

**“The Determinants of Cognitive Achievements in Primary  
Schools in Kenya”**

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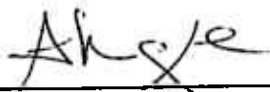
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## DECLARATION

This Research Paper is my original work and has not been presented for award of degree in any other University

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This Research Paper has been submitted for examination with our approval as University Supervisors:

  
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## **Dedication**

**To My Wife and Children: Nthenya, Innocent, Teresa, and Joan.**

## Abstract

*This study analyses the relationship between educational inputs and cognitive achievements in reading English and Mathematics for primary schools in Kenya with a view to identify inputs, which are most effective in raising primary education pupils' achievements. The study uses the recent SACMEQ II data, which collected information on pupils' personal, family, teachers and schools organizational characteristics in Kenya. The analysis is based on education production process and estimates the effect of pupils' personal and family socioeconomic status, and school related characteristics on cognitive achievements for grade 6 pupils in Kenya. The study findings show that factors related to pupils' personal and their families socio economic characteristics as well as physical facilities, class size, teacher characteristics and school organization and management are key determinants of cognitive achievements in primary schools in Kenya. The findings provide support to the notion that additional resources are required to improve learning achievements in Kenya and provide a basis for policy intervention in directing budgetary resources to those educational inputs, which are likely to enhance learning achievements.*

## Table of Contents

Declaration.....	II
Acknowledgements.....	III
Dedication.....	IV
Abstract.....	V
Table of Contents.....	VI
List of Tables and Appendices.....	VII
List of Abbreviations.....	VIII
Chapter 1.....	- 1 -
1.0 Introduction.....	- 1 -
1.1 Kenya's Primary Education System.....	- 2 -
1.2 Provision of Educational Inputs.....	- 4 -
1.3 Performance in Learning Achievements in Primary Education.....	- 7 -
1.4 Statement of Problem.....	- 10 -
1.4 Objectives of the Study.....	- 12 -
1.5 Significance of the Study.....	- 12 -
Chapter 2.....	- 14 -
2.0 Literature Review.....	- 14 -
2.1 Theoretical Literature.....	- 14 -
2.2 Empirical Literature.....	- 17 -
2.3 Overview of Literature.....	- 22 -
Chapter 3.....	- 24 -
3.0 Methodology.....	- 24 -
3.1 Conceptual Framework.....	- 24 -
3.2 Analytical Framework.....	- 25 -
3.3 Econometric Model Specification.....	- 26 -
3.3.1 Hypothesis.....	- 27 -
3.4 Data Source and Type.....	- 28 -
3.4.1 Description of Variables.....	- 29 -
3.5 Limitations of the Study.....	- 31 -
Chapter 4.....	- 32 -
4.0 Results.....	- 32 -
4.1 Introduction.....	- 32 -
4.2 Descriptive Analysis.....	- 32 -
4.3 Regression Results.....	- 35 -
Chapter 5.....	- 41 -
5.0 Conclusions and Policy Implications.....	- 41 -
5.2 Policy Implications.....	- 41 -
5.3 Areas of Further Research.....	- 43 -
References.....	- 44 -
Appendices.....	- 47 -

## **List of Tables and Appendices**

Table 1.1	Public Primary Schools Enrolment 1989 - 2003 -----	3
Table 1.2	Expenditure per Pupil and Pupil/Teacher Ratio 1983 - 2002-----	5
Table 1.3	KCPE Performance by Province 1993 - 2004 -----	9
Table 1.4	Primary School Drop-Out and Repetition Rates 1999 and 2003 -----	10
Table 3.1	Description of Variables-----	30
Table 4.1	Descriptive Statistics of Variables used in the Analysis -----	33
Table 4.2	The Estimated Coefficients-----	37
Appendix 1	Education Key Indicators -----	47
Appendix 2	Heteroscedasticity Test-----	48
Appendix 3	Multicollinearity Test -----	49



### **List of Abbreviations**

<b>EFA</b>	–	<b>Education For All</b>
<b>FPE</b>	–	<b>Free Primary Education</b>
<b>GER</b>	–	<b>Gross Enrolment Rate</b>
<b>HIV/AIDS</b>	–	<b>Human Immunodeficiency Virus/ Acquired Immunity Deficiency Syndrome</b>
<b>IEA</b>	–	<b>International Association for the Evaluation of Educational Achievements</b>
<b>KCPE</b>	–	<b>Kenya Certificate of Primary Education</b>
<b>MoEST</b>	–	<b>Ministry of Education, Science and Technology</b>
<b>SACMEQ</b>	–	<b>Southern Africa Consortium for Monitoring Educational Quality</b>
<b>TSC</b>	–	<b>Teacher Service Commission</b>
<b>UNICEF</b>	–	<b>United Nation Children’s Fund</b>
<b>UNESCO</b>	–	<b>United Nation Education, Scientific and Cultural Organization</b>
<b>USA</b>	–	<b>United States of America</b>
<b>VIF</b>	–	<b>Variance Inflation Factor</b>

## Chapter 1

### 1.0 Introduction

Primary schooling is widely accepted as an important contributor to both economic growth and equity objectives of development. This is demonstrated by the fact that developing countries devote substantial budgetary resources in creation and operation of schooling system. Kenya, for instance, spends between 55 and 57 per cent of total recurrent expenditure on primary education, the largest expenditure item in education budget [MoEST, 2003]. The achievement of primary schooling yields higher returns for individuals, households and society in developing countries than other forms of educational investment [Psacharopoulos, 1994]. As such, investment in primary schooling provides means for tackling widespread poverty experienced by the developing countries.

Education enhances and inculcates knowledge and skills, which shape attitudes and behavior necessary for faster economic growth and social change. Although education cannot in isolation bring development, evidence has it that it has a powerful factor that accelerates development. It does this by increasing labour productivity and facilitating accumulation of productive factors, information and knowledge. The improved productivity associated with primary schooling stems largely from cognitive achievements<sup>1</sup> brought about by schooling process [Colclough, 1982].

Most developing countries face the challenge of how to mobilize additional resources to ensure adequate supply of education to all children given that public spending per pupil on primary

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<sup>1</sup> Cognitive achievements refers to what pupils ultimately gain from education system. The pupils achieve cognitive skills - measured by standardized test scores – in reading, writing and mathematics mainly through formal schooling.

schooling (in real terms) for these countries is low as compared to developed countries<sup>2</sup>. The low per capita expenditure on schooling is mainly due to budgetary constraints faced by most of these countries and not because education is not considered as a priority. Under such circumstances, expansion and improvement of primary schooling is quite difficult and the question of how to improve the quality becomes an important research issue. This study is motivated by the importance attached to acquisition of cognitive skills to economic development and budgetary resource constraint facing Kenya, like other developing countries, in allocation of resources to primary education. The study intends to identify factors, which determine cognitive achievements in Kenya's primary education system. This study will facilitate allocation of budgetary resources to primary schooling.

### **1.1 Kenya's Primary Education System**

The primary education system<sup>3</sup> in Kenya consists of network of schools spread throughout the country. Most schools are public since private schools accounts for only 3 per cent of total enrolments as per 2003 Annual Schools Census. Officially, public schools are open to all children aged 6-13 years and it takes at least eight years to complete irrespective of their learning achievement. The number of public primary schools increased from 6,058 in 1963 to 18,000 in 2003. The expansion of facilities and institutions was accompanied by phenomenal expansion in student enrolment [MoEST, 2003]. As presented in Table 1.1, the primary schools enrolment

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<sup>2</sup> The conclusive comparison of per capita expenditure on schooling between developing and developed countries is derived from UNESCO EFA Global Monitoring Report 2002, Table 11: page 278 - 280.

<sup>3</sup> The education system includes 8 years of primary education, 4 years Secondary and at least 4 years University education.

rose from a total of 0.9 million in 1963 to 6.9 million in 2003<sup>4</sup>. Kenya almost attained Universal Primary Education recording highest enrolment of 105.4 per cent in 1989.

**Table 1.1: Public Primary Schools Enrolment 1989 - 2003**

	1989	1990	1991	1992	1993	1995	1996	1997	1998	1999	2000	2003
<b>Enrolment in Million</b>	5.194	5.392	5.456	5.530	5.429	5.536	5.598	5.765	5.920	5.868	5.883	6.906
<b>Gross enrolment Rate</b>	105.4	101.8	91.4	91.0	87.8	86.8	86.4	87.7	88.8	90.4	87.6	104.0

Source: Ministry of Education, Science and Technology

The expansion of the primary education system has been due to a deliberate policy of the government to ensure that education is accessible to all children as an essential basic service and to meet the manpower needs of the economy. It also arose out of demand for schooling by Kenyans out of belief that education enhances the prospect of wage employment in the formal sector of the economy and guarantees higher income and better working condition [Development Plan, 1997 -2001].

Despite the expansion, primary gross enrolment rate (GER) declined from 105.4 per cent in 1989 to 87.6 percent in 2000 with the lowest GER recorded in 1996. Large inter district disparities in enrolment and an increasing number of children out of school have emerged overtime. The 1999 population census estimated that out of 6.0 million of school going age children, 0.7 million children were out of school. However, with introduction of free primary education in 2003, enrolment rose dramatically and recorded a GER of 104 per cent [MoEST, 2003].

