UNIVERSITY OF SOUTHAMPTON

FACULTY OF SOCIAL, HUMANITIES AND MATHEMATICAL SCIENCES

Southampton Education School

Educational process factors for effective education in resource-constrained countries:

A multilevel analysis

Hamis Mugendawala

Thesis for the degree of Doctor of Philosophy

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ABSTRACT

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Earlier conceptualisations of educational effectiveness magnified the importance of the need for significant amounts of fiscal and material resources to attain effective education. In the past, this has seemed to be justification for resource-constrained countries to seek mainly external support to fund their educational budgets in anticipation of attaining an effective education. Indeed, on many occasions any attempt to attain effective education in resource-constrained countries has been thwarted by the perceived lack of fiscal and material resources. Nonetheless, it is emerging that resource-constrained countries can actually have access to effective education. Using hierarchical linear modelling analysis, this study draws on the Southern and Eastern Africa Consortium on Monitoring Educational Quality (SACMEQ) database to generate an effective education model for resource-constrained countries, through a critical analysis of educational process factors that account for significant variations in educational outcomes.

The Rasch technique was used to construct most of the educational process indicators that were fed into the estimated multilevel models for reading and mathematics outcomes. On adjusting for pupil characteristics, contextual factors and school resource inputs, the process factors that significantly predict both mathematics and reading outcomes include opportunity to learn (OTL), school management competences, school-community relationships and school-based HIV/AIDS support. Further, for both mathematics and reading there is a significant interaction effect between teacher academic and professional capital (TAPC) and OTL; the effects of TAPC are completely mediated by OTL. On the other hand, whereas resource usage significantly predicts reading attainment, it does not predict mathematics attainment. Additionally, educational processes jointly explain more variance in mathematics attainment (16.5%) than that in reading (6%). Nonetheless, the preferred models explain about 25% and 26% of total variance in reading and mathematics, respectively. Overall, each of the two models explains more variance at Level 3 (school level) than other levels. Unexpectedly, whereas there is inequity in the distribution of school inputs and opportunities for pupils to learn (OTL), there is limited evidence of inequity in the general distribution of learning outcomes by socio-economic status (SES) groupings.

The findings of this study extend the theory and practice of educational effectiveness, especially in developing countries where educational effectiveness research has always been limited to examining the potential impact of easily quantifiable educational inputs (using production functions) on educational outputs. Moreover, the study provides the various educational constituencies with sound evidence of various educational process factors that could positively impact educational outcomes, and implores policy makers and practitioners to abandon input-output models for system-based models, simultaneously to pursue both quality and equity dimensions within educational outcomes and, most importantly, to refocus attention on the school and teaching processes.

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DECLARATION OF AUTHORSHIP

I, Hamis Mugendawala, declare that this thesis entitled

Educational process factors for effective education in resource-constrained countries: A multilevel analysis

and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;

2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;

3. Where I have consulted the published work of others, this is always clearly attributed;

4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;

5. I have acknowledged all main sources of help;

6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;

7. Either none of this work has been published before submission, or parts of this work have been published as: ……

Signed: ……

Date: ……

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List of acronyms used

AIDS: Acquire Immune Deficiency Syndrome
Cf: Cited from
CPD: Continuous Professional Development
CVF: Competing values framework
DASI: Dynamic Approaches to School Improvement
Df: Degrees of freedom
DME: Dynamic Model of Educational Effectiveness
EE: Educational Effectiveness
EER: Educational Effectiveness Research
EFA: Education for all
EPF: Education production functions
EPRC: Educational policy review commission
ESA: Education standards agency
GCSE: General Certificate of Secondary Education
GDP: Gross domestic product
GER: gross enrolment ratio
GIR: gross intake ratio
HDI: Human development index
HIV: Human Immune Virus
ICC: Intra-class correlation coefficient
Ln: Natural log
LR: Loglikelihood ratio
MDG: Millennium Development Goals
MLM: Multilevel Models or Multilevel Modelling
NAPE: National Assessment of Progress in Education
NCDC: National Curriculum Development Centre
NER: Net enrolment ratio
NIR: Net intake ratio
OLS: Ordinary least squares
PCA: Principal components analysis
PLE: Primary leaving examinations
PTC: Primary teachers training college
PTR: Pupil-teacher ratio
RUS: Resource usage scale
SACMEQ: Southern Eastern African Consortium on Monitoring Educational Quality.
SCRI: School community relations indicator
S.E: Standard error
SES: Socio-economic status
TAPC: Teacher academic and professional capital
TIMSS: Trends in international mathematics and science study
UACE: Uganda Advanced Certificate of Education
UCE: Uganda Certificate of Education
UNDP: United Nations Development Programme

UNEB: Uganda National Examinations Board
UNESCO: United Nations Educational, Scientific and Cultural Organisation
UPE: Universal primary education
VPC: Variance partition coefficient

Definition of terms used

Effective education: An education that manifests both dimensions of quality and equity in a stable and consistent manner.

Educational attainment: Refers to cognitive learning outputs.

Curriculum implementation: This phrase is used to capture any or all of the following: curriculum content delivered to pupils by their teachers, and curriculum content exposure to pupils in a class. It may also include the quality of instruction in delivering the intended curriculum.

Resource-constrained countries: In this study, this term is used interchangeably with 'developing countries' and or 'poor societies'. It is intended to carry the World Bank definition. These are low-income countries or societies living on not more than $1.25 a day. Such countries are characterised by abject poverty, low levels of education, low levels of industrialisation, low levels of life expectancy, and high infant and maternal mortality, among others (World Bank, 2014b).

Fiscal resources: Refers to the monetary resources possessed by an education system, school or society.

Physical or material resources: Refers to the non-monetary inputs possessed by an education system, school or society. These include buildings, classrooms, furniture, library, and other inputs.

Primary schools: Refer to schools that provide primary education to primary school pupils. For avoidance of doubt, they exclude pre-primary and post-primary institutions.

Index: this is also called an indicator. These two terms are used interchangeably to mean the scales constructed using the Rasch modelling technique, to proxy the processes factors and other control variables that are estimated in the model.

CHAPTER ONE: INTRODUCTION

1.1. Background to the study

> Class sizes have fallen, qualifications of teachers have risen, and expenditures have increased. Unfortunately, little evidence exists to suggest that any significant changes in student outcomes have accompanied this growth in resources devoted to schools. (Hanushek, 2003, p.67)

Earlier conceptualisations of educational effectiveness magnified the importance of significant amounts of fiscal and material resources in attaining effective education (see Akerhielm, 1995; Angrist and Lavy, 1997; Figlio, 1997). Hitherto, this seemed to be the justification for resource-constrained countries' to seek mainly external support to fund their educational budgets in anticipation of attaining an effective education. Indeed, any attempts to attain effective education in resource-constrained countries have, on many occasions, been thwarted by the perceived lack of fiscal and material resources (Cassen and Kingdon, 2007; Smith et al., 2006; Wilby, 1983). However, it is emerging that resource-constrained countries can actually have access to effective education. This fact is reinforced by the maiden studies of Levin and Lockheed (1993) that identified schools that provided effective education in resource-constrained countries. Moreover, more evidence has been highlighted by Muijs et al. (2004), Cole-Henderson (2000) Harris et al. (2006), Taylor et al. (2000) and Acker-Hocevar et al. (2012) on the possibility of improving educational effectiveness in such societies.

Despite the considerable effort that has been put in by resource-constrained countries with regards to fundraising for educational fiscal and material resources, as highlighted by the exponential growth in national educational budgets, not much progress has been registered in terms of access to effective education in such countries (see Hanushek and Luque, 2003; Rivkin et al., 2005; Hanushek, 2003). This questions whether, on its own, staking significant resources in terms of money and materials can guarantee effective education. This implies that, while fiscal and material resources are important in ensuring access to effective education (Cassen and Kingdon, 2007; Smith et al., 2006; Wilby, 1983), the contribution of such inputs can only be guaranteed where they can be effectively processed into quality and equitable educational outcomes (UNICEF, 2000).

This is the view of the landmark studies of Goodlad (1979), and Levin and Lockheed (1993), which did not attract much attention from wider scholarship, given the greater influence of the input-output studies that kept on asserting that fiscal and material resources could generate the required educational outcomes, since less attention was paid to processing such inputs.

Uganda, the focus of this study, has for some decades had education that has been enviable in the region (Kasirye, 2009). It continues to attract a significant proportion of the national budget relative to other sectors (Zuze and Leibbrandt, 2011). In 2005, education took the biggest allocation (17.1%) from the national budget, and this was increased to 22% in 2007. Since 2007, the education budget has on average been at least 15% of the national budget, coming second to that of the ministry of works and transport (Ministry of Finance Planning and Economic Development, 2005; 2007; 2010; 2013).

Similarly, the education sector receives significant funding from the donor community (Ward et al., 2006). This significant increase in finances is said to have translated into more than a 100% increase in teacher recruitment. Teachers now constitute more than half of all public servants (Uwezo, 2011). There has been construction of more classrooms and other school infrastructure. Moreover, it is indicated that, since the adoption of universal primary education in 1997, there has been a surge in enrolment from 3.1 million to slightly over 8 million pupils in 2012 (Oonyu, 2012; Uganda Bureau of Statistics, 2012).

Nonetheless, a number of reports indicate an insignificant improvement in the quality of learning outcomes in primary schools to match the magnitude of the resources being invested in the sector (Barrett et al., 2007; Kasirye, 2009; Nannyonjo, 2007; Nishimura et al., 2008; Twikirize, 2012; Wamala and Seruwagi, 2012). For instance, the completion rate in the primary section stands at less than half. Only half of the pupils in the sector are reported to have attained the defined proficiency levels in both mathematics and English (UWEZO, 2011; 2012). This could, in part, be evidence that materials alone, without aligned coherent processes, may not improve learning in poor primary school settings (Lucas et al., 2013).

This study undertakes to suggest an effective education model for a resource-constrained country such as Uganda, through a critical analysis of educational process factors that account for significant variations in educational outcomes. This is conceived using the input-process-output-context models and the dynamic model of educational effectiveness (DME) (Creemers and Kyriakides, 2006) from earlier empirical studies in educational effectiveness. Further, this study conceives effective education from two dimensions; that is, quality and equity aspects in educational outcomes.

To this end, educational effectiveness prevails where educational units (schools) can yield high-quality educational outcomes while offsetting the effects of learners' characteristics on their educational outcomes.

The study is based on the assumption that educational outcomes are attributable to a range of factors, such as individual pupil characteristics, family socio-economic characteristics, and communal and societal characteristics, operating in concert with effective school and classroom processes. Thus, there is an assumed existence of a relationship between the educational inputs, the processes and the outputs. Moreover, it is assumed that the context in which schools operate could directly or indirectly influence inputs and processes. In this study, I argue that, with the right amounts of inputs and effective processes, high-quality and equitable educational outcomes can be expected. To this end, what happens at school level has profound effects on the quality and equity of educational outcomes. Similarly, the classroom processes such as instruction time, feedback and reinforcement, instruction evaluation, teaching methods, frequency of homework and appropriate use of questioning techniques are assumed to influence educational outputs profoundly.

This research pays the process factors more attention, given that most are within the manipulative control of the school administrators and teachers, unlike fiscal and material inputs. It is my view that, whereas school administrators are constrained with regards to increasing the fiscal and material inputs, a considerable contribution could be made if they performed well the tasks within their ambits. Moreover, this would be the most cost-effective way to tackle dysfunctional educational systems in resource-constrained economies. Further, with the emergence of severe competition between education provision and the need to provide for other much-needed public services, resource-constrained countries have no choice but to rethink the processing of their education inputs. As Reynolds et al. (1994) observed, available empirical research has failed to 'mainstream' school and classroom processes satisfactorily (collectively referred to as educational processes) in their conceptual explanations of educational effectiveness. Moreover, those that have tried mainly relate to education systems of western, developed economies, thereby leaving a lacuna in empirical knowledge in the developing countries. This study partly comes in to fill this gap. A much clearer illustration is given on the rationale of this study in the subsections that follow the statement of the problem.

1.2. Statement of the problem

The Ugandan constitution treats primary education as an inherent right that every Ugandan should enjoy, regardless of their gender, ethnicity or socio-economic background, among others. This is aligned with global universal primary education campaigns such as the Jomtien[1] and the Dakar[2] declarations for education for all, to which Uganda is a signatory (UNESCO, 2005). Moreover, the country believes that her current economic disadvantages could be leveraged if her people were educated. This has been the view held since missionary and colonial educational times. Besides the constitution, there are a number of educational legislations, commissions and policies that have been enacted to operationalise the country's desire to accord her citizens equal opportunities to education. Most important of all is the Education Policy Review Commission (EPRC) of 1987. This provided the basis for most subsequent educational policies and legislation in the country (Evans and Senteza, 1994).

To demonstrate her commitment to providing unconditional access to primary education, Uganda launched universal primary education (UPE) in 1997. Available statistics indicate a significant increase in enrolment since the launch of the UPE. To illustrate, there was a 72.8% annual increase in the gross enrolment at primary level in the country, with 5,303,564 pupils enrolling in primary schools in the year 1997, up from 3,068,625 pupils in 1996. Total enrolment has continued on a rising trend to the current (2012) enrolment of 8,327,084 pupils in the entire primary section (Ministry of Education and Sports, 1999; Ministry of Education and Sports, 2013). The enrolment ratios indicate that Uganda competes favourably with her regional neighbours. For example, the country boasts a higher net enrolment ratio (above 90%) than that of the region, which is 77% (UNESCO Institute for Statistics, 2014).

Nonetheless, the significant increase in enrolment has not been in tandem with the rate of growth in ancillary factors such as the size of the teaching force, the physical infrastructure, and the fiscal requirements of such enrolment (Zuze and Leibbrandt, 2011). This compounded the existing challenges to the education system, such as poor pupil-teacher ratios, pupil-classroom ratios, dropout rates and sanitary amenities in schools (see Ward et al., 2006; Ministry of Education and Sports, 2011; Penny et al., 2008).

[1] At the Jomtien conference (1990), government leaders from 150 countries agreed to make education universal to all children.
[2] At the Dakar world education forum (2000), government and non-government organisational leaders met to review their commitment to educating every citizen in every society.

The government and the donor community have significantly invested in both the training of more primary school teachers and construction of the physical infrastructure such as classrooms, toilets and other utility facilities. These efforts have translated into some decline in pupil-teacher ratio to the currently reported 1:54, and the pupil classroom ratio to the currently reported 1:67. Moreover, there has been an increase in qualified teachers with 95.2% reportedly having the minimum standard (Ministry of Education and Sports, 2011; Wamala and Seruwagi, 2012).

Albeit the significant educational sector investment that Uganda has made most especially in the primary section, critiques (Kasirye, 2009; Nannyonjo, 2007; UWEZO, 2012) say such has mainly translated into more quantitative rather than qualitative schooling. Hitherto, the country's educational outcomes at the primary school level continue to be of poor quality. To illustrate, the National Assessment of Progress in Education (NAPE) report (see Uganda National Examinations Board, 2012), which is an annual publication of the Uganda National Examination Board (UNEB), indicates that among the primary 3 pupils surveyed, 30.1% and 46.7% could not demonstrate the required skills in numeracy and literacy respectively, as specified by the national curriculum for primary 3. Moreover, quality in educational outcomes was found to deteriorate further at higher grades. For example, 54.8% and 59.2% of primary 6 pupils, lacked the minimum level of numerical and literacy proficiency as prescribed in the respective national curriculum for this grade. Similar indicators have been highlighted in other national surveys. UWEZO (2012) published a report that indicated that only one out of every ten pupils from Primary 3 to Primary 7 was able to read a Primary 2 level story and correctly solve Primary 2 level numeracy questions. This is an incident where pupils in higher grades fail to solve academic problems for lower grades. This could imply the possibility of learners getting promoted to higher grades without attaining the necessary prior level competencies.

The lack of improvement in the quality indicators of Uganda's primary education, notwithstanding the noble government attempts to increase on the material and fiscal resources, is reinforcement of the fact that materials on their own may not sustainably influence the quality of educational outcomes (see Boulding, 1972; Coleman et al., 1966; Hanushek and Luque, 2003; Rivkin et al., 2005; Hanushek, 2003). Rather, this study contends that the way such inputs are processed matters for quality outcomes. This is the springboard of this current study.

1.3. Objectives of the study

i. To establish the educational process factors that account for significant variations in educational outputs in Uganda's primary education.
ii. To establish how random are the effects of some of the educational process factors on educational outputs in Uganda's primary education system.
iii. To establish the extent to which educational inputs, processes and outputs reflect the equity dimension of educational effectiveness.
iv. To model school attainment residuals in order to suggest an effective education model for a resource-constrained country such as Uganda.

1.4. Rationale of the study

The intended output of this research is a critical thesis suggesting an effective education model for a resource-constrained society. It is my wish and belief that this study will be of invaluable importance to, inter alia, education policy makers and funders, educational processors and producers, and educational consumers.

This study intends to provide educational funders such as national government, local governments, the donor community and parents with sound evidence on the various educational process factors that are likely to yield higher educational outcomes and hence more value for money. Moreover, the fact that primary education attracts the lion's share of the national educational budget of Uganda and yet there is dismal reported persistent sectoral performance makes this research indispensable. It asserts that the effect of fiscal materials on educational outcomes may not be maximised without effective processes (*throughput* factors) in classrooms and schools. It might also inform a paradigm shift leading to crafting of policy and a concentration of resources towards particular throughput factors. These factors include effective instruction that maximises the influence of the fiscal and material inputs on educational outcomes. Moreover, this study illustrates to school administrators and teachers the fact that most of the throughput factors, such as school leadership, a friendly school and class environment, teaching processes and community participation, are within their manipulative capacity. This is in contrast to fiscal and material inputs, which are mainly decided upon by central government. This would seem to be the most cost-effective way to tackle dysfunctional educational systems in resource-constrained societies such as Uganda.

Above all, empirical consensus is building on the importance of educational process factors, given that they provide the overall framework within which teachers and classrooms operate (Sammons, 1995, p.28).

On the other hand, this thesis intends to benefit education consumers such as the pupils and parents, as it adds to the scanty literature, especially in the developing world, on the best and most cost-effective school and classroom processes that research has found significantly improve pupil attainment. This would be of great importance to most of the Ugandan pupils, whose level of academic attainment has been reported to be on a steady decline.

Last but not least, this study renews the focus upon the education of the disadvantaged societies. It does so by extending the theory and practice of educational effectiveness research (EER) in such communities where studies have always been limited to examining the potential impact of easily quantifiable educational inputs (using production functions) on educational outcomes. Moreover, little of that research has tried to look at educational effectiveness through the lenses of equity and quality (Kyriakides and Creemers, 2011; Zuze and Leibbrandt, 2011). By looking at educational effectiveness through these two lenses, this study does not only contribute to the development of the conceptual framework of EER but provides suggestions on how policy, school and classroom practice could be improved to promote both quality and equity dimensions in education. It also tries to switch emphasis from the use of educational production functions to an input-process-outcome-context framework as the basis to explain educational effectiveness. This is most likely to succeed among the very few multilevel studies in developing countries (see Scheerens, 2012; Chapman et al., 2012; Zuze and Leibbrandt, 2011) that not only measure school and classroom processes using the Rasch modelling technique but seek to integrate the estimation of the influences of such processes with other system-based components, such as context. This could be a breakthrough, as it might act as a basis for more international comparative policy studies, all of which require a thorough understanding of various national educational contexts.

Finally, this study could be among the first to examine the impact of HIV/AIDS on the indicators of educational effectiveness in poor countries. It is important to note that, whereas the HIV/AIDS pandemic has severely affected the education systems of most African countries, especially the sub-Saharan area, this reality has always been ignored by contemporary educational effectiveness studies.

Incorporating this variable in the conceptualisation of educational effectiveness may not only extend the theory and practice of educational effectiveness, but create significant curiosity for further research on this subject.

1.5. Research questions

i. What are the educational process factors that account for significant variations in educational outputs in Uganda's primary education?

ii. How random are the effects of some of the educational process factors on educational outputs in Uganda's primary education system?

iii. To what extent do educational inputs, processes and outputs reflect the equity dimension of educational effectiveness?

CHAPTER TWO: CONTEXT

2.0. Introduction

This chapter gives a brief on the country in which this study is conducted. This is crucial, given that educational effectiveness studies are highly context bound. Sammons (1995), one of the leading scholars in educational effectiveness, and Fuller and Clarke (1994) indicate that there are differentials in educational effectiveness by country, gender, pupil ability, location of the school and educational level, among others. Thus, there is no universal truth about factors for educational effectiveness. This illustrates the importance of providing a detailed context. Moreover, this background is not only to highlight the country characteristics but aims to generate the justification for the study and for the variables included in the conceptual framework.

2.1. Country brief

Uganda is quite a small country (approximately 241,550 sq km), located in the East of Africa. It lies on the equator and it is a land-locked country with neighbours including Kenya in the east, Tanzania in the south, Rwanda in the south-west, DR Congo in the west and South Sudan in the north. The country is divided into 112 administrative units, as at 2012, called districts. These serve as the local authority units and derive their powers of administration from the Local Government Act. They are responsible for service delivery, including the provision of primary education. Nonetheless, central government retains overall authority to formulate policy in education, and also sets and supervises educational standards through the Ministry of Education and the Education Standards Agency (ESA).

Politically, Uganda became a British protectorate in the late 1800s. This implies that the British government was responsible for all the administrative duties in the country. In 1962, the country gained independence and established self-rule by the indigenous Ugandans. However, it retained Commonwealth membership.

According to the World Bank (2013), Uganda's population stands at 36.3 million (as at 2012), and is said to have one of the highest growth rates (3.1 per year) and fertility rates, with each female having six children, on average (UNDP, 2013b). Development indicators classify Uganda as one of the 26 poorest countries of the world, with a GDP of $19.2 billion (UNDP, 2013a) and a per capita income of $506.

Further, with a Human Development Index (HDI) of 0.456 (in 2012), the country lies in the Low Human Development category and it is in position 161 of 187 countries and territories (UNDP, 2013a). This position on the HDI index is illustrated by the vulnerability and income poverty of the population. For example, 51.5% of all adult Ugandans experience severe income poverty, while 19% of those who are above the poverty line are vulnerable to sliding back into poverty. These indicators are significant to education research such as this, given that they illustrate the basis for particular education policies such as universal primary education (UNDP, 2013b; World Bank, 2013).

The country also performs poorly on other development indicators that are said to impact on education. To illustrate, the country has a very young population, with those under 14 years accounting for 48% of the total population (UNDP, 2013b). This implies that more resources are required for these young persons in the primary and lower secondary educational sectors. On the health front, 5% of Ugandan children die before their first birthday and one in every 11 children dies before their fifth birthday (Uganda Bureau of Statistics and ICF International Inc, 2012). This state of affairs tends to increase the demand by parents for more children, since they are more uncertain of their survival. This later translates into bigger families, for which parents may not be able to cater in terms of the basic necessities, including education.

Indicators that relate to access to knowledge, such as the mean number of years of schooling, for the adult population, and the expected years of schooling, for children of school entrance age, show that the country still experiences slow progress. For instance, the mean number of years of schooling is estimated at 4.7, yet the expected number of years of schooling is 11.1. This translates into lower rates for those who have at least secondary education. For example, the HDI report indicates that 23% and 24% of the female and male populations respectively have accessed at least secondary level (UNDP, 2013a). Given the role that parents play in the education of their children, this indicator is of great importance to educational researchers.

It is critical to note that, the above statistics notwithstanding, some reports indicate that the country has indeed progressed with regards to some human development indicators. To illustrate, the GDP per capita has been rising for the past two decades. A similar outlook is held by the World Bank (see graph below). However, this increase is constrained by the high population growth rate and the political turmoil the country has experienced since Independence.

Further, the country has managed to raise her adult literacy from 56.1% to 73.2% between 1991 and 2010. This aspect is of importance to this study, given that parental characteristics in terms of education levels are said to impact on pupil educational attainment (World Bank, 2013).

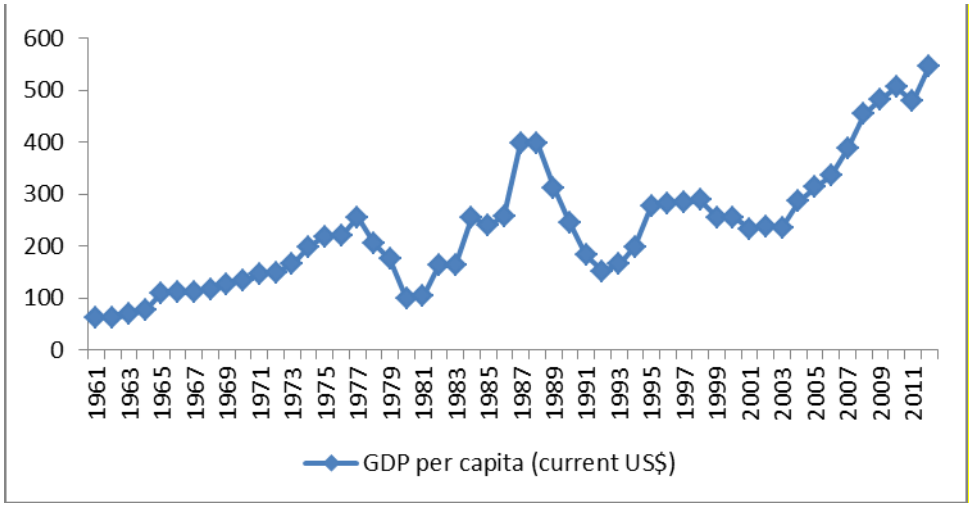

Figure 1 Uganda's GDP per capita (USD)
Source: World Bank (2013)

2.2. Uganda's education system

Officially, Uganda's education system runs from primary through secondary, tertiary and then university. However, pre-primary thrives under private arrangements, as there is yet to be a policy for pre-primary education, hence government neither provides nor supervises it. The primary section is supposed to run for seven (7) years, and the official age for Primary 1 is 6 years, and a child is expected to finish the primary school cycle at the age of 12 (Ministry of Education and Sports, 2011). However, these official ages are just for the purposes of policy; in reality, ages overlap in classes, due to late starters and grade repetition (UNESCO Institute for Statistics, 2014). At the end of primary school education, pupils take a national examination called the Primary Leaving Examination (PLE). This acts as the basis to matriculate to secondary school level.

Secondary education in Uganda consists of two levels; that is, ordinary secondary level, normally known as 'O' level, and the Advanced Certificate of Education, or 'A' levels. The 'O' level takes four years and is comparable to the British GCSE. At the end of the four years, students take a national examination called the Uganda Certificate of Education (UCE), which acts as a basis to matriculate to either 'A' levels or other tertiary and trade colleges.

After two years of 'A' levels, students take a national examination for the award of a Uganda Advanced Certificate of Education (UACE), which serves as the basis for matriculation to either tertiary or university education. Officially, the secondary school age range is 13 to 18 years (Ward et al., 2006).

Tertiary education includes universities, colleges of commerce, technical colleges and teachers' colleges. These institutions have entry requirements that should be fulfilled by prospective entrants. For example, technical colleges, which mainly train craftsmen, technicians and other skilled persons for the industry, require entrants to have completed at least primary school. However, in most cases these institutions would prefer entrants to have completed at least UCE or UACE to enrol for advanced qualification such as certificates and diplomas. Those intending to enrol at university should have completed 'A' levels or their equivalent. On average, certificate courses take not less than a year, diploma courses take not less than two years and degree courses take not less than three years. There are significant variations in course durations, with medical, engineering and law courses taking more than three years to graduate.

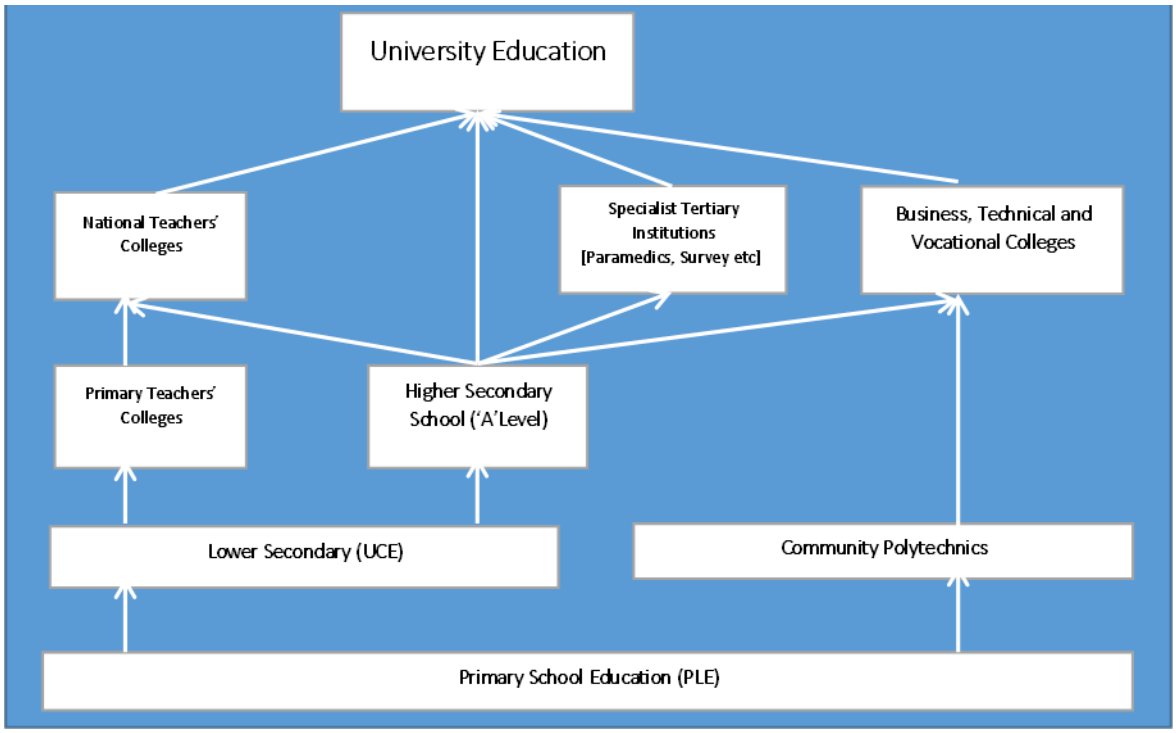

Figure 2 Illustration of the structure of the Ugandan education system
Source: Author's design derived from Muhwezi (2003).

2.2.1. Trends and milestones in Uganda's education system

Provision of education in Uganda, pre-Independence, was largely the responsibility of faith organisations, especially missionary societies (Evans and Senteza, 1994). The missionaries founded mission schools and set up policies guided and implemented mainly by their faith organisations. The education provided at the time was quite basic and mainly concerned with propagation of religion by training catechist teachers and bible teachers (Penny et al., 2008). At that time, the chiefs were the most important educational authorities through which the missions recruited learners. To this end, the chiefs identified various people to form school management committees to supervise the attendance, discipline and maintenance of school structures, if any. However, the Ugandan indigenous people continued running their 'African curriculum' alongside the mission curriculum. Thus, at home, learners were taken through the 'African curriculum' while at school they were taken through mostly the European curriculum (Mumford and Parker, 1937). The African curriculum concentrated more on preparing boys for manhood and girls for motherhood. To this end, boys were taught how to hunt, be brave and provide security to their families, while the girls would be prepared to be good wives and mothers in the home. Besides teaching religion, the mission schools taught some basic sanitation and hygiene, agriculture and basic literacy.

As the colonial government took shape in the early 1900s, a commission sponsored by the Phelps Stokes fund, known as the Phelps Stokes Commission, was instituted in 1925 to look into the state of affairs in the education sector of Uganda and other British colonies in Africa at the time. Among its findings was the fact that the education being provided at the time was inadequate and only served the interests of missionaries and the chiefs. In its recommendations, the commission advocated for active government participation in the provision of education. This was to be achieved through government taking over the supervision and giving financial assistance to the mission schools. This was implemented through the establishment of the first department of education, under the auspice of a full director responsible for African education (Evans and Senteza, 1994).

Prior to Independence, and on the basis of the Phelps Stokes Commission findings, the British colonial government instituted numerous commissions to look further into the education status of the country. Just as in any other African country at the time, Uganda's education was characterised by lack of a unified formal curriculum that reflected the needs of the indigenous communities.

Moreover, during that time education was mainly provided to children of chiefs, leaving most of the ordinary citizens without access. Furthermore, quality and equity were the main issues that required attention, apart from financing (Evans and Senteza, 1994; Mumford and Parker, 1937; Penny et al., 2008). Therefore, the commissions that were instituted by the colonial government were meant to address these issues and make recommendations to inform policy.

The De la Warr education commission was instituted in 1938 to chart ways of improving access to higher education in the country. This was against a backdrop whereby, by the end of the 1930s, fewer than 1% of all pupils enrolled were able to progress beyond primary school level (Mumford and Parker, 1937). One of the main recommendations that was implemented outright was the establishment of Makerere College as an interterritorial college for higher education, with independent financing. Later on, issues to do with financing of education in the country were entrusted to the Thomas education commission of 1940. Specifically, this was to review guidelines for the implementation of grants and to design a development programme for the country's education sector over the period of 1941–1945 (Evans and Senteza, 1994). Unfortunately, the recommendations of this commission were left to gather dust, as the Second World War disrupted all financial commitments from the British government.

After emerging from the Second World War, an East African study group sponsored by the British Colonial Office and the Nuffield Foundation was constituted to review the education status of Uganda, including her East African partners such as Kenya and Tanzania. Led by De Bunsen, this commission was named the De Bunsen Commission and made a detailed review of the education sector of the region. Among its recommendations were the need to:

- substantially expand the educational capacity in Uganda with the intent to prepare the country for Independence
- increase enrolment at primary education level
- reorganise and improve teacher training
- review the duration of both the primary and secondary levels. The recommendation was to have primary section run for eight years instead of six, while the secondary section was to be reduced from six years to four
- devolve authority to offer primary education to local authorities. (Evans and Senteza, 1994).

The De Bunsen Commission recommendations shaped the Ugandan education system until Independence, which she attained on 9 October 1962 from her colonial master, Britain.

2.2.2. Uganda's education post-Independence

2.2.2.1. At Independence and a decade after (1962–1971)

Uganda attained Independence at a time when there was remarkable burgeoning interest and faith in education as a tool to lift the indigenous African populace from abject poverty, and to spur economic growth at a time when finances from the colonial masters were expected to be drastically reduced. Most importantly, at Independence, Uganda's education system was still in the hands of the faith organisations and it is said to have lacked national character, due to the fact that each faith organisation ran a curriculum that resonated well with its ideals, so, the country had a multi-curricular system (Evans and Senteza, 1994; Heyneman, 1975; Heyneman, 1983; Penny et al., 2008). This perpetuated stark inequalities, as schools were set up in areas where faith organisations had a presence and hence people had embraced that faith. Also, there were significant differentials in the school fees charged by the various faith organisations. As the main players, faith organisations were still performing the functions of teacher training, deployment and remuneration, and inspection, using discretional criteria (Heyneman, 1983; Penny et al., 2008).

Further, as the government still had little involvement in education at Independence, for children of the poor, access to education remained elusive, and most attended village schools, at times referred to as bush schools. These were the result of community effort, and lacked qualified staff and educational facilities. Further, at Independence, there was scarcity of highly skilled manpower in the country; the available local labour was basic and trained mainly to serve clerical functions in the colonial governments (Heyneman, 1983 p.75). This created an urgent need for a quick review of the existing education system to structure the system to the needs of the country.

Reacting to these challenges at Independence, the Uganda Education Commission, later known as the Castle Commission, was instituted in 1963, chaired by Professor E.B Castle, who is said to have had long experience in East African education. According to Evans and Senteza (1994), this was the first major education policy event after Independence to provide for the review and development of a national education system for the country. The terms of reference for the commission were:

> To examine in the light of the approved recommendations of the International Bank Survey Mission Report and Uganda's financial position and future manpower requirements, the content and structure of education in Uganda; to consider how it may best be improved and adapted to the needs of this country to submit recommendations accordingly. (Evans and Senteza, 1994, 129-130)

The commission's work was guided by the following question

> When over half of the nation is illiterate and the people rightly clamour for education, when teachers are in short supply and inadequately trained, when government and industry demand trained recruits, when unemployment is widespread and increasing, when the nation is poor,- what policy should the government pursue? (Evans and Senteza, 1994 p.130)

In its report, the Castle Commission recommended a 10-year development programme, with its priorities being:

- training of skilled manpower by expanding both secondary and teacher training
- focusing on provision of quality accessible primary education to all, including those in the remotest parts of the country
- improving the standards of technical and agricultural education
- expanding girls' access to education
- providing more adult and literacy education.

In response, the government of Uganda issued a memorandum commenting on the Castle Commission report through the Uganda Government Sessional Paper no.4 in 1963. Further, the government, through the Ministry of Education Circular no. 66 of 1963, set out its plan to implement the Castle Report recommendations (Evans and Senteza, 1994). It is said that most of the recommendations of the Castle Commission were implemented by the government. To illustrate, immediately after Independence till 1971, there were significant increases in enrolment in secondary and tertiary education. This is understandable, given that the new government wanted to staff government departments that had been run by the colonial government. Nonetheless, the primary sector was neglected, as only half of the age groups could access this sector (Evans and Senteza, 1994).

2.2.2.2. Uganda's Education during the period of Austerity and political turmoil (1971–1986)

In 1971 there was a military coup in Uganda, which is said to have thrown the country into turmoil and anarchy, and affected the education sector in the country. The country went under military rule and rule by decree up to 1979. This period was punctuated by insecurity, 'brain drain', economic sanctions and diplomatic isolation. Moreover, this was the period when Asians were expelled from Uganda. They were a significant force in the education sector as some had established schools while others had worked in the educational civil service as secondary school teachers and university faculty. This state of affairs culminated in severe shortages of secondary school teachers, a scarcity of instructional materials and rising costs of educational equipment, all of which undermined the educational structure inherited from the colonial government and the short-lived government following Independence (Evans and Senteza, 1994).

Critically important, as Heyneman (1983) indicates, while the events between 1971 and 1979 had a significant effect on public service delivery, education was not as severely impacted as has always been reported. To illustrate, Heyneman observes that education thrived, as seen in the doubling of enrolment to primary schools between 1969 and 1979: from 600,000 to 1.2 million learners. Other achievements during this period of austerity were the creation of the National Curriculum Development Centre (NCDC) in 1973, with its central responsibility being the development and implementation of the primary and secondary curriculum throughout the country. It was also made responsible for determining the curriculum content and appropriate teaching methodologies, and overseeing the development of appropriate textbooks and learning aids.

The other educational milestone associated with this period of austerity was the launch of a new curriculum in 1975. This placed significant emphasis on science, mathematics and practical subjects such as agriculture, carpentry, bricklaying and other vocational skills. It was thought that this would enable such trainees to be absorbed easily by the ever-shrinking job market, due to the prevailing economic sanctions. Moreover, the launch of the new curriculum could have been tactical and politically motivated, as the new military government wanted the education system to reflect the new ideological shifts in government. Furthermore, on realising that the earlier educational policies and recommendations set up by the Castle Commission were untenable by the military junta, it was deemed fit to review the whole

education system. The government indicated that such policies were set up by commissions led by the colonialists, thus did not reflect the wills and wishes of the Ugandan indigenous community. To this end, in 1977, an Education Policy Review Commission (EPRC) was established.

The 1977 EPRC was led by a distinguished educational scholar, Senteza Kajubi, who was the then vice-chancellor of the only national university – Makerere University. The EPRC was tasked with providing guidance for the development of an appropriate education system that resonated well with the immediate needs of the local communities. Specifically, the commission's terms of reference included the following:

- to review established policy documents and statements, and existing recommendations concerning objectives, structure, content, and policy for education
- examine education and training in terms of capacity to promote economic, social, and cultural development
- consider the aims and objectives, structure, examinations, curriculum, scope, organisation and financing of education
- propose long-range objectives for human resource development for each level of education
- recommend curricular, administrative and financial policies to facilitate effective implementation of objectives and programmes by institutions, regions and communities
- recommend a procedure and mechanism for periodic review of education policies, in the context of changing social, economic and administrative conditions. (Evans and Senteza, 1994 p.137)

Unfortunately, the works of this commission were interrupted by another military overthrow of the government that had taken over power in a coup. The findings of the report were left to gather dust.

Uganda's education sector continued to suffer, even after the liberation war of 1979, since that the country remained politically unstable through the early 1980s. In 1986 another guerrilla military group, led by the current president (Yoweri Museveni), seized power in an armed struggle. All these armed struggles left extensive destruction of especially the education infrastructure.

Most of the schools were destroyed and looted, and the insurgency prevented learners from attending school. Moreover, most of the structures that were responsible for implementing educational policy did not have the chance to do so, as all government efforts and available resources were directed towards fighting the war.

2.2.2.3. Education after 1986 government takeover

Most educational historians (Ssekamwa, 1997; Ssekamwa and Lugumba, 2001) imply that significant educational reforms, policies and programmes in Uganda started after 1986. This could be based on the fact that this was the time when the country received a new government that came in with an ambitious reconstruction programme, after the country had been at war for decades. Moreover, after taking over a war-ravaged country, the new government wanted to use education as a vehicle to create an ideological shift with the intent to heal the country from the deep divisions in the people along ethnic, religious and regional lines. Further, significant educational reforms were necessary at this point in time as the new government was faced with the burden of a failing economy and escalating cost burden from financing education. To effect the changes, the government instituted the 1987 Education Policy Review Commission, also known as the Kajubi Commission (Senteza Kajubi was the chair of the commission) (Evans and Senteza, 1994).

Specifically, the 1987 EPRC terms of reference included recommending:

- policies at all educational levels of the country
- aims and objectives of the country's education system
- the structure of the education system
- the integration of commercial and technical subjects
- improvement in management of education in the country
- strategies for cost reduction and financing of the country's education system
- reviews in the assessment and examination structure and
- the role of the private sector in the education of the country. (Evans and Senteza, 1994).

At the end of two years, the commission made various recommendations, including the following general aims and objectives for the country's education:

- To promote understanding and appreciation of the value of national unity, patriotism and cultural heritage, with due consideration of internal relations and beneficial inter-dependence
- To inculcate moral, ethical and spiritual values in the individual and to develop self-discipline, integrity, tolerance and human fellowship
- To inculcate a sense of service, duty and leadership for participation in civic, social and national affairs through group activities in educational institutions and the community
- To promote the scientific, technical and cultural knowledge, skills and attitudes needed to promote development
- To eradicate illiteracy and to equip individuals with the basic skills and knowledge to exploit the environment for self-development, as well as national development, for better health, nutrition and family life, and the capability for continued learning
- To contribute to the building of an integrated, self-sustaining and independent national economy. (NCDC, 2008a)

Further, the commission recommended specific aims and objectives for each education level, that is, primary and secondary. The aims and objectives of primary education are:

a. To enable individuals to acquire functional, permanent and development literacy, numeracy and communication skills in English, Kiswahili and at least one Ugandan language
b. To develop and maintain sound mental and physical health among learners
c. To instil the values of living and working cooperatively with other people and caring for others in the community
d. To develop and cherish the cultural, moral and spiritual values of life and appreciate the richness that lies in our varied and diverse cultures and values
e. To promote understanding and appreciation for the protection and utilisation of the natural environment, using scientific and technological knowledge and skills
f. To develop an understanding of one's rights and civic responsibilities and duties, for the purpose of positive and responsible participation in civic matters
g. To develop a sense of patriotism, nationalism and national unity in diversity;
h. To develop prerequisites for continuing education
i. To acquire a variety of practical skills for enabling one to make a living in a multi-skilled manner

j. To develop an appreciation for the dignity of work and for making a living by one's honest effort
k. To equip the child with the knowledge, skills and values of responsible parenthood
l. To develop skills in management of time, finance, as well as respect for private and public property
m. To develop the ability to use the problem-solving approach in various life situations
n. To develop discipline and good manners. (NCDC, 2008a, p.2-3)

The aims and objectives of secondary education in Uganda, as specified by the EPRC, include:

a. Instilling and promoting national unity and an understanding of social and civic responsibilities; strong love and care for others and respect for public property, as well as an appreciation of international relations and beneficial international cooperation
b. Promoting an appreciation and understanding of the cultural heritage of Uganda, including its languages
c. Imparting and promoting a sense of self-discipline, ethical and spiritual values and collective personal responsibility and initiative
d. Enabling individuals to acquire and develop knowledge and an understanding of emerging needs of society and the economy
e. Providing up-to-date and comprehensive knowledge in theoretical and practical aspects of innovative production, modern management methods in the field of commerce and industry their application in the context of socio-economic development of Uganda
f. Enabling individuals to develop basic scientific, technological, technical, agriculture and commercial skills required for self-employment
g. Enabling individuals to develop personal skills of problem-solving, information gathering and interpretation, independent reading and writing, self-improvement through learning and development of social, physical and leadership skills such as are obtained through games, sports, societies and clubs
h. Laying the foundation for further education

i. Enabling the individual to apply acquired skills in solving problems of the community and to develop in him a strong sense of constructive and beneficial belonging to that community
j. Instilling positive attitudes towards productive work and strong respect for the dignity of labour and those who engage in productive labour activities. (NCDC, 2008b, p.vii)

Other recommendations of the EPRC concerned curriculum reforms. It is imperative to note that, before and after Independence, the curriculum design of Ugandan education has been contentious. The commission indicates that society was highly dissatisfied with the education set up, as it failed to promote a sense of unity, self-reliance, social justice, equity, scientific knowledge, cultural values, literacy or a sense of responsibility in local communities. Moreover, by the time the commission was constituted, the World Bank had just issued the 1988 policy document, Education in Sub-Saharan Africa (World Bank, 1988), which urged African countries to 'embrace the task of formulating and implementing an internally coherent set of policies that reflect the nation's unique history and aspirations and that effectively addresses its own recently exacerbated problems in the education and training sector' (Evans and Senteza, 1994, p.143). To this end, the commission recommended for curricular reforms to mainstream practical skills in whatever is taught, to foster national development. Further, it was suggested that the primary school curriculum be lengthened from seven years to eight years. This was against a backdrop that most of the learners who were graduating from primary schools were very young, and would not actively participate in the labour market at all if they dropped out of school at such a level.

With regards to the funding of education, the commission was aware of the escalating burden of education financing, besides a deficit budget. To this end, the commission recommended cost sharing at secondary and tertiary levels. Prior to this recommendation, tertiary education was entirely government funded, without any contribution from students. This recommendation came at a time when World Bank research (Psacharopoulos, 1981; Psacharopoulos and Hinchliffe, 1973) had indicated that the social returns to education were higher for primary or basic education than for higher education. Higher education was said to benefit individuals more than society, so it was prudent for its consumers to share the costs.

Reacting to the recommendations of the EPRC, the government issued a white paper in 1991/92. While it referred to most of the recommendations as feasible, those that were contentious, such as the language of instruction, the extension of the primary curriculum from to eight years and the general reform of the curriculum, were first halted. Given the resource constraints, amidst myriad national programmes, the government decided to phase the implementation of the recommendations. It classified those recommendations that required urgent attention as short term, and hence to be tackled immediately; and medium term, that would be tackled after some time. Whereas this commission's report was the springboard for most of the current education policy in the country, such as the decentralisation of the primary education system, the introduction of cost sharing at institutions of higher learning and liberalisation of education, the main policy so far implemented is UPE.

2.2.3. Uganda's primary education from 1997 to present

The year 1997 marked yet another milestone in Uganda's education system, with the launch of UPE. UPE came after a presidential declaration of 1996, prior to the general election. The policy was rolled out in 1997. Originally, the programme was to cater for four children from each family, two of whom had to be girls (Penny et al., 2008). However, due to the burgeoning demand for education, the policy of four children per family could not be enforced and hence government opened up free-fees enrolment for each school-age child. The rationale for free UPE was the need to offer free primary education, increase enrolment, enforce compulsory school attendance, and to ensure the effective use of resources, the provision of adequate additional facilities, instructional materials and qualified teachers (Penny et al., 2008). Moreover, it was seen as the way to fulfil the Jomtien and Dakar declarations of education for all.

The aforementioned are reflected in the major objectives of the UPE policy, as seen below:

- Making basic education accessible to the learners and relevant to their needs, as well as meeting national goals
- Making education equitable, in order to eliminate disparities and inequalities
- Establishing, providing and maintaining quality education as the basis for promoting the necessary human resource development
- Initiating a fundamental positive transformation of society in the social, economic and political fields

- Ensuring that education is affordable by the majority of Ugandans by providing, initially, the minimum necessary facilities and resources, and progressively the optimal facilities, to enable every child to enter and remain in school until they complete the primary education cycle. (Ministry of Education and Sports, 1999, p.10)

On launching the UPE programme, the government of Uganda committed itself to offering maximum support to the programme for its sustainability. To illustrate, the government offered to pay for tuition for every child of school age, procure instructional materials including textbooks, construct the basic physical infrastructure such as classrooms, libraries, laboratories and teachers houses, and pay and train teachers (Ministry of Education and Sports, 1999, p.10). Government funding for UPE is done through two modalities; that is, the capitation grant and the school facilities grant. The capitation grant is a function of the number of pupils enrolled and government pays Uganda Shillings 5,000 (close to $2) per year for each child enrolled in Primary 1 to Primary 3. For children enrolling from Primary 4 to Primary 7, government pays Uganda Shillings 8,100 (close to $3.5) per year per head (Penny et al., 2008; Zuze and Leibbrandt, 2011). On the other hand, the school facilities grant is a function of the number of classrooms, teachers' houses and toilets, among others, that need to be constructed or maintained in a school. All these funds are channelled through the local authorities to the respective schools. This is said to cause some delays, due to the lengthy supply chain involving many actors (Penny et al., 2008). It is critical to note that UPE does not absolve the parents from contributing towards the education of their children. In fact, there has been a great misunderstanding about this, to the extent that parents look to government to provide scholastic materials such as exercise books, pens and pencils, and uniforms to their children, although the government is constrained in terms of resources.

It is said that in the past two decades the country has made tremendous achievements in the primary sector (Zuze and Leibbrandt, 2011). Likewise, such achievements have presented the country with significant challenges (Ward et al., 2006). This state of affairs is further discussed below with regards to access, quality and equity indicators. This is of significant importance to this study as it seeks to understand educational contexts and processes that account for differences in education outcomes in poor societies.

2.2.3.1. Access to education

All the legal and institutional frameworks that guide the operations of education in Uganda emphasise the need to provide every child of school age in the country with access to basic education. To illustrate, the Constitution, which is the supreme law of the land, makes education an inherent right. The same is reinforced by various laws and policies, including the government white paper on education sector review of 1992, the Education Act 2008, the UPE policy, the education sector strategic plan (2007–2015) and international commitments on education such as the EFA and the MDGs. It is important to note that most of these frameworks emphasise access, but tend to fall short of defining the kind of education to which children are to be exposed. This could imply the importance for poor countries first to put children into schools before aspects of quality and equity can be addressed.

The graph below highlights the trend in enrolment in the primary education sector of Uganda.

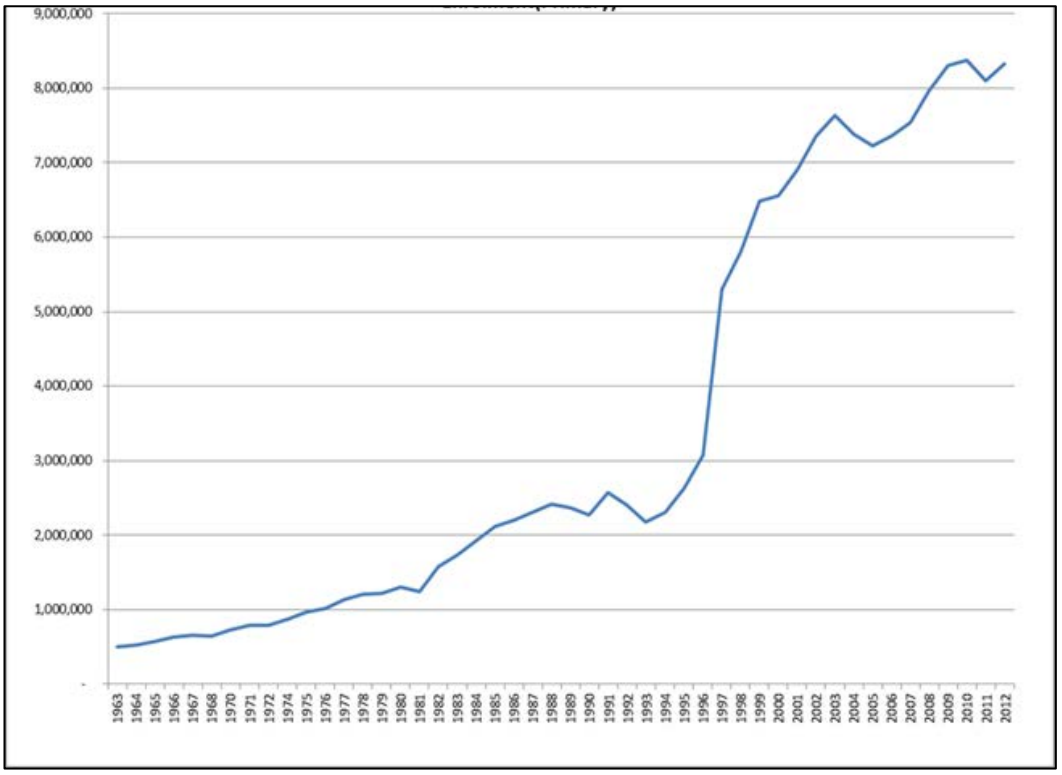

Figure 3 The Trend of primary pupil enrolment in Uganda
Source: Authors data compilation using data from Ministry of Education and Sports (1999), Oonyu (2012), Uganda Bureau of Statistics (2012).

Since Independence, enrolment in the Ugandan education sector has been rising fairly steadily. This could partly be explained by the higher population growth rate and the conducive educational policies that have argued for more investment in primary education.

As seen from the enrolment graph above, immediately after Independence (1962), enrolment in primary schools was about 0.5 million pupils. By 2012, it was up to 8.3 million pupils. However, the increase in enrolment was modest, immediately post-Independence. This could be partly due to the fact that at such a time the focus of the indigenous government was to increase manpower to take up the offices left by the colonial service employees (Chesswas, 1966), so much effort was directed towards increasing enrolment in post-primary education at the expense of primary education (Heyneman, 1983). Enrolment dropped slightly between 1971 and 1972, from 793,530 to 783,276. This was supposedly due to the military coup that happened during the same time. This might have affected access to primary schools. Nonetheless, enrolment quickly picked up during the years of political turmoil to 1978. Access to primary education declined between 1980 and 1981, from 1,302, 377 to 1,246,399. This was a period when the country was plunged into another wave of political strife. Enrolment remained fairly stagnant to 1997, when there was a phenomenal 72.8% increase (from 3,068,625 to 5,303,564) in the number of pupils in the country enrolled in primary schools. This could be explained by the launch of the UPE in 1997 (Ministry of Education and Sports, 1999; Oonyu, 2012; Uganda Bureau of Statistics, 2012).

Though the trend in enrolment after 1997 is positive, it remains quite unstable. This is illustrated by the 3.4%, 2.1% and 3.3% declines of 2004, 2005 and 2011, respectively. This is a reflection of the difficulties for the education system to enrol and retain learners in primary schools. To illustrate, less than 60% of those enrolled in primary schools continue to Grade 5 (the fifth year of primary school) (Oonyu, 2012). The trend has been deteriorating since 2001. For example, in 2001 58.5% of those enrolled in primary school stayed on to Grade 5. Retention rates dropped to 52%, 52% and 49% in 2003, 2005 and 2007, respectively (Oonyu, 2012). Further, fewer than 40% of the pupils who enrol remain in school to Grade 7 (the final class in primary).

Various reasons have been given for this trend in dropout rates. These include lack of interest, pregnancy, marriage, fees problems, child labour, health problems, family responsibilities and discipline problems (Ministry of Education and Sports, 2000). In 2000, lack of interest and health-related problems explained more of the dropout rates in lower primary classes, while pregnancy, marriage, child labour, family responsibilities and indiscipline were cited for the upper primary classes (Ministry of Education and Sports, 2000). This could partly be due to the fact that lower primary classes are attended by relatively young persons who may still have

strong attachment to their families, and hence may lack interest in school, while upper primary classes attract teenagers, who tend to be sexually active and hence prone to early pregnancies and marriage.

In explaining high rates of truancy in schools of poor countries, empirical studies tend to ignore causes associated with the school and the classroom processes. Yet a number of studies highlight the importance of leadership and teacher effectiveness in retaining especially those pupils from poverty stricken societies from dropping out of school (see Koedel, 2008). I hold the view that pupil dropout in poor countries such as Uganda may partly be a symptom of poor or even lack of appropriate teaching and leadership, to the extent that parents do not realise the importance of their children attending school. They could as well be engaging in competing economic activities, such as gardening. The current study realises the importance of effective school and classroom processes in improving learning that can, in turn, retain learners in school. This is of significant importance in developing countries such as Uganda, where pupils, especially in rural schools, are likely to drop out of school due to ineffective teaching and learning processes. This is sometimes perpetuated by high rates of teacher absenteeism (Barr and Zeitlin, 2010; Kamuli et al., 2012), undermining the efforts of such countries to enrol all school-age children in school.

Other metrics for access include the gross enrolment ratio (GER), the net enrolment ratio (NER), the gross intake ratio (GIR), and the Net Intake Ratio (NIR). According to these metrics, Uganda has made significant progress. To illustrate, the GER, which is a general measure for pupil participation in primary schooling, regardless of their age, rose from 70% in 1990 to 137% in 1997 and 117.7% in 2011 (Ministry of Education and Sports, 1999; Ministry of Education and Sports, 2003; Ministry of Education and Sports, 2011; Uganda Bureau of Statistics, 2012). This implies that, in 1990, only 70% of those meant to be in primary school (6–12 years) had access to education, but that this number grew significantly to 137% in 1997, partly due to the introduction of universal primary education. This percentage (137%), which is greater than 100%, implies that more than the number of children who were officially supposed to be in school actually attended school. This indicates that some of them were over- or under-age. This was to be expected, since at the introduction of universal primary education many parents, especially those that had been constrained by fees, decided to send their children to school. However, some who enrolled were of varying ages; that is, quite younger than 6 years while others being beyond 12 years (Ministry of Education and Sports, 2011).

Over-age enrolment could also be explained by rampant class repetition, that cause delays in pupils getting to their rightful grade levels. Significant age variance tends to complicate the teaching processes, as pupils may have significantly different knowledge and experiences that the teacher has to accommodate in lesson planning. To illustrate, Kamuli et al. (2012) indicated that the mature learners in the lower grades in Ugandan primary schools in their study were too old for the curriculum offered, to the extent that the content related to their personal growth, development and sexual maturation, thus it was obsolete for them. Some of these revelations support the need for more investigation into the effect of age, not only on attainment but on teaching processes.

Critically, access to primary education with specific reference to age is yet to improve. This is illustrated by the GIR, which measures the total enrolment in Primary 1 as a proportion of the total population aged 6 years, which is the official age for starting Primary 1. For example, in 2003 it was 156% and in 2010 it rose to 160%, before reducing to 140% in 2011. These percentages (156%, 160% and 140% are all above 100%) signify that more pupils are enrolling into Primary 1 than just those aged 6 years. This highlights the fact that still many are outside the official age bracket. On the other hand the NIR, which measures the proportion of children aged 6 who are enrolled in Primary 1, indicates significant improvement. For instance, 59% of children aged 6 had the chance to enrol in Primary 1 in 2003 and this has been improving to 2010, with 70%. The NIR declined in 2011 to 63.9%, probably due to parents not enrolling children of school age (Ministry of Education and Sports, 1999; Ministry of Education and Sports, 2003; Ministry of Education and Sports, 2011; Uganda Bureau of Statistics, 2012).

Overall, one would say that Uganda has made some progress as far as access to education is concerned. This view is upheld by the findings of Anyanwu and Erhijakpor (2007), who indicate that Uganda's achievement with regards to access to primary education is greater than that of her neighbours, including Sudan, Tanzania, DR. Congo and Mozambique. This has been partly due to the introduction of universal primary education in 1997. Nonetheless, it is also apparent that completion rates continue to deteriorate, due to various reasons discussed above. This trend is worrying, as it defeats the efforts of getting children to enrol in school. This implies that more effort and research is required to find ways to retain pupils who are enrolled. This current study tries to fill this gap by investigating the best processes and practices, in classrooms and the school in general, that enhance effective learning and hence create interest in children to stay on in school.

Moreover, some studies (see UWEZO, 2012) have indicated that Uganda has placed the emphasis on access without striking a balance between quantity and quality. The lack of balance tends to make learners and their parents lose interest in education (Ward et al., 2006). This study proceeds to provide a detailed account of the quality of education in Uganda.

2.2.3.2. Quality indicators of the Ugandan Primary education sector

While quality education remains an elusive construct that has no universally accepted definition, various indicators have been cited to represent it (Thomas et al., 2001; UNESCO, 2004). Quality indicators to be reviewed in the Ugandan primary education system include pupil cognitive attainment, the quality enhancers such as educational inputs and the equitability in quality indicators.

i. Teachers

Training and remuneration of most of primary school teachers is the function of the state. Basically, training of newly qualified teachers for primary level takes two years at a Primary Teacher Training College (PTC). By 2011, there were 169,503 teachers available to teach 8,098,177 pupils enrolled in the primary sector. Overall, 95.2% had the minimum qualification to teach and were distributed as follows:

- Teachers with basic entry qualification known locally as Grade III (GIII) – 70%
- Teachers with a diploma qualification known locally as Grade V (GV) – 21%
- Teachers with at least a degree qualification known locally as graduate teachers – 2.7%)
- Teachers with no formal teaching qualification, but licensed to teach (licensed teachers) – 3% (Ministry of Education and Sports, 2011).

Reports indicate that, prior to Independence and immediately after Independence, Ugandan teachers were regarded as well trained and of high quality and were much sought after in the region (Heyneman, 1983). This was partly due to the fact that the entry requirements to the profession were set high, and so only high performers in the national exams could join. Research and surveys (see Ward et al., 2006) indicate that neither preservice nor in-service teacher trainings are well directed to the needs of the primary sector, particularly when it comes to reading, writing and numeracy. This state of poor quality of teachers is further illustrated by the Wane and Martin (2013) World Bank survey, which indicated that only 19% of primary school teachers in public schools showed mastery of the curriculum they taught.

The National Assessment of Progress in Education report (Uganda National Examinations Board, 2012) has also cited teachers' lack of mastery of the national curriculum as one of the explanatory factors for lower attainment in literacy.

The effects of insufficient teacher training and the lack of mastery of the curriculum on pupil attainment are compounded by the astronomical increase in class size as a result of the introduction of universal primary education. This has led to extremely high pupil-teacher ratios PTR) in almost all schools. To illustrate, whereas PTRs were in the range of 1:28 to 1:38 from Independence to 1996, the introduction of UPE raised this ratio to a national average of 67 (see Ministry of Education and Sports, 1999). Although there have been reports of declining pupil-teacher ratios, to the currently reported 1:54 (see Ministry of Education and Sports, 2011), there is wide variation by school and location. To illustrate, most government schools that implement the UPE and are located in rural areas are reported to have very high pupil-teacher ratios (Ward et al., 2006). This could be partly due to the hardships and unfavourable conditions putting teachers off from going to teach in such schools. Moreover, those that choose to take employment in such schools are absent most of the time, making the few teachers who are physically present having to handle quite large classes (UWEZO, 2011; Wane and Martin, 2013; Ward et al., 2006; Kamuli et al., 2012).

