RESEARCH REPORT

BOTSWANA
EXAMINATIONS
COUNCIL

TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY (TIMSS) 2011 - STANDARD 6

TIMSS 2011

TR E N D S IN IN TE R N A T I ON A L M A T H E M A T IC S AN D S C IE N C E S TU D Y (TIMSS)

October 2014

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Printed by: A-One Security

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ISBN: 978-99968-452-1-5

TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF FIGURES

FOREWORD

Botswana, like many countries around the world, is repositioning itself in the global economy. There is recognition that Science and Technology will continue to be major drivers of the economy in the 21st century and that human capital has become a critical determinant of success in knowledge and the technologically driven economy. The Ministry of Education and Skills Development has therefore identified among others, e.g. TVET, Mathematics and Science for special emphasis in its education and training programmes.

Education policy makers, planners and teachers require the use of research evidence as a basis for decision making in the quest for quality education. National and international surveys, school-based assessments, national examinations are all different sources of information for monitoring and evaluation of the quality of educational outcomes. The Trends in International Mathematics and Science Study (TIMSS) is an international project designed to generate information on Mathematics and Science achievements at the 4th and 8th grade levels as well as at advanced stages of learning. They also generate information on curriculum implementation, contexts of learning and successful pedagogical practice across all participating countries. Botswana started participating in TIMSS during the 2003 Cycle. The selection of TIMSS as an index for monitoring global competitiveness in Mathematics and Science learning and achievement was motivated by the national aspiration for a standard of education that is internationally competitive.

The TIMSS 2011 Report presents a wealth of information on Science and Mathematics curriculum coverage, the contexts of learning and the country‟s global competitiveness in Mathematics and Science achievement. The report presents research findings that may inform education strategy, curriculum and assessment, curriculum delivery, teacher development, supervision and educational management at school level, stakeholder involvement (i.e. parental involvement in the learning experiences of their children), and a myriad of comparative data from other education systems.

The only way to change the outcomes of our education system is to change what and how we educate. Planners, policy makers, teachers, parents, learners all need to effect changes that will improve the experiences of all learners and provide them with an opportunity to develop their potential and to contribute meaningfully to their own development and that of their country. I therefore invite you to read this report with an action oriented focus.

Prof Brian Mokopakgosi
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ACKNOWLEDGEMENTS

Our gratitude for the successful completion of the TIMSS 2011 Study goes mainly to the Ministry of Education and Skills Development and the BEC for THE financial support, the National Research Coordinator (NRC) in all National Research Coordinators meetings and training workshops hosted in various countries that participated in the study. Various offices of the IEA such as The International Study Centre in Boston, Statistics Canada and the Data Processing Centre in Hamburg tirelessly assisted the BEC to handle procedural issues as they arose.

Our sincere gratitude goes to the Regional Offices that permitted us to conduct the study in their schools. Our appreciation goes to the school administrators whose high level of understanding of the significance of such studies, permitted them to modify their tight schedules to accommodate us to administer the instruments. We would like to thank all teachers who participated in the completion of questionnaires which allowed us to have an insight of teachers‟ variables that are linked with pupils‟ performance. Our biggest appreciation goes to the parents who allowed their children to take the tests and themselves completed the questionnaires to allow us to understand other variables at play in their children‟s learning.

Lastly, we thank all the Standard 6 pupils who participated in this very important study. They were true ambassadors of the country and represented other pupils and their country well. A great deal of acknowledgement also goes to all staff of Botswana Examinations Council for the various roles each person played in the project. Data collection engaged a number of people from all walks of education as instrument administrators. They are too many to mention by name but provided an important service. Thank you very much. We are also indebted to teachers who helped in the administration and the scoring of both the pilot and main study instruments (See appendix A). At school level, School Coordinators handled all matters connected with the project and did it exceptionally well.

We are also grateful to Mr J. Makakaba, Mr. P. Mpho and Dr. Hulela who served as National Quality Control Monitors. We would also like to thank Mr. D. Khame and Mr. K. K. Mogasha who served as the External Quality Control Monitors during the final data collection. While not everyone can be acknowledged by name without covering so many pages, we recognize the core group, which was responsible for the execution of the project up to the writing of this report. The production of this report would not have been possible without the sleepless nights by data capturers who captured data within a reasonable period of time. In particular, our appreciation goes to the following Research Assistants: Tebogo Maposa, Sethunya Ruda, Thato Gaboitsiwe, Lechani Mabutho, One Moreo, Bonang Keagakwa, Boipuso Mosalakgotla, Masego Sethibe, and Tuelo Rasenai. We would also like to thank Thato Gaboitsiwe and Maureen Kemoabe for tirelessly type-setting this report.

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EXECUTIVE SUMMARY

The meaning and purpose of TIMSS

This is the third cycle of Trends in International Mathematics and Science Study (TIMSS) in which Botswana participated. TIMSS is administered by the International Association for the Evaluation of Educational Achievement (IEA). The Association is composed of countries around the globe who are interested in finding out the extent to which their learners have mastered what they are taught in Mathematics and Science and how their learning achievements compare with those of learners at the same level in other countries.

The main objective of TIMSS is to assess what pupils around the world know and can do in Mathematics and Science, with the aim of providing a rich source of information to policy makers, education managers, curriculum developers, teacher trainers, teachers, assessment bodies, researchers and all stakeholders on the outcome of learning Mathematics and Science and on how the various factors surrounding the learners relate to achievement in learning.

Another important objective of TIMSS is to compare the performance of pupils in the participating countries in Mathematics and Science and to assess how the various factors that impact on the learning of Mathematics and Science operate in different countries.

Why Botswana participated in TIMSS 2011

It is a national desire to be competitive and to use Mathematics and Science as vehicles for industrial growth. Botswana remains committed to improving the qualitative aspect of the educational attainment to supplement the quantitative success that has been scored in sending children to school. Both RNPE and Vision 2016 advocate for the improvement in the quality of learning. Pursuant to recommendation 17b, (RNPE, 1994, p. 17), TIMSS is sued as one project for monitoring t h e performance of education. Information obtained from TIMSS is used for informing curricula reviews and planning and implementing educational initiatives. Comparing the performance of Botswana pupils with the best pupils around the world is a challenge that the country proudly undertakes because it provides direction for channelling efforts into making Botswana a competitive country in the global economy.

How the study was conducted

The initial effort on TIMSS 2011 was devoted to analysing the commonality between the TIMSS frameworks and the Botswana Standard Four (4). A country is not supposed to participate if its curriculum covers less than 70% of the frameworks. The frameworks are a compromise among participating countries and fit no particular country perfectly. Items were then constructed to cover the Mathematics and Science contents defined by the frameworks. Questionnaire items were constructed to elicit background information from pupils, teachers, School Heads and parents.

Twenty-five (25) schools participated in the pilot test. Two classes were sampled from each school to participate in the study. For the main survey, there were 150 schools that participated and from each school, one class was sampled to complete the instrument. This means that 150 School Heads responded to the research instrument. A school coordinator was appointed by each sampled school and these coordinators were trained on their study roles. Names of the pupils in the sampled classes were obtained and entered into a database.

It is essential for an international study like TIMSS that the procedures be highly standardised. Botswana trained teachers for the administration of both the pilot and the final data collection instrument. Teachers were used as coders and were trained in the procedure TIMSS uses for scoring the work of learners. Botswana coders were mostly teachers from junior secondary schools.

A great deal of effort was expended on data capturing since it was manual. The captured data were transmitted to the Data Processing Centre (DPC) for TIMSS to verify. After data cleaning, scoring and scaling, countries were then able to carry out their data analysis and write reports. IEA uses International database Analyser (IDB Analyser), which participating countries use for data analysis.

Major Findings

Performance of Botswana pupils

Botswana pupils did not perform well in the achievement tests. They scored 419.22 in Mathematics and 367.33 in Science, both of which were below the TIMSS scale average of 500. Although Botswana participated at a higher grade (that is Standard 6 instead of 4), the country was ranked third and second from the bottom in Mathematics and Science respectively.

Twenty-three countries assessing 4th Grade and the three assessing ninth grade pupils had an average achievement below the scale average of 500 in Mathematics. In Science, Twenty countries assessing fourth grade and the three assessing ninth grade pupils had average achievements below the scale average of 500. It is evident that 40% of pupils in mathematics and 57% in Science still failed to even reach the lowest benchmark, compared to 100% of Korea Republic who reached the lowest benchmark in Mathematics and 99% of Korea Republic, Finland and Japan who reached the lowest benchmark in Science.

Pupils‟ performance in the content domains was the same irrespective of when the content was taught for both Mathematics and Science. Girls performed better than boys overall, and in both content and cognitive domains in both subjects.

Pupils' performance by background variables

Pupils‟ performance is not dependent on the resources and quality of instruction only; background variables also play an important role in explaining their performance. A number of background variables such as the number of books at home, home possessions, home support, bullying at school, and young age were also investigated. It was found that the availability of desirable factors or the absence of undesirable factors is related to pupils‟ performance. This notwithstanding, the regression model shows that providing the best condition for Botswana pupils will result in higher achievement scores of 420.16 and 438.56 for science and Mathematics respectively. However, these scores are still lower than the scale average of 500.

Pupils' performance by *Teacher background variables*

The importance of the teacher in the learning of the pupils cannot be overemphasized. The quality of teachers is one factor that determines the quality of educational outcomes. It has been revealed that generally most pupils were taught by teachers who had at least a degree in education qualification. However, pupils who were taught by teachers with diploma qualification, teachers who had more experience performed better.

Most of the pupils were taught by teachers who were concerned by the conditions or school environments within which they worked. Furthermore, availability of computers and associated assistance to teachers seemed to enhance the performance of the pupils, yet few pupils were taught by teachers with such kind of resources.

Attitudes and behaviours of teachers towards their profession played significant role in teachers‟ ability to deliver lessons and imparting knowledge to the pupils. The more teachers were satisfied with their profession (general conditions within their profession), the higher their efficiency and effectiveness in teaching, translating to higher performance of the pupils.

General lack of resources, lack of participation in professional development, lack of confidence and preparedness to teach certain content domains hampered teacher efficiency and

effectiveness, consequently affecting pupils‟ performance. As such, these issues needed to be addressed for the betterment of the overall performance of pupils.

Pupils‟ performance by *School background variables*

Most schools had enrolment of between 400 and 1200. However, there were a sizeable proportion of schools which had small enrolments of about 200 pupils. Majority of pupils attended schools in villages and remote rural areas where there were a lot of economically disadvantaged families. The performance of the pupils varied with the locality of the school, with pupils from urban areas performing better than pupils from other localities in the sample. Pupils from affluent families performed significantly better suggesting that better families tended to support their children‟s education better. However, the size of the school was not linked with performance.

The results indicates that the performance of pupils was not affected much by the availability of resources like computers, science lab and other resources needed to carry out instruction. Pupils were taught by teachers who had moderate to high job satisfaction, teacher understanding of the curricula, and teachers‟ degree of success in implementing curriculum. Evaluation of teachers work was mainly through observation by the principal or senior staff and pupil achievement only. Teacher peer review and observation by inspectors can still be improved. Pupils started their primary school whilst they were still unable to count, read and write basic letters and/or numbers. Pupils from schools with a higher percentage of those who could read, write or count performed better than the pupils from schools where the percentage was lower.

Pupils' performance by *Parent background variables*

Findings indicated that learners engaged in non-formal pre-school activities like numeracy and literacy. Such learners scored higher marks. Pupils who attended Pre-schooling were slightly less than half (46.43%).and children who attended Pre-schooling were found to significantly perform better than those who did not. However, parents who did not have the means to send their children to pre-primary formal set-up, continued with informal teaching of their children at home, as evidenced by children‟s high literacy rate (92.0%) and some arithmetic competence when they started school. About 9% of the pupils started school when five years or younger. Generally, 94.55% of Botswana children started school when they were 7 years or younger, as per the policy requirement and tended to perform better. However, either early schooling or the number of years spent in pre-school was also of paramount importance in the child learning and performance.

Majority of parents went as far as attaining some junior secondary education (40%). It was therefore not surprising to find that a small proportion of children (27.5%) had parents who spoke English at homes with them before beginning schooling. Parents‟ level of education had some implications on children‟s learning as they had to help their children with school work. Children

who either spent some time doing their homework and/or being helped by parents tended to perform better than those who spent less time and/or did not do their homework at all. Generally, parents were therefore found to take an active role in their children‟s learning.However, there are some schools which still did not give pupils homework (9%), yet learning can be done anywhere and anytime.

Furthermore, more books and interest in reading were related to educational level of the parents which were in turn positively related to children‟s performance. Despite high proportion of parents with low levels of education, they had high expectation of children achieving higher levels of education.

CHAPTER ONE
INTRODUCTION

Trends in International Mathematics and Science Study

An education system that is not assessed cannot lay claim to quality. Botswana takes assessment and evaluation as critical in attaining her objective of developing an educated and informed nation. The country does not only want to know how education is progressing, but is interested in comparing its educational achievement with those of other countries around the world. For this reason, Botswana has joined an important international assessment body, the International Association for the Evaluation of Educational Achievement (IEA). IEA carries out a number of studies, one of which is the Trends in International Mathematics and Science Study (TIMSS).

TIMSS is a project aimed at assessing what pupils at various stages of learning Mathematics and Science know and are able to do. It is carried out by various countries around the world under the auspices of IEA. The IEA is an independent international cooperative body of national assessment or research institutions of the participating countries. It was founded in 1959 for the purpose of conducting comparative research studies on educational policies, practices and outcomes.

Botswana participated in TIMSS Standard Six for the first time in 2011. The majority of countries carried out the study at Standard Four level. TIMSS data collection is carried out every four years. Southern Hemisphere countries collected data in October/December 2011 while the Northern Hemisphere countries collected their data in May 2011.

The Aims of TIMSS

The following constitute the major objectives of the TIMSS project:

- assessing the level of Mathematics and Science learning of pupils
- identification of factors that impact on teaching and learning

detection of trends in the learning achievement as well as in the education system

- comparison of achievement and teaching and learning conditions among the participating countries.

The purpose of carrying out the study is to provide policy makers, education managers, curriculum developers, teacher trainers, assessment bodies, researchers and all stakeholders with a rich source of information that can be used for the advancement of Science and Mathematics education. Information generated through TIMSS is intended to be used by educators to plan and execute activities that lead to improved learning of Mathematics and Science. Instead of one country believing that the standard of its Mathematics and Science education is high, an opportunity is provided so that each country can compare its standards with other countries. Basing the assessment on a common framework enables each country to diagnose the strengths and weaknesses in its Mathematics and Science curricula. These comparisons are very pertinent in a world that is quickly shrinking into a tiny village through digital and technological advances.

Contextual Background to the Study

The resolve of the Ministry of Education to use assessment as a means of monitoring and uplifting the quality of education can best be understood by taking a look at where the country intends to go. The Theme for National Development Plan 9 is: *Towards Realisation of Vision 2016: Sustainable and Diversified Development through Competitiveness in Global Markets.* Indeed Vision 2016 has become the cornerstone of Botswana‟s development. The relevant pillar for education of Vision 2016 reads thus: „An educated and informed nation‟. The task of producing an educated and informed nation falls directly under the Ministry of Education. It is this Ministry that is called upon to produce the requisite manpower necessary for driving the economy forward.

The National Development Plan, NDP 10 adopts the theme of accelerated achievement of the objectives of Vision 2016 and the Millennium Development Goals, through the enhancement of project implementation and improvement in service delivery in order to make the country more competitive internationally. This means that the call on the Ministry of Education to avail the needed manpower is more urgent than ever before. In turn, the Ministry is tackling its tasks through a variety of approaches: teacher training, curricular review, with emphasis on development of higher order thinking skills in the learner, work oriented training and putting emphasis on Mathematics, Science Engineering, and entrepreneurial skills.