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<sup>4</sup> The Appendix provides more detailed information on enrolment

A number of factors may explain the negative trend in enrolments in primary schools. The 8-4-4 system introduced in 1985 and Cost-Sharing policy of 1989 imposed increased private cost to households and placed a heavy burden on parents and communities in financing education. The districts endowed with resources were able to provide the required support. Increased poverty at household level also affected primary schooling by reducing the ability of households to cater for education of their children. According to Second Poverty Report of 1997, 30.7 per cent of children out of school cited affordability as the reason of being out of school. The private cost of education due to broad curriculum<sup>5</sup> placed heavy burden on parents to provide resources for educational services. As such, access to schooling was not affordable due to high private cost for attending school relative to household income [Deolalikar, 1999].

## **1.2 Provision of Educational Inputs**

Availability of school inputs are critical determinants of the amount of education and of its quality to be supplied. The school inputs which includes: curriculum, instructional and learning materials, equipments, physical facilities, school management and teacher development have an important influence on pupils' learning as they enhance effectiveness of the education system. Prior to 2003, provision of educational inputs to schools was through Cost Sharing Policy (partnership between government, parents and local communities) as outlined in Sessional Paper No. 6 of 1988 and Development Plan of 1989 - 1993. Parents and communities, with exception of municipalities, provided land on which schools were established as a way of stimulating local demand, facilitated physical development of schools and in addition, provided learning materials

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<sup>5</sup> Curriculum involves all subjects taught and activities provided by school; and time devoted to each subject and every activity.

such as textbooks, stationery e.t.c. The Government on its part provided teachers, quality assurance, curriculum development and evaluation of the primary education system.

The Cost-Sharing Policy brought dramatic changes to budgetary resources allocated to education for operation of schools. As shown in Table 1.2, the public expenditure per pupil grew by almost ten times from KSh. 613.11 in 1983 to KSh 5361.71 in 2002 in nominal terms. The large growth in expenditure per pupil reflects the relative growth in number of teachers engaged by government in an effort to supply teachers to schools established by parents and communities. The proportion of trained teachers increased from 70.6 percent 1983 to 98.0 percent in 2002 signifying improvement in teacher quality.

**Table 1.2: Expenditure per Pupil and Pupil/Teacher Ratio 1983 - 2002**

	1983	1988	1993	1998	2002
Expenditure Per Pupil in KShs.	613.11	909.48	2,401.86	4,301.72	5,361.71
Pupil/Teacher Ratio	36.82	32.91	31.35	30.78	33.52
Proportion of Trained of Teachers (%)	70.6	69.6	82.0	96.6	98.0

Source: Ministry of Education, science and Technology

A teacher is the most important input in learning process. The level of pupil/teacher ratio indicates the utilization and distribution of teachers. The overall pupil/teacher ratio fell from 36.82 in 1983 to 33.52 in 2002 before the government intervention of 2003. This suggests that the supply of teachers to public schools improved and it implies that performance in pupils' achievements should have improved due to increased quantity and quality of teachers.

The national class size fluctuated between 30 and 38 over the period between 1990 and 2003 an indication that there is adequate capacity to enroll all children in primary schools given the stipulated official class size is 40. The Coast, Eastern, Nyanza, North-Eastern provinces have

low class sizes as compared to Nairobi, Central, Western and Rift Valley provinces. The variation in classroom resources across provinces suggests that class size should have varying impact on learning achievements. It should be noted that large classes may have a negative effect on the teaching/learning process, as teachers cannot adequately pay attention to slow learners or carry out proper assessment of their pupils [MoEST, 2003].

The supply of textbooks, stationery and other instructional materials by SEPU<sup>6</sup> to schools was discontinued in 1987 and parents were required to take over the expenses of instructional materials. Schools started experiencing critical shortage of textbooks, equipments and instructional materials. At one point the book/pupil ratio was found to be 1:17, which is unacceptable for any meaningful learning to take place [UNICEF, 1994]. With rapid rise in inflation and increased poverty at household level, the provision of essential instructional materials worsened in public schools. Similar inadequacies were observed in provision of essential physical facilities such as classrooms, library and other facilities. The 1995 primary school census indicated that 27 percent of desk and 36 per cent of chairs required for schooling were not available in primary schools classrooms.

The introduction of the 8-4-4 curriculum and cost sharing policy had the effect of reducing the time and material resources needed by schools, teachers and learners to ensure mastery of formal education. Time allocated to teaching key disciplines (languages, mathematics and sciences) was reduced. The schools responded by increasing school hours for upper classes and started offering private tuition. The amount of material resources available for schooling was reduced since poor

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<sup>6</sup> SEPU – School Equipment Production Unit of Ministry of Education, Science and Technology

households and communities were unable to meet the material requirements necessary for the practical schooling [Deolalikar, 1999].

The worsening trend was reversed by declaration of Free Primary Education Program (FPE) in 2003. The government took over provision of learning materials; and abolished school levies and fees in public primary schools. In addition to supply of teachers, curriculum development and other administration costs; the government gave a capitation grant of KSh. 1,020 per pupil in every public primary school. The FPE program emphasis is on improving the existing schools other than establishing new schools.

### **1.3 Performance in Learning Achievements in Primary Education**

The ultimate goal of the primary education system in Kenya is to produce learners who are literate and numerate. To this end, Kenya has achieved an impressive increase in adult literacy since its independence. Adult literacy rate in Kenya was merely 20 per cent in 1960. The rate doubled to 40 per cent within 15 years, increased to 59 per cent by 1985 and then to 77 per cent in 1995. The literacy achievements reflect Kenya's impressive expansion in access to education during the last four decades, largely due to a comprehensive network of schools spread throughout the country. Despite impressive performance in access to primary education, there is still a significant proportion of population of Kenya, which is still illiterate [Deolalikar, 1999].

Assessment of learning achievements in Kenya is mainly based on performance in KCPE<sup>7</sup> examination - terminal examination for those completing primary education cycle. Reputation of

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<sup>7</sup> KCPE exam questions are set in English with exception of Kiswahili. It is expected that for pupils to fare well in KCPE exam to have mastered competencies in English and Mathematics.



a school is determined by its performance in KCPE examination and number of pupils it sends to secondary schools. Some schools responded to this incentive by promoting only their best students to the eighth grade forcing others to repeat to ensure good performance in KCPE grade.

The overall KCPE performance in English and Mathematics has recorded no improvement for period 1990 and 2000 and has remained slightly below 50 mean score as shown in Table 1.3. The KCPE results of 2004 showed some improvement. The Nairobi province has consistently performed better than other provinces with over 50 mean score over the same period. Central and Rift Valley provinces have also recorded mean score above 50 marks. Analysis reveals that KCPE performance across provinces does not correspond to their class size and pupil/teacher ratio, proxy of resource allocation to the provinces. Coast, Eastern and Nyanza provinces with smaller class sizes have not performed better than Nairobi, Central and Rift valley with relatively larger Class sizes. Resource allocation to schools cannot adequately explain performance in achievements in English and mathematics in public primary schools.

The head teachers and school management committees determine the organization and management of resources in each school. Although teaching and learning activities are controlled within school level, factors outside schools influence its performance. Deployment of teachers is done centrally by Teachers' Service Commission (TSC) and schools have no say in deployment of teachers. It can be concluded that effectiveness of schools vary significantly and each school performance depends on how factors within and outside the school are organized and managed.

**Table 1.3: KCPE Performance by Province 1993 - 2004**

Mean scores out 100

Province	1993		1994		1996		1999		2000		2004	
	English	Maths	English	Maths	English	Maths	English	Maths	English	Maths	English	Maths
Coast	39.89	40.65	41.03	41.78	43.38	43.3	48.06	46.39	48.12	47.24	47.32	47.74
Central	52.71	52.47	51.35	52.02	51.16	50.43	48.04	48.48	49.09	50.89	52.01	50.73
Eastern	49.01	48.25	48.33	47.88	47.45	47.73	49.9	49.39	49.11	48.55	48.6	48.2
Nairobi	61.42	49.56	61.42	51.54	59.28	49.32	59.88	48.40	60.8	49.98	63.31	64.36
Rift Valley	50.4	49.62	51.39	50.69	51.34	50.98	50.93	51.97	49.09	51.25	48.82	51.7
Western	48.55	46.19	47.14	46.54	52.08	48.36	51.77	49.87	48.7	48.02	50.72	48.72
Nyanza	48.33	50.75	46.91	48.15	47.32	49.38	46.27	49.35	47.19	49.31	49.55	51.78
North Eastern	42.93	42.5	38.42	40.65	41.77	44.59	39.95	43.69	42.55	41.88	42.92	43.49
<b>National</b>	<b>49.16</b>	<b>47.5</b>	<b>48.25</b>	<b>47.41</b>	<b>49.29</b>	<b>48.02</b>	<b>49.35</b>	<b>48.44</b>	<b>49.33</b>	<b>48.19</b>	<b>50.41</b>	<b>49.59</b>

Source : Kenya Examination Council Newsletter (various issues)

Other measures of performance indicate that the system is also characterized by persistent repetition and dropout rates. Table 1.4 shows repetition and drop-out rates for public schools in 1999 and 2003. The higher repetition rate has continued to be in grade 7 and may be explained by the fact that pupils repeat grade 7 in-order to improve performance in KCPE exams and be able to transit to secondary education level. Pupils from poor households are likely to drop out of school or perform poorly in KCPE as they lack incentives for better performance in terms of transiting to secondary schools. As shown in Table 4 promotion rates improved in 2003. Drop out and repetition rates declined to 2.0 and 9.6 per cent, respectively.