The teaching processes in the classrooms have also been critiqued, with indications for a need for reform. It is suggested that not much has actually changed with regard to the teaching methodologies used in typical Ugandan classrooms. To illustrate, Ward et al. (2006) characterises the teaching process in Uganda's primary schools as mainly teacher directed, involving 'chalk and talk' and significant rote learning. Further, there is waning interest in continuous assessment, with less than half of the primary school teachers giving homework and which is, at times, not scored. Moreover, due to rampant teacher absenteeism, there is low teacher pupil contact time (Kamuli et al., 2012). School management processes have also been faulted. Ward et al. (2006) indicate that most primary school head teachers seem to be clueless with regards to providing professional leadership, guidance and mentorship to their staff. These observations further justify my study, to try to establish whether such variations in teaching and management processes could indeed explain any variations in pupil attainment.

ii. Budgetary allocations/per pupil expenditure

Relative to other sectors, education accounts for a greater share of the budgetary allocation in the country. In 2005, education took the chief allocation from the national budget at 17.1%, and this was increased to 22% in 2007. Since 2007, the education budget has on average been at 15% of the national budget, coming second to the Ministry of Works and Transport (Ministry of Finance Planning and Economic Development Background to the Budget 2005, 2007, 2010, 2013). Similarly, the sector receives significant funding from the donor community. It is imperative to note that the primary sector attracts the lion's share of the entire national budget. More of the primary budget (92%) goes on recurrent expenditure, including paying salaries and administration functions, with only 9% being used for capital expenditure (UNESCO Institute for Statistics, 2011). This could explain the ailing physical infrastructure of the country's primary education.

It is important to note that, even with such a significant investment in education, the country's per pupil expenditure (which is on average approximately $24 per annum), is ranked among the lowest in the world (Mugendawala, 2010). For example, according to UNESCO Institute for Statistics (2011), Uganda's per pupil expenditure as a percentage of her GDP is far less than that of her neighbours such as Kenya, Rwanda and Tanzania. This points to inadequate financing of education in the country. It could be linked to the current lack of adequate material and human resources that are critical for quality education. Most stakeholders in education have implored for increased financing of the primary sector, and there are also indications that the system is not efficient in using the meagre resources available. Further, merely increasing funding to the system without a proportionate improvement in the processing of such inputs would likely sustain the status quo. This study maintains that inputs would have more impact on pupil attainment if effective processes are ensured in schools and classrooms. Nonetheless, it is also cognizant of the need for a critical mass of resources that can sustain the effective processing of educational inputs to give rise to quality outputs.

iii. Outputs

There have been a number of initiatives involved in collecting primary data on the country's quality and equity in educational outcomes in the primary sector. These initiatives include the National Assessment of Progress in Education (NAPE), UWEZO, and the Southern and Eastern Africa Consortium on Monitoring Educational Quality (SACMEQ).

Though the initiatives use different metrics and methodologies in measuring outcomes, they are unequivocal that the country's educational attainment remains among the poorest in the region.

In its 2012 annual report on the quality indicators of Uganda's primary education, UWEZO (2012) indicates that learners who complete primary school in Uganda lack the basic and necessary competences that are required and expected of them. Underperformance is said to be prevalent in reading comprehension and numeracy. To illustrate, UWEZO (2012) indicates that only one of every 10 pupils from Primary 3 to Primary 7 could read a Primary 2 level story and correctly solve Primary 2 level numeracy questions. Ideally, it would be expected that pupils are able to demonstrate the required competencies for levels below their current grade so, where pupils apparently in higher grades fail to solve academic problems for lower grades, it is an indicator of learners who are being promoted to higher grades without attaining the necessary prior level competencies. Further, according to the UWEZO (2012) report, poor educational attainment is more profound in government than private schools. For instance, whereas only 3% of Primary 3 pupils from government primary schools could read a Primary 2 level story, 10% could in private schools.

Similarly, the NAPE Report (Uganda National Examinations Board, 2012), which is a publication of the UNEB, a government body, highlights some of the poor quality indicators in the outcomes of the Ugandan primary education system. NAPE is a national survey of Primary 3 and Primary 6 pupils. These two grades are the key stages in the primary school system in Uganda. Overall, the report indicates that, among the Primary 3 pupils surveyed, 30.1% and 46.7% could not demonstrate the required skills in numeracy and literacy, respectively, as specified by the national curriculum for Primary 3. Quality in educational outcomes was found to deteriorate further at higher grades. To illustrate, 54.8% and 59.2% of pupils in Primary 6 lacked the minimum level of numerical and literacy proficiency, as prescribed in the respective national curriculum for this grade. Primary 6 cohort comparisons indicate performance instabilities since 2007 in both mathematics and English (see table below).

	2007	2008	2009	2010	2011	2012
Mathematic	41.4%	53.5%	53.3%	54.8%	45.6%	45.2%
English	49.6%	47.8%	48.1%	50.2%	41.3%	40.8%

Table 1 Trends in the proportion of Primary 6 pupils that have demonstrated proficiency in mathematics and English in Uganda
Source: NAPE Report (Uganda National Examinations Board, 2012)

Quality in educational outcomes varies considerably according to gender, location of the school, school ownership and age of pupils (Oonyu, 2012; Uganda National Examinations Board, 2012). According to the NAPE Report (Uganda National Examinations Board, 2012), gender differences in performance in both mathematics and English are insignificant in lower classes, but become more pronounced with progression in grades and age. For example, in Primary 3 there has been no significant difference in the proportions of boys and girls reaching the minimum proficiency levels in mathematics and English (Uganda National Examinations Board, 2012). However, stark gender differences start to emerge when it comes to higher grades. For example, according to the NAPE Report (ibid.), in Primary 6, a significantly higher proportion of boys were found to be proficient in mathematics than girls. The same report indicates that the within and between gender differences are escalated by location, age of pupil and school ownership across both subjects. For example, overall, pupils in private schools have been found to perform better than those in government schools. Further, learners that attend urban schools on average perform better than those in rural areas. It was also found that pupils who are older than the official grade age tend to perform worse than their counterparts of official grade age. Some of these insights provided by the NAPE Report (ibid.) justify the need for my study to model educational effectiveness further, in the context of school ownership, location, gender and age, among others.

2.2.4. Emerging issues in the education system of Uganda

2.2.4.1. The HIV/AIDS pandemic

Uganda is one of the Sub-Saharan African countries that have been severely affected by the HIV/AIDS pandemic. The effects cut across all the stakeholders to education in Uganda: the parents; teachers; administrators and the pupils. Statistics from the UNAIDS indicate that currently, between 1.4 and 1.8 million Ugandans live with HIV/AIDS. The most affected age group is 15–49, with a prevalence rate of 7.2%. Women aged 15 and above form the biggest proportion (57%) of those living with HIV/AIDS. Further, it is indicated that around 190,000

children aged under 14 are living with HIV/AIDS. Around 63,000 persons are said to die annually from HIV/AIDS (UNAIDS, 2012).

HIV/AIDS has led to the education system of Uganda being overwhelmed by over 2 million orphaned children, of which 45% is attributable to HIV/AIDS (Kasirye and Hisali, 2010; UNICEF, 2008). It has increased the morbidity rates among teachers (Nyamurungi et al., 2007). This scenario has affected especially the primary education sector in terms of school enrolment, attendance, school performance and school completion and education attainment. A report commissioned by the Uganda National Teachers' Union (UNATU) indicates that HIV/AIDS remains the leading health problem afflicting teachers. In fact, the majority of the teachers consider themselves at risk of contracting the disease. This is due to the fact that some teachers are involved in sexual relationships with the pupils whom they teach (Nyamurungi et al., 2007). This report further indicates that 92% of the teachers in the country agreed to have been affected by HIV/AIDS, either directly or indirectly, and all this has been manifested in increased absenteeism, loss of teaching time to caring for the sick, inefficiency in teaching and stigma at work.

Though there have been ambivalent findings on the impact of HIV/AIDS on education outcomes, some studies have linked the effects of HIV/AIDS to poor outcomes. To illustrate, Kasirye and Hisali (2010) indicate that HIV/AIDS orphans in Uganda sometimes withdraw from school to look after their ailing parents. However, the same study indicates that HIV/AIDS orphans are not less likely to continue schooling, yet that orphans by far are more likely to fall below their appropriate grades. HIV/AIDS is also said to have worsened the socio-economic status of children left behind due to the death of their parents, their sole supporters in terms of education. To this end, Oleke et al. (2007) in their study in northern Uganda indicate that many HIV/AIDS orphans in Uganda are vulnerable, as they have no source of income, lack food and all this predisposes most of them to work in heavy domestic labour, and this affects their schooling.

The effects of HIV/AIDS on education have also been manifested in the ill health of some schoolchildren who have been infected through mother-to-child transmission at birth. The Uganda AIDS Commission indicates that 13% of those living with HIV/AIDS are children aged under 15. In most cases, such children lack the required medical, psychological and financial

support. This makes them vulnerable to opportunistic infections that make them skip school and, at worst, to drop out of school.

In response to the effects of the pandemic on education, the government, through the Ministry of Education, came up with awareness and support campaigns that are integrated into the school curriculum. Among others, these demand that schools give lessons on HIV/AIDS and appropriate sex education to pupils and staff. This is based on the assumption that awareness of how HIV is transmitted, and its effects on the person infected and their surroundings, will result into informed health behaviours. Further, schools are encouraged to offer support, including guidance and counselling, and in the form of reading materials and home visits, especially to orphans, as they are more likely to drop out of school. Further, HIV/AIDS-related knowledge and attitudes are now tested in the end of year primary examinations in Uganda. Much of the literature has been on evaluating the impact of HIV/AIDS on academic performance (Kasirye and Hisali, 2010), and it is largely unknown as to whether these school-based interventions reverse such effects. Elsewhere, some studies point to a positive effect (see Ma et al., 2014). The current study attempts to fill this gap by investigating this further, with reference to Uganda.

2.2.4.2. Widening academic performance gap

Although the country has tried to narrow the gap in enrolment with regards to socio-economic status and gender, there is an emerging trend in the Ugandan primary education system. This is the duality in the performance of learners. In the earlier years, just after Independence, Heyneman, (1976a) conducted in-depth research in Uganda which indicated that socio-economic status did not explain pupil attainment and that the poor were performing as well as rich children in class. This seems to have changed. The performance indicators show a dichotomy in pupil performance. Reports indicate a pyramid in the distribution of performance, with a small proportion of learners attaining the best grades, and a massive proportion located at the bottom quintile of the performance distribution.

Twikirize (2012) indicates that the small group attaining better grades is mostly from elite and affluent families, mainly living in urban areas and attending private schools in either the central or western districts of the country. This study indicates that poor performers are from poor families, mainly living in rural areas and attending government-aided schools located in either northern or eastern Uganda.

This is illustrated by the SACMEQ III project, which indicates that children from the bottom 25% of the socio-economic index performed far below the country average, and that the top 25% on the index perform far above the country average. The difference is said to widen even further in reading skills. Further, SACMEQ reports wider variations in scores in mathematics and reading in the four regions of the country. I see socio-economic status as the underlying cause of this. To illustrate, according to the SACMEQ scores, in both mathematics and reading the pupils from the central and western parts of Uganda (where fairly rich people reside) perform well above than the national average and those children from northern and eastern Uganda (where most of the poor pupils reside) perform far below, (SACMEQ, 2014).

The above is happening at a time when several reports are indicative of a widening socio-economic divide in the country. The World Bank classifies Uganda as one of the most unequal societies with regards to income and expenditure, with its income Gini measuring 44.3% (World Bank, 2014a). It could also be argued that the socio-economic divide that the country is experiencing is probably reflected in the widening gap in academic performance, especially in the primary education sector. This is reinforced in the study carried out by Mugendawala (2012) that indicated glaring educational inequalities based on income quintiles. In this study, findings indicate a widening gap in educational attainment between pupils in households in income quintile 1 and those in the fifth income quintile. To put this in perspective, quintile 1 households in the Ugandan context would be taken to be such households that are chronically poor and that manifest the following characteristics:

i. May not afford a meal each day of the week
ii. Spend less than a dollar a day
iii. Family members live with fewer than two sets of clothes
iv. Children in the household are most likely involved in child labour
v. Large family size, with extended family members
vi. Low parental education
vii. Reliant on subsistence or peasant farming
viii. No reading materials at home
ix. Engrossed in cultural rituals that hinder education of their children
x. Ill health, among others. (Kaduru, 2011; Uganda Bureau of Statistics, 2010)

It has also been indicated that the introduction of the UPE widened the performance gap (in terms of cognitive scores) between the socio-economic groups.

For instance, on the introduction of the UPE in 1997, most poor households who had their children not attending school due to fees problems took advantage of the opportunity and let their children re-enrol. Most of these poor children enrolled in poorly facilitated government schools that are free, and this is said to have further compromised the quality of education provided in government schools due to the surge in numbers amidst limited infrastructure and human resource. This scenario created a significant demand for quality private education for middle- and high- income pupils.

Hundreds of private schools have been established in the country and continue to achieve the best grades, while government-aided primary schools (where most of the children of the poor study) continue to deteriorate in standard. This study tries to illustrate further the extent of this widening gap in performance through its conceptualisation of education effectiveness in terms of equity and quality dimensions. Moreover, this is necessary in the light of the earlier empirical findings that indicate that socio-economic status had little or no influence on pupil attainment. The assumption taken by these studies was that African societies were more homogeneous and not highly stratified, unlike high income countries (Fuller, 1987; Heyneman and Loxley, 1983).

2.2.5. Concluding remarks on Uganda's primary education sector

The current state of Uganda's education is a culmination of different legislations and transformations that date back to the missionaries and the colonial masters from Britain. Policy making has been characterised by persistent themes such as increasing access, provision of skilled manpower for development, provision of an education relevant to societal needs, and building a high-quality primary school education through to university (Evans and Senteza, 1994). Whether such wishes have been achieved is still debatable.

There have been intermittent shifts in policy, mainly guided by the political dynamics and, to some extent, the donor community. For instance, it was in the interest of the post-Independence government to invest heavily in higher education to close the manpower gap created by the evacuation of the colonial service men. However, later research by the World Bank and the changing global trends (see Psacharopoulos and Hinchliffe, 1973), which tended to link primary education to greater societal benefits, probably led to the government shifting funding from higher education to primary education. Progress in the country's education sector has, to a greater extent, been constrained by various factors including fiscal and material, the unwavering political and civil instabilities and, most likely, the ineffective

processing of educational inputs. As discussed earlier on, political instabilities characterised by war and other forms of violence greatly affected the education sector, since much of the educational physical infrastructure was destroyed. Moreover, such turmoil led to educational human resources such as qualified teachers fleeing to neighbouring countries. The abject poverty associated with the country has also been a constraint to progress in the education sector.

The above notwithstanding, Uganda has made strides with regards to making primary education accessible to most school-age children. This is supported by legislation that made education a constitutional right, and the global campaigns such as EFA and the educational MDGs. The enrolment ratios indicate that Uganda is favourably competing, and at times outcompeting, her regional neighbours. For example, the country boasts a higher net enrolment ratio (above 90%) than that of the region, which stands at 77% (UNESCO Institute for Statistics, 2014). Nonetheless, some critiques say that the country has been obsessed with quantity at the expense of quality (Kasirye, 2009, Nannyonjo, 2007, Twikirize, 2012). These arguments seem plausible and have been reinforced by the standard of the outcomes of the country's primary education system. As discussed earlier, the Uganda National Examination report (2012), the UWEZO report (2012) and earlier reports have all painted a damning picture of the quality of educational indicators. They have indicated that fewer than half of the children leaving primary education system attain the required proficiency levels in numeracy and literacy in English that are prescribed by the national curriculum. Moreover, there are worrying trends emerging in the education system; that is, the HIV/AIDS pandemic in the education sector and the widening performance gap between richer and poorer children.

Other quantitative efforts in the country's education system have focused mainly on increasing the fiscal and human resources of the sector. Whereas this is a welcome campaign, much research has cast doubt on whether this can result in quality educational outcomes (Boulding, 1972; Coleman, 1966; Hanushek and Luque, 2003; Rivkin et al., 2005; Subotnik and Walberg, 2006; Hanushek, 2003). This implies that the relationship between educational inputs and outputs is more complex than thought earlier and that merely staking educational resources without significant improvements in the processing of such inputs can never guarantee quality outcomes. This study believes that with better classroom and school processes in place, there is a higher likelihood of the educational inputs yielding higher quality outputs. It is for this reason that this study undertakes to model educational process factors that account for

significant variations in educational outputs at various levels in Uganda's primary education. This undertaking is informed by the assumption that educational process factors are under the manipulative control of the school administrators and teachers, unlike the fiscal and material inputs. It advances the view that, whereas school administrators and teachers are constrained with regards to increasing on the supply of fiscal and material inputs for their schools, a considerable contribution could be generated if they performed the tasks that lie within their domains well. Moreover, this would be the most cost-effective way to tackle dysfunctional educational systems in resource-constrained economies such as Uganda.

CHAPTER THREE: LITERATURE REVIEW

3.0. Introduction

This chapter reviews key literature on educational effectiveness. This forms the basis for a better and clearer conception of the topic of study. Moreover, it is out of the review that this study can establish what has been researched so far in educational effectiveness with the intent to identify the knowledge gaps that need filling. The chapter engages with the different theories that can be used to guide the conceptualisation of educational effectiveness. Further, it undertakes a detailed review of various studies in developed and developing countries, partly to answer the questions raised at the beginning of this study. The chapter concludes with a critical review of educational effectiveness studies that have been conducted in Uganda in order to develop more hypothetical answers to the study questions.

3.1. The theory of educational effectiveness

The maiden study of Coleman et al. (1966) questioned the importance of the school in explaining variations in education outcomes. This created more impetus for further educational effectiveness research (EER). At the centre of EER is the quest to counter the mistaken belief that schools are insignificant in explaining variations in pupil attainment and that they have nothing to do with changing society around them (Reynolds et al., 2011). This quest has further shaped EER through various methodological (Goldstein, 2011) and conceptual phases (Teddlie and Stringfield, 1993). Nonetheless, significant inconsistencies in empirical studies with regards to what explains an effective education continue to thrive (Opdenakker et al., 2002; Reynolds et al., 2011). Brief highlights of the key EER models are given.

3.1.1. The education production function models (EPF)

These models adopt macro and micro-economic theories to explain effective education (Scheerens, 2012). Using the macro-economic theory, effective education prevails if its products can solve the macro-economic problems of society such as unemployment and economic growth. Given the difficulty in trying to model accurately the wider benefits of education and the macro-economic aspects, most of the proponents of the production function models have preferred to define effective education from the micro-economic theory. Through this lens, effective education is said to prevail if the material inputs to the education

system yield maximum possible educational outcomes (Fraser et al., 1987; Hough, 1991). In this case, educational effectiveness is computed as a ratio of total inputs to total outputs.

EPF models assume a defined direct relationship between educational inputs and outcomes (Scheerens et al., 1989). Also, they assume that all educational inputs can be quantified in monetary terms and that their costs can be determined. These assumptions could be seen as the weak points of these models in conceptualising effective education. To illustrate, Fox (1981), and Creemers and Kyriakides (2006) dispute the existence of such a direct relationship between inputs and outcomes in an education system, given that all inputs are processed through the school and the classroom. Moreover, given the complexity of producing educational outcomes, not all inputs to the system can easily be quantified in monetary terms. Further, Scheerens et al. (1989) indicate that EPF models are quite rudimentary and have always failed to distinguish the variations explained by fiscal and material inputs from those explained by process factors (throughput factors). In other words, they fail to open the process 'black box' to investigate the contribution of the school and classroom to educational outcomes. These criticisms notwithstanding, the EPF models remain popular in educational effective research, partly due to their ease of application in research (Heyneman, 1976b; Heyneman and Loxley, 1983).

3.1.2. The competing values framework (CVF)

The competing values framework, which is a clone of the organisational effectiveness models, defines educational effectiveness from four dimensions. These are the rationality of educational goals (rational goal model), openness of the educational system (open systems model), staff job satisfaction (human relations model) and the formal structures and procedures that ensure order in the school (internal process model) (Cameron and Whetten, 1983; Lewin and Minton, 1986; Quinn and Rohrbaugh, 1981). According to this framework, an education system would be judged effective if it optimises learning time, provides for parental involvement, ensures job satisfaction and creates an orderly school atmosphere for learning to occur (Griffith, 2003). This framework is said to be quite comprehensive and at the same time parsimonious in conceptualising educational effectiveness. This is reinforced by its ability to classify all educational effectiveness-enhancing factors into only four categories. Moreover, some scholars (Ten Bruggencate, 2009) indicate that it is among the few models that could be used to predict both the direct and indirect effects of school leadership on attainment. Further, the framework pays more attention to educational processes, provides a variety of educational

effectiveness criteria and conceives effectiveness as a function of all educational stakeholders (Reagan and Rohrbaugh, 1990). Nonetheless, the four categories of the CVF are too general and open to different interpretations. For instance, the open systems model could as well refer to educational theories, or even context, besides parents. Further, though the model purports to explain educational effectiveness, the fact that it fails to mainstream pupil learning and outcomes at its core serves to limit its application in EER, whose major aim is to improve the quantity and quality of learning outcomes. Moreover, each of the four perspectives appears to exert conflicting demands with regards to educational effectiveness.

3.1.3. The dynamic model of educational effectiveness (DME)

The dynamic model of educational effectiveness builds on the earlier effectiveness models of Carroll (1963) and Creemers (1994). It was suggested by Creemers and Kyriakides (2006) and is an illustration of the production processes of education which discern various levels, that is, pupil, classroom, and school level nested within systems level, also known as context. At the core of this model is the need to investigate effective education-enhancing factors at various levels and over time (Scheerens, 2012). In fact, the DME is an extension of Creemers (1994) comprehensive effectiveness model which conceives effective education through the formal principles of effective education, that is, consistency between activities at different levels, cohesion among staff, constancy or stability over time and control or internal accountability (Scheerens, 2012). Moreover, the DME argues for a broad conceptualisation of the effectiveness factors and educational outcomes. According to the DME, measurements of educational outcomes should transcend the frequently used cognitive scores.

In fact, the model argues for the integration of both the psychological and the sociological dimensions of educational effectiveness; that is, quality and equity, within the different domains of educational outcomes. To this end, effective education would prevail if school organisational and instructional processes are able to yield high-quality and equitable educational outcomes with consistency and stability over time (Kyriakides and Creemers, 2011; Rumberger and Palardy, 2004).

The DME model assumes that effective educational outcomes are attributable to a range of factors that discern levels in such a way that what happens at the school level is of paramount importance to classroom and pupil learning outcomes. Similarly, the model is cognizant of the fact that the school and hence the classroom processes are constrained by a context (systems

level) characterised by various educational policies, school ownership and assessment regimes, all of which profoundly affect the school, classroom operations and hence the educational outcomes (Drent et al., 2013; Reezigt et al., 1999; Reynolds et al., 2011). For example, the context sometimes defines the outcomes as generated by an education system, set the benchmarks and evaluation procedures. Yet, at the same time, the context sometimes presents certain constraints to the functioning of the education process (Scheerens, 2004).

Key educational effectiveness literature (Reezigt et al., 1999; Reynolds et al., 2011; Scheerens, 2012; Kyriakides and Creemers, 2011) indicates that the dynamic model is one of the most up-to-date multilevel model for educational effectiveness. This claim is further reinforced by Creemers and Kyriakides' (2012) claim that the DME is the theoretical framework for establishing appropriate approaches to educational effectiveness. This is based on the fact that it encompasses various levels of the education system, it is built on giving more attention to effective instruction and that it has already resulted in a proliferation of research studies with the potential to bring about more coherent research (Scheerens, 2012, p.10). Moreover, this model is said to yield accurate results since it adopts a multilevel framework that seeks to partition variations in educational outcomes to the various operational levels.

The current study is partly guided by the DME to establish the educational process factors that account for significant variations in educational outputs at different levels in Uganda's primary education. Moreover, it is further informed by the DME to fill the knowledge gap that earlier effectiveness research left when studies kept on suggesting a one-size-fits-all educational effectiveness model (see Kyriakides and Creemers, 2011). This implies that studies that envision differential effectiveness would benefit from using the DME as a framework, for instance, theory that hints that teachers and schools perform inconsistently across different educational effectiveness indicators (Kyriakides, 2007).

Nonetheless, it is important to note that developing countries tend to have their own unique contexts relative to the western world, where this model has been widely tested. Foremost, whereas the DME strongly argues for measuring each of the EE factors using the five dimensions of frequency, focus, stage, quality and differentiation, this may be untenable in some of the resource-constrained societies where comprehensive and multidimensional datasets are yet to be available. For example, teacher effectiveness variables such as orientation, lesson structuring and questioning technique would heavily rely on data that

contain observations of classroom processes for their measurement. These data are not available in most resource-constrained societies due to limited resources and structural and institutional instabilities.

Data constraints have further complicated the conceptualisation of particular process factors when trying to operationalise this model in the developing world. For instance, there are significant differences in the way factors such as school and classroom environments, quality of teaching, educational outputs and socio-economic status are measured in poor countries and the western world. An example is how some studies in poor countries (see Nannyonjo, 2007) have measured socio-economic status of pupils using parents' education, family size, distance from school, location, number of textbooks at home, pupil's age and the languages spoken at home by the learner. This measure may not discriminate well between pupils in an industrialised western country, where children in a particular grade are of fairly similar age, tend to live near the school that they attend and speak the same national language. Also, whereas having free school meals in the western world tends to be used as a reflection of low SES, in poor countries this could indicate a good school environment (see Bundy et al., 2009). Similarly, whereas the western conception of process factors such as teaching quality (see Creemers and Kyriakides, 2006) seems plausible, it may be impracticable within the context of resource constrained countries. Particularly, the overwhelmingly large classes and lean staff in poor countries tend to limit the teachers' ability to: interact with and attend to the needs of individual pupils; effectively use small learning groups; effectively manage class time; effectively assess learners; and create order in class (also see Teddlie, 2003).

In light of the above, researchers need to be careful when measuring educational effectiveness variables in different contexts. The same perception should be reflected while trying to apply the dynamic model in developing countries. The current study tries to do this by mainstreaming contextually bounded variables, such as HIV/AIDS and school term residence, to highlight the probable consequences that they may have had on educational effectiveness, especially in Sub-Saharan Africa.

Additionally, some of the formal principles and themes that need continual attention while applying the DME in studying educational effectiveness may not be applicable in resource-constrained societies, strictly speaking. To illustrate, whereas constancy and consistence (time dimensions) are important principles in the conceptualisation of effective education, most of

the education systems and the schools in developing countries are quite young and still vulnerable to fluctuations. This would deem them to be ineffective, even when they may not be. This would call for some relaxation of the principles, to capture the fact that such young systems could be effective but fluctuate.
Moreover, since not many such countries maintain longitudinal data over an extended period, there could be justification for using repeated cross-sectional forms of effectiveness in such countries, where it is possible.

As hinted earlier, the DME conceives educational outcomes through quality and equity dimensions. Nonetheless, there are no explicitly agreed definitions of the two dimensions in education. This study therefore proceeds by reviewing key literature on the aforementioned dimensions, and contributes to the debate on conceiving and measuring them.

3.2. Dimensions of educational effectiveness

Previous empirical studies have indicated various perspectives or dimensions that could be adopted to conceptualise educational effectiveness. Hitherto, these have not been generally agreed, but in all propositions to the conceptualisation of educational effectiveness, quality and equity are constants (Kyriakides and Creemers, 2011; Sherman and Poirier, 2007; Reynolds et al., 2014). In fact, Kyriakides and Creemers (2011) indicate that the proper conceptualisation of educational effectiveness can best be achieved through examining the extent to which an education system, unit or entity espouses the dimensions of equity and quality in providing education. The current study adopts this argument in its discussion of the dimensions of educational effectiveness. This is against the backdrop that educational systems in developing countries, the primary concern of this research, have been obsessed with the achievement of educational quantitative dimensions such as number of pupils enrolled, and have had minimum concern for quality and equity aspects (Hanushek and Woessmann, 2010; Thomas et al., 2001; Kasirye, 2009; Motala, 2001; Tikly and Barrett, 2007; UNICEF, 2000). Moreover, Hutmacher et al. (2001) indicate that effective education systems are those that can achieve three main goals: raising mean achievement level; reducing disparities in achievement; and decreasing the correlation between student's performance and their social characteristics (p.14). These goals can be conscripted into the two effectiveness dimensions of quality and equity.

3.2.1. The quality dimension of educational effectiveness

In the past, what quality education is has remained an unresolved debate. This is not surprising, given the differences in the perceptions of quality between the different educational stakeholders. In addition, the various frameworks used to conceptualise educational quality, the different sources of knowledge that inform the conceptualisation of quality, the different philosophical paradigms adopted by different authors on quality education, and the complex contexts in which education is processed and delivered among others serve to complicate the task of defining the quality concept effectively.

Moreover, the absence of or difficulty in generating objective data to measure educational quality comprehensively remain an obstacle to an acceptable definition of educational quality.

All the above challenges have constrained the efforts of those who have tried to contribute to a definition of quality education. But, as Glasser (1990) indicates, even with such ambiguities in the way that quality education is conceptualised, 'we always recognise it when we see it'. This view is further elucidated by Motala (2001), who indicates that, notwithstanding the complexity involved in trying to define education quality, there are clear and non-conflicting goals that provide an explicit indication of whether quality education has been attained or not. The current study joins the current debate by reviewing the relevant empirical definitions of quality education with the aim of extending the theoretical boundaries towards understanding educational quality.

A systematic review of the different conceptualisations of quality education can group them into the following themes:

i. Outcome based models of quality education
ii. Multimodal conceptualisation of quality education
iii. Quality models based on educational traditions
iv. System-based models of quality education.

3.2.1.1. Outcome-based models of quality education

Outcome-based models of quality education focus on educational outcomes, or outputs, to define and measure quality of education. Such quality models emphasise educational outcomes in terms of cognitive attainment, measured by tests and examination scores (Thomas et al., 2001). To this end, quality education would be implied by learners obtaining good grades, and the reverse would hold true for poor quality. These models have been

criticised for being too narrow in their conceptualisation of quality education (Muijs, 2006). It is said that the effects of education transcend the cognitive domain, so a quality education would be one that has an effect on each of the other domains. While outcome-based models can occasionally be extended to include the affective and psychomotor domains in measuring quality, the kind of information required to measure such domains is hard to come by, so the proponents of these models argue that cognitive scores remain popular because they are tangible, easy to collect and more objective than other outcomes. Moreover, others have argued that cognitive scores have a direct relationship to the school and classroom activities, given that the greatest part of the school curriculum revolves around causing cognitive development (Kyriakides and Creemers, 2011). Further, those who adopt these models to define quality education indicate that the other measures of educational outcomes have many factors that influence them over time other than the school (Sherman and Poirier, 2007; Kyriakides and Creemers, 2011).

One of the greatest weaknesses of outcome based models is that they perceive quality education as an event rather than as a process. Yet, the outcomes to education are as a result of the various systemic components that work in concert to cause cognitive change. Although this criticism may be valid, it is imperative to note that the output or outcome-based models to measure education quality are still popular for to the reasons mentioned, including the fact that they are said to be the most proximate measures of school effects. To this end, international tests and examinations used in comparative educational studies continue to rely on these models. These include the OECD's Programme for International Student Assessment (PISA), the Trends in International Mathematics and Science Study (TIMSS), the US National Assessment of Educational Progress (NAEP) and the Progress in International Reading Literacy Study (PIRLS), among others. The popularity of these standardised tests and the policies arising from them is partial evidence of the important role that outcome-based models play in measuring and defining quality education.

Various influential studies in educational effectiveness have also defined and measured quality education using outcome-based models. To illustrate, Coleman et al.'s study (1966), which generated the curiosity in academia to investigate the effect of schools on pupil attainment, was based on pupils' test marks. This study turned around education policy in the US and, as a result, many equality movements emerged to exert pressure on government to provide all-inclusive education to Americans, regardless of race, colour and gender, among other

attributes. Kyriakides and Creemers (2011), in their study investigating the extent to which schools can attain the two dimensions of educational effectiveness, defined quality education as pupil achievement gains in the cognitive and other domains.

With reference to resource-constrained countries, output-based models for measuring quality dominate. This is due in part to the absence of comprehensive data to measure other dimensions that would reflect quality education. To illustrate, whereas it would be imperative to measure the quality of an education system using both cognitive and non-cognitive domains, the forms of assessment in most poor countries remains largely summative. Even when some countries have tried to establish education management information systems, these are strictly limited to collecting basic data within schools.

3.2.1.2. The system-based models of quality education

System-based models draw on the input-process-output-context models of education effectiveness. The main assumption in these models is that quality education is a function of a quality system, including the context, inputs, processes, and the outcomes (Adams and Chapman, 2002; Ginsburg et al., 2001; Iacovidou et al., 2009; Scheerens, 2004; Tikly and Barrett, 2007; UNESCO, 2005; UNICEF, 2000). This implies that quality education is not an event in itself, but a characteristic of the set of the elements in the input, process and output of an education system that provides services wholly to satisfy both the internal and external educational constituencies by meeting their implicit and explicit expectations (Cheng and Tam, 1997, p.23). This makes quality education the sum total of the different contributions by each unit of the system towards quality educational outcomes.

This definition seems very broad and therefore may be problematic to operationalise. Nonetheless, its proponents indicate that it can only be out of a critical analysis of the quality aspects of the different components of the educational production process that a valid definition of educational quality can be claimed. This raises the question of how far each component of the education production system can be used to define quality education. Various scholars and institutions, including Adams and Chapman (2002), Ginsburg et al. (2001), Iacovidou et al. (2009), Scheerens (2004), Tikly and Barrett (2007), UNESCO (2005), and UNICEF (2000) have suggested how to examine critically the quality aspects of educational context, educational inputs, processes and outcomes. They also suggest the quality aspects of learners that would reflect a quality education.

The context, according to Scheerens (2004), is the source of inputs, but it also presents constraints to quality education. Moreover, it is the context that determines the benchmarks for quality education, coupled with evaluating the quality of educational outcomes. Further, Adams and Chapman (2002) indicate that quality education is contextual and so should be defined as such. It is argued that, since education is produced in various contexts with regards to educational funding, curriculum objectives, community involvement, language of instruction, political environment and legislation on inclusiveness, the definitions of quality education should mainstream such contextualities. To this end, based on the context, quality education can be taken to be the one that takes place in a favourable context. However, what would constitute a favourable context is a matter for debate.

According to UNICEF (2000), a favourable context for quality education would be constituted by:

- An environment that budgets enough resources, materials and facilities for education
- Curriculum whose objectives resonate well with those of the stakeholders
- Knowledge in such areas as gender equity, health, nutrition, HIV/AIDS and peace.

The above context is quite ideal. For instance, what constitutes 'enough' resources is a matter for debate, and depends on the community, region and country. Moreover, given that stakeholders espouse different objectives of education, it would be illusory to claim that the curriculum of instruction is in consonance with the will of all stakeholders. Nonetheless, through such ideals, countries and communities can try to map their standing in terms of providing a friendly context for quality education.

The system-based models also indicate that quality education could be defined in the form of the amount and quality of the inputs (Thomas et al., 2001; Zuze and Leibbrandt, 2011). This draws on the input-output theories of educational effectiveness, which associate educational quality and efficiency (Fraser et al., 1987; Hough, 1991). To this end, quality education would be proxied by the quality of the inputs that are fed into an education system, inter alia:

- Enough well-trained and paid teachers
- Enough and well-equipped classrooms
- Adequate per pupil expenditure

- Adequate textbooks per pupil, among others (see also Levin and Lockheed, 1993; Scheerens, 1990; Scheerens, 1991; Thomas et al., 2001).

Nonetheless, the fact that learning cannot take place merely by having quality inputs (see Boulding, 1972; Coleman et al., 1966; Hanushek and Kim, 1995; Hanushek and Luque, 2003; Rivkin et al., 2005; Thomas et al., 2001) highlights the importance of including the educational process factors in the educational quality equation.

This study maintains that educational inputs can only reflect quality education according to how well they are processed by the teachers in the classroom and in schools at large. To this end, through the lens of educational processes, quality education could be said to entail better teaching and learning practices, and school management practices that support teaching and learning.

Many scholars (see Adams, 1993; Bosker and Witziers, 1995; Campbell et al., 2012; Drent et al., 2013; Lumby, 2001; Mortimore et al., 1989; Muijs and Dunne, 2010; Muijs et al., 2004; Muijs and Reynolds, 2000, 2003, 2010; Opdenakker et al., 2002; Scheerens, 2001; Scheerens and Creemers, 1989) have tried to detail these processes that reflect quality education. Some are: a systematic and logical sequence of teaching; an orderly, a safe and healthy environment; clear, instructional objectives; maximum time on the classroom task; regular homework; high achievement expectations; regular monitoring of learning and feedback on all assessments; knowledge of and commitment to education quality by school management; and commitment to provision of adequate facilities.

From the above discussion, it is seen that defining the quality of education by using the system-based approach is quite comprehensive but is also demanding in terms of the information required. Thus, its operationalisation could be an uphill task. Moreover, it may not necessarily be the case that all the various components of the educational production functions have to be of high quality to result in quality education. This study holds the hypothesis that quality education could be a possibility, even in inadequate contexts and with inadequate inputs. This view is based on various empirical studies, including those of Muijs et al. (2004) and Levin and Lockheed (1993) that have hinted at the possibility of quality education in poor societies.

3.2.1.3. The multimodal conceptualisation of quality education

The above discussions about defining educational quality have an aspect in common; that is, that there is no universally accepted definition of quality education. To this end, some scholars including Cheng and Tam (1997) have proposed multimodal conceptualisations of quality education. These have mainly been transplanted from operations management into education. This could as well be a weakness, as it may well hinder their applicability to education. Nonetheless, they seem attractive to those obsessed with interdisciplinary research.

Cheng and Tam (1997) proposed seven models to define educational quality. These include:

i. Goal- and specification-based models
ii. The resource-input based model
iii. The process model
iv. The satisfaction model
v. The legitimacy model
vi. The 'absence of problems' model
vii. The organisational learning model.

The goal- and specification-based model defines quality education as one that achieves the specified goals and conforms to given curriculum specifications. This model assumes the presence of clear and consensual goals to be pursued by educational institutions. This assumption is idealistic, given that stakeholders are unlikely to agree on the same educational goals and curriculum objectives (Adams, 1993). According to the resource-input based model, quality education is defined by the quality of resources and other inputs into an educational institution (also see Zuze and Leibbrandt, 2011). The model assumes that scarce and high-quality resources are necessary for the achievement of diverse educational objectives and the provision of quality education. It is critical to note that this model ignores the role of educational processes in the definition of quality education. The process model defines quality education in terms of the efficiency and effectiveness with which an institution is able to turn inputs into outputs (Cheng and Tam, 1997). Just as the other process models, this model focuses mainly on the smoothness of the internal processes that allow teachers to perform effective teaching that yields quality outcomes. The satisfaction model is mainly applicable to the service industry, to measure service quality. According to this model, quality education is defined as one that can satisfy the needs and expectations of the core stakeholders to education. This implies that, if the education system can satisfy the expectations of the

teachers, learners, parents, the board, alumni, the industry, the community and the ministry, then it would be defined as being of quality. Given the diversity of expectations by the different constituencies of education, this model seems idealistic and not easy to operationalise.

Cheng and Tam (1997) indicate that the legitimacy model defines education as being of quality if the provider of such education can attain and maintain a legitimate level of reputation or position, relative to the peers in the same industry. This model assumes that only institutions that provide quality education can survive and become reputable. On the other hand, the 'absence of problems' model defines quality education as one provided by institutions that have no problems and internal difficulties in their operation. This is a very subjective definition and quite hard to operationalise since, in reality, no institution can exist without challenges or problems, as claimed by the model. Moreover, it is the quest to solve problems that perpetuates the existence of organisations. Finally, the organisational learning model defines quality education as one that is continuously being developed and improved. According to Cheng and Tam (1997), this assumes that quality education is dynamic, involving continuous improvement and development.

3.2.1.4. Quality models based on educational traditions

The body of education has been much shaped by the anthology of humanities, including sociology and psychology. To this end, these subject bodies have their own laid down frameworks for defining quality education.

The humanistic tradition, which draws heavily on the works of Jean Jacques Rousseau and John Locke, defines quality education as one that places the learner at the centre of each and every aspect of learning (Norman and Spohrer, 1996; O'Sullivan, 2004; Schweisfurth, 2011; UNESCO, 2005). This tradition asserts that quality education appeals to the idealist philosophy of how one teaches, of the relationship between the teacher and the student, of the way the classroom is set up and of the nature of the curriculum (Norman and Spohrer, 1996). The humanistic tradition rejects stifling, teacher-centred methods that rely on didactic, frontal, 'chalk and talk' teaching where the main focus is on rote learning (Schweisfurth, 2011; UNESCO, 2005). The humanistic tradition assumes that quality education involves learners engaging with knowledge or problems to construct their own meanings. In this process, the teacher takes the role of a mere facilitator rather than an instructor (Schweisfurth, 2011;

UNESCO, 2005). Whereas most countries and communities would wish to define quality education through this tradition, many obstacles make them unable to do so. Schweisfurth (2011) and O'Sullivan (2004) both illustrate that the presence of teachers' limited professional capacities, limited educational resources, a high pupil-teacher ratio and differences in how teaching and learning are conducted and understood by various educational constituencies tend to obstruct the operationalisation of such a definition.

The behaviourist tradition defines quality education on the basis of the cognitive achievement of learners. This tradition draws much on the theory of cognitive psychology that emphasises behaviour manipulation (stimuli) to attain particular intended results. This tradition makes many assumptions about human behaviour, such as:

- Learners are not intrinsically motivated or able to construct meaning for themselves
- Human behaviour can be predicted and controlled through reward and punishment
- Cognition is based on the shaping of behaviour. (UNESCO, 2005)

Therefore, this tradition suggests that quality education should involve direct and structured instruction, frequent monitoring of learning achievement, and motivating and guiding of learners (UNESCO, 2005). Similar to the outcome-based models, the behaviourist model regards tests and exams as central features of learning, the main benchmarks for quality planning and for delivering rewards and punishments (UNESCO, 2005).

Behaviourist quality models have been accused of restricting the educational agenda to just cognitive development, yet educational objectives transcend the cognitive domain. Despite such criticism, the behaviourist models remain popular in educational quality studies. As hinted earlier, most of the international quality comparisons use cognitive scores. Moreover, much of the country's curriculum and education reform agenda have been based on the cognitive objectives of learning (see Meghir and Palme, 2005; Card and Payne, 2002). This is against a backdrop where cognitive scores seem to be objective and easily quantifiable, and more closely related to classroom and school effects than other domains.

The other tradition that has been used to define quality education is the sociological perspective. Using this perspective, quality education is one that causes social change (Sreelakshmi, 2010). Moreover, quality education is perceived as the one that empowers learners with not only cognitive development but skills, attitudes and values that can enable

them to function well, to their personal and societal benefit. In fact, this tradition perceives quality education through the wider benefits of education, such as being able to enhance the socialisation process initiated by the family. This includes transmitting the core values of society and equipping learners with relevant skills, as required by society (UNESCO, 2005). This implies that society must be an integral part of curriculum development, in order to mainstream its needs in the curriculum. This tradition takes a broader perspective to defining quality education. Most of the measures suggested are not easy to quantify; neither are the outcomes easy to identify, as they may require some time to manifest themselves.

Finally, educational quality has been defined using the indigenous approaches that were spearheaded by Julius Nyerere and Mahatma Gandhi. This approach defines quality education as one that is able to liberate the citizenry from colonialism by integrating indigenous cultural values, self-reliance ideologies, equity and rural employment into the curriculum (UNESCO, 2005). Further, quality education is perceived as one that transcends the boundaries of the classroom and school, and involves non-formal and lifelong learning activities. This paradigm of quality education arose at a time of nationalism, when indigenous communities were reforming their education systems, as opposed to those propagated by their colonial masters through educational reforms. While this perspective on defining quality education has been lauded for agitating for the localisation of education, customised to the needs of the local communities, its operationalisation has been obstructed by globalisation and the modernisation agenda. This view is illustrated by Champagne (2009), Abu-Saad and Champagne (2006), and Burford et al. (2003), who indicate that globalisation of the language of instruction, coupled with the international educational treaties that try to make the education of different countries and communities comparable, plus pressure from donor communities for education systems to modernise and adopt western methods of teaching, have all made the operationalisation of this indigenous philosophy of educational quality untenable.

3.2.1.5. Reflection and conclusion on educational quality

I appreciate the uphill task of trying to define quality of education. Hitherto, there has been no generally agreed definition of quality education. Partly, this is due to the fact that quality is contextually bound, so each education constituency tends to emphasise particular aspects of education in defining quality education. Moreover, differences in the philosophical paradigms taken by different scholars in defining quality education further compound the task.

To this end, a critical review of the quality literature revealed emerging themes that form the basis of defining quality of education. To illustrate, some definitions are outcome based, others are system based and some are based on educational traditions, while others have been based on the multimodal conceptualisations of educational quality. Myriad definitions have accrued.

For instance, as highlighted earlier, the outcome-based models define quality education by the good grades scored by learners in cognitive tests and examinations. On the other hand, the systems-based models look at quality education as a process rather than an event, such that quality education is perceived to be the sum total of the different contributions by each unit of the educational system towards quality outcomes. The multimodal conceptualisation of education quality co-opts the various quality service models from operations management into education. It has been highlighted that quality has been defined using different educational traditions: humanist; behaviourist; sociologist; and indigenous paradigms.

All the above conceptualisations lead us to various definitions of educational quality. Nevertheless, apart from the different dimensions to defining educational quality, what is cross-cutting in all the definitions is the fact that quality education is associated with some improvement in the learning, achievement or attainment of the learner. This raises the problem of defining learning, achievement or attainment.

The scenario of lacking a generally accepted definition of education quality implies that policies on attaining quality education can never converge. This could explain the persistence of poor quality education, despite policy reforms. Moreover, some of the comprehensive and widely regarded definitions of quality such as the one suggested by the system-based model are quite difficult to operationalise, due to limited data and resources, divergent cultures and limited teacher capacity, among others.

In light of resource-constrained countries, the task of trying to define quality education is more complicated than ever. Most of the educational policies in poor countries are focused on getting all school age children to enrol in school – aspects to do with quality are secondary. Moreover, most of the quality frameworks have significant fiscal and material implications, such that quality is associated with the quantity of resources, which poor countries lack. In the context of poor countries, this makes the available quality frameworks look far-fetched.

While the system-based definition of education quality would be a plausible choice, I would be reluctant to prescribe the same in whole for poor countries. Rather, I would propose a functional definition heavily based on the systems model, but that gives more prominence to the quality of educational processes. This is against a backdrop where, given the constrained context and fewer inputs at these countries' disposal, quality would mainly be defined by what happens in the classroom and school at large. Moreover, the fact that empirical research has shown that some schools in poor societies are able to offer quality education reinforces my argument. To this end, quality education in the context of poor countries would prevail when pupils are able to score highly on the cognitive domain, with little regard for their background, context and school wealth.

Again, the above definition still attracts criticisms of being too narrow in conceptualising education outputs. This is true! However, it is a matter of keeping in touch with reality in poor countries. To illustrate, not many poor countries have paid attention to collecting comprehensive data that enable the measurement of other educational outcomes in addition to cognitive ones. The cost of doing so is prohibitive for these countries. Moreover, quantity rather than quality in education is still the focus of current education policies in most of these poor countries.

3.2.2. Equity dimension of educational effectiveness

Most of the arguments for equity in education have been based mainly on economic benefits of education, and they are well known (see Gorard and Smith, 2004; Hanushek and Kimko, 2000; Krueger and Lindahl, 2000; Thomas et al., 2001; Sherman and Poirier, 2007; Zuze and Leibbrandt, 2011). Besides the economic reasons for the need to have equity in education, there are social benefits that indicate the long-term advantages from education, accruing to the whole society. These include promoting social cohesion, citizenship, political participation and healthy living (Meschi and Scervini, 2013; Scervini and Segatti, 2012). All these reasons justify society's belief that equity in education should be pursued. Nonetheless, many structural rigidities continue to stand in the way of this ideal aspiration. Inequity persists in various education systems of the world. This has made educational equity a constant item on the international educational agenda. However, what remains elusive is how to perceive and conceptualise equity in education. Many debates on this seem to derail the actual policy formulation and implementation. For instance, some ask questions such as: equity of what and for whom? Moreover, there have been questions as to whether all inequality is really unfair, or some could be tolerated (Hutmacher et al., 2001).

This study attempts to add to the prevailing equity debate with regard to how it is conceived and measured. It is only then that we can make informed policy manoeuvres that are aimed at narrowing the education gap.

This study starts with a critical examination of the various equity frameworks that have been suggested to define and or measure equity in education. These include:

1. The Berne and Stiefel Framework (1984)
2. The EU Commission and OECD Systemic Framework (see Hutmacher et al., 2001; Sherman and Poirier, 2007)
3. The sociological paradigms to inequality.

3.2.2.1. The Berne and Stiefel (1984) Equity framework.

Berne and Stiefel, in their seminal work, 'The measurement of equity in school finance: Conceptual, methodological, and empirical dimensions', came up with a comprehensive equity framework with regards to the way school finances were being appropriated in the USA. This framework is a clone of the canons of taxation and is widely used in tax law. Berne and Stiefel's (1984) framework conceives equity through three dimensions;

i. The horizontal dimension of equity
ii. The vertical dimension of equity
iii. The equal opportunities dimension of equity.

Using the horizontal dimension, equity prevails where equally situated beneficiaries are treated the same, in terms of resource or opportunity appropriation (Sherman and Poirier, 2007; Musgrave, 1959; Musgrave, 1990). In education, equity through this dimension would prevail where pupils, schools or their local administration authorities that have the same needs are accorded the same amount of resources in terms of funding, teachers and textbooks, among others. Simply put, an equal education system will be one that ensures the equal appropriation of educational resources and opportunities to learners, schools and local authorities with the same intensity of need. Given that Berne and Stiefel's (1984) framework adopts the measures of dispersion such as range and coefficients of variation, the indicators of horizontal equality in education would include the presence of little or no variation in the dispersion of access, resources and cognitive scores in education. Specifically, equal education systems would be expected to manifest little or no differences in enrolment ratios,

expenditure per pupil, pupil-teacher ratios and pupil textbook ratios, among others, that are provided for the equally situated pupils, schools and local authorities. Horizontal equity assumes that a homogenous community exists (a community of equals) and that it is possible to identify with certainty those pupils or education-providing units that receive disproportionate educational resources. Unfortunately, this may not be possible in reality. For instance, communities consist of various learners, schools and local authorities, and trying to identify which units are equally situated is a daunting task. Moreover, realising that no communities are equal in terms of need and preference, some scholars have suggested an extension of the definition of horizontal equity as 'almost equal treatment of those who are almost equal' (Kaplow, 1989, p.140). The critiques of the horizontal dimension have suggested that, given that individuals and institutions are likely to be initially unequal, a better definition that is cognizant of this fact should be used. This calls for defining equity through the other dimensions; that is, vertical and equal opportunities.

The vertical equity dimension defines equity as the unequal treatment of unequals. Kaplow (1989) puts it simply, that equity in a system prevails when there is proper treatment of the unequals. In education, Iatarola and Stiefel (2003) used vertical equity dimension to define equity as the treatment of differently situated pupils differently. To this end, policies that espouse vertical equity would involve more appropriations of educational resources to pupils and educational institutions that incur high learning costs, due to their characterisation. For instance, vertically equal education systems would appropriate more resources to schools or learners that are disadvantaged. Disadvantage may be linked to disability, poverty, ethnicity, among others.

Sherman and Poirier (2007) applaud this definition of equity, in that it recognises the fact that each learner or educational institution has a different starting point relative to the rest, and therefore such individual characteristics should determine the differential treatment in resource appropriation. Indicators of equity using this dimension would include weighted expenditure per pupil, and weighted pupil-teacher ratios. Although this equity conceptualisation is preferable to horizontal equity, the crux lies in how to measure objectively how different are the various individuals or educational institutions before trying to come up with a method that would be regarded as fair to all, without creating more inequity. Moreover, there would be difficulties in trying to isolate the individual inequalities created by genetics and personal effort which may not actually be as a result of unfair distribution of resources

and opportunity. In this case, care has to be taken in trying to establish the equalisation factor for the unequal individuals and institutions.

The third dimension to defining equity, as suggested by Berne and Stiefel (1984) is equal opportunity. Using this dimension, equity prevails where learners have equal chances to succeed, and that success should depend only on their innate and individual motivation, not their ascribed characteristics such as socio-economic status and place of residence (Sherman and Poirier, 2007). This conceptualisation of equity would be termed a neutral formulation if there is no relationship between appropriation of educational resources and the characteristics of historically disadvantaged groups (Iatarola and Stiefel, 2003). On the other hand, those that espouse Marxist notions on equity believe in affirmative action.
To this end, Berne and Stiefel (1984) term this kind of equal opportunity as affirmative formulation of equity. Hence, equity is seen as prevailing where there is a positive relationship between the appropriation of educational resources and the historical characteristics of the disadvantaged groups.

Many countries have used affirmative formulation to define and enforce equity. To illustrate, Uganda used affirmative action to try to attain equity in higher education by providing more academic incentives to female students to enter public universities. One of the policies was the lowering of university entry threshold required by females, compared to those required by males. However, such policies have been criticised for trying to create same societies, instead of equity in education.

3.2.2.2. The EU Commission and OECD Systemic Framework

The European Commission and the OECD provide a more systemic approach to conceptualising equity in education in various countries (Hutmacher et al., 2001; Sherman and Poirier, 2007). This conceptualisation of equity draws on the fact that education exists as a combination of systems that work in concert to produce educational outcomes. To this end, equity has to be disaggregated in terms of the various components of the education system. According to the systemic framework, each component of the education process has to reflect equity dimensions. For example, an equitable education system should be seen to have equitable context, process, internal results and external results (Hutmacher et al., 2001). Specifically, contextual inequality would prevail where access to educational resources such as teachers and expenditure per pupil are associated with the context in which the learner or institution

operates. These contextual factors would include the community characteristics, school location, school size and budget framework for education. On the other hand, equity in processes would be defined according to the extent to which teaching and learning processes differ in classes, schools and local authorities. In other words, significant variations in the opportunity to learn would constitute unequal processes. To this end, if a particular proportion of pupils receives less curriculum content coverage and exposure than their counterparts, this would point to inequity in educational processes. Further, equity in internal results would be defined by the extent to which attainment in cognitive-based assessment is disproportionately distributed across student or school SES groupings. Finally, equity in external results would be defined by the extent to which the long-term benefits that accrue from education, such as social mobility, are disproportionately distributed among individual and societal SES groupings. The assumption taken in defining equity using the systemic approach is that inequity in one of the system components can be perpetuated in another system component. For example, according to Zuze and Leibbrandt (2011), whereas many developing countries have tried to create equity in their education systems through universal primary education (seen through increased enrolment ratios), inequity persists given that little effort has been directed to deal with contextual inequalities. To illustrate, even when education is free, there are still contextual rigidities such as family poverty, cultural constraints, distances to the nearest school among others that perpetuate inequity in the other components of the education system such as the processes and outputs. This therefore illustrates how important it is to take a systemic approach in policy making to tackle inequities in education.

Nonetheless, this illustrates how difficult it could be to apply this definition, since all the various components of the system have different actors. These may not agree on the ideals in tackling inequity. For instance, what schools view as the best policy to attain equity may seem impractical to parents and policy makers, and vice versa. Such tensions in the conceptualisation of equity have to be acknowledged and taken care of in any attempt to alleviate inequity.

3.2.2.3. The sociological paradigms to inequality

Benadusi (2001) suggested four sociological approaches by which equity could be defined. I personally hold the view that Benadusi's framework does not actually define inequality; rather, it explains how inequality arises. Nonetheless, it has been widely referred to in trying to

understand inequality in society. The four approaches through which equity could be conceived include:

i. The functionalist approach
ii. The social or cultural reproductive theory
iii. Cultural relativism approach
iv. The methodological individualism.

The functionalist approach draws on the works of Durkheim and Parsons, which postulate that inequality stems from two factors: ascription and achievement. Benadusi (2001) argues that inequality is a function of the factors that one has at birth, and these include social class, gender, ethnicity and nationality. Achievement factors include one's personal natural endowment and abilities. These explain why some persons can perform better or have more of particular type of educational resources than others. I argue that achievement factors are irrelevant to policy making in alleviating inequality, as there is nothing much to do about personal natural endowments. However, inequality that arises due to ascription is indeed relevant.

Using the social or cultural reproduction theory, Benadusi (2001) draws on the works of Pierre Bourdieu, where a discussion of the role of culture in reproducing class inequality is presented. To this end, Benadusi argues that, given that culture manifests itself through, among other things, the accumulation of resources and transmitting the same from one generation to another, inequality in propagated in society. Benadusi argues that not even schools are able to break such inequalities perpetuated by culture. Moreover, it is argued that education not only ratifies culturally generated inequalities, it participates in reproducing them in instances where education becomes a means to higher social stratification. While some of the assumptions taken by the social or cultural reproduction theory seem plausible, they may not be generalisable. For instance, contrary to what this theory suggests, there are many empirical studies that indicate how education can alter the disadvantages of historical minorities (Kewalramani et al., 2007).

Similar to the assumptions in the social or cultural reproduction theory, the cultural relativism approach to defining equity indicates that differences in people's culture perpetuate intergroup inequalities. This is reinforced by the argument that culture shapes individual

behaviour, thought, emotions and perceptions, which generate differences in the amounts of resources that particular people have access to.

Methodological individualism indicates that, in whichever incidence of inequality, individuals are the cause. Arrow (1994), Udehn (2002) and Agassi (1960) all suggest that, more often than not, individuals espouse personal aims and goals that may deprive others of equal access to resources. This way of conceiving inequality is quite limiting, as it may not be possible to control individual actions. This is even more so the case in capitalistic and competitive market economies, where individualism defines success at the cost of equality.

3.2.2.4. Measures of (In)equity in education

A number of metrics have been suggested by which to measure inequity in education. Sherman and Poirier (2007), Kelly (2012), Kelly (2015), Agrawal (2014), Gorard and Smith (2004), Haughton and Khandker (2014), and Kyriakides and Creemers (2011) provide a variety of metrics for educational inequity. These include the range, the range ratio, the coefficient of variation, the variance, the standard deviation, the correlation coefficient, the McLoone index, the Gini coefficient, the Theil index, the regression slope, the Lorenz curve and the attainment equity, among others.

Though there are a variety of metrics to measure inequity in education, there are common themes in the formulation of these measures, such as the deviation, dispersion, skewness and variance from the norm. The choice of the measure will always be guided by, among others, the principal cause of inequity, the equity definition adopted, the level at which policies are actualised, the robustness of the measure, the nature and availability of data, the kind of question on inequality being answered and, sometimes, value judgements (Haughton and Khandker, 2014; Kelly, 2015). Further, Kelly (2015) indicates that the transferability, scale invariance and decomposability of the metric could also affect choice of equity metrics.

It is critical to note that the quest to measure equity in education systems has emphasised equity in inputs and outputs. This claim is reinforced by the different metrics highlighted above. And yet, inequity in outputs is most likely a symptom of unequal exposure to key educational processes, in both the school and the classroom (Herman et al., 2000; Reeves and Major, 2012). This could be in terms of unequal exposure to the curriculum implementation processes, marked by significant differences in curriculum content exposure and coverage, and the

quality of instruction entailed in the classroom (see Jaafar, 2006; Osafehinti, 1987). This, therefore, reckons the importance of measuring the extent to which the school or classroom processes, or both, ensure equal exposure to curriculum content and quality of curriculum instruction.

In the absence of explicit metrics, the concept of opportunity to learn (OTL) is increasingly used as a proxy for the measurement of equity in educational processes (see Reeves and Major, 2012). Porter (1993) highlights three cross-cutting dimensions of opportunity to learn that have formed the basis for the development of some of the process equity measures. These are content coverage, content exposure and quality of instruction delivery.

Some studies that have tried to operationalise the OTL measure have used various metrics to approximate each of the three dimensions (Herman et al., 2000; Jaafar, 2006; Reeves and Major, 2012). In fact, this is one of the shortcomings of using the OTL to measure equity in educational processes. Nonetheless, the use of a variety of measures for the OTL dimensions by various scholars may be justified, given the inherent difficulties of measuring school and classroom processes. This is compounded by the lack of agreement on the process stage at which to take the measurement. Some of the metrics used to measure OTL are the number of lessons that teachers deliver per week, the time spent on task, classroom observation scores and OTL indices (Herman et al., 2000; Jaafar, 2006; Reeves and Major, 2012).

3.2.2.5. Conclusions and reflections on the best way to conceptualise equity in education

From the discussion above, it is clear that there is a variety of definitions and measures of educational inequity. The Berne and Stiefel Framework (1984), the EU Commission and OECD Systemic Framework, and the sociological paradigms of inequity all provide ways to conceptualise inequity in education. I have to say that none of the frameworks can be taken as self-sufficient in conceptualising equity. Moreover, care needs to be taken in the context of resource-constrained societies, where particular forms of inequality are fused with culture and/or societal values, and sometimes with factors beyond societal or governmental control. To illustrate, it is sometimes acceptable in most poor societies to give preference to boys' education, in instances where the family cannot afford to educate all the children in the household (Mehra, 1991; Kasente, 2003). In other instances, instabilities associated with poverty tend to widen inequality gaps. These include political instabilities, war, civil strife and

the abject poverty that lead to school dropout. Moreover, data constraints apparent in resource-constrained societies may limit the operationalisation of various equity definitions and measurements, and thus derail effective policy formulation and implementation. For instance, the equity measure method used by Kyriakides and Creemers (2011) requires a longitudinal dataset to estimate the divergence or convergence in attainment distances. Therefore, any definition and measure of (in)equity in resource-constrained countries need to be informed by the information available, and the context to include the cultural norms, prevailing educational policy regimes and educational funding, among others.
To this end, I would argue for equity definitions and measures that highlight the extent to which individuals or groups of individuals are able to take advantage of education in terms of opportunity and outcome. Such definitions would resonate well with the current educational policy pursuits in poor countries; that is, providing especially primary education to all.

The current study seeks to measure equity in the distribution of key inputs and outputs, such as attainment. Further, the study intends to establish the extent to which classroom processes offer all pupils an equal opportunity to learn. The educational Gini coefficient would be appropriate to measure equity in the distribution of educational outputs by SES groupings. This choice is against a backdrop that the educational Gini is an output-focused equity measure and that it fulfils the key properties of a good equity measure. To illustrate, the education Gini is mean independent, independent of population size, symmetrical and fulfils the Pigou-Dalton transfer sensitivity property (Haughton and Khandker, 2014; Hale, 2003). Moreover, it has a definite scale, which makes it easier to interpret than other measures that vary to infinity (Kelly, 2015). Most importantly, it is applicable to both cross-sectional and longitudinal datasets.

To measure equity in the distribution of inputs, I would argue for the Theils *T* index, given that it is an input-focused measure. Moreover, the fact that the Theils *T* is associated with a higher marginal utility of equity for transfers from the 'have-lots' to the 'have-nots' could be of paramount importance to policy making in resource-constrained countries, where the 'have-nots' form the majority. Nonetheless, this is also a weakness, as it fails to demonstrate the transferability property (Kelly, 2015). Moreover, its range is from zero to positive infinity, making interpretation and comparability complex.

3.3. Effective education processes

The dynamic model for educational effectiveness conceives educational effectiveness from the systemic perspective, with various components operating in concert to give rise to effective education. To this end, effective education is presumed to be as a result of:

i. Effective schools
ii. Effective classrooms (effective teachers)
iii. Adequate fiscal and material inputs
iv. A favourable context.

Effective education processes are taken to be the activities, routines, undertakings and settings that characterise educational processing units; that is, schools and classrooms and, in some instances, the community. These enhance the likelihood of learners acquiring the knowledge, skills and dispositions that they need to succeed in life. Many studies have been undertaken to investigate why, given the same resources and context, some schools provide higher quality education than others. Such questions have led to revelations that point to the presence of significant differentials in the activities, routines, undertakings and settings among schools that explain the differentials in pupil attainment. This has shifted attention from the study of the effect of educational inputs on educational outputs, towards the study of what takes place in the schools and, most importantly, the classroom. For this reason, the scope of this review is limited to educational processes in schools and classrooms.