Given what education has to achieve, the need for monitoring becomes an imperative action. It is no longer just a matter of participating in TIMSS in fulfilment of the policy of continuous monitoring (REC.17b of the RNPE, 1994, p. 17), but indeed a check to see if the thrusts that had been put into the process of education and the activities associated with TIMSS 2003 and TIMSS 2007 reports had an impact. In other words, the 2011 cycle was to check if Botswana was becoming more and more competitive in accordance with the aspirations expressed in **Vision 2016** of being globally competitive with the best countries in the world.

TIMSS 2011, like its predecessors, offered countries an opportunity to assess either Standard Four or Form One, or both, but Botswana opted for both. However, the pilot test results indicated that Botswana pupils were unable to answer most TIMSS items hence the reliability of the results would be questionable. This is why the questionnaire ended up being administered to Standard Six pupils.

Conceptual Framework for the Study

The determination of Botswana to utilise education to prepare the country to be progressive and technologically oriented is quite strong. This has been reflected in the RNPE (1994, p21) in a number of ways:

Among the accepted goals for the Junior Certificate curriculum are the following:

- the capacity to use computational skills for practical purposes;
- an understanding of scientific concepts and interest in the material world;
- an appreciation of technology and the acquisition of basic skills in handling tools and materials;
- computer literacy – each pupil is to take basic computer awareness course(Recommendation 32);
- critical thinking, problem-solving ability, individual initiative and interpersonal skills.

Having participated in TIMSS 2003 and 2007, there was a keen interest in finding out if the performance of Botswana pupils had improved even though the time for the interventions to have an impact was short. Not only was there interest in finding out if performance had

improved, but the standing of the country in comparison to the other participating countries was expected to have improved. The concern that the nation has set itself a low benchmark by comparing itself with poor countries, rather than with the best in the world was a driving force for moving forward with TIMSS 2007 and 2011.

Educational Structure of Botswana

Botswana operates a 7:3:2:4 system of education. Primary education takes seven years while junior secondary education lasts three years. Learners selected to go into senior secondary education take two years. In the same way, university education takes four years for most courses.

Pupils take the Primary School Leaving Examination (PSLE) at the end of primary education. The PSLE results are used to provide diagnostic information intended to be used to improve the quality of teaching and learning. Virtually every pupil taking the PSLE proceeds to Junior Secondary, after which they sit the Junior Certificate Examination (JCE). The JCE is a selective examination for those proceeding to senior secondary level. The primary and junior secondary education forms the ten-year Basic Education and the intention is for every child to complete the basic education programme. After two years of senior secondary education, learners take the Botswana General Certificate of Secondary Education (BGCSE), the results of which are used for selection into tertiary institutions.

CHAPTER TWO
THE PROCESS OF THE STUDY

TIMSS Working Structures in Botswana

TIMSS is a large scale exercise that requires the involvement of a large number of people. Teachers, Examination Officers, Mathematics and Science Officers from the Ministry of Education and Skills Development (MOESD) were involved in the study. Professionals drawn from such institutions constituted the Working Team which had the mandate of scrutinising the TIMSS 2007 draft assessment frameworks.

The developed instrument must be administered. This made it necessary to identify and train staff for the administration of the instrument. During administration, it was necessary to check that the manual was adhered to. This was done by quality controllers, who were recruited and briefed thoroughly on their role. IEA engaged an International Quality Control Monitor while Botswana engaged National Quality Control Monitors. The responses of the pupils on the tests were coded by teachers after training. The curriculum questionnaire was also completed with information obtained from this group of trained teachers.

The Core team led by the TIMSS National Research Coordinator (NRC) carried out day-to-day operations of the project. The National Research Coordinator was the link with the IEA structures. The participating school appointed a School Coordinator to handle most of the study activities at the school level, as they were trained on their project roles. All communications on the project were subsequently directed to the attention of the School Coordinator.

Population and Sampling

Botswana"s target population for the 2011 study was Standard Six pupils. These were pupils who had six years of schooling. Botswana, Yemen and Honduras used Standard Six pupils while the rest of the countries used the Grade Four pupils. This was because the pilot results showed that our Standard Four pupils were scoring too low and this introduced a lot of measurement error in the international and respective country results. IEA duly advised that

Botswana and other countries with similar results should use pupils from a higher grade (Standard Six).

Names of all Junior Secondary Schools and Private English Medium schools in the country were obtained from the Department of Planning and Research Services (DPRES) of the Ministry of Education. A form designed by Statistics Canada Office was sent to all schools for completion according to the criteria specified (district and inspectoral region of the school, urban or rural location, ownership of the school, total number of pupils, and the number of classes (streams)).

The sampling frame was sent to Statistics Canada, which is the institution responsible for handling sampling for IEA. TIMSS study excluded special needs pupils from the sample because they could not cope with the test demands. Also excluded were private study groups because there is no-age limit in their enrolment. The sampling was multi-stage, stratified cluster, with the probability of being sampled proportional to the school size (PPS). Statistics Canada used software designed for this purpose and sampled 25 schools for piloting and 150 schools for the main data collection. The number of pupils in the main data collection was about 6000. Two classes were randomly selected in each school sampled for the pilot, while only one class was selected at random for the main survey.

The School Coordinator was then requested to list the pupils in each class that was selected. The names of these pupils were entered into the database, assigning each pupil a unique ID using the software supplied by Statistics Canada.

Defining the Assessment Frameworks

For a country to participate in IEA studies, its syllabus in the school system should match that of the IEA international framework by about 70%. Countries discuss and agree on these international frameworks as the basis for assessing achievement. IEA sends these frameworks to participating countries for discussion and comments at national level. The Frameworks are sent with questionnaires eliciting country responses on the content and cognitive dimensions that should be assessed. The 2007 objectives were listed and countries were to indicate against each objective whether it should be retained or dropped for the 2011 assessment. Countries were also asked to suggest new objectives that should be included.

These responses were sent to the International Study Centre at Boston College. They then involved expert panels to scrutinise country responses in order to come up with revised frameworks for 2011. The revised draft was then circulated to countries for their comments before the final version was produced. It is necessary to involve experts and countries at various stages of frameworks development to ensure that what is going to be assessed is appropriate and important. New trends in curricula have to be captured.

Table 2. 1: *Target percentages of TIMSS 2011 Mathematics Assessment devoted to Content domains*

	Content Domains	Percentages
Mathematics	Number	50
	Geometric Shapes and Measures	35
	Data Display	15
Science	Life Science	45
	Physical Science	35
	Earth Science	20

Table 2. 2: *Proportion of Mathematics and Science Cognitive Domains for assessments*

Cognitive Domains	Percentages	
	Mathematics	Science
Knowing	40	40
Applying	40	40
Reasoning	20	20

Source: TIMSS 2011 Assessment Frameworks, Mullis et al TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College

The percentages reflect the perceived emphasis put on the content and cognitive dimensions in most of the participating countries.

International Benchmarks

The scale of achievement used by TIMSS gives a summary of performance of pupils on a test that is designed to measure the achievement of pupils of wide ability ranges. To make sense of what performance on such a scale means, TIMSS identified four points on the scale and used them as benchmarks. Items that pupils at each benchmark are likely to answer correctly are then used to describe the pupils‟ knowledge and understanding at that benchmark. This exercise is called scale anchoring. The four benchmarks identified for each subject are low,

medium, high and advanced. The brief descriptions of these anchors are given in Table 2.3, below which there is an extended description of each benchmark.

Table 2. 3: *Brief description of international benchmarks*

Benchmark	***Score level***	***Description of each benchmark in***	
		Mathematics	*Science*
Advanced	*625*	*Reason, draw conclusions, make generalizations, and solve linear equations*	*Communicate an understanding of complex and abstract concepts in biology, chemistry, physics, and earth science.*
High	*550*	*Apply knowledge and understanding in a variety of relatively complex situations.*	*Demonstrate understanding of concepts related to science cycles, systems, and principles.*
Intermediate	*475*	*Apply basic knowledge in a variety of situations.*	*Apply understanding of basic scientific knowledge in various contexts.*
Low	*400*	*Some knowledge of whole numbers and decimals, operations, and basic graphs.*	*Recognize some basic facts from the life and physical sciences.*

TIMSS 2011 International Benchmarks of Mathematics Achievement

Advanced International Benchmark - 625

Pupils can organise and draw conclusions from information, make generalisations, and solve non-routine problems. They can solve a variety of ratio, proportion, and percent problems. They can apply their knowledge of numeric and algebraic concepts and relationships. Pupils can express generalisations algebraically and model situations. They can apply their knowledge of geometry in complex problem situations. Pupils can derive and use data from several sources to solve multi-step problems.

High International Benchmark - 550

Pupils can apply their understanding and knowledge in a variety of relatively complex situations. They can relate and compute with fractions, decimals, and per cents, operate with negative integers, and solve word problems involving proportions. Pupils can work with algebraic expressions and linear equations. Pupils use knowledge of geometric properties to solve problems, including area, volume, and angles. They can interpret data in a variety of graphs and tables and solve simple problems involving probability.

Intermediate International Benchmark - 475

Pupils can apply basic mathematical knowledge in straightforward situations. They can add and multiply to solve one-step word problems involving whole numbers and decimals. They can work with familiar fractions. They understand simple algebraic relationships. They demonstrate understanding of properties of triangles and basic geometric concepts. They can read and interpret graphs and tables. They recognise basic notions of likelihood.

Low International Benchmark – 400

Pupils have some knowledge of whole numbers and decimals, operations, and basic graphs.

TIMSS 2011 International Benchmarks of Science Achievement

Advanced International Benchmark – 625

Pupils demonstrate a grasp of some complex and abstract concepts in Biology, Chemistry, Physics, and Earth Science. They have an understanding of the complexity of living organisms and how they relate to their environment. They show an understanding of the properties of magnets, sound, and light, as well as demonstrate an understanding of the structure of matter, physical and chemical properties and changes. Pupils apply knowledge of the solar system and of Earth"s features and processes, and apply understanding of major environmental issues. They understand some fundamentals of scientific investigation and can apply basic physical principles to solve some quantitative problems. They can provide written explanations to communicate scientific knowledge.

High International Benchmark – 550

Pupils demonstrate conceptual understanding of some Science cycles, systems, and principles. They have some understanding of biological concepts including cell processes, human biology and health, and the interrelationship of plants and animals in ecosystems. They apply knowledge to situations related to light and sound, demonstrate elementary knowledge of heat and forces, and show some evidence of understanding the structure of matter, and chemical and physical properties and changes. They demonstrate some understanding of the solar system, Earth"s processes and resources, and some basic understanding of major environmental issues. Pupils demonstrate some scientific inquiry skills. They combine information to draw conclusions, interpret tabular and graphical information, and provide short explanations conveying scientific knowledge.

Intermediate International Benchmark – 475

Pupils recognise and communicate basic scientific knowledge across a range of topics. They demonstrate some understanding of characteristics of animals, food webs, and the effect of population changes in ecosystems. They are acquainted with some aspects of sound and force and have elementary knowledge of chemical change. They demonstrate elementary knowledge of the solar system, Earth‟s processes, and resources and the environment. Pupils extract information from tables and interpret pictorial diagrams. They can apply knowledge to practical situations and communicate their knowledge through brief descriptive responses.

Low International Benchmarks- 400

Pupils recognise some basic facts from the life and physical Sciences. They have some knowledge of the human body and demonstrate some familiarity with everyday physical phenomena. Pupils can interpret pictorial diagrams and apply knowledge of simple physical concepts to practical situations.

TIMSS 2011 Pupil Booklet Design

A major consequence of TIMSS‟ ambitious reporting goals is that many more questions are required for the assessment than can be answered by any one pupil in the amount of testing time available. Accordingly, TIMSS 2011 used a matrix-sampling approach that involved packaging the entire assessment pool of mathematics and science items at each Standard level into a set of 14 pupil achievement booklets, with each pupil completing just one booklet. Each item appears in two booklets, providing a mechanism for linking together the pupil responses from the various booklets. Booklets are distributed among pupils in participating classrooms so that the groups of pupils completing each booklet are approximately equivalent in terms of pupil ability. TIMSS uses item-response theory scaling methods to assemble a comprehensive picture of the achievement of the entire pupil population from the combined responses of individual pupils to the booklets that they are assigned. This approach reduces to manageable proportions what otherwise would be an impossible pupil burden, albeit at the cost of greater complexity in booklet assembly, data collection, and data analysis.

To facilitate the process of creating the pupil achievement booklets, TIMSS groups the assessment items into a series of item blocks, with approximately 10-14 items in each block at the fourth Standard and 12-18 at the eighth Standard. As far as possible, within each block the distribution of items across content and cognitive domains matches the distribution across the item pool overall. As in the TIMSS 2007 assessment, TIMSS 2011 has a total of 28 blocks, 14

containing mathematics items and 14 containing science items. Pupil booklets were assembled from various combinations of these item blocks.

Accordingly, the 28 blocks in the TIMSS 2011 assessment comprise 16 blocks of trend items (8 Mathematics and 8 Science) and 12 blocks of new items developed for 2011. As shown in Exhibit 10, the TIMSS 2011 Mathematics blocks are labelled M01 through M14 and the science blocks S01 through S14. Blocks with labels ending in odd numbers (01, 03, 05, etc.) contain the trend items from the 2007 assessment, as do blocks ending in 06. The remaining blocks with labels ending in even numbers contain the items developed for use for the first time in TIMSS 2011.

Figure 2. 1: TIMSS 2011 Item Blocks

Exhibit 10: TIMSS 2011 Item Blocks – Fourth and Eighth Grades

Mathematics Blocks	Source of Items	Science Blocks	Source of Items
M01	Block M13 from TIMSS 2007	S01	Block S13 from TIMSS 2007
M02	New items for TIMSS 2011	S02	New items for TIMSS 2011
M03	Block M06 from TIMSS 2007	S03	Block S06 from TIMSS 2007
M04	New items for TIMSS 2011	S04	New items for TIMSS 2011
M05	Block M09 from TIMSS 2007	S05	Block S09 from TIMSS 2007
M06	Block M10 from TIMSS 2007	S06	Block S10 from TIMSS 2007
M07	Block M11 from TIMSS 2007	S07	Block S11 from TIMSS 2007
M08	New items for TIMSS 2011	S08	New items for TIMSS 2011
M09	Block M08 from TIMSS 2007	S09	Block S08 from TIMSS 2007
M10	New items for TIMSS 2011	S10	New items for TIMSS 2011
M11	Block M12 from TIMSS 2007	S11	Block S12 from TIMSS 2007
M12	New items for TIMSS 2011	S12	New items for TIMSS 2011
M13	Block M14 from TIMSS 2007	S13	Block S14 from TIMSS 2007
M14	New items for TIMSS 2011	S14	New items for TIMSS 2011

Source: TIMSS 2011 Assessment Frameworks, Mullis et al TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.

In choosing how to distribute assessment blocks across pupil achievement booklets, the major goal was to maximize coverage of the framework while ensuring that every pupil responded to sufficient items to provide reliable measurement of trends in both

Mathematics and Science. A further goal was to ensure that achievement in the Mathematics and Science content and cognitive domains could be measured reliably. To enable linking among booklets while keeping the number of booklets to a minimum, each block appears in two booklets.

In the TIMSS 2011 booklet design, the 28 assessment blocks are distributed across 14 pupil achievement booklets (see Exhibit 11). Each pupil booklet consists of four blocks of items; two blocks of Mathematics items and two of Science items. In half of the booklets, the two Mathematics blocks come first, and then the two Science blocks, and in the other half the order is reversed. Additionally, in most booklets two of the blocks contain trend items from 2007 and two contain items newly developed for TIMSS 2011. For example, see Figure 2.2.