The completion rates help to track progress of the children completing primary education. Prior to 2003, 50 per cent of children who join grade 1 drop out of school before completing primary cycle at grade 8 and sit for KCPE exam. In 2003 out of 947,800 children who enrolled in grade 1 in 1996, 541,600 completed grade 8 in 2003 representing 57.2 per cent completion rate. This shows that the FPE programme has started bearing fruits. The system is likely to produce widespread cognitive achievements if the improvement in completing primary education is sustained. In this case KCPE will be a tool for testing knowledge and skills acquired by terminal

pupils as opposed to being a tool for secondary schools selection, as observed by Makau, et al (1986).

**Table1.4: Primary School Drop-Out and Repetition Rates 1999 and 2003**

Class	Drop Out		Repetition	
	1999	2003	1999	2003
Grade 1	4.7	1.9	17.2	9.3
Grade 2	4.2	1.8	13.0	9.2
Grade 3	4.6	1.9	12.6	8.7
Grade 4	5.2	2.0	13.3	9.3
Grade 5	5.3	2.1	12.0	9.1
Grade 6	6.0	2.5	12.4	7.8
Grade 7	7.0	2.9	17.0	11.0
Grade 8	2.3	1.2	4.1	8.8
TOTAL	4.9	2.0	13.2	9.6

Source : Ministry of education , science and Technology

#### **1.4 Statement of Problem**

The analysis of Kenya's supply of education reveals that primary education is not yet generally available to all children in spite of huge budgetary resources devoted to the sector. A significant number of children in Kenya fail to complete primary schooling and may not have acquired basic reading, writing and numeracy skills. Completion rate of children enrolled in grade 1 in 1996 is estimated to have improved to slightly above 50 per cent and annual drop out rate reduced to 2.0 per cent. On the other hand per capita expenditure on primary schooling and quality of teachers has continued to rise over the years. The increasing unit cost and low completion rates demonstrate the inefficiency of the system in utilization of educational inputs.

The growth of educational resources allocated to primary schools has not been accompanied by a significant improvement in cognitive performance as measured by KCPE results. The mean scores for KCPE results for English and Mathematics have remained slightly below or above 50 per cent. The distribution of KCPE means score across provinces indicate significant variation

that does not correspond to the budgetary resource allocation to schooling. An analysis, which may help to determine the ideal mix of educational inputs to improve learning achievement, is necessary.

The success of education policy depends on how the government provide schools with a particular set of inputs; school facilities, instruction material, improved pedagogical inputs and performance evaluation; and reform management of the entire school system, that are effective in producing the desired results. An understanding of how school inputs are combined to produce cognitive skills will help to address the problem of resource allocation. Policy reform initiated in 2003 to reverse the deteriorating situation was based on well founded assumptions and intuition with regards to the extent educational inputs are effective on improving achievements rather than on factual knowledge. The additional provision of inputs to all public schools was not supported by empirical evidence on impact of educational inputs to pupils' cognitive achievements. The extent to which the additional inputs contributed to the improved performance in learning achievements is not known. In view of this, an empirical investigation on the relationship between educational inputs and achievements becomes important.

Most research work in Kenya has focused more on factors that influence enrolments in primary schools. Little attention has been devoted to estimation of impact of educational inputs on cognitive achievements. Situation Analysis studies like those of Abagi, et al (1997 and 1999) have helped to review the performance of primary education system but have not provided a detailed understanding of the key factors that determine better performance. Some of recent empirical studies have only focused on effect of specific inputs ignoring others. As such studies are yet to establish relationship between key educational inputs and pupils' achievements and

there exists no benchmark performance of key educational inputs. This study attempts to contribute to this area.

This study analyzes the determinants of cognitive achievements in primary schools in Kenya and the effect of school inputs on learning outcomes. It links the pupil cognitive achievements to physical facilities, learning materials, teachers' effectiveness, school management and family contribution to learning. The estimates obtained are useful in evaluating school inputs, which are effective in promoting cognitive skills formation in reading and numeracy.

#### **1.4 Objectives of the Study**

The overall objective of the study is to analyze relationship between educational inputs and achievement performance.

The specific objectives of this study are as follows:

1. To identify factors that influence cognitive achievements;
2. To analyze determinants of cognitive achievements in Kenya;
3. Based on 1 and 2 draw policy implications.

#### **1.5 Significance of the Study**

The study is motivated by the fact that government of Kenya allocates large portion of its budgetary resources to primary education. Despite the huge investment in primary education, Kenya is yet to attain sustainable universal primary education. Given that performance of a particular school reflects the amount of resources employed to produce cognitive achievements,

establishing the relationship between educational inputs and achievements provides a different approach in resource allocation to primary education.

Primary schooling is one of most important forms of education because it's more observable than others and is thought to be particularly affected by policy changes. Fiscal policy adjustments directly affect supply of primary schooling in various ways. General cuts in public spending can cause shortage of materials and personnel inputs. It is only possible to guard the sector from adverse policy changes if the impact of inputs on performance of the sector is known.

## **Chapter 2**

### **2.0 Literature Review**

The literature reviews the cognitive achievement and factors, which influence it. It traces the theoretical and empirical developments in educational production functions faced by the developing countries like Kenya.

### **2.1 Theoretical Literature**

Blaug M., (1970) argues that education system faces problem of allocating resources within individual educational institutions. The education Administrators pursue multidimensional objectives some of which cannot be measured in units directly comparable to the resource cost of education and may not be maximizing education objectives. Blaug suggests that an optimizing principle may be adopted to address the problem of resource allocation where inputs may not be efficiently combined at any moment but may be made to achieve a given objective. Alternatively Blaug argue that production function for education may be useful in resource allocation. The production function describes the relationship between inputs and school outcomes. The argument is based on theoretical objective of efficiency, which is to obtain optimal combination of inputs such as teacher experience, expenditure per student to achieve at the least costs, desired outcome such as level of reading achievement.

Brown and Saks (1975) considers economic problem in education process as problem of schools on how resources are utilized in improving the cognitive achievements of students. The schools are complex non profit organizations in which teachers, administrators, parents, political authority and students all make or participate in decision making. The school opportunities are

determined by production and resource allocation constraints. There is production relation for each student in which student's score is determined by how much of each of the different kinds of inputs get applied to the particular student. A school tries to maximize some welfare function of students' scores subject to production and input allocation constraints.

Colclough, C. (1982) in his review of recent research work from different countries found that schooling increased labour productivity in both urban and rural areas economic returns to investment are typically high. Schooling is important to productivity growth due to cognitive and non-cognitive changes brought by school. Evidence from most countries shows that cognitive abilities are enhanced by schooling. It is established that more schooling mean higher cognitive achievement and schools are fundamental to the process of cognitive change. Coclough argues that although most of studies made so far include small number of developing countries, results suggest that the lower the income the country is, the lower the effect of socio economic status on cognitive achievement. Teachers and school quality are very effective

Abagi et al, (1999), carried out a situational analysis to determine the requirements for Kenya to attain Universal Primary Education by 2015. The analysis considered wide range of educational inputs, which included: teachers, textbooks, classrooms, curriculum and pedagogical process and estimated financial requirements. This was to address issues of overloaded curricula, lack of teaching materials, poor teaching methods, poor or lack of adequate supervision are among factors which affect student performance in primary schools. The analysis concluded that more resources are required for primary schooling but did not point out its implications to academic performance.



Abagi, et al (1997) undertook study to establish factors, which have contributed to performance of education sector. They found that primary schools are operated inefficiently. The study revealed that primary education system was characterized with high dropout rates and repetition rates and completion rates remained low. The pupil to teachers' ratio was quite low at 31. The poor performance in learning achievements was attributed to the in-efficiency in utilization of learning time and resources in most public schools. They found that the main cause of inefficiency was inappropriate education, teacher based factors like teachers attitude (teacher characteristics, school environment and household characteristics and gender issues).

Deolalikar, A.B (1999) in a study to review performance of primary and secondary education in Kenya found that the resource allocation within the budget was inappropriate and ineffective. Teacher salaries accounted for 95-97 per cent of recurrent expenditure. The remaining public resources are not adequate for other school inputs such as textbooks and learning materials. Poor provision of inputs implied that effectiveness of teacher was significantly reduced. The system of education has created learning environment, which is inappropriate for student learning to take place. The study also found that the pupil to teacher ratio for Kenya has been declining steadily over time from 39 in 1963 to 29 in 1999. The falling ratio was not associated with improved performance in education achievement. The reason why the reduced class size has not improved learning achievements as indicated by worsening performance of KCPE, the reduced class size has be accompanied by reduced provision of textbooks which tend to reduce teachers effectiveness. Deolalikar concluded that there is a link between performance of KCPE and physical facilities and learning materials.

Makau and Somerset (1980) found that performance of Kenya Certificate of Primary Education (KCPE) was low and unevenly distributed. The Nairobi schools performed better than rural schools. The disparity in performance was attributed to poor quality of teaching. The results suggest that the huge performance enjoyed by Nairobi pupils is due to quality of educational inputs they receive as compared to the rural pupils. There is no evidence to suggest that Nairobi pupils have superior abilities than rural pupils.