This study starts by reviewing key classical studies at the core of the emergence and progress of the body of knowledge of effective educational processes. This is done by region, because most educational effectiveness studies have been regionally based and, to some extent, dominated by the USA, the UK and the Netherlands.

i. The USA

Some scholars (see Sammons, 1995; Teddlie and Reynolds, 2000) single out a number of studies that have provided the basis for further investigations in effective educational processes. These among others include studies by Weber (1971), Edmonds (1979), Brookover et al. (1979), and Teddlie and Stringfield (1993).

Weber (1971), who was an associate director for the council for basic education in the USA, conducted a study entitled Inner-city Children can be Taught to Read: Four Successful Schools. He examined the ongoing processes in four low socio-economic urban schools that were unusually effective in offering quality education to mainly ethnic children in New York, Kansas and Los Angeles. This study came just after the publication of Coleman's finding that the school did not much matter in effecting change in learners, thus seemed directed against such findings. Weber (1971) found that strong leadership, higher expectations, good atmosphere and careful evaluations of pupil progress characterise effective poor schools. Strong leadership, according to Weber, is characterised by an instrumental principal who sets the tone of the school, who crafts the school instructional strategies, and who is at the centre of the organisation and distribution of school resources. He indicates that all the principals of the four schools studied exhibited such characteristics. Further, Weber regarded a good atmosphere in schools as being constituted by an orderly, quiet and pleasant environment that favours academic concentration. Careful evaluation emphasises the acquisition of reading skills, reinforced by frequent evaluations of pupil progress. These results were in contrast with those of Coleman et al. (1966); Weber (1971) maintained that failure in learning to read was not the fault of learners or their backgrounds, as had been claimed by Coleman et al. (1966), but of the schools. This brought the school back into the equation of education effectiveness.

Inspired by Weber's work, Edmonds (1979) built on his findings to study the processes that explained differentials in pupil attainment further. Edmonds wanted to establish whether there were any schools that were instructionally effective for poor children in the state of Michigan, USA. He operated on the hypothesis that all children were eminently educable and that it was the school that was critical in determining the quality of education. Some of the conclusions drawn by Edmond do not differ greatly from those highlighted earlier by Weber. Edmonds established that schools that were offering fairly effective education to the children of the poor in Detroit model cities were characterised by:

1. A strong 'tyrannical' administrative leadership that brings and keeps all the elements of good schooling together. He argued that this kind of leadership should be in position to compel teachers to teach all children to at least the minimum levels of mastery of the basic skills
2. A climate of higher expectations in which no child is permitted to fall below the minimum levels of achievement

3. An orderly school atmosphere that is not rigid, is quiet but not oppressive, and generally conducive to learning and teaching
4. Total commitment to pupils' attainment of basic skills.

Edmonds indicated that some effective schools would, where necessary, divert non-academic resources to enable activities that would further the attainment of the fundamental objective of the school—making all children attain the basic level of reading and mathematics skills.

In addition to the above factors (which are exactly those highlighted by Weber), Edmonds indicated that effective schools that served poor children had a politicised parental teacher organisation that held the school to close instructional account. This may have been among the first studies to highlight the importance of parental involvement in the effective learning of their children. Edmonds did not explicitly define what he meant by a politicised organisation. Further, he indicated that, above all, effective schools were keen and eager to avoid things that do not work in the provision of effective education, as they were committed to implementing those that do. This highlights the importance of schools being flexible in trying to offer effective education. Moreover, it reinforces the fact that there can never be any single, rigidly prescriptive model to explain school effectiveness for the poor, or any other social class subset. Rather, it is imperative for stakeholders to scan their context to see what works and what does not.

The other classical study in the USA on school processes was that of Brookover et al. (1979). This was a study of school social systems and student achievement, to establish whether schools could make a difference in pupil attainment. Interestingly, it took place in the same area as Edmonds' (1979) happened—Michigan. This study was extensive, and covered a larger sample of elementary schools in the state of Michigan, with some cases of low socio-economic schools that were improving and others that were in decline. The Michigan Department for Education wanted to know the characteristics of elementary schools that were consistently improving and those that were declining. Using questionnaires and onsite visits and interviews, this study established differences between high-achieving and low-achieving schools. In fact, some of the findings overlap with those of the earlier studies by Weber (1971) and Edmonds (1979). This is to be expected, since the subject under investigation was mainly studied using similar units of analysis; that is, the school, the classroom and the pupil. Moreover, as Edmonds noted, effective education studies encourage applying what we already know.

To this end – besides strong leadership, higher expectations, a good atmosphere and the evaluation of pupil progress – Brookover et al. (1979) extended the investigation and added more school processes that characterised high-achieving schools relative to low-achieving schools. These include:

1. The time allocated and spent on instruction: Brookover et al. (1979) indicated that teachers in high-achieving schools were more actively involved in instruction in reading and mathematics than their counterparts in low-achieving schools, who spent most of their time attending to administrative duties.
2. Reinforcement practices: Brookover et al. (1979) indicated that high-achieving schools had appropriate methods of reinforcement of learning. These were inconsistent in low-achieving schools. To illustrate, high-achieving schools used proactive reinforcements and were receptive to the various available tools that would enable them effectively manage the process of learning and teaching. By contrast, low-achieving schools were mainly reactive, with reinforcement arising from of an event of poor performance.
3. Grouping and streaming of pupils: In this study, low-achieving schools were obsessed with grouping pupils according to particular characteristics, which tended to be disruptive to learning. This was not the case in high-achieving schools.
4. Staff levels of satisfaction: Staff in declining schools were found to be more satisfied with the current level of their pupils' attainment than their counterparts in improving schools, who were always less than satisfied and believed that there was room for their pupils to improve. The high levels of satisfaction in declining schools, according to Brookover et al. (1979), could be explained by a complacency created by the belief that teachers in such schools had nothing much to offer to effect change to the already condemned children in their schools.

Given the limited information on the methodologies used by Brookover et al. (1979) with regards to data analysis, it is quite hard to establish how objective these results are. Nonetheless, the fact that most of the findings corroborate those of the earlier studies reinforces their reliability.

Perhaps one of the breakthrough studies in the USA on effective school processes was that by Teddlie and Stringfield (1993). This was not only a comprehensive study with comprehensive findings, but a response to the apparent appeal of the need to use longitudinal data in such

work. Critically, most of the earlier cross-sectional studies could only serve to provide a snapshot of the processes in schools, thus had an inherent weakness due to the fact that they did not allow for the testing of consistency and issues of stability (Sammons, 1995).

Teddlie and Stringfield (1993) conducted a longitudinal school effectiveness project in Louisiana with the aim of finding contrasting features between effective and ineffective schools in different contexts. It is to be applauded for being among the first to include contextual variables such as the socio-economic background of learners in school effectiveness studies. Moreover, it used classroom observations, which are held to be the gold standard in terms of generating data on effective classroom processes.

Teddlie and Stringfield (1993) specifically collected information on the various processes, activities and settings in schools, grouped by socio-economic background. Schools were classified as middle SES and low SES. In each group, schools were categorised according to how effective they were in yielding quality education. This gave rise to four groups of schools that were analysed. These included:

1. Middle SES effective schools
2. Middle SES ineffective schools
3. Low SES effective schools
4. Low SES ineffective schools.

The main finding from this study was the fact that similar schools, with similar resources, could have completely different trajectories of pupil attainment, school and classroom environments. To illustrate, some schools of middle SES that could be expected to be effective in teaching were absolutely ineffective, while some schools of low SES that could be expected to be ineffective proved to be effective. This reinforced Edmonds' assertions that academic failure was neither the pupils' responsibility nor their characterisation, but that of their school.
The main themes that arose from this study revolved around leadership, faculty orientation and pupil involvement in school activities. Specifically, Teddlie and Stringfield (1993) hinted that the character and leadership style of the school principal was one of the significant process factors in the provision of an effective education. To this end, regardless of their socio-economic status, effective schools were found to have principals that were on top of all the activities taking place in the school. For instance, effective schools had principals who were active in instruction, supervision of instruction, had a close relationship with both academic

and non-academic staff, shared academic leadership with other staff, and who were fully involved in the hiring and guidance of teaching staff. This implies that principals of effective schools expended all their efforts, time and other resources mainly on teaching and the acquisition of academic skills. In contrast, leadership in ineffective schools was overly taken up with non-academic endeavours. For instance, they were spending much time and resources on administrative duties, not instruction.

Teddlie and Stringfield (1993) also noted that effective schools' staff members were more committed and interested in teaching all pupils, not merely some. The staff were warm and friendly, cohesive and worked as a team. Further, in such schools much time was spent on teaching, lesson preparation and assessment, and there was generally uniform teaching and curriculum coverage across all classes. Above all, staff in effective schools held high pupil expectations. These were clearly communicated by staff, who helped learners to work towards them.

With regards to student management, Teddlie and Stringfield (1993) indicated that effective schools involved their pupils heavily in the running of the school, provided a student-oriented atmosphere and had clearly set-out discipline management procedures, illustrated in the school rules and codes of conduct. Moreover, effective schools used corporal punishments as a tool of discipline management less than ineffective schools. Although the methods used in this study were quite different from those of Weber (1971) and Edmonds (1979), the results are comparable.

Nonetheless, Teddlie and Stringfield (1993) could be faulted for assuming a symmetrical difference between effective and ineffective schools. The study gives an impression that the processes in ineffective schools are the exact opposite of those in effective schools, which may not be the case. This is reinforced by the fact that effectiveness or ineffectiveness may have a contextual connotation, so eliciting literal antonyms of effectiveness processes to represent those in ineffective schools may not actually hold and may be fallacious. This is illustrated by the observation made by Gray, Wilcox and Woods (1996), that the factors that may be required to improve an ineffective school may, indeed, differ from the way effective schools maintain their effectiveness.

ii. The United Kingdom

According to Teddlie and Reynolds (2000), some of the classical studies that shaped the body of knowledge of educational processes in the UK include those by Rutter et al. (1979), Mortimore (1991) and Mortimore et al. (1989). It is also widely recognised that Pam Sammons' systemic OfSTED analysis of 1995 extended the theory and practice of educational processes in the UK. It is believed that most of the contemporary studies in the UK have built on the aforementioned study findings (see Reynolds et al., 2014).

Rutter and his colleagues' study, resulting in a publication named *Fifteen Thousand Hours: Secondary schools and their effects on children,* is said to be one of the most influential school process studies. It stimulated parental interest and involvement in the schooling process, as it argued for a return to more formal schooling (Burgess, 1981). This study wanted to establish answers to two puzzling questions. These were as follows:

1. Does it matter which school a child attends?
2. If there are consistent differences between schools, what are the features of schools that matter?

Using a sample of 12 inner-city London comprehensive secondary schools, mainly located in economically depressed communities, Rutter et al. (1979) undertook comprehensive studies of in-school processes. Using correlations and analysis of variances (ANOVA), it was concluded that the school that a child attends counts. This conclusion was illustrated by the presence of significant variations in the four outcome variables (academic achievement, students' behaviour, attendance and delinquency) in the schools in the study. For instance, Rutter et al. established that schools with better academic achievement did better also on other outcomes, such as attendance, behaviour and delinquency. Moreover, these results were said to have been consistent over a five-year spell.

Rutter et al.'s study is very important to the current study, in that their findings resonate well with my core objective. For instance, Rutter et al. made it clear that differences in school outcomes were not closely associated with the physical and fiscal variables in terms of the school buildings, the number of teachers at a school or the amount of money that the school had, among others. Rather, the significant differences emerged from the differences in the in-school processes. To this end, Rutter et al. listed the processes that were found to be significantly associated with higher-quality outcomes:

1. The amount of instruction time that a teacher spent teaching the whole class
2. The amount of homework that was given and appropriately assessed
3. Timely lessons that ran up to their conclusion
4. Generally accepted standards of behaviour, prevalent throughout the school
5. Displays of pupils' work and recognition of pupil achievement
6. Heavy involvement of pupils in the running of the school
7. Heavy involvement of teachers in the school activities, especially policies and practices
8. A clean, tidy and decorated (attractive) school environment. (see Burgess, 1981)

While some previous writers held that school processes predict pupil outcomes, Rutter et al. indicated that this is not the absolute truth. They hinted that such variables are less important in their own right than in the part they play in contributing to a broader school ethos or an atmosphere of expectations (see Burgess, 1981). This implies that such factors should be taken as preconditions for effective schooling.

Whereas Rutter et al.'s study partly forms the basis of school effectiveness research, some critics (see Burgess, 1981) argue that their findings need to be taken with caution. Foremost, given that the study used mere correlations and linear regressions such as ANOVA, it is impossible to claim any firm conclusions about causality, such as Rutter et al. would wish to portray from their findings. Moreover, given their small sample, generalisation would be a problem. Nonetheless, the fact that Rutter et al.'s findings corroborate those of various studies, including those done in other regions such as the USA, is a reinforcement of the importance of educational processes.

The other classical educational process study is provided by Pam Sammons in her OfSTED study of 1995. In her systemic analysis review of school effectiveness research (1995), she reviewed a number of studies to identify the key determinants of school effectiveness in elementary and secondary schools. From the review, Sammons established 11 processes characterising effective schools. She indicated that the effect of these processes on pupil outcomes seemed to differ with context and educational level. My current study further pursues this aspect by investigating more of the differential effects of the various educational processes on pupil outcomes.

Similar to the other classical studies on school processes, Sammons indicated that effective schools were characterised by: professional leadership; shared vision and goals; a learning environment; a concentration on teaching and learning; purposeful teaching; high expectations; positive reinforcement; monitoring of progress; an emphasis on pupil rights and responsibilities; home-school partnerships; and the school as a learning organisation. This elaborate list of findings from Sammons' (1995) review illustrates an ever-growing body of knowledge on educational effectiveness, so no one can ever claim a definitive list or prescription of process factors for effective schools. Moreover, as Reynolds et al. (2014) note, with the advent of more sophisticated methods of analysis and expansion of the body of educational effectiveness knowledge, the list keeps on growing. Nonetheless, given that most of the studies take place in similar regions and use similar units of analysis such as the school and classroom, most of the findings and hence the process factors tend to overlap. Accordingly, there are some factors that have had consistent acknowledgement with regards to having significant effect on pupil outcomes.

Muijs et al. (2014), Teddlie and Reynolds (2000), Scheerens (1991), Scheerens (2001) and Sammons (1995) highlight processes for which there has been greater consensus that they are significantly associated with highly effective schools. These can be redefined into the following themes. These would merit further review:

1. Leadership process
2. The teaching process (effective teaching, the quantity of academic activity and the quality of instruction)
3. School and classroom atmosphere.

3.3.1. The leadership process

There is wide acknowledgement that the leadership process significantly differentiates the effective from the ineffective institutions (Hallinger and Heck, 2010; Robertson and Timperley, 2011; Robinson et al., 2008; Sammons, 1995; Waters et al., 2003). Nonetheless, it is critical to acknowledge that some studies have found a small and weak effect of leadership on learning outcomes (see Kyriakides et al., 2010; Scheerens et al., 2005). Such differences in the magnitude and direction in the leadership effects could be attributable to among others the location where the studies were undertaken and the presumed nature of the relationship (direct or indirect) (see Bush et al., 2010; Hallinger and Heck, 2010; Mulford and Silins, 2003). Moreover, small leadership effects could arise in instances where there is limited variation in

the leadership processes within education providing units. Further, the difficulty in trying to gain consensus on what constitutes an effective leadership process could be another confounding factor in studying leadership effects in EER. Nonetheless, using management theory, an effective organisational leadership entails the execution of the core management functions of planning, leading, organising and controlling (see Drucker, 2012; Marquis and Huston, 2009; Robinson et al., 2008). Indeed, the many taxonomies of effective leadership, as suggested by various empirical studies, can be redefined into four management functions.

In schools, the planning function of leadership involves setting up a shared vision and goals, and crafting strategies to achieve such goals. Sammons' (1995) and Robinson et al.'s (2008) systemic analyses find that effective school leadership created shared visions and goals that enhanced the unity of purpose, consistency of practice, collegiality and collaboration. Sammons further illustrated that, through clear vision and goals, effective leadership is able to galvanise all stakeholders to function as a 'coherent whole', committed to quality in all aspects of school activities. This implies that effective school leadership needs to understand fully the school's needs by getting actively involved in school activities, so as to envision the destiny of the institution and possible threats to it (Mortimore et al., 1989).

Besides planning, Cole-Henderson (2000) and Reynolds et al. (2014) indicate that effective leadership involves leading, which entails motivating and directing staff towards the ultimate attainment of the set goals. To this end, as Sammons (1995) and Teddlie and Stringfield (1993) indicated, such leadership is always willing to share responsibilities with other staff, and able to provide support and resources to such staff in executing their duties. However, it is imperative to note that effective leaders are also able to judge carefully when to apply what style of leadership and when to involve others. Further, as part of the leading function, Cole-Henderson (2000), Reynolds et al. (2014), Teddlie and Reynolds (2000), and Marks and Printy (2003) maintain that effective leadership involves parents and students in the running of the school. Mortimore et al. (1989) found that schools that operated an 'open door' policy encouraged parents to become more involved in the education of their children, hence achieved better educational outcomes. Nonetheless, this contradicts the findings of Brookover and Lezotte's (1977) classical study that concluded that parental involvement per se may not be an indicator of effective leadership. Rather, they noted that parent-initiated involvement seems to be more effective, as suggested by evidence from their study.

It has also been argued that effective school leadership plays an organising function. This involves the establishment of a framework for the performance of school activities in a systematic manner. Teddlie and Stringfield (1993) indicated that effective school leaders tend to establish appropriate organisational structures that define staff responsibilities, which translated into effective use of staff and other resources. Moreover, clear organisational structures have been said to lessen staff conflict and to increase staff cohesion, since they clearly set out staff expectations and the relationships between the various departments. Further, Reynolds et al. (2014) and Sammons (1995) indicate that, as part of the organising function, effective leadership must have the capacity to organise for the acquisition of additional resources to potentiate innovation and change.

Finally, effective school leadership entails effective control of all the processes, activities and resources in the school. Effective head teachers have been found to be actively engaged in the direct monitoring, assessment and correction of both academic and non-academic activities. Sammons (1995) and Reynolds et al. (2014) hint that monitoring and evaluating teachers, pupils and the whole school enable leaders to gauge the extent to which the set goals are being realised, and refocus the various school stakeholders towards such goals.

Whereas the above could be taken to constitute effective leadership, they may all be necessary but not sufficient in all situations. Waters et al. (2003) and Sammons (1995) argue that effective leaders need to generate styles that are customised to the situation obtaining in their organisations, rather than sticking to general prescriptions from empirical studies. It is further argued that other confounding factors, such as the head teacher's experience, the specialised training they have undertaken and their educational levels, tend to differentiate between effective and ineffective leadership. To illustrate, Waters et al. (2003) argue that experiential knowledge and some specialised training increase the likelihood of effective educational leadership. Nonetheless, the effect of the educational level of the school leader is quite ambivalent. For instance, Clark et al. (2009) find little evidence of any relationship between the principal's education and effectiveness of leadership, and hence school performance. This could partly be the reason for including this variable in the measurement of the school management competence indicator.

3.3.2. The teaching process

According to Muijs et al. (2014), the amount of time that teachers spend on instruction that is related to the curriculum, the amount of time that pupils spend on tasks related to the curriculum and the amount of time that teachers spend on lesson preparation significantly differentiate the effective from ineffective schooling processes. It is said that the quantity of teaching activity is a crucial process factor that reflects how effective or otherwise a school may be. To illustrate, it is said that effective school processes are characterised by better opportunities for pupils to learn by emphasising academic study, maximising learning time and having staff and administration actively involved in direct instruction that is academically focused (Brookover et al., 1979; Edmonds, 1979; Joyce and Showers, 1988; Reynolds et al., 2014; Teddlie and Reynolds, 2000; Teddlie and Stringfield, 1993).

The assumption of most empirical studies is that there is a linear relationship between duration of instruction, as a school process, and pupil attainment. Nonetheless, some studies have not found the amount of time spent on instruction as important (Scheerens and Bosker, 1997). This implies that merely spending considerable time on instruction does not imply an effective schooling process. Rather, as Muijs et al. (2014) indicate, all the time spent by students and their teachers should be on curriculum-related academic activities. This aspect is vital, as it highlights the core business of schooling; that is, teaching and learning.

Besides quantity of teaching, instructional quality is said to be an important aspect of an effective teaching process. This implies that it is important for teachers not only to focus on the time spent in class but also the quality of the work undertaken while in class. Muijs et al. (2014) indicate that quality teaching would involve a well-structured lesson that makes it easy for pupils to memorise what has been taught. Specifically, the teacher is expected to introduce the lesson, develop it into the body of the lesson and then to provide a review and summary of what has been learned. To illustrate quality instruction further, Stevenson and Nerison-Low (2002), using a classical example from Japan, indicate that:

> In Japan, emphasis is placed in a mathematics class, for example, on presenting a practical problem in mathematics, eliciting different solutions from students, getting other students to evaluate the effectiveness of the solutions, and then bringing the lesson to a close by summarizing the lesson and stating the rules that govern the solutions to the problem. (p.139)

Quality teaching is also reflected in the correct use of the questioning technique, praise for correct answers and a focus on the class as a whole (see Hattie, 2013; Joyce and Showers,

1988; Muijs et al., 2014; Scheerens and Bosker, 1997; Stevenson and Nerison-Low, 2002; Teddlie and Stringfield, 1993). All of the above characterisation of quality teaching require prior lesson preparation. The Third International Mathematics and Science Study (TIMSS) epitomised the importance of lesson planning in mathematics. As Peterson (2005) illustrates, lesson planning and preparation remain the distinguishing variable between the way mathematics is taught and learned in Japan and the USA. This is partly illustrated as below:

> Lessons are carefully planned, including the questions that will be asked, the examples that will be used, the sequence with which the material will be presented, and the kinds of information that will be conveyed through the medium of textbooks, worksheets, practice books, and notes on the chalkboard. (p.132)

Both the quantity and quality of teaching rely heavily on some core competencies and qualities possessed by a teacher (Jepsen, 2005). This is reflected in the words of Hamachek (1999): 'Consciously, we teach what we know; unconsciously, we teach who we are' (p. 209). This implies that teachers cannot give what they do not have, therefore teaching processes tend to be reflective of the qualities, attitudes and experiences of the teacher who passes on the knowledge. In their comprehensive systematic review, Wayne and Youngs (2003) highlight that teachers that possess an integrated body of knowledge related to the subject taught, and a higher qualification aligned to the subject being taught and some teaching experience tend to impact on pupils' learning positively (also see Korthagen, 2004; Sammons, 1995; Cole-Henderson, 2000; Feng and Sass, 2013). Further, it is indicated that teachers who are satisfied and motivated to teach are said to be effective in teaching. Opdenakker and Van Damme (2006), Brookover et al. (1979), and Korthagen (2004) all highlight the importance of job satisfaction, indicating that it cultivates and nurtures a strong sense of self-worth, deep feelings of love for the profession and a sense that they can positively contribute to pupils' learning.

Nonetheless, it is important to note that the relationship between some teacher characteristics and effective teaching remains indeterminate. To illustrate, it is very difficult to clearly interpret such relationships, given that some seem to be mediating factors while others seem to be measures of different constructs. An example is given by Wayne and Youngs (2003) of how diverse the interpretation of teaching experience and effective teaching can be. On the one hand, such a relationship could be a reflection of motivation. This is because motivated teachers are likely to stay longer in their profession and hence gain much experience. To this end, it is quite difficult to separate the effect of motivation from experience in trying to explain variations in teaching effectiveness. Moreover, similar scenarios could arise with regards to the

effect of qualification on teacher effectiveness. Wayne and Youngs (2003) indicate that higher qualifications tend to attract higher pay. This may increase the motivation of staff, which may result in more effective teaching.

It could be for the above reasons that some studies have not found teacher characteristics such as educational level to be significant in explaining teaching effectiveness, and hence pupil attainment (see Ehrenberg and Brewer, 1994; Ehrenberg et al., 1995; Jepsen, 2005). Such inconsistencies could also be related to contextual differences. The current study adds to this debate by including some of the above contentious characteristics to the conceptualisation of a key variable; that is, Teacher Academic and Professional Capital (TAPC).

Some studies have argued that teacher effectiveness could be induced mainly through customised CPD training. At the core of these arguments is the assumption that constraints to effective teaching may be ameliorated through specialised training for teachers (Cole-Henderson, 2000; Reynolds et al., 2014; Korthagen, 2004). Moreover, it is argued that such programmes help teachers to reflect, access new ideas, experiment and share experiences within the school. This is expected to translate into school and classroom improvement (Hargreaves, 1994; Muijs and Reynolds, 2010; Talbert and Mclaughlin, 1994). Nonetheless, such claims are difficult to validate, given the limited frameworks for evaluating the impact of CPD on teacher effectiveness (Muijs and Lindsay, 2008).

3.3.3. The school and classroom environment

Even when the Coleman et al. study (1966) discounted the importance of schooling in predicting educational outcomes, many scholars (Mortimore et al., 1989, Muijs and Dunne, 2010, Muijs and Reynolds, 2003, Opdenakker et al., 2002) continued to argue that the school accounts for significant variation in pupil attainment. Similar results have been found in key studies by Scheerens (2001), Scheerens et al. (1989), and Bosker and Witziers (1995). Specifically, these scholars argue that what happens in the school, and with regards to the school environment, profoundly impacts on the quantity and quality of education accessed by learners.

Whereas there has been some consensus generated on the school environmental effects on educational effectiveness, the same is not true when it comes to its conceptualisation. This is partly due to the fact that different educational stakeholders have different experiences of the

school (Griffith, 2000), from which scholars produce particular snapshots to constitute 'school atmosphere'. Organisational theorists such as Tagiuri et al. (1968) indicated that organisational atmosphere would be constituted by the setting, situation, atmosphere, scene, location and surroundings of an organisation within which work occurs.
This definition has been illustrated in educational terms by Osher and Boccanfuso (2014), who indicate that the school (and implicitly classroom) environment would be constituted by such dimensions as:

i. The physical environment
ii. The academic environment
iii. The social environment.

It is seen that all these environmental dimensions play in concert to provide an appropriate school or classroom environment, or both, in which effective teaching and learning can take place (Lehr, 2004).

3.3.3.1. The physical environment

Osher and Boccanfuso (2014) highlight that the physical environment, constituted by the state of school buildings, physical safety, school wide protocols and classroom management, is a very important aspect of an effective school. Even when some of the suggested dimensions of the physical environment do not merit a school process, the assertions by Osher and Boccanfuso (2014) have been reinforced by the findings of Sammons (1995), Cole-Henderson (2000) and Rutter et al. (1979). To illustrate, Sammons found that an attractive physical environment, characterised by a good state of repair and maintenance, improves teaching and learning morale, and that it is a precondition for effective school processes. She further indicated that neglected buildings tend to encourage vandalism, which in turn disrupts academic activities. Similarly, Cole-Henderson affirms the fact that the physical ecology in terms of well-kept school buildings is a precondition for effective schooling.

Another aspect of the physical environment that is characteristic of effective school processes is the orderliness and safety of the physical environment. Opdenakker and Van Damme (2006), Sammons (1995), Reezigt et al. (1999), Scheerens (1990), Lezotte and Snyder (2010), Teddlie and Reynolds (2000), and Osher and Boccanfuso (2014) all indicate that effective school processes entail well-arranged schools and a quiet atmosphere, non-chaotic, free from risky

behaviours, allow feelings of belonging without discrimination, and have rules and regulations that guarantee safety for teachers and students against any form of physical and or psychological abuse. Scheerens et al. (2007) further write that such schools will have well elaborated procedures and interventions to deal with deviant behaviour or class and lesson disturbances.

In resource-constrained communities, which are the focus of this study, the physical environment is a very important aspect of effective schooling. To illustrate, it is vital to note that these communities are still struggling to provide the basic physical environment for learning to happen. For instance, most of the schools lack adequate sitting space, writing space and teaching aids in classes, yet these are inherent aspects for any learning activity to happen. Further, textbooks are still an important aspect of the physical environment, given the limited Internet penetration in such societies. Of course, there have been contrasting findings as to whether having textbooks in classrooms and good buildings is a reflection of an effective physical environment (see Kasirye, 2009; Najjumba and Marshall, 2013; Nannyonjo, 2007). This study adds to the little evidence available on whether variations in the aspects of the physical environment, especially in poor societies, would indeed be reflected in the variations in educational effectiveness.

3.3.3.2. The academic environment

It is said that effective schools have an academic environment that challenges students. Such an environment holds high expectations of their pupils academically. They provide rigorous academic opportunities, nurture strong academic motivation and are connected to the students' life goals (Osher and Boccanfuso, 2014). Many scholars have highlighted the importance of high expectations of pupils' performance to the creation of an effective academic environment (Brookover et al., 1979; Cole-Henderson, 2000; Joyce and Showers, 1988; Lezotte and Snyder, 2010; Reynolds et al., 2014; Sammons, 1995; Teddlie and Reynolds, 2000; Weber, 1971). To illustrate this further, Muijs et al. (2014) hint that 'students that teachers expect to do well tend to perform better, while students who are expected to do badly tend to fulfil their teachers' expectations as well' (p.235). Similarly, Sammons (1995) indicates that holding high expectations of pupils' academic attainment creates a general culture that demands everyone in the school to contribute to pupils' learning. Moreover, Sammons elucidates that such expectations need to be communicated and backed up by an intellectually challenging environment.

It is however critical to note that the contribution of pupils' high expectations to their effective schooling, and hence academic attainment, tends to be tricky to interpret (Muijs et al., 2014, Sammons, 1995). For instance, there are indications of schools that have held high expectations for their pupils yet they have remained ineffective in improving pupil attainment (see Teddlie and Stringfield, 1993). This implies that higher expectations need to be backed up by the ability of learners, mainly through the provision of rigorous academic opportunities coupled with strong personal motivation. Other scholars have characterised an academic environment as one with pervasive focus on academic activities and outcomes (Liu, 2006; Opdenakker et al., 2002; Teddlie and Reynolds, 2000). Moreover, this is aimed at creating the motivational beliefs of self-efficacy and self-regulated learning that characterise an effective academic environment.

3.3.3.3. The social environment

The social environment as described by Osher and Boccanfuso (2014) entails interpersonal relations between students and staff, respect for diversity, emotional wellbeing and sense of safety, student engagement, school and family collaboration, and community partnerships. Critically, some of these dimensions overlap with other school processes. Nonetheless, in their meta-analyses, Muijs et al. (2014) reinforce that teacher-student interaction, student to student interaction, students' treatment by their teachers, competition and collaboration among students, and classroom orderliness are key preconditions for an effective classroom social atmosphere.

The above revelations indicate that educational stakeholders, especially the teachers and head teachers, should not only focus on academic activities but must establish and ensure a social environment in which all students can thrive. This is against a backdrop of students being supported socially, engaged, and helpfully challenged, and can result in a number of outcomes such as increased learning and achievement, enhanced school connectedness, reduction in school dropout, prevention of bullying and other forms of violence, and higher teacher retention rates (Ciccone and Freiberg, 2013; Osher and Boccanfuso, 2014). Nonetheless, the creation of a conducive social environment in school requires an empowering administration that can enable learners to participate in a wide range of pro-social activities. At the same time, learners bond with caring, supportive adults who can act as their role models (Osher and Boccanfuso, 2014).

3.3.4. Educational processes in resource-constrained countries

3.3.4.1. Introduction

I define resource-constrained countries and societies as those classified by the World Bank as poor (World Bank, 2014b). Most of these countries are found in Africa south of the Sahara, East Asia, the Pacific and Latin America. These countries are characterised by abject poverty, low levels of education, low levels of industrialisation, low levels of life expectancy, and high infant and maternal mortality, among other factors. All these indicators have ramifications for the quality of education in such communities.

Quite a number of studies have correlated the ineffective educational systems of poor countries to a lack of material resources (Boissiere, 2004; Heyneman and Loxley, 1983; Owoeye and Yara, 2011). To this end, poor countries have always justified and sometimes disguised their poor educational indicators amid their inherent poverty, which has tended to frustrate accountability. Moreover, many efforts in such countries have been biased towards seeking external support for their educational systems in the hope that they will attain effective education, which remains an illusion.

Whereas poor countries indeed need the critical resources to boost their education systems, it is also becoming apparent that some institutions within poor societies can offer effective education (see Acker-Hocevar et al., 2012; Harris et al., 2006; Taylor et al., 2000). Nonetheless, these incidences have not received wide attention in terms of research to showcase the kind of processes apparent in such institutions that have broken the norm by providing effective education, their poor status notwithstanding. Yet, while some scholars would wish to do so, a number of constraints may not enable them to. Foremost, the lack of comprehensive datasets with significant observations on the educational processes, mainly in the school in general and the classroom in particular, remains a barrier to educational effectiveness research in such societies. Most research is limited to estimating the effect of easily quantifiable variables such as classrooms, teachers and textbooks on academic attainment. Moreover, those that have tried to model educational effectiveness in a more comprehensive manner have been faced with issues to do with misspecification of particular crucial variables such as pupil background and ability, due to incomplete data. Consequently, there have been either over- or under-estimations of some multivariate effects.

With the advent of research initiatives such as the SACMEQ, it is becoming possible to analyse educational processes that have been linked to better academic attainment in poor countries. Even with such datasets, in-depth process analyses cannot be sustained since they are broad but rather shallow. Moreover, most datasets from such initiatives are cross-sectional.

The current study is among those much needed to highlight the fact that resource-constrained communities deserve, and can attain, effective education if the processes that matter receive attention. Going forward, this study provides a brief review of educational processes that have been identified by studies conducted in these societies as significantly affecting education attainment.

3.3.4.2. Processes that explain effective education in resource-constrained countries

Earlier conceptualisations of educational effectiveness in developing countries (Heyneman, 1976b; Heyneman and Jamison, 1980) used educational production functions, specified with mainly easily quantifiable variables such as the teacher-pupil ratio, teachers' qualifications, teachers' salaries, expenditure per pupil and the number of buildings. Similar trends have been noticed in most of the comprehensive educational studies (see Boissiere 2004) in developing countries, mainly funded by the World Bank. These were restricted to establishing the factors that were strongest in determining academic attainment, to justify the heavy investment by the bank in the education sectors of developing societies. Since, with the advent of more sophisticated statistical techniques such as multilevel modelling, structural equation modelling and other advanced techniques such as the Bayesian inference methods, there is an emerging trend in the study of educational effectiveness with an emphasis on the internal effectiveness of the school and the classroom.

3.3.4.3. The educational effectiveness studies in developing countries

Given the wider diversity of developing countries, there is no space in this study for a country-by-country review of educational processes. Nonetheless, the study will depend heavily on some of the most comprehensive systematic reviews of the various studies conducted in most of these countries. To this end, general perspectives are highlighted that relate more to poor countries. Further, a few individual empirical studies are to be reviewed to reinforce and illustrate the generally highlighted aspects from the meta-analyses.

Overall and throughout the review, it is imperative to realise the importance of interpreting the various process factors within a context (institutional, cultural, political and economic) that differentiates developing societies from developed ones (see Yu, 2007).

Foremost, Fuller (1987) produces one of the most classical systematic reviews of 60 empirical studies conducted in developing countries in Africa, Latin America and East Asia on school materials and processes that affect academic attainment. While some of the studies analysed were not strictly concerned with educational processes, they provide some insights into material factors that play a significant role in academic attainment in these countries. One of the aspects reviewed by Fuller is the classroom environment, with regards to whether or not a classroom had textbooks relating to reading and writing, and whether or not the class had enough desks or seating space. After controlling for pupil characteristics, 16 of 24 studies reviewed found the influence of having textbooks in the class on academic attainment to be significant. It is also indicated that differential effects were apparent. For instance, the textbook effects were greater in poverty-stricken rural areas. Though the studies fail to elaborate on the mechanisms that lead to this finding, it might be the case that poor children have no other source of reading material apart from that provided by the school in their classrooms, so any form of access to textbooks would have a greater impact than that to their counterparts from rich families, who usually do. Fuller indicates that this would be one of the most effective ways to turn around educational systems in resource-constrained countries, given that the magnitude of the effect of textbooks on pupil attainment outweighs the benefit from of trying to reduce class sizes in these countries. Nonetheless, more research is needed on this variable, given that its impact could also depend on whether teachers are well trained to use textbooks.

Having a place to sit and write was another classroom environment factor that was found to predict pupil attainment in Fuller's review. Most of the studies reviewed indicated a significant positive effect. This reinforces the fact that poor economies are still struggling to provide the basic infrastructure that supports learning to take place. Fuller argues that desks offer a space to sit, read and write, thereby increasing the opportunity of a pupil to learn.

Quality of teachers was another latent process variable reviewed. This was measured by teacher characteristics and the organisation of instruction by the teacher. Teacher qualities included teacher qualification, teaching experience, the subject knowledge possessed by the

teacher and teachers' remuneration. Organisation of instruction was observed through the time spent on the instruction task, homework assignments, teaching practice and teachers' expectations of the pupils' performance in class. The findings had many inconsistencies, with some results yielding the expected signs and levels of significance while others were insignificant or had an unexpected direction of correlation. This could be blamed mainly on the significant differences in the way that most of these variables are conceptualised, which is also a function of the data that are both available and accessible to the researchers.

Finally, Fuller (1987) reviewed studies on school management structures. This entailed looking at the organisational structure available at the school, and the principal's characteristics. The findings indicated inconsistencies. Most importantly, Fuller (1987) indicates that schools with good organisational structures were able to manage the few available resources effectively and hence were able to affect academic attainment more than those that had poor leadership. It is also indicated that effective management structures entailed pursuit of clearly set goals and procedures to galvanise the support of other stakeholders towards their attainment. On the other hand, the principal's characteristics that were found to influence academic attainment included their qualification, experience and possession of acumen for decision making.

The other study that stands out with regards to educational effectiveness in developing countries was done by Levin and Lockheed (1993). This project involved locating effective schools in developing countries, and hinted at the critical problems faced by most of the African schools. These include the large proportions of pupils who enrol in school but drop out after a short stint. Moreover, they indicate that there was very little progress in teaching and learning, reflected in the low levels of competencies manifested by pupils. All these were indications that most of the schools that were visited by Levin and Lockheed (1993) were ineffective. In conclusion, Levin and Lockheed (1993) suggested that to create effective schools in developing countries, there was need to:

i. Provide the necessary inputs in terms of curriculum, instructional materials, quality time for learning, and teaching practices that promote student active learning
ii. Create facilitating environment entailing community and parental involvement, school-based professionalism in leadership, collegiality, commitment and accountability, flexibility and adapting to local needs such as curricular relevance

iii. The will to change and act.

As not much is known about the methodologies used by Levin and Lockheed (1993) in generating the above list, it is not possible to ascertain the rigour with which these results were obtained and the extent to which they are generalisable. Moreover, the mechanisms through which such factors would lead to higher academic attainment are not clear. Nonetheless, the issues presented have received some form of consensus as being significant in predicting pupil attainment, not only in developing but also in developed countries.

The other study that is said to have contributed to the theory and practice of educational effectiveness in developing countries was done by Boissiere (2004). In the review of the determinants of educational quality in developing countries, Boissiere (2004, cf Yu, 2007) concluded that the following factors were significant in predicting academic outcomes in developing countries:

i. Hardware factors, which included school buildings, classroom and furniture, and sanitation
ii. Software factors, such as the curriculum, pedagogy, textbooks and writing materials
iii. The teacher factor, which entails knowledge of subject matter, pedagogical skills and teacher motivation such as performance incentives
iv. Management and institutional structure
v. Context and background variables, including student nutrition and health status, academic ability, family and community background. (Yu, 2007)

Although I would disagree with some of the variable classifications, Boissiere's (2004) conclusions seem to corroborate those of the studies reviewed earlier. The other weakness of this study emerges from the implicit assumption that the variables cited have the same effect across all schools, thereby ignoring the differential effects of some highlighted variables.

From the studies reviewed above, a number of cross-cutting educational effectiveness variables keep being noticed. This may not be surprising, given that developing countries' educational systems tend to be identical. Nonetheless, the contention sometimes lies with the conceptualisation and measure of the factors, and the direction and size of the effects from

these factors (see Hungi, 2011). To this end, going forward, the current study presents a brief review of some other recent empirical studies, besides those reviewed above.

3.3.4.4. Recent studies in developing countries

Using the SACMEQ data, Hungi (2011) tried to account for variations in quality of primary schools in 15 countries in eastern and southern African countries, including Uganda. Using multilevel models for both reading and numeracy, Hungi (2011) indicates that most of the children who were likely to perform better than otherwise were: from richer families; given regular homework that was also corrected; younger in age; had more meals per week; undertook fewer domestic chores; lived with their parents; had preschool attendance; and came from families with books at home. Similarly, the schools that significantly impacted on pupil performance in most countries were: better resourced; located in urban centres; offered free meals; were surrounded by a peaceful neighbourhood; had lower teacher-pupil ratios; had teachers always present; had teachers possessing higher mathematics and English abilities; and with a principal with greater experience. Nonetheless, there were some exceptions. To illustrate, pupils' SES did not influence pupil performance in Uganda or Malawi (mathematics model). Further, gender was not influential in Lesotho, Swaziland, Zanzibar and Zimbabwe.

Whereas Hungi's work seems comprehensive, it is apparent that his models were over-fitted with too many individual items that seem to measure related underlying constructs which might have resulted in multicollinearities. Further, he mainly considered traditional and usually modelled variables and left out more of the processes including time spent by teachers on lesson preparation, and whether or not classrooms had a place for pupils to sit and write, among others. Moreover, the study is obsessed with drawing comparisons among the SACMEQ countries rather than supporting an in-depth understanding of educational processes in the different countries.

In Uganda, strictly speaking, there are not many studies that have focused on educational processes such as in the current study. In fact, among the studies that stand out include the recent World Bank sponsored project by Najjumba and Marshall (2013) and that by Nannyonjo (2007) and Kasirye (2009). Najjumba and Marshall (2013) indicate that teacher attendance, school size, availability of toilets and first aid services at school explain 13% of variations in pass rates in Ugandan primary schools. Interestingly, key inputs such as trained teachers and

textbooks were not significantly associated with the proportion of passes in the primary sector of the country. These latter findings reinforce the main argument of the current study. This is that the traditional method of improving educational effectiveness, which involves staking material resources in schools without improving the conditional processes, has proved futile. Location was found to be significantly associated with attainment differentials, with urban schools performing favourably. Another interesting variable is ownership, where private schools outperformed government owned schools. However, this trend is reversed at the higher education level. Some pupil characteristics posted the expected signage. For instance, gender and age were significant, with boys performing better than girls at higher school levels, and older students performed slightly better. With regards to teacher characteristics, the study found significant though small effects from teacher subject knowledge on academic attainment. This implies that even when teachers seem to have superior knowledge about their subjects, they may not be adequately prepared with the most appropriate pedagogy to pass over the same to their students (Najjumba and Marshall, 2013). Teacher experience, measured in number of years in service, was insignificant in predicting pupil performance. This signifies the need to have experience backed up by better methods of teaching (see Fuller, 1987).

Still in Uganda, Kasirye (2009) drew on the SACMEQ data to estimate single level linear regressions for the effects of school quality, household incomes, child and household characteristics and school-related costs on educational attainment. School infrastructure such as classroom space, teacher training measured in number of years, preservice training and school resources were found to influence academic attainment significantly. Nonetheless, just as in Hungi's study, Kasirye did not find a significant association between pupils' SES and pupil attainment. Equally, there was no significant relationship between the pupil-teacher ratio, the pupil-textbook ratio, teachers' characteristics and academic attainment. Although Kasirye's study seems comprehensive, it dwelt more on traditionally investigated school effectiveness factors and ignored those on the process side. Moreover, the use of single level regressions ignored the nested structure of the data.

Finally, Nannyonjo (2007) used the NAPE dataset to study the key inputs to academic attainment in Uganda. Using OLS, pupil characteristics and teaching strategy were found to be significant in influencing academic attainment. To this end, pupils from elite and smaller-sized families, living in urban centres, having more than ten textbooks at home, and using both

English and the vernacular at home were likely to perform better than otherwise. Moreover, teaching strategies that involved regular homework, going over work with the whole class, working together in small groups and active participation of pupils in the teaching learning process significantly influenced academic outcomes.

Nonetheless, school-based characteristics including class size, pupil textbook ratio, funding per pupil, learning time, pupils per desk and teacher's characteristics were found to be weakly associated with academic attainment. While these findings are consistent with those of earlier studies (see Hanushek, 2003), the finding that learning time is insignificant in predicting academic outcomes calls for further investigation. Such a finding may imply that most of the time in class was not spent on curriculum-related activities. This is in line with Muijs et al.'s (2014) caution that, for the duration of instruction to be of any relevance, time has to be spent on curriculum-related activities.

3.3.4.5. My personal reflections

Even when the focus of my current study is on educational processes in resource-constrained countries, this does not in any way discount the importance of physical and material factors such as buildings, libraries, number of teachers, number of textbooks and per pupil expenditure on academic attainment. In fact, such factors have been found to be significant in many studies (see Hanushek, 2003; Hungi, 2011; Van Der Berg and Louw, 2006), indicating that they are preconditions for effective processes to flourish.

Nonetheless, the central argument by this study is that, while material and physical factors are important for effective education, because the communities under review are constrained in terms of resources, options need to be sought to allow especially poor schools with the ability to convert the scant resources at their disposal into outcomes effectively. Further, the lesson needs to be learned that even schools that have staked considerable resources in their schooling systems have not been able to convert them effectively into quality educational outcomes without effective processes. This was the revelation made by Hanushek and Kim (1995) that hoping for quality education through the traditional approach of simply providing more inputs was frequently ineffective. Moreover, in light of severely limited resource envelopes amidst competing pressures on the national budgets of poor countries, it remains a fact that resources will continue to be very scarce in such systems. And so, as Fuller (1987) illustrates, the most efficient and cost-effective way to improve academic attainment in

resource-constrained countries is to focus critically on the processes that are within the ambit of the frontline stakeholders in schools and the community. There is empirical support to this assertion (see Fuller, 1987; Hanushek, 2003; Najjumba and Marshall, 2013).

I realise that the constraints lie mainly in terms of a lack of comprehensive datasets that have limited educational process studies to recycling traditional and easily quantifiable variables in empirical studies. This explains the apparent lag in cutting-edge research into educational effectiveness in these countries. This emphasises the need for more investment in comprehensive datasets, with multiple observations on the daily operations of schools. Moreover, in order to be able to track changes and the extent of stability in academic attainment in poor countries, longitudinal studies need to be undertaken. This would aid the estimation of growth curves, among others.

Finally, from this review I realised that a number of factors might create a clear distinction in educational effectiveness studies between developed and developing countries. These are briefly highlighted below:

Free meals in school: Whereas free schools meals is a proxy for low SES in developed countries, it is emerging that in the developing world this could be an indicator of a conducive school environment (Bundy et al., 2009). It is indicated that incidences of hunger have affected the nutrition and wellbeing of learners in some developing countries, most especially south of the Sahara. To this end, schools that provide meals for pupils have been said to improve their academic attainment. In Uganda, when the government introduced free primary education, schools lost the ability to provide meals, as was the tradition. Some reports indicate that children leave home hungry and stay hungry in school, which hinders their learning. This revelation first came to light when Heyneman and Jamison (1980), and Balderston et al. (1981) found a positive relationship between school feeding programmes and pupil academic attainment in Uganda, Chile, and Guatemala, respectively. Similar findings have been highlighted by Hungi (2011), where meals per week were found to be significant across nine sub-Saharan countries.

HIV AIDS: The developing world has been severely affected by the HIV pandemic and it is proving to have significant negative impacts on pupil attainment. Research undertaken in Uganda (see Kasirye and Hisali, 2010, UNICEF, 2008, Nyamurungi et al., 2007) indicates that

HIV has increased the number of orphans in the school system. Moreover, the disease has directly and indirectly affected the education system, since some of the pupils are of poor health and thus cannot learn well, while others are directed into child labour in order to fend for their ailing parents, instead of attending school. Some teachers have also been affected by the disease, and part of teacher absenteeism is attributable to the pandemic (Nyamurungi et al., 2007).

Classroom size: Whereas western research has advocated for smaller classroom sizes, it is emerging that such recommendations may be detrimental to educational effectiveness in resource-constrained countries. To illustrate, early research carried out in Botswana (see Heyneman and Loxley, 1983), Bolivia (see Morales and Pinellsiles, 1977) and Chile (see Schiefelbein and Farrell, 1973) indicates that fewer students per teacher has never improved the quality of interaction and hence fails to raise achievement. These studies indicate that having classes below the threshold size depletes schools of resources that would otherwise be available for other, more pressing materials and processes needs and would impact on learning more. Nonetheless, many debates continue around this variable, given that the aforesaid studies did not define what the appropriate threshold is for a typical classroom in a developing country. The current study is investigating this variable to add to the current debate.

Abusive school environment: While most abuse reported in western research involves verbal insults and some kinds of bullying, extreme cases have been reported in developing countries that involve physical harm to learners particularly by their teachers (AFP, 2014; UNICEF, 2010). This is reinforced by the fact that some schools in developing countries still rely on corporal punishment such as strokes of the cane, spanking and hard labour to enforce and manage discipline. To this end, any improvement in the safety of the school and class environment is likely to have a greater impact on academic attainment in developing than in developed countries. This is my personal opinion, and it would require further empirical research to prove.

Culture: In some developing countries and in some families, culture dictates that boys' education is put before that of girls, so most of the processes that would aid attainment are more favourable for boys than girls. To illustrate, girls do more domestic chores, while boys revise from their books. Moreover, some school environments such as sanitation facilities do not favour girls (Najjumba and Marshall, 2013). Most schools in poor countries have one toilet

facility shared by both boys and girls, and this is said to increase the likelihood of girls dropping out of schools. Further, some cultures encourage early marriage, of especially girls, which hampers their education achievement.

Physical resources: Critically, what seems basic to western countries' education systems is still a struggle to obtain in resource-constrained countries. It is for this reason that a slight improvement in material resources is likely to have more influence on pupil attainment than in the western world. To illustrate, a recent World Bank study in Uganda (Najjumba and Marshall, 2013) observes that having toilets in a school can explain a significant amount of variation in pupil attainment. This highlights the importance of hygiene, especially for girls in schools.

3.4. The conceptual model

As earlier hinted, this study attempts to suggest an effective education model for a resource-constrained country or society. The study contends that the earlier conceptualisation of effective education, which magnified the importance of physical and fiscal resources to attaining better education, needs to be refocused on the realities of poor countries. This it does through the critical modelling of those educational process factors that are thought to account for significant variations in educational outputs.

From this literature review is a visual impression of the framework of the final conceptualisation of educational effectiveness. It is important to note that, according to the current model, effective education is presumed to prevail if various domains within the education production system are able to yield quality and equitable educational outcomes with consistency and stability over time (see Kyriakides and Creemers, 2011, Rumberger and Palardy, 2004).

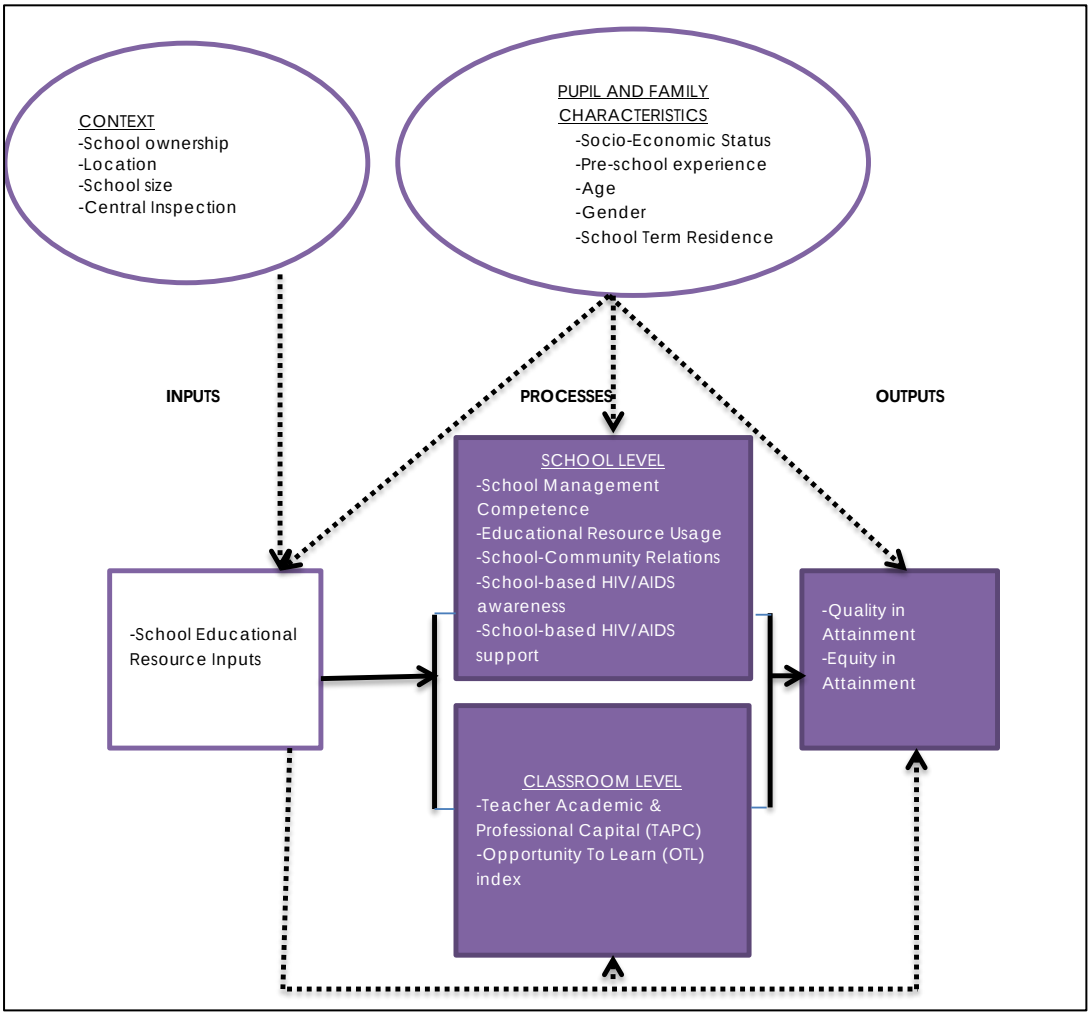

Figure 4 Visual representation of the conceptual model

The conception of the above model is mainly guided by the DME suggested by Creemers and Kyriakides (2006), and Kyriakides (2012), with modifications informed by the educational quality framework suggested by UNESCO (2004), the comprehensive model of educational effectiveness (Creemers, 1994), the Carroll model (1963) and other empirical studies (see Creemers and Scheerens, 1994; Drent et al., 2013; Scheerens, 1990; Stringfield et al., 1992; Laplante, 2012).

Just as highlighted in the literature review, the choice of the dynamic model is informed by the fact that it provides some guidance on a broader conceptualisation of educational effectiveness. Most importantly, it integrates the ideals of the two influential effectiveness models (Creemers' comprehensive model and Carroll model) into the study of educational effectiveness. Moreover, it is said to yield accurate results, given that it adopts a multilevel framework that seeks to partition variations in educational outcomes by operational level.

The current model shares particular features with DME with regards to its having multiple levels, some general groupings of effectiveness variables and a greater emphasis on classroom and school processes. The model takes a broader outlook with regards to the criteria for educational outcomes, emphasising the need to transcend the cognitive measures. Whereas the current study shares this ideal of considering other domains of learning outcomes, it was limited by the dataset to using cognitive outcomes. Nonetheless, some scholars argue that cognitive outcomes significantly predict other domain outcomes (see Chapman et al., 2016).

The current model differs from the DME to a greater extent, due to the modifications necessary to make it align with the realities of resource-constrained societies and the study objectives. To illustrate, the current model adopts part of the UNESCO (2004) educational quality framework and Scheerens model (1990) to classify variables into context, inputs, processes and outcomes. This is done to align the model with the study objectives and the questions to be answered. Moreover, as highlighted in the context chapter and literature review, the variables in the current model are reflective of the educational characteristics of developing countries. For instance, variables such as school-based HIV/AIDS awareness and support have been included in the model to focus attention on ways that poor countries are trying to ameliorate the effect of HIV/AIDS pandemic on learning. They also highlight some of the policies that schools have adopted to create awareness of the pandemic within the school

community. Some literature has indicated that this reality is consistently ignored by contemporary models.

Further, rather than adopting the eight teacher effectiveness variables suggested by the DME, the current study has found it suitable to adapt them to the construction of a variety of factors that have also been heavily informed by a number of empirical studies from the African continent and the west. This is in line with advice by Creemers and Kyriakides (2012) that factors included in the DME have situational effects that need to be acknowledged in effectiveness studies and interventions. Also, whereas the DME suggests the multidimensional treatment of each selected variable with regards to the frequency, focus, stage, quality and differentiation dimensions, the current study does not strictly follow suit. Rather, the research objectives, data available and the analysis methods have dictated the dimensions measured within the selected variables. Nonetheless, where the data permitted, items measuring the different suggested dimensions were merged into a single indicator using the Rasch modelling technique. The modifications are well aligned to the philosophy of the DME; that is, dynamism and flexibility in the conceptualisation and measurement of effectiveness factors (see Creemers and Kyriakides, 2012).

The current model is therefore an illustration of the production process of education that discerns three levels. These are pupil, classroom and school levels, operating within a particular context. Guided by the works of Hutmacher et al. (2001), and Kyriakides and Creemers (2011), effective education is proxied by two dimensions of educational outputs—quality in pupil attainment (numeracy and literacy), and equity in the distribution of educational outputs, inputs including some processes.

Based on empirical literature, the framework is justified in assuming that educational outcomes are attributable to a range of factors clustered at different levels. At pupil level, the model hypothesises that individual pupil characteristics and their family's socio-economic characteristics contribute to educational outcomes. Likewise, the context of schooling, the school, the classroom and educational inputs provided by governments and society contribute to educational outputs (Glewwe and Jacoby, 1994; Reynolds et al., 1996; Riddell, 2008; Smith et al., 2006; Fraser et al., 1987). To this end, the model assumes the existence of relationships (direct and indirect) between inputs, processes and pupil characteristics, and educational

outputs. Moreover, the context in which the school or the classroom operates could influence pupil outcomes.

It is critical to emphasise here that the term 'context' has been used differently from the way it is conceived by the DME. In fact, in the DME, 'context' is a systems level in which schools are nested. In the current study, while contextual variables are estimated in the model, the context as a system level is not included. 'Context' is taken to represent the variables that characterise the environment within which schools and or classrooms operate, but not as a nesting unit. This is to limit the model to three levels (pupil, classroom and school), and to give more importance to classroom and school levels, which are the pillars of the DME.

From the model, school educational inputs – such as the number of teachers, number of classrooms, and the library and other school material resources such as water and sanitation facilities, fencing, toilet facilities, playground, electricity and printing facilities – are expected to affect the ability of the school and the classroom to produce quality and equitable educational outputs. Moreover, school educational and other inputs may also directly affect the educational outputs. On the other hand, educational inputs to a large extent depend on context in which the school operates, such as budgetary allocations, school location, school size, school ownership and quality assurance policies such as central school inspections. Further, it is also conceived that school inputs could be affected by pupils' and their families' characteristics. For instance, it is hypothesised that there will be more school inputs in schools that enrol a greater proportion of children from rich and elite families, and the reverse would probably be true.

On the whole, this model derives from a major assumption that, *ceteris paribus*, with the right amount of inputs and a favourable context, high-quality and equitable educational outcomes would be expected, provided there are effective processes at the classroom and school levels. To this end, processes in the classroom – that is, TAPC and classroom environment that offers greater opportunity to learn (OTL) – are likely to affect learning outputs profoundly. Similarly, school processes – that is, school management competencies, the school's ability to use educational resources for learning (resource usage), school-parental and community partnerships and the school-based HIV/AIDS awareness and support available – are thought to impact learning outputs.

This study is principally concerned with educational processes and educational outcomes (the coloured region in the conceptual framework). For this reason, some of the other variables and their paths may not actually be estimated, for they have been included in the model only for the purposes of illustration. The model assumes that educational process factors are within the manipulative control of school administrators and teachers, unlike fiscal and material inputs. Accordingly, whereas school administrators and teachers are constrained with regards to increasing the supply of fiscal and material inputs for their school, school and classroom processes seem within their ambit. Moreover, this would be the most cost-effective way to tackle dysfunctional educational systems in strapped economies.

It is imperative to note that this study's views do not in any way seek to understate or trivialise the importance of other factors, especially fiscal and material inputs. In fact, as highlighted in the literature and, indeed, in this conceptual model, any education system requires a certain critical level of fiscal and material facilitation for process factors to yield significant outcomes (Levin and Lockheed, 1993; Scheerens, 1990; Scheerens, 1991). Such an observation is also elucidated by UNESCO:

> it is obvious that schools without teachers, textbooks or learning materials will not be able to do an effective job. In that sense, resources are important for education quality. Nonetheless, these are mainly enabling agents and their effect also depends heavily on how they are processed. (UNESCO, 2005, p.36)

This implies that the effect of inputs on educational outputs is likely to be more pronounced with effective processes in place (Fullan, 2005; Hanushek, 1986; Hopkins et al., 1997; Levin and Lockheed, 1993; Lockheed and Verspoor, 1991).

CHAPTER FOUR: METHODOLOGY

4.0. Introduction

This chapter sets out the procedures, steps and analysis techniques that are used in order to answer the following study questions:

i. What are the educational process factors that account for significant variations in educational outputs in Uganda's primary education?
ii. How random are the effects of some of the educational process factors on educational outputs in Uganda's primary education system?
iii. To what extent do the educational inputs, processes and outputs reflect the equity dimension of educational effectiveness?

4.1. Philosophical paradigm

This is a quantitative study that draws on the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) database project III (2007-2011) to arrive at conclusions to the above research questions.

The discussion to justify the choice of the quantitative approach to this study draws heavily on the works of Carter and Little (2007), and Bryman (2012), who postulate that choice of a research approach should be pegged on inter alia epistemology, ontology, research questions and expected outcomes that entail the phenomena under study.

The epistemological stance of this study is that of realism, as postulated by positivists. This is premised on the fact that it seeks generalisable answers (see Sandelowski, 2008) to its questions by using scientifically proven methods. Moreover, the study makes an ontological assumption that the social phenomena being investigated can be scientifically verified are objective and reproducible, rule-governed and measurement-oriented (Avis, 2003; Guba, 1990). And so, valid and reliable answers would only be generated through the application of scientifically proven and set methodological guidelines that can lead to replicable results. This precludes the application of interpretivism approaches mainly associated with qualitative research.

My stance notwithstanding, I am aware of the emerging epistemological perspectives in research methods such as those of pure and modified post-positivism (Kuhn, 1970; Fischer,

1998; Schumacher and Gortner, 1992) that highlight epistemological constraints to conducting research based on the positivistic paradigm. Pure post-positivists (Bronowski, 1978; Cook et al., 1979; Hanson, 1959; Kuhn, 1970; Popper, 1959) dismiss the principle of empiricism as the sole basis for truth and claim to knowledge as held by the positivists. Further, they indicate that the positivists' obsession with rules of research design and statistical analysis narrows the essence of social research (Fischer, 1998). And so, according to them, researchers would be better off if they adopted an ontological perspective of critical realism and the epistemological stance that is cognizant of the fact that total objectivity can never be achieved but, rather, efforts should be made for the inquirer to be as neutral as possible (Guba, 1990). To them, this is a more realistic perspective of social science that is not preoccupied with empirical data *per se* but with the underlying assumptions to accepted belief (Clark, 1998; Fischer, 1998).