Figure 2. 2: *TIMSS 2011 Student Achievement Booklet Design*

Exhibit 11: TIMSS 2011 Student Achievement Booklet Design – Fourth and Eighth Grades

	Assessment Blocks			
Student Achievement Booklet	Part 1		Part 2	
Booklet 1	M01	M02	S01	S02
Booklet 2	S02	S03	M02	M03
Booklet 3	M03	M04	S03	S04
Booklet 4	S04	S05	M04	M05
Booklet 5	M05	M06	S05	S06
Booklet 6	S06	S07	M06	M07
Booklet 7	M07	M08	S07	S08
Booklet 8	S08	S09	M08	M09
Booklet 9	M09	M10	S09	S10
Booklet 10	S10	S11	M10	M11
Booklet 11	M11	M12	S11	S12
Booklet 12	S12	S13	M12	M13
Booklet 13	M13	M14	S13	S14
Booklet 14	S14	S01	M14	M01

Source: TIMSS 2011 Assessment Frameworks, Mullis et al TIMSS & PIRLS International Study Center, Lynch School of Education, Boston College.

Development of the Instruments

IEA releases some items from time to time and these have to be replaced. One of the National Research Coordinators" meetings was used for the construction of items, and Botswana sent two experts in Mathematics and Science to take part.

In the 2011 assessment, items were of the select-format as well as problem-solving in an open-ended format. IEA aims at putting emphasis on questions and tasks that offer better insight into the analytical, problem-solving and inquiry skills of pupils. More investigative and production-based tasks were advocated for in order to be able to cater for the cognitive domains that had been identified.

After compiling the test booklets, each country had to go through cultural adaptation of the items. This involved checking the items as presented to see if there was any cultural aspect in the item that would make it unsuitable for the intended population in a country. In such a case, a country was required to propose an amendment to the item that would solve the cultural concern at hand, but without changing the nature of the task in any way. These suggestions were sent to IEA Headquarters in Amsterdam. The IEA secretariat appointed an independent verifier of the cultural adaptations for each country and where this verifier did not agree with the suggestions; the proposed changes could not be made. This tight control had to be maintained to ensure that countries around the world would be administering the same items.

The process of cultural adaptation included translation from English to the language of instruction in countries that do not use English for instruction. Countries that needed to translate the tests from English to the language of instruction had to go through the verifier to make sure that the translated items were the same as the original ones in English. Botswana made slight changes only during the process of translation since the language of instruction is English.

Background questionnaires were developed for School Heads, Mathematics and Science teachers and for the pupils. The piloting of the questionnaires was done during the same time with that of the Mathematics and Science items. Botswana used the 2007 parent questionnaire which it developed specifically for local use. The questionnaires were similarly subjected to cultural adaptation and translation as were the achievement items.

Piloting the Instruments

The pilot data collection in Botswana was a d m i n i s t e r e d on Standard Fives. This is because piloting was carried out in March-April 2010 and by that time Standard Four pupils had covered very little of their curriculum as the school year begins in January. The items targeted pupils who had completed four years of education. Test administration followed and adhered to the detailed procedure documented in the Administration manual. This was necessary for standardisation of the procedures in all the schools and in every participating country. Administrators who were mainly retired teachers were trained on the administration procedures.

The exercise basically involved informing the schools when the instruments would be administered in their schools, and requesting the School Coordinator to prepare a hall where the tests would be administered. Upon reporting to the school head, the test administrators were handed over to the School Coordinator who in turn took them to the t e s t hall .

The test administrators gave the correct booklet labelled with the pupil‟s identification particulars. In case a booklet was spoilt or torn, a procedure was f ollowed on how to replace it . Each test booklet had two parts which were independently sealed so that while working on part one, pupils had no access to part two. After a short break pupils would return for part two, followed by completion of the pupil questionnaire. While all these were going on, the school head, as well as the Mathematics and Science teachers completed their respective questionnaires.

Open-ended responses needed marking (coding). Country representatives were trained in the diagnostic coding procedure that IEA uses for TIMSS. The Botswana NRC and another Core Team member who were trained by IEA trained colleagues and selected teachers from primary Schools. These then coded the responses of the pupils included in the pilot sample. A sample of the scripts had to be coded by two coders each to ensure that there is reliability in the coding exercise. Temporary research assistants were recruited to assist with data capture as there was massive data to be captured. The pilot data were then sent to IEA‟s Data Processing Centre in Hamburg, Germany. The pooled responses from piloting countries were analysed to check on how the items functioned at the pilot stage. A National Research Coordinators‟ workshop was convened to discuss and decide on the piloted items to be included in the 2011 assessment.

The Test Booklets for Final Data Collection

There were fourteen (14) booklets for the final data collection. Like in the pilot, each booklet contained both Mathematics and Science items. The old and newly developed items were arranged into mutually exclusive blocks of Mathematics and Science. The estimated time for completion of each block was fifteen (15) minutes, though the numbers of items in the blocks were not the same. Each block was systematically assigned between two to four test booklets. Each test booklet had two parts and each part was separately sealed so that a pupil working on one part could not read the items for the other part. Each part had to be completed in forty-five (45) minutes.

Background Questionnaires

TIMSS 2011 had five questionnaires: pupil questionnaire, teacher questionnaire (one for Mathematics teacher and another for Science teacher), school questionnaire and curriculum questionnaire. Botswana opted for an additional parent questionnaire. The pupil questionnaire elicited background information from them, including study aspirations and attitude towards Mathematics and Science. The teacher questionnaire was separated into Mathematics teacher questionnaire and Science teacher questionnaire. This questionnaire sought information from the teacher as to the curriculum that was actually implemented at classroom level, academic and professional background of the teacher, instructional practices and attitude towards the subject. The School head was requested to provide background information about the school, such as enrolment, teachers, facilities, etc. The curriculum questionnaire sought national views on the objectives in the frameworks as to whether they were in the curriculum. The parent questionnaire sought background information from the parents relating to the education of their child.

Main Survey Data Collection

The process of data collection for the main survey was the same as the pilot data collection. The same officers who participated in pilot data collection were reinforced with newly trained test administrators (teachers) so as to be able to cover the schools within the programmed two weeks. The final instruments were administered to Standard Six pupils in October-November, 2010. Though the TIMSS project was for 2011, Southern Hemisphere countries had to collect their data earlier while Northern Hemisphere countries had to collect theirs in May/June 2011 when their school year ended.

The data collection schedule was sent to the sampled schools for the main data collection. Instruments and other documents required for each school were printed and packed. The test booklet for each pupil was labelled with his/her name and identity number. As at the pilot, the administrators had to strictly adhere to the scripts in the administration manual. One expert in assessment was identified and sent to Amsterdam to train as international quality control monitor. This officer was fully supported by IEA during the data collection to ensure that there was minimal contact between him and the project team. His report indicated great adherence to the administration procedures. Three other Quality Control Monitors were trained by the NRC

and supported by the project funds. The idea here was to increase coverage of the testing centres as recommended by IEA. Indeed most of the centres were visited and these National Quality Control Monitors came back with very impressive reports on how the test administrators handled their work.

The teachers and officers who coded the pilot scripts were engaged in coding the open- ended responses for the main survey. As in the pilot sample, some of the scripts were double-coded for assessing the reliability of the coding exercise. These reliability scripts were eventually sent to DPC at Hamburg for scanning so that the scripts could be available for future coding.

The curriculum questionnaire was responded to by the coders under the leadership of a curriculum development officer as they constituted the body of practitioners who knew what was in the curriculum up to Form One level of education. Responses were then transmitted to DPC online.

Data Capture and Cleaning

More temporary data capture assistants were engaged in capturing data in addition to those who captured data for the pilot study. Data was subsequently sent to DPC. Throughout the study, IEA took measures to enhance the quality of the data collected from each country. A booklet was produced to give guidance on data entry so that the structure of the data was the same from country to country. Once received, DPC went through extensive data cleaning procedures, and corresponded with NRCs to clear emerging queries. Considering the massive data captured, Botswana data were relatively clean and there were no major concerns raised by DPC.

Data Analysis and Report Writing

The data from DPC scored pupils" responses and the development of the scales for reporting.

Item response theory (IRT) models were used for item and persons" parameter estimates. The three-parameter model was used for multiple- choice items scored correct/incorrect; the two-parameter model was used for free-response items scored correct/incorrect and the partial credit model was used for polytomous free- response items with two or more score points. IRT

allows performance of pupils to be summarised on a common metric or scale even though individual pupils did not respond to the same items. A scale average was set at 500 (as mean) and a standard deviation of 100. Rather than a single value of ability estimate for each pupil on each scale, plausible values were generated and five of these were used for obtaining mean values for specified groups.

Because of lack of random sampling and use of plausible values, SPSS could not be used directly for obtaining mean values and percentages. IEA studies use SPSS sitting on the International database Analyser (IDB Analyser) platform.

Interpretation of results

(a) Means, standard error and significant differences

The results are mostly presented in tables indicating percentages and means of pupils in various groups as well as the standard errors of these percentages and means. Where subgroups are compared, mean differences and the standard error of the mean differences are reported. Standard errors indicate the extent of the accuracy of an estimation of the mean or mean difference. An example is presented in Table 2.4.

Table 2. 4: *Pupils' Performances by Number of Books in the Home*

# of books	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
0-10	1,639	40.46	405.39 (3.86)	83.43	1,2:-26.26	342.52 (5.39)	121.11	1,2:-42.98
11-25	1,360	33.47	431.65 (3.35)	82.55	1.3:-40.37	385.50 (5.44	122.29	1,3:-70.90
26-100	662	16.52	445.76 (6.94)	92.48	2,3: -15.11	413.42 (9.60)	134.84	2,3:-27.92

** Significant mean differences at 5% level*

Then is the number of pupils in each category and the percentage they constitute.

The Mathematics mean of 405.39 with a standard error of 3.86 means that the mean could be between 401.53 and 409.25. Mean differences (**Diff)** is used throughout this report for checking whether subgroup differences are significant. In the example above, interest centres on finding out if there are significant differences in the performance of pupils who come from homes with different numbers of books. Is the difference in the Science performance of pupils from homes with *0-10 books* and pupils from homes with *11-25 books* statistically significant?

This question is answered by looking under the column of **Diff** for Science. The first row in this column starts with „1, 2". This means that the mean difference being considered is for the means of rows one and two. Under Science, row one mean is 342.52 and row two mean is 385.50. The difference between the two means is - 4 2 . 9 8 . A significant mean difference (Diff) is indicated by an asterisks (*).

(b) Regression Analysis

In some instances it is required to fit a complex model in order to estimate the effect of one or more variables on performance. The analysis of TIMSS data is complex in nature because there are inter relationships between the pupils" achievements and exogenous factors, including pupils" background variables. In most cases, estimating the mean performance of pupils without taking into account this unique relationship between variables may result in misleading outcomes. The regression model which aims to relate the dependent variable and independent variable(s) was used. The essence of regression analysis is to predict the effect of one factor on the dependent variable in the presence of other factors which may have different effects on the same variable. Technically, interpretation of the effect of one variable on the dependent variable in the presence of other factors is referred to as estimating the effect of one factor on the outcome when other factors are kept constant or are controlled for. This is the terminology used in the analysis of the TIMSS data. The flexibility of regression analysis, allows for the use of different variables of varying measurement scales, e.g. ratio scale, ordinal, nominal or interval as independent variables. But the dependent variables need to be continuous in nature for example pupils" achievements scores. In order to aid the readers to understand the regression analysis outcome in this report, a simple example on regression analysis is interpreted below:

Table 2. 5: *Regression analysis*

Variables	Coefficients	Standard Error (SE)	t-Value
Constant	497.44	10.96	45.37
Age	-24.96	2.08	-11.99*
Sex			
Male	-5.05	3.72	-1.36
Home Possession			
Low	-49.64	7.1	-6.99*
Medium	-29.51	5.01	-5.89*
Number of Books at Home			
0--10 Books	-17.07	8.85	-1.93
11--25 Books	-11.54	8.29	-1.39
26--100 Books	-5.09	8.88	-0.57

The table above shows four variables in the model, namely; *Age, Sex, Home possession* and *Number of books*. All variables except *Age* are categorical in nature. *Age* is continuous and it has been centred on the mean age of the group so that the intercept of the model translates to the overall mean score of the pupil. The coefficient for *Age* is -24.96. This value suggests that a pupil who is one year older than the *mean Age* of the pupil being studied will score on average 24.96 points lower than a pupil at the *mean Age*.

Sex has two categories; "*Male"* and "*Female".* The *"Female"* category is used as a reference point for comparison with the *male* category. For instance the coefficient - 5.05 means that "Male" pupils scored 5 points lower than the *"Female"* pupils, when taking into account the effect of other variables in the model.

Home possession has 3 levels, *"High",* "*Medium*" and *"Low*". The category *"High" is a* reference for comparison with other categories of this variable. For example the coefficient of - 49.64 for *low* means a pupil who comes from a household with home possessions regarded as "*Low"* scored 49.64 points lower than a pupil who comes from a household with home possessions regarded as "High". For "Medium" household the difference is -29.51.

For the variable Number of books at home, the reference level is *"100 or more books at home",* so all levels are contrasted to this level. The difference between pupils with *"0-10 books at home" and "100 or more books at home" is -17.07,* suggesting that pupils who have *"0-10*

books at home" will score 17.07 points lower on average compared to those with "100 or more books at home". For "11-25 books at home" the difference is -11.54 and it is -5.09 for pupils with "26-100 books at home".

The Constant term in the model represents the mean performance of pupils who have characteristics similar to the reference level in each variable. For instance, 497.44 implies that a "Female" whose age is around the "mean Age" of the pupils studied, comes from a household with home possessions regarded as "High", and has "100 or more books at home" will score an average of 497.44 points. The t-value indicates statistically significance at 5% level for a two-tailed test. A T-value of -11.99* indicates that older pupils achieve significantly lower than the younger ones and this is not due to chance occurrence.

(c) Indices

Questionnaires were made up of themes under which there were many items. The items were grouped together to form one or more construct. An index was therefore obtained by calculating the mean response for an individual for that construct. Negatively worded items were reversed before analysis to align with the rest. Naming the construct was a mammoth task because the name given must be representative of the underlying construct. In order for better appreciation by the readers, an example on how an index was constructed is given below. An Index of "frequency of parents support" is constructed from the following questions asked to pupils;

(1) My parents ask me what I am learning in school
(2) I talk about my schoolwork with my parents
(3) My parents make sure that I set aside time for my homework
(4) My parents check if I do my homework

The pupils had to indicate how often these things happen to them at home by responding "Every day or Almost Every Day", "Once or twice a week", "Once or twice a month" and "Never or almost Never" for each question. Responses were coded 1, 2, 3 & 4 respectively. The index is constructed by first computing the mean response of pupil and the categorizing the mean into four categories "Every day or Almost Every Day", "Once or twice a week", "Once or twice a

month" and "Never or almost Never". The frequency distribution of mean response is displayed in Table 1. By so doing only one variable with 4 responses is created. Forming categories of the Index is done by recoding the mean into 4 levels. Determining the threshold of the levels is arbitrary, for the "frequency of parents support" the cut points for "Every day or Almost Every Day" was 1.25, for "Once or twice week" was 2.25, for "Once or twice a month" was 3.25 and for "Never or almost Never" was 4.

Table 2.6: ***Frequency Distribution of the Mean Response***

Mean Response	Frequency	%
1.00	1539	37.0
1.25	853	20.5
1.33	7	.2
1.50	418	10.1
1.67	9	.2
1.75	401	9.7
2.00	278	6.7
2.25	164	3.9
2.33	8	.2
2.50	203	4.9
2.67	4	.1
2.75	84	2.0
3.00	65	1.6
3.25	48	1.2
3.50	26	.6
3.75	16	.4
4.00	32	.8
Total	4155	100.0

CHAPTER THREE
PUPIL ACHIEVEMENT

This chapter presents the performance of Botswana pupils in Mathematics and Science. The mean performance of pupils is displayed in Table 3.1.