Makau (1986) in his study attempted to conceptualize teacher effectiveness in terms of learning outcomes and explored factors that influence effective cognitive development of pupils. The result shows that teacher work could lead to higher quality through provision of more funds for physical facilities, learning resources, more attractive remuneration, accelerated replacement of untrained teachers and improved school management. However given the financial constraints it is not feasible for a country to make substantial allocations to teachers training and remuneration and other inputs which facilitate teacher's work.

## **2.2 Empirical Literature**

Development of empirical literature on analysis of determinants of cognitive achievements in developing countries has been hampered by lack of data that links school inputs (that is teacher, pupil, family, schools and community characteristics) to individual pupil achievements. Various recent studies have exploited data sets not designed to study the role of school inputs in determining pupils' achievements and have attempted to explore school characteristics which determine children schooling outcomes. Evidence available shows that the amount of schools inputs seem to matter in developing countries than in developed world.

Handa and Simler (2000) compared the response of quantity versus quality investments in school supply on schooling in rural Mozambique. Using the Probit model the results showed that family background characteristics are significant determinants of the probability that a child will be enrolled in school. The school supply results show that quantity is more important than school quality in determining a child's chances of ever attending school. The study concluded that Pupil/Teacher Ratio is a determinant of both attainment and achievement especially in places where schooling is not developed.

Lloyd et al (1998) undertook a study on the effects of primary school quality on the educational participation and attainment of Kenyan Girls and Boys. The study was designed to assess the importance of school quality to enrolment, retention and ultimate grade attainment. Aggregate measures for school quality were developed such as distance to school as measure of accessibility, resources per student, teachers' credentials and teacher/student ratio. The conceptual framework for this study encompasses a variety of dimensions of school policy such as classroom dynamics and teacher attitudes, which are important to the overall atmosphere of the school and amount of encouragements to students, particularly girls. Three models were estimated to explore the relationship between school quality and educational achievement of adolescent boys and girls. Using logistic regression determinants of school dropout were estimated. The study found out that the determinants of children remaining in school remain largely in the hands of parents and school factors matter in affecting academic achievement.

Simmons and Alexander (1978) attempted to review studies linking cognitive achievement with factors which promote students cognitive achievement as measured by school examination results. The studies found that certain factors have influence on achievement to the expectations

of educationists. Teacher experience - a measure of teacher's quality - was found to have positive influence on performance in primary schools. Studies indicated that expenditure variables such as cost of school facilities per student are insignificant in influencing student's performance. Teacher motivation as indicated by the actions of teachers - time spent in lesson preparation - was found to be positively related to performance. Textbooks availability at primary level may be an important predictor of performance in developing countries. Simmons and Alexander argue that increasing the quality and quantity of traditional inputs such as teachers training or expenditure per student may not improve student achievement.

Harbison and Hanushek (1992) in their study delved into analysis of interrelationship between quantity and quality of schooling and the underlying determinants of achievements. The analysis reveals that provision of quality facilities and adequate instructional materials improves performance. The empirical results lend strong support to efficiency of improving overall achievement by ensuring minimally adequate materials resources.

Tan et al (1997) estimated a model of student achievement using data from Philippines collected from randomly selected schools, which took achievement tests in mathematics and English at the beginning of the year (July 1990) and towards the end (Feb 1991). The following equation was estimated to establish the relationship between educational inputs and cognitive achievements:

$$OTS_{its} = f(ITS_t, PC_i, FB_i, PSC_i, CE_t, SE_s) + \epsilon_{its}$$

**OTS<sub>its</sub>**            Is Test Score of Pupil i belonging to class taught by t and attending school s at the end of academic year

<b>ITS<sub>i</sub></b>	<b>Is Test Score of Pupil i belonging to class taught by t and attending school s at the beginning of academic year</b>
<b>PC<sub>i</sub></b>	<b>Is Pupil i Personal Characteristics</b>
<b>FB<sub>i</sub></b>	<b>Is Pupil i Family background characteristics</b>
<b>PSC<sub>i</sub></b>	<b>Past Schooling Characteristics of pupil i</b>
<b>CE<sub>t</sub>, SE<sub>s</sub></b>	<b>Classroom t and school Environment s Characteristics</b>
<b>ε<sub>its</sub></b>	<b>random error</b>

The empirical results found that preschool attendance influenced school performance. Interestingly, regression coefficient for class size and teachers' qualification were insignificant. The availability of textbooks in schools improved performance. However textbook ratio of 2:1 was as effective as 1:1 ratio.

Glewwe, et.al (2000) estimated the impact of flip charts and other school inputs from data collected from 100 schools randomly selected in Busia and Teso districts in Kenya for grades 6, 7 and 8. Retrospective and prospective analysis approaches were used in this study. Regression results for retrospective analysis suggest that adding flip charts raises test scores by about 20 per cent. Prospective estimates show no impact on pupil's performance in academic test in Kenya. The study did not take into consideration other school inputs such as family background, physical facilities and class size.

Bedi et al. (2002) in their study on decline in primary schools enrolment in Kenya estimated a Probit model to determine the factors that influence primary school enrolment in Kenya. School

input variables such as student teacher ratio, proportion of qualified teachers in a district and KCPE mean scores were included in the model to explain enrolments. The study established that there is no link between school inputs and enrolments rates in Kenya. It concluded that pedagogical process, school management practices, motivation of teachers, which were not captured, play important role in determining educational outcomes. However individual estimates suggest that enrolments rates and skill level of teachers are positively correlated. This implies that school inputs have indirect influence on the school enrolment decisions through their effect on the KCPE exam scores. The school inputs could not be used to explain the declining enrolments. The study used district level data as opposed to school level data. The variation in school inputs in schools in the same district was ignored. The limited variation in the school inputs data probably affects the standard error of our estimates and reduces their precision.

Wöbmann, L. (2005) estimated the importance of family features and school policies on learning achievement in primary schools in Argentina and Columbia. Treating the inputs factors as additively separable an econometric equation for educational production function was estimated as follows:

$$T_{is}^t = T_{is}^{t-1} \beta_1 + B_{is} \beta_2 + S_{is} \beta_3 + D_{is} \beta_4 + \epsilon_{is}$$

$T_{is}^t$  is the Test Score of  $i^{th}$  pupil in school  $s$  in the fourth grade

$T_{is}^{t-1}$  is the measure of pre-school reading performance

$B_{is}$  is Vector of Pupil's Family Background data

$S_{is}$  is Vector of School characteristics data

$D_{is}$  is dummy for each variable in  $B$  and  $S$  that has missing data

$\epsilon_{is}$  is random error term (unobserved effects)

The results show that there is strong evidence of relationship between pupils' educational performance and numerous measures of their family background, but results on school characteristics are inconsistent. The evidence presented in the paper is consistent with USA evidence emphasizing basic family background factors.

### **2.3 Overview of Literature**

Most of the literature reviewed on the determinants of pupils' achievement from schooling which includes Simmons and Alexander (1978) and Harbison and Hanushek (1992) and Tan, Kane and Coustere (1997) report that there is relationship between inputs and cognitive achievements. The findings of the studies reviewed show that some factors are important in explaining academic achievements. The factors include: class size, teachers' quality, physical facilities, learning materials, curriculum, school management and family related factors. The significance of factors varies from one study to the other.

Among the studies reviewed some are descriptive in nature -Makau and Somerset (1980), Makau (1986), Abagi (1997) and Deolalikar (1999) - and offer no statistical support for their conclusions. The studies are of limited use in drawing policy implication that will be effective to achievements. Nevertheless Deolalikar (1999) offer useful insight on factors, which influence achievements in Kenya namely: physical facilities, learning materials and community contribution. An econometric analysis by Jee-Peng Tan et al. (1997) is among the studies, which analyzed the relationship between educational inputs and cognitive achievement. This study follows closely the works of Tan et al (1997), Hanushek et al (1992) and Wöbmann (2005).

Recent studies in Kenya on educational performance, particularly Bedi et al (2003) and Lloyd et al (1998), focused on factors, which influence enrolment in primary schools. Bedi et al (2002) used district level data as opposed to school level data. As such variation in school inputs between schools in the same districts is ignored. Study by Glewwe et al (2002), which used data from one district, does not have national outlook. It only analyzed the impact of learning materials ignoring other factors. As mentioned earlier, major problem in estimating relationship between educational inputs and achievements has been lack of data that links inputs to individual's achievements.

This study utilizes the recent SACMEQ<sup>8</sup> II 2000 data which has wider coverage and links individual pupil's achievement to educational inputs. The results of the study are likely to be credible in explaining determinants of cognitive achievement in Kenya since the database has wide range of variables and broader national coverage.

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<sup>8</sup> SACMEQ is acronym for Southern and Eastern Africa Consortium for Monitoring Educational Quality and is a research project set to study the condition of schooling and achievement for pupils at grade 6 in which Kenya is a participant.