Despite the foregoing counter arguments, it is more appropriate for my study to assume the positivistic paradigm, given that there is still a general lack of acknowledgement of the application of pure post-positivism philosophy in research (Clark, 1998). Some of the studies that have tried otherwise, that is, mixed methods designs, have sometimes been criticised for being less ambitious with regards to gaining to the proximate truth of social phenomena (Clark, 1998). Moreover, adapting to the pure post-positivism perspective is said to create more methodological blunders, given the general lack of agreeable methodological principles of a pure post-positivistic social science (Clark, 1998). Indeed, it could be due to some of the ontological and epistemological ambiguities created by pure post-positivism that scholars such as Guba (1990) have suggested more modifications. These have taken on names such as constructionism, relativism and critical realism, which are actually epistemological litanies that can be plotted on a positivism and pure post-positivism continuum.

Further, I maintain that taking a positivistic epistemological paradigm is more appropriate, for it would guide the generation of consistent outcomes, given that it advocates for a nomothetic structural analysis that is aligned to my study objectives (Anderson, 2006; Carter and Little, 2007; Cassell and Symon, 2011; Charoenruk, 2009; Moriarty, 2011; Ritchie and Lewis, 2003; Steinke, 2004; Bryman, 2012). Moreover, the positivist paradigm which is associated with the quantitative approach is necessitated because the data used are survey based, and numerous preconceived hypotheses are to be tested using empirical statistical tests (Guba, 1990).

4.2. Data

As hinted earlier, this study uses secondary data maintained by the SACMEQIII project. Using secondary data in research remains contentious (see Heaton, 2008; Parry and Mauthner, 2005). From the methodological perspective, there are various drawbacks to using secondary data that have been highlighted. To illustrate, Hinds et al. (1997) indicate that some methods used to collect data are highly biased by the primary collector's memory and intuition. This is compounded by probable misinterpretations by the secondary analyst (Heaton, 2008). Moreover, it is a methodological concern that not much may be known about how the primary data collector dealt with missing data.

In this study, the above may not present much of a problem since the researcher requested the codebook and data transformation criteria from the primary data collector, to become aware of the proximate contexts in which the data were generated (see Irwin and Winterton, 2011) for robust claims to be generated.

Further data-bound drawbacks have been highlighted with regards to using secondary data. Heaton (2008), Seale (2010) and Hinds et al. (1997) indicate that there are ethical and legal consequences associated with its use and that, if not well handled, may compromise the study. This study had options out of this. Foremost, the research underwent an ERGO application process through which the ethical issues underlying the use of this dataset were highlighted and suggestions generated on how to handle them. Moreover, the researcher obtained the express consent of the data owner to use this database in this study. Further, no attempt was made to establish the identities of any participants.

Despite these drawbacks, the use of secondary data is increasingly becoming the norm in quantitative research. This could be partly explained by the heavy cost of generating comprehensive datasets and the advent of rigorous methodologies that make it possible to deal with bias, precision and other abnormalities that may be apparent in the dataset. These are discussed further in the following general account on how the survey for the collection of data was conducted, including sampling procedures and questionnaire design.

4.2.1. The SACMEQ data

4.2.1.1. Overview

The SACMEQ is a collaborative network of 15 countries' ministries of education from eastern and southern Africa (Grisay and Griffin, 2006). These countries include Botswana, Kenya, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Uganda, Zambia, Zanzibar and Zimbabwe. Launched in 1995, with support from UNESCO's International Institute of Educational Planning (IIEP), SACMEQ is a research project aimed at increasing the capacity of such countries to monitor and evaluate the quality parameters of their education system. Further, SACMEQ tries to produce and disseminate continuous cross-sectional assessment and monitoring of education quality and learning achievement to inform policy. The ultimate intent is improved delivery of quality education, especially at primary school level.

The SACMEQ project involves the collection of comprehensive data on the different educational quality indicators at primary school level. Further, using such data, it provides assessment of learning achievement at the end of primary school to establish the relative impact of the various education inputs on learning achievement. Comparative analyses are also generated with the respective ministries of education's data and other benchmark standards (Grisay and Griffin, 2006).

Since its launch in 1995, it has so far accomplished three projects. The first, code named SACMEQ I (1995–1999), was mainly concerned with learning achievement. SACMEQ II (2000–2004) was based on the first project, but incorporated a numeracy outcome variable and so assessed both reading and numeracy domains. The SACMEQ III project was fully accomplished in 2011, and this is the database used by the current study. It contains school, teacher and pupil characteristics, and the other educational quality and equity indicators that form the core of the current study. SACMEQ IV is underway, although it is not possible to indicate when the data will be available for public use. Most importantly, all archive data from SACMEQ are available to the public on application. Below is a highlight of the design characterisation of the SACMEQ data collection and preparation procedures.

4.2.1.2. Population

a. Desired study population

The population for studies carried out using SACMEQ III dataset refers to all pupils at Grade 6 attending schools in the 15 defined countries. It is indicated that choice of grade description, as opposed to age-based description, is based on complexities that accrue from the absence of any standard ages for pupils attending particular classes in most African countries. Due to the high incidence of late starters and grade repetition, it would require the collection of data across many grade levels (Hungi, 2011).

b. Defined population

Given that SACMEQ III project depended on the register of mainstream registered primary schools of the defined countries as its sampling frame, it would imply that the defined population for this study are the pupils in Grade 6 in 2007 who were attending registered mainstream primary schools (Hungi, 2011). Theoretically, this framework seems comprehensive. However, it may have excluded Grade 6 pupils attending schools that were not registered with the respective ministries of education at the time of the survey.

4.2.1.3. Sample design

Multistage cluster sampling (two-stage) was adopted in the SACMEQ III survey to allow interviewers to be geographically concentrated, given the wider area of the survey (Hungi, 2011). Some scholars have indicated that this design affects the precision of the estimates (see Corbetta, 2003). Nonetheless, according to Turner et al. (1996) and Brogan et al. (1994), such effects are countered by reaching more respondents on a fixed budget than other designs. More than that, the stratification that is embedded in this kind of design is said to inject an extra increment of precision into the probability sampling process, since variation between strata is eliminated (Bryman, 2012).

4.2.1.4. Sample selection procedure

In the SACMEQ III study, schools were stratified by their regions or provinces from which the individual schools were randomly selected. Each individual school had a probability of selection proportional to the size of the total pupil enrolment in the respective region. At the second stage, a simple random sampling technique was applied to each of the earlier selected schools to select 25 pupils (Hungi, 2011). The sample analysed constitutes 5,307 Grade 6 pupils drawn from 316 classrooms in 264 primary schools in Uganda.

The table below indicates the number of schools, teachers and pupils involved in SACMEQ III for Uganda.

Schools	Teachers	Classrooms	Pupils
264	274	316	5,307

Table 2 Number of Grade 6 pupils, teachers and schools in the SACMEQ III (Uganda)
Source: Hungi, 2011

4.2.1.5. Sampling error and bias

As in any other survey, the fact that SACMEQ did not survey the whole population and that it used survey instruments means that there is a likelihood that it was predisposed to various errors, that is, sampling and non-sampling errors. Sampling error arises from the impossibility of attaining a representative sample, variability in the population and sampling design (Bryman, 2012). Non-sampling error in this dataset arises from planning and interpretation, questionnaire design, respondents, processing and estimation of data (Bray et al., 2012; Campanelli et al., 1997; Queensland Treasury, 2013). Further, bias is anticipated from a difference in attitudes held by the respondents and non-respondents, and the sampling frame (see Bray et al., 2012; Davern, 2013).

According to Hungi (2011), SACMEQ III tried to mainstream strategies to limit the impact of both sampling and non-sampling errors, and bias on the quality of results. For instance, to reduce the sampling error, a larger sample size was drawn from the population (for Uganda's case n=5,307). Further, though clustering would likely reduce the precision of this survey, random sampling was maintained within the clusters.

4.2.1.6. SACMEQ questionnaires

SACMEQ III used questionnaires consisting of a range of questions that cover different themes of quality education, such as pupil characteristics, teacher characteristics, principal characteristics, pupil achievement, teacher achievement and school resources. The questionnaires were designed for different respondents — pupils, teachers and heads of school. These questionnaires are said to have been developed out of a rigorous process involving a committee of experts drawn from the participating countries, the International Institute for Educational Planning (IIEP) and private consultants.

Moreover, it is indicated that recommendations from the earlier SACMEQ I and II studies were mainstreamed into the third project questionnaire (Hungi, 2011).

Governments and policy makers in the respective participating countries were also consulted in order to mainstream particular questions that would enable the generation of data to inform the policy concerns arising in the respective countries (SACMEQ, 2004). It is also said that the questionnaires were piloted. A critical examination of the questionnaire booklet indicates that clear instructions were given to respondents and that questions were kept short and simple, matching the comprehension abilities of respondents. Impressive response rates were attained, with all respondents' categories registering above 70% (Hungi, 2011). Nonetheless, it is also critical to acknowledge that some of the items asked to pupils in the pupils' questionnaire seem to be beyond their cognition and might have introduced measurement errors for some variables like SES. For instance, it is doubtful as to whether pupils could accurately respond to items requesting for their parents' educational levels and the material wealth of their homesteads in trying to measure SES. Equally, some aspects particularly of leadership and teacher and instruction quality asked in the respective questionnaires could have been more accurately measured through some form of observation protocols rather than relying only on survey means.

4.2.1.7. Construction of SACMEQ reading and mathematics tests

In order to capture pupil achievement, reading and mathematics tests were constructed and administered to Grade 6 pupils across all 15 countries. Given the variations in the curricula followed in all these countries, detailed consultations with the different national curricular were undertaken to generate cross-cutting core competencies that pupils were expected to have mastered while in this grade. Moreover, the item construction for both reading and mathematics tests was guided by the International Association for the Evaluation of Education Achievement's (IEA) reading literacy study, IEA's TIMMS study and the newly constructed items by the national research coordinators from the respective countries participating in the SACMEQ arrangement.

4.2.1.8. SACMEQ procedures after data collection

Data collection is a function of the respective national research coordinators who then send it to the SACMEQ headquarters housed at the UNESCO's IIEP for validation activities. Such activities include:

- Unique identification checks, aimed at checking for the uniqueness of identification codes for the units of analysis.
- Wild code checks, aimed at identifying variables and cases that contain values that exceed the valid range.
- Link checks, aimed at comparing the achieved sample school list with the planned sample school lists.
- Within-file consistency checks, aimed at examining the item consistency within the same questionnaire for related items or variables.
- Between-file consistency checks, aimed at assessing the consistency of related variables or items across the different questionnaires. (SACMEQ, 2004)

If SACMEQ headquarters find any data failing the validation activities, these are sent back to the respective national research coordinator for more cleaning to meet the standard.

After validation, files are merged and prepared for different formats such as Excel, SPSS and other software. Other variables are then derived, in addition to those in the original data instruments. This is done especially where there is a necessity to respond to particular high priority policy questions that may not ordinarily be answered using only the items originally in the instruments. Weights are applied in order to inverse the probability of pupil selection. Further, SACMEQ imputes missing values and assigns them to cases that have missing values on particular items. This is done using the item mean for continuous variables, or the mode for categorical variables. Sampling errors are computed in order to estimate the error committed in trying to infer to the population under study (SACMEQ., 2004).

4.3. Variables in the current study

4.3.1. Pupil-level variables

A number of questions in the SACMEQ III questionnaire capture pupil characteristics. In the current study, pupil-level variables include SES, preschool experience, pupil age, gender and school term residence. SES is a latent construct measured by multiple items including parental education and home financial or material possessions. The SES index is given in the data. It was constructed by the SACMEQ using the Rasch modelling technique. In their methodological elaboration, it is indicated that the index was developed in reflection of the African context. To this end, items such as parents' level of education, textbooks available at home, basic

resources owned at home, the quality of the materials used to build the pupil's home, livestock owned and source of lighting in the home were used to construct the index. It is indicated that the eventual SES index was standardised with a mean of 500 and standard deviation of 100.

Choice of the SES factor is partly informed by the first Coleman (1966) inquiry in the United States. This indicated that the impact of SES on pupil attainment is profound during the primary years of schooling.
Moreover, other studies on the continent have indicated that SES remains at the core of the distribution of learning (Zuze and Leibbrandt, 2011; Dolata, 2005). Further, it is emerging that the performance gap between rich and poor children is widening, as is the income gap. This is happening at a time when Uganda is implementing universal primary education, one of the aims of which is to provide quality and equitable education to all, regardless of their socio-economic background. This makes this variable important for this study, as it examines educational effectiveness through equity and quality dimensions.

Preschool experience is another pupil-level variable that is proxied by whether or not a learner attended preschool. Choice of this factor is informed by the fact that preschool in most of the African countries in general, and Uganda in particular, is not universally accessible. It is thought that learners who receive early childhood education are likely to perform better in subsequent educational levels. This is reinforced by UNESCO (2004) in their assertion that while, trying to model educational outcomes, 'The extent to which pupils and students have benefited from learning opportunities in early childhood also comes into play' (p.7). Moreover, the Coleman study (1966) indicated that the variation in subsequent pupil attainment attributable to preschool experience outweighs all the impacts of school quality summed together.

Age is another factor at pupil level. This factor is important to this study, given that, in Uganda, learners start school at various ages and so the same class could have very diverse age regimes, sometimes performing differently academically. Variations in age regimes in Ugandan schools is partly perpetuated in cases where schools are far from homes, which makes parents delay enrolment of their children until such an age when they may be deemed fit to brave such long distances to school (Ministry of Finance Planning and Economic Development, 2008). Also, age differences are a result of truancy that sometimes leads to grade repetition. This study would

be interested in establishing whether age is a factor that contributes to the variation in pupil attainment in Uganda.

School term residence is a pupil-level variable that intends to establish whether a pupil's place of residence during school terms is important to their academic performance. This variable is against the backdrop of increasing incidence of the HIV/AIDS pandemic, where many children in most Ugandan primary schools are without parents (Kasirye and Hisali, 2010; UNAIDS, 2012; UNICEF, 2008). It is said that some are taken up by other homesteads or children's homes and orphanages. It is hypothesised that such arrangements could have consequences on a pupil's performance relative to their counterparts who stay at their family homes. On the other hand, the school term residence could possibly reflect SES in instances where it is mostly affluent families that are able to send their children to boarding schools, due to the higher costs involved.

4.3.2. Classroom-level variables

Classroom-level variables are constituted by two process factors: a) TAPC; and b) Opportunity to Learn (OTL).

The TAPC is an index constructed using items such as individual teachers' mathematics and English competence levels, appropriate teaching-subject training, exposure to continuing professional development (CPD), educational levels of the individual teachers and teaching experience. By contrast, OTL is measured through an index constructed using Rasch modelling. This index, among others, includes the quantity and quality of teaching that the learners are exposed to. Moreover, classroom environmental factors that aid/disrupt the opportunity for learning to occur in class are included in the index. Specifically, some of the items that constitute the OTL index are instruction time, time spent on lesson preparation, frequency of formative and summative assessments, frequency of pupil and teacher absenteeism, late coming to class and rates of deviant behaviour in class.

4.3.3. School-level variables

Though earlier studies trivialised the contribution of the school to variations in educational outcomes, there have been disparities in the reported proportion of variance in educational outcomes explained by the school. Moreover, given the differentials in context between such places where these studies have been carried out (mainly the west) and those in Africa, there

is a valid argument to continue studying the contribution of the school and its processes to pupils' attainment. This is reinforced by the findings of Salim (2011) that schools in Zanzibar explained a greater proportion of pupil performance of up to 39% after adjusting for factors outside of the school's control, such as prior attainment, pupil background characteristics and some school contextual factors. School-level variables are therefore justified for inclusion in this study.

School-level variables are also processes, including a) school educational resource usage; b) school management competencies; c) school-community relations; d) school-based HIV/AIDs awareness; and e) school-based HIV/AIDS support initiatives.

Items that constitute school management competencies include the head teacher's experience (competent to teach), specialised training undertaken (competences derived from CPD), ability to support teaching and learning activities, and his or her educational qualification (academic competence).

On the other hand, educational resource usage is constructed using the Rasch modelling technique. This is a proxy for the ability of school processes to convert some of the inputs to impact pupil learning directly. Inclusion of this factor is informed by some reports indicating that some schools, especially in sub-Saharan Africa, struggle to convert school inputs into learning outcomes (Van Der Berg, 2008). To this end, some of the items that constitute resource usage scale include:

i. Whether or not pupils are allowed to take out books from their school or classroom library to their home for private study.
ii. Whether or not textbooks in their classrooms are used during lessons.
iii. Whether or not pupils use a computer at school.
iv. Whether or not the classroom has access to teaching/instructional materials such as chalk, chalkboard, teaching aids, geometry instruments, and teacher's guide. Implied usage is assumed, in case the classroom has access to such materials and in instances where such items are found to be correlated with other usage items in the scale.
v. Whether or not the school provides pupils with meals (mainly lunch).

Whereas free school meals have always been considered a proxy for low SES in the west, emerging research indicates that such could be a signal of an effective school environment in poor countries, sometimes with the ability to impact on pupil attainment (see Bundy et al., 2009; Hungi, 2011). The current study believes that the provision of school meals would be one of the more responsible educational resource usages in a school to impact learning, especially in resource-constrained communities where some children come to school without breakfast.

School-community relations is another school variable that is a proxy for the ability of school leadership to engage with the parents and community to impact learning. Measurement items for this factor include the extent to which the school involves the parents in school and learning activities, and the perceived community cooperation and contribution to improving learning.

School-based HIV/AIDS awareness is a variable intended to capture the ability of school leadership to respond to the effects of the HIV/AIDS pandemic on the education system of Uganda. It is currently a requirement for schools to protect their learners and teachers from the effects of HIV through fusion of HIV/AIDS awareness into the school curriculum. This is an index constructed using the Rasch modelling technique. It is constituted by items that entail the various HIV/AIDS awareness activities that the school is engaged in.

School-based HIV/AIDS support is an index variable that entails the school-based support available to those affected by or infected with HIV/AIDS in school and around the community.

4.3.4. Contextual variables

To highlight the fact that educational effectiveness is highly contextual, key contextual variables such as school ownership, location, school size and the central government regulatory framework have been suggested as additional control variables in the model. School size is measured by total school enrolment and it is continuous. On the other hand, ownership is a nominal variable, coded as either public owned (owned by government) or privately owned (owned by the private persons and or bodies). The central government regulatory framework is proxied by the number of times a primary school is evaluated by the education standards agency. Finally, location is a nominal variable with three categories; that is, schools located in rural or isolated areas, small towns and in the large city.

Educational inputs is another key control variable. While the core of this research is not concerned with the effect of educational inputs on pupils' attainment, it is important to control for inputs, given that much empirical research has hinted at the significant effects that they exert on pupil attainment. Moreover, it has been argued that educational inputs could explain much variance in poor societies that are struggling to build the basic educational infrastructure.

The study conceives inputs as physical materials owned by the school. As many items constitute this variable, an index is generated using Rasch modelling technique. Most of the educational inputs can be classified into:

i. Infrastructure
ii. Equipment or appliances
iii. Classroom furniture
iv. Materials and teaching aids.

4.3.5. Outcome variables

The overall outcome variable for this study is pupil achievement in both mathematics and English. However, this is analysed from two dimensions. As hinted earlier, this study conceives effective education from quality and equity perspectives. Just like most of the latent variables, quality of education is quite hard to conceive and hence to quantify appropriately (Thomas et al., 2012; UNESCO, 2004). For example, from the humanists' paradigm (Locke and Rousseau, James Dewey and Jean Piaget), quality education would be the one that fully engages the full participation of pupils. On the other hand, behaviourists who believe in shaping and controlling of human behaviour through reward and response would conceive quality in terms of tests and exam scores. By sociologists, quality education would be taken to be the one that can enable social change.

It is apparent that, for whichever perspective of quality is used, the aspect of measurement remains problematic. Nonetheless, the behaviourists' approach to measuring quality seems to be the most adopted, given that pupils' exam or test scores can be easily quantified. However, mere raw exam marks to proxy quality has been criticised for being unfair in judging schools with disadvantaged learners (UNESCO, 2004). To this end, this study adopts the behaviourist's perception of quality with some modifications. Quality will be proxied by raw marks, but adjusted for pupil backgrounds. This means that quality education would be taken to be the

one where pupils are able to score highly, regardless of their background. Further, choice of the cognitive measures of educational quality has been premised on the fact that non-cognitive learning outcomes are said to be very difficult to measure and that they are overwhelmingly determined by other factors in society other than the school (Kyriakides and Creemers, 2011). Moreover, according to Reynolds et al. (2014), non-cognitive outcomes are always given less emphasis in the curriculum and, most importantly, societies set up schools primarily to teach cognitive skills.

It is critical to note that this choice does not in any way argue for the restriction of educational outcomes to only cognitive outcomes. This is because the objectives of education transcend cognitive outcomes, since a school is also taken to be a social agent (Kyriakides and Creemers, 2011).

4.4. Analysis procedures and techniques

Because some latent constructs are measured by numerous items that are on completely different scales, and the fact that this study is primarily interested in having scores for particular factors, the Rasch modelling technique is used to derive such scores. The choice of the Rasch model is partly based on the nature of the response items in the dataset. The Rasch model is lauded for its ability to transform different scales into the interval scale through a logistic link function (Dolata, 2005). Moreover, they are said to espouse good psychometric scale properties; that is, reliability, validity and separability (Dolata, 2005). Items that are binary are transformed to the logit scale using dichotomous models, as follows:

$$Probability(X_{ni} = 1|\alpha_n, \delta_i) = \frac{e^{(\alpha_n - \delta_i)}}{1+e^{(\alpha_n - \delta_i)}}$$

where α_n, δ_i represent ability and item difficulty, respectively. This function estimates the probability of an individual *n* (*n*=1,…..,N) with ability α_n faced with δ_i level of item difficulty, getting item X_i correct (score of 1) (*i*=1,….,I).

But $\alpha_{n=Ln\frac{P_{n1}}{1-P_{n1}}}$ which estimates the probability of an individual to answer an item with zero difficulty correctly and $\delta_{i=Ln\frac{1-P_{1i}}{P_{1i}}}$ estimates the probability of an individual with zero ability answering an item correctly.

On the other hand, constructs that have items on varying scales are estimated using the partial credit rating models, while those on the Likert scale are estimated using the rating model as follows:

$$P_{nij}|P_{ni(j-1)} = \frac{e^{[\alpha_n - (\delta_i + \varphi)]}}{1 + e^{[\alpha_n - (\delta_i + \varphi)]}}$$

where

P_{nij} is the chance of an individual *n* choosing alternative *j* over the prior alternative *(j-1)* in responding to item *i* (a summation is carried out for all alternatives to obtain overall probability)

α_n is the ability of individual *n*

δ_i is the location of item *i* on the item difficulty scale where the highest and lowest categories of the item are equally probable,

φ represents the various threshold parameters in item *i* (difficulty of the j^{th} step relative to $j\text{-}1^{th}$). This is the point where j^{th} and $j\text{-}1^{th}$ are equally probable (Linacre, 2013).

However, the above opportunities provided by Rasch models can only result in robust results when the data fit the Rasch model, in the light of the assumptions imposed by such models. To illustrate, the model assumes a replicability of response order or pattern if the same sample of persons were given different sets of items measuring the same latent construct (Mahmud, 2011). Moreover, the data are expected to follow the incremental hierarchical structure, such that persons endorsing difficult items are able to do so for the less difficult (Bradley et al., 2010). Similarly, in the case of items, lower rating categories are expected to attract lower measurement scores than higher rating categories. Most importantly, Rasch models expect the data to fit the models. Fit indices are examined for this purpose. For ease of interpretation, all scales have been standardised with the mean fixed at 500 and standard deviation at 100. This procedure has been used by SACMEQ and in other international studies such as the TIMSS. It is highly recommended, given the difficulty that some readers face in interpreting the logit scale.

The multilevel modelling (MLM) technique is used to estimate the hierarchical regression equations that consist of the variables, discerning different levels including pupil, classroom, and school levels. This implies that the MLM analysis technique is well aligned to the underlying structure of the SACMEQ dataset, which is hierarchical. Further, the residual analysis function of the MLM would allow for the profiling of schools, based on the final models' effectiveness scores. This is of significance to this study as it would highlight the extent to which the model is aligned to the actual data. Also, profiles of more effective schools would be used to inform practice.

Nonetheless, as Peugh (2010) warns, just because data are nested is no warranty to use the MLM technique. In fact, if the higher level does not account for some significant variation of the response variable, single level regressions could suffice. This implies that an intra-class correlation coefficient needs to be estimated to establish whether the higher levels explain

significant variance in the outcome variable. Assuming $v_k \sim N(0, \sigma_v^2)$, $u_{jk} \sim N(0, \sigma_u^2)$ and that $e_{ijk} \sim N(0, \sigma_e^2)$, then the intra-correlation (ICC) would be computed following Siddiqui et al.'s. (1996) framework. According to Siddiqui et al. (1996), the intra-class correlation is given by the correlation between the observed and estimated outcomes.

Assuming $y_{ijk}, and\ y_{\overline{ijk}}$ are the observed and estimated attainments for pupil *i* in classroom *j* and school *k,* then,

$$corr\left(y_{ijk}, y_{\overline{ijk}}\right) = \frac{cov(y_{ijk}, y_{\overline{ijk}})}{\sqrt{var(y_{ijk})}\sqrt{var(y_{\overline{ijk}})}}$$

But $cov\left(y_{ijk}, y_{\overline{ijk}}\right) = cov(\beta_0 + v_k + u_{jk} + e_{ijk} + \beta_0 + v_{\bar{k}} + u_{\overline{jk}} + e_{\overline{ijk}})$

$$= cov(v_k, v_{\bar{k}}) + cov\left(u_{jk}, u_{\overline{jk}}\right) + cov(e_{ijk}, e_{\overline{ijk}})$$

And $var\left(y_{ijk}\right) = var\left(y_{\overline{ijk}}\right) = \sigma_v^2 + \sigma_u^2 + \sigma_e^2$

Therefore $corr\left(y_{ijk}, y_{\overline{ijk}}\right) = \frac{cov(v_k, v_{\bar{k}}) + cov\left(u_{jk}, u_{\overline{jk}}\right) + cov(e_{ijk}, e_{\overline{ijk}})}{\sqrt{(\sigma_v^2 + \sigma_u^2 + \sigma_e^2)}\sqrt{(\sigma_v^2 + \sigma_u^2 + \sigma_e^2)}}$

$$= corr\left(y_{ijk}, y_{\overline{ijk}}\right) = \frac{cov(v_k, v_{\bar{k}}) + cov\left(u_{jk}, u_{\overline{jk}}\right) + cov(e_{ijk}, e_{\overline{ijk}})}{\sigma_v^2 + \sigma_u^2 + \sigma_e^2}$$

Assuming ρ= $corr\left(y_{ijk}, y_{\overline{ijk}}\right)$, and given that $cov(v_k, v_{\bar{k}}) = \sigma_v^2, cov\left(u_{jk}, u_{\overline{jk}}\right) = \sigma_u^2,$

$$cov\left(e_{ijk}, e_{\overline{ijk}}\right) = \sigma_e^2,$$

then, $\rho_{class} = \frac{\sigma_u^2 + \sigma_v^2}{\sigma_v^2 + \sigma_u^2 + \sigma_e^2}$.

On the other hand, the intra-class correlation coefficient (ICC) at school level would be computed by $\rho_{school} = \frac{\sigma_v^2}{\sigma_v^2 + \sigma_u^2 + \sigma_e^2}$. Note that the school ICC value indicates the correlation in attainment scores of different pupils from various classrooms attending the same school. Similarly, the classroom ICC computes the correlation in the scores of different pupils attending the same classroom and school.

While not much contention is apparent with regards to the computation of school-level intra-correlation, various methods (different from Siddiqui et al., 1996) have been suggested for the classroom-level intra-correlation. To illustrate, Davis and Scott (1995) argue that the classroom intra-correlation should be computed as a stand-alone component and should not be aggregated with that at school level. Although both methods have been validated, this study adopts Siddiqui et al.'s suggestion for computing classroom-level ICC, due to the fact that pupils in the same classroom have to be from the same school and so, at the classroom level, the school variance component is present. Probably, the Davis and Scott (1995) method would suffice for computing the variance partition coefficient (VPC).

The decision to carry on with multilevel modelling technique is also based on whether higher levels account for any variation in the outcome variable. Thus, the ICC value equal to zero would sometimes indicate no hierarchy in the data, while an ICC of one would indicate identical units at all the levels. The former condition would not warrant the use of multilevel modelling, since a single regression would suffice (Goldstein, 2011). However, using the traditional statistical models such as single-level regressions for this study and these particular questions would require either aggregating or disaggregating the pupil and school-level data, respectively, to be able to answer the various level-specific questions. This would lead to committing two theoretical fallacies, both ecological and atomistic (Goldstein, 2011; Luke, 2004). Statistically, such fallacies would lead to a pooling of error terms, given that the effect of clustering data in levels is ignored, hence inaccurate inferences are likely to result (Buxton, 2008; Day and Rasbash, 2006; Goldstein, 2011; Hallinger and Heck, 1998; Luke, 2004). One would be tempted to argue simplistically that the use of ANOVA and ANCOVA would actually alleviate the above theoretical and statistical challenges generated by fitting single-level models on nested data. However, it is imperative to note that, where many groups are involved, the ANOVA and ANCOVA would lose out on power and parsimony due to the various dummy variables that would need to be created for each group (Luke, 2004). Moreover, such methods are said to be highly inflexible in handling missing data and unbalanced research designs.

Additionally, other variance component analyses such as the VPC are computed to reinforce further the appropriateness of the multilevel models. Moreover, the VPC would highlight the relative importance of the clusters. The assumption here is that each of the levels should account for some variance in the response variable to justify the presence of hierarchy. VPCs for the different levels are calculated, as below:

$$VPC_v = \frac{\sigma_v^2}{\sigma_v^2 + \sigma_u^2 + \sigma_e^2}$$

$$VPC_u = \frac{\sigma_u^2}{\sigma_v^2 + \sigma_u^2 + \sigma_e^2}$$

$$VPC_e = \frac{\sigma_e^2}{\sigma_v^2 + \sigma_u^2 + \sigma_e^2}$$

where VPC_v, VPC_u, VPC_e, are the variance partition coefficients at levels 3, 2 and 1 respectively. On the other hand, σ_v^2 , σ_u^2, σ_e^2 are the response variable variances explained by levels 3, 2 and 1, respectively. Although the ICC and VPC for level 3 are the same from the symbolic specifications, this may not hold in complex models that involve randomised slopes (see Leckie, 2013).

Finally, the log likelihood ratio is used to further test for the most suitable model and levels. Leckie (2013) advises for the use of the likelihood ratio to test a joint hypothesis related to the random terms. The hypothesis is tested using the likelihood ratio obtained using the general equation, as below:

$$LR = (-2LogL_0) - (-2LogL_1)$$

where LR is the likelihood ratio, L_0 is the likelihood of a lower level model (such as single level model against the level 2 model) and L_1 is the likelihood of a higher level or cluster model. The obtained LR statistic is then compared to the Chi-square statistic with the same degrees of freedom to determine the level of significance.

The hypotheses to be tested include:

1. Whether or not there are higher level effects at all,

H_0: $\sigma_v^2=0$, $\sigma_u^2=0$

H_a: $\sigma_v^2>0$, $\sigma_u^2>0$

2. Whether or not there are any school effects at all,

H_0: $\sigma_v^2=0$,

H_a: $\sigma_v^2>0$

Where the three level model is selected, the general multilevel equation is estimated and takes the basic format as below:

$$Y_{ijk} = \beta_0 + \beta_r X_k + \beta_q W_{jk} + \beta_p Z_{ijk} + V_k + U_{jk} + e_{ijk}$$

where: Y_{ijk} is the outcome score for pupil *i* in classroom *j* in school *k.*

β_0 is the intercept which would be taken to be the grand mean of the outcome variable.

X_k is a vector of school *k* covariates.

W_{jk} is a vector of covariates located at classroom *j* within school *k.*

Z_{ijk} is a vector of covariates relating to pupil *i*, in classroom *j* in school *k.*

β_r is a vector of the corresponding estimated effects of *r* school-level covariates (*r=1…..r*).

β_q is a vector of the corresponding estimated effects of *q* classroom-level covariates (*q=1….q*).

β_p is a vector of the corresponding estimated effects of *p* pupil-level covariates *(p=1….p).*

V_k is the variance component located at school level (in this case Level 3).

U_{jk} is the variance component located at the classroom level (Level 2).

e_{ijk} is the error term for pupil level (in this case Level 1)

This general equation may undergo various transformations, depending on the assumptions taken such as random intercepts and random slopes, and hypothesised interactions as deemed appropriate.

On the other hand, this study provides a snapshot of the equity dimension in the distribution of attainment, educational processes and school inputs. To estimate equity in the distribution of educational attainment, the Gini coefficient is estimated using the direct and the indirect methods. The main aim here is to establish whether attainment is proportionally distributed relative to the proportions of pupils in the various SES groupings. A general coefficient is estimated for the whole school sample. While it would be more appropriate to estimate a Gini for each school, this is not pursued due to the few cases (about 20) per individual school. Choice of the Gini index is justified in the literature review chapter. The direct method estimates the following equation:

$$GINI = [(\frac{1}{\mu}) \sum_{i=2}^{n} \sum_{j=1}^{i-1} P_i P_j |y_i - y_j|]$$

where:

Gini is the educational Gini coefficient.

μ is the mean of the outcome variable for which equity is being measured, in this case it would be the pupil attainment. This will be computed as $\mu = \sum_{i=1}^{n} P_i y_i$;

P_i and P_j are proportions of population (in defined SES categories) with y_i and y_j as the corresponding units of outputs for the different SES groupings.

n is the number of SES groups derived in the data.

Computation of the Gini coefficients is followed by the indirect method; that is, the Lorenz curve to illustrate graphically the extent of (in)equality in the distribution of educational outputs among the various population proportions based on SES.

The Theils *T* index is used to investigate equity in the distribution of inputs among schools. This is an input-focused equity measure and is decomposable within and between schools. Its computation is as follows:

$$T_{ind} = \sum_{i=n}^{n} [\left(\frac{1}{n}\right) . \left(\frac{v_i}{\mu}\right) . ln \left(\frac{v_i}{\mu}\right)]$$

where:

T_{ind} is the Theils T index for an individual unit of analysis. The summation of individual Theils *T* indices yields the total inequity measure in the distribution of inputs.

n represents the number of schools in the sample

v_i is the value of school inputs for school i.

μ is the sample inputs mean.

v_i/μ is the ratio of individual school inputs value to the sample mean inputs and the natural log of v_i/μ determines whether that individual school Theils *T* element is positive (when individual school inputs value is greater than the sample inputs mean), negative when otherwise or zero when the two are equal (every individual school has exactly the same as the group average) (see Kelly, 2015).

Finally, as indicated earlier, variations in OTL are used to proxy the equity dimension in the educational processes.

CHAPTER FIVE: DATA ANALYSIS AND PRESENTATION

5.0. Introduction

In this chapter, data are analysed in the light of the methods specified in the methodology chapter and the research questions. Before embarking on answering research questions, preliminary data analyses are undertaken, as well as the procedures for deriving the required variables for the model. The current study is primarily concerned with establishing the educational process factors that explain variations in pupil attainment. To this end, a number of processes have been constructed from various individual items that, according to theory and practice, have been thought to constitute those particular processes. The development of the process indices and scales has been elaborated.

5.1. Scales development

In this section, an explanation is given on the construction of scales and indices to proxy the educational process factors. The process factors include: educational resource usage; school management competences; school community relations; school-based HIV/AIDS awareness;school-based HIV/AIDS support; and TAPC and OTL. On the other hand, school educational resources is a key control variable for this study, hence an index is constructed in addition to the above process factors.

As hinted earlier on, this study entails a number of latent variables that are measured by numerous items. The study argues against including all the individual items that constitute the latent scales into the model, as such a practice would not only introduce several multicollinear associations between items measuring the same underlying construct, but also would over-saturate the model and hence lose the key virtue of statistical modelling: parsimony. Moreover, the study is not interested in individual items' effects but rather the effect of the underlying constructs on pupil outcomes. To this end, methods are preferred that are used to combine individual items to constitute a scale of the underlying construct. The Rasch modelling technique is adopted in the construction of the aforementioned scales. Justification for this choice has been elaborated in the methodology chapter (Chapter 4).

Various Rasch models are to be estimated, based on the response structures of the items that constitute the scales. Most importantly, where data are binary, the dichotomous Rasch model is estimated. This is specified as follows:

$$Probability(X_{ni} = 1|\alpha_n, \delta_i) = \frac{e^{(\alpha_n - \delta_i)}}{1+e^{(\alpha_n - \delta_i)}}$$

where α_n, δ_i represent person ability and item difficulty respectively. This function estimates the probability of an individual *n* (*n*=1,…..,N) with ability α_n faced with δ_i level of item difficulty, getting item X_i correct (score of 1) (*i*=1,….,I).

On the other hand, where the data structure is consisted of items that share different groups of response categories, the Rasch-grouped Rating Scale Model is to be estimated as follows:

$$log_e\left(P_{nij}\middle|P_{ni(j-1)}\right) = \propto_n - \delta_{gi} - \theta_{gj}$$

where P_{nij} is the probability that person n with ability $\propto_n$ faced with an item *i* with a rating structure belonging to group *g* with item difficulty δ; will prefer to choose alternative *j* as opposed to alternative *j-1*. On the other hand, θ_{gj} is the threshold point where the person n is indifferent to having to choose between item alternatives *j or j-1*. In other words, the same probability applies to whichever choice made (either *j* or *j-1*).

5.1.1. School Educational Resources Index

This is estimated to profile the school by the educational resources it owns. The dichotomous Rasch model is the most suitable for the response structure of the educational resource items (binary).

Diagnostics

On first calibration, the average item infit is .99 (minimum .84 and maximum 1.17), while the average item outfit is .99 (minimum .50 and maximum 1.58). On the other hand, average person infit is 1 (minimum .42 and maximum 2.73) and average outfit is 1 (minimum .30 and maximum 1.63). This implies that, whereas on average items and persons fit the Rasch model, there are some individual misfits. These are investigated further. Investigations indicate that some items concerning possession of CD player, VCR player, DVD player, Internet, fax machine, projector, tape recorder, flush toilets and a computer room were almost out of reach of the sample schools and, therefore, they were not being fully measured by the sample schools. These were dropped from further calibration, as they were not adding any information to the scale.

The second calibration indicated fit improvement, with most of the item and person fit indices lying within the Rasch limits (close to 1). Nonetheless, some items including availability of

sitting space, writing space, temporary classrooms, playground, and pit toilets had slightly higher than the 1.30 outfit thresholds. This implies that their measurement was more unstable than expected. Nevertheless, all these items have their infit indices within the Rasch limits. This implies that, while their measurements entailed greater than expected variance, they were well targeted to the abilities of the schools in the sample. To this end, they were retained in the item pool.

With regards to category functioning, the categories are ordered and distinct, thereby upholding the key Rasch principle of monotonicity. The scale is reliable and reproducible as indicated by higher person and item alpha values of .81 and .99 respectively. Further, schools and items are fairly well spread on the latent construct continuum, as highlighted by the wider measurement range. To illustrate, school spread stands at 6.85 logits (minimum -3.81 and maximum 3.04) and that for items is 6.15 (minimum -3.28 and maximum 2.87). Wider spread is also reinforced by higher separation indices for persons (2.1) and items (9.97).

The scale is unidimensional with limited suggestion of a secondary dimension.

Table of STANDARDIZED RESIDUAL variance (in Eigenvalue u			
		-- Empirical	
Total raw variance in observations	=	76.6	100.0%
Raw variance explained by measures	=	33.6	43.9%
Raw variance explained by persons	=	8.3	10.8%
Raw variance explained by items	=	25.3	33.1%
Raw unexplained variance (total)	=	43.0	56.1%
Unexplned variance in 1st contrast	=	4.3	5.6%
Unexplned variance in 2nd contrast	=	2.8	3.7%
Unexplned variance in 3rd contrast	=	2.7	3.5%
Unexplned variance in 4th contrast	=	2.1	2.8%
Unexplned variance in 5th contrast	=	1.8	2.3%

Table 3 Principal components in data measuring School Educational Resources Indicator

From the principal component analysis (PCA), the current latent construct accounts for 44% of the total variance in the data, while the secondary dimension accounts for only 5.6% of the total variance. This could be taken to be very low, to suggest an imminent secondary dimension. Unidimensionality is further confirmed by the all positive point biserial correlation, and all are above 10%, apart from those for the two items of enough sitting space and enough writing space.

The scale shows fair item targeting, although items are on average more difficult to endorse relative to the school abilities. This implies that schools still find it difficult to own particular resources. This is reflected in the school mean of -.24 logits, compared to item mean fixed at

zero on the logit scale. Item redundancy is also noticeable, mainly due to intensification of the inquiry on particular types of resources possessed by the schools. Nonetheless, approximately 95% of the school's abilities are well targeted by 65% (28 of 43 items) of the total items. Overall, it can be inferred that the scale meets the Rasch scale expectations.

The final educational resources scale is constituted by 43 items (see Appendix 1) and is standardised with an item mean of 500 and standard deviation of 100 for easy interpretation. Resources can be fairly classified as:

i. School infrastructure items
ii. School equipment and or appliances items
iii. Classroom furniture items
iv. Learning materials and or teaching aids.

School scores	**Estimate**
Mean resources owned by schools	475.75
Resources owned by the richest school	803.89
Resources owned by the poorest school	119.48
Median school score	472.43
Standard error	5.84

Table 4 Summary statistics for School Educational Resources Index

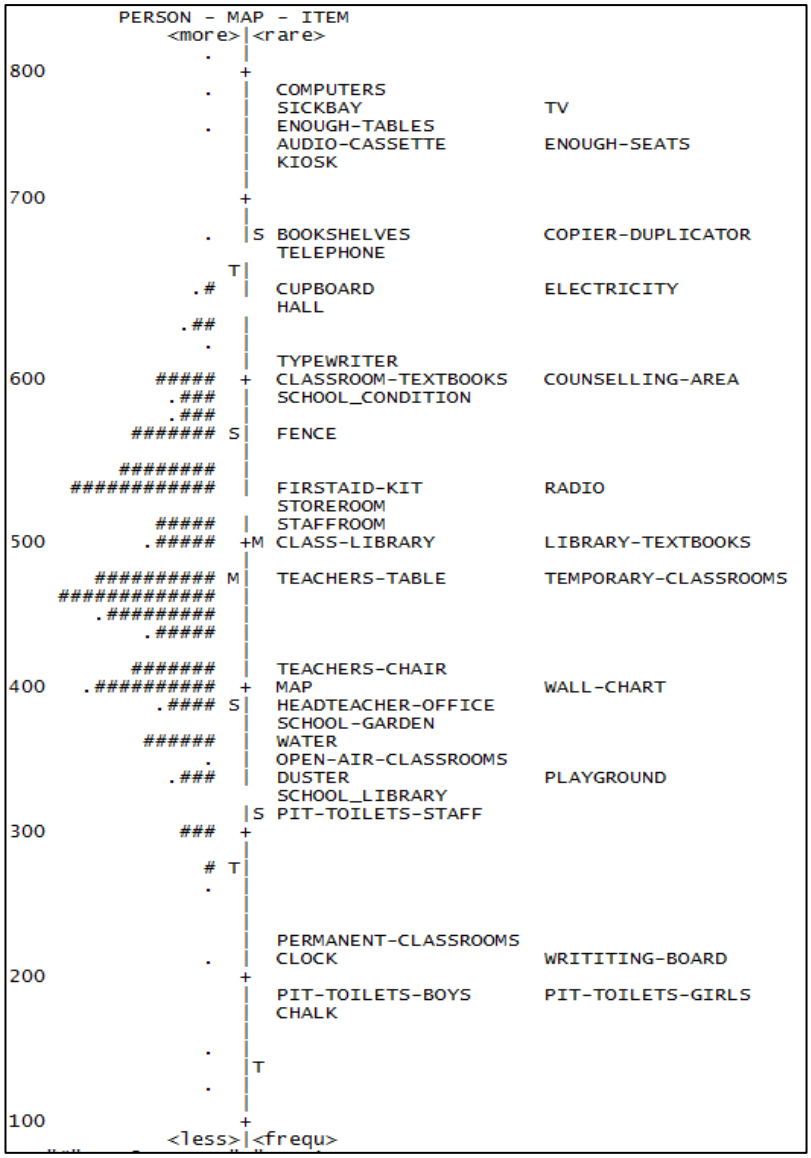

Figure 5 Item map for school educational resources

The mean score of 475.75 indicates that an average Ugandan school owns resources of this magnitude on the scale. From the above item map (Figure 5), an average school would be able to have all the items that are within its ability (any items whose difficulty score is less or equal to 475.75). The richest school in Uganda owns resources to the scale of 803.89, while the poorest is at 119.48. Half of the schools (50%) own resources up to the scale 472.43 (median score), which is less than the resources expected to be found in an average school.

The item map is dominated by items that belong to school infrastructure classification (over 50% of items). This is typical of schools in poor societies, given that they are still struggling to have the basic infrastructure such as buildings, library, toilets, playground (hardware) to operate. Infrastructural resources are spread all over the scale and resources such as pit

latrines, permanent classrooms, school library, playground, a water source, school garden and head teacher's office are the most commonly possessed by schools in Uganda. On the other hand, it is difficult for average schools to have infrastructural resources such as a fence or hedge, school hall, counselling area, electricity, kiosk or sickbay.

A few resources are classified as equipment and appliances; that is, clock, radio, typewriter, copier/duplicator, telephone, audio cassette, TV and computers. Of these items, an average school is easily able to own a clock. On the other hand, there is less likelihood of Ugandan schools owning the other appliances aforementioned. Computers remain the most difficult appliances for primary schools to own in Uganda.

Classroom furniture is another classification of the resources. Of these, an average Ugandan primary school is most likely to own a writing board, duster, teachers' table and chair. On the other hand, schools are less likely to have enough seats and writing spaces for each and every pupil in the class, or bookshelves or a cupboard in the classroom.

The last classification of resources is learning materials and teaching aids. Within these, an average primary school is most likely to have chalk, a wall map and a chart. They are less likely to have enough library and classroom textbooks.

5.1.2. School Management Competence Indicator

This scale attempts to measure the wealth of competences possessed by the school leadership, specifically the head teacher. The Rasch-grouped Rating Scale Model is estimated. This is against a backdrop that various items to constitute the scale have differing item response structures. Yet, some items do share similar response structures, and this justifies the grouping of the rating scale (see Linacre, 2013).

On first calibration, average personal ability is greater than item difficulty, as indicated by the higher mean person ability (.66 Logits) than zero (0 logit means the mean point mark and so it should not be interpreted as a ratio scale). This implies that respondents found the items slightly easier, on average. The average fit statistics on first calibration fell within the expectations of the Rasch models (Mean Square error close to 1). This is the case for items, persons and category measures. These statistics imply that, on average, the people and items collectively exhibited the expected variability.

Nonetheless, the item thresholds for structural groupings 1 (items with rating scale of four options) and 2 (items with rating scale of three options) are not distinct enough. This is illustrated more by the disordered category measures for structural grouping 2 (see Appendix 2). Moreover, the category probability curves for the 3 and 4 response option items further confirm the disordered structure, which violates monotonicity. More cross-examination indicates that some individual persons and items are misfitting and therefore not informative to the scale. To illustrate, about four items have disordered categories with lower categories attaining a higher measure on the latent scale than higher order categories (see Appendix 2). This violates the principle of monotonicity, which is the core of any item response theory (IRT) models.

The scale has good item reliability index (.98), but with low person reliability alpha (.31). Further, the Alpha KR-20 of .53 is considered low. Nonetheless, the person raw scores correlate well with the overall measure (Corr=.88). The reliability problems with person measures are further confirmed by the low person separation index of .67 – an indication that person's abilities have very limited variability than would be expected. The same is reflected in the spread of person measures, where the range is quite narrow at 2.44 logits (minimum $^{-}$.63 and max $^{+}$1.81 logits). On the other hand, the good reliability index of items is also reflected in a higher separation index of 7.95 and a wider spread in item difficulty measure with a range of 5.32 logits (min $^{-}$3.34 and max $^{+}$1.98). Nonetheless, there are more easy items than difficult ones (larger minus logit value and smaller positive logit value). This implies that the items could be improved by adding some less agreeable items.

As regards unidimensionality, the principal components analysis (PCA) (Table 5) of the standardised residuals does not explicitly support multidimensionality. While the main measure explains 34.2% of the total variance in the data, the first contrast explains 13.1% and it is three Eigen values strong. Further, the data have some items with negative and or very low point biserial correlation, which is indicative of multidimensionality.

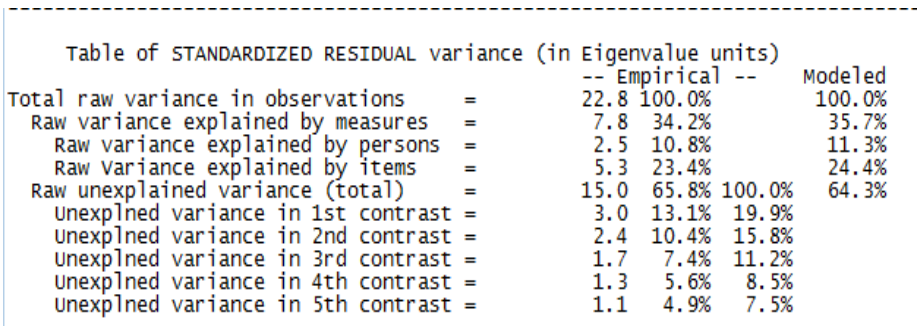

Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)

		-- Empirical --		Modeled
Total raw variance in observations	=	22.8	100.0%	100.0%
Raw variance explained by measures	=	7.8	34.2%	35.7%
Raw variance explained by persons	=	2.5	10.8%	11.3%
Raw Variance explained by items	=	5.3	23.4%	24.4%
Raw unexplained variance (total)	=	15.0	65.8% 100.0%	64.3%
Unexplned variance in 1st contrast	=	3.0	13.1% 19.9%	
Unexplned variance in 2nd contrast	=	2.4	10.4% 15.8%	
Unexplned variance in 3rd contrast	=	1.7	7.4% 11.2%	
Unexplned variance in 4th contrast	=	1.3	5.6% 8.5%	
Unexplned variance in 5th contrast	=	1.1	4.9% 7.5%	

Table 5 Principal components in the data measuring school management competence

Though the initial item map (Appendix 3) indicates a good spread among the items on the latent scale, the persons are concentrated within two standard deviations from the mean (above and below). The map shows many items sharing locations on the latent scale (item clumping), which is indicative of item redundancy or intensification of the tool items on a specific theme or area and ignoring others. On average, there seems to be fair item targeting, although there are three items that are outside the abilities of the sample.

In the light of the above diagnostics, the scale does not fit with the expectations of the Rasch modelling technique. Various modifications were explored to try to improve the scale fit and reliability. These included collapsing the dysfunctional categories, and deleting and reversing the response structures of some items. These improved the psychometric properties of the scale. The final scale is constituted by 13 items (Appendix 5) and the summary statistics are as below:

Persons' scores (head teachers)	Estimate
Mean competence	535.42
Most competent head teacher score	731.78
Least competent head teacher score	333.07
Median competence score	527.5
Standard error	4.88

Table 6 School Management Competence scale statistics

The statistics indicate that person ability is spread between 333.07 (least competent head teacher) and 731.78 (most competent head teacher) units on the latent scale. This implies a range of 398.71, which is a wide spread.

The averagely competent head teacher score is 535.42. The statistics show that 51% (135 of 264) head teachers have a competence score of below average, while 49% (129 out of 264) are above average.

Overall, head teachers' abilities were, on average, higher than the item difficulty (person mean=535.4, item mean=500). Nonetheless, the difference is small, indicating that items were fairly targeted to individual ability.

5.1.3. School Resource Usage Scale (RUS)

This scale is aimed at establishing whether schools are using the resources that are allocated to them for learning. Initially, the Rasch-grouped rating scale model was specified, given that items were on different rating scales, with some sharing the same rating structure. On estimating the model the following were diagnosed:

The average person and item fit indices fell within the acceptable ranges. For instance, the person infit average is 1.10 and outfit is 1.14. On the other hand, the average infit index for items is .99 while outfit is 1.29. These are close to one. Nevertheless, there is wide variation within the fit indices of the individual persons and items. For persons, the infits and outfits range between .13 and 5.00, and .10 and 9.90 respectively. The maximum values for person fit indices are of great concern, as they reflect more noise than information. Infit and outfit indices for items range between .76 and 1.52, and .61 and 3.42 respectively. This also implies that some variance in items is due more to noise than information.

Category functioning was investigated using the empirical item category functioning map, which indicated disordered categories. This was reaffirmed using the item probability curves and threshold measurement values. For instance, the item probability curves indicate that for group 1 (items with five response options structure), response options 2 and 4 were never probable on the latent scale. Similarly, the probability curves also indicate that for group 2 (with four response options structure), response options 2 and 3 were never probable on the construct continuum. Additionally, response option 2 of group 3 items (items with three response options structure) was never probable at any one point on the latent construct scale. This scenario was also reflected by the disordered thresholds in group 1 items, where response option 4 had higher threshold than option 5 and with a very small distinction between the thresholds of options 2 and 3.

For group 2 items, response option 2 had a higher threshold value than the rest of the options. Lastly, group 3 items reflected negligible difference between response options 2 and 3. All these findings indicate that the items in the data violated the key principal of monotonicity of category thresholds and measures.

With regards to reliability, item alpha is .98, while person reliability is slightly lower (at .68) than expected. This implies that, while the respondents provide more reliable information about the 13 items of the RUS scale, the items have less ability to provide information to appropriately measure the persons. Lower person reliability is also reflected in the low separation index (1.5) compared to that of items (above 10). Nonetheless, both items' and persons' measures are fairly well spread along the latent continuum. For instance, the distance between the less able or least agreeable person (measure=-3.03logits) and the most able or most agreeable person (measure=2.69 logits) is 5.72 logits. On the other hand, items also represent a wider distribution on the latent continuum, with the difference between the most easy item (measure=-1.18) and the most difficult item (measure=2.36 logits) being 3.54 logits.

In terms of unidimensionality, the PCA (Appendix 18) indicates that the current construct explains 48% of the total variance in the data, while the first construct explains 16.1% (it is four items strong, Eigen value=4). This could point to the presence of a secondary dimension in the data, besides resource usage. On the other hand, the point biserial coefficients are all positive and of good magnitude.

From the initial item map (Appendix 19), items were not well targeted to the abilities of the persons. For instance there is a very wide gap in the distribution of the items between the averagely difficult and the most difficult. This left a great number of person abilities (about two standard deviations from the mean ability) without appropriate items targeting them. Such person measures are more likely to have more noise and little information. There is also some evidence of item redundancy, with some items clumped together in the same position on the latent scale. This could as well be representative of intensification of the items towards one particular thematic area of the scale. The map indicates that pupil access to computers in school (item label=UseComputer) and access to free school meals (item label= FSM) are the most difficult items to endorse on the RUS. On the other hand, teacher's access to an English Dictionary (Dictionary) and English guide (TrGuide1) were the easiest items to endorse on the RUS scale.

From the above diagnostics, it can be concluded that the data do not fit the model in its current form and structure. To this end, further modifications were undertaken that included collapsing malfunctioning categories. After the modifications, there was a need to re-specify the model from Rasch-Grouped rating scale to a dichotomous model, given that the latter provided more improvement.

After all the modifications, the scale fairly meets the psychometric properties of the Rasch models. The final scale is constituted by 13 items (see Appendix 21) and the summary statistics below:

School scores	**Estimate**
Mean resource usage	533.60
School with highest usage score	1117.49
School with least usage score	54.90
Median usage score	531.67
Standard error	1.99
Total variance explained	51.1%

Table 7 Resource usage scale statistics

The scale statistics indicate that school mean resource usage was 533.60, with wider variations around the mean as indicated by the wide range (minimum=54.90 and maximum=1117.49). This could be reflective of wider variations in the resources available to different schools in Uganda and the differences in the abilities of such schools to put such resources to a use that is relevant to academics. Distribution of respondents on the latent construct indicates that 38% are above the mean resource usage, while 62% are yet to attain the average usage. This could imply limited usage of what is available or it could as well imply absence of what to use in most schools.

The final item map (Appendix 20) indicates that fewer schools provide their pupils with computers to use in school, and that fewer schools provide their pupils with meals and or snacks while at school. Further, pupils find it difficult to endorse being allowed to take books home from their classroom library. On the other hand, pupils are more agreeable to the fact that they use reading textbooks by themselves or by sharing with classmates.

Moreover, more teachers use an English dictionary in school and more pupils are allowed to take textbooks home from the school library rather than from their classroom library.

5.1.4. Teacher academic and professional capital (TAPC)

This scale is constituted by key cumulative skills and trainings attributable to teachers. The Rasch-grouped rating scale is justified for the structure of the items that constitute the scale.

The preliminary diagnostics indicate that the average person infit and outfit indices are 1.04 and .94 respectively. Similarly, average item infit and outfit indices are 1.00 and .94 respectively. From the empirical item category measures plot (Appendix 6), no item violates the additive assumption. The same view is reinforced by the summary of category measures and the item characteristic curves. Nonetheless, response options for grouping 3 (items with three response options structure), do not discriminate well between the response options on the latent variable. For instance, response options 1 and 3 are least probable on the latent scale. On average, the empirical item category measures plot does not point to any violations of monotonicity. As regards reliability of the scale, persons' responses to the items were less reliable (alpha score of .58), but a higher item reliability score of 1 was recorded. With regards to unidirectionality, the point biserial correlations indicate positive coefficients for all items, save for two items whose signage (negative) contradicts the model expectation. The two items were recoded into binary, which marginally improved the scale.

The PCA (see Table 8) indicates that the construct explains about 30% of the total variance in the data, while the secondary construct explains 11%. This is quite substantial and suggestive of the presence of a secondary dimension. More alternative modifications were tried to improve the scale but instead made it worse than before.

Table of STANDARDIZED RESIDUAL variance (in Eigenvalue un			
		-- Empirical	
Total raw variance in observations	=	25.6	100.0%
Raw variance explained by measures	=	7.6	29.6%
Raw variance explained by persons	=	4.3	16.9%
Raw Variance explained by items	=	3.3	12.7%
Raw unexplained variance (total)	=	18.0	70.4% 1
Unexplned variance in 1st contrast	=	2.7	10.7%
Unexplned variance in 2nd contrast	=	2.4	9.4%
Unexplned variance in 3rd contrast	=	2.0	7.7%
Unexplned variance in 4th contrast	=	1.4	5.4%
Unexplned variance in 5th contrast	=	1.3	5.2%

Table 8 Principal components in the data measuring TAPC

The final TAPC scale is constituted by 18 items (Appendices 7 and 8), with the following statistics:

Person Scores (teachers)	**Estimate**
Mean TAPC score	565.5
Teacher with highest TAPC score	938.36
Teacher with lowest TAPC score	278.68
Median TAPC score	568.47
Standard error	1.26

Table 9 TAPC scale statistics

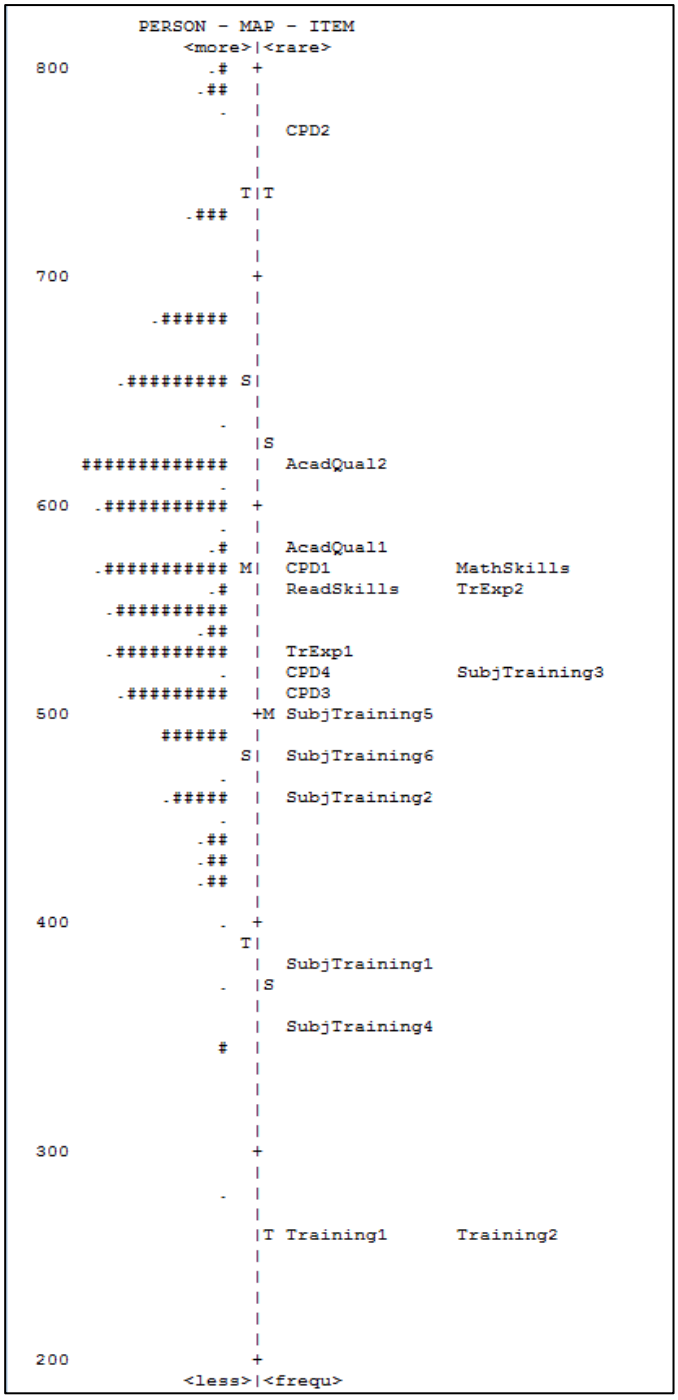

Figure 6 Item map for TAPC
Note: for full names of the variable labels, see Appendix 8.

From the item map (Figure 6), most of the teachers found it easy to endorse such skills and competences accumulated from teacher training and appropriate subject training. Similarly, reading teachers found it easier to endorse more professional capital gained from exposure to in-service training and courses. On the other hand, more teachers found it difficult to endorse possession of higher academic qualifications and, in the case of mathematics teachers, it was very difficult to agree with the fact that they had gained any professional capital through being

exposed to in-service courses. The item map also indicates that about half of the total number of the teachers in the sample could demonstrate the required mathematics and English competences.

5.1.5. Opportunity to Learn (OTL) Index

This indicator is a proxy for the quantity and quality of teaching that the learners are exposed to. Classroom environmental factors that aid/disrupt the opportunity for learning to occur in class are also taken into consideration. The index is informed by the earlier works of Porter (1993), who indicated that OTL could be manifested through three dimensions; that is, content coverage, content exposure and quality of instruction delivery. To develop the OTL scale, the Rasch-grouped Rating Scale Model is used. This is against a backdrop that various items have differing item response structures. For instance, some items are binary, while others have three and four response options.

Diagnostics

The average item infit and outfit indices are 1.00 and 1.01, respectively. For persons, the average infit and outfit indices are 1.05 and 1.02, respectively. The indices on average fall close to the expected score of one. This implies that the variations in the item and person response patterns are within the expectations of the Rasch model. Moreover, the infit indices imply that the items are averagely targeted to the abilities of the persons. Nonetheless, close examination of the individual items and persons indicate wider ranges in the fit indices. For instance, the individual person infits range between 0.21 and 2.61, while the outfits range between 0.28 and 9.90. Similarly, item infits range between 0.58 and 1.41, while the outfits range between 0.58 and 1.49. These statistics indicate that some individual person and item measures have more error than expected. Moreover, smaller values (far below 1) could also indicate the presence of less variable items or too predictable items in the data. All these scenarios call for further investigation.

