or inputs to perfect the activities in order to produce results. Some outputs are changes attained in students' knowledge, behaviour, attitude, competencies and/or skills. In this case, outputs include levels of goals and objectives achieved or produced, or the effects of outcomes once inputs are transformed through processes into result. To a large extent, outcomes indicate major changes in knowledge skills, learning competencies of the learners, literacy levels, numeracy levels and returns to labour market. Outputs include such variables as scores in national examinations, enrolment rates, transition levels, survival rates, efficiency in teacher utilization and internal efficiency, among others. Evidently, for any education system to be productive and yield a competitive labour force, there must exist strong linkages between system inputs, process variables, outputs and outcomes (UNICEF, 2000).

of employing such analytical framework comprise possibility of identifying areas of improvement and policy levers for improving productivity at primary education level. Figure 4.1 presents a framework for interactive forces between the three pillars in an input-process and output/outcome model.

Related to the above model is the schooling productivity model, which then leads us to model specification. Ladel and Hansen (1999) observe that a school is productive if both efficiency and effectiveness objectives are met in the schooling process. In this case, efficiency refers to minimizing inputs (costs and resources) for a desired level of outputs, while effectiveness means maximizing output without major reference to inputs (Ladel & Hansen, 1999). In summary, school productivity is captured through interaction between inputs and processes of schooling in the best possible way in order to achieve desired outputs.

Figure 4.1: Relationships between education inputs and outputs/outcomes



Source: Authors' Conceptualization

5. Analytical Framework

Analyses of impact of primary schooling inputs on outputs/outcomes in Kenya is estimated using an Education Production Function (EPF). EPF is a typical input-process-output/outcome schooling model that identifies context, inputs, processes and outputs/outcomes of the primary school system. The theoretical model holds that outcomes such as learning achievements are determined by a combination of system inputs, schooling conditions, teaching and learning processes and classroom environment. Ideally, a school system should be able to capture information that enables tracking individual students entering, flowing through and exiting from a particular school system, including the outcomes attained.

However, with a constraint of limited recent student level database, school level empirical analysis is undertaken using school level data from a sample of 448 schools in Kenya collected in the year 2006 by the Ministry of Education and the 2006 Kenya Certificate of Primary Education mean scores dataset.

Indicators that reflect the conditions of learning and internal efficiency include such factors that affect the teaching-learning process, which are malleable by either the school or central government. These include access and effective use of teaching learning materials, school environment, parental support and quality of physical facilities, among others. The effects of these factors are estimated using a regression model on the impact analysis³ of educational inputs, such as learning materials, teacher in-service training programmes (like school based teacher development, school management, guidance and counselling and HIV/AIDS), availability and utilization of textbooks, proportion of in-service trained teachers in a school to total number of teachers, school management, school infrastructure, among others, on learning outcomes proxied by KCPE performance.

It is important to bear in mind errors in the estimation that will come from omitted inputs (such as student ability). But despite such challenges, it is possible to focus on key inputs that are of interest to

³ The authors acknowledge the use of some ideas advocated for by various authors including Mingat, Tan & Sosale (2003); Boissiere (2004); Suryadarma, Suryahadi, Sumarto & Rogers (2004).

policy makers with a view to establishing their relative impact on performance. The choice of the inputs for the EPF is, therefore, influenced not only by data availability but also policy significance of the input.

5.1 Model Specification

A production function attempts to relate a firm's inputs to outputs. The concept can be extended to education. The model for pupil performance used in the study follows a simple firm production function, which was also used by Boissiere (2004), Suryadarma, Suryahadi, Sumarto and Rogers (2004), Kingdon and Teal (2002), and Hanushek (1995). The dependant variable is the school level average KCPE 2006 scores.