## **Chapter 3**

### **3.0 Methodology**

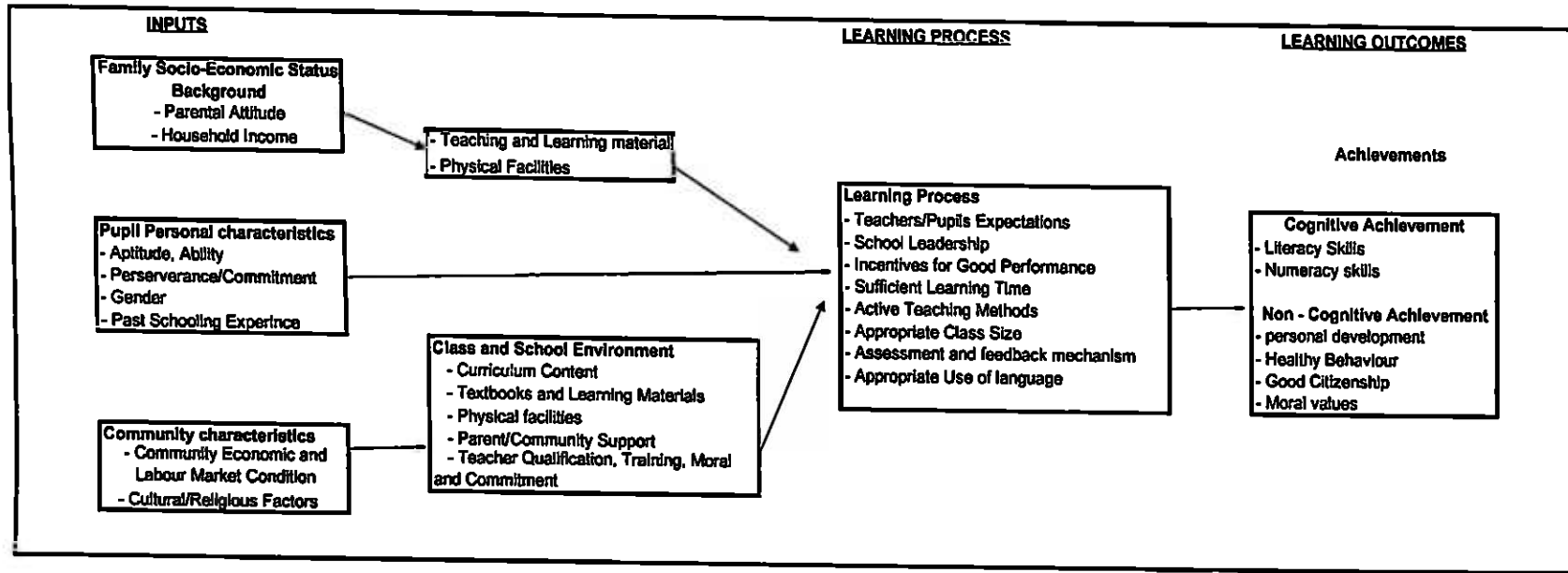
#### **3.1 Conceptual Framework**

The conceptual framework for analysis of this study is built within education production process as shown in Figure 1. The framework is designed to help in describing and analyzing education process for primary schools in Kenya and follows previous works by Hanushek and Harbison, (1992); Tan, Lane and Coustère, (1997) and Wöbmann, (2005). The arrows in Figure 1 indicate the directions in which respective inputs influence learning process and in which learning process influence achievements.

The cognitive achievement of an individual pupil at a particular period is assumed to relate current and past educational inputs from various sources - home, school and community. As indicated in Figure 1 achievements are influenced by supply of inputs from parents, the pupils themselves, community and government subsidy (in form of pedagogical inputs and learning materials). The socio-economic status of pupils' families, community endowment and the pupil themselves have an important effect on achievements. The parents contribute to pupils schooling by ensuring the pupils' well-being, providing uniforms, learning materials and equipments and above all motivating pupils to attend school. Communities supply land and participate in physical development and management of schools.

All these inputs from various sources combine to produce cognitive achievements. Each of these inputs may consist of numerous set of variables, which combine to determine achievements. The

**Fig 1: FRAMEWORK of FACTORS INFLUENCING ACHIEVEMENTS in a PRIMARY SCHOOL**



achievement of pupil  $i$  in school  $s$  may be stated as a function of the following inputs: family background ( $FB_{is}$ ), personal characteristics of the pupil ( $PC_{is}$ ), school environment factors ( $SF_{is}$ ) and community characteristics ( $CC_{is}$ ).

$$A_{is} = f [PC_{is}, FB_{is}, SF_{is}, CC_{is}] \quad (1)$$

The education process produces two types of learning outcomes - cognitive and non-cognitive -, which interact with each other. This study assumes that each of learning outcomes is independently produced and the objective of Kenya's education system is to maximize production of cognitive achievements. The assumption is based on the fact that primary education system puts more emphasis on cognitive skills formation. The production function of cognitive achievements in primary schools is therefore simplified to a single equation model.

### 3.2 Analytical Framework

This study uses regression analysis method to examine the existence and direction of the relationship between educational inputs and cognitive achievement in reading English and Mathematics for grade 6 pupils and use these estimates to evaluate which factors are effective in promoting achievement in primary schools in Kenya.

The unit of analysis for this study is an individual pupil in a randomly selected school and focuses on learning outcomes. Since teaching and learning takes place in a school where teachers and pupils interact in the process of imparting and acquiring knowledge, achievements depends on the way the school is organized and managed. At school level, the resources are organized into a learning process and combine with other resources from family, pupils' personal and

community inputs to produce learning achievements. The pupils' achievements depends on availability of physical facilities and learning resources, teachers' effectiveness and the way the school is organized and managed.

### 3.3 Econometric Model Specification

The appropriate model to analyze this relationship is based on education production process where schools maximize achievements. The model assumes that a linear relationship exists between educational inputs and cognitive achievement in reading English and Mathematics for grade 6<sup>9</sup> pupils in primary schools. Two equations for production function of achievements in reading English and Mathematics for grade 6 were estimated using regression analysis method and the estimated coefficients are used to analyze the relationship between educational inputs and achievements.

The model to be estimated was as follows:

$$A_{isz} = \alpha_z + \sum_{j=1}^4 \beta_{jz} PC_{ijs} + \sum_{k=1}^3 \delta_{kz} FB_{ijs} + \sum_{l=1}^{13} \gamma_{lz} SF_{ijsz} + \lambda_z CC_{isz} + \varepsilon_{isz} \quad (2)$$

Where:

- |                           |                                                                                          |
|---------------------------|------------------------------------------------------------------------------------------|
| $j = 1, 2 \dots\dots 4$   | <i>Represents number of pupil's personal characteristics proxy variables</i>             |
| $k = 1, 2 \dots\dots 3$   | <i>Represents number of family socio-economic status characteristics proxy variables</i> |
| $l = 1, 2 \dots\dots 13.$ | <i>Represents number of school environment characteristics proxy variables</i>           |
| $Z = 1, 2$                | <i>Represents the two subjects Reading English and Mathematics</i>                       |

<sup>9</sup> Grade 6 was agreed upon as a year or grade for completion of primary schooling as case for some of participating countries. Besides that EFA goal is that every child in every country should completes at least Five to Six years of primary education of adequate quality and is expected during that time to have acquired basic reading, writing, numeracy and problem solving skills.

- $A_{is}$**  Is the achievement either in reading English or Mathematics-as measured by test score of  $i^{th}$  pupil belonging to the class in grade 6 and attending school  $s$
- $PC_{is}$**  Are variables capturing pupil's personal characteristics (age of pupils, gender of the pupils, pupil's school attendance and grade repetition)
- $FB_{is}$**  Are variables capturing pupil's family socio-economic status (parents' education, quality of pupil's home and books at pupil's home).
- $SF_{is}$**  Are variables capturing school related characteristics (school resources endowment, availability at textbooks, classroom teaching resources<sup>10</sup>, pupil/teacher ratio, teachers' experience, teachers' in-service training, teacher mastery of subject, school organization and management age, time allocated to teaching, school inspection visits, pedagogical process teaching time per week, homework given to pupils and frequency of testing).
- $CC_{is}$**  is variable capturing community characteristics (school location).
- $\epsilon$**  is random error term (unobserved effects).

$\beta_{jz}, \delta_{jz}, \gamma_{jz}$  and  $\lambda_z$  are the parameters to be estimated and  $\alpha_z$  is intercept.

The model was estimated twice, one equation for achievements in reading English and the other for achievements in Mathematics. The intercept was allowed to vary for each subject.

### 3.3.1 Hypothesis

In-order to assess the impact of variables on achievements, the study attempts to answer the following hypothesis:

**Ho: Null hypothesis**

There is a significant relationship between educational inputs and cognitive achievements.

<sup>10</sup> Classroom Teaching Resources includes: chalk, wall charts, wall maps, dictionary, chalkboard, bookshelves

H<sub>1</sub>: Alternative

There is no significant relationship between educational inputs and cognitive achievements.

### 3.3.2 Expected Signs of Coefficients

1.  $\alpha_1, \alpha_2, \beta_{1z}, \beta_{4z}, \delta_{1z}, \delta_{2z}, \delta_{3z}, \gamma_{1z}, \gamma_{2z}, \gamma_{3z}, \gamma_{5z}, \gamma_{6z}, \gamma_{7z}, \gamma_{8z}, \gamma_{10z}, \gamma_{11z}, \gamma_{12z}, \gamma_{13z}$  are expected to be Positive

2.  $\beta_{3z}, \gamma_{4z}, \gamma_{9z}$  are expected to be Negative

3.  $\beta_{2z}, \lambda_1, \lambda_2$  Uncertain

The signs for the variables indicate the influence of the variables on achievements

### 3.3.3 Heteroscedasticity Test

Since the data used in this study is cross-sectional it is suspected that heteroscedasticity would be a serious problem. White's method will applied to test presence of heteroscedasticity.