As regards category functioning, while the binary and the three-response option items function as expected, the group 3 (items with four response options) items have disordered category functioning and indistinctive threshold between response options 3 and 4. Response option 3 is not probable at all on the latent construct (see Appendix 9).

Persons' alpha for the scale is 0.55 and that of items is 1.0. Persons' alpha indicates less reliable personal response patterns, whereas the alpha for items indicates highly reliable items. Poor person reliability measure is also reflected in the low personal separation index of 1.11, while a higher item alpha is also reflected in a higher item separation index of 11.44.

The point biserial correlations are all positive, an indication that one dimension is more likely. However, some coefficients are actually small for some items, indicating limited correlation between the point measure and the overall construct measure. The initial PCA (Appendix 10) suggests the presence of a secondary dimension, besides OTL. To illustrate, while the latent construct explains 30% of the total variance in the data, the first contrast explains as much as 15.2% of total variance, and it is four Eigen values strong.

The initial item map (Appendix 11) suggests poor item targeting, with some items lying in the bottom tail without any matching person abilities for such items. Further, there are gaps in the distribution of the items on the latent scale. Moreover, there are personal abilities that correspond to such gaps. This increases the error in measuring such persons who are without items that match their abilities.

Modifications are undertaken in the light of the above. These entailed collapsing group 3 items and deleting seriously misfitting items. Four persons were excluded from further calibration. On modification, there was significant improvement in the psychometric properties of the scale, with infits and outfits lying within the expectations. All categories are normally functioning and the persons' alpha increased from .55 to .68. Further, the PCA (see Table 10) indicates unidimensionality with no suggestion of a significant first contrast. From the table below, OTL accounts for 47.4% of the total variance in the data while the first contrast accounts for 12.5%, with an Eigen value of 3.8.

```
     Table of STANDARDIZED RESIDUAL variance (in Eigenvalue
                                                -- Empirica
Total raw variance in observations     =          30.4 100.0%
  Raw variance explained by measures   =          14.4  47.4%
    Raw variance explained by persons  =           3.4  11.2%
    Raw Variance explained by items    =          11.0  36.2%
  Raw unexplained variance (total)     =          16.0  52.6%
    Unexplned variance in 1st contrast =           3.8  12.5%
    Unexplned variance in 2nd contrast =           1.8   5.8%
    Unexplned variance in 3rd contrast =           1.6   5.1%
    Unexplned variance in 4th contrast =           1.4   4.5%
    Unexplned variance in 5th contrast =           1.1   3.6%

        STANDARDIZED RESIDUAL VARIANCE SCREE PLOT
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Table 10 Principal components in the data measuring OTL scale

The final OTL scale is measured by 16 items (Appendix 12). Below are the descriptive statistics and the item map.

Classroom scores	**Estimate (scaled)**
Mean OTL	473.47
Highest OTL score	797.43
Lowest OTL score	268.19
Median OTL score	467.53
Standard error	4.73

Table 11 OTL scale statistics

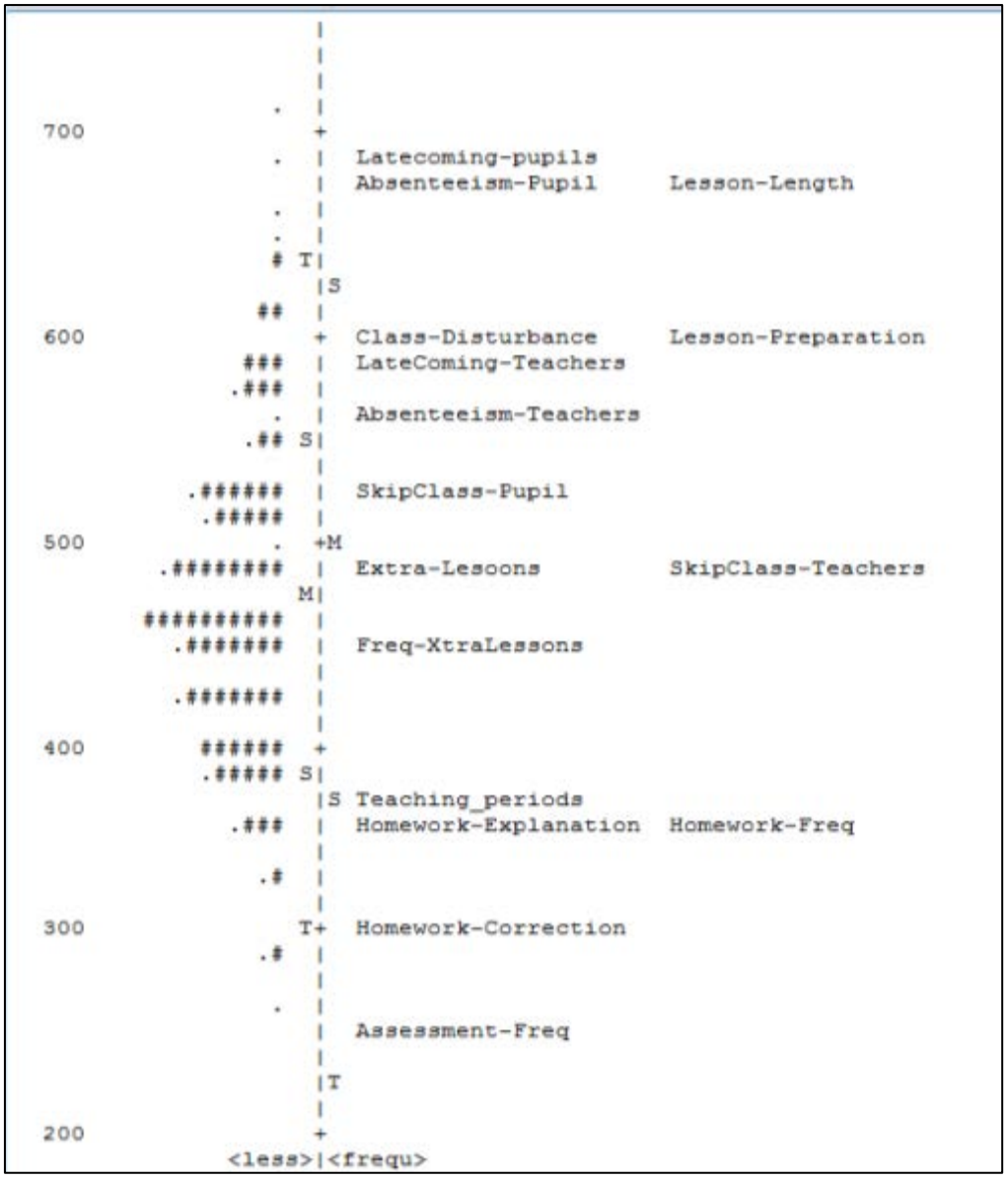

Figure 7 Item map for OTL scale
Note: The variables in the item map are described in Appendix 12.

Interpolating the above figures on the item map indicates that, on average, teachers provide opportunities for their pupils to learn mainly through frequent extra lessons, teaching more periods in a week (more endorsed teaching between 21 and 40 periods a week), giving frequent homework and written tests. Moreover, on average teachers are more likely to correct pupils' homework and explain the answers thereafter. Further, on average, teachers emphasise content coverage and exposure over quality of instruction and assessment.

On the other hand, on average, classrooms in primary schools in Uganda are faced with a number of conditions that threaten the opportunity for pupils to learn. For instance, more schools often experience teachers and pupils skipping class, teachers and pupils absenting

themselves from class unjustifiably, pupils and teachers coming late to class and class disturbances. Further, while a few teachers indicated providing more opportunity to learn through longer than typical lessons, this practice was not agreeable to most teachers. It is also important to note that, on average, teachers do not spend much time on lesson preparation and marking, as reflected by the higher difficulty score of the item (lesson preparation difficulty score is 602.99 on the scale). This has much to say about the quality of instruction, given that high quality lessons would generally require greater preparation.

5.1.6. School Community Relations Indicator (SCRI)

A number of empirical studies have made claims about the extent to which community participation in the school impacts on academic attainment. To illustrate, Miller-Grandvaux and Yoder (2002) claim that school-community partnerships could improve educational quality and student achievement. This indicator is therefore a proxy for the ability of the school leadership to engage with the parents and community to improve learning. A dichotomous Rasch model is used to construct the scale, given that the items that constitute the scale are binary.

Diagnostics

The average person fit indices are within the acceptable range (average infit and outfit indices are 0.97 and 1.14, respectively). Nonetheless, there are serious outliers, with outfit indices of up to 9.90. Particularly, one item which inquires about how often community members volunteer to cover for absentee teachers, is a complete misfit. Similarly, 3 seriously misfitting schools were without responses on some of the scale items.

In terms of reliability, item and person alphas are fairly high an indication of consistence in response patterns in measuring the latent construct (item alpha=0.99, person alpha=0.75). The higher item alpha indicates that the schools provide sufficient information about the items. Reliability of the scale is further reflected by the good item separation index of 8.31 and fairly wider person and item spreads (item spread=6.75 logits and person spread=7.77 logits).

As for unidimensionality, PCA (see Table 12) indicates unidimensionality, with the latent construct accounting for 40% of the total variance in the data while the suggested first contrast accounts for 6.6% (Eigen value=2.0). Unidimensionality is supported by the all positive point biserial correlations of 10% and above.

Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)				
		-- Empirical --		
Total raw variance in observations	=	29.8	100.0%	
Raw variance explained by measures	=	11.8	39.6%	
Raw variance explained by persons	=	4.3	14.3%	
Raw Variance explained by items	=	7.5	25.2%	
Raw unexplained variance (total)	=	18.0	60.4%	100.0%
Unexplned variance in 1st contrast	=	2.0	6.6%	11.0%
Unexplned variance in 2nd contrast	=	1.7	5.6%	9.2%

Table 12 Principal components in data measuring school community relations indicator

With regards to item targeting, the items are not well targeted to the abilities of the schools. This is reflected by the presence on the item map of many very difficult items to endorse (see Figure 8). Moreover, while items are well spread on the scale, there are wider gaps within the distribution of the items, an indication that more items would be required to measure the latent construct fully.

In the light of the above, modifications were undertaken including deleting the misfitting item. The changes greatly improved the scale on all diagnostics.

The final scale is constituted by 18 items (see Appendix 13), with the following statistics.

School scores	**Estimate**
Mean SCRI	402.63
School with highest SCRI score	781.15
School with lowest SCRI score	117.63
Median school SCRI score	405.16
Standard error	8.41

Table 13 SCRI scale statistics

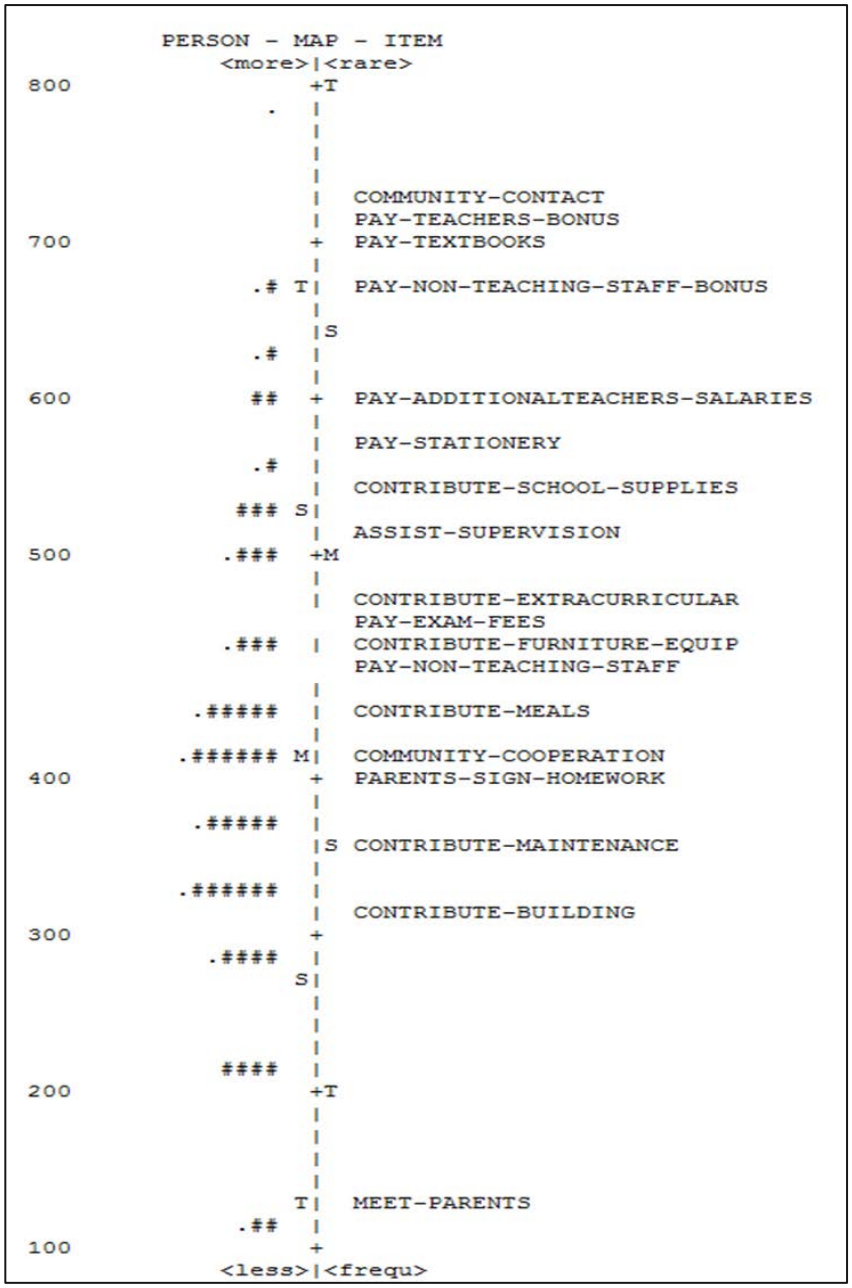

Figure 8 Item map for SCRI

Interpolating the above statistics on the item map (Figure 8) would imply that an average primary school in Uganda is located at 402.63 score on the SCRI scale. Such a school would easily endorse such items that have a difficulty score up to the mean. To this end, on average, primary schools in Uganda are more likely to engage in the following school-community relations:

i. Meet with parents or guardians of the pupils at least once a year to discuss the pupils' performance or related matters

ii. Cooperate with the community

iii. Ask parents or guardians to sign an indication that pupils have completed their home assignment
iv. Community and or parents contributing to the maintenance of school facilities such as classrooms, teachers houses among others
v. The community and or parents contributing to building of school facilities such as classrooms or teachers' houses.

On the other hand, an average primary school in Uganda is unable to or less likely to engage in the school-community relations proxied by items above the mean score on the scale. Such schools are less likely to have the communities or parents:

i. contribute to the provision of school meals
ii. pay salaries to non-teaching staff
iii. contribute to the construction or maintenance and repair of furniture, equipment
iv. pay exam fees
v. contribute to extra-curricular activities
vi. assist in school supervision without pay
vii. contribute to the purchase of stationery and other school supplies
viii. pay for the acquisition of textbooks
ix. pay teachers bonus
x. maintain contact with the school.

Wider variations are manifested in the extent to which schools engage in school-community-relations. A number of schools are located in the extreme tails; that is, those in the uppermost tail on the item map are actually doing better with regards to engaging with the community or parents, while those in the bottom tail are performing poorly on this latent construct.
For instance, although some nine schools (in the topmost tail with score of at least 676.63) would find it easy to endorse 15 out of the 18 SCRI items (83%), 55 out of 264 schools (21%) are only likely to engage in just one SCRI activity; that is, meeting with parents (score 133.59 on the scale).

5.1.7. School-Based HIV/AIDS Awareness Indicator

The Ugandan education system is said to be overwhelmed by orphaned children, amounting to over 2 million, of which 45% are attributable to HIV/AIDS (Kasirye and Hisali, 2010; UNICEF, 2008). Moreover, it has increased morbidity rates of teachers (Nyamurungi et al., 2007).

This scenario has affected especially the primary education sector in terms of school enrolment, attendance, school completion and attainment. It is believed that the level of knowledge and or awareness could impact on children's school outcomes.

The current indicator intends to estimate items related to HIV/AIDS awareness into a single indicator that can be used in further analyses. The items used for this indicator are binary and this justifies the estimation of the dichotomous Rasch model.

Diagnostics

On first calibration, the scale had both person and item fit indices within acceptable ranges (all close to 1). Nonetheless, there were marked variations in fit indices per individual person and item. All items had their categories functioning as expected, save for 4 items, which had their categories disordered and in contradiction of the key principle of monotonicity. Moreover, a number of schools (20 schools) were misfits, as they had fewer observations on the scale items. The scale indicated higher reliability indices for persons and items (.92 and .99 respectively). Reliability was also reflected by good separation indices for both items and persons (8.53 and 3.44 respectively).

With regards to unidimensionality, the PCA (Table 14) indicates that the scale measures one underlying construct and that it explains about 52% of the total data variance compared to only 6.1% explained by the first contrast. Moreover, the point biserial correlations are all positive and of bigger magnitude (above .1).

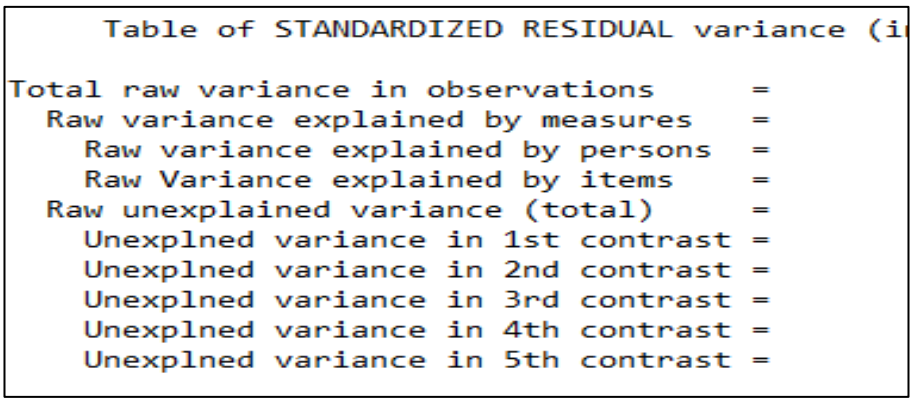

Table 14 Principal components in data measuring school-based HIV/AIDS Awareness indicator

The item map (Appendix 15) indicates good usage of the scale, with the items and persons well spread over the map. Nonetheless, there are some gaps in the distribution of items and persons on the scale which increases the error in the measurements of the former and the

latter parameters. Most importantly, there are a number of persons (in this case schools) that have extremely low abilities without any of them matching the item difficulties. Moreover, there is a ceiling effect, where a few schools are agreeable to all items.

Based on the above diagnostics, a number of modifications were undertaken, including deleting the four misfitting items. However, the 20 misfitting schools were maintained in the calibrations given that excluding them would create missing data problem. The scale diagnostics slightly improved after the above modifications.

The final scale is constituted by 36 items (see Appendix 14).

School scores	**Estimate**
Mean awareness score	644.05
Highest awareness score	1050.87
Lowest awareness score	136.33
Median awareness score	633
Standard error	14.2

Table 15 School-based HIV/AIDS awareness scale statistics

5.1.8. School-Based HIV/AIDS Support Indicator

This indicator highlights the various support (material and in kind) that primary schools in Uganda are likely to provide to their pupils and staff who are affected by the HIV/AIDS pandemic. Children that have lost parents are more likely to drop out of school if they are not supported both with scholastic materials and psychological help.

This scale is constituted by 23 items (Appendix 16), and all of them are on a binary scale, given that they inquire about whether or not the school provides particular kinds of support. To this end, a dichotomous Rasch model is estimated.

The items for this scale fit the Rasch model fairly well without modifications. To illustrate, the mean infits and outfits for persons and items are within the acceptable ranges (see Table 16).

	Average infit indices	Average outfit Indices
Persons	.99	.97
Items	.98	.97

Table 16 School-based HIV/AIDS support fit indices

Nonetheless, some individual questions and persons greatly deviated from the norm. Even so, a closer investigation indicated that at least one of the two indices of each of such persons and items was within the range. Response categories functioned as expected, with the lower categories scoring low on the latent construct, and the reverse is also true (see Appendix 17). The scale is fairly reliable, with person and item alphas of .84 and .99 respectively. The separation indices reinforce the reliability of this scale, with person and item separation indices at 2.27 and 8.7 respectively. With regards to unidimensionality, the PCA (Table 17) indicates that the latent construct explains about 43% of the data variance, while the secondary dimension explains 8.4%.