An Education Production Function (EPF) attempts to estimate the impact of school inputs (e.g. teacher in-service training, teacher pre-service training, class size, and availability of textbooks among others) to a school outcome or output of interest, for instance KCPE score—as a proxy for student performance. This can be represented in a mathematical expression where by on the left hand side we have the school outcome or output (dependent variable) of interest and the right hand side we have the possible explanatory factors (independent variables). The equation is as given below.

$$\text{KCPE mean score} = B_0 + B_1 (\text{teacher in-service}) + B_2 (\text{school feeding}) + B_3 (\text{textbook}) + \dots + e$$

Where the B's are the unknown population parameters. The education production function estimates the effect of the independent variables on the school performance proxied by the KCPE 2006 examination scores and enables testing for the importance (significance) of each of the explanatory variables in explaining the performance. We estimate the model using ordinary least squares (OLS). We also estimate the median regression to complement the Ordinary Least Squares (OLS) estimates.

5.2 Data and Definitions of Variables

Data used in the study is from an Instruction Materials Programme and In-Service Teacher training (IMP/INSET) survey conducted during the month of July/August 2006. The data collected information on text

books and how the textbooks are used, community support for the sample schools, key resource teachers at the school level, issues to do with school management, school facilities, and school feeding, among others. The primary school level KCPE 2006 exam scores were obtained from KNEC. The two datasets were merged to form one set of data with the relevant variables used in the analysis.

A total of 448 schools were surveyed and some were dropped because they could not be merged with the corresponding KCPE 2006 exam scores obtained from KNEC. Due to this, the sample declined from 448 to 311 schools. Some 29 observations were further dropped due to missing values for several variables that are used in the analysis, bringing the sample used to 282 schools.

All independent variables in the model were obtained from the head teacher questionnaire administered during the IMP/INSET survey of July/August 2006 while the dependent variable, that is KCPE 2006 examination scores, were obtained from KNEC. The independent variables used in the analysis are as defined in Annex 1.

6. Study Results

In this section we present the descriptive statistics and the results of the regression equation. We start by presenting the descriptive statistics followed by the regression results.

6.1 Descriptive Statistics

The descriptive statistics are as shown in Table 6.1. On average, the 2006 KCPE mean score for the sample schools was 244 marks (out of maximum of 500 marks) with a minimum mean score of 152 and maximum mean score of 380. About 48 per cent of the sample schools were implementing a school feeding programme. The proportion of permanent classrooms to the total number of classrooms in each school is 77 per cent, on average. The proportion of key resource teachers (KRT) to the total number of teachers in each school is about 5 per cent, while the pupil KRT ratio is on average 173. The pupil KRT teacher ratio is too high compared to the overall pupil teacher ratio, indicating that the key resource teachers are few in each school. The pupil teacher ratio in each school is about 37 on average, with a maximum of 88 in some schools. Mean class size was 36 pupils, which is lower than the optimal class size of 40 to 45 established in the teacher staffing norms study.

The utilization of textbooks by students in the sample schools seem to be high—about 97 per cent—and the textbook pupil ratio in 2006 is

Table 6.1: Descriptive statistics

Variable	N	Mean	Std. Dev.
KCPE 2006 mean score	311	244	33.4
Existence of school feeding programme	444	0.48	0.50
Quality of school management	448	27	5.4
Number of permanent classrooms as a proportion of total number of classrooms	448	0.77	0.32
Proportion of KRT teachers in a school	416	0.045	0.37
Pupil Teacher Ratio (Both TSC and PTA Teachers)	448	37	12
Pupil KRT ratio	415	173	170
Class size	447	36	15
Utilization of textbooks	442	0.97	0.14
Pupil Textbook Ratio	416	2.6	0.46
Pupil Toilet Ratio	438	41.7	33.4
Dummy for schools in localities moderately affected by poverty	446	0.39	0.489
Dummy for schools in localities severely affected by poverty	446	0.32	0.467

about 2.6. The poverty situation in the data is captured by two dummy variables. These are a dummy variable for schools in localities moderately affected by poverty, and a dummy variable for schools in localities severely affected by poverty. The proportion of the two groups, that is, schools in localities that are moderately and severely affected by poverty are 39 per cent and 32 per cent, respectively. The remaining 29 per cent is for schools in localities that are not severely affected by poverty.