### 3.3.4 Multicollinearity Test

It is possible that some of explanatory variables may be highly correlated with each other. An attempt was made to detect presence of high collinearity among the explanatory variables using the Tolerance ratio and Variance Inflation Factor (VIF). The rule of thumb is that if VIF of a variable exceeds 10 then the variable is highly collinear [Gurjarati, 2004].

### 3.4 Data Source and Type

The study utilized cross sectional data for Kenya derived from SACMEQ II database. The data were collected in 2000 using Two Stage Cluster Sampling Procedures in which the strata were

Education Administrative Region. The sample design used in the SACMEQ II survey was selected to meet standards set down by the International Association for the Evaluation of Educational Achievements (IEA) [Nzomo et al, 2001]. The target population was all pupils enrolled in grade 6 in formal schooling during the eighth month of the school year. SACMEQ II data is the most recent and comprehensive data linking pupils' achievement in reading English and Mathematics with the pupils' characteristics and their family and school characteristics.

The sample was designed to cover 185 schools and 20 pupils in each school. The sample size for the survey was 3700 pupils in 185 schools spread in 8 provinces. However the survey covered 3299 pupils and collected information on achievements in reading English and Mathematics of grade 6 pupils and their respective teachers. The information on pupils' achievements was obtained by administering English and Mathematics tests to grade 6 and to their English and Mathematics teachers. In addition to testing, information on pupils' personal, family socio-economic status, teachers and school characteristics was obtained by interviewing pupils, teachers and head teachers. Due to the problem of missing data among some of the variables, the sample sizes for this study are 2721 for reading English and 2830 for Mathematics.

#### **3.4.1 Description of Variables**

The dependent and explanatory variables are described in Table 3.1.

##### **Dependent Variables**

The dependent variables used in the analysis are pupils' test scores achieved in reading English and Mathematics tests. The achievement tests were constructed to test a range of relevant skills and competencies in reading English and Mathematics of pupils and their teachers. Each subject was tested using a broad sample of tasks with differing levels of difficulty to reflect the pupils'

**Table 3.1 Description of Variables**

<b>VARIABLES</b>	<b>MEASUREMENTS</b>
<b>DEPENDENT VARIABLES</b>	
Pupils' Test Scores in Reading English and Mathematics	Scale between 0 and 1
<b>EXPLANATORY VARIABLES</b>	
<b>Pupils' Characteristics</b>	
Age of Pupils	Age in Years
Gender of Pupils	Dummy (Girl =1, and Boy=0)
Pupils Absenteeism in days	Number of days absent
Pupils' Past Schooling Experience	Dummy (Repeater= 1, Non-Repeater = 0)
<b>Family SocioEconomic Status</b>	
Parents Education	No. of Years Attained in Formal Education
Home Quality	Index ranging between 0 and 16
Books Possession by Pupils at Home	Number of Books available to pupils at home
<b>Physical and Pedagogical Inputs</b>	
School Resources Endowment	School Resources Index ranging between 0 and 22
Availability of Textbooks for reading and mathematics	Dummy (Own TextBook=1, No Textbook = 0)
Classroom Teaching Resources	Index ranging between 0 and 5
Pupil/Teacher Ratio	Pupils per teacher
Teachers' Experience in Years	years of experience
Teachers Inservice training	Number of inservice training
Teachers' Test Scores in Reading English and Mathematics	Scale between 0 and 1
<b>Community Characteristics</b>	
School location	Dummy (Rural = 1, Urban = 0)
<b>School Management and Organization</b>	
Age of Head Teacher	Number of Years
Head Teacher Teaching Time	Minutes per Week
School Inspection Visits for reading and mathematics	Number of Inspection Visits
<b>Pedagogical Process</b>	
Hours of Teaching for reading and mathematics	Hours per Week
Teacher gives Pupils Homework for reading and mathematics	Dummy (Homework Given = 1, No Homework Given = 0)
Frequency of Testing of Pupils for reading and mathematics	Dummy (No Test=0, Weekly Test =1)

Source: SACMEQ II database



cognitive abilities and teachers' mastery of their respective subject. The English test included 79 test items for pupils and 47 test items for their teachers. Mathematics on the other hand had 60 and 41 test items for pupils and their teachers respectively.

### **Explanatory Variables:**

In this study, 21 variables were included in the model as explanatory variables to tease out factors that influence pupils' achievements in reading English and Mathematics. The variables were grouped in five broad categories namely pupil's personal, family socio-economic status, physical and pedagogical inputs, school organization, teaching practices (pedagogical process) in primary schools and community characteristics. Table 3.1 also presents measurements of the explanatory variables.

### **3.5 Limitations of the Study**

The model depicts the achievements for grade 6 pupils as function of current (contemporaneous) inputs. It does not take into account the effect of past inputs. The standard technique is to use value-added specification model, which takes in to account the cumulative nature of education process. This is not possible due to data constraints in SACMEQ II database. Given the constancy of schooling inputs over the time, the estimated model is quite useful in identifying those educational inputs, which are influential to cognitive achievements. The results serve as benchmark parameters for further analysis.

## **Chapter 4**

### **4.0 Results**

#### **4.1 Introduction**

This chapter presents descriptive and regression results of the variables included in the estimated models. The descriptive analysis gives an overview of educational inputs derived from the SACMEQ II data and achievement test scores of the pupils and their teachers in reading English and Mathematics. The section on empirical analysis gives regression results of fitted models.

#### **4.2 Descriptive Analysis**

Table 4.1 presents descriptive statistics of variables included in the estimated models for reading English and Mathematics. The statistics shows that there is no gender imbalance in enrollment of grade 6 pupils. The enrolment for boys stand at 51.4 per cent of all pupils enrolled in grade 6. The estimated mean age of the pupils is 14 years and range between 10.7 and 20.8 years. Since the official entry age to grade one is six years, the expected age of grade 6 pupils should ideally be 11 to 12 years old. The age of pupils enrolled in grade 6 is above the expected age by 2 to 3 years mainly due to delayed entry to schools and grade repetition.

Other descriptive statistics on pupils' personal characteristics shows that on average, grade 6 pupils absent themselves from schooling for an average of 2 days per month while 57.7 per cent of the pupils have repeated at least in one grade. This confirms the high repetition rates recorded in upper primary classes in-order to ensure good performance in K.C.P.E.

**Table 4.1 Descriptive Statistics of Variables used in the Analysis**

Variable	No. of Observation	Reading English		Mathematics	
		Mean	Standard Deviation	Mean	Standard Deviation
<b>Pupils' Characteristics</b>					
Age of Pupils in years	3299	13.94	1.59	13.94	1.59
Gender of Pupils	3299	0.49	0.5	0.49	0.5
Pupils Absenteeism in days	3299	1.88	2.92	1.88	2.92
Pupils' Past Schooling Experience	3299	0.58	0.49	0.58	0.49
<b>Family Socio-Economic Status</b>					
Parents Education	3299	7.4	2.97	7.4	2.97
Home quality	3299	9.2	2.57	9.2	2.57
Books Possession at Pupils at Home	3299	27.89	58.8	27.89	58.8
<b>Physical and Pedagogical Inputs</b>					
School Resources Endowment	3282	7.99	3.48	7.99	3.48
Availability of Textbooks	3214	0.27	0.43	0.23	0.42
Classroom Teaching Resources	3102, 3214*	4.6	1.78	4.54	1.86
Pupil/Teacher Ratio	3282	34.2	9.38	34.2	9.38
Teachers' Experience in Years	3119, 3214*	13.1	7.79	13.8	7.99
Teachers' number of Inservice training	3119, 3214*	3.7	6.92	3.9	6.31
Teachers' Inservice Training in days	3119, 3214*	10.9	26.6	14.8	36.43
<b>Community Characteristics</b>					
School location	3282	0.75	0.43	0.75	0.43
<b>School Management and Organization</b>					
Age of Head Teacher	3282	44.19	0.85	44.19	0.85
Head Teacher Teaching hours in minutes per week	3282	887.5	344.74	887.5	344.74
School Inspection Visits	3282	2.41	2.41	2.12	2.12
<b>Pedagogical Process</b>					
Hours of teaching per Week	3119, 3214*	21.99	5.71	22.24	5.5
Teacher gives Pupils Homework	3119, 3214*	0.64	0.48	0.7	0.46
Frequency of Testing of Pupils	3119, 3214*	0.69	0.65	0.58	0.45
<b>Achievement Test Scores</b>					
Pupils' Test scores Reading English and Mathematics	3299	0.62	0.163	0.51	0.147
Teachers' Test Scores Reading English and Mathematics	3119, 3214*	0.73	0.087	0.86	0.101

Source: SACMEQ II database

\* For these variables, 3119 observations were recorded in reading English data while 3214 observations were recorded in Mathematics data.

Although the sample data does not indicate absenteeism as a serious problem in Kenyan schools, in the areas with high child labour and HIV/AIDS prevalence rates, absenteeism is known to be a major problem [MoEST, 2003].

On socio-economic status characteristics, the sample data shows that the mean educational attainment in formal education for both parents of the grade 6 pupils is 8 years. Further analysis reveals that the mean of home quality index stand at 9 points implying that learning conditions faced by the pupils in their homes is above average. The estimated number of books available to the pupils in their homes stands at 29 books, an indication that pupils in Kenya come from homes with reasonable reading materials.