Table 3. 1: *Performance of Botswana Pupils in Mathematics and Science*

			Mathematics		Science	
Year	**n**	%	Mean (SE)	SD	Mean (SE)	SD
2011	4198		419.22(3.71)	89.34	367.33(5.49)	130.68

Botswana pupils did not perform well in the achievement tests. The overall mean achievement for Mathematics is 419.22 while for science it is 367.33. Both the scores are lower than the international benchmark mean of 500. Science scores were more spread than the Mathematics scores as indicated by the large standard deviation of 130.68. Botswana"s performance in Mathematics is about four-fifth standard deviation below the TIMSS scale average of 500, while in Science it is about one and a third standard deviation. Compared to the best performing countries, Botswana performed more than two standard deviations below in Mathematics and more than one standard deviation in Science.

Performance by Content and Cognitive Domains

The content domains for Mathematics were Data Display, Geometric Shapes and Measures, and Number, while those for Science were Earth Science, Life Science, and Physical Science. Pupils" performances on the content domains are presented in Table 3.2.

Table 3. 2: *Pupils Achievement by content Domains*

Subject	Content	N	Mean (SE)	SD
Mathematics	Data Display	4198	427.06(3.98)	93.81
	Geometric Shapes & Measures	4198	403.76(4.45)	96.63
	Number	4198	421.09(3.66)	89.93
Science	Earth science	4198	375.94(5.74)	131.45
	Life science	4198	344.59(6.30)	143.51
	Physical Science	4198	379.69(5.53)	135.43

Pupils scored the highest marks in Data Display domain compared to other domains in mathematics, while in science pupils scored the highest marks in Physical Science. Amongst the Science content domains, pupils performed better in Physics with a mean score of 379.69 followed by Earth Science with a score of 375.94. The difference in pupil"s performances was statistically significant at 5% level for some domains. For instance the difference between Earth Science and Life Science is significantly different from zero.

Test items were based on three cognitive domains, namely: knowing, applying and reasoning, as presented in Table 3.3.

Table 3. 3: *Pupils Achievement by cognitive Domains*

Subject	Content	n	Mean (SE)	SD	
Mathematics	Knowing	4198	424.02(4.51)	95.75	1,2:3.44
	Applying	4198	420.58(3.86)	92.32	1,3: 22.41*
	Reasoning	4198	401.61(3.72)	89.03	2,3:18.97*
Science	Knowing	4198	343.63(6.21)	151.77	1,2: -35.38*
	Applying	4198	379.01(5.50)	127.31	1,3: -33.37*
	Reasoning	4198	377.00(5.92)	129.68	2,3: 2.01

Pupils" performance in mathematics cognitive domain was best in Knowing and worst in Reasoning, while in science pupils performed best in Application least in Knowledge. The difference in pupils" performance was statistically significant at 5% level for some domains.

Performance in Mathematics and Science by Sex

Boys and girls have long shown variation in performance in both Mathematics and Science. In the past, boys used to outperform girls in these subjects but it was discovered in TIMSS 2007 studies that the reverse was true. In this section, the relationship between boys and girls performance was explored. Table 3.4 presents the results.

Table 3. 4: *Pupils Achievements in Mathematics by Sex*

Sex	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Girl	2139	51.5	428.45 (3.99)	85.9	1,2: 18.39*	374.73 (5.82)	125.04	1,2: 14.86
Boy	2037	48.5	410.06 (4.19)	91.78		359.87 (6.38)	136.16	

** Statistically significant at 5% level*

Girls were slightly more in number (51.50%) than boys (48.50%). Girls performed better than boys both in Mathematics and Science studies. The mean performance is lower than the International Benchmark mean of 500 for both subjects. The differences between male and females were not statistically significant at 5% for Science but significantly different for Mathematics.

Pupils' Performance in Mathematics Content Domains by Sex

The relationship between boys and girls in performance is further compared based on the content domains as shown in Table 3.5.

Table 3. 5: *Pupils Achievements in Mathematics Content Domains by Sex*

Content Domain	Sex	N	%	Mean (SE)	SD	Diff
Data Display	Girl	2139	51.50	437.57(4.40)	90.20	1,2: -20.76*
	Boy	2037	48.50	416.81(4.60)	96.14	
Geometry	Girl	2139	51.50	408.25(4.38)	93.23	1,2: 8.70
	Boy	2037	48.50	399.55(5.42)	99.87	
Number	Girl	2139	51.50	431.59(3.89)	85.95	1,2: 21.05*
	Boy	2037	48.50	410.54(4.52)	92.75	

** Statistically significant at 5% level*

Girls still performed better than boys in all the content domains of Mathematics. Both groups performed better in Data Display and performed worst in Geometry. In all content domains, the variability between male scores is high compared to females". For example, the standard deviation for the score for Data Display was 96.14, 99.87 for Geometry and 92.75 for Number. This suggested that boys scored differently from each other. Some scored low while others score high.

Pupils' Performance in Mathematics Cognitive Domains by Sex

The relationship between boys and girls performance in cognitive domains was further explored as shown in Table 3.6.

Table 3. 6: *Pupils Achievements in Mathematics Cognitive Domains by Sex*

Cognitive Domain	Sex	n	%	Mean	SD	Diff
Knowing	Girl	2139	51.50	434.87(4.50)	92.10	1,2:21.85*
	Boy	2037	48.50	413.02(5.39)	98.20	
Applying	Girl	2139	51.50	431.19(4.29)	88.44	1,2:21.09*
	Boy	2037	48.50	410.10(4.26)	94.89	
Reasoning	Girl	2139	51.50	407.56(3.90)	87.54	1,2:11.89*
	Boy	2037	48.50	395.67(4.58)	90.21	

** Statistically significant at 5% level*

Girls performed better than boys in all the cognitive domains. Both groups performed slightly better in Knowing and the performance was low in Reasoning. The mean performance in girls and boys was significantly different in all domains.

Pupils' Performance in Science Content Domains by Sex

The relationship between boys and girls in performance is further compared based on the cognitive domains; Earth Science, Life Science and Physics in Table 3.7.

Table 3. 7: *Pupils Achievements in Science Content Domains by Sex*

Content Domain	Sex	N	%	Mean (SE)	SD	Diff
Earth Science	Girl	2139	51.50	382.29(6.88)	125.65	
	Boy	2037	48.50	369.47(6.49)	137.20	1,2: 12.82
Life Science	Girl	2139	51.50	354.66(6.15)	137.67	1,2: 20.02
	Boy	2037	48.50	334.64(8.20)	148.89	1,2: 9.30
Physics	Girl	2139	51.50	384.55(6.19)	130.02	
	Boy	2037	48.50	375.25(6.50)	140.87	

** Statistically significant at 5% level*

The girls performed better than the boys in all the content domains of Science. Both groups performed better in Physics and were poor in Life Science. The difference between male and female is not statistically significant at 5% in Earth Science and Physics but significantly different in Life Science. The mean scores of the girls and boys in Life Science differed considerably at 354.66 and 334.64 respectively.

Pupils' Performance in Science Cognitive Domains by Sex

The relationship between boys and girls in performance is further compared based on the cognitive domains; Knowing, Applying and Reasoning in Table 3.8.

Table 3. 8: *Pupils Achievements in Science Cognitive Domains by Sex*

Cognitive Domain	Sex	N	%	Mean (SE)	SD	Diff
Knowing	Girl	2139	51.50	353.85(6.59)	146.10	
	Boy	2037	48.50	333.42(7.17)	157.03	1,2: 20.43*
Applying	Girl	2139	51.50	382.36(5.58)	122.57	
	Boy	2037	48.50	375.75(6.37)	132.31	1,2: 6.61
Reasoning	Girl	2139	51.50	387.22(5.58)	123.51	
	Boy	2037	48.50	366.82(7.43)	135.21	1,2: 20.40*

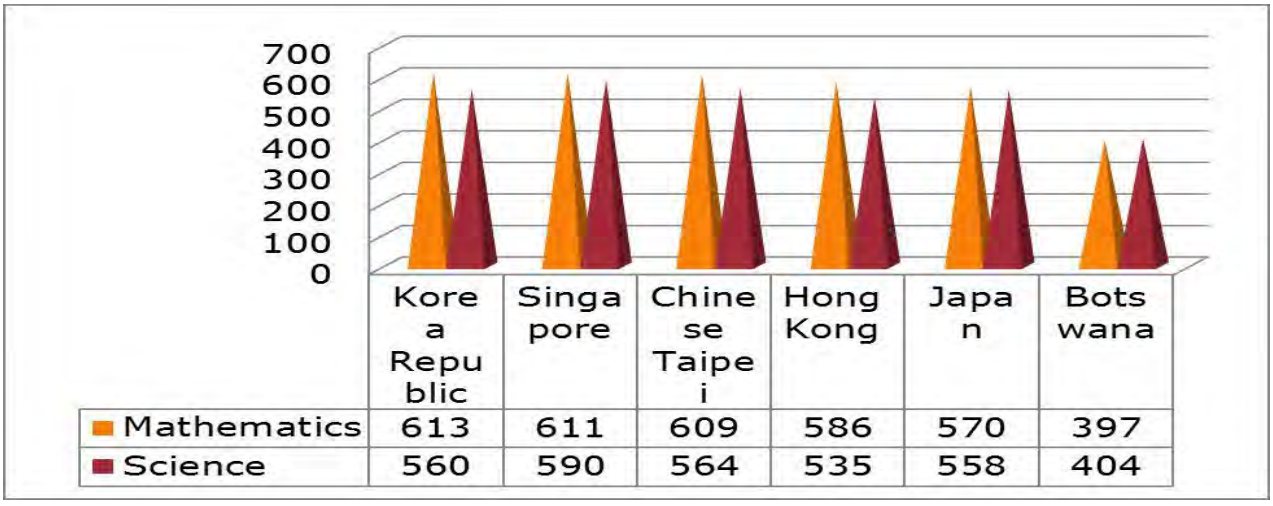
** Statistically significant at 5% level*

Girls performed much better than boys in all cognitive domains. There are significant differences between male and female in the Knowing and Reasoning dimensions but in Application there was no significant difference.

Performance of Botswana Pupils Compared to those of other Countries

The performance of Botswana pupils compared to those of other participating countries is shown in Figure 3.1.

Figure 3. 1: Performance of Botswana Pupils Compared to those of other Countries



East Asian countries continue to lead the world in Mathematics achievement. The top five performing countries were Korea, Singapore, Chinese Taipei, Hong Kong SAR and Japan in

that order. There was a substantial range in performance from the top-performing to the lower-performing countries. Twenty-seven countries assessing grade eight and the three assessing their grade nine pupils had average achievements below the scale average of 500. In Science, the top performing countries were Singapore, Korea, Chinese Taipei, and Japan. Twenty-four countries assessing eighth grade and three assessing ninth grade had average achievement below the scale average of 500. Despite Botswana‟s participation at a higher grade, it was ranked third from the bottom in both Mathematics and Science.

P*erformance of Botswana Pupils at International Benchmarks*

The percentages of Botswana pupils reaching International Benchmarks is shown in Table 3.9.

Table 3. 9: *Percentages of Botswana Pupils Reaching each International Benchmark*

Benchmark	Mathematics	Science
Low	0.0	1.0
Intermediate	2.0	6.0
High	15.0	28.0
Advanced	50.0	55.0

It can be deduced that 50% of pupils in mathematics and 45% in Science still failed to even reach the lowest benchmark, compared to 99% of Korea Republic which reached the lowest benchmark in Mathematics and 100% in in Science.

In 2011 50% of the pupils from Botswana failed to reach even the lowest benchmark in Mathematics while in Science the corresponding percentage was 45. This tells us that our form two pupils cannot handle material that can be handled with ease by pupils of lower grade from other countries. There is need to identify the root cause of the problem, whether it is the pupils, resources, teachers or the school environment which leads to such poor performance.

Pupils Performance in Mathematics and Science by Sex

In this section, the pupils‟ performance in Mathematics and Science is associated with the gender of the pupils. It is important to establish if pupils‟ performance in these subjects varies by level of sex. The results of the analysis are shown in Tables as shall be presented in this section. In some tables, the comparison is made between the cognitive and content domains of the same subject. Further, the differences between pupils‟ gender is highlighted among cognitive and content domains for each subject.

Performance in Mathematics and Science by Sex

Boys and girls have long shown variation in performance in both Mathematics and Science. In the past, boys used to outperform girls in these subjects but it seems most recently in TIMSS 2007 studies the reverse is true, girls perform better than boys. In this section, the relationship between boys and girls performance is studied.

Table 3. 10: *Pupils Achievements in Mathematics by Sex*

Sex	N	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Girl	2139	51.5	428.45 (3.99)	85.9	18.39*	374.73 (5.82)	125.04	14.86
Boy	2037	48.5	410.06 (4.19)	91.78		359.87 (6.38)	136.16	

** Statistically significant at 5% level*

The number of girls was slightly more (51.50%) than that of the boys (48.50%). Girls performed better than boys in both Mathematics and Science studies. The mean performance is lower than the International Benchmark mean of 500 for both subjects. The differences between male and females are not statistically significant at 5% for Science but significantly different for Mathematics.

Pupils' Performance in Mathematics Content Domains by Sex

The relationship between boys and girls in performance is further compared based on the content domains; Data Display, Geometry and Number in Table 3.11.

Table 3. 11: *Pupils Achievements in Mathematics Content Domains by Sex*

Content Domain	Sex	n	%	Mean (SE)	SD	Diff
Data Display	Girl	2139	51.50	437.57(4.40)	90.20	1,2: 20.76*
	Boy	2037	48.50	416.81(4.60)	96.14	
Geometry	Girl	2139	51.50	408.25(4.38)	93.23	1,2: 8.70
	Boy	2037	48.50	399.55(5.42)	99.87	
Number	Girl	2139	51.50	431.59(3.89)	85.95	1,2: 21.05*
	Boy	2037	48.50	410.54(4.52)	92.75	

** Statistically significant at 5% level*

Girls still performed better than boys in all the content domains of Mathematics. Both groups performed better in Data Display and performed poorly in Geometry. In all content domains, the variability between male scores is high compared to females. The standard deviation in Data Display part is 96.14, 99.87 for Geometry and 92.75 in Number. This suggests that the boys themselves scored differently from each other. Some score low marks and others score higher marks just like the girls.

Pupils' Performance in Mathematics Cognitive Domains by Sex

The relationship between boys and girls in performance is further compared based on the cognitive domains; Knowing, Applying and Reasoning in Table 3.12.

Table 3. 12: *Pupils Achievements in Mathematics Cognitive Domains by Sex*

Cognitive Domain	Sex	n	%	Mean	SD	Diff
Knowing	Girl	2139	51.50	434.87(4.50)	92.10	1,2:21.85*
	Boy	2037	48.50	413.02(5.39)	98.20	
Applying	Girl	2139	51.50	431.19(4.29)	88.44	1,2:21.09*
	Boy	2037	48.50	410.10(4.26)	94.89	
Reasoning	Girl	2139	51.50	407.56(3.90)	87.54	1,2:11.89*
	Boy	2037	48.50	395.67(4.58)	90.21	

** Statistically significant at 5% level*

Girls performed better than boys in all the cognitive domains. Both groups performed slightly better in Knowing and the performance was low in Reasoning. The mean performance in girls and boys is significantly different in all domains. The girls outperform boys in all cognitive domains.

Pupils' Performance in Science Content Domains by Sex

The relationship between boys and girls in performance is further compared based on the cognitive domains; Earth Science, Life Science and Physics in Table 3.13.