6.2 Regression Results

Table 6.2 presents the regression results for the estimated parameters based on the school level OLS and median regression. School performance as mentioned earlier is the dependent variable and proxied by the KCPE mean examination scores for each school in the sample. We are not able to fully control all variables in the equation. Due to this, variables such as unobserved pupil ability and parental support are not included in the regression. However, the variables included give a picture of some of the important factors in determining performance at the primary school level.

As indicated in Table 6.2 the main factors that affect examination performance in primary schools are utilization of textbooks, especially

Table 6.2: Regression results —KCPE 2006 mean examination score is the dependent variable

Input variable	Ordinary Least Square (OLS) estimation (t-statistic)	Median estimation (t-statistic)
Existence of school feeding programme	0.030*** (1.88)	0.025*** (1.73)
School management	0.003*** (1.70)	0.005* (3.66)
Proportion of permanent classrooms	0.028 (1.07)	0.013 (0.54)
Proportion of KRT teachers in a school	0.027** (2.09)	0.013 (1.16)
Total PTR (TSC and PTA teachers)	-0.065*** (-1.79)	-0.069** (-2.17)
Class-size	0.088* (2.65)	0.103* (3.42)
Utilization of textbooks	0.031 (0.58)	0.091** (2.06)
Textbook pupil ratio in 2006	0.045 (0.93)	0.024 (0.55)
Pupil toilet ratio	-0.023 (-1.40)	-0.038* (-2.55)
Dummy for schools in localities moderately affected by poverty	0.034*** (1.83)	0.040* (2.37)
Dummy for schools in localities severely affected by poverty	0.029 (1.33)	0.064* (3.22)
Constant	5.148* (44.15)	5.121* (51.84)
Adjusted R2	0.0644	-
Prob >F	0.0021	-
Pseudo R2	-	0.065
Number of observations	282	282

if pupils are allowed to take them home for purposes of doing homework, quality of teachers, quality of school facilities, existence of a school feeding programme and quality of school management.

Utilization of textbooks

There is a positive and significant relationship between KCPE performance and utilization of textbooks. This is captured by a dummy variable on use of textbooks by pupils in doing homework. The marginal effect of pupil textbook ratio is insignificant, implying that whereas textbook provision is important, it is actually the utilization that matters most. The marginal effect of textbook utilization on KCPE mean score is positive and statistically significant. The fact that use of textbooks when doing homework especially at home has a positive impact on KCPE performance indicates that it is the extent to which textbooks are available and utilized by pupils that improves school performance. Thus, the Instructional Materials Programme that is aimed at increasing pupils' access to a textbook has had a positive impact on performance in KCPE examinations. This is because when FPE parents paid for textbooks, this policy unfairly disadvantaged students from poor households as their parents were most likely unable to buy textbooks and some were unable to access school due to user charges. Thus, effective utilization of teaching and learning materials provided to schools has contributed to positive changes in the learning environment and improved performance.

Quality of teachers

Teachers constitute one of the main inputs in any education system. However, of most importance is the quality of teachers, which is improved by pre- and in-service training in addition to academic qualifications. Most of the teachers in primary schools (about 84%) have secondary school education, that is O-Level KCSE academic qualification.

In-service training undertaken includes school-based teacher development within which Key Resource Teachers (KRTs) are trained, school management, guidance and counselling, and HIV and AIDS. The results show that a high number of KRT in a school have a statistically positive impact on school outputs. Thus, low teacher competence due to either lack of in-service training has serious handicap for efficient

and quality of teaching. The school-based teacher development programme was developed with the aim of improving the pedagogical skills of teachers, hence improved teacher quality.

Quality of school infrastructure and other facilities

The number of permanent classrooms and sanitary facilities (toilets) in a school are used to capture the school environment effects with regard to availability and quality of physical facilities in a learning environment. *A priori*, it is expected that poor school infrastructure tend to hinder effective teaching while the opposite is true. The ratio of permanent classrooms to total number of classrooms in a school has a positive but insignificant effect on school performance. However, the pupil toilet ratio has a negative and statistically significant effect on school performance. This implies provision of good quality school facilities, and particularly availability of sanitary facilities, has a positive impact on performance. Thus, the Ministry of Education efforts under Kenya Education Sector Support Programme that targets improvement and expansion of physical infrastructure in targeted schools is a positive move and is likely to have a positive impact on learning achievements.