```
    Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)
                                              -- Empirical --
Total raw variance in observations     =         40.0 100.0%
  Raw variance explained by measures   =         17.0  42.5%
    Raw variance explained by persons  =          7.3  18.2%
    Raw Variance explained by items    =          9.7  24.3%
  Raw unexplained variance (total)     =         23.0  57.5% 100.0%
    Unexplned variance in 1st contrast =          3.4   8.4%  14.6%
    Unexplned variance in 2nd contrast =          2.2   5.5%   9.5%
    Unexplned variance in 3rd contrast =          1.8   4.6%   7.9%
    Unexplned variance in 4th contrast =          1.6   4.1%   7.1%
    Unexplned variance in 5th contrast =          1.4   3.5%   6.1%
```

Table 17 Principal components in data measuring school-based HIV/AIDS support indicator

The item map (Figure 9) shows some extent of poor item targeting, with the lower end of the item scale having no items to match to the abilities of the persons occupying the same region. Below are the summary statistics for the scale:

School scores	Estimate
Mean support score	430.19
School with highest support score	896.54
School with lowest support score	27.27
Median support score	423.58
Standard error	9.56

Table 18 School-based HIV/AIDS support indicator statistics

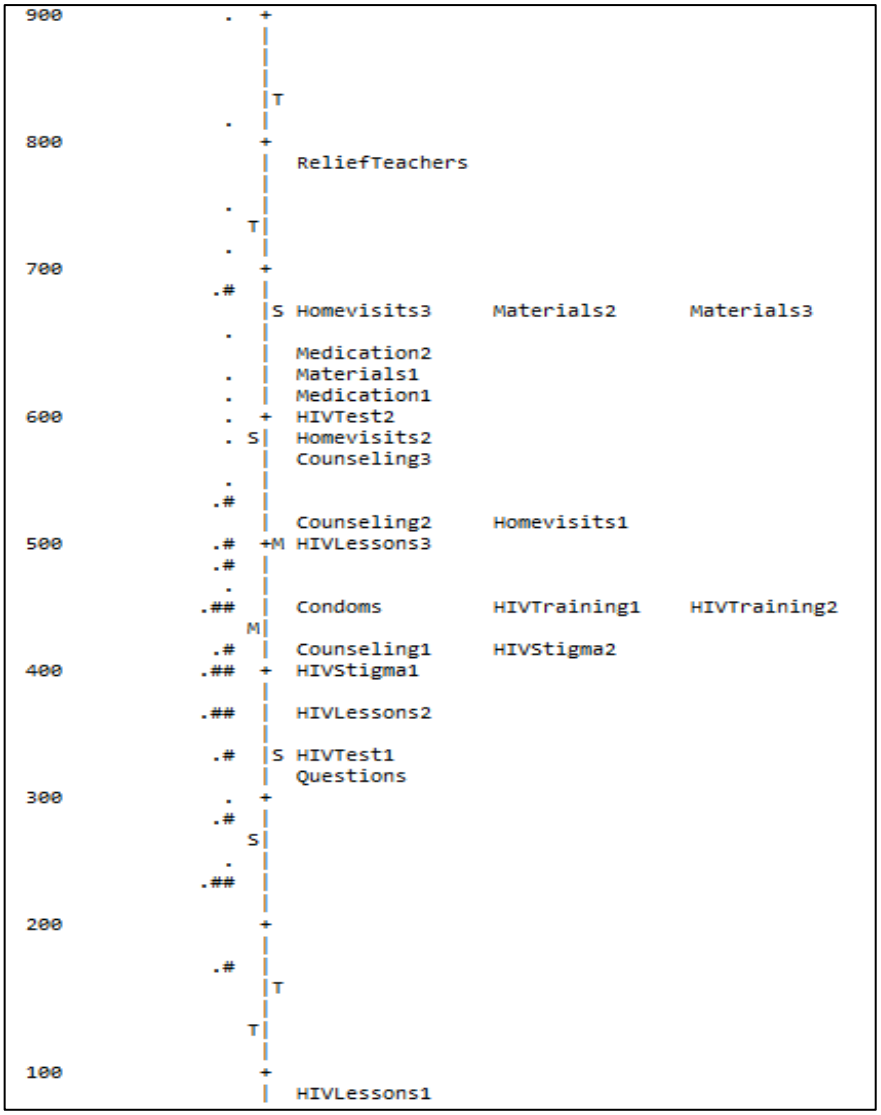

Figure 9 Item map for school-based HIV/AIDS support indicator

Note: Labels for variables in the item map are described in Appendix 16.

If interpolated on the item map, an average primary school in Uganda would most likely provide support limited to such items as:

- providing lessons or activities on HIV/AIDS related aspects
- Responding to sensitive questions from pupils about HIV and AIDS during lessons on HIV/AIDS
- A place where HIV testing is carried out
- Giving lessons in life-skills-based HIV and AIDS education
- Discussing among pupils and staff about combating stigma and discrimination against HIV
- Providing guidance and counselling services for those affected by HIV/AIDS.

On the other hand, there is a less likelihood of an average school endorsing items above the average score, such as:

- Giving teachers specialised training in life-skills-based HIV/AIDS
- Making home visits to orphans, vulnerable pupils and staff with AIDS related diseases
- Medication for pupils and staff with HIV/AIDS
- Providing learning materials for use at home by orphans and vulnerable pupils
- Paying for relief teachers to replace sick staff.

5.2. Data exploration

Before fitting the models, below is a summary description of the dataset to be analysed to arrive at conclusions with regards to the research questions.

5.2.1. The data frame

The sample analysed constitutes 5,307 Grade 6 pupils drawn from 316 classrooms in 264 primary schools in Uganda. An average primary school has an enrolment of 748, but with wider variations manifested by school ownership and location. For instance, schools in the large city are bigger in terms of enrolment relative to those in the countryside. On the other hand, government schools are on average bigger in terms of enrolment compared to private schools (see table 19 below).

Location	**Number in sample**		**Mean enrolment**
Rural/isolated	196	74.2%	726
Small town	47	17.8%	705
Large city	21	8%	1046
Ownership			
Government	235	89%	780
Private	29	11%	483

Table 19 Enrolment in schools by location and ownership

The cross-tabulation between ownership and location indicates that more government schools in the sample are located in rural or isolated areas, while more private schools in the sample are located in the large city and small towns.

			Location			
			Rural/ isolated	Small town	Large city	Total
Ownership	Government	Count	183	35	17	235
		% within ownership	77.9%	14.9%	7.2%	100%
	Private	Count	13	12	4	29
		% within ownership	44.8%	41.4%	13.8%	100%
Total		Count	196	47	21	264
		% within ownership	74.2%	17.8%	8.0%	100%

Table 20 Cross-tabulation of school ownership and location

The total enrolment in the 316 classes of the sampled schools is 20,883, implying that on average there are 66 pupils per individual class stream. Nonetheless, there are wide variations in class sizes, with some classes having as few as three pupils while others have as many as 168 pupils in the same classroom. Moreover, variations in class size are also manifested by school ownership, but not location. To illustrate, while enrolment per classroom is within the same confidence interval for both rural and urban areas, government-owned schools have above-average class enrolment relative to their private counterparts.

There are 274 teachers for the 316 Grade 6 classes in the sample, implying that some teachers teach more than one stream (the number of classes is more than the number of teachers). This results into a teacher pupil ratio of 1:77.

At pupil level, the sample is more balanced, with 49.5% (2628) boys and 50.5% (2679) girls. Pupils' ages differ widely, with about 50% being above the mean age of 14. There are extreme cases, aged above 20 years. Officially, children are expected to enrol in primary schools in Uganda at 6 years old and they are expected to be in Grade 6 at about 11 years.

Schools	**Class rooms**	**Teachers in sample**	**Pupils in sample**	**Grade6 enrolment in the 264 sampled schools**
264	316	274	5307	20883

Table 21 Summary of data frame

5.2.2. Basic variable statistics

The current study entails two dependent variables; that is, pupil attainment in mathematics and reading tests. The histograms below illustrate the general distribution of the pupil scores on the two variables.

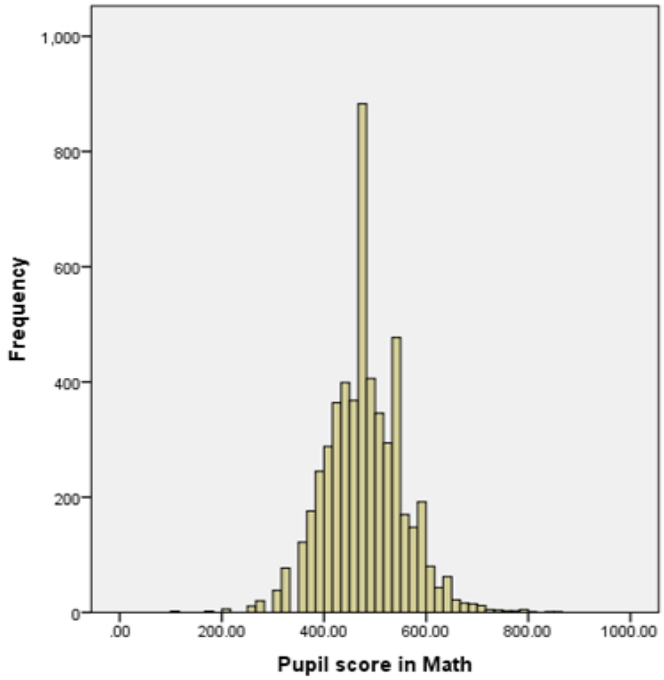

Figure 10 Frequency distribution of Mathematics

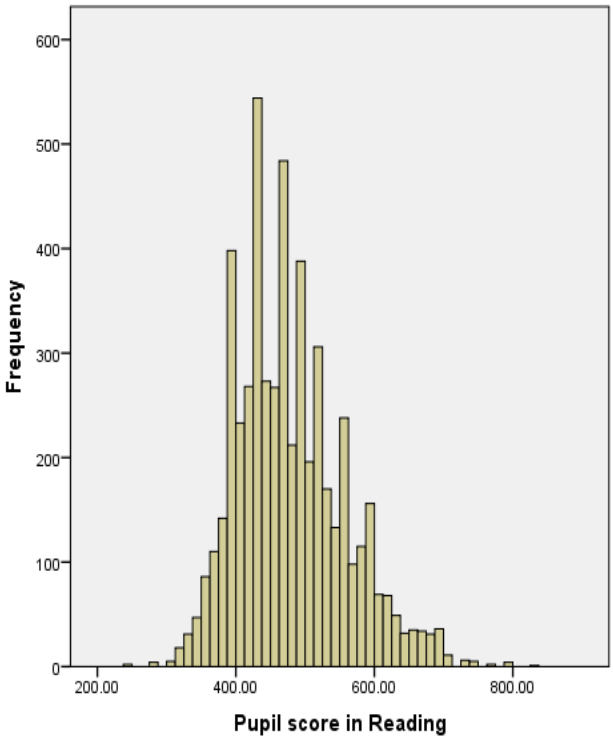

Figure 11 Frequency distribution of reading

The histograms indicate that most of the pupils' scores in both mathematics and reading are concentrated around the measures of central tendency. The mean scores for mathematics and reading are 479.657 and 478.678, respectively. Within-subjects variations are apparent. For mathematics, some pupils scored as low as 105.86 and as high as 861.31. Similarly for reading, there is a wide range, with the lowest and highest pupil scores at 245.6 and 834.65 respectively.

The distribution of pupil attainment also manifests in variations across pupils' gender, school ownership and location, among others (see Table 22 below).

Subject	**Gender**		**Location**			**Ownership**	
	Boy	Girl	Rural	Small town	Large City	Government	Private
Reading (Mean)	481.1	476.3	463.5	507.7	544.5	472	531.7
Mathematics (Mean)	484.6	474.9	469	500.6	524.5	475.4	513.3

Table 22 Pupil attainment by gender, location and school ownership

The table indicates that pupils from rural government-owned schools performed lower in both subjects than their counterparts in towns and city, and attending private schools. Moreover, girls performed lower than boys in both subjects. Nonetheless, the gender gap ought to be wider in mathematics than in reading. On the other hand, the location and ownership gap ought to be wider in reading than in mathematics.

5.3. The model

Two models are to be estimated, one for mathematics and the other for reading. This is against a backdrop that there could be differences in the magnitude and direction in the effects of the predictor variables on the two dependent variables.

While this study had earlier presumed three levels in the data, appropriate statistical tests need to be performed to establish whether a three-level model is better than a two or a single level model, or an ordinary linear regression, for estimating variance in the outcome variables. The log likelihood ratio test and variance component analyses are used for this purpose.

5.3.1. Testing Hypothesis 1

Higher clusters do not explain significant variance in the response variables

This is done by comparing the single-level model likelihood and the three-level model likelihood.

H_0: $\sigma_v^2=0$, $\sigma_u^2=0$

H_a: $\sigma_v^2>0$, $\sigma_u^2>0$

$LR_{Maths}=LR_{Single}-LR_{ThreeLevel}$

$LR_{Reading}=LR_{Single}-LR_{ThreeLevel}$

LR_{Maths}=60982.418-59177.697, (2df)

$LR_{Reading}$=61260.346-58599.315, (2df)

where LR is the log likelihood ratio, and df are the degrees of freedom.

In both instances, the null hypothesis is rejected, the three-level model is preferred to the single-level model, $X^2(2)=1804.721$, $p<0.001$ (mathematics model), $X^2(2)=2661.03$, $p<0.001$ (reading model). Moreover, in both models $\sigma_v^2>2S.E>0$, and $\sigma_u^2>2S.E>0$ (in all $p<0.05$). This means that the 5307 pupils do not act as 5307 independent observations, but rather are clustered by classrooms and schools.

5.3.2. Testing Hypothesis 2

Two-level model is better than three-level model

H_0: $\sigma_v^2=0$,

H_a: $\sigma_v^2>0$

$LR_{Maths}=LR_{TwoLevel}-LR_{ThreeLevel}$

$LR_{Reading}=LR_{TwoLevel}-LR_{ThreeLevel}$

LR_{Maths}=59275.816-59177.697, (1df)

$LR_{Reading}$=58750.076-58599.315, (1df)

In both instances, the null hypothesis is rejected, and the three-level model is preferred to the two-level model, $X^2(1)=98.119$, $p<0.05$ (mathematics model), $X^2(1)=150.76$, $p<0.05$ (reading model). Moreover, in both models $\sigma_v^2>2S.E>0$ (in all $p<0.05$). This means that the school level is separately significant and that pupils from the same school are more homogeneous than their counterparts in other schools.

We can therefore conclude that the three-level model improves the estimation of variance in the outcome variables. This is based on the fact that the higher variance components are significantly different from zero and that their inclusion into the estimation significantly reduces the error of estimation.

5.3.3. Further justification of the three levels model using the variance components analysis (VPC and ICC)

Besides using the likelihood ratio to justify the choice of an appropriate multilevel model, the variance components analysis could further reinforce the absolute and relative importance of the higher levels. To this end, variance partition coefficients and the intra-class correlation coefficients help us to justify the model choice further.

5.3.3.1. Variance partition coefficient

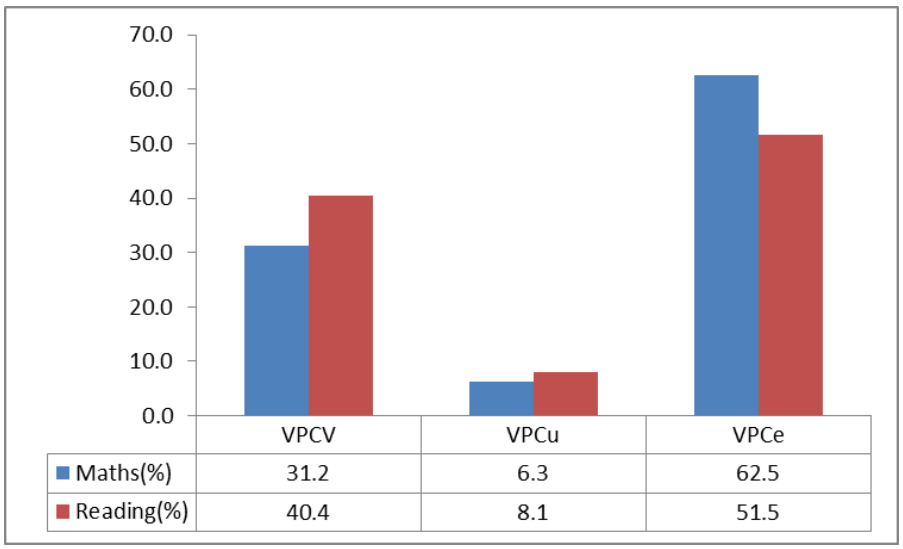

Figure 12 Variance Partition Coefficient (VPC) for mathematics and reading

where:

VPC_V is the proportion of total variance in the outcome variables located at Level 3 (school level)

VPC_u is the proportion of total variance in the outcome variables located at Level 2 (classroom level)

VPC_e is the proportion of total variance in the outcome variables located at Level 1 (pupil level)

From the graph, assuming there are no predictors of pupil attainment, the pupil level explains the highest variance in both subjects (pupil-level mathematics=62.5%, reading=51.5%).

The school is next to pupil level (school-level variance mathematics=31.2%, reading=40.4%), and the classroom level explains the least variance in pupils' mathematics (6.3%) and reading attainment (8.1%). The VPC analysis therefore implies that all levels are important, as they explain some variance greater than zero. This is another reason to retain the three levels.

5.3.3.2. The Intra-class Correlation Coefficient (ICC)

Multilevel models assume homogeneity within the members of the same cluster, therefore they should be somehow correlated. If members in a cluster are completely uncorrelated, then most likely such a cluster should not be justified in the model. Below is an estimation of both Level 2 and 3 ICC. Given that this is a null model, the Level 3 ICC is equivalent to the Level 3 VPC.

Nonetheless, as Leckie (2013) hints, this condition may not hold in especially complex models with random slopes and interaction terms. ICC computation procedures and formulae have been elaborated in the methods chapter (Chapter 4).

Level 3 ICC

Level 3 ICC computes the correlation coefficient between two different pupils from two different classrooms from the same school.

$$ICC_{math} = \frac{1780.647}{1780.647+357.082+3567.473}$$=0.31 or 31%

$$ICC_{Reading} = \frac{2445.225}{2445.225+490.123+3122.771}$$=0.40 or 40%

The ICC values for both mathematics and reading indicate presence of clustering such that different students in the same school have their mathematics and reading test scores correlated at 0.31 and 0.40 respectively.

Level 2 ICC

Level 2 ICC computes the correlation coefficient between two different pupils from the same classroom and school.

$$ICC_{math} = \frac{1780.647+357.082}{1780.647+357.082+3567.473}$$=0.375

$$ICC_{Reading} = \frac{2445.225+490.123}{2445.225+490.123+3122.771}$$=0.485

More strong correlation and hence evidence of clustering at Level 2 for both mathematics and reading.

5.3.4. Conclusion on the choice of the most appropriate model

The loglikelihood ratios, VPC and ICC estimates have all indicated the presence of a high degree of clustering. Further, estimates indicate that the three-level model is more appropriate to explain variance in pupil attainment in both subjects. Nonetheless, the results indicate that clusters are concentrated at Levels 1 and 3, with moderate clustering at Level 2. In the next section, the model-fitting procedure is explained.

The current research is concerned with attainment in both mathematics and reading. To this end, different models are estimated for each of the subject area. This section deals with fitting the mathematics model.

5.4. The mathematics model

It is important to check for key assumptions before fitting multilevel models. This is against a backdrop that multilevel models subscribe to key assumptions, most importantly that of normal distribution of random terms within the clusters and constant variance in the response variable against each of the predictor variables. These assumptions are tested before embarking on building the mathematics model.

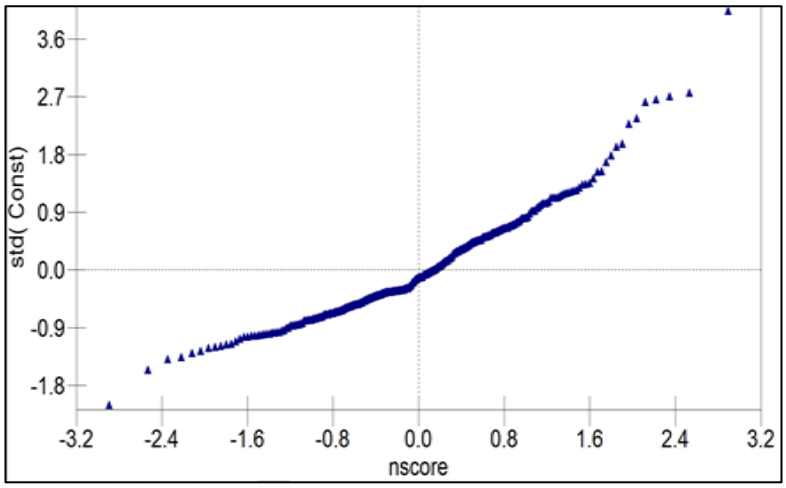

Figure 13 Normality test for Level 3 residuals (mathematics)

The quantile-quantile plots of the Level 3 residuals suggest that the random effects for mathematics are fairly normally distributed, given that they are close to the line of perfect normality (45^0 line). Nonetheless, there are a few deviant cases that lie at the extremes of the line. These represent very low and high achievers. Level 2 quantile-quantile plots (see Figure

14 below) follow a similar trend, as is the case with Level 3 clusters. This signifies the importance of having higher cluster residuals normally distributed.

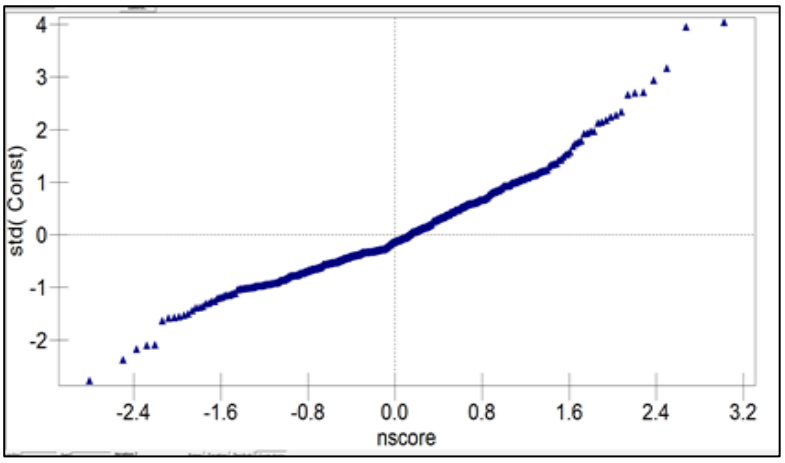

Figure 14 Normality tests for Level 2 residuals

5.4.1.1. Constant variance tests

The residual plots for mathematics do not manifest a clear trend. This could be interpreted as fairly constant variance.

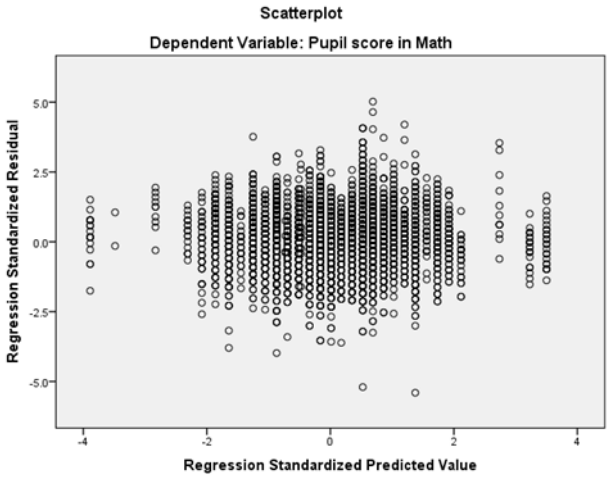

Figure 15 Constant variance test (mathematics)

It could be concluded that the residuals of the outcome variable fairly meet the key assumptions of normal distribution and constant variance.

5.4.2. Estimating the model

5.4.2.1. The null model

While the primary purpose of the current study is to establish the educational processes that explain significant variance in pupil attainment, it is important to estimate the unconditional

model to establish the relative importance of the various levels. This helps to obtain an insight into whether schools and classrooms matter in pupils' performance and, if they do, in what proportions? Moreover, estimating the null model acts as the basis for comparisons with other subsequent models to establish the significance of predictors added to the estimated models. The null model is estimated by:

$$MathScore_{ijk} = \beta_{0ijk}Constant$$
$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

where β_0 is the grand mean in mathematics across all schools, classrooms and pupils, $v_k + u_{jk} + e_{ijk}$ are the variances located at Levels 3, 2 and 1 respectively.

	Mathematics model	**S.E**
FIXED		
β_0 Constant	478.57	2.95
RANDOM TERMS		
σ_v^2	1780.65	238.21
σ_u^2	357.08	148.1
σ_e^2	3567.47	71.75
Total variance	5705.20	
-2Llikelihood	59177.697	

Table 23 Mathematics null model

The unconditional model indicates that pupils' average score across all schools (grand mean) was 479. To put this result into perspective, it is important to note that the attainment scale was standardised to a mean of 500 and standard deviation of 100. This implies that pupils in Ugandan primary schools on average scored below the standard mean (500). Most of the unexplained variance in the model lies at the pupil level (62.5%) and the school level (31.2%). The classroom holds the least amount of unexplained variance (6.3%). It is important to note that these percentages do not indicate the absolute influence of the respective three levels. Rather, they indicate the likely influence of the respective levels if there were no variables to explain the outcome variable.

5.4.2.2. Modelling mathematics attainment

Primarily, the current study is concerned with establishing the educational processes that explain significant variance in pupil attainment in mathematics and reading. Before estimating the effects of educational processes on pupil attainment, it is important to control for pupil background characteristics and the context in which the schools operate. Random intercept and fixed slopes models are estimated initially, while random slopes models are to be

estimated in response to the relevant research question(s). The step-up approach to building multilevel models is adopted, as suggested by Raudenbush and Bryk (2002). This approach takes an incremental procedure to multilevel modelling where subsequent variables are added to the model, which is then compared to previous models until the final model is obtained. Insignificant control variables that are not key to the current study are withdrawn from the model before subsequent model estimations are conducted. This is required for parsimonious models.

5.4.2.3. Pupil characteristics and mathematics attainment

In order to establish the joint effects of pupil characteristics on mathematics attainment, all the variables that characterise the pupils are included in the model. These include SES, preschool experience, age, gender and school term residence. SES is a scale constructed by the SACMEQIII project, with a mean fixed at 500 and standard deviation at 100. Preschool experience is a nominal variable with three categories; that is, never attended/attended nursery up to a year; for two years; and above three years. On the other hand, age is a variable centred on the official age group expected to be in Grade 6. In the Ugandan education system, this is at age 11. School-term residence is a variable with three categories, that is, 'other people's homes' (reference category), 'family home' and 'boarding school'. School-term residence is of particular importance, as it could highlight the indirect effects that the HIV/AIDS has had on the education system of Uganda. It is argued that most of those orphaned as a result of HIV/AIDS sometimes live with other families. But also, school-term residence would signify SES, as most affluent families can afford to have their children attend boarding schools. The model being estimated is as follows:

$$MathScore_{ijk} = \beta_{0ijk}Constant + \beta_1 SES_{ijk} + \beta_2 Presch2years_{ijk} + \beta_3 Presch3yearsover_{ijk} + \beta_4 Age_{ijk} + \beta_5 Girl_{ijk} + \beta_6 FamilyHome_{ijk} + \beta_7 BoardingSchool_{ijk}$$

$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

Mathematics model				
FIXED	**Coefficients**	**SE**		
β_0 Constant	489.951	4.419		
B_1SES	0.016	0.018		
B_2Presch2years	**7.710**	**3.062**		
B_3Presch3years over	0.690	2.651		
B_4Age	**-3.262**	**0.598**		
B_5Girl	**-13.624**	**1.695**		
B_6FamilyHome	4.777	2.826		
B_7BoardingSchool	**14.055**	**4.463**		
RANDOM TERMS				**Percentages (Unexplained var)**
σ_v^2	1637.43	225.615		29.8%
σ_u^2	351.262	145.693		6.39%
σ_e^2	3503.887	70.47		63.8%
Variance Explained	**Level 3 (school)**	**Level 2 (classroom)**	**Level 1 (pupil)**	**Total**
Percentage variance Explained in comparison with previous model	67.36%	2.74%	29.90%	3.73%

Table 24 Pupil characteristics and mathematics attainment Note: **Bolds** are significant relationships

Jointly, the pupil characteristics explain 3.73% (from 5705.202 to 5492.579) of the total variation in pupil's mathematics attainment. While it seems a small proportion, it is highly significant ($X^2(7)$= 108.744, $p<0.05$). All the pupil characteristics explain more variance at school level compared to the rest of the levels. This implies that most of the schools in the sample have pupils who share similar characteristics.

Below is the explanation for the individual variable effects on pupils' mathematics attainment: SES is positively associated with pupils' mathematics attainment. This implies that, other factors remaining constant, pupils of higher economic status are more likely to attain higher mathematics scores, and those from poor backgrounds are more likely to attain lesser mathematics score. Nonetheless, the association is not significant (β_1<2S.E, p>0.05). This variable remains insignificant, even when entered independently in the model.

Preschool experience is positively associated with pupils' mathematics attainment. This is illustrated by the positive directions on the two categories of the variable in the model. Each of the categories is compared to the reference categories, that is, 'never attended nursery/attended up to one year'. The results indicate that, while, overall, preschool experience is a significant predictor of pupils' mathematics attainment, it is more likely to be

that of up to two years. Beyond two years (such as 3 years and above), the effects weaken and are insignificant (β_3<2S.E, p>0.05).

Age is negatively associated with pupils' mathematics attainment (β_4>2S.E, p<0.05). This implies that, other factors held constant, being older than the average official grade age is associated with a reduction in the score by 3.262 points. Adding age as the only predictor in the model significantly reduces the -2loglikelihood ($X^2(1)$= 25.5*, p<0.05).* Age explains more of the school-level variance (3.4% of school-level variance) than the other levels.

Gender is negatively associated with pupils' mathematics attainment. Given that the reference category is 'boys', the results imply that, other factors held constant, girls are more likely to score less than boys in mathematics by 13.62 points. This difference is highly significant (β_5>2S.E, p<0.05). Adding gender as a single predictor in the model significantly differentiates the estimated model from the null model ($X^2(1)$= 58.678*, p<0.05)*. Moreover, the variable explains more of the classroom variance (2.2% of the Level 2 unexplained variance).
School-term residence is positively associated with pupils' mathematics attainment. This implies that where the child resides during school term time greatly affects their mathematics attainment. The reference category of this variable is 'other people's home', against which the other two categories, that is, 'my family home', and 'boarding school' are compared. Other factors held constant, children that live in their family homes and in boarding schools, on average perform better in mathematics than their counterparts who live in other people's residences and orphanages. Nonetheless, the differences in performance are only significant for those staying in boarding schools. Overall, including this variable in the model as a single predictor significantly improves it over the null model ($X^2(2)$= 11.5*, p<0.05).* The *s*chool-term residence variable explains more of Level 3 variance (2.3% of Level 3 variance) than other levels.

5.4.2.4. Contextual effects

Before adding contextual variables to the previous model, SES is withdrawn from the subsequent estimations, given that it was insignificant on the first calibration. Moreover, its withdrawal would not affect the study since it is a control variable and does not form part of the answers to the research questions. As hinted earlier, in this study the context is proxied by the environment in which schools operate—who owns them, the central regulatory framework available, location and size. Measurement of these variables has been elaborated in the

methodology chapter. The central inspection variable is recoded into binary with the following categories: 'up to three times of inspection' and 'above three times of inspection'. The recoding was guided by the reported number of times schools have been inspected by officials from the education standards agency within a year. The value of three was chosen because it was close to the measures of central tendency (mean, mode and median inspection). Finally, rural/isolated category is the reference for the location.

The model being estimated is as follows:

$$MathScore_{ijk} = \beta_{0ijk}Constant + \beta_1 Presch2years_{ijk} + \beta_2 Presch3yearsover_{ijk} + \beta_3 Age_{ijk} + \beta_4 Girl_{ijk} + \beta_5 FamilyHome_{ijk} + \beta_6 BoardingSchool_{ijk} + \beta_7 PrivateSchool_k + \beta_8 SmallTown_k + \beta_9 LargeCity_k + \beta_{10} Inspection > 3times_k + \beta_{11} SchoolSize_k$$

$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

	Mathematics model			
FIXED	**Coefficients**	**SE**		
β_0 Constant	459.576	4.986		
B_1Presch2years	**6.492**	**3.057**		
B_2Presch3years over	0.101	2.641		
B_3Age	**-3.015**	**0.595**		
B_4Girl	-**13.568**	**1.693**		
B_5FamilyHome	5.177	2.82		
B_6BoardingSchool	**13.317**	**4.434**		
B_7 PrivateSchool	**31.279**	**8.983**		
B_8 SmallTown	**21.61**	**7.047**		
B_9 LargeCity	**43.188**	**9.78**		
B_{10} Inspection>3times	**17.395**	**5.302**		
B_{11} SchoolSize	0.009	0.007		
RANDOM TERMS				**Percentages (Unexplained var)**
σ_v^2	1242.251	200.546		24.25%
σ_u^2	382.205	148.312		7.46%
σ_e^2	3498.948	70.37		68.29%
Variance Explained	**Level 3 (school)**	**Level 2 (classroom)**	**Level 1 (pupil)**	**Total**
Percentage variance Explained in comparison with previous model	98.66%	0.00%	1.34%	6.72%

Table 25 Context and mathematics attainment.
Note: **Bolds** are significant relationships

After controlling for pupil background, the contextual variables jointly explain 6.72% of the total response variance, with most of the variance explained being at the school level [98.66%

of the total explained variance (369.175)]. The variables do not explain any variance at the classroom level and, in fact, an unusual finding is that, on adding contextual variables, Level 2 variance increases (from 6.39% to 7.46%) rather than reducing. This scenario could be attributable to a number of reasons. Most likely, the fact that most of the sampled schools have a single Grade 6 class would imply that classroom variance is synonymous with school variance. Some scholars (see Singer and Willett, 2003) attribute this scenario to the discord in the directions of the variable effects at the various levels. On the other hand, it could as well indicate the inability to model material information that predicts the Level 2 variance adequately, such that any addition of other variables upsets its variance, given the loss in degrees of freedom associated with such an addition.

Overall, adding contextual variables improves the previous model as reflected by the significant difference in the two loglikelihoods of the previous and current models (X^2 (5)= 54, $p<0.05$). It is, however, interesting to note that on controlling for contextual variables, most of the previously estimated pupil background variables maintained their magnitude and direction in effect.

From the model it is clear that controlling for other factors, school ownership, location and the number of times that a school is centrally inspected are significant predictors of pupils' mathematics attainment (β_7-β_{10}>2S.E, $p<0.05$). To this end, pupils in privately owned schools, located in small urban centres and large city and regularly inspected more than three times a year, are more likely to score 31.279, 21.61, 43.188, 17.395 points higher than their counterparts in publicly owned schools located in rural/isolated areas and receiving less than three inspections a year. On the other hand, school size does not significantly predict pupils' mathematics attainment ($p>0.05$). This could be due to the fact that most of the primary schools in Uganda have higher enrolment, therefore there is less variance in the variable. This variable is withdrawn from further estimations.

5.4.2.5. Educational inputs and pupils' mathematics attainment

In the previous model (with pupil backgrounds and contextual variables), we added educational inputs into the model to ascertain its influence on mathematics attainment. The measurement of this variable is elaborated in the scales development section. The model being estimated is as below:

$$MathScore_{ijk} = \beta_{0ijk}Constant + \beta_1 Presch2years_{ijk} + \beta_2 Presch3yearsover_{ijk} + \beta_3 Age_{ijk} + \beta_4 Girl_{ijk} + \beta_5 FamilyHome_{ijk} + \beta_6 BoardingSchool_{ijk} + \beta_7 PrivateSchool_k + \beta_8 SmallTown_k + \beta_9 LargeCity_k + \beta_{10} Inspection > 3times_k + \beta_{11} InPuts_k$$

$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

Mathematics model				
FIXED	**Coefficients**	**SE**		
β_0 Constant	462.293	4.985		
B_1Presch2years	**6.657**	**3.057**		
B_2Presch3years over	-0.011	2.641		
B_3Age	**-2.952**	**0.595**		
B_4Girl	**-13.581**	**1.693**		
B_5FamilyHome	5.086	2.819		
B_6BoardingSchool	**12.954**	**4.434**		
B_7 PrivateSchool	**27.221**	**8.88**		
B_8 SmallTown	**17.208**	**7.029**		
B_9 LargeCity	**35.104**	**9.88**		
B_{10} Inspection>3times	**16.531**	**5.196**		
B_{11} Inputs	**0.095**	**0.03**		
RANDOM TERMS				**Percentages (Unexplained var)**
σ_v^2	1168.368	195.132		23.14%
σ_u^2	382.028	147.744		7.56%
σ_e^2	3499.718	70.383		69.30%
Variance Explained	**Level 3 (school)**	**Level 2 (classroom)**	**Level 1 (pupil)**	**Total**
Percentage variance Explained in comparison with previous model	99.76%	0.24%	0.00%	1.43%

Table 26 School inputs and mathematics attainment.

Note: **Bolds** are significant relationships

The results show that adding educational inputs significantly improves the previous model that had pupil background and contextual variables ($X^2(1) = 10.2$, $p<0.05$). It is also noted that educational inputs explain 1.43% of the total unexplained variance (reduction from 5123.404 to 5050.114) and that almost the whole of this variance is located at the school level [99.76% of explained variance by education resource inputs (73.3)].

Controlling for pupil background and contextual factors, educational resources are positively associated with pupils' mathematics attainment, such that a unit increase in educational inputs would likely yield 0.095 point increase in pupils' mathematics attainment. This result is

significant, given that the coefficient is about three times the standard error. Lack of variance explained at Levels 1 and 2 (zero variance explained) could be partly due to the fact that educational resources, are a school-level variable, where pupils and classrooms have been assigned the school score and, given that most of the sampled schools have a single Grade 6 class, variance at Level 2 would be expected to be limited.

After controlling for pupil background, context and educational inputs, it is time to answer the first research question, as indicated below, by adding educational processes to the model.

5.4.3. Answering Research Question 1

What are the educational process factors that account for significant variations in educational outputs in Uganda's primary education?

5.4.3.1. Effects of educational processes on pupils' mathematics attainment

For purposes of this study, a number of processes were constructed using the Rasch modelling technique, as elaborated earlier on in the scales development section of this chapter. These processes include:

i. Opportunity to learn (OTL)
ii. Teacher Academic and Professional Capital (TAPC)
iii. School management competences (SchMgt)
iv. Educational resource usage (ResUse)
v. School community relations (ComRelate)
vi. School-based HIV/AIDS awareness (HIVAwareness)
vii. School-based HIV/AIDS support (HIVSupport)

This section answers this question by estimating a random intercept and fixed slopes model, as specified below:

$$MathScore_{ijk} = \beta_{0ijk}Constant + \beta_1 Presch2years_{ijk} + \beta_2 Presch3yearsover_{ijk} + \beta_3 Age_{ijk} + \beta_4 Girl_{ijk} + \beta_5 FamilyHome_{ijk} + \beta_6 BoardingSchool_{ijk} + \beta_7 PrivateSchool_k + \beta_8 SmallTown_k + \beta_9 LargeCity_k + \beta_{10} Inspection > 3times_k + \beta_{11} InPuts_k + \beta_{12} TAPC_{jk} + \beta_{13} OTL_{jk} + \beta_{14} SchMgt_k + \beta_{15} ResUse_k + \beta_{16} ComRelate_k + \beta_{17} HIVAwareness_k + \beta_{18} HIVSupport_k$$

$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

Mathematics model				
FIXED	**Coefficients**	**SE**		
β_0 Constant	466.393	4.502		
B_1Presch2years	**6.72**	**3.045**		
B_2Presch3years over	0.465	2.629		
B_3Age	**-2.769**	**0.593**		
B_4Girl	**-12.834**	**1.692**		
B_5FamilyHome	4.964	2.808		
B_6BoardingSchool	**12.305**	**4.414**		
B_7 PrivateSchool	**16.706**	**7.387**		
B_8 SmallTown	**14.378**	**5.964**		
B_9 LargeCity	**27.589**	**8.307**		
B_{10} Inspection>3times	**13.199**	**4.413**		
B_{11} Inputs	**0.074**	**0.029**		
B_{12} TAPC	0.01	0.01		
B_{13} OTL	**5.306**	**1.051**		
B_{14} SchMgt	**0.166**	**0.027**		
B_{15} ResUse	0.006	0.013		
B_{16} ComRelate	**4.787**	**1.864**		
B_{17} HIVAwareness	-0.012	0.011		
B_{18} HIVSupport	**-0.034**	**0.014**		
RANDOM TERMS				**Distribution of unexplained var**
σ_v^2	687.37	158.58		15.07%
σ_u^2	376.787	140.523		8.26%
σ_e^2	3498.117	70.328		76.67%
Variance Explained	**Level 3 (school)**	**Level 2 (classroom)**	**Level 1 (pupil)**	**Total**
Distribution of Variance Explained by Process factors	98.60%	1.07%	0.33%	9.7%

Table 27 Educational process factors and mathematics attainment.
Note: **Bolds** are significant relationships

Adding the process factors to the previous model, which contained pupil background, context and educational inputs, further improves the model. This is seen in the significant drop in deviance by 92.04 (from -2LL 59004.791 to 58912.748). This improvement is highly significant ($X^2(7) =$ 92.04*, p<0.05)*. Jointly, the process factors explain about 10% of the previous model's total unexplained variance (a decline in unexplained variance from 5050.114 to 4562.274). Virtually all the explained variance is located at Level 3 (98.6%), and only 1.1% and 0.3% at classroom and pupil levels, respectively. This trend is confirmed by the significant reduction in the unexplained variance at Level 3.

TAPC

The results indicate that, while TAPC is positively related with pupils' mathematics attainment, the effect is not significantly different from zero (β_{12}<2S.E, p>0.05). Nonetheless, if TAPC is entered in the model independently, it significantly explains pupils' mathematics attainment. Only until OTL is added into the model is the TAPC effect on mathematics insignificant. This suggests an interaction effect between TAPC and OTL.

OTL

OTL is positively associated with pupils' mathematics attainment. This implies that teachers or classrooms that provide pupils with greater opportunities – in terms of time of instruction, time on curriculum relevant tasks, formative assessment and positive feedback and lesson planning activities, among others – are more likely to help pupils perform higher in mathematics than otherwise. The effect of OTL is improved upon adding school management competences, an indication that highly competent school management increases the effect of OTL on mathematics attainment, other factors remaining constant.

School management competence

The results indicate that having more competent school management (school headship) is positively associated with higher mathematics attainment by pupils, other factors being constant. This result is highly significant (β_{14}>2S.E, p<0.05). It is important to note that the effects of this variable remain relatively stable, even after adding other predictors.

Educational resource usage

Resource usage does not significantly predict mathematics attainment. This is an unexpected result. Nonetheless, when estimated as the only variable in the model, resource usage significantly predicts pupils' mathematics attainment. The cause of this insignificance could be the fact that resource usage is a significant correlate of educational resource inputs, so it is probable that the influence of resource usage is shared with educational resource inputs.

School community relations

The results indicate that pupils who attend schools that relate better to the community are more likely to perform better in mathematics. This effect is highly significant (β_{16}>2S.E, p<0.05). An interesting aspect to note is that upon adding the HIV awareness and support indicators into the model, the effect of school community relations improves.

This could be due to the fact that some of the HIV/AIDS support and awareness activities portray good school community relations.

School-based HIV/ AIDS awareness

This variable is not significantly associated with pupils' mathematics attainment

School-based HIV/AIDS support

Although this variable is significantly associated with mathematics attainment, it carries an unexpected signage (negative) from that which had been hypothesised earlier. In this instance, it would imply that pupils who attend schools that provide support for those affected with HIV/AIDS would be less likely to perform better. This could be attributable to the fact that most of the support activities have ramifications on school finances and other resources that would otherwise be used to support learning. On the other hand, it is probable that schools that offer more HIV support have a higher concentration of low SES pupils who require support.

5.4.4. Research Question 2

How random are the effects of some of the educational process factors on educational outputs in Uganda's primary education system?

Given that the earlier educational processes model assumed fixed effects for all the predictors, this question tries to establish whether any of the effects of such processes vary at any of the levels in the model being estimated. To this end, a random effects model is estimated. While there is yet no explicit theoretical framework on how to determine which variables to randomise, this study adopts the guidance provided by Snijders (2005). To this end, a decision is taken to estimate a random slope for only the significant relationships between the process factors and mathematics attainment. Insignificant random terms are excluded from the final mixed effects model. The preliminary analyses indicate that only one random slope is significant, and hence could add value to the model. This is for OTL. Consequently, this random slope is added to the previous fixed effects model. Further, Snijders (2005) indicates that an interaction term could be taken as an indication of random effects. To this end, an analysis is undertaken to establish whether OTL completely mediates the relationship between TAPC and mathematics score. This study adopts the Baron and Kenny's (1986) framework to examining a complete mediation effect.

Accordingly, a complete mediation effect would be confirmed if:

a. TAPC significantly predicts mathematics attainment
b. TAPC significantly predicts OTL
c. OTL significantly predicts mathematics attainment
d. The effect of TAPC on mathematics attainment tends to zero on inclusion of OTL in the model.

All the above conditions are satisfied. It can be concluded that the relationship between TAPC and mathematics attainment is completely mediated by OTL.

An interaction term between TAPC and OTL is added to the model, alongside the OTL random slope. The final mathematics model is a mixed effects model, estimated as below:

The final mixed effects mathematics model

$$MathScore_{ijk} = \beta_{0ijk}Constant + \beta_1 Presch2years_{ijk} + \beta_2 Presch3yearsover_{ijk} + \beta_3 Age_{ijk} + \beta_4 Girl_{ijk} + \beta_5 FamilyHome_{ijk} + \beta_6 BoardingSchool_{ijk} + \beta_7 PrivateSchool_k + \beta_8 SmallTown_k + \beta_9 LargeCity_k + \beta_{10} Inspection > 3times_k + \beta_{11} InPuts_k + \beta_{12} TAPC_{jk} + \beta_{13j} OTL_{jk} + \beta_{14} SchMgt_k + \beta_{15} ResUse_k + \beta_{16} ComRelate_k + \beta_{17} HIVAwareness_k + \beta_{18} HIVSupport_k + \beta_{19}(TAPC) * (OTL)_{jk}$$

$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

$$\beta_{13j} = \beta_{13} + u_{13j}$$

Mathematics model				
FIXED	**Coefficients**	**SE**		
β_0 Constant	464.054	4.23		
B_1Presch2years	**7.022**	**3.029**		
B_2Presch3years over	1.066	2.614		
B_3Age	**-2.871**	**0.591**		
B_4Girl	**-12.161**	**1.748**		
B_5FamilyHome	4.594	2.785		
B_6BoardingSchool	**12.207**	**4.38**		
B_7 PrivateSchool	**14.147**	**6.86**		
B_8 SmallTown	**18.15**	**5.445**		
B_9 LargeCity	**27.851**	**7.89**		
B_{10} Inspection>3times	**11.387**	**3.982**		
B_{11} Inputs	**0.072**	**0.026**		
B_{12} TAPC	0.013	0.011		
B_{13} OTL	**6.334**	**1.252**		
B_{14} SchMgt	**0.142**	**0.025**		
B_{15} ResUse	0.003	0.012		
B_{16} ComRelate	**4.654**	**1.734**		
B_{17} HIVAwareness	-0.01	0.01		
B_{18} HIVSupport	**-0.032**	**0.013**		
B_{19} TAPC* OTL	**0.014**	**0.005**		
RANDOM TERMS				**Distribution of Unexplained Var**
$\boldsymbol{\sigma^2_{v0}}$	671.034	140.293		15.91%
$\boldsymbol{\sigma^2_{u0}}$	146.416	124.724		3.47%
$\boldsymbol{\sigma^2_{u013}}$	138.692	28.521		
$\boldsymbol{\sigma_{u013}}$	95.498	32.997		
$\boldsymbol{\sigma^2_{e0}}$	3401.001	69.889		80.62%
Variance Explained	**Level 3 (school)**	**Level 2 (classroom)**	**Level 1 (pupil)**	**Total**
Distribution of Variance Explained by the adding a random slope and interaction term	4.8%	67.0%	28.2%	7.54%

Table 28 Mixed effects mathematics model
Note: **Bolds** are significant relationships.

Defining the new terms in the model:

β_{13j} is the effect of OTL on mathematics attainment for classroom j.

β_{13} is the mean effect of OTL on mathematics attainment across all classrooms

σ^2_{u013} total individual classroom variations from the mean effect of OTL on mathematics attainment

σ_{u013} is the covariation between the mean mathematics attainment and OTL slope

Adding the random slope and an interaction term significantly improves the model by explaining an additional 7.54% of the unexplained variance left by the fixed effects model. More of the explained variance on addition of the two terms is located at the classroom (67%) and pupil (28%) levels, while about 5% is located at the school level. From the results, it is clear that adding the two terms models all the variance at Level 2. To illustrate, level 2 variance becomes insignificant upon adding these two terms.

The two terms also improve the influence of the process factors. For instance, when a fixed effects model was estimated, the process factors could explain about 10% of the unexplained variance left by pupil background and contextual variables. This increases to about 16.5% upon inclusion of the random slope and an interaction term. Moreover, for the first time we see the mixed effects model explaining significant amounts of variance at all three levels. This implies that the mixed effects model is better at explaining variance at all three levels of mathematics attainment.

To answer Research Question 2, the effects of only two process factors, that is, TAPC and OTL on mathematics attainment, vary while for the rest are fixed. We could argue that, although OTL positively influences mathematics attainment, such influence is dependent on classrooms. To illustrate, the positive and significant covariation between the mean mathematics attainment and the OTL slope implies that a greater OTL effect would be expected in classrooms with a higher mean mathematics attainment than those with lower mean mathematics attainment. On the other hand, it is also apparent that the effect of TAPC on mathematics attainment is completely dependent on OTL.

5.4.5. Summary of findings with reference to mathematics attainment model

1. The final preferred model (mixed effects) explains 26% of the initial unexplained variance in the empty model.

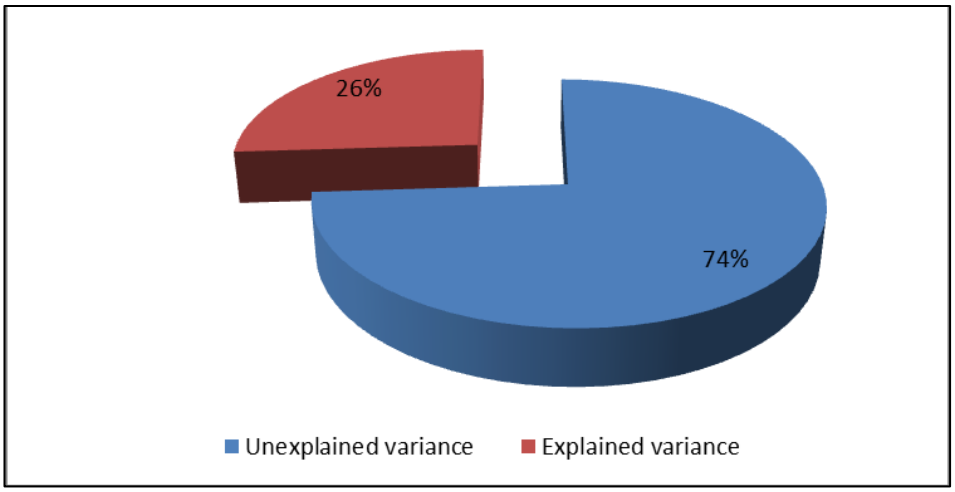

Figure 16 Variance explained by preferred mathematics model

2. The estimations indicate that educational processes explain the greatest variance in mathematics attainment, in comparison with other groups of variables as indicated in Figure 17 below.

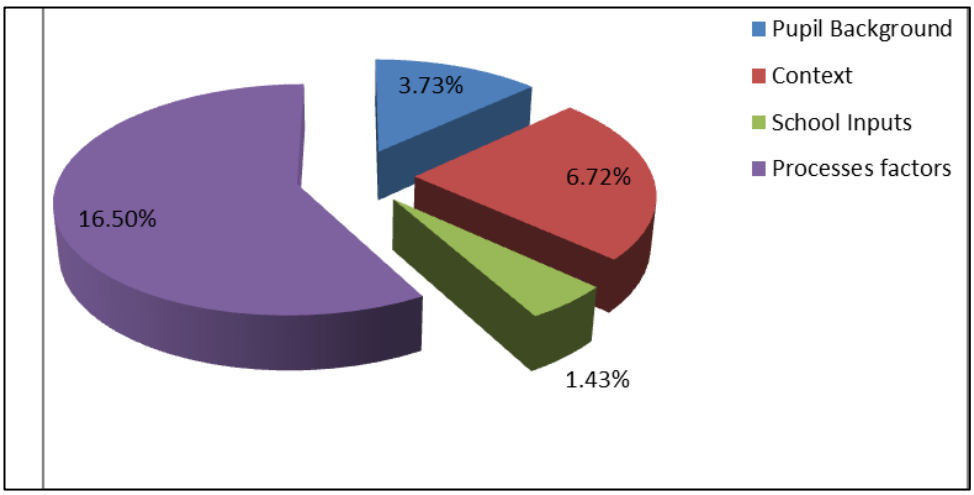

Figure 17 Variance explained by each group of factors in the preferred mathematics model

3. The model explains more variance at the school and classroom levels, as in Figure 18:

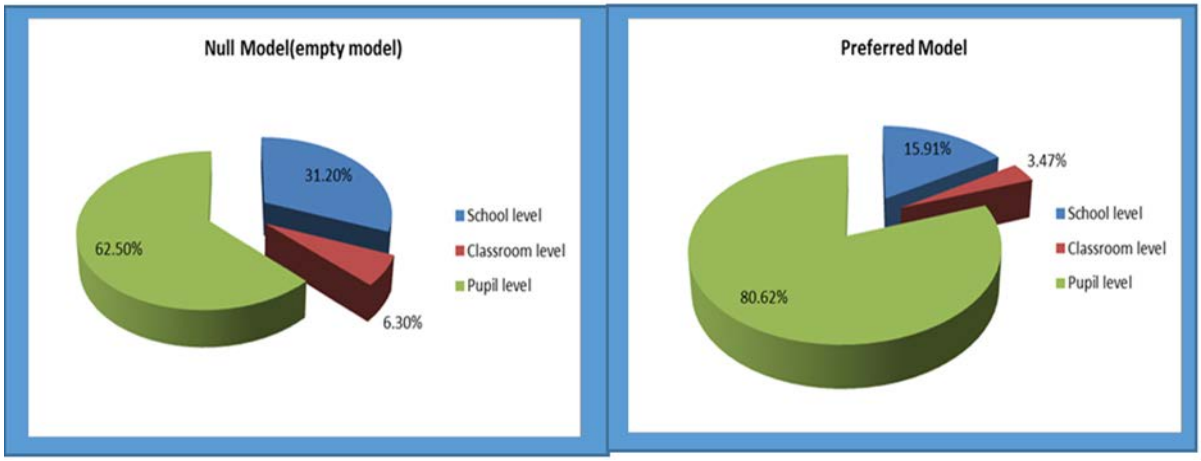

Figure 18 Comparing the null and preferred mathematics models

4. Significant variables include the following:
    a. Pupil background: preschool experience, age, gender and school-term residence. SES does not predict mathematics attainment
    b. Context: school ownership, location and central inspection. School size does not predict mathematics attainment
    c. Inputs: school inputs are significantly and positively associated with mathematics scores
    d. Educational processes: OTL, school management competence, school community relations and HIV support. Additionally, the effect between TAPC and mathematics score is completely mediated by OTL. Moreover, the effect of OTL on mathematics score varies by classroom.

It is however critical to note that while the classroom level explains relatively smaller variance (VPC=6.3% for maths and 8.1% for reading) compared to other levels, the analysis for model choice justified a three level model compared to all possible alternative models including single and two level models (see pages 150-153). Moreover, there was significant clustering at level 2 with ICC of 0.375 and 0.485 for maths and reading respectively. This further justified maintaining level 2 within the multilevel models.

5.5. Fitting the reading model

Testing model assumptions

As indicated earlier, multilevel models ascribe to various parametric assumptions. Pivotal to such assumptions are normally distributed residuals of the different levels of the model and constant residual variance in the outcome variable against each of the predictors. To test for normality, quantile-quantile plots are used, and residual scatter plots are used to test for constant residual variance.

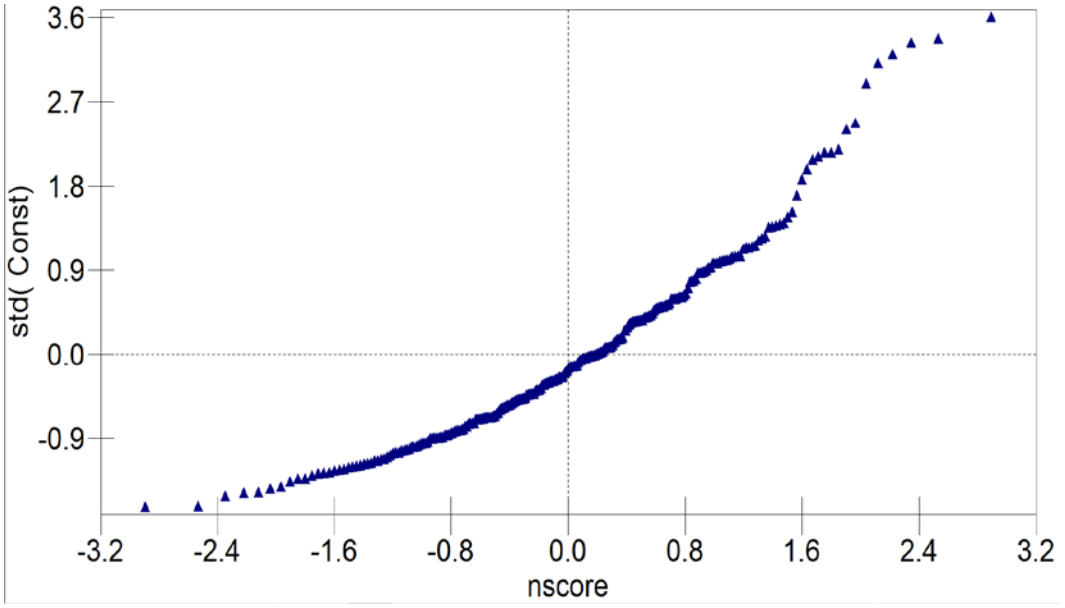

Figure 19 Normality test for Level 3 residuals (reading)

The quantile-quantile plots indicate fairly normally distributed residuals along the line of perfect normality (the 45^0 line). We could argue that Level 3 residuals are normally distributed. Nonetheless, the residual plot indicates the presence of some extreme cases on either end. This implies that there are very low and very high school scores in the distribution.

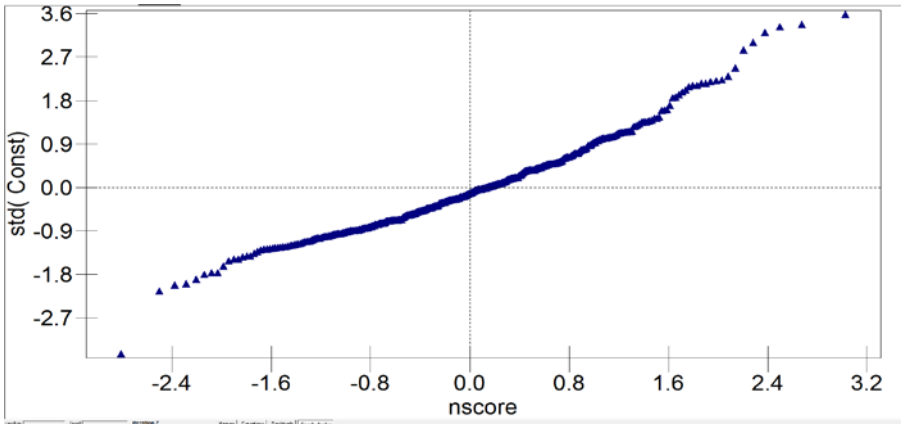

Figure 20 Normality tests for Level 2 residual (reading)

Similar to the Level 3 residuals, the Level 2 residuals do not greatly deviate from the line of perfect normality. Nonetheless, the extreme negatives and positives imply that some classes under-attained to an extreme degree, while others over-attained in reading. We could argue that the Level 2 residuals are normally distributed.

Constant variance tests

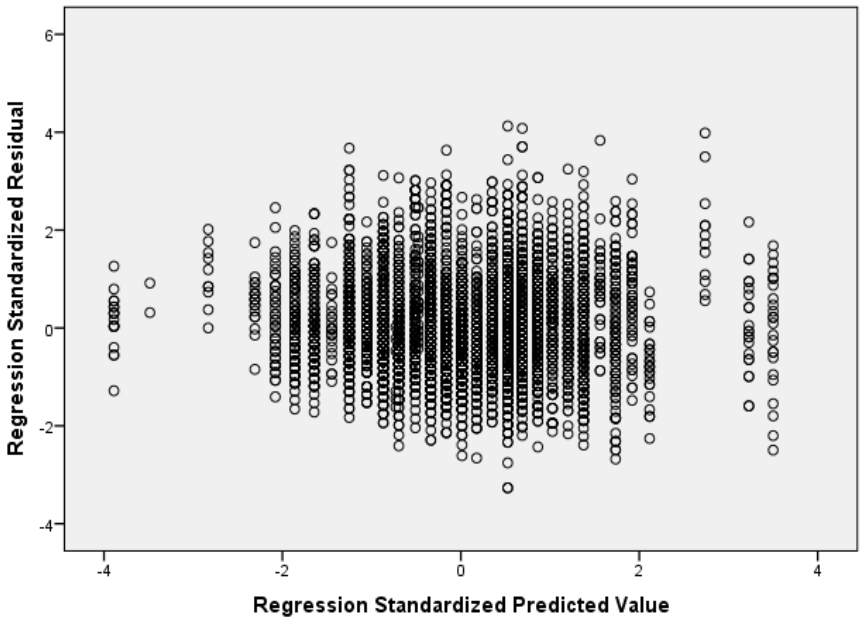

Figure 21 Scatter plot (reading)

The residual scatter plot does not portray any clear trends, therefore we could argue that the predicted and the standardised residuals are not correlated.

5.5.1. Estimating the null model

The null model is specified as follows:

$$ReadingScore_{ijk} = \beta_{0ijk}Constant$$

$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

where: $ReadingScore_{ijk}$ is the reading score attained by pupil *i* in classroom *j* and in school *k*.

β_0 is the grand mean for reading across all schools, classrooms and pupils.

v_k is the variance in reading located at the school level.

u_{jk} is variance in reading accounted for by the classroom within a school.

e_{ijk} is the deviation from the grand mean due to pupils being different from each other.

It is important to note that these parameter definitions are to be maintained throughout the analysis and, to avoid repetition, will not be defined again.

	Reading model	S.E	
FIXED			
β_0 Constant	476.35	3.40	
RANDOM			Distribution of unexplained var
σ_v^2	2445.23	300.1	40.4%
σ_u^2	490.12	160.0	8.1%
σ_e^2	3122.77	62.85	51.5%
Total variance	6058.12		
-2Llikelihood	58599.315		

Table 29 Null reading model

From the null model, the mean reading score across all schools, classrooms and pupils is 476.352. This value is slightly different from the mean value computed earlier (478.678) during data exploration, and this is due to multilevel adjustments. Wider variations are manifested in the performance. The random part of the model indicates that more variance in reading lies at the pupil level (51.55% of total variance). On the other hand, 40.36% of the total variance lies at the school level, and less variance (8.1%) lies at the classroom level. This implies that there are more differences in reading attainment due to pupil differences than would be attributable to the school and classroom levels.

5.5.2. Modelling reading attainment

We use the incremental procedure to model building, as illustrated earlier in the development of the mathematics model. To this end, pupil characteristics are to be introduced into the previous model (empty model) then, later on, contextual variables, and next educational resource inputs. Finally, educational processes will be introduced into the model to answer Research Questions 1 and 2.

5.5.2.1. Joint effects of pupil characteristics on reading attainment

$$ReadingScore_{ijk} = \beta_{0ijk}Constant + \beta_1 SES_{ijk} + \beta_2 Presch2years_{ijk} + \beta_3 Presch3yearsover_{ijk}$$
$$+\beta_4 Age_{ijk} + \beta_5 Girl_{ijk} + \beta_6 FamilyHome_{ijk} + \beta_7 BoardingSchool_{ijk}$$

$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

where:

$\beta_1 - \beta_7$ are the coefficients that indicate the magnitude in the effects of SES, preschool, age, gender, and school-term residence, respectively, on pupils' reading attainment.

	Reading model			
FIXED	**Coefficients**	**SE**		
β_0 Constant	470.575	4.038		
B_1 SES	**0.067**	**0.017**		
B_2 Presch2years	3.129	2.862		
B_3 Presch3years over	0.476	2.479		
B_4 Age	**-5.908**	**0.559**		
B_5 Girl	**-8.361**	**1.581**		
B_6 FamilyHome	**10.700**	**2.640**		
B_7 BoardingSchool	**17.397**	**4.171**		
RANDOM TERMS				**Distribution of Unexplained var**
σ_v^2	2069.744	262.045		37.4%
σ_u^2	431.097	148.136		7.8%
σ_e^2	3038.474	61.145		54.9%
Variance Explained	**Level 3 (school)**	**Level 2 (classroom)**	**Level 1 (pupil)**	**Total**
Distribution of variance Explained by Pupil Background	72.4%	11.4%	16.2%	8.6%

Table 30 Pupil characteristics and reading attainment.
NB. **Bolds** represent significant relationships

Jointly, the pupil characteristics significantly differentiate the current model from the null model [$X^2(7)= 182.731, p<0.05$].Further, the pupil characteristics explain 8.6% of the total variation in reading attainment. It is important to note that 72.4% of the explained variance (total explained variance=518.803) is located at the school level, and 11.4% and 16.2% at classroom and pupil levels, respectively. This implies that differences between school performances are significantly reduced on accounting for SES.

Socio-economic status is significantly associated with pupils' reading attainment in such a way that, other variables remaining constant, pupils from more affluent families are more likely to perform better than those from less affluent families (β_1>2S.E, p<0.05). When SES is added to the model as the sole predictor, it has an even greater effect, as reflected in the higher coefficient (β_1=0.087, S.E=0.017). Moreover, it significantly improves the model ($X^2(1)= 26.45, p<0.05$). Nonetheless, its effect diminishes on the addition of school-term residence to the model. This could be a pointer to some interaction between the two variables.

Moreover, it could as well be that school-term residence could be partly a reflection of a pupil's SES. To illustrate, most pupils from affluent families in Uganda are more likely to stay in boarding schools than those from less affluent families. This is because boarding schools in Uganda cost higher fees, and this tends to exclude low-SES pupils. Nonetheless, the addition of the interaction term between SES and school-term residence failed to improve the model significantly.

Preschool experience is not significantly associated with pupils' reading attainment. Also, although each of the categories is positively associated with pupils' reading attainment, none of them significantly differs from the reference category (β_2, β_3<2S.E, p>0.05). This implies that while pupils who attend preschool tend to be associated with higher attainment than those who never attended or attended for only up to a year, the difference could be attributable to chance. Similar results are obtained when preschool experience is added to the model as the only predictor. This variable is dropped from further estimations.

Age is negatively associated with pupils' reading attainment. This result is significant (β_4>2S.E, p<0.05). This implies that pupils who are older than the official grade age tend to attain less (5.908 points) than those of the official age.

Gender is negatively associated with pupils' reading attainment in such a way that girls are more likely to perform 8.361 points lower than the boys' scores in reading. This result is highly significant (β_5>2S.E, p<0.05) and greatly improves the previous model [$X^2(1)$= 28.103*, p<0.05*].

School term time residence is positively associated with pupils' reading attainment in such a way that pupils who live in their family homes and in boarding schools are more likely to attain higher in reading than their counterparts who live in other people's homes or orphanages. These results are highly significant (β_6, β_7>2S.E, p<0.05). Moreover, the addition of this variable as the only predictor improves the model ($X^2(2)$= 21.97*, p<0.05)*.

5.5.2.2. Contextual effects

After controlling for pupil background, we proceed by adding the contextual variables to the model. These variables have been defined in the mathematics model and they remain the same but now predict reading attainment. The model is specified as below:

$$ReadingScore_{ijk} = \beta_{0ijk}Constant + \beta_1 SES_{ijk} + \beta_2 Age_{ijk} + \beta_3 Girl_{ijk} + \beta_4 FamilyHome_{ijk} + \beta_5 BoardingSchool_{ijk} + \beta_6 PrivateSchool_k + \beta_7 SmallTown_k + \beta_8 LargeCity_k + \beta_9 Inspection > 3times_k + \beta_{10} SchoolSize_k$$

$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

Reading model with contextual variables added				
FIXED	**Coefficients**	**SE**		
β_0 Constant	448.358	5.078		
B_1SES	**0.051**	**0.017**		
B_2Age	**-5.685**	**0.558**		
B_3Girl	**-8.358**	**1.579**		
B_4FamilyHome	**11.034**	**2.633**		
B_5BoardingSchool	**16.76**	**4.157**		
B_6 PrivateSchool	**45.035**	**9.47**		
B_7 SmallTown	**28.339**	**7.438**		
B_8 LargeCity	**62.826**	**10.356**		
B_9 Inspection>3times	**13.413**	**5.581**		
B_{10}SchoolSize	0.01	0.007		
RANDOM TERMS				**Distribution of Unexplained var**
σ_v^2	1399.249	213.355		28.7%
σ_u^2	448.607	148.496		9.2%
σ_e^2	3034.967	61.067		62.2%
Variance Explained	**Level 3 (school)**	**Level 2 (classroom)**	**Level 1 (pupil)**	**Total**
Distribution of variance Explained by contextual variables	99.5%	0.00%	0.5%	12%

Table 31 Context and reading attainment

*NB. **Bolds** represent significant relationships*

The results indicate that pupils' reading attainment varies with the context in which schools operate. To illustrate, after controlling for pupil characteristics, contextual variables explain 12% of the total unexplained variance in reading scores, compared with the previous model (having pupil characteristics only). One interesting finding is that almost all variance explained by the contextual variables is located at school level (99.4%). However, adding contextual variables slightly increases variance at classroom level.

This could be due to the fact that all the contextual variables are measured at school level, and that most of the sampled schools have only one Grade 6 class stream.

The results indicate that pupils who attend schools that are privately owned, located in an urban area or a large city and receiving regular central inspection are significantly associated with reading attainment higher than those that attend schools that are government owned, located in isolated or rural areas and receiving less than three annual central inspections (β_6 ,β_7, β_8, β_9>2S.E, p<0.05). School size does not matter in predicting pupils' reading attainment (β_{10}<2S.E, p>0.05) and it is now dropped from further estimations.

School ownership and location separately explain the highest proportion of the total unexplained variance in pupils' reading attainment, with each covariate explaining approximately 5.13% and 8.8% of the total variance, respectively. The importance of the above two variables is also reflected in the significant contributions to the model upon separately introducing each of them into the model. For instance, adding school ownership to the model reduces the -2LL by 29.202 ($X^2(1)$= 29.202*, p<0.05)*, while location reduces -2LL by 55.1 ($X^2(2)$= 55.1*, p<0.05)*.

5.5.2.3. Educational inputs and pupils' reading attainment

After controlling for pupil background and context, there is need to control for the educational inputs owned by the respective schools before estimating the educational process effects on pupils' reading scores. To the previous model, school inputs are added and estimated:

$$ReadingScore_{ijk} = \beta_{0ijk}Constant + \beta_1 SES_{ijk} + \beta_2 Age_{ijk} + \beta_3 Girl_{ijk} + \beta_4 FamilyHome_{ijk} + \beta_5 BoardingSchool_{ijk} + \beta_6 PrivateSchool_k + \beta_7 SmallTown_k + \beta_8 LargeCity_k + \beta_9 Inspection > 3times_k + \beta_{10} InPuts_k$$

$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

Reading model with school inputs variable added				
FIXED	**Coefficients**	**SE**		
β_0 Constant	451.003	5.094		
B_1SES	**0.049**	**0.017**		
B_2Age	**-5.645**	**0.558**		
B_3Girl	**-8.387**	**1.579**		
B_4FamilyHome	**10.939**	**2.633**		
B_5BoardingSchool	**16.534**	**4.157**		
B_6 PrivateSchool	**38.59**	**9.059**		
B_7 SmallTown	**24.198**	**7.459**		
B_8 LargeCity	**57.498**	**10.239**		
B_9 Inspection>3times	**12.586**	**5.502**		
B_{10} Inputs	**0.097**	**0.031**		
RANDOM TERMS				**Distribution of Unexplained var**
σ_v^2	1356.145	207.7		28.1%
σ_u^2	429.359	145.678		8.9%
σ_e^2	3036.354	61.093		63.0%
Variance Explained	**Level 3 (school)**	**Level 2 (classroom)**	**Level 1 (pupil)**	**Total**
Distribution of variance Explained by School Inputs variable	68.40%	31.60%	0.00%	1.25%

Table 32 School inputs and Reading attainment.
Note: **Bolds** are significant relationships

Controlling for pupil background and context, school educational inputs are significantly associated with pupils' reading attainment, such that pupils in schools with more educational resources are likely to perform better than those in poorly resourced schools (β_{10}>2S.E, p<0.05). Educational resources significantly improve the model, relative to the previous model ($X^2(1)=$ 7.80, $p<0.05$). School inputs explain more variance at school level (68.40%) and classroom level (31.60%) and none at Level 1.

5.5.2.4. Educational processes effects on pupils' reading attainment

The processes' definitions and their measurements have been elaborated earlier in the mathematics model, so will be maintained across all analyses involving the same process variables.

5.5.3. Research Question 1

What are the educational process factors that account for significant variations in educational outputs in Uganda's primary education?

A similar procedure used in the mathematics model is followed in trying to estimate the process effects on reading attainment. Initially, a fixed effects model is estimated and later on

is translated into a mixed effects model in an attempt to answer Research Question 2. The model estimated is specified as below:

$$ReadingScore_{ijk} = \beta_{0ijk}Constant + +\beta_1 SES_{ijk} + \beta_2 Age_{ijk} + \beta_3 Girl_{ijk} + \beta_4 FamilyHome_{ijk} + \beta_5 BoardingSchool_{ijk} + \beta_6 PrivateSchool_k + \beta_7 SmallTown_k + \beta_8 LargeCity_k + \beta_9 Inspection > 3times_k + \beta_{10} InPuts_k + \beta_{11} TAPC_{jk} + \beta_{12} OTL_{jk} + \beta_{13} SchMgt_k + \beta_{14} ResUse_k + \beta_{15} ComRelate_k + \beta_{16} HIVAwareness_k + \beta_{17} HIVSupport_k$$

$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

Reading model with educational process factors added				
FIXED	**Coefficients**	**SE**		
β_0 Constant	453.96	4.892		
B_1SES	**0.046**	**0.017**		
B_2Age	**-5.474**	**0.555**		
B_3Girl	**-7.851**	**1.574**		
B_4FamilyHome	**10.61**	**2.618**		
B_5BoardingSchool	**16.17**	**4.133**		
B_6 PrivateSchool	**34.951**	**8.656**		
B_7 SmallTown	**20.464**	**7.005**		
B_8 LargeCity	**54.427**	**9.845**		
B_9 Inspection>3times	**10.184**	**5.17**		
B_{10} Inputs	0.039	0.033		
B_{11} TAPC	0.003	0.01		
B_{12} OTL	**5.197**	**0.982**		
B_{13} SchMgt	**0.092**	**0.031**		
B_{14} ResUse	**0.059**	**0.014**		
B_{15} ComRelate	**5.82**	**2.041**		
B_{16} HIVAwareness	**-0.024**	**0.012**		
B_{17} HIVSupport	**-0.036**	**0.016**		
RANDOM TERMS				**Distribution of unexplained var**
σ_v^2	1121.859	188.999		24.65%
σ_u^2	422.978	142.416		9.29%
σ_e^2	3006.418	60.485		66.06%
Variance Explained	**Level 3 (school)**	**Level 2 (classroom)**	**Level 1 (pupil)**	**Total**
Distribution of variance explained by process factors (fixed effects)	86.58%	2.36%	11.06%	5.61%

Table 33 Process factors and reading attainment.

The results from Table 33 indicate that, after controlling for pupil background, context and school inputs, educational processes significantly predict pupils' reading attainment. This is reinforced by the fact that adding the process indicators significantly differentiates the current model from the previous model($X^2(7)$= 86.1, $p<0.05$). Moreover, the processes jointly explain

5.6% of the total unexplained variation in pupils' reading attainment, after controlling for pupil background, context and school inputs.

With regards to the process factor effects on pupils' reading attainment, the results indicate that OTL, school management competence, resource usage, school community relations, school-based HIV/AIDS awareness and school-based HIV/AIDS support are significantly associated with pupils' reading attainment ($\beta_{12}, \beta_{13}, \beta_{14}, \beta_{15}, \beta_{16}, \beta_{17}$>2S.E, $p<0.05$).

Although the effect of TAPC is insignificant, it is interesting to note that, if entered separately into the model, TAPC is significantly and positively associated with pupils' reading attainment (see Table 34 with TAPC as the only predictor). However, TAPC becomes insignificant when OTL is added into the model. This is indicative of an interactive relationship between TAPC and OTL. This is further examined in the next section that investigates the random and varied relationships.

	Reading model	**SE**
FIXED TERMS		
β_0	476.406	3.332
B_1 TAPC	0.030	0.008
RANDOM TERMS		
σ_v^2	2330.736	290.104
σ_u^2	481.968	158.474
σ_e^2	3121.142	62.817
Model Comparison	**Null**	**Current Model**
Total variance	6058.119	5933.846
-2Llikelihood	58599.315	58585.205

Table 34 Reading model with only TAPC

On the other hand, while all the variables in the previous model (which contains pupil background, context and school inputs) were fairly stable in terms of magnitude and direction of their effects on reading attainment, school inputs became insignificant upon the addition of the process factors. Specifically, when school resource usage is added into the model, the school inputs variable becomes insignificant. This suggests that the two variables interact. This is further examined in the next section on random and varied effects.

5.5.4. Research Question 2

How random are the effects of some of the educational process factors on educational outputs in Uganda's primary education system?

A similar procedure of establishing the significant random effects used for the mathematics model is applied for the reading model. The preliminary analyses indicated that only two random slopes are significant and hence could add value to the general fixed effects model. These are for OTL and resource usage.

Consequently, two random slopes are added to the previous fixed effects model. On estimation, the random terms are barely significant, and their slopes intercept covariances are insignificant. Moreover, the addition of the two random terms did not improve the model sufficiently to justify the complexity of introducing them into the model. Instead, a decision was taken to add the interaction term between TAPC and OTL. The final and preferred model is as specified below:

$$
\begin{aligned}
ReadingScore_{ijk} &= \beta_{0ijk}Constant + +\beta_1 SES_{ijk} + \beta_2 Age_{ijk} + \beta_3 Girl_{ijk} + \beta_4 FamilyHome_{ijk} \\
&+ \beta_5 BoardingSchool_{ijk} + \beta_6 PrivateSchool_k + \beta_7 SmallTown_k \\
&+ \beta_8 LargeCity_k + \beta_9 Inspection > 3times_k + \beta_{10} InPuts_k + \beta_{11} TAPC_{jk} \\
&+ \beta_{12} OTL_{jk} + \beta_{13} SchMgt_k + \beta_{14} ResUse_k + \beta_{15} ComRelate_k \\
&+ \beta_{16} HIVAwareness_k + \beta_{17} HIVSupport_k + \beta_{18}(TAPC * OTL)_{ijk}
\end{aligned}
$$

$$\beta_{0ijk} = \beta_0 + v_k + u_{jk} + e_{ijk}$$

Final reading model				
FIXED	**Coefficients**	**SE**		
β_0 Constant	452.939	4.891		
B_1SES	**0.046**	**0.017**		
B_2Age	**-5.484**	**0.555**		
B_3Girl	**-7.78**	**1.573**		
B_4FamilyHome	**10.58**	**2.617**		
B_5BoardingSchool	**16.189**	**4.131**		
B_6 PrivateSchool	**35.896**	**8.615**		
B_7 SmallTown	**20.397**	**6.971**		
B_8 LargeCity	**54.317**	**9.794**		
B_9 Inspection>3times	10.063	5.145		
B_{10} Inputs	0.038	0.033		
B_{11} TAPC	0.002	0.01		
B_{12} OTL	**5.128**	**0.982**		
B_{13} SchMgt	**0.087**	**0.031**		
B_{14} ResUse	**0.059**	**0.014**		
B_{15} ComRelate	**5.744**	**2.035**		
B_{16} HIVAwareness	-0.023	0.012		
B_{17} HIVSupport	**-0.036**	**0.016**		
B_{18} TAPC*OTL	**0.013**	**0.005**		
RANDOM TERMS				**Distribution of unexplained var**
σ_v^2	1104.65	187.63		24.4%
σ_u^2	424.85	141.51		9.4%
σ_e^2	3003.67	60.43		66.3%
Variance Explained	**Level 3 (school)**	**Level 2 (classroom)**	**Level 1 (pupil)**	**Total**
Distribution of Variance Explained by Process factors and the interaction term(Mixed effects)	87.1%	1.6%	11.3%	6.0%

Table 35 Final reading model

Adding an interaction term to the model further improves it and increases the influence of the processes factors on reading attainment. For instance, without the interaction term, process factors could jointly explain 5.6% of the unexplained variance and this increases to 6% on addition of the interaction term. This increment is highly significant ($X^2(1) = 6.91, p < .01$).

To answer Research Question 2, we could argue that only the effects of TAPC on reading attainment vary according to OTL while the rest are fixed. The positive interaction term would imply that provide more TAPC effect would be expected in classrooms that more OTL.

5.5.5. Summary of the findings with reference to the reading attainment model

1. The final preferred model explains 25% of the initial unexplained variance in reading (reference is made to the empty model).

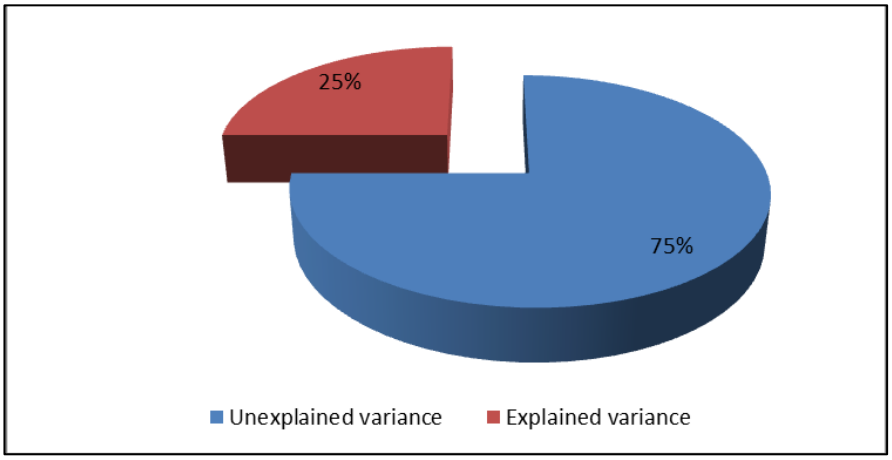

Figure 22 Variance explained by the preferred reading model

2. The estimations indicate that context explain the greatest variance in reading attainment, as indicated in Figure 23 below.

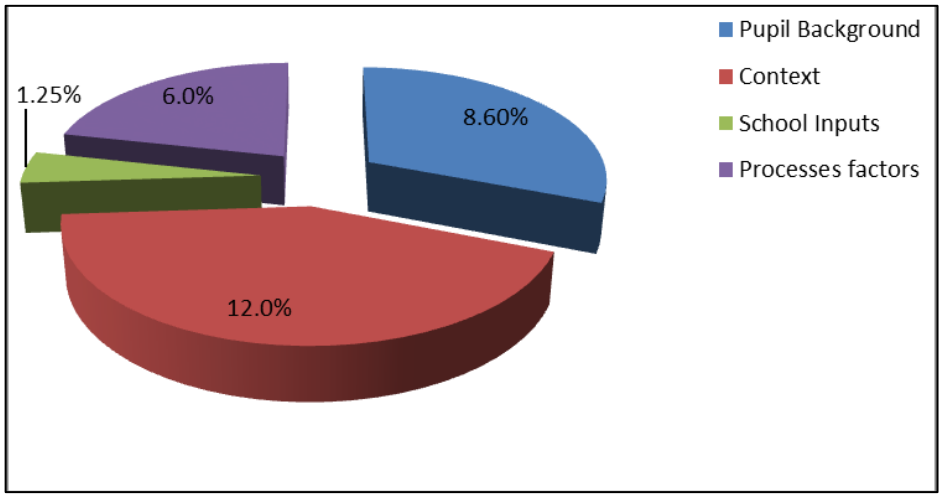

Figure 23 Variance explained by each group of factors in the reading model

3. The model explained more variance at the school level, as indicated in Figure 24 below:

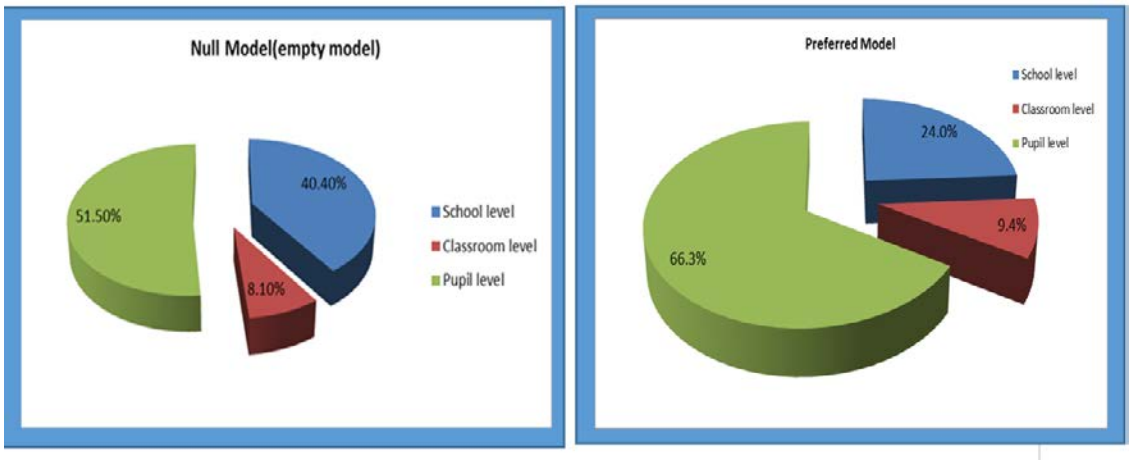

Figure 24 Comparison between the null and the preferred reading model

4. Significant variables include the following:
    a. Pupil background: SES; age; gender; and school term residence. Preschool experience does not predict reading attainment.
    b. Context: school ownership; location; and central inspection. However, we note that central school inspection becomes insignificant on estimating the mixed effects model (model with interaction term). School size does not predict reading attainment.
    c. Inputs: school inputs are significantly and positively associated with reading scores. We note that this variable becomes insignificant upon adding educational processes.
    d. Educational processes: OTL; school management competence; resource usage; school community relations and HIV support significantly predict reading attainment. Also, there is a significant interaction effect between TAPC and OTL, and the effects of TAPC on reading are completely mediated by OTL.

5.6. Comparing the mathematics and reading models

A comparison of the two models (maths and reading) is driven by the intent to establish whether effectiveness factors affect the two learning outcomes in a similar or different way. This is key for policy and practice given that most of the EER tend to address effectiveness factors for either of the two learning outcomes. Moreover, the foregoing analysis presents some interesting nuances with regards to the effects of the effectiveness factors on the two learning outcomes that need to be teased out in this comparison.

Foremost, both models conform to the key assumptions of multilevel modelling; that is, normal distribution of Levels 2 and 3 residuals and constant variance. Both models indicate the presence of some extreme cases; that is, best and worst performing schools and classrooms.

From the null models, similar trends are reflected in both models with regards to variance partitioning. Although there are differences in the magnitude of variances located at the different levels, the pupil level accounts for the highest proportion of unexplained variance, while classroom level accounts for the least (see Figure 25 below). The small variance proportion at the classroom level could be attributable to the fact that most of the sampled schools had only one class stream at Grade 6. It is, however, important to note that reading manifested a higher total unexplained variance (6058.12) than did mathematics (5705.20).

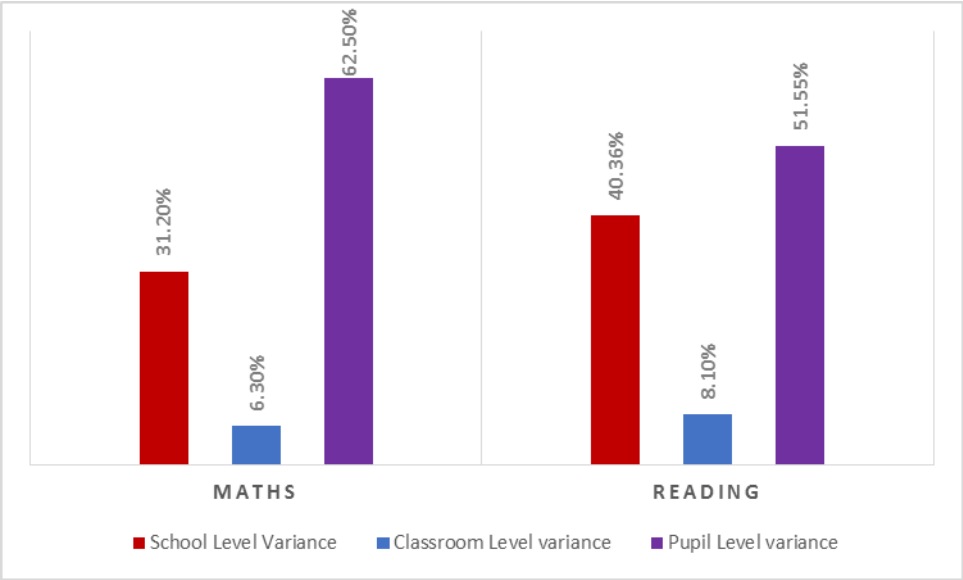

Figure 25 Comparison between the mathematics and the reading models

Compared to the null models, the final and preferred models for both mathematics and reading explain similar proportions of variance overall. For instance, on controlling for all the variables in the model, 26% of variance in mathematics attainment is explained by the preferred model, while 74% remains unexplained. Similarly, for reading, 25% is explained by all the variables estimated in the preferred model, while 75% remains unexplained.

Stark differences are manifested in the proportions of explained variance attributable to the various variable groupings across the two subjects. For instance, whereas educational process factors explain the greatest proportion of variance in mathematics (16.5%), this is not the case in reading. Contextual factors seem to matter very much for reading, as they claimed the

greatest proportion of variance explained (12%). Nonetheless, educational processes also explain a great percentage in reading attainment (6%). On the other hand, whereas pupil background characteristics matter more in reading (explain 8.6% of variance), this is not apparent for the mathematics model, where they explain only 3.73%. In both models, school inputs explain the least percentage.

Further, in both models, more school-level variance was explained than that at other levels. For instance, in reading, school-level variance fell from 40.4% (in the empty model) to 24%, upon controlling for all the variables in the model. A similar trend is reflected in the mathematics model, where it fell by about 50%; that is, from 31.2% to 15.91%, after controlling for the variables. On redistribution of the residual variance (unexplained variance after controlling for all variables), we see more of the unexplained variance located at the pupil level in both mathematics (80.62%) and reading (66.3%).

With regards to the magnitude and direction of the individual variable effects, similar trends as well as contrasts are manifested in each model. For instance, with regards to pupil background, whereas SES is a significant predictor of reading it is insignificant for mathematics. On the other hand, we see preschool experience as being significant for mathematics but not for reading. Moreover, while gender is a significant predictor in all the models, we see a more pronounced gender gap in mathematics. Further, with reference to contextual variables, although there is consistency in the direction and magnitude of the effects of the contextual variables in both models, there are more marked school ownership and location gaps in reading attainment than in mathematics.

With reference to educational processes, most of them are consistent in magnitude and direction of their effects on mathematics and reading. However, this is not the case with resource usage. This variable is significant for reading, but not for mathematics. With regards to how random the effects of education processes are in predicting mathematics and reading attainment, TAPC and OTL have varied effects. For instance, in each model, the effects of TAPC are dependent on OTL. Equally, the effects of OTL on mathematics attainment vary by classroom.

5.7. Effectiveness profiles of schools (residual analysis)

Whereas there is relative consensus on the policy and practical importance of estimating the school contribution to student learning (also known as value added), a vexing problem lies with how to adjust the attainment means for covariates prior to deriving school effectiveness scores (Raudenbush, 2004). Various suggestions and practices are noticed in the literature. For instance, while Kyriakides and Creemers (2011) would favour adjusting mean attainment for only pupil attributes and prior attainment, some studies have used various covariates including contextual variables, school inputs, and teacher characteristics, to adjust mean attainment prior to estimating school effectiveness scores (see Chetty et al., 2014; Sass et al., 2014; Strand, 1997). The weakness with controlling for only pupil background and prior attainment is that inflated school effectiveness score will arise due to the influence of the uncontrolled variables that impact learning outcomes. On the other hand, the latter approach of controlling for all key covariates is more conservative as it tries to approximate the net school effectiveness scores if key covariates are controlled for. In light of the above, the current study adopts the conservative approach as it recognises the dynamic relationships amongst various effectiveness variables that act in concert to impact learning outcomes. To this end, the final models for mathematics and reading are used to profile schools according to the value added to pupils' attainment in the two subjects. Nonetheless, it is critical to note that this approach tends to hold schools accountable for variables that might be beyond their control.

Using residual analysis, the most effective, least effective and typical schools can be identified for each by plotting the differences between the expected and actual effectiveness scores by school (see Kyriakides and Creemers, 2011). The standard error of estimate is used to determine the 95% confidence intervals within which the true estimate of the school score in the population lies. To this end, the most effective schools would be those whose confidence intervals lie above and do not overlap the zero line (for the typically effective school). Further, least effective schools would be those whose confidence intervals lie below and do not overlap the zero line. Schools whose confidence intervals cross the zero line (mean effectiveness) would be taken to be the typically or averagely effective schools.

It would also be of interest for this study to characterise the different schools in terms of some policy relevant control variables. For instance, it would be of interest to establish the characteristics of pupils, context and processes that dominate the most effective and least effective schools. This would further highlight the extent of alignment of empirical findings

with the realities in the dataset and, most importantly, such insights would shed light on what most effective schools do.

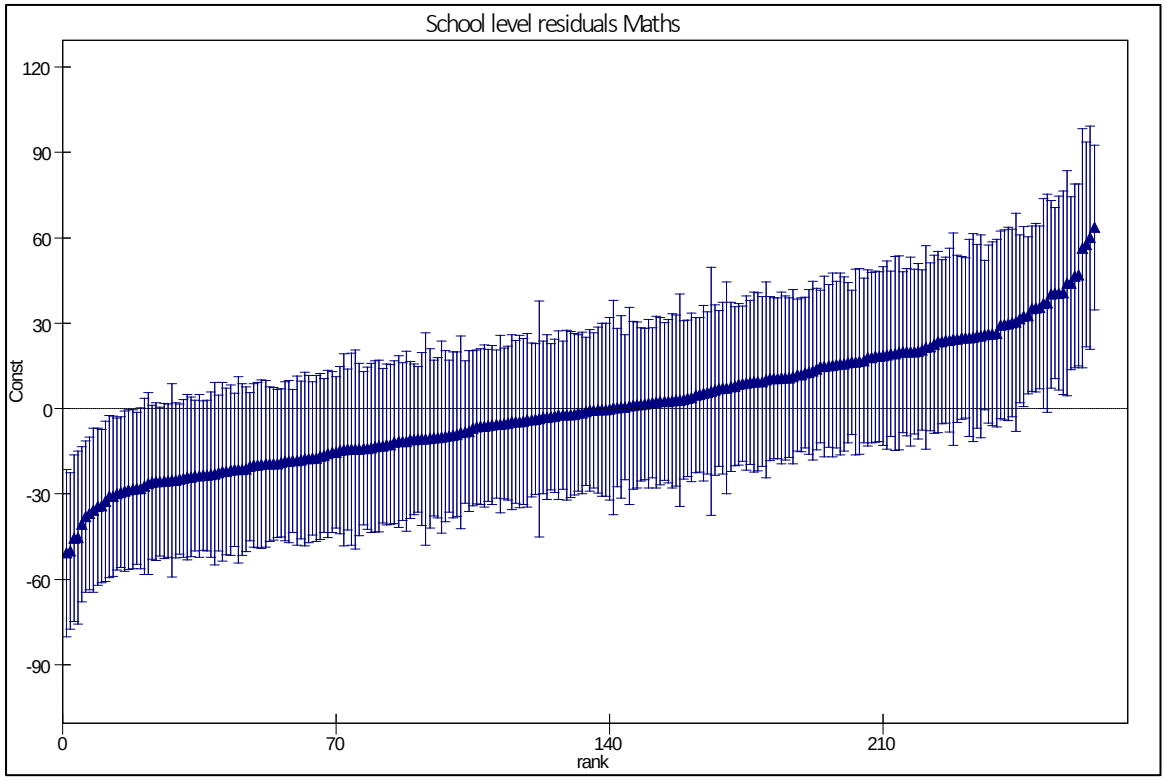

Figure 26 Value-added plot (mathematics)

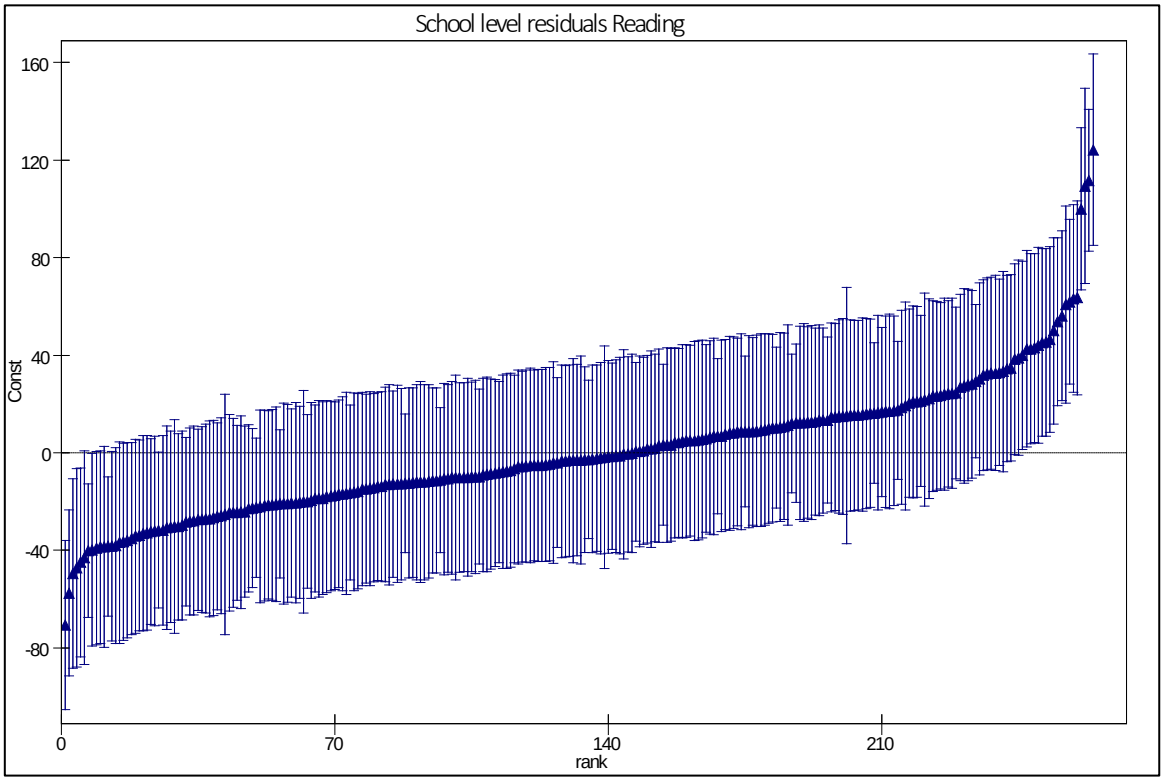

Figure 27 Value-added plot (reading)

	SES	Age	Central Inspection	Inputs	TAPC	OTL	Sch Mgt Competence	Resource Usage	Sch Comm. Relations	HIV/AIDS awareness	HIV/AIDS support
Below overall group mean	55%	55%	33%	56%	11%	11%	33%	67%	44%	56%	44%
Above overall group mean	45%	45%	67%	44%	89%	89%	67%	33%	56%	44%	56%

Table 36 Profiles of the most effective 10 schools in mathematics and reading

Note: Five most effective schools were from each subject. Only one school appeared in both.

	SES	Age	Central Inspection	Inputs	TAPC	OTL	Sch Mgt Competence	Resource Usage	Sch Comm. Relations	HIV/AIDS awareness	HIV/AIDS support
Below overall group mean	89%	33%	22%	67%	89%	89%	56%	22%	44%	56%	33%
Above overall group mean	11%	67%	78%	33%	11%	11%	44%	78%	56%	44%	67%

Table 37 Profiles of the 10 least effective schools in mathematics and reading

Note: Five least effective schools were from each subject. Only one school appeared in both.

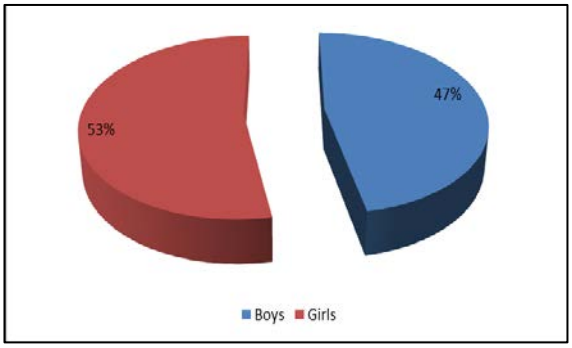

Figure 28 Gender in the top 10 schools

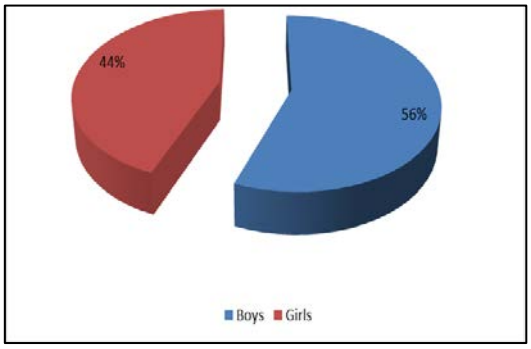

Figure 29 Gender in the bottom 10 schools

The Level 3 residual analysis for the final mathematics and reading models indicates that the most effective schools tend to consist of more young pupils and slightly more girls than boys. Young age could as well imply that most effective schools see less grade repetition. Further, 55% of the most effective schools scored below the average SES, with 45% coming from higher SES status. In addition, 56% of the most effective schools have below average inputs. With regards to processes, the most effective schools scored above average on processes factors such as TAPC, OTL, school management competence, school-community relationships and HIV/AIDS support. Conversely, the most effective schools scored below average on resource usage and school-based HIV/AIDS awareness. The residual analysis further highlights that least effective schools are profiled by low SES and older pupils, and with below-average school inputs. Older pupils could be an indicator of more grade repetition in poorly performing schools.

With reference to processes, least effective schools perform poorly on all the processes, save for resource usage, school-community relationships and school-based HIV/AIDS support. Moreover, the least effective schools enrol higher proportions of boys than girls.

5.8. Research Question 3

To what extent do the educational inputs, processes and outputs reflect the equity dimension of educational effectiveness?

The Gini coefficient, Theils *T* and variance analysis were used to examine the extent to which the distributions of educational outputs, inputs and processes were (in)equal, respectively.

5.8.1. Equity in the distribution of pupil attainment (outputs)

Mathematics

The Gini estimation tries to highlight how fair or unfair is the distribution of school mathematics attainment with reference to the SES quartile they belong to. This was estimated at 0.03 out of one. This implies that only 3% of the total distribution in mathematics attainment among schools across the different SES backgrounds was disproportionate. This is quite a small indication of inequality, therefore we could argue that there is fairly proportionate distribution of mathematics outcomes with reference to SES categories. This finding is consistent with the earlier finding in the multilevel model estimation. This found that SES was not a significant predictor of variance in mathematics attainment. Below is the visual illustration of the closeness of the Lorenz curve to the egalitarian line.

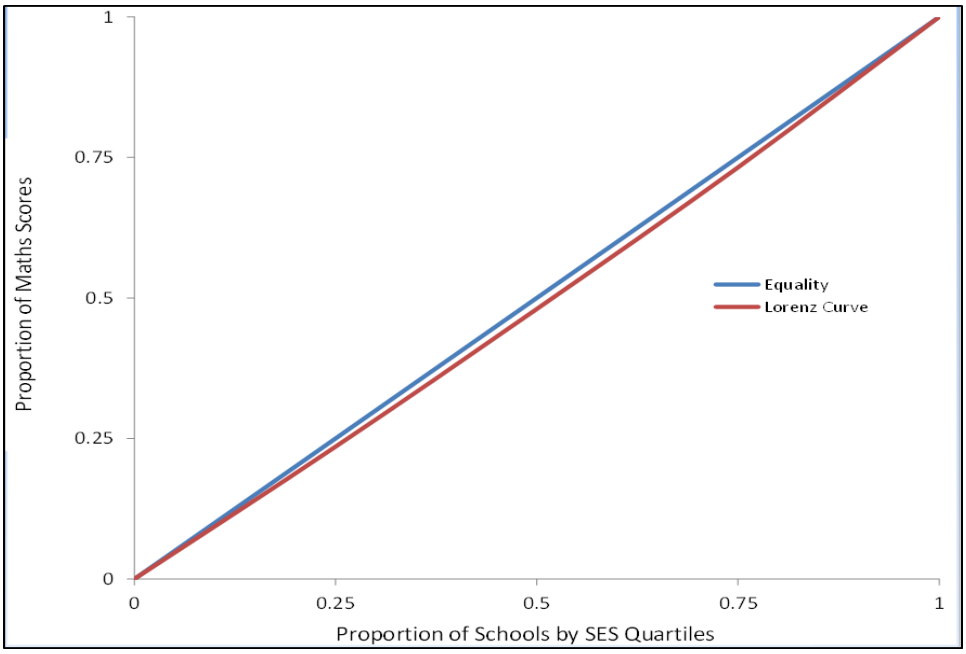

Figure 30 Lorenz curve for distribution of mathematics attainment by SES

5.8.1.1. Reading

The Gini estimation for reading is at 0.10 out of one. This implies that about 10% of the reading attainment distribution among schools under the different SES groups is disproportionate. To this end, we could argue that there is some inequality in the distribution of reading attainment. This is attested to by the earlier finding that SES is a significant predictor of variations in reading attainment. The graphical illustration below indicates equality within the lower SES schools, but the gap widens slightly as we approach the top quartile.

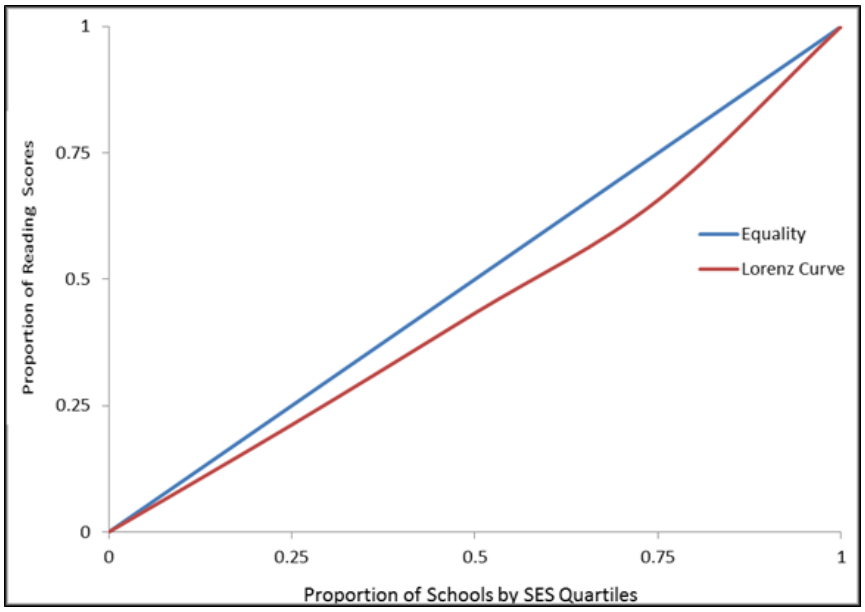

Figure 31 Lorenz curve for distribution of reading attainment by SES

5.8.2. Equity in the distribution of educational resources (inputs)

While the Gini can be used to estimate inequalities in educational inputs, the Theils *T* is indicated to be appropriate for estimating inequality in inputs such as school finance. The overall Theils *T* is supposed to be a summation of the between-schools and within-schools inequality. Nonetheless, in this study, it is constituted by only one component; that is, between-schools *T*. This is because educational resource is a school-level variable where every case (student) assumes the resource value scored by its respective school, hence no inequality among pupils (within-school). This is also reflected in a Theils *T* value of zero (0) for within-school distribution.

As hinted earlier in the methodology, the estimated Theils *T* is a product of the school mean proportion of resources owned relative to the entire sample mean and the individual school population relative to the total sample size. In this case, the individual school mean resources and population are compared with the sample mean resources of 479.83 and total sample of

5307. The estimation yielded a Theils *T* of 3.0325. Theils *T* tends to be difficult to interpret unless the upper limit of the probable Theils *T* range, which signifies perfect inequality, is given. In this case, given the sample size of 5307, the upper limit of the *T* would be given by:

Ln(5307)= 8.577.

This implies that the range of *T* would be 0-8.577 .Therefore, a score of 3.032 would indicate a disproportionate distribution to a certain degree. We would then argue that there is an unfair or disproportionate distribution of educational resources between the primary schools of Uganda.

It is important to interpret the equity metrics in this study with caution. To illustrate, although the Gini coefficients estimated allude to a fairly equitable distribution of, most especially, attainment scores among schools, such numbers could also indicate that a significant number of schools in the whole sample performed poorly, even when there could be some wider variation in the performance distribution. Moreover, as most of the schools are poor in terms of resource inputs, the inequality measure is most likely to be narrower than expected.

5.8.3. Equity in the opportunity to learn (processes)

Opportunity to learn (OTL) is a key process to effective learning. To this end, equitable distribution of OTL among the pupils need not be emphasised. OTL was, in this study, a scale that was constructed using the Rasch technique. Variance analysis is used to determine differences in the opportunities that schools provide for pupils to learn.

Government versus private schools

Group Statistics					
	School ownership	N	Mean	Std. Deviation	Std. Error Mean
OTL	Government	235	465.1697	67.67625	4.41471
	Private	29	520.6181	66.98044	12.43796

Table 38 Differences in mean OTL by school ownership

Independent Samples Test									
		Levene's Test		t-test for Equality of Means					
		F	Sig.	t	df	Sig. (2-tailed)	Std. Error	95% Confidence Interval	
								Lower	Upper
OTL	Equal variances assumed	.195	.659	-4.167	262	.000	13.31	-81.65	-29.25
	Equal variances not assumed			-4.201	35.4	.000	13.20	-82.23	-28.67

Table 39 Significance of the differences in mean OTL by school ownership

From the above independent samples T test, equality of variance is assumed. The results indicate a significant difference between OTL provided by private and government schools [t(262)=4.167, p<.05]. The mean score for government schools is lower than that for private schools. We could argue that private schools agree to most of the items assumed to constitute better OTL than their government-owned counterparts.

Rural versus urban schools

Descriptives						
					95% Confidence Interval for Mean	
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
Rural/Isolated	196	456.11	65.81	4.70	446.84	465.38
Urban/Town	47	502.83	64.88	9.46	483.78	521.88
City	21	542.02	45.60	9.95	521.26	562.77
Total	264	471.26	69.67	4.29	462.82	479.70

Table 40 Differences in mean OTL by school location

Table 40 indicates that schools located in urban and the city offer higher opportunities for pupils to learn than those in rural or isolated schools. Nonetheless, the confidence intervals for the urban/town and the city overlap indicating that while schools in the city offer slightly higher OTL than those in urban/town centres, the difference may not be significant. This was reinforced by results from the preliminary ANOVA. These two categories were merged into urban category and an independent samples T test was conducted to establish whether the difference in OTL between rural and urban schools is statistically significant.

Independent Samples Test									
		Levene's Test		t-test for Equality of Means					
								95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Std. Error	Lower	Upper
OTL	Equal variances assumed	.044	.834	-6.44	262	.000	9.13	-76.80	-40.85
	Equal variances not assumed			-6.63	123	.000	8.87	-76.37	-41.27

Table 41 Significance of differences in mean OTL by school location

From the independent samples t test, equal variances are assumed. The results indicate that the urban schools scored higher than rural schools on the OTL scale, and the difference between them is significant [t (262)=6.44, p<.05]. This implies that there is a significant difference in the opportunities provided for learning for pupils in rural and urban schools.

CHAPTER SIX: DISCUSSION OF THE FINDINGS

6.0. Introduction

In this chapter, findings of the study are discussed with reference to the empirical literature and theory. Prior to the main discussion, an overview of the findings and their meaning is given.

The current study undertook to examine the educational processes that explain variations in educational outcomes in Ugandan primary schools. It presumes that, while educational inputs are important to the operation of schools, without effective processes in the classrooms and the schools, poor outcomes are more likely to obtain. The study is located within the education effectiveness body of knowledge and is guided by a modified dynamic model of educational effectiveness that reflects the contextual realities of poor societies.

The study asked the following questions:

i. What are the educational process factors that account for significant variations in educational outputs in Uganda's primary education?
ii. How random are the effects of some of the educational process factors on educational outputs in Uganda's primary education system?
iii. To what extent do the educational inputs, processes and outputs reflect the equity dimension of educational effectiveness?

In answering the above questions, two models had to be estimated; that is, one for mathematics outcomes and the other for reading outcomes. Nonetheless, a single, integrated discussion is undertaken that allows for comparisons and contrasts between the meaning and theoretical implications of the predictor effects on the two outcome variables. The discussion follows the order of the research questions. Below is an overview of the key findings that are to inform the discussion.

After controlling for pupil characteristics, contextual factors and school resource inputs, the process factors that significantly predict both mathematics and reading outcomes include OTL, school management competence, school-community relationships and school-based HIV support.

Further, for both mathematics and reading, there is a significant interaction effect between TAPC and OTL, and the effects of TAPC are completely mediated by OTL. On the other hand, while resource usage significantly predicts reading attainment, it does not predict mathematics attainment. Additionally, on controlling for pupils' backgrounds, context and resource inputs, the educational processes jointly explained more variance in mathematics attainment (16.5%) than in reading (6%). Nonetheless, the preferred models explained similar proportions of variance in both outcomes; that is, 26% and 25% for mathematics and reading, respectively. Overall, each of the models explains more variance at Level 3 (school) than the other levels.

With reference to Research Question 2, the findings indicate that, for the reading model, while all the process effects are fixed, the effect of TAPC is dependent on OTL. For the mathematics model, the effects of TAPC are completely mediated by OTL. Moreover, the effects of OTL on mathematics attainment vary by classroom, such that more effect would be expected in classrooms with a higher mean mathematics attainment.

With reference to Research Question 3, the Gini estimates indicate that only 3% of the total distribution in mathematics attainment among schools grouped by SES backgrounds was disproportionate, in favour of higher SES schools. On the other hand, 10% of the reading attainment distribution among schools under the different SES groups was disproportionate in favour of higher SES schools. Further, the Theils *T (T=3.032 out of maximum 8.577)* indicates the presence of unfair or disproportionate distribution of educational inputs among primary schools in Uganda. Finally, an independent samples *T* test revealed significant inequality in the distribution of some process indicators, particularly OTL. The findings indicate that pupils attending private schools or located in urban centres were more likely to be exposed to more opportunities to learn than their counterparts in government-owned schools or located in rural areas.

6.1. Discussing Research Question 1

What are the educational process factors that account for significant variations in educational outputs in Uganda's primary education?

6.1.1. Teacher academic and professional capital (TAPC) and reading and mathematics outcomes

To both mathematics and reading attainments, the effects of TAPC are completely mediated by OTL. In both instances, although the main effects are insignificant, they are positive. This

implies that the effects of TAPC on mathematics and reading outcomes are not independent of OTL. To illustrate this finding further, even though pupils taught by teachers with higher academic and professional capital are more likely to attain higher in mathematics and reading, this is dependent on the available OTL created by such teachers. The positive interaction effect further implies that a greater TAPC effect would be expected in mathematics and reading attainment in instances when pupils were exposed to more OTL. This finding is quite surprising, given that the ideal expectation was that TAPC would directly impact on learning outcomes. This hypothesis had been shaped by some of the empirical studies (Cole-Henderson, 2000; Feng and Sass, 2013; Korthagen, 2004; Sammons, 1995; Wayne and Youngs, 2003) that had hinted that possession of an integrated body of knowledge relating to the subject taught, higher qualifications aligned to the subject taught and more teaching experience tend to impact directly and positively on learning. This is further validated by Cole-Henderson (2000), Reynolds et al. (2014) and Korthagen (2004). They posit that the skills that accrue to the teacher from training and, most especially, continuing professional development programmes (CPD) tend to ameliorate the constraints on effective teaching. They help teachers to reflect and to access new ideas and experiences that result in positive outcomes.

Nonetheless, this finding challenges the norm by highlighting the fact that the teachers' academic and professional capital only matter if they are used to create more opportunities for pupils to learn. It could be the case that teachers with higher levels of TAPC are able to create more opportunities for pupils to learn. This is corroborated by Jepsen (2005), who posits that the core competencies of the teacher heavily influence the quantity and quality of teaching (OTL). Further, Ehrenberg and Brewer (1994), Ehrenberg et al. (1995) have all hinted that teacher characteristics on their own cannot significantly impact on learning. The current study's finding could be used to qualify such empirical research findings by indicating that, rather, it is what the teacher can do using the capital that they possess that augments the effect of TAPC on learning outcomes. This paradigm shift is also being reflected in practice. In Uganda, the government is reluctant to fund teacher training beyond the officially required qualification, citing a lack of evidence that teachers with higher than basic qualifications and skill inventories have a major impact on pupil learning. Moreover, this stand has been reinforced by recent empirical studies in Uganda that have given an ambivalent signal with regards to the effects of teacher training and qualifications on pupil outcomes (see Kasirye, 2009; Najjumba and Marshall, 2013; Nannyonjo, 2007).

This finding has a number of ramifications on the theory and practice of teacher effectiveness and education effectiveness. On the one hand, it may be taken out of context to imply that TAPC is not important to positive learning outcomes. This would be unfortunate. But, most importantly, there are also valid arguments that are worth pondering. These include how theory, practice and training could ensure that teachers use what they have learned and experienced to provide more opportunities for pupils to learn. Moreover, based on this finding, we could seek another paradigm shift with regards to teacher training. This would be in the area of teacher training programmes that are applied, rather than instructing teachers 'mostly in theory' on what they are supposed to do. All these questions are but a reflection of the fact that educational effectiveness is a fast-growing body of knowledge yet remains context-bound, with no 'one-size-fits-all' solution to improving learning outcomes.

6.1.2. Opportunity to learn (OTL), and reading and mathematics attainment

This process factor is measured by the quantity and quality of teaching provided to students. Moreover, aspects that disrupt the OTL within the classroom are also factored into this variable. The results indicate that, holding other factors constant, OTL significantly predicts mathematics and reading outcomes such that a unit increase in OTL is associated with 5.13 and 6.33 unit increases in reading and mathematics attainment respectively. This finding was expected, based on the theory and practice of educational effectiveness. Although it is difficult to disaggregate the general OTL effect on learning outcomes by the main dimensions of OTL; that is, quantity and quality of learning, empirical literature that hints on any of the dimensions of OTL can be taken as relevant to inform the discussion.

Foremost, the amount of time that teachers spend on instruction, which in this study would be construed to be the quantity dimension of OTL, has been associated with positive learning outcomes (Creemers and Kyriakides, 2012; Muijs et al., 2014; Teddlie and Reynolds, 2000; Teddlie and Stringfield, 1993). Nonetheless, some studies have disagreed with this claim (see Nannyonjo, 2007; Scheerens and Bosker, 1997). Here we see that the current study's finding is both corroborated and also contended by empirical studies. The insignificant findings are probably due to the differences in the way that the quantity dimension of OTL is measured by some studies. To illustrate, rather than measuring quantity of instruction as merely the time reportedly spent on instruction, the current study considers it to be the time spent on curriculum-related instruction. This is of empirical and practical importance as echoed by Muijs et al. (2014), that differential schooling effects can only arise if more time is spent on

instruction that is related to the curriculum. To this end, the current study maintains that just spending time on instruction without directing it towards curriculum-related tasks is less likely to impact learning outcomes.

This study measures OTL using a second dimension of quality of teaching. This entails aspects such as the time spent on lesson planning, correcting homework and feedback. The results are implicit of the fact that, when teachers spend more time on planning their lessons, correcting homework and giving formative feedback, more positive learning outcomes are likely to obtain. This is corroborated by a number of empirical studies. Muijs et al. (2014) indicate that instruction quality is vital to impacting on positive learning, on the basis that it makes it easy for pupils not just to memorise but also to understand what has been taught. Moreover, Stevenson and Nerison-Low (2002) demonstrate the quality dimension in a Japanese mathematics class. They illustrate how this remains the most distinguishing feature of superior Japanese mathematics attainment. It is, however, imperative to note that, due to data limitations, this dimension is narrowly focused. This study would have wished to include key aspects of quality instruction using classroom observations of teaching aspects such as questioning, lesson structuring, and orientation among others, rather than basing it solely on survey responses.

Within the context of resource-constrained societies, the current findings emphasise the need to provide more OTL. This is reflected by the big coefficients of OTL on both mathematics and reading, compared with other standardised effect sizes. This implies that, of all the process factors, providing an opportunity to learn is vital if learning is to be impacted. This finding, therefore, lets us understand why most policy guidelines in many African countries are trying to address OTL. To illustrate, poor educational outcomes across the continent have been blamed on factors such as teacher absenteeism, limited curriculum coverage – most especially in rural schools – poor assessment methods and pedagogy that only promotes rote learning, leaving no space for pupil creativity (see Uganda National Examinations Board, 2012; Wane and Martin, 2013; Ward et al., 2006).

6.1.3. School management competence and mathematics and reading attainments

The results indicate that, other factors remaining constant, school management competence is positively associated with reading and mathematics attainment. This means that when a

school has school leadership with a wealth of competences, higher pupil attainment in reading and mathematics are to be expected. A number of empirical studies would agree with this finding. Foremost, nearly all the maiden studies in educational effectiveness across continental Europe and the Americas (see Cole-Henderson, 2000; Dejaeghere et al., 2009; Sammons, 1995; Teddlie and Reynolds, 2000; Teddlie and Stringfield, 1993) indicate that effective schools are epitomised by effective leadership that is able to execute the key leadership functions of controlling, leading, organising and planning. Just as highlighted in this current study, Fuller (1987), Levin and Lockheed (1993), and Hungi (2011) have characterised competent school leadership as being exposed to specialised training and professional development, plus being thoroughly experienced, academically qualified and with the required teacher training. Nonetheless, there are counterarguments by some scholars (see Clark et al., 2009) who have found limited evidence to link leadership competences and characteristics to pupil attainment. A number of reasons would explain this, foremost of which are differences in the way that the variable is measured and or conceived. For instance, while the current study lumped all the leadership competences and characteristics into a single indicator, other studies estimate the individual items that measure the overall latent factor in the models, which make them unable to estimate the overall latent effect with certainty. Secondly, school management would have no impact on pupil attainment in instances where the greatest proportion of the leadership in the sample either lacks the relevant competences or, equally, possesses them. Moreover, although this study maintains that school management competences matter, the focus should not be on the competences *per se* but, rather, what such competences can afford to affect the learning process.