Table 3. 13: *Pupils Achievements in Science Content Domains by Sex*

Content Domains	Sex	n	%	Mean (SE)	SD	Diff
Earth Science	Girl	2139	51.50	382.29(6.88)	125.65	1,2: 12.82
	Boy	2037	48.50	369.47(6.49)	137.20	
Life Science	Girl	2139	51.50	354.66(6.15)	137.67	1,2: 20.02
	Boy	2037	48.50	334.64(8.20)	148.89	
Physics	Girl	2139	51.50	384.55(6.19)	130.02	1,2: 9.30
	Boy	2037	48.50	375.25(6.50)	140.87	

* Statistically significant at 5% level

The girls performed better than the boys in all the content domains of Science. Both groups performed better in Physics and were poor in Life Science. The difference between male and female is not statistically significant at 5% in Earth Science and Physics but significantly different in Life Science. For Life science girls scored a mean of 354.66 and boys scored 334.64 which are too different.

Pupils' Performance in Science Cognitive Domains by Sex

The relationship between boys and girls in performance is further compared based on the cognitive domains; Knowing, Applying and Reasoning in Table 3.14.

Table 3. 14: Pupils Achievements in Science Cognitive Domains by Sex

Cognitive Domain	Sex	n	%	Mean (SE)	SD	Diff
Knowing	Girl	2139	51.50	353.85(6.59)	146.10	1,2: 20.43*
	Boy	2037	48.50	333.42(7.17)	157.03	
Applying	Girl	2139	51.50	382.36(5.58)	122.57	1,2: 6.61
	Boy	2037	48.50	375.75(6.37)	132.31	
Reasoning	Girl	2139	51.50	387.22(5.58)	123.51	1,2: 20.40*
	Boy	2037	48.50	366.82(7.43)	135.21	

** Statistically significant at 5% level*

Girls performed much higher than the boys in all cognitive domains. There are significant differences between males and females in Knowing and Reasoning dimensions but in Application there was no significant difference.

Pupil Performance in Mathematics and Science by Background Variables

The achievement of the pupils was analysed looking at some variables which might have an association with performance like, number of books at home, amount of home possessions, frequency of bullying at school, frequency of parent support at home, Pupils" attitudes toward learning Mathematics and Science; and computer usage.

The number of books and Pupils' Performance

The amount of book available to pupil at home is used as an indicator for the educational status of a given household. A household with many types of books covering a wide range of topics suggests that those families are literate or that such families take the education of their children seriously by buying them books to read.

Table 3.15 Pupils Achievements in Mathematics and Science by Number of Books at Home

No. of books	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean(SE)	SD	Diff
0-10	1639	40.46	405.39 (3.86)	83.43	1,2: -26.26*	342.52 (5.39)	121.11	1,2: -42.98*
11-25	1360	33.47	431.65 (3.35)	82.55	1,3: -40.37*	385.50 (5.44)	122.29	1,3: -70.90*
26-100	662	16.52	445.76 (6.94)	92.48	1,4: -14.37	413.42 (9.60)	134.84	1,4: -28.17
100+	388	9.56	419.76 (10.46)	105.32	2,3: -14.11	370.69 (13.98)	151.9	2,3: -27.92*
					2,4: 11.89			2,4: 14.81
					3,4: 26.00*			3,4: 42.73*

** Statistically significant at 5% level*

The results show that 40.46% of pupils have 0-10 books, 33.47% have 11-25 books, 16.52% have 26-100 books and 9.56% have 100 or more books at home. It was observed that a higher performance in both Mathematics and Science is associated with a higher number of books up to 100 books but there after the performance goes down with increasing number of books at home. The pupils who come from homes with 100 or more books performed lower than the pupils who come from homes with 26-100 books. However, the number of books at home is a proxy for the educational status of those households. It is expected that literate families have more books compared to families with little or no educational background. So, pupils whose

parents are educated tend to take education seriously because their parents encourage them to do so.

Significant tests suggest significant differences in Mathematics mean performance between pupils with 0-10 books and 11-25 books also between pupils with 26-100 books and 100 or more books. However, no significant differences are observed between pupils with 0-10 books and 100 or more books also between 11-25 books and 100 or more books. The reason may be that the mean performance for 100 or more books category has more error compared to the rest of the groups. In Science, significant differences in performance between pupils who come from homes with 26-100 books and (0-10 books and 11-25 books; 26-100 books and 0-10 books; and 26-100 books and 100 or more books were observed. No significant differences were observed between 0-10 books and 100 or more books; and 11-25 books and 100 or more books. For both Science and Mathematics, the effects of the number of books on achievement diminish when the number of books increases beyond 100.

Pupils' Home Possessions and Pupils Performance

The variable "home possessions" is an index representing the following items the pupils have or do not have at home; Computer, Study desk/table, Books of their own, Own room, Internet connection, Calculator, Dictionary, Running tap water, Electricity, Television and Radio. Pupils were requested to indicate if any of these items were available at home. The results of the analysis associating pupils for the index are presented in Table 3.16.

Table 3.16: Pupils Achievements by Home Possessions

Level of Home	**n**	**%**	**Mathematics**			**Science**		
Possession			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
high	1080	26.26	463.30 (6.32)	83.53	1,2: 50.95*	440.42 (9.22)	121.48	1,2: 86.72*
medium	2364	56.48	412.35 (3.20)	85.20	1,3: 79.38*	353.70 (4.70)	124.64	1,3: 129.33*
low	685	17.26	383.92 (5.68)	82.53	2,3: 28.43*	311.09 (7.22)	115.04	2,3: 42.61*

** Statistically significant at 5% level*

Pupils who reported that they had "High" home possessions tend to perform better in Mathematics and Science with a mean of 463.30 and 440.42 respectively. There were significant differences between pupils who come from homes with "High" possession and

"Medium" or "Low" in both Mathematics and Science. This suggests that the socio-economic status of pupils must improve for them to perform well at school.

Frequency of bullying at school and Pupils' Performance

The index for "frequency of bullying at school "represents the following questions; I was made fun of or called names at school, I was left out of games or activities by other pupils at school, someone spread lies about me at school, something was stolen from me at school, I was hit or hurt by other pupils at school and I was made to do things I didn't want to do by other pupils at school. The pupils were supposed to indicate how often these things happen to them at school. The results of the analysis are shown in Table 3.17.

Table 3.17: Pupils Achievements by Frequency of Bullying at School

Frequency of bullying	n	%	Mathematics			Science		
			Mean (SE)	Diff	SD	Mean (SE)	SD	Diff
At least once a month	1003	27.01	409.27(4.54)	1,2:-12.10	89.77	352.01(6.75)	133.03	1,2:-16.88
A few times a year	1953	53.93	421.37(4.28)	1,3:-39.76*	87.63	368.89(6.58)	130.34	1,3:-61.46*
Never	704	19.06	449.03(5.91)	2,3:-27.66*	81.77	413.47(8.35)	115.56	2,3:-44.58*

** Statistically significant at 5% level*

Bullying of pupils by others was associated with low level of performance in Mathematics and Science. Those pupils who reported being bullied "At least once a month" experience low performance compared to those who have "Never" been bullied or have been bullied "A few times a year". However, the difference in performance was not statistically significant between pupils who were bullied "At least once a month" and "A few times a year". But a significant difference is observed between pupils who were "Never" bullied and those who were bullied "At least once a month" or "A few times a year".

The Frequency of Parents Support and Pupils Performance

The variable "frequency of parents support" is an index representing the following questions asked to pupils; my parents ask me what I am learning in school, I talk about my schoolwork with my parents, my parents make sure that I set aside time for my homework and my parents

check if I do my homework. The pupils had to give the frequency at which these things happen to them at school.

Table 3.18: Percentage of Pupils and their Average Achievements by Frequency of Parents Support at home

Frequency	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Every day	2392	57.48	434.36(3.81)	82.25	1,2:26.28*	390.44 (5.71)	121.9	1,2:43.9*
Twice a week	1270	30.8	408.08(4.96)	91.43	1,3:49.01*	346.54(6.97)	133.74	1,3:71.96*
Twice a month	404	9.92	385.35 (7.50)	97.33	1,4:51.81*	318.48(10.19)	139.6	1,4:61.06*
Almost never	74	1.8	382.55(16.2)	102.03	2,3:22.73*	329.38 (23.24)	138.48	2,3:28.06*
					2,4:25.53			2,4:17.16
					3,4:2.80			3,4:-10.90

* Statistically significant at 5% level

A descriptive analysis of association between frequency of parents support and pupils‟ achievements suggests that the pupils who come from homes where parents were frequently involved in school performed better. If parents give pupils support “Every day”, the pupil is likely to perform better compared to a pupil whose parent “Never” showed any interest in pupil work. The mean performance in both Mathematics and Science was positively associated with increased frequency of parental involvement. For instance the study shows that a pupil who was supported by his/her parent “Every day” will score 434.36 in Mathematics compared to 408.08 of pupils who were supported just “Twice a week”. Even though the performance differences in means were insignificant between pupils who were “Never” supported at home and those who were supported “Twice a week” or “Twice a month”, there was a significant difference between pupils who were supported “Every day” and those supported “Twice a week”, “Twice a month” and “Almost never”. This indicates that the frequency of support is associated with performance. The reader must note that the proportion of pupils who fall in the category “Almost never” is too small and the significant test may not be consistent in the long run.

Pupils Perceptions about School and pupils' Performance

The pupils were asked how they feel about the school. An index representing pupils‟ perceptions about their school was created by combing the responses from the following items; I like being in school, I feel safe when I am at school and I feel like I belong at this school. Pupils were required to indicate whether they agree or disagree with these items. These items

are positive and pupils who agree with them have good perceptions about school. Those who disagree have bad perceptions about the school.

Table 3.19: Pupils Perceptions about School and Average Achievements in Mathematics and Science

Extent of Agreement	n	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Agree a lot	1255	30.91	440.50 (3.51)	79.72	1,2: 16.14*	397.81 (5.30)	116.06	1,2: 24.48*
Agree a little	2169	53.04	424.36 (4.13)	86.38	1,3: 63.64*	373.33 (6.13)	128.34	1,3: 92.92*
Disagree a little	608	14.67	377.16 (6.47)	92.88	1,4: 72.67*	304.89 (9.62)	137.49	1,4: 90.45*
Disagree a lot	55	1.38	367.83 (22.35)	110.02	2,3: 47.20*	307.36 (29.19)	162.57	2,3: 68.44*
					2,4: 56.53*			2,4: 65.97*
					3,4: 9.33			3,4: -2.47

* Statistically significant at 5% level

Table 4.12 shows that pupils who “Agreed a lot” constituted 30.91% of the pupils in the sample and had a mean score of 440.50. Those who “Agree a little” constituted 53.04% and scored 424.36. Pupils who “Disagree a lot” (1.38%) score the smallest mean of 367.83. The pattern of results showed that pupils who have a good impression about school seem to perform better compared to those who do not. The same pattern was observed in Science.

Computer Usage and Pupil Performance

In this section, the usage of computer at home, school and other places is associated with pupils‟ performance. Pupils use computers to do their work, surf the network for academic information etc. The study wanted to find out what the impact of using a computer was on a pupils‟ performance. The results are displayed in Table 3.23, Table 3.24 and Table 3.25.

Computer Usage at Home and Average Performance in Mathematics and Science

The use of computer at home is associated with the pupils‟ performances. The results are shown in Table 3.20.

Table 3.20: *Computer Usage at Home and Average Performance in Mathematics and Science*

Frequency of usage	n	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Every day	912	22.17	408.83(7.36)	98.38	1,2: -24.72	353.49(11.08)	146.23	1,2: -40.22*
Once or twice a week	685	16.73	433.55(7.15)	91.97	1,3: -10.11	393.71(10.14)	135.86	1,3: -17.65
Once or twice a month	307	7.38	418.94(6.53)	96.9	1,4: -14.40 2,3: 14.61	371.14(10.62)	142.11	1,4: -15.71 2,3: 22.57
Never	2168	53.72	423.23(3.72)	80.71	2,4: 10.32 3,4: -4.29	369.20(5.40)	117.77	2,4: 24.51* 3,4; 1.94

** Statistically significant at 5% level*

Table 3.23 shows that the majority of the pupils (53.72%) had "Never" used computers at home. Those who used computers at home are only 46.28%. This includes pupils who use computer "Everyday" (22.17%), "Once or twice a week" (16.73%) and "Once or twice a month" (7.38).

Those who used computer "Once or twice" at home scored a higher mean in Mathematics (433.55) and Science (393.71) compared to others. The performance according to the frequency of computer usage at home is not compatible with the universal notion of improving performance. This is because pupils who use computers everyday might not be using them for anything related to educational purposes.

Computer Usage at School and Average Performance in Mathematics and Science

The use of computers at school is associated with the pupils" performances. The results are shown in Table 3.21.

Table 3.21: Computer Usage at School and Average Performance in Mathematics and Science

Frequency of usage	n	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Every day	648	15.73	362.70(5.23)	77.76	1,2: -75.88* 1,3: -41.33	274.28(7.75)	110.57	1,2: 118.56* 1,3: 71.77*
Once or twice a week	775	19.51	438.58(13.13)	101.17	1,4: -70.51* 2,3: 34.55*	392.84(19.59)	148.07	1,4: 115.65* 2,3: 46.79*
Once or twice a month	329	8.16	404.03(7.97)	94.21	2,4: 5.37	346.05(10.56)	132.76	2,4: 2.91
Never	2311	56.6	433.21(3.84)	79.11	3,4: 29.18*	389.93(5.89)	116.11	3,4: 43.88*

* Statistically significant at 5% level

Pupils who had “Never” used computers at school constituted a majority (56.60%) compared to those who used them at school (44.40%). In both Mathematics and Science, pupils who used computers “Once or twice a week” performed much better compared to others. The least performing pupils were those who used computers “Every day” at school.

Computer Usage at Other Places and Average Performance in Mathematics and Science

The use of computers at other places except school and home is associated with the pupils‟ performances. The results are shown in Table 3.22.

Table 3.22: Computer Usage at Other places and Average Performance in Mathematics and Science

Frequency of usage	n	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Every day	742	18.06	395.33(4.09)	87.51	1,2: -34.31*	336.08(6.43)	129.18	1,2: -47.21*
Once or twice a week	968	23.46	429.94(4.94)	85.69	1,3: -43.80*	383.29(7.85)	126.46	1,3: -64.47*
Once or twice a month	844	20.62	439.13(5.48)	89.62	1,4: -24.24*	400.55(8.22)	132.40	1,4: -25.33*
Never	1491	37.86	419.57(4.44)	86.74	2,3: -9.19	361.41(6.44)	126.92	2,3: -17.26
					2,4: 10.37			2,4: 21.88*
					3,4: 19.56*			3,4: 39.14*

** Statistically significant at 5% level*

Pupils usually access computers in some places other than home and school. The results of this study show that 37.86% of pupils “Never” go to other places to use the computer. For those who frequently visit other places to use computers, the performance in Mathematics and Science is better for pupils who visit other places “Once or twice a month” compared to others. In both subjects the least performing pupils are those who visit other places “Every day” for computer usage.

Pupils’ attitudes toward learning Mathematics and Science and their Performance in the subjects

Learning Mathematics and Science is usually characterised by resentment by many pupils. An index showing attitudes towards learning Mathematics and Science was constructed by several positive questions relating to pupils experiences about learning Mathematics and Science. The

index named attitudes “towards learning mathematics” is made up of the following questions; I enjoy learning Mathematics, I wish I had to study Mathematics, Mathematics is interesting, I learn interesting things in Mathematics, I like Mathematics, It is important to do well in Mathematics. The index named “attitudes towards learning Science” is made up of the following questions; I enjoy learning Science, I wish I had to study Science, I read about Science in my spare time, Science is interesting, I learn many interesting things in Science, I like Science, It is important to do well in Science. The pupils had to indicate how much they agree with these statements.