Pupil-teacher ratio and class size

Pupil-teacher ratio is an efficiency indicator that shows the level of teacher utilization. In addition, class size indicates the teacher-pupil contact time. In a teaching and learning situation, the teacher has learners of different learning behaviour, thus calling for a variation in pedagogy. Low PTR would mean low teacher utilization, but there could be a relatively high teacher student contact and less workload for teachers hence being more effective but not necessarily cost-effective. Furthermore, small class sizes are associated with effective teaching and learning. However, despite such an advantage, there exists a threshold beyond which economic costs of smaller classes outweigh the learning benefits associated with such classes.

Regression results show that PTR has a negative and significant influence on performance. The negative sign was expected given that the higher the PTR the lower the probability of a teacher student contact and this is likely to have a negative impact on outputs. The assumption here is that such contacts are used effectively in teaching and learning and hence lead to increased performance.

The regression results for class size had a positive and significant influence on performance. This is not surprising given that the average class size in the sample schools is low and within the range that does not affect performance. Smaller classes are relatively more manageable, with teacher-pupil contact being increased. The staffing norms study (Government of Kenya, 2005b) puts such an optimal size between 40 and 45 pupils, beyond which class size will lead to a decline in mean score.

Quality of school management

Quality of school management was measured by availability of school plan, textbook policy, frequency of staff meetings, school instructional meetings and parents meetings, and how well the schools kept their instructional materials as indicated by their Instructional Material Stock register. School management was found to positively influence KCPE performance. A well-managed school instructional material system creates an enabling environment for teachers and pupils to effectively engage in the teaching and learning process. In addition, this may make both teachers and pupils to find the school interesting. From the results, good school management practices positively influence performance as expected. The head teacher and school's management committees are important instruments for effective school management. The Ministry of Education and the Kenya Education Staff Institute have held in-service school management courses for these institutions. It would seem that such courses have been effective in terms of generating the desired school outcomes. Also, the schools are adhering to good management practices as spelt out in various policy guidelines for implementing the FPE. Such guidelines include the maintenance of cashbook, material receipt register, and adherence to the orange book.

Existence of a school feeding programme

A school feeding programme provides a short term intervention on hunger and malnutrition. Hungry and/or malnourished pupils are unable to concentrate on learning, in addition to having a short concentration span due to low calories in their body system. Provision of meals at school, especially in areas characterized by food insecurity is likely to promote learning. A dummy variable that indicated existence of a school feeding programme or lack of it was used to measure this

variable. Results showed that existence of a school feeding programme has a positive and significant effect on learning achievements in national examinations.

Social economic background of the student

The analysis showed a positive and significant (at 1%) relationship between poverty dummy variables and KCPE 2006 mean score. This meant that students from schools in relatively poor areas are performing relatively well in KCPE examinations. This could be explained by the overall Free Primary Education interventions that have enabled schools from relatively poor areas to enjoy equal access to quality education. In addition, this is evidence that pupils in schools from poor backgrounds and/or pupils from poor households can enhance their performance given an equal opportunity of access to education.

7. Conclusions and Recommendations

Pupil achievement in KCPE is higher when schools have a greater utilization of textbooks, especially by giving pupils take home assignments. Also, existence of school feeding programme, school management and quality of school infrastructure had a positive impact on performance. Process variables that play a critical role in enhancing school inputs include regular teacher training, improving the provision of textbooks and providing incentives for communities and schools to provide school meals, and infrastructure. In view of the foregoing, the following recommendations are made:

(i) *Expansion of physical facilities to reflect set norms:* Expanding physical infrastructure, especially number of toilets and permanent classrooms can be either through community contributions and/or envisaged physical infrastructure programmes under the Kenya Education Sector Support Programme (KESSP). It is, however, critical that classroom infrastructure expansion is linked with mapping of schools to ensure more classrooms are only constructed in areas with inadequate facilities. It is also important to link any expansion of classrooms to class size norms and availability of other resources such as teachers.