Majority of primary schools are located in rural areas. The data indicates that 74 per cent of schools sampled in the SACMEQ II survey are located in rural areas. The analysis also reveal that mean index measuring the availability of physical facilities especially learning equipments, water and sanitation facilities stand at 9.2 points while that of classroom teaching resources stand at 4.6 points on average for both reading English and Mathematics. The pedagogical inputs includes: availability of text books to the pupils, pupil/teacher ratio, teachers' experience, qualification, number of in-service years of training and the length of in-service training measured in days. The statistics shows that less than 30 per cent of pupils in grade 6 own textbooks for English and Mathematics. The average, pupil/teacher ratio stands at 34.2 and range between 15.5 and 52.9. It can be seen from the descriptive statistics that majority of pupils were in schools, which did not have adequate textbooks and basic facilities on one hand, while on the other hand the pupils were taught by experienced and qualified teachers. The teachers experience is estimated to stand at about 13 years for both English and Mathematics teaching.

The data on school organization characteristics indicate that school head teachers commit 887.5 minutes (20 Lessons) to teaching per week and are aged 44 years. Further analysis reveals that on average, schools allocate 22 hours to teaching English per week as well as to Mathematics. Other teaching methods in primary schools includes: frequent testing of grade 6 pupils and giving of homework to pupils.

Table 4.1 also presents average scores for grade 6 and that for their teachers in reading English and Mathematics. The mean scores of grade 6 pupils stand at 0.62 and 0.51 out of maximum possible scores for reading English and Mathematics respectively. The pupils' performance in reading English is better than in Mathematics by 0.11 points. On teachers' performance the statistics shows that English teachers scored on average 0.73 while Mathematics teachers scored 0.86 out of the maximum possible scores.

### 4.3 Regression Results

The regression analysis presents results of regressing cognitive achievements on pupils' personal and families' socio-economic status characteristics; and school related factors (physical and pedagogical inputs, teaching practices, school organization). Diagnostic tests were performed to detect presence of heteroscedasticity and multicollinearity.

The heteroscedasticity problem was detected (see appendix 2) and standard errors were corrected for heteroscedasticity. The presence of multicollinearity was detected among some of explanatory variables and one of the variables which were highly collinear was dropped.

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Table 4.2 summarizes the effects of pupils' personal, families' socio-economic status and school characteristics on cognitive achievements as estimated by equation 2. The reported t-statistics are based on Robust Standard Errors. The estimated models explain 29.5 and 22.5 per cent of pupils' achievements in reading English and Mathematics respectively. Most explanatory variables meet priori expectations and the coefficients are statistically significant. The results of  $R^2$  are similar to other studies in other parts of the world and range between 6 and 49 per cent (E. Velez et al, 1993). The variables are jointly significant as shown by the F statistic of 51.41 and 34.44 for reading English Mathematics achievements respectively. The large values of F statistics indicate that the variations in pupils' achievements are quite large for both Reading English and Mathematics.

The estimation shows that the pupils' personal characteristics variables have the expected effect on cognitive achievements. The results indicate that boys in grade 6 perform better than girls in both Mathematics and reading English, contrary to evidence found in similar studies in other parts of the world that girls perform better than boys [Glewwe et al, 1995]. It should be noted that grade 6 pupils are at an age when adolescence sets in, gender differences start emerging and pupils expectations come into play in determining educational achievements. The evidence suggests that girls in grade 6 have lower expectations towards education than boys which holds true given that sample is skewed towards rural areas.

**Table 4.2 The Estimated Coefficients**

Variable	Reading English Model		Mathematics Model	
	Reading English Test Score		Mathematics Test Score	
Dependent Variables	Coefficients	t	Coefficients	t
Constant	0.788	4.04*	0.714	3.19*
<b>Pupils' Characteristics</b>				
Age	-0.007	-6.84*	-0.006	-7.00*
Gender of Pupils	0.092	2.85*	0.245	9.13*
Pupils Absenteeism	-0.038	-6.62*	-0.024	-5.03*
Grade Repetition	-0.215	-6.06*	-0.093	-3.14*
<b>Family SocioEconomic Status</b>				
Parents Education	0.044	6.77*	0.031	5.74*
Home quality	0.046	5.45*	0.017	2.41**
Book Possession at Pupils' Home	0.001	1.7***	0.001	2.64*
<b>Physical and Pedagogical Inputs</b>				
School Resources Endowment	0.037	5.84*	0.027	5.04*
Availability of Textbooks	-0.006	-0.17	0.042	1.26
Classroom Resources	0.026	2.28**	-0.003	-0.37
Pupil/Teacher Ratio	-0.019	-10.34*	-0.016	-9.65*
Teachers' Experience	0.003	1.55	-0.001	-0.70
Number of Teachers' Inservice Training	-0.004	-1.44	0.006	2.91*
Teachers' Test Score	0.118	4.79*	0.032	1.99**
<b>School Management and Organization</b>				
Age of Head Teacher	-0.011	-4.03*	-0.008	-3.53*
Hours committed to teaching by Head teacher	-0.00002	-0.38	0.000	0.82
School Inspector's Visit	-0.0199	-2.78*	-0.019	-2.82*
<b>Pedagogical Process</b>				
Teaching Hours per Week	-0.003	-1.05	-0.007	-2.61*
Homework given to pupils	0.060	1.71***	0.128	4.17*
Testing Frequency				
Weekly	0.007	0.16	0.093	2.75*
No test	-0.057	-0.08	-0.063	-1.78***
<b>Community Characteristics</b>				
School loc: Rural	0.123	2.68*	0.154	4.15*
Urban	n/a	n/a	n/a	n/a
R <sup>2</sup>	0.2954		0.225	
F - Statistic	51.41		34.44	
Number of Observations	2721		2830	

\* Significance level at 1 percent

\*\* Significance level at 5 percent

\*\*\* Significance level at 10 percent

The pupils' age and grade repetition variables have negative and significant effect on learning achievements for both reading English and Mathematics. The coefficients of effect of pupils' age on achievements on reading English and Mathematics are estimated to be -0.0007 and -0.0006 respectively. The results also indicate that starting school later than age six and grade repetition have negative and significant effect on pupils' performance in reading English and Mathematics and non-repeaters are estimated to perform better than their colleagues. As expected the regression results lends support that absenteeism does not promote learning achievements. The estimated results show that absenteeism has negative and significant effect on learning achievements as indicated by the sign of reading English and Mathematics coefficients. Given that school attendance, indicates the importance parents attach to schooling, the results suggest that parents do not give full support to their children schooling.

The parents' education and home quality variables are statistically significant at 1 per cent level. The pupils who live in better learning condition and have educated parents were tend to achieve better performance in reading English and Mathematics. Further analysis shows that parents' education has higher effect on reading English (0.04) than Mathematics (0.03) achievements. The results show that the effect of books possession at pupils' homes on pupils' performance in both Mathematics (0.001) and reading English (0.001) achievements is positive and significant.

The estimated results show that physical facilities have positive and significant impact on reading English (0.04) and Mathematics (0.03) achievements for grade 6 pupils. However, classroom teaching resources has significant effect on reading English only. The evidence reinforces the notion that effectiveness of teaching Mathematics depends more on the competency of the teachers other than classroom resources. As expected the pupil/teacher ratio



has negative and statistically significant at 1 per cent level effect on pupils' performance. The results show that large class sizes have negative impact on pupils' performance in learning achievements.

The results on effect of teachers' characteristics on learning achievements show mixed and inconsistent results. The estimated effect on mastery of competencies in reading English and Mathematics has positive and significant effect on pupils' achievements. The findings of this analysis support the notion that teachers' mastery competencies in reading English and Mathematics is critical to pupils' performance. From the estimated results, the refresher courses mounted to improve teacher performance have positive effect on Mathematics performance but negative effect on reading English achievement.

Among the teaching practices in primary schools, giving grade 6 pupils homework has positive and significant effect on both reading English and Mathematics achievements. Doing written assignments on weekly basis has positive effect on reading English and mathematics achievements, but statistically insignificant at the 10 per cent level for reading English. The estimation also indicates that instructional time is negatively related to performance in reading English and Mathematics achievements and only significant in Mathematics achievement. This suggests that pupils' performance responds negatively to increased instructional time.

The analysis identifies several school organization variables, which influence learning achievement. The age of schools head teachers', has strong negative and significant effect on learning achievements. The results on school inspection visits indicates that school inspection has negative effect on pupils, performance in reading English (-0.02) and Mathematics (-0.02)

achievements. This may be attributed to either poor quality inspection of schools or schools do not implement suggestions contained inspection reports. On community characteristics, the results indicate that grade 6 pupils' schools that are located in rural areas perform better than those in urban schools for reading English and Mathematics achievements.

In summary the results confirm pupils' personal, family socio-economic status and some school characteristics are important determinants of learning outcomes in reading English and Mathematics. The factors with pronounced effect includes: the teachers' mastery competencies in either English or Mathematics, parents' education and living environment at home, the physical infrastructure in schools and pupils' personal characteristics. Among the pupils' personal characteristics grade repetition absenteeism appear to have the largest negative impact on pupils learning achievements while giving homework to pupils appears to be the teaching practices that enhances cognitive achievements.