Table 3.23: Pupil’s attitudes toward learning Mathematics and Science and Pupils Performance

Subject	Extent of Agreement	n	%	Mean(SE)	SD	Diff
Mathematics	Agree a lot	1509	36.24	464.00(3.2)	70.06	1,2: 58.07* 1,3: 101.24*
	Agree a little	1950	47.06	405.93(4.04)	85.08	1,4: 73.52*
	Disagree a little	645	15.58	362.76(6.59)	91.41	2,3: 43.17* 2,4: 15.45
	Disagree a lot	47	1.13	390.48(16.49)	99.95	3,4: -27.72
Science	Agree a lot	1565	37.49	449.95(5.15)	95.70	1,2: 104.4* 1,3: 201.92*
	Agree a little	1932	46.84	345.55(5.37)	119.38	1,4: 157.52*
	Disagree a little	613	14.86	248.03(7.07)	108.97	2,3: 97.52* 2,4: 53.12
	Disagree a lot	37	0.80	292.43(65.27)	157.9	3,4: -44.4

** Statistically significant at 5% level*

The results showed that most pupils (83.30%) had positive attitudes toward learning Mathematics and (84.33%) had positive attitudes towards Science. In both Mathematics and Science, pupils who had positive attitudes towards learning the subject scored higher than those with negative attitudes as seen in Table 4.23.

Pupils’ attitudes toward Mathematics and Science lessons and Pupils’ Performance

The index named “attitudes towards mathematics” lessons is made up of the following questions; I know what my teacher expects me to do, I think of things related to the lesson, my teacher is easy to understand, I am interested in what my teacher says, my teacher gives me

interesting things to do. The index named “attitudes towards Science lessons” is made up of the following questions; I know what my teacher expects me to do, I think of things related to the lesson, my teacher is easy to understand, I am interested in what my teacher says, my teacher gives me interesting things to do. The pupils had to indicate how much they agree with these statements.

Table 3.24: Pupil’s attitudes toward Mathematics and Science lessons and Pupils’ Performance

Subject	Extent of Agreement	N	%	Mean(SE)	SD	Diff
Mathematics	Agree a lot	1041	25.00	460.00(4.02)	73.95	1,2: 42.26*
	Agree a little	2401	57.97	417.74(3.56)	85.08	1,3: 89.92*
	Disagree a little	667	16.08	370.08(7.03)	94.53	1,4: 95.77*
	Disagree a lot	40	0.95	364.23(19.18)	88.79	2,3: 47.66*
						2,4: 53.51*
						3,4: 5.85
Science	Agree a lot	1565	37.60	446.94(5.26)	98.18	1,2: 102.19*
	Agree a little	1932	46.54	344.75(5.36)	119.47	1,3: 199.06*
	Disagree a little	613	14.90	247.88(7.05)	108.91	1,4: 168.04*
	Disagree a lot	37	0.96	278.90(52.89)	150.10	2,3: 96.87*
						2,4: 65.85
						3,4: -31.02

* Statistically significant at 5% level

The results showed that positive attitudes were associated with better performance. Pupils with negative attitudes are likely to perform lower than those with positive attitudes. In mathematics, a larger proportion of pupils (82.87%) had positive attitudes compared with (17.13%) that had negative attitudes. In Science, (84.14%) of the pupils had positive attitudes compared with 15.86% who had negative attitudes. The mean performance suggests that positive attitudes are associated with better performance in Mathematics and Science.

Pupil’s attitudes toward Mathematics and Science in general and pupils Performance

The index named “attitudes towards Mathematics” in general is made up of the following questions; I usually do well in Mathematics, Mathematics is easier for me than for many of my classmates, I am just good at Mathematics, I learn things quickly in Mathematics, I am good at working out difficult Mathematics problems, my teacher tells me I am good at Mathematics,

Mathematics is easier for me than any other subject. The index named "attitudes towards Science in general" is made up of the following questions; I usually do well in Science, Science is easier for me than for many of my classmates, I am just good at Science, I learn things quickly in Science, I am good at working out difficult Science problems, my teacher tells me I am good at Science, Science is easier for me than any other subject. The results of the analysis are shown in Table 3.25.

Table 3.25: Pupil's attitudes toward Mathematics and Science in general and pupils Performance

Subject	Extent of Agreement	N	%	Mean(SE)	SD	Diff
Mathematics	Agree a lot	420	10.26	478.45(5.68)	71.00	1,2: 50.51*
	Agree a little	1749	42.80	427.94(3.80)	85.99	1,3: 80.28*
	Disagree a little	1716	41.89	398.17(4.15)	87.85	1,4: 33.96*
	Disagree a lot	207	5.06	444.49(9.00)	77.56	2,3: 29.77*
						2,4: -16.55
						3,4: -46.32*
Science	Agree a lot	808	20.13	458.87(7.29)	98.17	1,2: 80.74*
	Agree a little	1750	42.42	378.13(5.37)	123.55	1,3: 148.41*
	Disagree a little	1423	34.88	310.46(5.72)	123.23	1,4: 130.34*
	Disagree a lot	107	2.57	328.53(16.16)	125.75	2,3: 67.67*
						2,4: 49.6*
						3,4: -18.07

** Statistically significant at 5% level*

The results show that 53.06% of pupils agree with the statements in Mathematics and 62.55% of pupils agree with the statements in Science. In Mathematics, the pupils who show positive attitudes towards the subject perform better compared to those with negative attitudes. The same results are observed in Science.

The Effects of Pupils Background Variables on Mathematics and Science Achievement Scores

It is usually desirable to study the effects of factors under consideration in a response variable of interest. In this section, the background and demographic factors of pupils are related to the pupils‟ achievements. The previous sections studied the association between these variables with achievements independently. This section attempts to establish the relationship between

background and demographic factors on achievements taking into account the inter-relationship between factors and achievements. In most cases the performance of pupils is influenced by many external factors acting together and it is difficult to obtain the true mean achievements when these variables are analysed in isolation. The correlation between achievements and pupils factors is presented in the next section to give the strength and direction of relationship between these variables.

Correlations between Pupils Achievements in Mathematics and Science and some Background Variables

A correlation analysis is used to measure the strength of association between pupils" sores and pupils" background information. The significant test on correlation estimates was performed. The results of the analysis are shown in Table 3.26.

Table 3.26: Correlations between Pupils Achievements In Mathematics And Science And Some Background Variables

Variable	Mathematics Achievement		Science Achievement	
	Correlation	SE	Correlation	SE
Frequency of Parent's support	0.19*	0.02*	0.20*	0.02*
Amount of home possessions	0.3*	0.03*	0.34*	0.03*
Age of pupils	-0.39*	0.028*	-0.39*	0.02*
Number of books at home	0.1*	0.03*	0.12*	0.03*
Frequency of Bullying at School	0.15*	0.02*	0.15*	0.02*

* Statistically significant at 5% level

The correlation between Mathematics achievement and the frequency at which parents give attention to pupils school work is 0.19 and it is significantly positive. In Science, the correlation is 0.20, also significantly positive. Pupils whose parents are involved almost every day have a higher mean performance in Mathematics and Science compared to others. The amount of books the pupils have at home is also correlated positively with Mathematics and Science achievements. Although the correlation is too small, it is significant.

The age of pupils had a negative correlation with the achievement of pupils in both Mathematics and Science. Though the correlation is negative, it is significant. The negative sign shows that younger pupils performed better than older pupils in both Mathematics and Science. There are

conflicting results on the relationship between age and pupils‟ academic performance in the literature. Crosser (1991), Kinnard & Reinherz (1986), Laparo & Pianta (2000) found that older pupils fare better academically than younger pupils. In contrasts DeMeis and Stearns (1992); and Dietz & Wilson (1985) found no significant differences between age groups on achievements. These current findings are supported by Coleman et al. (1966), White (1982) and Jabor et al. (2011) who found that when pupils get older the correlation between age and achievement diminishes. Delaying school entry to give pupils advantage or retaining pupils in a certain grade to ensure pupils achieve to certain level of performance could be futile. Empirical evidence shows that older pupils are more likely to drop out of school.

Regression Analysis of Mathematics Achievements on Pupils Background Information

In this section, the relationship between pupils‟ achievements and background variable is studied. Regression analysis is used to estimate the effect of pupils‟ demographic variables and learning factors on performance. This procedure is important because, the mean performance of pupils is estimated controlling for similar variables across pupils. It is more superior to the method used in the earlier part of the report where the association between pupils‟ variables and achievements was studied independently without taking into account the inter-relationship between factors and performance. The results of the analysis are displayed in Table 3.27.

Table 3.27: Results of Regression Analysis of Mathematics Achievements on Pupils' Background Variables

	Mathematics			Science		
Variables	Effects	SE	t-Value	Effects	SE	t-Value
(Constant)	497.44	10.96	45.37	490.38	17.13	28.63
Age	-24.96	2.08	-11.99*	-32.54	2.97	-10.95
Sex						
Male	-5.05	3.72	-1.36	3.75	5.48	0.68
Amount Of Home Possession						
Low	-49.64	7.1	-6.99*	-74.41	9.66	-7.7
Medium	-29.51	5.01	-5.89*	-46.8	7.25	-6.46
Number Of Books At Home						
0--10 Books	-17.07	8.85	-1.93	-30.48	11.74	-2.63
11--25 Books	-11.54	8.29	-1.39	-23.29	11.42	-2.06
26--100 Books	-5.09	8.88	-0.57	-4.55	12.39	-0.37
Frequency of Bullying At School						
At Least Once A Month	-12.83	3.79	-3.39*	-42.4	6.64	-6.39
A Few Times A Year	-24.98	4.87	-5.13*	-22.06	6.08	-3.63
Frequency Of Home Support						
Once Or Twice A Week	-2.74	3.83	-0.72	-4.06	5.55	-0.73
Once Or Twice A Month	-12.33	5.47	-2.29*	-7.24	7.79	-0.93
Never	1.61	14.99	0.11	16.95	20.52	0.82
Pupils Attitudes						
Attitude Toward Learning	-34.19	5.62	-6.08*	-86.97	8.81	-9.96
Attitude Toward Lessons	-24.41	6.53	-3.74*			
Attitudes in General	-17.47	3.22	-5.42*	-50.54	4.43	-11.4

** Statistically significant at 5% level*

The results for the regression analysis of Mathematics achievements on background variables are shown in Table 3.30. Most background variables are categorical in nature and they are included in the model as dummies. In this case, the coefficients obtained represent contrasts between the focal level of the variable and the level considered as a reference category. For instance, the variable frequency of home support has four levels; "Everyday", "Once or twice a week", "Once or twice a month" and "Never or almost never". The level of "Every day" is used as

a reference such that all categories for this variable can be compared to it. The coefficient -2.74 for “Once or twice a week” means that a pupil who gets assistance or support from parents “Once or twice a week” has a mean achievement of 2.74 points lower than a pupil who gets support from parents “Every day” after controlling for other pupils‟ background information. For “Once or twice a month” the achievement of pupils is 12.33 points lower. The constant term in the model represents the mean performance of pupils who have characteristics similar to reference level in each variable. For instance, 497.44 means that a female whose age is around the mean age of the pupils studied, coming from a household with home possessions regarded as “High”, have “100 or more books at home”, whose parents support her/him “Every day”, having positive attitudes towards Mathematics learning and lessons; and “Never” gets bullied at school by other pupils got a mean performance of 497.44 points.

This is an ideal situation that every female pupil requires in order to do well. However, it turns out that even when we give our pupils the best scenario they fail to score the minimum 500 international bench mark standard. Nevertheless, the mean achievements are much better than for pupils who do not have these characteristics specified by the reference levels. In the model, all contrasts are negative implying that any female pupil who has characteristics different from the characteristics specified by the reference levels will have a mean lower than 497.44. For instance, a female pupil who comes from a household with home possessions regarded as

“Low”, has” 0-10 books at home”, who is bullied “At least once a month” at school, her parents “Never” support her at home and have negative attitudes towards learning scored 389.89 (497.44-49.64-17.07+1.61-24.98-17.47 =389.89) points. This analysis suggests that when more factors are controlled for in the model better estimates for the mean achievements can be obtained and proper classification of pupils can be done.

Previous TIMSS reports have found that girls outperform boys in Mathematics and Science achievements. It has been noted in Table 3.3 that girls significantly outperform boys in content and cognitive domains. The regression analysis results suggest that after controlling for other pupils background factors, girls outperform boys by 5.09 points which is non-significant at 5%. Therefore, the difference between girls and boys in performance cancels out when you consider pupils background factors. This tells us that pupils are the same in performance irrespective of their gender. Therefore, the differences between girls and boys in performance are mainly due to their different life experiences not their ability. The variable Number of books is non-significant at 5% level. This means that after controlling for other factors, the effect of number of

books at home diminishes. Compared to household with large numbers of books, pupils who come from households with a small number of books perform relatively the same with pupils with large amounts of books at home. Pupils‟ positive attitudes towards Mathematics lessons, attitudes towards learning and general perceptions about Mathematics are associated with better performance.

In science studies, a girl pupil whose age is around the mean age of pupils studied, come from a household with possession regarded as “High”, having “100 or more books at home”, getting assistance from parents “Every day”, having positive attitudes towards learning and lessons; and are “Never” bullied at school scored 490.38 points.

The male pupil counterpart with similar characteristics scored 3.75 points higher than the female pupil. Though the difference is insignificant, it is a new finding because all past TIMSS reports have concluded that females outperform males in Science but this result obtained without controlling for other pupil background factors. However, after controlling for other factors, males outperformed females in Science. This suggests the differences between boys and girls performance in Science are brought about mainly by pupils‟ background variables and not the level of their ability. As in Mathematics, the number of books at home has an insignificant effect on achievement. The results suggest that there is no difference in performance between pupils with more books and those with fewer books. The difference between pupils with “High” home possession and those with “Low” home possession is 74.41. And it is 42.40 for households with “Medium” possession. From this analysis it can be deduced that pupils who have computer, study desk, electricity, tap water etc. are likely to perform better than pupils who have less or nothing of these items. Therefore, long strategies on education must make sure that the socio-economic status of pupils is improved before any intervention on educational curriculum is made.

Likewise, a pupil who is bullied at school more frequently is likely to perform dismally compared to those who are not bullied. Therefore, the safety of pupils in school is paramount if success in achievement is to be reached. Other factors that affect pupils‟ performance are their attitudes towards learning and lessons. It has been discovered that pupils with positive attitudes towards science lessons are likely to perform better than those with negative attitudes. A pupil who has

negative attitudes towards Science lessons scores 86.97 points lower than those with positive attitudes.

Summary

Analysis gave an intriguing insight on relationship between students‟ demographics and students‟ background variables on achievements. A raw analysis of relation between students‟ sex and achievements suggests that girls are more superior to boys in both Mathematics and Science achievements. However, when a regression analysis is used where background variables are controlled for, it was found that girls still perform better than boys in Mathematics but the difference is insignificant. In Science, boys perform better than girls after controlling for student background variables. However, the difference is insignificant.

The result also suggests that an older student in class performs poorly compared to younger students taking into account student life experience differences. Therefore, it is not a panacea to delay students to start school hoping that they will do well when they are older. This applies to retaining students to school or making a student retake a year or two may not help in her/his performance in Mathematics and Science. So, any national policy in education that suggests that students who dropped from school or who failed earlier on must go back to school is likely results in low average performance or decline in performance.

The results also suggests that students‟ safety at school, involvement of parents in students‟ work and availability of basic amenities such water, electricity, internet, etc are positive indicator for better performance. It is therefore paramount for any governing body to improve family socio-economic status so that the students‟ performance can be properly compared to the international students.

Recommendations

The recommendations drawn from the study are based on factors discussed in the study and found to have a significant impact on student performance. These factors are; students age, students‟ amount of home possessions, number of books at home, safety of school and;

Students‟ attitudes towards learning and attending classes. The recommendations are as follows;

(1) Students‟ age at school must be controlled so that the student at the same level of education belongs to the same age cohort. There must not be large variation in age because such scenarios will compromise the general performance of the school or the class. Older students tend to grasp things slowly especially if their schooling was delayed and join the other youthful cohort later. The youthful cohort tends to make fun of the older group and that can lead to animosity in school and class.