(ii) *Enhance textbook utilization:* Improving pupil-textbook ratio norm from 2:1 and 3:1; to 1:1 and 2:1 for upper and lower primary school levels, respectively, is critical. This will enable effective use of books and access especially when doing homework at home. Indeed, the study established that textbooks had more impact on learning and performance when pupils are allowed to take them home for purposes of doing homework.

(iii) *Provision of school meals:* The presence of a meal during the school session enhances pupil concentration during instruction. While the Government of Kenya should continue including more needy schools into the school feeding programme (SFP), parents in medium and high agricultural areas should ensure that pupils take at least one meal every day when the school is in session.

(iv) *School management:* School management was found to be an important input that influences student performance. In view of this, it is imperative to initiate a mechanism for rewarding school managers that perform well based on an agreed performance contract. This is

aimed at motivating the school manager to always act in the best interest of the school.

References

- Bedi, A. S., Kimalu, P. K., Manda, D. K. and Nafula, N. (2004), "The Decline in Primary School Enrolment in Kenya", *Journal of African Economies*, Volume 13, Number 1, pp. 1-43.
- Boissiere, M. (2004), Determinants of Primary Education Outcomes in Developing Countries. A Background Paper for the Evaluation of the World Bank's Support to Primary Education, The World Bank Operations Evaluation Department, Washington DC: The World Bank.
- Fuller, B (1987), What School Factors Raise Achievement in the Third World? *Review of Educational Research No. 57*.
- Government of Kenya (2005a), Ministerial Public Expenditure Review, Ministry of Education, Science and Technology, unpublished.
- Government of Kenya (2005b), Draft Report on Teacher Staffing Norms, Ministry of Education, Science and Technology, unpublished.
- Government of Kenya (*nd*), Education Statistical Booklet 1999-2004, Ministry of Education.
- Government of Kenya, (2003), Economic Recovery Strategy for Wealth and Employment Creation, Nairobi: Government Printer.
- Hanushek, E. (1995), "Interpreting Recent Research on Schooling in Developing Countries," *World Bank Research Observer*, 10(2), pp.227-46.
- Hanushek, E. (1998), The Evidence on Class Size. Rochester, New York: W. Allen Wallis Institute of Political Economy. Occasional Paper 98-1. Available at: <http://petty.econ.rochester.edu/eah.htm>.
- Hawes, H. and Stephens, D. (1990), *Questions of Quality: Primary Education and Development*. Harlow: Longman.
- Kingdon, G. and Teal, F. (2002). "Does Performance Related Pay for Teachers Improve Student Performance? Some Evidence From India." *Centre for the Study of African Economies Series Ref: WPS/2002-06*.
- Ladel, H. F. and Hansen, J. S. (1999), *Making Money Matter*, Washington DC: National Academy Press.
- Leidi, S., McDermott, B. and Stern, R. (2004), STATA for Surveys. *Unpublished*.
- Levin, H. M. and Lockheed, M. E. (1991), *Effective Schools in Developing Countries*, Washington DC: World Bank.