Although the current study is limited to trying to provide the mechanism through which school management competences lead to higher pupil attainment, neither theory provides explicit guidance on how school leadership could translate its competences into positive learning outcomes. Nonetheless, with reference to the way this indicator was constructed, we see that items that relate to the specialised training provided to head teachers, and their active participation in teaching, had higher point-biserial correlations. This is an indication that they are very important in measuring the latent construct. Further, from the scale development, the item relating to administrative competencies is least important. Conversely, school management competences, including the ability to support teaching and learning activities directly, skills obtained from specialised training and CPD and the ability to counsel staff on pedagogy and other academic related issues, could easily translate into positive learning

outcomes (also see Brookover et al., 1979; Edmonds, 1979; Joyce and Showers, 1988; Reynolds et al., 2014; Teddlie and Reynolds, 2000; Teddlie and Stringfield, 1993).

When SES was added to the model, the effect of school management competences on pupils' mathematics and reading outcomes remained robust and stable. This finding is crucial, especially within the practice of educational effectiveness in resource-constrained societies. It implies that, regardless of the SES, having competent school management could turn around the fortunes of all pupils in terms of academic attainment. This argument is corroborated by the maiden study by Teddlie and Stringfield (1993). In their effort to establish the factors that explained differences in academic performance between resource-constrained schools in Louisiana, they found that it was mostly about leadership competence. To illustrate, Teddlie and Stringfield indicate that effective poor schools had principals that were active in the instruction and supervision of instruction. By contrast, in poor ineffective schools, the leadership was overly obsessed with administrative and non-academic endeavours.

6.1.4. Education resource usage and pupils' mathematics and reading attainment

The results indicate that, on controlling for pupil background, context and school educational inputs, educational resource usage is positively and significantly associated with reading attainment. On the other hand, resource usage is not significantly associated with mathematics attainment. This implies that, other factors remaining constant, schools that used the available educational resources on affecting learning managed to achieve positive learning outcomes in reading. This particular finding was expected, given that a number of studies had found similar results. In one of the most comprehensive systemic reviews of the predictors of pupil attainment mainly in resource-constrained societies, Fuller (1987) highlights the importance of allowing the use of textbooks in classes. Subsequent studies such as by Boissiere (2004, cf Yu, 2007) and Hungi (2011) found textbook usage to be vital in predicting attainment, especially in poor societies.

It is important to note that there are yet to be studies that have conceived and measured resource usage, such as in the current study. To this end, the findings herein cannot entirely be corroborated with available empirical literature. For instance, although most of the studies have adopted textbook usage to proxy resource usage, the current study conceives resource usage in terms of the extent to which pupils are allowed to take textbooks out of school or

classroom libraries for their private reading and homework, the extent to which teachers have access to the key teaching materials in their classrooms, and computer usage. Moreover, based on the emerging literature (see Bundy et al., 2009), the ability of a school to provide a meal for learners in schools was construed to be an appropriate use of resources, especially in resource-constrained communities where pupils leave home hungry and remain so in schools. In this context, the findings implore schools to use whatever resources are available for the benefit of learning.

The results also highlight the differential effects of resource usage on the subjects. From the results, it is clear that, to attain reading skills, learners need to use most of the materials both at school and home. This makes practical sense, given that more exposure to reading material is required in order to learn how to speak and read. Moreover, textbooks such as dictionaries are important in the development of vocabulary. On the other hand, the insignificant relationship between resource usage and mathematics attainment could be explained from a number of perspectives. Foremost, it would be an indication that most of the schools in the sample are poor with regards to mathematical resources and hence unable to reflect any variance in the mathematics outcome. This is further attested to in the Rasch model, where respondents were more agreeable to using reading materials than mathematics. On the other hand, given that resource usage is a correlate of school inputs in this sample, it could be argued that the effect of resource usage on mathematics is attenuated by school inputs. This is a plausible argument, given that resource usage remains significant in predicting mathematics until school inputs are added to the model. The other argument relies on whether schools know how to use resources, especially textbooks, to impact on the learning of mathematics. Fuller (1987) notes that sometimes just having and giving textbooks to learners, without appropriate knowledge of how to use them, would attenuate the effects of such materials on pupil attainment. This is of practical importance, and the insignificant relationship in this study is pivotal to the need for more training, especially of teachers on the effective usage of textbooks.

6.1.5. School-community relationships, and reading and mathematics attainment

From the results, other factors being constant, it is clear that school-community relationships improve learning outcomes for both reading and mathematics. This means that schools that engage and involve their communities in school activities tend to realise positive learning

outcomes. While there is a general agreement in the empirical literature that school-community engagement is beneficial to positive learning outcomes (see Cole-Henderson, 2000; Marks and Printy, 2003; Reynolds et al., 2014; Sammons, 1995; Teddlie and Reynolds, 2000), there are also many fundamental disagreements on the conception of the latent variable. The current study's conception of school-community relationships discerns two dimensions; that is, the school-community engagement dimension, and the community contribution and support dimension. Of course, this is still relatively a narrow way to measure this hugely fluid variable. On the other hand, emerging themes from the literature include home-school partnerships, parental involvement in schools, an 'open door' policy in schools, and a facilitating environment for parental involvement, when referring to school-community relationships.

The mechanisms through which school-community relationships translate into higher school attainment may not be linear, as may be suggested by the study. This is partly illustrated by the unstable coefficients of this factor with the addition of other variables to the model. It could therefore be argued that the effects of school-community relationships on pupil learning outcomes are the result of concerted relationships with other co-operant variables in the model. The literature would find this to be a plausible argument. For instance, Mortimore et al. (1989) argue that school-community relationships, through policies that encourage parents to become more involved in their children's education, could yield positive learning outcomes. This is implicit of the fact that by having a close relationship with parents, it is more likely that parents will become involved in assisting their children in doing their homework, encourage their children to stay in school and reinforce positive behaviour, all of which would result in positive outcomes.

In measuring this factor, it is seen that most of the school-community relationships in resource-constrained countries such as Uganda are dominated by financial or other forms of support in kind, especially from the communities to schools. By contrast, western school-community relationships seem to be non-financial or non-materially based. This presents a complex scenario in trying to corroborate this study finding with those of studies undertaken in other parts of the world that view school-community relationships from a completely different perspective. This further reinforces this study's earlier assertion of how educational effectiveness tends to be contextually bound.

From the results, we see that the coefficients of school-community relationships in both models are quite big. These highlight the importance of such relationships on learning outcomes within the context of resource-constrained societies. This is echoed by Levin and Lockheed (1993), who identified parental involvement in schools as being one of the most important differentiating variables between highly effective and ineffective schools in poor societies. This could be explained by the fact that communities and families in poor societies tend to fill the resource gap left by the inability of their poor governments to finance education adequately. Moreover, given that a significant number of schools in Africa are community owned amplifies the effect of any community contribution to positive learning outcomes.

6.1.6. School-based HIV support and pupils' reading and mathematics attainment

The results indicate that pupils who attended schools that offer more HIV/AIDS support were less likely to achieve highly in mathematics and reading. It is quite difficult to localise this finding within the empirical research, given that HIV/AIDS has not attracted enough empirical research within the context of education. Those who have tried have limited themselves to the effects of HIV/AIDS on schooling (see Kasirye and Hisali, 2010; Nyamurungi et al., 2007; UNICEF, 2008). It is hoped that this study may create the impetus for others to follow suit with more studies. Nonetheless, this finding can be explained by various dimensions. Foremost, given that HIV/AIDS support requires resources which would otherwise be available for academic purposes, it is to be expected that more investment in such activities would have negative ramifications on learning outcomes, as suggested by the findings. On the other hand, it is probable that schools that have students in need of support tend to be in low social class locations, therefore the effect of HIV/AIDS support could be a reflection of the effects of social structuring rather than HIV support. These alternative explanations are of significance, given that this study is not intended in any way to discount the importance of HIV/AIDS support in keeping the millions of orphans in school. Rather, the finding should be interpreted within this context.

From the results, the magnitude of the effect of HIV/AIDS support on pupils' reading and mathematics attainment is quite small. This could indicate that HIV/AIDS support has only a threshold effect on learning outcomes, and is yet to claim a significant position if it is related to other variables such as OTL and school-community relations. Most likely, it is too early to try to

adduce the effects given that, by the time the data were collected, most of the school-based HIV/AIDS support programmes had only just been initiated in the school curricula of Uganda.

6.1.7. School-based HIV awareness, and pupils' reading and mathematics attainment

From the results, it is clear that efforts by the schools to increase HIV/AIDS awareness among pupils and staff in primary schools in Uganda do not significantly impact on the learning of mathematics and reading. In fact, as highlighted earlier, results that relate to HIV/AIDS are quite challenging to localise in the empirical research. The reason is that it is a highly contextual aspect that has recently formed the agenda for studying educational quality in mainly sub-Saharan Africa, where reports have hinted at the likely negative effects of the pandemic on the education sector. In fact, the earlier SACMEQ study waves (SACMEQ I and II) did not collect any data on HIV/AIDS. This only came up in SAMEQ III data, which are used by the current study. This is not to sound apologetic for including such HIV/AIDS-related variables in this study. Ideally, the current study is partly responding to emerging literature (see Kasirye and Hisali, 2010; Nyamurungi et al., 2007; UNICEF, 2008) about HIV/AIDS within the context of educational effectiveness. Moreover, this finding initiates debate on the need to establish the likely mechanisms through which school-based interventions against HIV/AIDS could be linked to cognitive attainment.

Nonetheless, the insignificant relationship could as well highlight the absence of a clear, direct linear relationship between school-based HIV/AIDS awareness initiatives and subject performance. This is a plausible hypothesis, given the difficulty in trying to illustrate the mechanism by which awareness of HIV and AIDS translates into academic performance. Perhaps this variable could have been directly and linearly related to cognitive attainment if the learning outcomes (mathematics and reading) in the current study consisted of items that were intended to estimate the extent to which pupils and staff were aware of HIV AIDS. I doubt whether such items constituted any of the two subjects under consideration by the current study.

6.2. Discussing Research Question 2

How random are the effects of some of the educational process factors on educational outputs in Uganda's primary education system?

Generally, most of the process factors' effects on mathematics and reading scores are fixed across classrooms and schools, with the exception of OTL and TAPC. This means that there is no difference between the group and individual effects of most of the process factors on learning outcomes. This could point to greater homogeneity across schools and classrooms with regards to the predictor variables. This is not surprising, given that schools were selected from bigger cluster areas and it would ideally be the case that schools from the same cluster are highly similar on most of the predictor indicators.

This finding is of empirical importance, especially in resource-constrained societies that may not be in a position to afford differentiated policy formulations and implementation. To illustrate, policies arising from these findings could be applicable to most of the schools, given their greater homogeneity. This could seem cheaper and easier than trying to craft different policies to reflect individual differences between schools and classrooms. To this end, it is easier to implement policies that target groups of schools rather than individual schools, as the latter would exert more resource pressure on the already meagre funds at the disposal of poor societies.

The differential effects of OTL are of significant importance. The implication of this finding is that many individual classrooms do not have the same ability to exploit available opportunities to impact positive learning outcomes. Although the results do not explicitly illustrate why the effect of OTL on pupils' mathematics attainment would be greater in some classes than others, the teacher and pupils would be major contributors to such differences. Foremost, the results indicate that classrooms that have higher mean class attainment tend to benefit more from the opportunities available to learn than their counterparts in classrooms with poor mean mathematics attainment. This could point to the ability for OTL to respond to the differences in cognitive abilities, such that talented students are more likely to exploit most of the opportunities available than their counterparts who are less talented. On the other hand, it could also be the reason that high attaining classes have highly effective teachers, possibly with higher TAPC, which enable them to create better avenues for students to utilise the opportunities at their disposal to learn. This is attested to by the significant interaction term between TAPC and OTL.

The key lesson provided by this finding for the education stakeholders, especially the teachers, is the revelation that pupils manifest differences in the way that they utilise opportunities

open to them to learn. This is implicit of the need to attend to pupils' individual differences, with reference to the extent to which individual pupils are able to use the opportunities presented to them to learn. It is only then that the opportunities that teachers create for pupils to learn would be utilised in a way that could significantly impact on their learning outcomes. Indeed, just as Edmonds (1979) in his maiden study posited, the fundamental object of schools is to make every child attain the basic level of reading and mathematics skills, regardless of their social characterisation.

6.3. Discussing Research Question 3

To what extent do the educational inputs, processes and outputs reflect the equity dimension of educational effectiveness?

The results do not indicate any significant disproportionate distribution of mathematics outcomes by school SES classification. On the other hand, for reading, 10% of the distribution is disproportionate, in favour of the richer schools. This finding is consistent with the finding highlighted earlier that, although SES did not predict differences in mathematics attainment, it did for reading. Most of the empirical literature does not differentiate between subjects that are more affected by SES, but there is general agreement on the fundamental effects of SES in perpetuating inequity in learning outcomes (see Mugendawala, 2012; Nannyonjo, 2007; Twikirize, 2012). There could be a number of reasons for the differential effects of SES on mathematics and reading outcomes. Foremost, in developing countries where reading assessment is mainly in the colonial dialect, it is probable that children from elite families learn to read and write faster than their counterparts. It could therefore be generally the case that reading and literacy skills are more easily acquired at home than those of mathematics. This could be explained by the fact that, in high SES homesteads, English or other colonial languages tend to be spoken, there are reading materials in colonial languages, they are concentrated in urban areas associated with top-quality private schools, have educated parents, do not engage their children in endemic domestic chores, and have a tendency to enrol their children in preschool. Some of these variables that characterise elitism facilitate quicker development of reading and writing skills (see Kasirye, 2009; Nannyonjo, 2007; Twikirize, 2012). Moreover, according to the World Bank (2014a), the income Gini for Uganda is estimated at 44.3%. This could have negative ramifications on the extent of equity expected in learning outcomes. Similarly, at the school level, it could be argued that some high-SES schools tend to attract children from elite families. Many of these schools are likely to have the

critical resources in terms of the infrastructure, materials and teachers required to attain literacy and writing skills.

The finding of a more equitable distribution of mathematics attainment, regardless of school's SES categorisation, is in part the cornerstone of this study. Throughout, this study has maintained that although school and family resources are important in schooling, effective educational institutions should guarantee quality and equitable outcomes regardless of a child's characterisation. Arguments such as these are vital, amidst the current knowledge body that is awash with unilateral pronouncements indicating that schools and or classrooms do not matter (Coleman et al., 1966). To poor societies, such pronouncements are frustrating and could be taken as a justification for their poor learning outcomes.

A number of reasons could help us to understand why the distribution of mathematics outcomes is insensitive to the school or pupil SES categorisation. Foremost, mathematics skills, just such as other sciences, tend to be more influenced by what goes on in the school and the skills that teachers possess in teaching them. To this end, with the rightful processes in schools and classrooms, children from various SES backgrounds are more likely to learn mathematics effectively and perform as well as those from elite SES classes. A number of studies have demonstrated the possibility for poor schools to improve learning outcomes (Acker-Hocevar et al., 2012; Cole-Henderson, 2000; Harris et al., 2006; Levin and Lockheed, 1993; Muijs et al., 2004; Taylor et al., 2000; Teddlie and Stringfield, 1993). It is, however, important to be cautious in interpreting this result, as it could create complacence with the illusion that all is well with regards to the distribution of mathematics attainment in primary schools in Uganda. This is because the apparently equitable distribution of mathematics outcomes could also be due to the normalisation of the scores undertaken by the primary data collector.

Another finding under this research question is that there is disproportionate distribution of school inputs. While the Theils *T* is limited with regards to explicitly indicating the favoured categories in the distribution of school inputs, post-hoc analyses indicate that private schools and those located in the peri-urban and the city centre tend to be endowed with more school inputs than those owned by the government and located in rural or isolated areas. This is generally expected and it seems to be the case with some countries, including the developed world. Nonetheless, the key implication of this finding is not to argue for equity in the distribution of educational inputs. This is because the study is aware of the difficulty of

attaining parity in open social institutions. Rather, this finding should be an axis to argue for the provision of the critical amount of resources that can enable effective learning to take place in the class or school. The study maintains that, with the critical level of resources required for optimal operation, coupled with efficient educational processes, positive learning outcomes are probable across the various school and pupil SES backgrounds.

6.4. Commonalities and contrasts between the maths and reading models

From the analysis in chapter five, it is clear that the maths and reading models compare and contrast each other. Comparability is noticeable with regards to the trend of variance partitioning, and the effectiveness variables that significantly explain both learning outcomes. It is clear that pupil characteristics such as age, gender and school term residence significantly affect both learning outcomes. This implies that the pupil remains at the centre of any interventions for any positive learning outcomes (also see Kasirye, 2009; Spaull, 2013; Stoet and Geary, 2013). Equally, contextual variables including school ownership, location and school inspection significantly explain both maths and reading. Given that these variables are out of the school control, it is critical that policy makers most especially outside the school environment strive to provide favourable contexts in which schools can thrive. Additionally, school inputs and school processes including OTL, school management, school community relations and school-based HIV support significantly explain both maths and reading scores. This finding re-echoes the key hypothesis of this study that effective processes are necessary in all circumstances to convert the available resources into positive learning outcomes.

Nonetheless, the two models contrast on some aspects. Foremost, it is clear that pupil characteristics jointly impact reading more than maths. Moreover, some pupil characteristics including preschool experience and SES show differential subject effects with the former being significant for only maths, with the latter being significant for only reading. Similar results have been posted by (Spaull, 2013). Differential preschool effects are hard to locate within the education effectiveness literature and to comprehend why such a variable would impact only maths as opposed to reading. Perhaps, the non-significant effects for reading are a sign of an indirect relationship or parity within the literacy skills attained by pupils in preschool compared to maths within the Ugandan education context. On the other hand, some studies have tried to highlight why SES maters for reading (Aikens and Barbarin, 2008; Sonnenschein et al., 2016; Spaull, 2013). It is observed that higher income families tend to nurture a more favourable home literacy environment in terms of the language used, textbooks and reading

literature within the home. Such variables tend to leverage language and vocabulary acquisition amongst high income children compared to their low income counterparts. On the other hand, it is observed that most homes irrespective of their income status rarely nurture a positive home numerical environment. To this end, the school remains the most probable source of numerical and science skills. Finally, just as has been earlier highlighted in section 6.1.4, the maths and reading models are contrasted by the differential effects of resource usage. It is clear that resource usage matters more for reading than maths. Nonetheless, whereas some of the probable explanations for such a result have been given in section 6.1.4, it is critical to highlight that the insignificant relationship between resource usage and maths may as well be due to poverty across schools with regards to maths materials.

CHAPTER SEVEN: CONCLUSION AND RECOMMENDATIONS

7.0. Introduction

This is the final chapter of the current study. It intends to provide a complete picture of the current study by highlighting how it emerged, its location within EE theory and the hypothesised theoretical framework that guided it. Further, the chapter demonstrates that the study has been brought to its conclusion by linking the findings to the general rationale of conducting the study, as gleaned from Chapter 1. Moreover, an evaluation is undertaken of the extent to which the current study findings relate to the hypothesised theoretical model. Thereafter, the contributions of the current study to the theory and practice of EE within the identified limitations are highlighted. Finally, recommendations emerging from the study are specified for action and further research.

7.1. The synopsis

The rationale for the current study is to present a case for a paradigm shift from input-driven models to systemic approaches in the study of EE, particularly in resource-constrained countries. This it does by examining the educational processes that explain significant variations in learning outcomes of poor societies and countries. It broadens the conceptualisation of EE within the context of resource-constrained societies by challenging the propositions by earlier input-driven EE models and studies that tended to overemphasise the importance of educational inputs for positive learning outcomes. Such models and studies created an illusion that, if society had enough resources for its education system, then quality learning and outcomes would be guaranteed. Yet, in Chapter 1, the study highlights that although developing countries have been increasing their educational budget year after year, and while donor aid to such countries remains phenomenal, learning outcomes within such countries have not improved in direct proportion to the inputs. The study singles out Uganda in particular as a poor country that has been increasing her education budget yet has less than half of her Grade 6 pupils reaching the minimum proficiency levels in mathematics and reading (NAPE Report) (Uganda National Examinations Board, 2012). The study adduces more evidence to this effect through a detailed review of available literature. The general outlook gleaned from the literature is that merely staking educational resources in hope of attaining positive learning outcomes is dubious. To reinforce this assertion further, one of the key scholars in the subject area, Hanushek, postulates:

> Class sizes have fallen, qualifications of teachers have risen, and expenditures have increased. Unfortunately, little evidence exists to suggest that any significant changes in student outcomes have accompanied this growth in resources devoted to schools. (Hanushek, 2003, p.67)

However, the study identified glaring gaps within the EE literature in the context of resource-constrained societies. Foremost, most of the key empirical studies relate to the developed west, and only a few relate generally to the African continent. Moreover, those that do are plagued by the narrow conceptualisation of EE using input-driven models. Further, even with the recent theoretical and methodological advances in the study of EE, the review highlights that most studies on the subject, mostly in developing countries, have been restricted to examining the effects on learning outcomes of easily quantifiable variables, including school inputs, pupil characteristics and sometimes school characteristics. Indeed, as far as this study is aware, none has investigated educational processes and learning outcomes in sub-Saharan Africa as this study does. In fact, most treat the school and the classroom as 'black boxes' in their analyses.

The above is a reinforcement of the need for a paradigm shift in the study of EE, from input-driven models to systemic approaches. This partly explains the current study's adoption of the dynamic model of EE, but with modifications to reflect the contextual realities of poor societies. To this end, the current study makes the assumption that, given the critically required inputs, positive learning outcomes are only possible if such inputs are well processed. Therefore, this study gives more importance to school and classroom activities, routines and practices that impact on learning.

The findings are aligned with the earlier key proposition of the study as they suggest that, on controlling for pupil background, contextual variables and school inputs, the educational processes explain between 6% and 17% of the total variance in learning outcomes. Specifically, the current study finds that schools that:

i. Engage in activities and routines that create more opportunities for pupils to learn
ii. Have a teaching staff with higher academic and professional capital
iii. Encourage for the use of available resources to maximise learning
iv. Actively engage with the community to affect pupil learning
v. Have highly competent leadership
vi. Undertake HIV/AIDS support initiatives; are more likely to impact the learning outcomes significantly.

Further, the current study posits that effective education should be reflected through the quality and the equity dimensions. To this end, the findings indicate that, in Uganda, while there is equity in the distribution of mathematics attainment across the various schools classified by their SES, this is not the case for reading attainment. Moreover, within the equity dimension, results indicate that there is a disproportionate distribution of school inputs in favour of higher SES classifications.

In the section that follows, an attempt is made to link the study findings to the hypothesised theoretical model.

7.2. The study findings and hypothetical theoretical model

As highlighted earlier, Chapter 3 reviewed the literature and identified several gaps with reference to EE in resource poor countries. In an attempt to fill such gaps, the current study hypothesised a customised theoretical model. This model is cloned from the DME (see Creemers and Kyriakides, 2006), with significant modifications informed by the international and local literature and the author's experiences on the African continent. It would be of significant importance to evaluate the extent to which the study findings relate to the model. First, a brief review of the components and assumptions underlying the model is given.

Foremost, the model is based on an overarching assumption and or hypothesis that:

> ceteris paribus, given the critical inputs, pupil characteristics and context; quality and equitable educational outcomes would be expected provided there are effective processes at the classroom and school levels.

The above overarching hypothesis can be decomposed into the following hypotheses:

i. Educational outcomes are attributable to a range of factors classified as inputs, processes, and outputs, but operating in a context.
ii. The factors that affect educational outcomes discern various levels including pupil, classroom and the school.
iii. There are relationships (direct and indirect) between pupil background, school inputs, the context, the processes, and the learning outcomes (mathematics and reading scores).
iv. Educational effectiveness entails two dimensions of learning outcomes – equity and quality.

While not all the paths of the hypothetical model were estimated, the findings are to a great extent aligned with the model assumptions. Foremost, various variables ranging from pupil background, context and school inputs jointly explain significant variance in mathematics and reading scores. Moreover, addition of educational processes explain even more variance in the said outcomes. It is also confirmed by the findings that the pupil, classroom and school levels matter to learning. Indirect relationships are manifested through the instabilities observed in the magnitude and direction in the effects of some variables when other variables are added to the model. For instance, TAPC affects learning only if it enables a teacher to provide more opportunities for pupils to learn (OTL). Similarly, the effects of most of the control variables – that is, pupil characteristics, context and school inputs – are significantly or slightly reduced upon the addition of the educational process factors. In the reading model, it is clear that the addition of the process factors makes the effects of school inputs and preschool experience on learning outcomes insignificant. This result is aligned to the overarching model assumption that, with effective educational process, pupils from different backgrounds attending schools with different levels of inputs can all attain quality education.

The residual analysis presented in Chapter 5 further demonstrates an alignment of the study findings with the hypothetical model, to an extent. Foremost, the residual analysis reaffirms that learning outcomes in schools are attributable to a system-based mechanism in which variables from various domains and levels act in concert to impact on learning. It is clear that a number of pupil characteristics, contextual variations and educational process variables differentiate the highly effective from the least effective schools in both subjects. Most importantly, school profiles resulting from the residual analysis highlight the importance of effective school processes in the production of positive learning outcomes. It is clear that a number of key processes differentiate the highly effective from the least effective schools. These are TAPC, OTL and school management competences. Moreover, the profiles clearly highlight that, even with averagely lower school inputs, schools with higher process scores yield better learning outcomes. This is a very important finding of this study, as it is based on the assumption that, whereas educational inputs are enabling agents to positive learning outcomes, averagely resourced schools with effective classroom and school processes can yield quality learning outcomes. In addition, the profiles are well aligned, with the caveat given earlier in the model assumptions, that ‘critical amounts of school inputs are required to enable other components of the educational system, including the processes, to function. This is illustrated by the fact that although 56% of highly effective schools possess below-average

inputs, their input averages are not very far from the overall group average. Moreover, a significant proportion (45%) of the same group possesses above-average school inputs.

Nonetheless, just as it with any model, the residual analysis highlights some deviations from the hypothesised model. To illustrate, the hypothetical model assumes that all processes are vital to positive learning outcomes. Yet, from the residual rankings, some of the least effective schools had above-average scores for processes such as resource usage, school-community relationships and school-based HIV/AIDS support. Moreover, although the hypothetical model presumed mainly direct relationships, the findings point to the presence of some indirect and differential effects of some variables including OTL and TAPC on learning outcomes. These differences signify the complex relationships among variables in education systems. This aspect is much emphasised by Creemers and Kyriakides (2006).

7.3. Contributions and implications of the study findings

The current study has culminated into a suggested EE model for a resource-constrained country such as Uganda. The model which explains about 25% of the variations in reading and mathematics scores clearly demonstrates that, resource-constrained societies can attain effective education, given effective processes within schools and classrooms. This is of theoretical, policy and practical importance.

7.3.1. Contribution to the theory of EE

This could be the first study to suggest an EE model with reference to a resource-constrained society and giving pronounced importance to the educational processes. This assurance emerges from the gaps gleaned from a comprehensive literature review, in which most of the studies on particularly the African continent failed to mainstream educational processes in their conceptualisation of EE. Further, the current model not only broadens the study of EE but attempts to localise such studies within the milieu of resource-poor societies. This study, by suggesting this model, creates a basis for other studies to build on and, most importantly, opens up debate and impetus for subsequent studies to try to customise western-developed theories and models to the realities of developing countries. Through the study, it is clear that western theories indeed provide a general framework for the conceptualisation of EE in poor countries. To illustrate, models such as the DME can be used to create the general awareness of the methodological and theoretical advancements in the study of EE and, most importantly, the effectiveness factors associated with learning outcomes.

Nonetheless, while there is not much contention on the themes of effectiveness suggested by the DME and other theories, differences and difficulties arise with regards to the way such themes are operationalised and decomposed into individual effectiveness factors. To illustrate, the DME and most western studies indicate that orientation, structuring, questioning, teaching modelling, application, teacher managerial techniques, time management and teacher evaluation dimensions of teacher effectiveness are associated with learning outcomes (Creemers and Kyriakides, 2006; Creemers et al., 2013; Kyriakides and Creemers, 2011; Muijs and Reynolds, 2000). However, the current study and those from the African continent (Khosa, 2013) attach more importance to teacher subject knowledge, ability to plan lessons, ability to provide more opportunities to learn within the constrained environments, and mathematics and reading competencies as key components of teacher effectiveness. It is also important to note that poor countries have their own unique contexts that call for attention in modelling EE. For example, currently, most of the national education systems of poor countries are faced with the HIV pandemic, have large classes due to the recent universalisation of basic education and possess an acute lack of fiscal and sometimes human resources. Such factors need space within the EE models.

Further, given the current data constraints experienced in poor countries, there is a limit to how far the critical western theories of EE can be tested, operationalised or conduct more comprehensive EE studies. To illustrate, although it is necessary to broaden the way that EE factors and learning outcomes are conceived and measured, and although it is vital to monitor the stability of the effectiveness status of schools and systems continually over time, there are yet to be datasets with the required properties to enable such advancements. This is partly due to lack of resources, institutional and political instabilities and the fallible nature of education systems of the poor countries. Although the current study tries to discount some of the data constraints highlighted above by addressing mainly timeless core EE factors that are mainly identical in most of poor societies' education systems, the study seeks more theory-driven data collection designs that embed key EE theories into the design of instruments, and the identification of EE themes that underlie the question items. Moreover, and most importantly, it should be the most logical step to attract investment in longitudinal study designs as a way of addressing key effectiveness principles of stability and conceptual integrity. Nonetheless, given the resource constraints and that longitudinal studies are costly in nature, partnerships and collaborations would partly be the way out. Additionally, due to the importance attributed to the school and classroom processes by the study findings, it is

imperative for the designers of subsequent international studies, especially on the African continent, to give proportionate attention to the same. Additionally, school and classroom observations rather than surveys are increasingly becoming an imperative in most EE studies. This study would argue for descoping of the extensive and purely survey studies such as the SACMEQ so as to focus more on observations of processes and routines in schools and classrooms over time. This is in fact well aligned with the importance that the DME attaches to instructional effectiveness (Scheerens, 2012).

7.3.2. Contribution to the methods

The current study makes key contributions to methods of studying EE in resource-poor countries. Whereas multilevel modelling is almost synonymous with EE studies in western countries, the literature highlights that there is little of this in the developing world. The current study demonstrates how multilevel models are imperative in most EE studies whose data manifest nested structures. This is of critical importance as it allows for the decomposition of variance among the various levels including pupil, classroom and school. Through this study, it is clear that the relationships between EE factors and learning outcomes are more complex than are assumed by linear models. This has been embedded within the multilevel models, estimated by investigating indirect, differential and interactional relationships that emerged during the models' development. Nonetheless, such relationships have been limited to instances where they added value and without compromising parsimony.

Further, this study uses creative methods to construct the education process measures or indicators using multiple question items on different response scales. From the literature review, no study, particularly on the African continent, was found to have used Rasch models to measure OTL, TAPC, the school-community relationship indicator, the resource usage indicator, the school management competence indicator or the school-based HIV/AIDS awareness and support indicators as this study does. In fact, the literature revealed that most EE studies tend to include all the individual items that would constitute a single latent scale into the model, a practice that not only oversaturates the model but introduces multicollinear associations among such items. Perhaps the initiative of using data reduction techniques to create educational indicators would inform further studies, especially in Africa, that are more parsimonious, a key virtue in statistical modelling. Moreover, the Rasch modelling technique and generally the item response theory (IRT) family are increasingly becoming the gold standard in developing scales, in contrast to methods that are mainly simple statistical

descriptions of responses. Through the use of the Rasch technique, this study observes that the technique remains outstanding in terms of ability to combine responses of different categories of respondents and items on different response scales in a single analysis to develop a robust unidimensional scale (Saito, 2007). Further, it remains among the very few techniques with well-elaborated and robust procedures that are able to evaluate the psychometric properties of a dataset to establish its suitability for the development of a scale (also see Pampaka et al., 2012).

Additionally, the study has demonstrated how the Gini, Theils *T* indices and the Lorenz curve could be used in the measure of the second dimension of EE – equity in education. Such techniques need to be embraced, especially by studies in poor countries to monitor progress towards the education for all goals. Although such methods are robust and provide valuable information on the formulation of educational equity policy interventions, without longitudinal data it remains a challenge to estimate the progress made by systems in reducing the attainment gap between upper- and lower-SES groups.

7.3.3. Implications for policy

It is another uphill task to translate EE findings (research) into policy and school improvement practice. The reasons for this have been well elucidated by Reynolds (2012), Chapman (2012) and Hallinger and Heck (2011). Some hope is offered by Chapman (2012) when he indicates that sometimes policy makers listen to research arguments. Reynolds (2012) and Chapman (2012) also offer some guidance on how to lower the research, policy and practice divide.

Prior to and post-independence, most poor countries have been grappling with similar educational problems, including quality, equity, financing, teacher training and relevance of the curriculum to the personal, societal and national needs. Uganda's educational policies and laws claim to address the earlier highlighted general themes (Ministry of Education and Sports, 2016). Regrettably, such laws and policies have not translated into what they claim to achieve; that is, quality accessible relevant education. The literature review highlights that most of the developing countries' policies derive mainly from input-output models that over-emphasised the fact that increments of educational inputs would definitely lead to positive learning outcomes. The current study and model provide compelling evidence that system-based models, as opposed to input-output or output-driven models, are the best approaches not only to study EE but to intervene in poorly performing educational systems. Indeed, this model

and study come at an opportune moment when the World Bank and other international agencies are arguing for developing countries to abandon input-driven policy interventions in favour of system-based approaches to inform educational policy.

As demonstrated by the findings based on this model, variance in learning outcomes can be decomposed and attributable to various domains of variables that discern various levels; that is, pupil, classroom and school, so the current study seeks a refocus of key policies to enable especially the classrooms/teachers and schools to impact on learning positively. It is partly the reason for the current study to give paramount attention to educational processes within schools and classrooms. In fact, in the current study, processes jointly explain between 6% to 16% of the total variation in reading and mathematics. While there are differences on which level particularly deserves more policy attention (see Chapman, 2012; Muijs and Reynolds, 2002; Reynolds, 2012; Creemers and Kyriakides, 2012), what is constant in all the arguments is that whatever takes place in the classroom and school profoundly impacts learners' outcomes. This is against a backdrop that formal schooling takes place within schools, and so any policies and interventions should focus on improving school and classroom processes. Moreover, this implies that knowledge of school and classroom processes is crucial to the formulation of policies and improvement initiatives. In the case of Uganda, a number of policy interventions in the education sector have failed due to lack of understanding and appreciation of what actually takes place in schools and classrooms. For instance, although the country's teachers' code of conduct argues for child-centred learning, teachers indicate that this is untenable due to the overwhelming numbers in classrooms as a result of the universalisation of primary education. Similar observations are made by Teddlie (2003) in his review of school improvement studies in East Africa. Further, by emphasising educational processes, the current study believes that it could possibly lead to the formulation of cost-effective educational policy interventions. This could be of importance to poor societies that lack the resources, based on the assumption that most of the school and classroom processes are, to some extent, within the remit of school administrators and teachers with the limited resources available.

Another key policy implication derives from the two-dimensional conceptualisation of the educational outcomes; that is, equity and quality, as adopted by this study. The literature reviewed indicated that quantitative dimensions, including enrolment, have been over-emphasised in most of the educational policies of poor countries at the expense of quality

(Kasirye, 2009; Nannyonjo, 2007; Twikirize, 2012; UWEZO, 2012). While this is understandable from the point of view that, before the universalisation of primary education (UPE), many children in developing countries were out of school, only addressing the quantity dimension has to some extent been counterproductive. Some reports indicate that pupil absenteeism and truancy have sometimes been explained by poor quality learning in schools (Weideman et al., 2007). Though the emphasis on quantity schooling could as well be a weakness of policy implementation, this study seeks more emphasis on both dimensions within the key policies of UPE to address both access, or equity, and quality. Actually, there is much evidence indicating that quality learning is most likely to reinforce equity and access (Kyriakides and Creemers, 2011).

Additionally, the suggested reading and mathematics models explain more school-level variance (50%). This finding is of significance to both policy formulation and implementation in poor countries. To illustrate, models that relate to higher clusters require lesser policy differentiation than those that appeal to individual pupil interventions. Moreover, given limited resources, policies that aim at higher clusters tend to be more cost effective than those intended for individual pupils. In addition, it is easier to evaluate the progress of policies implemented for higher clusters: for instance, it is easier to compare progress of interventions by comparing schools than individual pupils within schools. Further, this finding implies that policies arising out of the currently suggested models could have the ability to reduce school differences in performance by half, assuming all other factors are stable.

7.3.4. Implications for practice

The recurrent issue in suggesting possible effectiveness interventions is where to start. Most of the studies in the western world favour the teacher or the classroom as the starting point. This is a context where teacher effects on pupil outcomes are many times greater than school effects (Reynolds, 2012). On the other hand, literature on the African continent (Teddlie, 2003), including the current study, report that school effects on pupil outcomes are far more than teacher or classroom effects. Besides, it becomes even more complex to try to suggest workable school improvement solutions in the context of resource-constrained countries in which many schools are in abject poverty, to the extent that they may lack critical resources required for processes to function.

A number of approaches to effecting school improvement interventions have been suggested. Some advocate for a within-school improvement approach over the between-schools and beyond-schools approaches (Chapman, 2012; Creemers and Kyriakides, 2012). This is in the context of formal learning happening in the school and classroom, and therefore this is where the change should focus.

Moreover, there is a compelling argument that the overarching objective for any school improvement project should be improving learning outcomes. I am convinced by the logic behind the within-school improvement approaches, yet some evidence on the African continent makes me think twice about which way to go. Khosa (2013) and Teddlie (2003) hint that no change within schools and classrooms can succeed within a failing wider education environment (such as federal, regional or government policy levels). This would perhaps imply that better policies at system level will change schools and classrooms for the better. However, Chapman (2012) regards this latter argument as misguided, insisting that researchers shifting attention from supporting schools and classrooms to influencing policy could be likened to abdicating their duty. His argument is that such attempts have earlier proved futile. My suggestions are, to some extent, compromised by this dilemma as they attempt to appeal to both the school and systems levels.

The current study used the school as the highest unit of analysis. The findings show that the least effective schools are characterised by below-average scores on most of the process effectiveness indicators. Conversely, a significant proportion of highly effective schools score well on most process factors. To this end, therefore, it would be more logical to base my suggestions for action on these key findings. However, it should be emphasised that the factors that may be required to improve a least effective school could differ from the way that effective schools maintain their effective status (Gray et al., 1994). Before any specific suggestions for action, I contend that schools need to acknowledge the need to change an effectiveness aspect as the logical starting point. Thereafter, I would encourage school stakeholders to perform a self-reflection or self-school evaluation (SSE) to establish the case for change or improvement. The dynamic approach to school improvement (DASI) (Creemers and Kyriakides, 2012) suggests that the SSE should be done with support from a technical or research team. This may not be possible, given that most of the schools in poor states do not have the budget to hire consultants. However, where schools have good school-parental relationship policies in place, they can always fall back on some of the school parents who

have technical expertise on improving schools for support in evaluation. Moreover, just as Chapman (2012) reminisces, schools have great untapped expertise for change. Likewise, given that districts in most poor countries including Uganda have inspectors of schools, these could be consulted for technical advice as part of their regular duties. Khosa (2013) emphasises the importance of involving districts' and other subsystems' officials in any school improvement project for, among other benefits, it helps to align the improvement activities within the milieu of the district or higher system programmes.

Using information from the SSE, and using the evidence provided by this current study and other key effectiveness frameworks, school stakeholders should be able to set priority areas and identify effectiveness areas/factors that need action, design plans for implementation and evaluate the outcomes. At this point, schools would be advised to focus on such processes that are closely aligned with their context and available resources and, most importantly, the system level policies. This is the system-based approach advocated by this study. The same approach has been said to be effective as it acknowledges the connectedness of inputs, processes and outputs, all within a context (Khosa, 2013; Kyeyune, 2004; Teddlie, 2003).

After the above general guidance, it is time to focus on what the current study findings suggest as the areas of critical concern for education practitioners.

i. Focus on the leadership process

From the findings, the leadership process is a variable that is one of the most important predictors of mathematics and reading. Unfortunately, almost half of the school leadership in Ugandan primary schools could be classified as being below the mean competence level on this indicator. Head teachers reported a lack of exposure to specialised school management training, which hampers their abilities to support teaching and learning effectively. Besides, the current recruitment criteria for school headship in Uganda are modest. For instance, in addition to an academic qualification, the time spent in service is the only key requirement criterion for becoming a school head. This study encourages practitioners particularly at policy level to mainstream specialised in-service management training for school head teachers. Moreover, it could be made a requirement to have had prior specialised management training before being appointed as a school head. Additionally, it would be sensible for head teachers to find creative ways to equip themselves for the role. These could include job shadowing so that head teachers with fewer competencies could shadow counterparts judged to be more

competent and to benchmark practices of excellence. Further, it could be cost effective to increase the leadership and management subject content of the preservice teacher training courses, at an early stage, to hone trainee teachers' management skills in case they ever rise to headship.

The above suggestions are not without challenges. To illustrate, although in-service or CPD programmes are the most recommended actions to improve management skills, in reality there tend to be no resources budgeted for them, especially in African education systems. Moreover, just as was observed by Kamanga (2013) in one of the projects in South Africa, CPDs tend to take a toll on the available time of an already constrained and overloaded school staff, which limits their effectiveness. Further, mentoring programmes have had issues, especially where they are associated with appraisal. What all this suggests is that there is no simple strategy to school improvement. Nonetheless, being aware of the lessons from theory and practice is the most pragmatic way to ameliorate such challenges.

From the study findings, there are key aspects of leadership that may not require external support to implement, yet they have been found to impact learning. For instance, head teachers need to reduce their administrative duties and refocus attention on teaching and learning related processes through monitoring pupil progress, providing pedagogical counselling to teachers, using staff meetings to share school and classroom practices that improve teaching and learning, and strictly enforcing the school timetable. The dynamic approaches to school improvement (DASI) (Creemers and Kyriakides, 2012) suggest that school leadership should be competent to ensure that school-level policies on teaching are in place to ensure quantity and quality of teaching and school/classroom environments that enhance opportunity to learn (OTL). This is of significance, given that the current study, during the construction of the OTL scale, found that pupil and teacher absenteeism, late lessons and poor lesson preparations were endemic in most schools. Moreover, from the author's experience as a teacher, such incidences are more prevalent in schools where the head teachers also arrive late for duty and leave early, before the end of school (professionally incompetent).

ii. Focus on the teacher and teaching process

This study found that teachers with higher academic and professional capital (TAPC) were able to create more opportunities for pupils to learn (OTL), and hence yield positive learning outcomes. Regrettably, for quite a while, teacher training curricula in resource-poor countries in general, and Uganda in particular, have not changed in a way that enables teachers in the prevailing constraints to provide adequate opportunities for pupils to learn (Jacob et al., 2007). Foremost, in 1997, Uganda declared UPE. This saw an influx of pupils back into school, who had been out of school due to lack of school fees. While the government has tried to recruit more teachers, pupil-teacher ratios remain high, with some teachers having to teach hundreds of children without training on coping strategies. The current study encourages practitioners to re-equip teachers to remain effective within this challenging environment. Issues on how to teach and assess large classes effectively need to be at the core of any intervention. Moreover, more cost-effective ways need to be charted to expose teachers to specialised trainings that address specific issues that are likely to inhibit teachers from creating more OTL. Nonetheless, external teacher effectiveness interventions such as workshops, CPD and mentoring should always be teacher driven, else they will not always yield the expected results (Kamanga, 2013; Teddlie, 2003).

Additionally, this study and the teacher effectiveness literature (Chapman, 2012) maintain that teachers could be a source of support in developing genuine evolving strategies to improve their own effectiveness. To this end, findings of the current study and other key teacher effectiveness literature can guide school stakeholders to 'grow their own' strategies. For instance, the current study seeks for teachers to increase the quantity and quality of teaching, while at the same time mitigating against such incidences that would squander an opportunity for pupils to learn. From my teaching experience in an effective poor school, I believe that if practitioners put in place frameworks that enable teachers, within their subject departments, to support and reinforce each other's teaching practice, teachers would improve in effectiveness. To illustrate, in my school, each department had templates of lesson plans, schemes of work and records of work taught that guided us in work and lesson preparation and delivery.

Another key aspect of teacher effectiveness is time management. Practitioners, especially the school leadership, can put in place policies and accountability systems that are uncompromising on teaching and time. In my former school, teachers were expected to lead

by example, and timeliness in all activities became the ethos. Also, practitioners should encourage staff members, within their subject departments, to anticipate activities that would interrupt normal schooling, including external activities such as national co-curricular activities, and devise strategies to regain lost time. This is a practice that is also suggested by the DASI.

School practitioners could also use staff meetings to share their practices used successfully in effective teaching. But, as other scholars argue, such initiatives should guard against labelling particular teachers as least or most effective. If they do, then they would implicitly be appraisal activities, something that is normally resented by most staff (Khosa, 2013). In my former school, for every staff meeting we chose an aspect of teaching and learning that any of us had demonstrable capacity to reflect on, with the intent to interest other staff members in adapting it to their teaching. This would only be possible in situations where open communication has been nurtured by the school leadership (also see Creemers and Kyriakides, 2012).

All these experiences and suggestions have one key message; that is, teacher effectiveness is a process and not an event. Moreover, it is within the abilities of the school practitioners. My study findings and other key literature can only guide the process.

iii. School resources should be used to maximise learning

The finding that the schools that used available resources to maximise learning saw their pupils attain higher achievements is sound evidence for head teachers and teachers to do the same. Although most schools in the sample were poor, those that encouraged their pupils to borrow textbooks from the classroom or school library for home private study, for instance, helped their learners to attain more, especially in reading. It has been said that some school head teachers and teachers in Uganda do not allow learners to borrow books from school for fear of loss or depreciation. The current study suggests that such practices are counterproductive. One interesting finding from the construction of the resource usage scale is the fact that the provision of meals at school constitutes a good use of school resources. This is important in the context of resource-constrained societies, as some children leave home without a meal. This affects their concentration and learning. In Uganda, hungry pupils have been an issue on the education agenda, and perhaps school leadership can chart ways to have the children fed in school. Of course, there are no easy options, given that the government of

Uganda abolished the charges that were previously levied from parents for schools to feed learners.

iv. Parents and or the community need to be more involved in schooling of their children

It was found that schools that managed to involve parents or the local community in their activities performed better in both reading and mathematics. Much has been said about the importance of community involvement in school. Indeed, the need for community or parental involvement in school activities cannot be overemphasised, especially in developing countries where public demand for education has outstripped the government's ability to supply it in the required quantity and quality. In the construction of this scale it is noticed that most schools fall back on parents for much financial support. Nonetheless, since the introduction of UPE in Uganda, there have been complaints of falling parental and community involvement in school activities. Perhaps the universalisation of education sent the wrong signal to parents, implying that government was now totally responsible for all aspects of children's schooling. This study encourages head teachers and teachers to engage with parents not only during fundraising but also in other school routines such as assessing children's academic progress, discipline management and co-curricular activities. Lessons from successful parental involvement projects (see Kedibone, 2013) emphasise the importance of schools developing a charter, or some form of policy that entails action plans and activities aimed at engaging parents and the general community in school activities.

v. Equip acutely poor schools with the critical inputs

The study found a disproportionate distribution of school inputs. While the study also found that some of the most effective schools possessed below-average inputs, it is clear that most poorly performing schools are acutely poor and lack resources that are critical for any effectiveness processes to function. Given that public schools in Uganda depend on central government for any resources, and the fact that parents no longer actively participate in the education of their children as they used to before the introduction of the UPE programme, this study observes that any strategies to ameliorate this can only come from government. We need to encourage the effective implementation of the minimum standards policy that highlights the critical physical inputs that should at all times be present in any Ugandan primary school.

7.4. Limitations

Any study is prone to limitations which sometimes prompt further research. The fact that the current study uses secondary survey data collected from a sample, and the fact that the suggested model could explain 25% of total variance in the learning outcomes, suggests possible limitations of the study. These aspects form the discussion below.

Foremost, the study uses cross-sectional survey data that were collected by the SACMEQ. This implies that the findings could be true to the point in time of data collection. The current study has tried to discount this limitation by tackling perpetual and timeless educational problems that are common in education systems, especially of poor countries. To illustrate, the question of how countries can ensure accessible quality education for their citizenry is timeless. Neither are the system-based components for the production process of education time bound.

Other limitations are associated with the use of secondary databases. Notably, the perspectives, questions and interests vested within this dataset are those of the primary data collector; that is, SACMEQ. Most of the question items were tethered to the interests of the respective government's policy interests. This, therefore, required some tailoring of especially the conceptualisation and measurement of some variables to items available in the data that were thought to be more proximal to the intended measures. Some concepts such as TAPC, OTL, resource usage and school-community relationships needed much more observational items to measure them effectively, which could not be done by the available dataset. Of course, this is expected with secondary datasets, as they are inherently collected for another purpose than for the secondary investigator (see Heaton, 2008; Rew et al., 2000; Vartanian, 2010).

The other limitation arises out of the insufficient documentation on the primary data collection and variable derivations processes. For instance, while it is briefly indicated that Rasch models were used to construct the learning outcomes and the SES variable, nothing much is known beyond this, unless more information is sought from the SACMEQ position papers.

The above limitations notwithstanding, it is critical to emphasise here that the SACMEQ dataset up until now is the only comprehensive and widely used data to study EE in sub-Saharan Africa. Moreover, given the data requirements for the methods engaged by the current study, it is dubious that the author could, within the time and other resource limits,

generate such a comprehensive dataset. Most importantly, a critical review of the survey design and the error control mechanisms involved in the collection and preparation of the SACMEQ data indicates that the dataset meets the standards that can guarantee credible and generalizable results.

Additionally, the final reading and mathematics models suggested by the study explain 26% and 25% of variance in the respective subjects. This is indeed a significant proportion to be explained in social phenomena, but it is also an implied model limitation. One would be tempted to argue for the inclusion of more variables into the model, hoping to improve its power. I call this 'model stuffing'. Although there might be some variance reduction upon adding other variables, it comes at a cost. One has to think of the key virtue of statistical modelling: parsimony. Parsimony, as a principle, encourages researchers to balance model simplicity and maximisation of model power. This is the guiding principle in this study. Nevertheless, this finding also highlights the limitation of pacified statistical models regarding modelling reality, which is rarely aligned to the assumptions held by most statistical models. Indeed, reality is complex and chaotic, and perhaps only laboratory-controlled experiments can claim more power in predicting particular occurrences of reality. Within the education milieu, true controlled experiments involve many ethical issues. And so, most results from social sciences are prone to the volatility of human behaviour and actions beyond the control of studies.

7.5. Recommendations for further research

The next logical step after this study is to evaluate the stability of the current findings. Given that they arise out of cross-sectional secondary data, there is a need to corroborate these findings with studies undertaken using recently collected data. Moreover, the stability of these results would be better evaluated if longitudinal data were available. I understand that SACMEQ wave IV dataset is in the pipeline and could be let out for public use shortly after this PhD thesis. I would be interested in furthering this study using the new dataset. Further, this study would be improved by using data collected with improved collection instruments, including classroom and school observation protocols. Such data would improve the measurement of key processes such as TAPC, OTL, school management competence and resource usage. I presume that such effort would reduce the error of measuring such variables and perhaps improve the proportion of variance explained by the suggested model.

Further investigations are sought about the effects of school-based HIV/AIDS awareness and support initiatives on learning outcomes. This is against a backdrop of the unexpected direction of the effects of these variables on learning outcomes.

Finally, whoever reads this work is in the best position to suggest what would make it better. This explains my desire to break it further into more readily consumable outputs, such as papers, that would perhaps be read by a wider audience. Otherwise, it would be a further logical step if this study could be translated into a project where an evaluation of the extent to which the thoughts in it align with the realities of education systems could be conducted.

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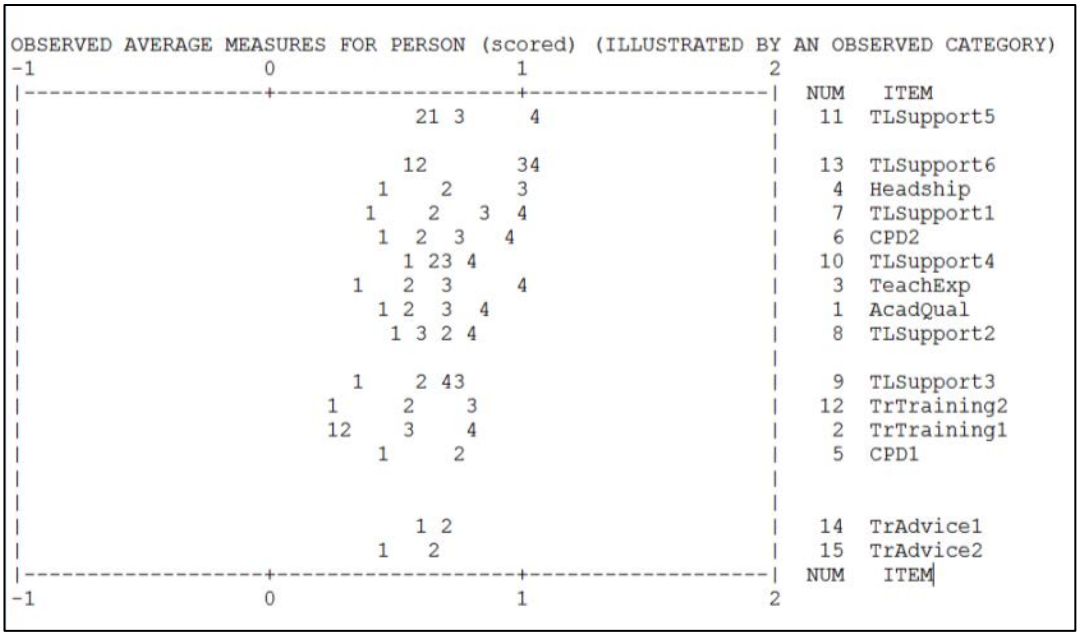
APPENDICES

Appendix 1: List of items for the school educational resources index

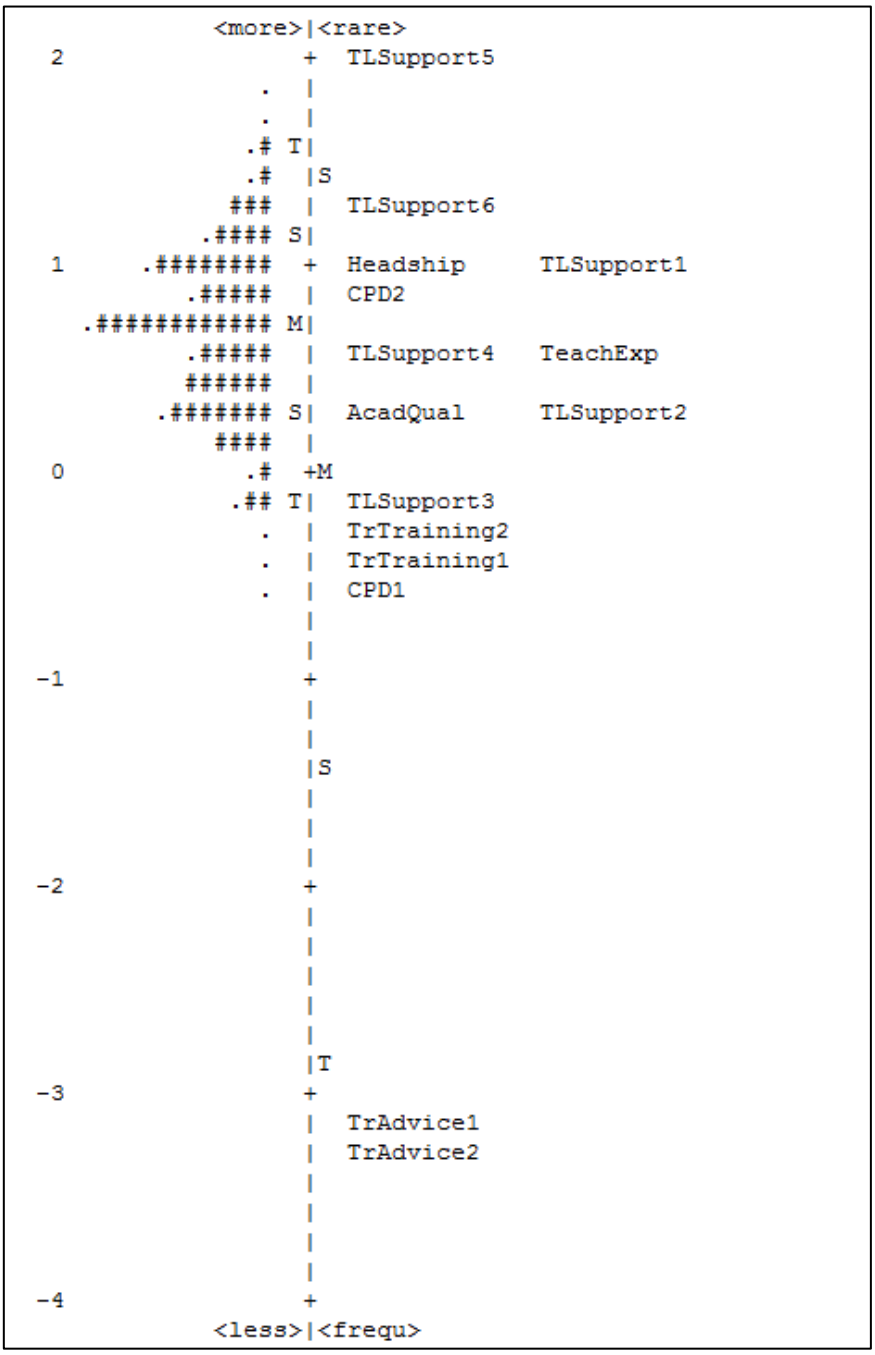
ITEMS AND RESPONSES	Codes	Freq(%)
SCHOOL INFRASTRUCTURE		
Does your school have a school library		
No library	0	59(22%)
Library in school	1	205(78%)
How many permanent classrooms does your school have?		
No permanent classroom	0	28(11%)
At least 1 classroom is permanent	1	236(89%)
How many temporary classrooms does your school have? (reversed coding)		
At least 1 classroom is temporary	0	132(50%)
No temporary classrooms	1	132(50%)
How many open-air teaching areas does your school have?(reversed coding)		
At least 1 classroom is open air	0	64(24%)
No open-air classrooms	1	200(76%)
Is a classroom library, book corner or book box available in your classroom		
No classroom library	0	145(55%)
Library in class	1	118(45%)
What is the general condition of your school buildings		
Poor condition	0	189(72%)
Good condition	1	75(28%)
Does your school have a school or community hall		
No hall in school	0	217(82%)
Hall in school	1	47(18%)
Does your school have teachers' / staff room		
No staffroom	0	152(58%)
Staffroom in school	1	112(42%)
Does your school have Separate office for School Head		
No head teacher's office	0	82(31%)
Head teacher's office in school	1	182(69%)
Does your school have store room (separate from the School Head's office)		
No storeroom	0	162(61%)
Storeroom in school	1	102(39%)
Does your school have special area for guidance and counselling		
No counselling area	0	195(74%)
Counselling area in school	1	69(26%)
Does your school have a sports area / playground		
No playground	0	61(23%)
Playground in school	1	203(77%)
Does your school have a school garden		
No school garden	0	77(29%)
School garden in school	1	187(71%)
Does your school have a Fence or hedge around school borders		
No fence or hedge	0	178(67%)
Fence is around the school	1	86(33%)
Does your school have a cafeteria / shop / kiosk		
No kiosk	0	238(90%)
Kiosk in school	1	26(10%)
Does your school have a first aid kit		
No first aid kit	0	160(61%)
First aid kit in school	1	104(39%)
Does your school have a Sick bay / sick room		
No sickbay	0	245(93%)
Sickbay in school	1	19(7%)
Does your school have piped water / water tank / borehole / spring		
No water in school	0	71(27%)
Water source in school	1	193(73%)
Does your school have electricity (mains or generator)		
No electricity or generator in school	0	217(82%)
Electricity or generator in school	1	47(18%)
How many Boys' pit toilet holes/squat holes does your school have		
No boys' pit toilet	0	19(7%)
At least 1 pit toilet for boys	1	245(93%)
How many girls' pit toilet holes/Squat Holes does your school have		
No girls' pit toilet	0	21(8%)
At least 1 pit toilet for girls	1	243(92%)
How many staff pit toilet holes/squat holes does your school have		
No staff pit toilet	0	57(22%)
At least 1 pit toilet for staff	1	207(78%)

SCHOOL EQUIPMENT AND APPLIANCES		
Does your school have a radio		
No radio in school	0	162(61%)
Radio in school	1	102(39%)
Does your school have TV		
No TV in school	0	245(93%)
TV in school	1	19(7%)
Does your school have audio cassette player		
No audio cassette in school	0	240(91%)
Audio cassette in school	1	24(9%)
Does your school have computers		
No computers in school	0	248(94%)
Computers in school	1	16(6%)
Does your school have a photocopier/duplicator		
No copier/duplicator in school	0	224(85%)
Copier/duplicator in school	1	40(15%)
Does your school have typewriter		
No typewriter in school	0	202(77%)
Typewriter in school	1	62(23%)
Does your school have telephone		
No telephone in school	0	227(86%)
Telephone in school	1	37(14%)
Does your school have a clock		
No clock in school	0	26(10%)
Clock in school	1	238(90%)
CLASSROOM FURNITURE		
Is a usable writing board (black, white, green) available in your classroom or teaching area		
No writing board in class	0	24(9%)
Writing board in class	1	238(91%)
Is a board duster / eraser available in your classroom or teaching area		
No duster in class	0	60(24%)
Duster in class	1	203(76%)
Is a cupboard or locker available in your classroom or teaching area		
No cupboard in class	0	222(84%)
Cupboard in class	1	41(16%)
Do you have one or more bookshelves available in your classroom or teaching area		
No bookshelves in class	0	224(85%)
Bookshelves in class	1	39(15%)
Is a teacher table available in your classroom or teaching area		
No teacher's table in class	0	131(50%)
Teacher's table in class	1	132(50%)
Is a Teacher chair available in your classroom or teaching area		
Teacher's chair in class	0	92(35%)
Teacher's chair in class	1	171(65%)
Do you have a seating space (bench or chair) for every Grade 6 pupil in your school		
Less seats in class	0	242(92%)
At least each pupil has where to sit	1	22(8%)
Do you have a writing space (desk or table) for every Grade 6 pupil in your school		
Less spaces to write	0	244(92%)
At least each pupil has where to write	1	20(8%)
LEARNING MATERIALS AND TEACHING AIDS		
About how many books are there in the school library		
No or Less than 1 textbook per pupil in whole school	0	148(56%)
At least 1 textbook per pupil in whole school	1	116(44%)
How many books do you have in the classroom library, book corner or book box		
No textbook or Less than 1 textbook per pupil in whole class		
At least 1 textbook per pupil in whole class	0	196(74%)
Is chalk (or other markers) available in your classroom or teaching area	1	68(26%)
No chalk in class		
Chalk in class	0	18(7%)
Is a wall chart of any kind available in your classroom or teaching area	1	246(93%)
No wall chart in class		
Wall chart in class	0	93(35%)
Do you have access to a map in your school	1	170(65%)
No map in school		
Map in school	0	89(34%)
	1	174(66%)

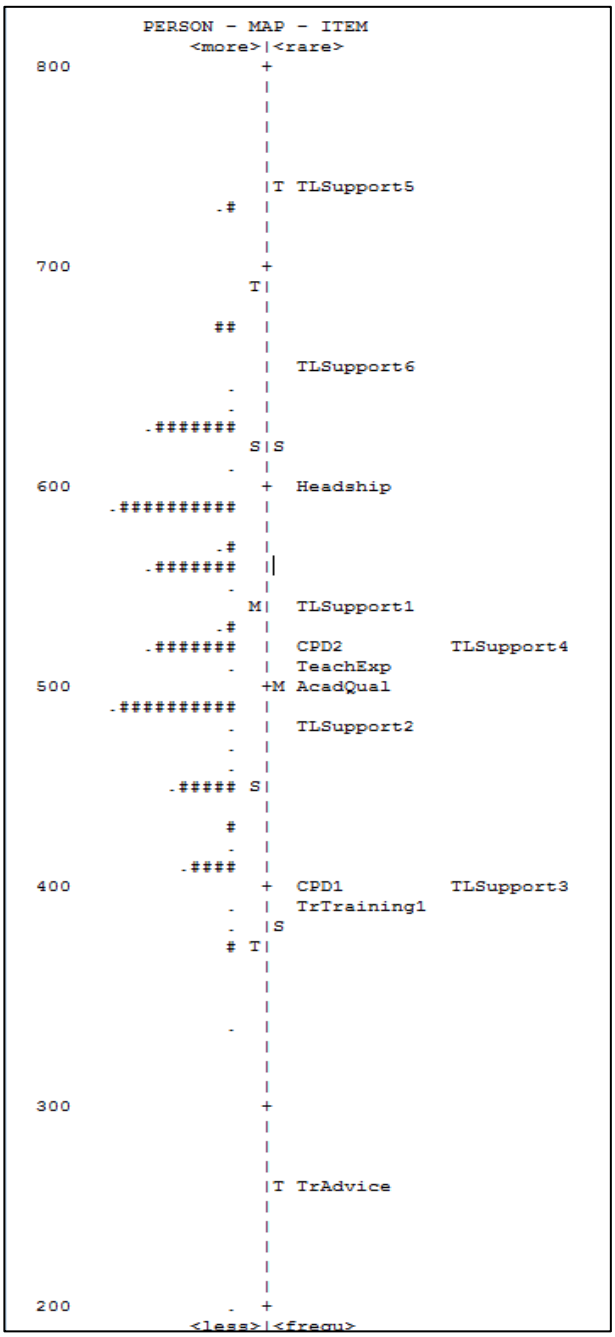
Appendix 2: Empirical category functioning for items measuring School Management Competences



Appendix 3: Initial item map for School Management Competence scale (before modifications)



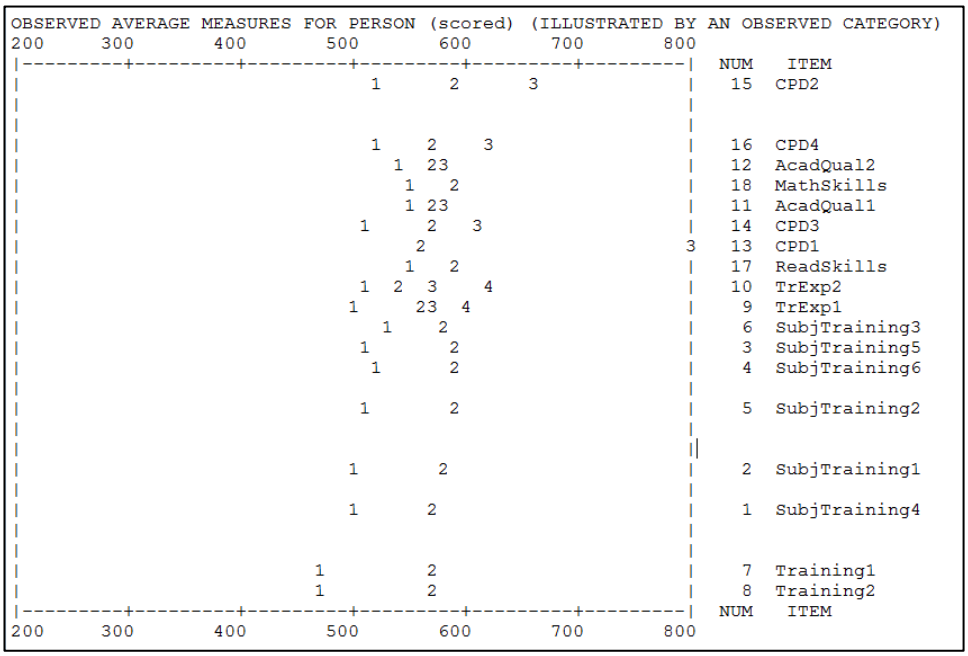
Appendix 4: Final item map for school management competence scale (after modification)



Appendix 5: Responses to items constituting the school management competence scale

ITEMS AND RESPONSES	Code	Freq(%)
ACADEMIC COMPETENCE		
What is the highest level of academic education you have attained (AcadQual)		
Senior secondary and below	1	111(42%)
"A" Level and or Tertiary	2	153(58%)
COMPETENCE ATTAINED FROM TEACHER TRAINING		
How many years of Professional teacher training have you received altogether(TrTraining1)		
Less than or equal to 2 years	1	59(22.3%)
Over 2 years	2	205(77.7%
COMPETENT TO TEACH		
How many years altogether have you been teaching (including when you have been head teacher) (TeachExp)		
0 to 19 years	1	118(45%)
Above 19 years	2	146(55%)
COMPETENT TO HEAD A SCHOOL		
How many years altogether have you been a school head or acting school head (Headship)		
Less or equal to 10 years	1	167(63%)
Above 10 years	2	97(37)
COMPETENCE GAINED OUT OF EXPOSURE TO CPD		
Did you receive specialised training in school management (CPD1)		
No training at all	1	61(23%)
Have done training	2	203(77%)
How much specialised training have you undertaken altogether in terms of days (CPD2)		
0 days	1	61(23%)
1 to 30 days	2	122(46%)
Above 30 days	3	81(31)
ABILITY TO SUPPORT TEACHING AND LEARNING		
How many lessons do you actually teach in a typical school week at this school (TLSupport1)		
1 to 5 periods	1	71(27%)
6 to 10 periods	2	121(46%)
Over 10 periods	3	72(27%)
How many hours do you actually teach in a typical week at this school (TLSupport6)		
Less or equal to 7 hours	1	179(74%)
More than 7 Hours	2	63(26%)
How important is monitoring pupil's progress to your work as the head (TLSupport2)		
1 Less important rank	1	93(37%)
2 Very import rank	2	159(63%)
How important are school administrative tasks to your work as the head (TLSupport3)		
1 Less important rank	1	59(24%)
2 Very import rank	2	191(76%)
How important is discussing educational objectives with your staff to your work (TLSupport4)		
1 Less important rank	1	116(46%)
2 Very import rank	2	136(54%)
How important are teacher CPD activities to your work as a school head (TLSupport5)		
1 Less important rank	1	213(86%)
2 Very import rank	2	35(14%)
ABILITY TO PROVIDING ADVISE TO TEACHERS ABOUT TEACHING		
Frequency of the head teacher's advice to staff about teaching (TrAdvice)		
Never	1	20(8%)
At least once a year	2	244(92%)

Appendix 6: Category item functioning for items measuring teacher academic and professional capital (TAPC)



Appendix 7: List of items constituting TAPC scale

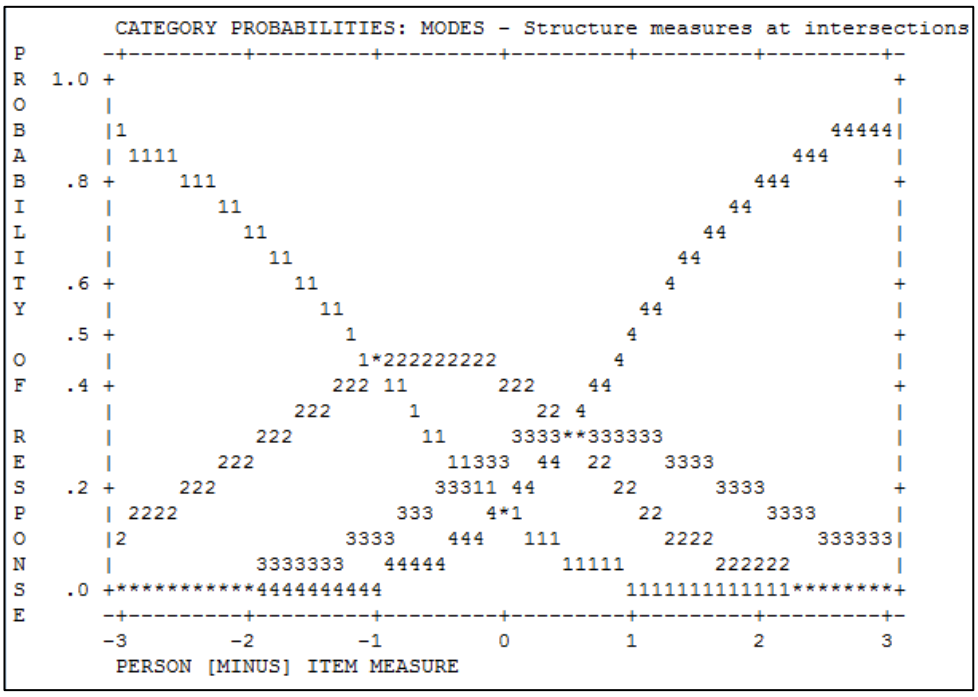
ITEMS AND RESPONSES	Code	Freq(%)
ACADEMIC EDUCATION		
What is the highest level of academic education you have attained (mathematics teachers)		
Primary or Equiv	1	32(12%)
Secondary or Equiv	2	227(83%)
Tertiary/University	3	12(5%)
What is the highest level of academic education you have attained (English teachers)		
Primary or Equiv	1	27(10%)
Secondary or Equiv	2	224(82%)
Tertiary/University	3	22(8%)
TEACHER TRAINING		
How many years of teacher training have you received altogether (mathematics Teachers)		
No Teacher Training	1	17(6%)
Did Teacher Training	2	255(94%)
How many years of teacher training have you received altogether (English Teachers)		
No Teacher Training	1	17(6%)
Did Teacher Training	2	256(94%)
TEACHING EXPERIENCE		
How many years altogether have you been teaching (mathematics Teachers)		
1 to 3 years	1	62(23%)
4 to 6 years	2	47(17%)
7 to 10 years	3	98(36%)
11⁺ years	4	65(24%)
How many years altogether have you been teaching (English Teachers)		
1 to 3 years	1	46(17%)
4 to 6 years	2	40(15%)
7 to 10 years	3	107(39%)
11⁺ years	4	80(29%)
EXPOSURE TO CPD		
[IN- SERVICE COURSES]		
After your initial Training, how many short in-service courses have you attended during the last 3 years (mathematics teachers)		
No in-service course at all	1	113(41%)
1-5 courses	2	140(52%)
6⁺ courses	3	19(7%)
After your initial TT, how many short in-service courses have you attended during the last 3 years (English teachers)		
No in-service course at all	1	0
1-5 courses	2	273(99.6%)
6+ courses	3	1(0.4%)
[INSERVICES TRAINING DAYS]		
After your initial Training, how many days have you spent attending in-service courses during the last 3 years (mathematics teachers)		
0 days	1	109(40%)
1 to 10 days	2	79(29%)
11+ days	3	85(31%)
After your initial Training, how many days have you spent attending in-service courses during the last 3 years (English teachers)		
0 days	1	110(40%)
1 to 10 days	2	6424%)
11⁺ days	3	100(36%)
APPROPRIATE TEACHING- SUBJECT TRAINING		
Are you currently teaching mathematics and you are trained for teaching mathematics		
No	1	48 (18%)
Yes	2	224(82%)
Are you currently teaching mathematics BUT you are trained for teaching Science		
No	1	77(28%))
Yes	2	195(72%)
Are you currently teaching mathematics BUT you are trained for teaching Social Studies		
No	1	108(40%)
Yes	2	164(60%)
Are you currently teaching reading and you are trained for teaching reading		
No	1	41(15%)
Yes	2	232(85%)
Are you currently teaching reading BUT you are trained for teaching Science		
No	1	102(37%)
Yes	2	171(63%)
Are you currently teaching reading BUT trained for teaching Social Studies		
No	1	94(34%)
Yes	2	179(66%)

TEACHER MATHS AND ENGLISH COMPETENCE LEVELS		
Standard reading score for all teachers		
Fail	1	123(49%)
Pass	2	130(51%)
Standard mathematics score for all teachers		
Fail	1	125(51%)
Pass	2	120(49%)

Appendix 8: Items measuring TAPC in their hierarchy of difficulty

Item Difficulty hierarchy (from most difficult to endorse to easiest to endorse)		
Item Number	**Item Notation**	**Item Description**
Item 15	CPD2	After your initial Training, how many short in-service courses have you attended during the last 3 years (mathematics teachers)
Item 12	AcadQual2	What is the highest level of academic education you have attained (mathematics teachers)
Item 11	AcadQual1	What is the highest level of academic education you have attained (reading teachers)
Item 18	MathSkills	Overall Teachers' competence in mathematics
Item 13	CPD1	After your initial TT, how many short in-service courses have you attended during the last 3 years (reading teachers)
Item 17	ReadSkills	Overall Teacher's competence in English
Item 10	TrExp2	How many years altogether have you been teaching (mathematics Teachers)
Item 9	TrExp1	How many years altogether have you been teaching (reading Teachers)
Item 16	CPD4	After your initial Training, how many days have you spent attending in-service courses during the last 3 years (mathematics teachers)
Item 6	SubjTraining3	Are you currently teaching mathematics BUT you are trained for teaching Social Studies
Item 14	CPD3	After your initial Training, how many days have you spent attending in-service courses during the last 3 years (reading teachers)
Item 3	SubjTraining5	Are you currently teaching reading BUT you are trained for teaching Science
Item 4	SubjTraining6	Are you currently teaching reading BUT trained for teaching Social Studies
Item 5	SubjTraining2	Are you currently teaching mathematics BUT you are trained for teaching Science
Item 2	SubjTraining1	Are you currently teaching mathematics and you are trained for teaching mathematics
Item 1	SubjTraining4	Are you currently teaching reading and you are trained for teaching reading
Item 7	Training1	How many years of teacher training have you received altogether (reading Teachers)
Item 8	Training2	How many years of teacher training have you received altogether (mathematics Teachers)

Appendix 9: Item category functioning for items with 4 response categories (OTL)



Appendix 10: Initial PCA for OTL

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     Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)
                                                -- Empirical --
Total raw variance in observations     =         25.7 100.0%
  Raw variance explained by measures   =          7.7  29.9%
    Raw variance explained by persons  =          2.1   8.3%
    Raw Variance explained by items    =          5.6  21.6%
  Raw unexplained variance (total)     =         18.0  70.1% 100.0%
    Unexplned variance in 1st contrast =          3.9  15.2%  21.7%
    Unexplned variance in 2nd contrast =          1.9   7.6%  10.8%
    Unexplned variance in 3rd contrast =          1.7   6.5%   9.3%
    Unexplned variance in 4th contrast =          1.2   4.6%   6.6%

       STANDARDIZED RESIDUAL VARIANCE SCREE PLOT
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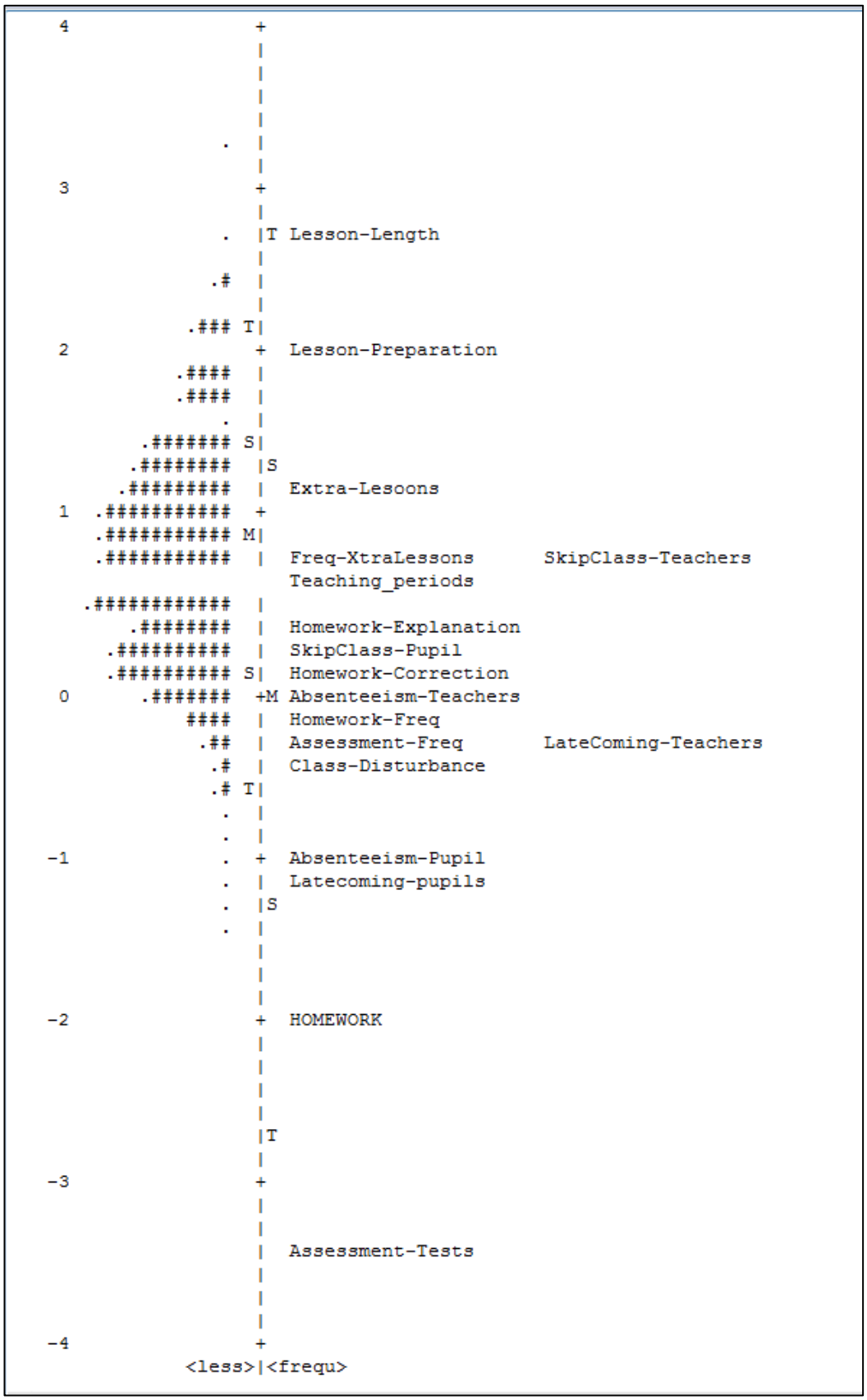
Appendix 11: initial Item map for the OTL scale



Appendix 12: Items constituting OTL scale

Item label	ITEMS AND RESPONSES	Codes	Freq (%)
	Content Coverage and Exposure		
Extra_Lesoons	Does your school offer extra tuition outside school hours		
	No	1	191(60.4%)
	Yes	2	125(39.6%)
Freq_XtraLessons	How many hours do you spend on extra lessons per week during school year		
	Zero hours	1	157(49.7%)
	At least 1 hour	2	159(50.3%)
Homework_Freq	How often are you given homework		
	Atmost twice a month	1	42(13.3%)
	Atmost twice a week	2	100(31.7%)
	Most days	3	173(54.9%)
Assessment_Freq	How often do you give a written test to pupils		
	Once a year	1	3(1%)
	Termly	2	95(30.2%)
	Monthly	3	216(68.8%)
Teaching_periods	How many periods/lessons of actual teaching do you have in a typical week at this school		
	Up to 15	1	72(22.9%)
	16 to 20	2	67(21.3%)
	21 to 40	3	175(55.7%)
Lesson_Length	How long is each period or lesson taught in the school (minutes)		
	Up to 40 minutes	1	269(85.7%)
	Above 40 minutes	2	45(14.3%)
	Quality of Instruction and Assessment		
Homework_Correction	How often does your teacher correct your homework		
	Never corrects	1	29(9.2%)
	Sometimes corrects	2	99(31.4%)
	Always corrects	3	187(59.4%)
Homework_Explanation	How often does your teacher explain the answers to your homework during class		
	Never explains	1	38(12.1%)
	Sometimes explains	2	114(36.2%)
	Always explains	3	163(51.7%)
Lesson_Preparation	How many hours on average do you spend on a typical school week working on lesson preparation and marking (outside school hours)		
	Up to 10 hours a week	1	171(54.5%)
	Between 11 and 20 hours	2	119(37.9%)
	Above 20 hours	3	24(7.6%)
	Factors that disrupt an opportunity to learn (all have reversed scores)		
Absenteeism_Pupil	About how often does the school have to deal with pupil absenteeism		
	Often	1	210(66.5%)
	Sometimes	2	105(33.2%)
	Never	3	1(3%)
SkipClass_Pupil	About how often does the school have to deal with pupils skipping class		
	Often	1	138(43.7%)
	Sometimes	2	111(35.1%)
	Never	3	67(21.2%)
Class_Disturbance	About how often does the school have to deal with classroom disturbance by pupils		
	Often	1	176(55.7%)
	Sometimes	2	112(35.4%)
	Never	3	28(8.9%)
Latecoming_pupils	About how often does the school have to deal with pupils arriving late at school		
	Often	1	227(71.8%)
	Sometimes	2	84(26.6%)
	Never	3	5(1.6%)
Absenteeism_Teachers	About how often does the school have to deal with unjustified teacher absenteeism		
	Often	1	132(41.8%)
	Sometimes	2	160(50.6%)
	Never	3	24(7.6%)
SkipClass_Teachers	About how often does the school have to deal with teachers skipping classes		
	Often	1	100(31.6%)

	Sometimes	2	137(43.4%)
	Never	3	79(25%)
LateComing_Teachers	About how often does the school have to deal with teachers arriving late		
	Often	1	142(44.9%)
	Sometimes	2	162(51.3%)
	Never	3	12(3.8%)

Appendix 13: Items constituting school community relations indicator

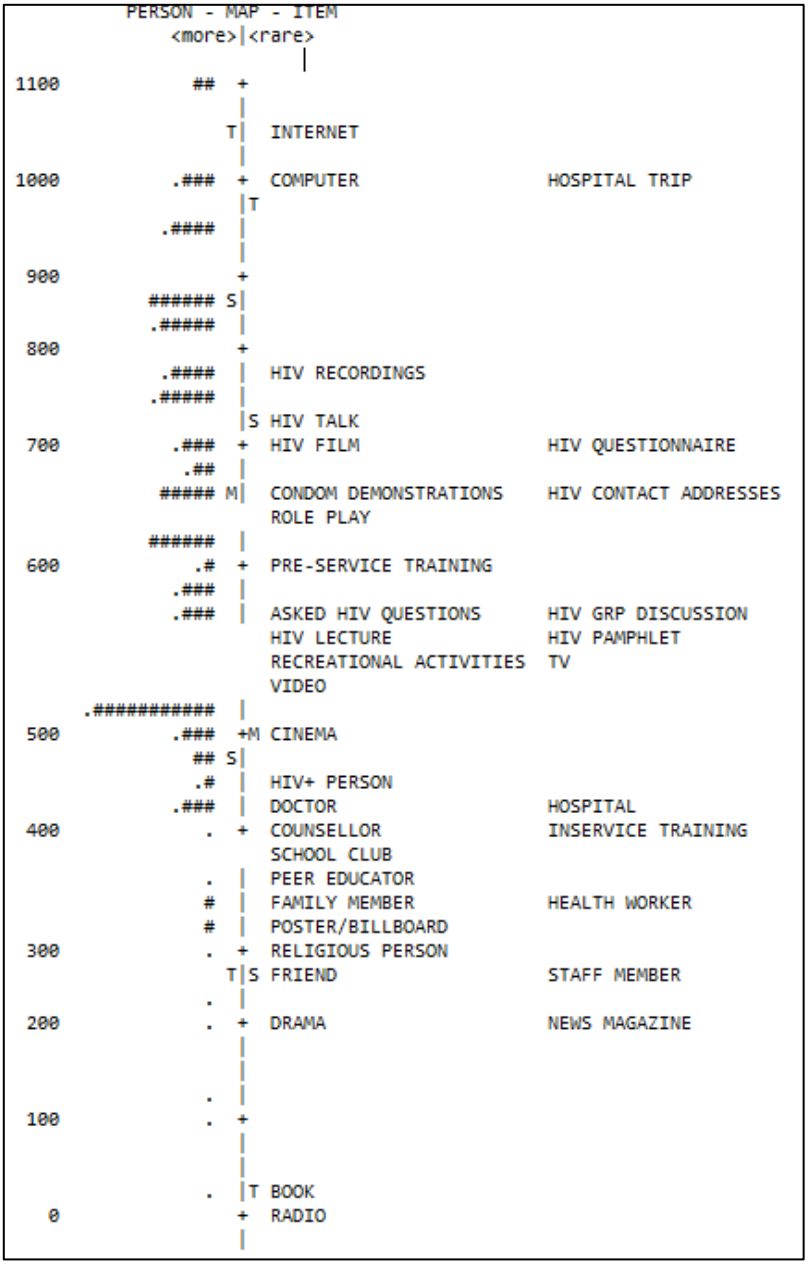
ITEMS AND RESPONSES	Codes	Freq(%)
SCHOOL-COMMUNITY ENGAGEMENT		
How important is keeping in contact with the community as a school head		
Not important	0	234(93%)
Very important	1	18(7%)
To what extent is lack of cooperation from the community a problem in your school?		
Not a problem	0	135(51%)
A major Problem	1	129(49%)
How often do you usually meet with the parents or guardians of the pupils in your class to discuss pupil performance or related matters?		
Never	0	32(12%)
At least once a year	1	230(88%)
Do you ask parents/guardians to sign that pupils have completed their home assignments		
No	0	126(48%)
Yes	1	137(52%)
COMMUNITY CONTRIBUTION AND SUPPORT		
Do parents and / or the community contribute to Building of school facilities (such as classrooms, teacher houses, etc.)		
No	0	90(34%)
Yes	1	174(66%)
Do parents and / or the community contribute to Maintenance of school facilities (such as classrooms, teacher houses, etc.)		
No	0	110(42%)
Yes	1	154(58%)
Do parents and / or the community contribute to Construction or maintenance and repair of furniture, equipment, etc.		
No	0	161(61%)
Yes	1	103(39%)
Do parents and / or the community contribute to The purchase of textbooks		
No	0	241(91%)
Yes	1	23(9%)
Do parents and / or the community contribute to The purchase of stationery		
No	0	209(79%)
Yes	1	55(21%)
Do parents and / or the community contribute to The purchase of other school supplies, materials and/or equipment		
No	0	201(76%)
Yes	1	63(24%)
Do parents and / or the community contribute to Payment of examination fees		
No	0	168(64%)
Yes	1	96(36%)
Do parents and / or the community contribute to Payment of the salaries of additional teachers		
No	0	219(83%)
Yes	1	45(17%)
Do parents and / or the community contribute to Payment of an additional amount on top of the normal salary of teachers		
No	0	244(92%)
Yes	1	20(8%)
Do parents and / or the community contribute to Payment of the salaries of non-teaching staff		
No	0	162(61%)
Yes	1	102(39%)
Do parents and / or the community contribute to Payment of an additional amount on top of the normal salary of non-teaching staff		
No	0	236(89%)
Yes	1	28(11%)
Do parents and / or the community contribute to Extra-curricular activities including school trips		
No	0	169(64%)
Yes	1	95(36%)
Do parents and / or the community contribute to Assisting teachers in teaching and / or pupil supervision without pay		
No	0	189(72%)
Yes	1	75(28%)
Do parents and / or the community contribute to Provision of school meals		
No	0	153(58%)
Yes	1	111(42%)

Appendix 14: Items constituting school-based HIV/AIDS awareness indicator

S/N	Label	ITEM	No (%)	Yes (%)
1	RADIO	Have you received information about HIV and AIDS from the-RADIO	10(4%)	254(96%)
2	TV	Have you received information about HIV and AIDS from the-TV	96(36%)	168(64%)
3	VIDEO	Have you received information about HIV and AIDS from the-Video player	98(37%)	166(63%)
4	INTERNET	Have you received information about HIV and AIDS from the-Internet	245(93%)	19(7%)
5	COMPUTER	Have you received information about HIV and AIDS from the-Computer	234(89%)	30(11%)
6	POSTER/BILLBOARD	Have you received information about HIV and AIDS from the-Poster/Billboard	32(12%)	232(88%)
7	BOOK	Have you received information about HIV and AIDS from the-Book	11(4%)	253(96%)
8	NEWSMAGAZINE	Have you received information about HIV and AIDS from the-Magazine/Newspaper	18(7%)	246(93%)
9	DRAMA	Have you received information about HIV and AIDS from-Drama	18(7%)	246(93%)
10	CINEMA	Have you received information about HIV and AIDS from the-Cinema	76(29%)	188(71%)
11	SCHOOL CLUB	Have you received information about HIV and AIDS from the-School Club	45(17%)	219(83%)
12	RECREATIONAL ACTIVITIES	Have you received information about HIV and AIDS from the-Recreational Activities	94(36%)	170(64%)
13	PRE-SERVICE TRAINING	Have you received information about HIV and AIDS from the-Pre-service training	116(44%)	148(56%)
14	INSERVICE TRAINING	Have you received information about HIV and AIDS from the-In-service training	44(17%)	220(83%)
15	HOSPITAL	Have you received information about HIV and AIDS from the-Hospital	50(19%)	214(81%)
16	STAFFMEMBER	Have you received information about HIV and AIDS from the-Teacher/School Head	25(10%)	239(90%)
17	FRIEND	Have you received information about HIV and AIDS from the-Friend	24(9%)	240(91%)
18	COUNSELLOR	Have you received information about HIV and AIDS from the-Counsellor	46(17%)	218(83%)
19	PEER EDUCATOR	Have you received information about HIV and AIDS from the-Peer educator	40(15%)	224(85%)
20	DOCTOR	Have you received information about HIV and AIDS from the-Doctor	55(21%)	209(79%)
21	HEALTHWORKER	Have you received information about HIV and AIDS from the-Health worker	35(13%)	229(87%)
22	RELIGIOUSPERSON	Have you received information about HIV and AIDS from the-Religious Person	27(10%)	237(90%)
23	HIV^{+} PERSON	Have you received information about HIV and AIDS from the-HIV^{+} Person	58(22%)	206(78%)
24	FAMILY MEMBER	Have you received information about HIV and AIDS from the-Family/Relatives	36(14%)	228(86%)
25	HIV PAMPHLET	Reading material(s) / pamphlet(s) were distributed during these classes / lessons on HIV/AIDS	93(35%)	171(65%)
26	HIV LECTURE	A course instructor gave a lecture during the classes / lessons on HIV/AIDS	96(36%)	168(64%)
27	HIV CONTACT ADDRESSES	We were given a list of contact addresses for further information and help during these classes / lessons on HIV/AIDS	134(51%)	130(49%)
28	HIVFILM	We watched a video / film during these classes / lessons on HIV/AIDS	155(59%)	109(41%)
29	HIVRECORDINGS	We listened to a radio and/or recorded programme during these classes / lessons	183(69%)	81(31%)

		on HIV/AIDS		
30	ASKED HIV QUESTIONS	We were able to ask questions during these classes / lessons on HIV/AIDS	92(35%)	172(65%)
31	HIV TALK	A person living with HIV gave a talk during these classes / lessons on HIV/AIDS	168(64%)	96(36%)
32	HIV GRP DISCUSSION	We had a group discussion during these classes / lessons on HIV/AIDS	93(35%)	171(65%)
33	HOSPITAL TRIP	We had an organized trip to a hospital / care centre during these classes / lessons on HIV/AIDS	234(89%)	30(11%)
34	HIV QUESTIONNAIRE	We completed a questionnaire during these classes / lessons on HIV/AIDS	158(60%)	106(40%)
35	ROLE PLAY	We participated in role play during these classes / lessons on HIV/AIDS	136(52%)	128(48%)
36	CONDOM DEMONSTRATIONS	We were given practical demonstrations – for example, condom usage during these classes / lessons on HIV/AIDS	136(52%)	128(48%)

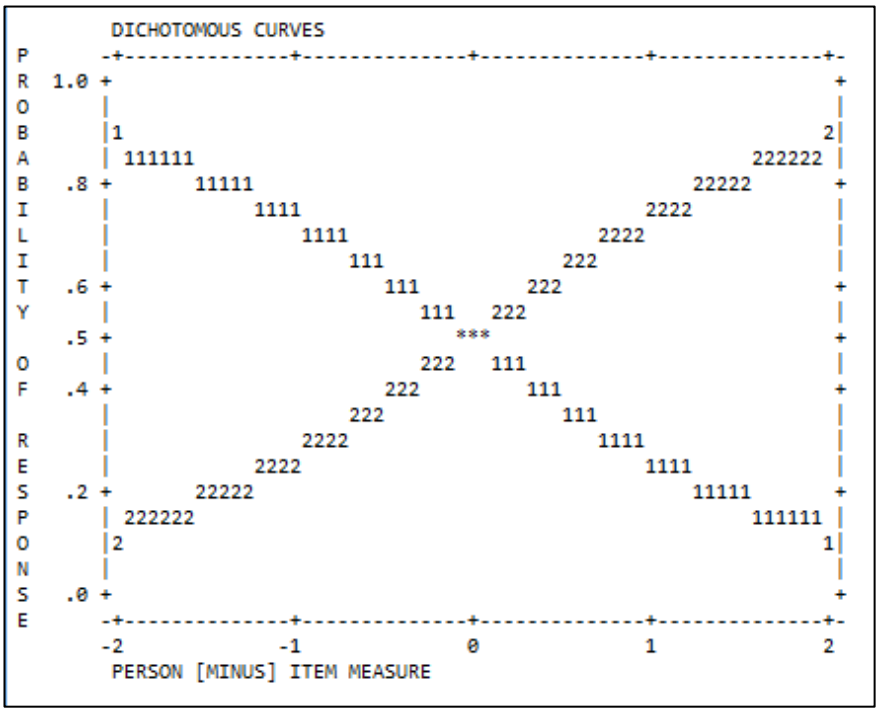
Appendix 15: Item map for school-based HIV awareness indicator



Appendix 16: List of items constituting the school-based HIV support indicator

S/N		Item description	No	Yes
1	HIVLessons1	My school provides lessons/activities on HIV/AIDS related aspects	6(2%)	258(98%)
2	HIVLessons2	Teachers in my school gave lessons in life-skills-based HIV and AIDS education during this school year?	106(40%)	158(60%)
3	HIVTraining1	Atleast one teacher in my school has received specialised training in life-skills-based HIV/AIDS Education	141(53%)	123(47%)
4	HIVLessons3	The Teacher(s) specially trained in HIV/AIDS Taught lessons on HIV/AIDS	164(62%)	100(38%)
5	HIVTest1	There is a place within walking distance where it is possible to have an HIV test?	91(35%)	166(63%)
6	HIVTraining2	I have received atleast 3 days of specialised training in HIV and AIDS after I became a school teacher?	141(53%)	121(46%)
7	Questions	I learnt how to respond to sensitive questions from pupils about HIV and AIDS during classes / lessons on HIV/AIDS	86(33%)	176(67%)
8	Condoms	Male/female condoms were made available at the meeting during classes / lessons on HIV/AIDS	141(53%)	121(46%)
9	Counseling1	Guidance / counselling for orphans and vulnerable pupils happened at my school this year	131(50%)	133(50%)
10	Counseling2	Guidance / counselling for pupils with HIV and AIDS happened at my school this year	171(65%)	93(35%)
11	Homevisits1	Home visits for orphans and vulnerable pupils happened at my school this year	173(65%)	91(35%)
12	Homevisits2	Home visits for pupils with AIDS related diseases happened at my school this year	197(75%)	67(25%)
13	HIVStigma1	Discussions among pupils about combating stigma and discrimination against HIV and AIDS happened at my school this year	119(45%)	145(55%)
14	Materials1	Learning materials for use at home by orphans and vulnerable pupils were given at my school this year	214(81%)	50(19%)
15	Materials2	Learning materials for use at home by pupils with AIDS related diseases were given at my school this year	225(85%)	39(15%)
16	Materials3	Learning materials for use at home by pupils caring for relatives with AIDS were given at my school this year	224(85%)	40(15%)
17	Medication1	Medication for pupils with HIV and AIDS was given at my school this year	207(78%)	57(22%)
18	Counseling3	Guidance / counselling for staff happened at my school this year	193(73%)	71(27%)
19	Homevisits3	Home visits for staff with AIDS related diseases happened at my school this year	225(85%)	39(15%)
20	HIVStigma2	Discussions among staff about combating stigma and discrimination against HIV and AIDS happened at my school this year	125(47%)	139(53%)
21	Medication2	Medication for staff with HIV and AIDS was given at my school this year	218(83%)	46(17%)
22	HIVTest2	HIV testing for staff happened at my school this year	201(76%)	63(24%)
23	ReliefTeachers	Payment for relief teachers to replace sick staff happened in my school this year	247(94%)	17(6%)

Appendix 17: Dichotomous characteristic curves for items measuring school-based HIV support



Appendix 18: Initial principal components in the data measuring resource usage scale

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     Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)
                                          -- Empirical --     Modeled
Total raw variance in observations     =         24.8 100.0%          100.0%
  Raw variance explained by measures   =         11.8  47.7%           52.6%
    Raw variance explained by persons  =          4.0  16.1%           17.8%
    Raw Variance explained by items    =          7.8  31.5%           34.8%
  Raw unexplained variance (total)     =         13.0  52.3% 100.0%    47.4%
    Unexplned variance in 1st contrast =          4.0  16.1%  30.8%
    Unexplned variance in 2nd contrast =          1.4   5.7%  10.9%
    Unexplned variance in 3rd contrast =          1.2   4.8%   9.2%
    Unexplned variance in 4th contrast =          1.0   4.1%   7.9%
    Unexplned variance in 5th contrast =           .9   3.7%   7.1%
```
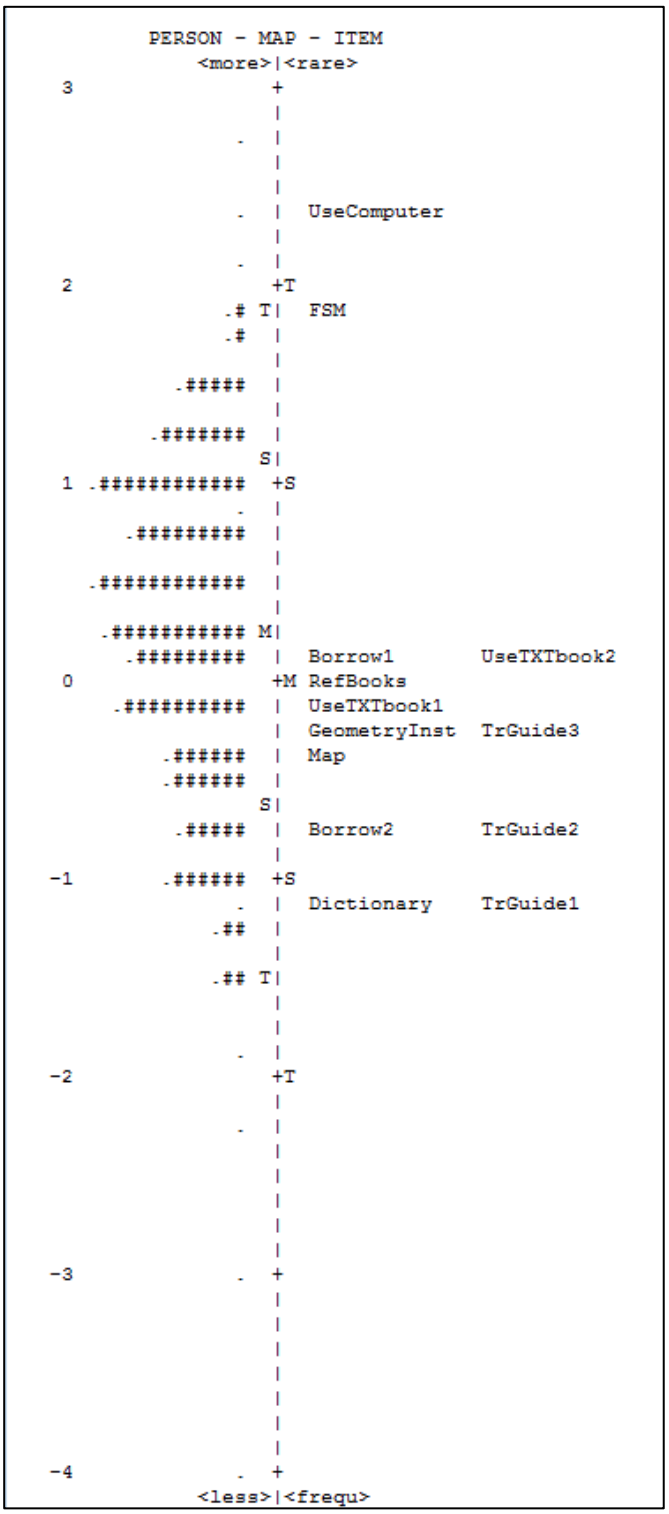
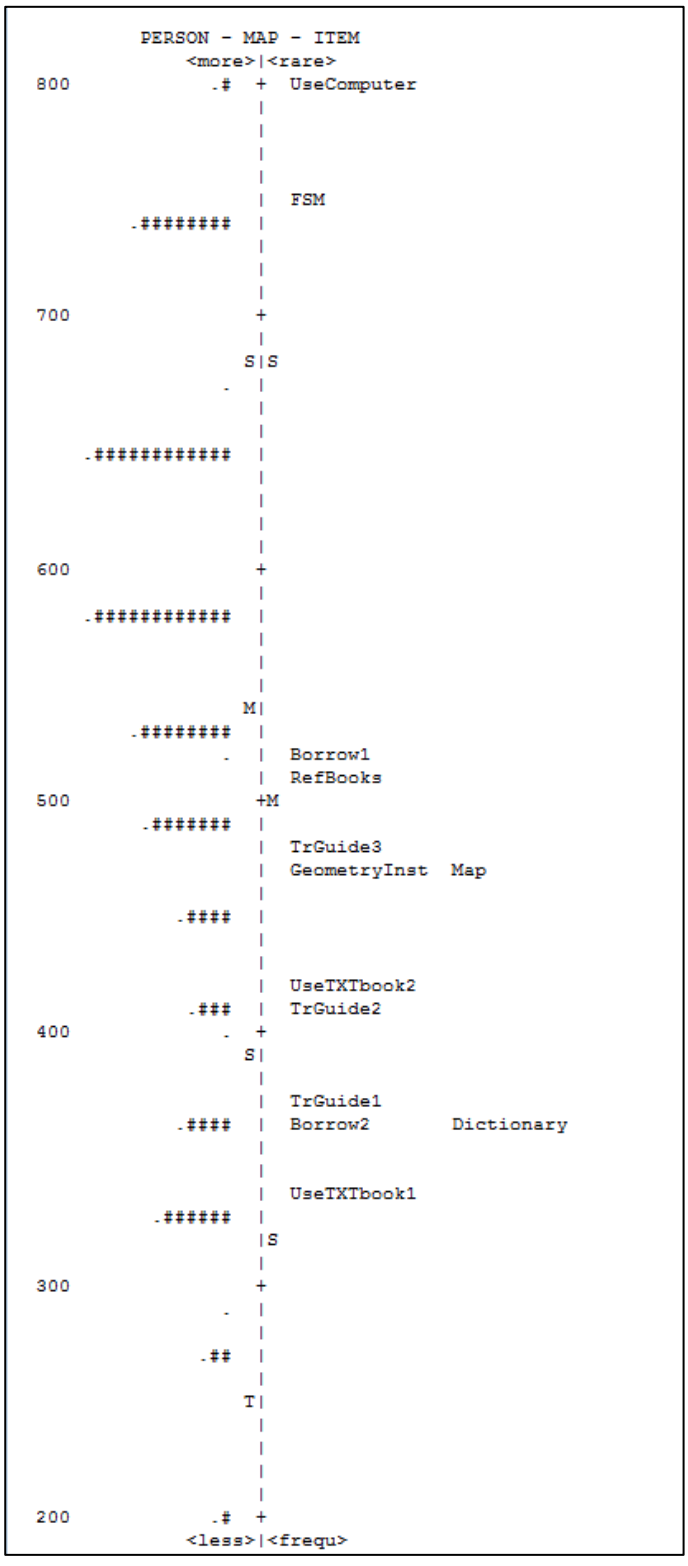