(2) Student‟s socio-economic status must be improved for them to perform well in education. Basic amenities such as water, electricity, books, internet, shelter, radio, TV, etc must be accessible to the students at home. Lack of these items may lead to student not concentrate at school and eventual perform badly. For students, who do not have these at home the government must make sure that they are provided at school if possible.

(3) Safety of student at school is paramount for student success. Any student found to be bullying other students must be rehabilitated and warned against doing it.

(4) Students‟ parental guidance is crucial for their performance. Students who reported to get support of some sort from their parents more frequently do better than those who do not get any support at all. The government must continue to seek more parent involvement in students learning because that will soon bear fruits.

(5) It is a concern that the students now days found learning Mathematics and Science not interesting. They feel that Mathematics and Science are very abstract and difficult. Some students have fear on the subjects such that attending the lessons becoming too boring and not related to their future careers. For any country to prosper economically and technologically it needs to develop manpower in Mathematical and Science discipline. Therefore, it is a challenge for the country to encourage students to take Mathematics and Sciences lesson seriously.

CHAPTER FOUR
TEACHERS' BACKGROUND VARIABLES AND PUPILS PERFORMANCE

The teacher plays an integral part in pupils learning. The role of teachers is to facilitate learning. This involves equipping pupils with knowledge and skills relevant at each level. It is therefore imperative that teachers themselves possess necessary knowledge and skills to effectively perform the duties expected of them. Moreover, the environment within which they function, as well as associated resources should necessitate that such duties are performed efficiently and effectively.

In this chapter, an attempt is made to evaluate teacher characteristics/ variables and relate such variables with pupils" performance. The characteristics of interest include the sex of the teacher, age, years of experience in teaching, as well as the environment or the resources availed to the teacher.

Demographic Variables

This portion deals with such demographic variables as sex, age, educational attainment, as well as experience of teachers as they relate to pupils" performance in Mathematics and Science.

Teacher's sex

The teaching profession used to be dominated by females, but there has been a gradual invasion by males. Table 4.1 shows the proportion of each group and how it is related to pupils" performance

Table 4. 1: *Sex of the teacher and pupil performance*

Subject	Sex	n	%	Mean(SE)	SD	Diff
Mathematics	Female	2 107	50.92	409.72 (4.00)	83.90	1,2: -21.20*
	Male	1 920	49.08	430.92 (6.86)	92.56	
Science	Female	2 206	55.61	360.34 (6.86)	125.21	1,2: -22.93
	Male	1 731	44.39	383.27 (11.76)	134.45	

**Statistically significant at 5% level*

In Mathematics, about 50.92 % of the pupils were taught by female teachers and about 49.08 % by male teachers. The pupils taught by male teachers in Mathematics performed significantly better than those taught by female teachers unlike in the previous studies where the gender of a teacher did not matter in the performance of the pupils.

In Science, more than half of the pupils (55.61 %) were taught by female teachers while 44.39 % of the pupils were taught by male teachers. Unlike in Mathematics, the sex of the teacher did not matter in performance as there is no significant difference between the pupils taught by female or male teachers. However, the pupils who were taught by male teachers performed a bit better than those taught by females. This trend is also observed in Mathematics. One can ask himself or herself whether male teachers are better instructors than females in Mathematics and in Science, or it could be that female teachers fail to give more exercises to pupils due to family commitments.

Teacher age and pupil performance

Teachers were grouped into categories of under 30 years, between 30 and 40 years, and at least 50 years. The proportion of these groups and how they related to pupils performance are presented in Table 4.2.

Table 4. 2: *Table showing Teacher age and pupil performance*

Subject	Age	N	%	Mean(SE)	SD	Diff
Mathematics	Under 30 years	790	19.82	402.51 (8.24)	87.91	1,2: -49.30*
	Between 30 and 49 years	344	8.31	451.81 (15.07)	87.30	1,3: -19.15*
	50 and above years	2 919	71.87	421.66 (5.16)	88.00	2,3: 30.15
Science	Under 30 years	714	18.64	353.81 (14.08)	130.04	1,2: -36.98
	Between 30 and 49 years	214	4.78	390.79 (40.78)	133.39	1,3: -19.10
	50 and above years	3 062	76.59	372.91 (7.28)	129.09	2,3: 17.88

**Statistically significant at 5% level*

The majority of the pupils (71.87 % for Mathematics and 76.59 % for Science) were taught by teachers aged 50 years and above. Thus most teachers are nearing the retirement age. Pupils taught by these teachers performed better than those who were taught by teachers aged below 30. This result is only significant in Mathematics. Pupils taught by teachers aged between 30 and 49 years performed the highest of the three age groups; again the result is only significant

in Mathematics. The results show that teachers" performance rises and then reaches climax and suddenly drops. This trend is observed under teachers experience discussion below.

Experience of teachers

In this study Mathematics and Science teachers were asked to indicate or write the number of years they have been teaching. The numbers of years of teaching were grouped into five categories; 1 – 10 years, 11 – 20 years, 21 – 30 years, 31 -40 years and 41 – 50 years.

Table 4. 3: *Table showing teaching experience and performance of pupils*

Subject	Years of Experience	N	%	Mean(SE)	SD	Diff
Mathematics	1-10	2 017	52.93	413.97 (4.99)	86.16	1,2: -14.08 1,3: -19.09
	11-20	956	27.11	428.05 (11.21)	91.17	1,4: 46.17* 1,5: 51.64*
	21-30	614	17.00	433.06 (13.07)	93.27	2,3: -5.01 2,4: 41.16 *
	31-40	77	2.11	386.89 (5.67)	85.32	2,5: 65.72* 3,4: 46.17*
	41-50	32	0.85	362.33 (6.50)	82.90	3,5: 70.73* 4,5 24.56)*
Science	1-10	2	52.93	413.97 (4.99)	86.16	1,2: -24.52 1,3: -29.87
	11-20	956	27.11	428.05 (11.21)	91.17	1,4: 43.33* 1,5: 89.55*
	21-30	614	17.00	433.06 (13.07)	93.27	2,3: -5.35 2,4: 67.85*
	31-40	77	2.11	386.89 (5.67)	85.32	2,5: 114.07* 3,4: 73.20*
	41-50	32	0.85	362.33 (6.50)	82.90	3,5: 119.42* 4,5: 46.22*

**Statistically significant at 5% level*

The majority of the pupils were taught by teachers (97.04 %) with 30 years or lower teaching experience. More than half of the pupils (52.93 %) were taught by teachers who had 1 - 10 years teaching experience and these pupils performed significantly better than those taught by

teachers who had 31 – 50 years teaching experience. Generally pupils who were taught by teachers with 30 years or lower teaching experience performed significantly better than those taught by teachers with over 30 years of teaching experience. It is evident that pupils‟ performance rises with teachers experience reaching optimum and then drops as the teacher gets more experienced.

Teachers' Highest Level of Education and pupil performance

Teachers teaching both Mathematics and Science at this level are expected to have at least Diploma in their respective subjects. Teachers‟ highest qualifications are indicated in table 4.4

Table 4. 4: *Teachers' Highest Level of Education and pupil performance*

Subject	Level of Education	N	%	Mean(SE)	SD	Diff
Mathematics	At most senior secondary	90	2.32	415.85 (14.04)	76.79	1,2: -33.17
	At most diploma	530	15.89	449.02 (15.69)	94.43	1,3: 0.77
	At least first degree	3 281	81.79	415.08 (4.47)	86.99	2,3: 33.94*
Science	utmost senior secondary	60	1.43	333.42 (32.82)	109.72	1,2: -64.99
	utmost diploma	616	15.85	398.41 (20.22)	129.79	1,3: -32.66
	At least first degree	3 269	82.72	366.08 (6.29)	129.09	2,3: 32.33

**Statistically significant at 5% level*

The majority of pupils were taught by teachers who had at least a degree qualification (81.79% in Mathematics and 82.72% in Science). Surprisingly, there are still some unqualified teachers who teach Mathematics and Science. This is interesting because a study by Bennel and Molwane (2008) showed that there was a surplus of qualified teachers in these subjects. The pupils taught by teachers with „At most Diploma‟ performed significantly better than those taught by teachers with „At least first degree‟ in Mathematics, while for Science there was no significant difference. This might be due to the fact that degree qualification is not remunerated for at this level yet at senior secondary it is. As such teachers could be frustrated. There was no statistical significant difference in the performance of the pupils taught by teachers with „Utmost Senior Secondary‟ and those taught by teachers with „Utmost Diploma‟ or „Utmost First Degree‟. The proportion of such teachers is small and so the results must be interpreted with caution.

Major Area of study for Teachers and pupil performance

During training, teachers do two subjects, one being major and the other minor. This strategy is meant to guard against teacher shortage in other subjects. The proportion of teachers who majored in each subject is presented in Table 4.5.

Table 4. 5: *Major Area of study for Teachers during their Post-Secondary Education and pupil performance*

Subject	Area of study	Endorsement	n	%	Mean(SE)	SD	Diff
Mathematics	Education Primary	Yes	2625	76.46	420.94 (5.51)	91.85	1,2: 0.01
		No	1170	23.54	414.92 (5.24)	79.17	
	Education Secondary	Yes	557	16.35	426.49 (6.89)	79.54	1,2: 12.77
		No	3207	83.65	418.26 (5.12)	90.91	
	Maths	Yes	988	37.55	422.35 (7.06)	87.03	1,2: 7.85
		No	2765	62.45	417.48 (6.19)	90.16	
	Science	Yes	1190	38.14	422.95 (8.23)	88.60	1,2: 5.74
		No	2594	61.86	417.53 (5.19)	89.41	
	English	Yes	1350	30.15	435.09 (8.35)	85.13	1,2: 12.3
		No	2403	69.85	413.28 (4.76)	89.96	
	Other	Yes	1728	48.78	420.27(6.47)	91.49	1,2: -3.67
		No	1833	51.22	423.94(7.60)	91.86	
Science	Education Primary	Yes	2625	71.08	370.23 (8.98)	133.45	1,2: 0.01
		No	1170	28.92	369.34 (9.63)	122.57	
	Education Secondary	Yes	557	13.12	402.54 (16.42)	116.55	1,2: 12.77
		No	3207	86.88	365.97 (7.12)	131.53	
	Maths	Yes	988	34.88	366.97 (10.61)	124.80	1,2: -7.85
		No	2765	65.12	371.86 (9.06)	133.32	
	Science	Yes	1190	40.90	376.57 (12.08)	128.36	1,2: 5.74
		No	2594	59.10	365.32 (8.00)	131.52	
	English	Yes	1350	28.16	395.29 (13.52)	126.58	1,2: 12.3
		No	2403	71.84	360.30 (7.53)	130.61	
	Other	Yes	1728	48.78	420.27(6.47)	91.49	1,2: -3.67
		No	1833	51.22	423.94(7.60)	91.86	

**Statistically significant at 5% level*

Most of the pupils in this study were taught Mathematics (76.46 %) and Science (71.08 %) by teachers who majored in „Education Primary / elementary". There were only few pupils taught Mathematics (37.55 %) and Science (38.14) by teachers who majored in the subjects. This calls for the Ministry of Education and Skills Development to increase the teacher trainee numbers at training institutions. The results also show that about 37.55 % of the pupils were taught Mathematics by teachers who majored in Science, while about 40.90 % of the pupils

were taught Science by teachers who majored in Mathematics. Also about 30.15 % of the pupils were taught Mathematics and about 28.16% of the pupils were taught Science by teachers who majored in English.

Characterisation of Teachers' instructional Practices and Pupils' Performance

It has been previously established that at least 97% of teachers were professionally qualified. It was expected therefore that teacher"s professionalism be of the highest level. Teacher instructional practice were investigated such as teachers" job satisfaction, teachers competency and understanding of school goals, teachers degree of success in implementing the school curriculum, teachers expectation of pupil achievement, and so on as outlined in Tables 4.6 and 4.7. Teachers indicated the degree to which these issues/factors were taking place in their schools and the results are presented in Tables 4.6 and 4.7.

It was found that a high proportion of pupils were taught by teachers who characterised the following as low: Parent support for pupils" achievement, parental involvement in school activities, pupils" regards for school property, pupils desire to do well in school. Pupils taught by teachers who characterise instructional practices as medium or high performed better.

Table 4. 6: *Teacher characterisation and Pupils' Performance in Mathematics*

Characteristic	Level	N	%	Mean(SE)	SD	Diff
Job Satisfaction	High	1 612	39.72	436.46 (7.40)	88.29	1,2: 24.0*
	Medium	1 918	48.51	412.38 (5.45)	87.65	1,3: 37.55
	Low	488	11.76	398.91 (11.72)	86.52	2,3: 13.47
Understanding of Curriculum	High	3 147	77.50	423.38 (5.15)	89.57	1,2: 13.11
	Medium	768	18.95	410.27 (7.25)	83.68	1,3: 14.75
	Low	138	3.55	408.63 (35.44)	92.10	2,3: 1.64
Degree of success in Implementing Curriculum	High	2 448	61.59	429.59 (6.07)	89.69	1,2: 22.33*
	Medium	1 333	33.52	407.26 (5.84)	85.88	1,3: 26.61
	Low	210	4.89	402.98 (15.14)	84.43	2,3: 4.28
Expectation for Pupil achievement	High	3 057	75.50	424.67 (4.90)	87.44	1,2: 12.8
	Medium	866	20.98	411.87 (9.73)	90.87	1,3: 45.64*
	Low	130	3.52	379.03 (19.07)	89.67	2,3: 32.84
Parental Support for pupil achievement	High	597	15.59	458.30 (15.57)	91.57	1,2: 21.5
	Medium	1 257	29.99	436.80 (7.06)	84.21	1,3: 57.84*
	Low	2 199	54.42	400.46 (4.47)	84.90	2,3: 36.34*
Parental involvement in school activities	High	441	12.20	462.78 (17.46)	88.87	1,2: 34.66
	Medium	1 361	33.26	428.12 (6.16)	86.34	1,3: 56.61*
	Low	2 251	54.54	406.17 (4.60)	86.54	2,3: 21.95*
Pupils' regard for school property	High	490	13.06	437.58 (14.02)	88.31	1,2: 9.11
	Medium	1 971	47.88	428.47 (6.47)	89.40	1,3: 32.88*
	Low	1 592	39.06	404.70 (6.06)	85.67	2,3: 23.77*
Pupil desire to do well	High	811	20.98	446.33 (12.86)	90.56	1,2: 18.63
	Medium	1 776	43.63	427.70 (5.60)	86.47	1,3: 49.11*
	Low	1 430	35.39	397.22 (5.65)	84.56	2,3: 30.48*

**Statistically significant at 5% level*

Table 4. 7: *Teacher characterisation and Pupils' Performance in Science*

Characteristic	Level	N	%	Mean(SE)	SD	Diff
Job Satisfaction	High	1 622	39.96	389.86 (10.58)	126.75	1,2: 31.27*
	Medium	1 722	46.23	358.59 (9.76)	131.24	1,3: 31.62
	Low	552	13.81	358.24 (17.39)	127.15	2,3: 0.25
Understanding of Curriculum	High	2 992	74.72	378.56 (7.75)	129.15	1,2: 25.23
	Medium	887	22.39	353.33 (11.56)	126.34	1,3: 93.59*
	Low	111	2.90	284.97 (32.48)	128.46	2,3: 68.36*
Degree of success in Implementing Curriculum	High	2 416	60.79	383.97 (9.16)	131.95	1,2: 34.92*
	Medium	1 320	33.97	349.05 (8.29)	123.39	1,3: 33.77
	Low	226	5.24	350.20 (21.55)	125.59	2,3: -1.15
Expectation for Pupil achievement	High	3 186	79.65	377.77 (6.77)	128.30	1,2: 31.99
	Medium	641	16.13	345.78 (16.61)	131.25	1,3: 57.08*
	Low	163	4.22	320.69 (26.80)	129.24	2,3: 25.09
Parental Support for pupil achievement	High	635	16.73	445.29 (19.78)	126.30	1,2: 57.77*
	Medium	1 316	32.00	387.52 (10.06)	123.07	1,3: 110.40*
	Low	2 039	51.27	334.89 (6.56)	122.12	2,3: 52.63*
Parental Support for pupil achievement	High	490	12.96	433.98 (22.53)	128.09	1,2: 45.45
	Medium	1 290	33.55	388.53 (10.29)	126.42	1,3: 90.72*
	Low	2 210	53.50	343.26 (7.13)	124.75	2,3: 45.27*
Pupils' regard for school property	High	428	10.61	381.46 (16.78)	125.50	1,2: -6.13
	Medium	2 126	54.27	387.59 (9.56)	131.42	1,3: 41.53*
	Low	1 436	35.12	339.93 (8.08)	122.82	2,3: 47.66*
Pupil desire to do well	High	908	23.37	415.05 (15.87)	127.71	1,2: 41*
	Medium	1 675	41.92	374.05 (8.54)	126.28	1,3: 79.68*
	Low	1 407	34.72	335.37 (8.81)	125.26	2,3: 38.68*

**Statistically significant at 5% level*

Job satisfaction

The mean scores of those pupils whose teachers said they were satisfied with their jobs were higher for both Mathematics and Science with Mathematics at 436.46 and Science at 389.86. Compared to those teachers with low job satisfaction, the mean score for Mathematics was

398.91 while for Science it was 358.24. The significance test showed that the differences in the mean scores were significant at 5% level.