- Lockheed, M. E. and Hanushek, E. (1988), *Improving Educational Efficiency in Developing Countries: What do we Know?* Washington DC: World Bank.
- Mingat, A., Tan, J. & Sosale S. (2003), *Tools for Education Policy Analysis*. Washington DC: World Bank.
- Nzomo J., Kariuki M. W., and Guantai, L. (2001), "The Quality of Education: Some Policy Suggestions Based on a Survey of Schools". UNESCO-IIEP.
- Onsomu E., Nzomo, J. and Obiero, C. (2005), *The SACMEQ II project in Kenya: A Study of the Conditions of Schooling and the Quality of Education*. Harare: SACMEQ.
- Pennycuick, D. (1998), *School Effectiveness in Developing Countries - A Summary of the Research Evidence -Education Research Paper*, Centre for International Education, University of Sussex.
- Riddell, A. R. and Nyagura, L. M. (1991), *What Causes Differences in Achievement in Zimbabwe's Secondary Schools? Pre-Working Papers Working Paper Series 705*, Washington DC: World Bank.
- Schieffelbein, E, and Simmons, J. (1981), *Determinants of School Achievement: A Review of Research for Developing Countries*, Ottawa, Ontario: International Development Research Centre.
- Suryadarma, D., Suryahadi, A., Sumarto, S., and Rogers, F. H. (2004), *The Determinants of Student Performance in Indonesian Public Primary Schools: The Role of Teachers and Schools*, SMERU Research Institute, Jakarta.
- Throsby, C.D. and Gannicott, K. (1990), *The Quality of Education in the South Pacific*, National Centre for Development Studies, Canberra.
- UNICEF (2000), *Defining Quality in Education*. Working Paper Series, New York: United Nations Children's Fund.
- Vulliamy, G. (1987), "School Effectiveness Research in Papua New Guinea". *Comparative Education*, 23.

Annex

Annex 1: Definition of variables

Variable	Definition
Log of KCPE 2006	This was log of the KCPE 2006 mean score for school
Existence of school feeding programme	Dummy variable taking on the value 1 if school had a School feeding programme, 0 otherwise
School management	Composite score for school management comprising availability of school plan, textbook policy, frequency of staff meetings, school instructional meetings and parents meetings
Proportion of permanent classrooms in a school	Number of permanent classrooms in a school as a proportion of total (permanent, temporary, open-air) number of classrooms
Proportion of KRT teachers in a school	Number of Key Resource Teachers as a proportion of total number of teachers in a school
Pupil teacher ratio (Both TSC and PTA teachers)	Ratio of enrolment to total number of teachers (both TSC and PTA Teachers) in a school
Class size	Total enrolment divided by total number of classes in a school
Utilization of textbooks	This was a dummy variable taking on the value 1 if pupils were allowed to take textbooks with them to use in doing homework after school hours, and 0 if not allowed to take books home for doing homework
Pupil text book ratio	Ratio of enrolment in four classes observed to total number of textbooks in the same four classes in a school
Pupil toilet ratio	Ratio of enrolment to total number of toilets in a school
Dummy for schools in localities moderately affected by poverty	This is the poverty level taking value 1 for medium poverty level and 0 otherwise
Dummy for schools in localities severely affected by poverty	This is the poverty level taking value 1 for high poverty level and 0 otherwise

Other Related KIPPRA Papers

1. Kimalu, P. K., Nafula N. N., Manda D. K., Mwabu, G. and Kimenyi, M. S. (2001), *Education indicators in Kenya*. KIPPRA Working Paper No. 4.
2. Bedi, A., Kimalu, P. K., Manda, D. K. and Nafula, N. N. (2002), *The decline in primary school enrolment in Kenya*. KIPPRA Discussion Paper No. 14.
3. Vos R., Bedi, A., Kimalu, P., Manda, D. K., Nafula N. N. and Kimenyi, S. (2004), *Achieving universal primary school education in Kenya*. KIPPRA Discussion Paper No. 46
4. Onsomu, E. N., Muthaka, D., Ngware, M. and Kosimbei, G. (2006), *Financing of secondary education in Kenya: Costs and options*. KIPPRA Discussion Paper No. 55.
5. Onsomu, E. N., Muthaka, D. I., Ngware, M. W. and Manda, D. K. (2006), *Determinants and strategies for expanding access to secondary education in Kenya*. KIPPRA Discussion Paper No. 63.
6. Ngware, M. W., Onsomu E. N. and Manda, D. K. (2006), *Private sector investment in education and training: A case of tertiary education in Kenya*. KIPPRA Special Report No. 6.
7. Impact of primary school education inputs and outputs in Kenya (forthcoming discussion paper)