## **Chapter 5**

### **5.0 Conclusions and Policy Implications**

The main objective of this study is to identify and examine the factors, which influence cognitive achievements among pupils in primary schools. Although the study focuses on grade 6 pupils, the results can be applied to all upper grades to the extent that school factors and family factors remain constant for some time. The findings of this analysis confirms that individual pupil's performance in cognitive achievements for both reading English and Mathematics is related to personal, family socio- economic status, community and school related characteristics. The study shows that there exists relationship between cognitive achievements and numerous measures personal, family socio-economic status and school characteristics. This suggests that for better performance in cognitive achievements attention has to be given to the identified factors.

At family level pupils' expectations and their behaviors towards schooling, parents' involvement in their children schooling and the conditions of the environment in which the pupils live are key determinants of cognitive achievements of pupils in primary schools. On the other hand, this study show that physical facilities, classroom resources, quality of teachers and class size play a key role in determining cognitive achievements for pupils of grade 6 in Kenya. The evidence lends support to research finding that providing basic facilities and adequate learning materials improve pupils' performance in reading English and Mathematics achievements.

### **5.2 Policy Implications**

The results of this study offers basis for choosing interventions on how to improve pupils' performance in reading English and Mathematics. The factors, which influence learning achievements, may be altered to make changes that may improve the learning environment for

pupils in primary schools. The study suggests that the variables which are statistically significant, should receive attention of policy makers. However, this does not mean that the insignificant variables should be ignored; it only implies that alternative approaches need to be adopted.

The study has demonstrated that there is relationship between pupils' personal and families' socio-economic status characteristics and learning achievements. The relationship acts through physical conditions of learning environment, attitude formation and direct involvement in the learning process. This has policy implications in that reducing grade repetition, tackling poverty and HIV/AIDs pandemic at household level, engaging the pupils, parents and public in general in-order to raise their expectations towards education and will lead to better learning outcomes.

The improvement of physical facilities at primary schools, provision of quality of teachers and pupil/teacher ratio are identified as important determinants of pupils' performance in cognitive achievements in Kenya. The evidence has policy implications on educational budgetary resources. The results suggest that either rationalization in deployment of teachers from surplus to deficit areas or recruitment of additional teachers need to be undertaken in order to improve learning achievements in primary schools. Given the inability of parents and communities to provide adequate physical facilities and learning materials, the government has to intervene by providing additional resources to improve the quality of education. To this end, the scarce resources need to be directed to those educational inputs, which are known to enhance pupils learning achievement by ensuring that there is minimal level of basic facilities such as textbooks, physical facilities and teachers in schools.

Based on the evidence found in this study a teacher who has mastery competencies in his/her subject is key factor in pupils' achievements. The teachers need to be highly skilled, motivated and with mastery competencies in their subjects. This implies that the quality of teachers matters in implementation of the curriculum since an experienced teacher controls classroom dynamics, directs efforts to help pupils learn and uses his/her education and experience to stimulate learning. More attention needs to be given to improving teachers' skills, motivation and school management and administration. This has potential of improving quality of education delivered in primary schools and may lead to internal efficiency since grade repetition and dropping out of school are likely to be reduced

On the other hand the amount of homework given to pupils and physical conditions at home are important determinants of learning achievements. The teaching practices that promote use of homework should be encouraged than frequent testing of the pupils. Also the teaching time that goes beyond the time set in curriculum is not helpful to pupils.

### **5.3 Areas of Further Research**

The results based on SACMEQ II data provide useful descriptive features of primary schools. However, further research on the underlying relationship between educational inputs and cognitive achievements, preferably based on experimental data, is required to confirm the findings of this study.

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## Appendices

### Appendix 1

#### Education Key Indicators

Year	Primary Education Expenditure Ksh Million	Total Government Expenditure Ksh Million	Percentage expenditure on education	Primary Schools Enrollment	Total Number of Teachers	Expenditure Per Pupil (KSh)	Pupil/Teacher Ratio
1978	1,500.0	13,952.0	10.8	2,994,894	92046	500.85	32.54
1979	1,953.3	15,368.8	12.7	3,698,246	92762	528.17	39.87
1980	2,154.1	19,005.8	11.3	3,926,629	102489	548.59	38.31
1981	2,399.2	22,450.0	10.7	3,981,162	110911	602.64	35.90
1982	2,558.2	23,810.0	10.7	4,184,602	115,094	611.34	36.36
1983	2,651.0	24,950.0	10.6	4,323,822	117,430	613.11	36.82
1984	3,491.0	31,220.0	11.2	4,380,232	122,788	796.99	35.67
1985	3,801.0	41,640.0	9.1	4,702,414	138,375	808.31	33.98
1986	4,440.0	44,300.0	10.0	4,843,432	142,807	916.71	33.92
1987	4,770.0	60,160.0	7.9	5,031,340	149,151	948.06	33.73
1988	4,659.8	64,300.0	7.2	5,123,581	155,694	909.48	32.91
1989	5,454.2	80,470.0	6.8	5,389,148	163,609	1012.07	32.94
1990	7,039.2	87,330.0	8.1	5,392,319	173,117	1305.41	31.15
1991	7,905.6	121,300.0	6.5	5,455,996	173,370	1448.97	31.47
1992	11,038.2	180,200.0	6.1	5,563,987	176,360	1983.87	31.55
1993	13,038.2	184,734.0	7.1	5,428,386	173,177	2401.86	31.35
1994	16,038.2	190,993.6	8.4	5,557,008	178,097	2886.12	31.20
1995	18,240.4	183,742.5	9.9	5,536,396	181,975	3294.63	30.42
1996	24,190.0	197,529.6	12.2	5,597,656	184,393	4321.45	30.36
1997	24,706.1	213,373.6	11.6	5,764,855	186,590	4285.64	30.90
1998	25,465.0	243,335.8	10.5	5,919,721	192,306	4301.72	30.78
1999	27,881.2	243,335.6	11.5	6,064,300	186,612	4597.60	32.50
2000	27,898.5	225,137.9	12.4	6,155,500	178,899	4532.29	34.41
2001	29,253.2	226,068.2	12.9	6,314,726	180,860	4632.54	34.91
2002	32,000.0	270,068.2	11.8	5,968,241	178,032	5361.71	33.52
2003	41,500.0	232,120.0	17.9	6,906,355	178,631	6008.96	38.79

Source: Ministry of Education, Science and Technology and Economic Survey (Various Issues)

**Appendix 2**

**HETEROSCEDASTICITY TEST**

<b>Reading English Achievement</b>				<b>Mathematics Achievement</b>			
White's test for Against		Ho: homoskedasticity Ha: unrestricted heteroskedasticity		White's test for Against		Ho: homoskedasticity Ha: unrestricted heteroskedasticity	
Chi2(267) = 459.89 Prob > chi2 = 0.0000				Chi2(267) = 474.54 Prob > chi2 = 0.0000			
Cameron & Trivedi's decomposition of IM-test				Cameron & Trivedi's decomposition of IM-test			
Source	chi2	df	p	Source	chi2	df	p
Heteroskedasticity	459.89	267	0.0000	Heteroskedasticity	474.54	267	0.0000
Skewness	52.09	22	0.0003	Skewness	84.46	22	0.0000
Kurtosis	3.87	1	0.0491	Kurtosis	22.76	1	0.0000
Total	515.85	290	0.0000	Total	581.75	267	0.0000

The above shows the calculated CHI Square values. Comparing the calculated values with their respective critical values, the Null hypothesis is rejected at 5 per cent level and indicates presence of heteroscedasticity

**Appendix 3**

**MULTICOLLINEARITY TEST**

Variable	Mathematics Achievement		Reading English Achievement	
	VIF	1/VIF	VIF	1/VIF
SCHOOL RESOURCES	1.92	0.52	1.81	0.55
NO TEST	1.79	0.56	1.45	0.69
WEEKLY TEST	1.74	0.57	1.52	0.66
HOME QUALITY	1.65	0.61	1.62	0.62
TEACHING RESOURCES	1.53	0.65	1.6	0.63
PARENTS EDUCATION	1.44	0.70	1.43	0.70
PUPIL'S AGE	1.33	0.75	1.33	0.75
HEAD TEACHERS' TEACHING TIME	1.28	0.78	1.27	0.79
RURAL	1.27	0.79	1.22	0.82
HEAD TEACHERS' AGE	1.21	0.82	1.21	0.82
PUPIL/TEACHER RATIO	1.16	0.87	1.23	0.82
INSERVICE TRAININGS	1.20	0.83	1.07	0.93
PUPIL'S OWNING TEXTBOOK	1.19	0.84	1.14	0.87
TEACHERS' EXPERIENCE	1.18	0.85	1.20	0.84
REPEATER	1.17	0.86	1.17	0.85
TEACHERS' TEST SCORE	1.15	0.87	1.06	0.95
INSPECTION VISITS	1.14	0.87	1.15	0.87
HOME WORK	1.10	0.91	1.06	0.94
TEACHING HOURS	1.09	0.92	1.11	0.90
PUPILS' ABSENTEEISM	1.05	0.96	1.04	0.97
MALE PUPIL	1.04	0.96	1.05	0.96
BOOKS AT HOME	1.04	0.96	1.08	0.93
Mean	VIF 1.29		1.26	

As can be seen from the Variance Inflation Factor there is severe multicollinearity among explanatory Variables but in the overall Multicollinearity does not affect the coefficients and their signs. The Rule of thumb applied here is if VIF of a variable exceeds 10 then the variable is highly collinear

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