Appendix 19: Initial item map for items measuring resource usage scale



Appendix 20: Final Item map for items measuring resource usage scale



Appendix 21: Items constituting the resource usage scale

Items and Responses	CODES	Freq(%)
Are you allowed to take books home from the class library (Borrow1)		
No classroom library/not allowed to borrow textbooks	1	2485(47%)
Allowed to borrow textbooks	2	2822(53%)
Are you allowed to take books home from the school library (Borrow2)		
No school library/not allowed to borrow textbooks	1	1231(23%)
Allowed to borrow textbooks	2	4076(77%)
Have you used a computer at school (UseComputer)		
Almost never	1	5195(98%)
Often	2	112(2%)
Did you receive free meal(s) supplied by your school during this school year (FSM)		
No	1	4437(84%)
Yes	2	870(16%)
How do you use the reading textbooks in your classroom during the lessons (UseTXTbook1)		
No personal reading textbooks	1	1035(20%)
Use by myself/share with other pupils	2	4272(80%)
How do you use the mathematics textbooks in your classroom during the lessons (UseTXTbook2)		
No personal mathematics textbooks	1	1682(32%)
Use by myself/share with other pupils	2	3625(68%)
Does the teacher have access to the map in your school (Map)		
No	1	2009(38%)
Yes	2	3269(62%)
Does the teacher have access to an English Dictionary in your school (Dictionary)		
No	1	1182(22%)
Yes	2	4096(78%)
Does the teacher have access to the Geometry instruments in your school (GeometryInst)		
No	1	2055(39%)
Yes	2	3223(61%)
Does the teacher have access to the English teacher's guide in your school (TrGuide1)		
No	1	1256(24%)
Yes	2	4022(76%)
Does the teacher have access to the Mathematics teacher's guide in your school (TrGuide2)		
No	1	1574(30%)
Yes	2	3704(70%)
Does the teacher have access to the Life skills and Health Education teacher's guide in your school (TrGuide3)		
No	1	2145(41%)
Yes	2	3133(59%)
Does your school have an extra library or reference books for teachers (RefBooks)		
No	1	2374(45%)
Yes	2	2904(55%)

Appendix 22: Final principal components in the data measuring resource usage scale

Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)		-- Empirical --		
Total raw variance in observations	=	26.6	100.0%	
Raw variance explained by measures	=	13.6	51.1%	
Raw variance explained by persons	=	4.4	16.7%	
Raw Variance explained by items	=	9.2	34.5%	
Raw unexplained variance (total)	=	13.0	48.9%	100.0%
Unexplned variance in 1st contrast	=	3.8	14.4%	29.5%
Unexplned variance in 2nd contrast	=	1.4	5.2%	10.6%
Unexplned variance in 3rd contrast	=	1.2	4.6%	9.4%
Unexplned variance in 4th contrast	=	1.0	3.7%	7.7%
Unexplned variance in 5th contrast	=	1.0	3.6%	7.4%