Understanding of the curriculum

The mean scores of those pupils whose teachers said they understood the curriculum were higher for both Mathematics and Science with Mathematics at 423.38 and Science at 378.56.

Compared to those pupils whose teachers" understanding of the curriculum was low; the mean score for Mathematics was 408.63 and 284.97 for Science. However, the significance test for Mathematics showed that the differences in the mean scores were not significant whereas the significance test for Science implied that the difference in the mean scores was significant.

Degree of success in implementing the curriculum

The mean scores of those pupils whose teachers had a high degree of success in implementing the curriculum were higher for both Mathematics and Science with Mathematics at 429.59 and Science at 383.97. When compared to those teachers with low degree of success in implementing the curriculum; the mean score for Mathematics was 402.98 and 350.20 for Science. The significance test showed that the differences in the mean scores were not significant in Mathematics, but significant in Science.

Expectation for pupil achievement

The mean scores of those pupils whose teachers indicated that they have high expectation for pupil achievement were higher for both Mathematics and Science with Mathematics at 424.67 and Science at 377.77. Compared to those pupils whose teachers said that they have low expectation for pupil achievement; the mean score for Mathematics was 379.03 and 320.69 for Science. The significance test showed that the differences in the mean scores were significant for both Mathematics and Science.

Parental Support for pupil achievement

Pupils whose teachers said are highly satisfied with parental support for pupil achievements have higher mean scores for both Mathematics and Science with Mathematics at 458.30 and

Science at 445.29. Compared to those teachers who said they have low satisfaction with parental support for pupil achievement; the mean score for Mathematics was 400.46 and 334.89 for Science. The significance tests showed that the difference in the mean scores was significant.

Parental Involvement in school activities

Those pupils whose teachers said they are highly satisfied with parental involvement in school activities had higher mean scores for both Mathematics and Science with Mathematics at 462.78 and Science at 433.98. Compared to those teachers who said they had low satisfaction with parental involvement in school activities; the mean score for Mathematics was 406.17 and 343.26 for Science. The significance test shows that the difference in the mean scores was significant.

Pupils' regard for school property

The mean scores of those pupils whose teachers said they have high regard for school property were higher for Mathematics at 437.58 and those rated low had a mean score of 404.70. The difference in the means in Mathematics was significant. In Science the highest mean score was for those pupils whose teachers" rated their regard for school property as medium at 387.59, followed by those rated high at 381. 46 and those rated low at 339.93. There was significant difference between those rated high and those rated low.

Pupil desire to do well

Those pupils whose teachers said they have a high desire to do well had higher mean scores in both Mathematics and Science. Mathematics was at 446.33 and Science at 415.05. Compared to those teachers who said their pupils have a low desire to do well; the mean scores for Mathematics was 397.22 and 335.37 for Science. The significance test revealed that the difference in scores was significant for both Mathematics and Science.

Teachers' Perception on the Safety of the School and Pupils' Performance

In this area, teachers were asked to respond on the safety of the school, which encompassed the location of the school as well as the behaviour or general discipline of the pupils. Teachers were as such responding to whether; the school is located in a safe neighbourhood, the teacher feels safe at the school, the school‟s security policies and practices are sufficient, the pupils behave in an orderly manner, and the pupils are respectful of the teachers. The results are summarised in tables 4.8 and 4.9 for Mathematics and Science teachers, respectively.

Teachers' Views on the Severity of Problems in School Facilities and Pupils' Performance

Schools should be adequately resourced for effective learning to take place in view of the fact that learning is pupil-centred and emphasis is placed on both individual holistic and analytic assessment. Resources needed for effective instruction include classrooms, enough contact hours, adequate workspace, and adequate instructional materials and supplies. Teachers‟ indication of availability of such resources is shown in Table 4.7.

Teachers' Perception on the Safety of the School and Pupils' Performance

In this area, teachers were asked to respond on the safety of the school, which encompassed the location of the school as well as the behaviour or general discipline of the pupils. Teachers were as such responding to whether; the school is located in a safe neighbourhood, the teacher feels safe at the school, the school‟s security policies and practices are sufficient, the pupils behave in an orderly manner, and the pupils are respectful of the teachers. The results are summarised in tables 4.8 and 4.9 for Mathematics and Science teachers, respectively.

Table 4. 8: Teachers‟ Perception on the Safety of the School and Pupils‟ Performance in Mathematics

Safety factor	Endorsement	n	%	Mean(SE)	SD	Diff
School is located in a safe neighbourhood	Agree	2 951	74.81	425.74 (5.25)	88.98	1,2: 22.53*
	Disagree	1 002	25.19	403.21 (7.90)	87.14	
I feel safe at this school	Agree	3 098	77.52	425.01(5.15)	90.44	1,2: 21.34*
	Disagree	883	22.48	403.67(5.84)	81.93	
This school's security policies and practices are sufficient	Agree	2 523	65.76	425.32 (5.87)	91.03	1,2: 12.48
	Disagree	1 412	34.24	412.84 (5.90)	84.51	
Pupils behave in an orderly manner	Agree	2 502	63.59	430.29 (6.09)	90.36	1,2: 27.68*
	Disagree	1 479	36.41	402.61 (4.64)	83.85	
The pupils are respectful of teachers	Agree	2 894	73.23	428.02 (5.35)	89.14	1,2: 29.16*
	Disagree	1 087	26.77	398.86 (6.36)	85.21	

**Statistically significant at 5% level*

Table 4. 9: *Teachers' Perception on the Safety of the School and Pupils' Performance in Science*

Safety factor	Endorsement	n	%	Mean(SE)	SD	Diff
School is located in a safe neighbourhood	Agree	2 797	71.32	376.00 (7.98)	131.49	1,2: 21.45
	Disagree	1 093	28.68	354.55 (11.24)	125.79	
I feel safe at this school	Agree	3 092	78.72	378.55(7.45)	132.30	1,2:40.53*
	Disagree	826	21.28	338.02(8.48)	116.33	
This school's security policies and practices are sufficient	Agree	2 543	67.51	375.73 (8.24)	131.87	1,2:13.07
	Disagree	1 329	32.49	362.66 (9.46)	125.38	
Pupils behave in an orderly manner	Agree	2 475	63.59	383.14 (9.10)	131.78	1,2:36.29*
	Disagree	1 443	36.41	346.85 (9.12)	123.86	
The pupils are respectful of teachers	Agree	2 835	72.67	376.16 (8.04)	130.03	1,2:23.25
	Disagree	1 057	27.33	352.91 (12.93)	129.82	

**Statistically significant at 5% level*

Safe neighbourhood of school location

The teachers were to think of the location of the school and indicate whether or not it was in a safe location. The mean scores of those learners whose teachers said they think the location of the school safe are higher for both Mathematics and Science. Mathematics was at 436.46 of 5.25 compared to those who disagree at 403.21, and Science was at 376.00 compared to those

who disagree at 354.55. The significance test for Mathematics showed that the difference in the mean scores is not significant. For Science, the test showed that the difference in the mean scores is not significant.

Feeling safe at school

The teachers were asked whether or not they felt safe at school. The mean scores of those learners whose teachers said they felt safe at school are higher for both Mathematics and Science. Mathematics was at 425.01 compared to those who disagree at 403.61, and Science was at 378.55 compared to those who disagree at 338.02. The significance test for both Mathematics and Science showed that the difference in the mean scores was significant.

School's security policies and practices sufficient

The teachers were asked whether or not the school"s security policies and practices are sufficient. The mean scores of those learners whose teachers said they agreed that the school"s security policies and practices were sufficient were higher for both Mathematics and Science. Mathematics was at 425.32 compared to those who disagreed at 412.84, and Science was at 375.73 compared to those who disagreed at 362.66. The significance test for Mathematics showed that the difference in the mean scores was not significant. The same was observed for Science.

Pupils behave in orderly manner

The teachers were asked whether or not the learners behaved in an orderly manner. The mean scores of those learners whose teachers said they agreed that the learners behaved in an orderly manner were significantly higher for both Mathematics and Science. Mathematics was at 430.29 compared to those who disagreed at 402.61, and Science was at 383.14 compared to those who disagreed at 346.85.

Pupils are respectful of the teachers

The teachers were asked whether or not the learners respected them. The mean scores of those learners whose teachers said they respected them were higher for both Mathematics and Science. Mathematics was at 428.02 compared to those who disagreed at 398.86, and Science was at 376.16 compared to those who disagreed at 352.91. However, the difference in the

mean scores was not statistically significant for Science, although it is significant for Mathematics.

Teachers' Views on the Severity of Problems in School Facilities and Pupils' Performance in Mathematics and Science

Teachers were requested to show whether there is a problem or not with the various conditions in their schools which could be of consequence to the performance of their teaching duties, and an attempt was then made to relate their responses with the performance of pupils in Mathematics and Science. Such conditions include; school building needs significant repair, classroom overcrowding, too many teaching hours, adequate workspace for preparation and meetings, and adequate instructional materials and supplies. The results are shown in tables 4.10 and 4.11.

Table 4. 10: *Teachers' Views on the Severity of Problems in School Facilities and Pupils' Performance in Mathematics*

School facility	Severity of problem	N	%	Mean(SE)	SD	Diff
School building needing significant repair	Not a problem	414	13.62	452.29 (17.12)	92.89	1,2: 37.14*
	Serious problem	3 567	86.38	415.15 (3.96)	87.35	
Classrooms are overcrowded	Not a problem	1 279	35.85	421.15(8.90)	95.69	1,2: 2.15
	Serious problem	2 673	64.15	419.60(4.63)	85.20	
Teachers have too many teaching hours	Not a problem	1 014	26.60	415.05(8.95)	92.80	1,2: -6.86
	Serious problem	2 883	73.40	421.91(4.66)	88.10	
Teachers do not have adequate workspace	Not a problem	925	25.42	445.18(11.73)	93.28	1,2: 32.98*
	Serious problem	3 001	74.58	412.20(4.16)	86.05	
Teachers do not have adequate instructional materials and supplies	Not a problem	191	6.78	522.58(18.72)	71.57	1,2: 109.81*
	Serious problem	3 790	93.22	412.77(3.59)	85.53	

**Statistically significant at 5% level*

Table 4. 11: *Teachers' Views on the Severity of Problems in School Facilities and Pupils' Performance in Science*

School facility	Severity of problem	n	%	Mean(SE)	SD	Diff
School building needing significant repair	Not a problem	419	13.67	431.27 (26.97)	136.64	1,2: 70.77*
	Serious problem	3 402	86.33	360.50 (5.96)	126.55	
Classrooms are overcrowded	Not a problem	1 426	40.07	362.58(11.79)	140.33	1,2: -12.38
	Serious problem	2 429	59.93	374.96(6.86)	122.96	
Teachers have too many teaching hours	Not a problem	1 101	29.43	385.78(13.74)	134.09	1,2: 22.24
	Serious problem	2 724	70.57	363.54(7.46)	128.22	
Teachers do not have adequate workspace	Not a problem	887	24.47	405.05(18.85)	137.77	1,2: 46.09*
	Serious problem	2 973	75.53	358.96(6.18)	125.50	
Teachers do not have adequate instructional materials and supplies	Not a problem	196	6.84	531.54(19.74)	86.84	1,2: 172.99*
	Serious problem	3 650	93.16	358.55(5.49)	124.92	

**Statistically significant at 5% level*

Generally, resources to facilitate pupil-centred learning were found to be in short supply in schools as shown in that the majority of pupils were taught by teachers who indicated that they lacked such facilities. For example, about 14% of pupils were taught by teachers who indicated that school buildings were in good shape, while about 25% was taught by teachers who indicated that there was adequate workspace for preparation. Generally, pupils taught by teachers who indicated availability of instructional resources performed significantly better in both Mathematics and Science than those in schools with little resources, with the exception of „classroom overcrowding" and „too many teaching hours" where the performance was the same.

The combined effect of availability of some resources and unavailability of some resources cancel each other out resulting in overall pupils" low performance. It is postulated that pupils taught by teachers who indicated that facilities were not a problem could be those of English medium nature.

Computer Usage by Teachers and Pupils' Performance in Mathematics and Science

Experiential learning is an important strategy particularly for both primary pupils and their teachers when using computers for learning purposes. Information on computer usage by teachers at primary school is provided in Tables 4.12 and 4.13.

Table 4. 12: *Computers usage by teachers and Pupils Performance in Mathematics and Science*

Computer usage	Endorsement	N	%	Mean(SE)	SD	Diff
Use computers for teaching	Agree	453	10.95	482.57 (17.43)	88.19	
	Disagree	3 600	89.05	412.73 (3.67)	85.77	1,2: 69.84*
Comfortable in using computers in teaching	Agree	374	81.59	461.60(20.24)	91.44	1,2: 47.76*
	Disagree	96	18.41	413.84(12.33)	80.83	
Have ready access to technical computer support staff in school	Agree	288	61.36	489.83(17.37)	76.90	1,2: 95.8*
	Disagree	182	38.64	394.03(11.05)	81.35	
Receive adequate support for integrating computers in teaching	Agree	221	51.09	488.96(22.16)	81.32	1,2: 76.6*
	Disagree	214	48.91	412.36(18.92)	89.58	

**Statistically significant at 5% level*

Table 4. 13: *Computer usage by teachers and Pupils Performance in Mathematics and Science*

Computer usage	Endorsement	N	%	Mean(SE)	SD	Diff
Use computers for teaching	Agree	297	6.68	505.84 (20.97)	96.13	1,2: 145.35*
	Disagree	3 693	93.32	360.49 (5.33)	126.39	
Comfortable in using computers in teaching	Agree	349	93.10	434.72(28.17)	128.36	1,2: 97.73*
	Disagree	30	6.90	336.99(9.11)	116.90	
Have ready access to technical computer support staff in school	Agree	261	72.90	460.89(32.08)	120.12	1,2: 139.85*
	Disagree	86	27.10	321.04(9.02)	111.52	
Receive adequate support for integrating computers in teaching	Agree	201	54.00	465.50(35.79)	122.97	1,2: 92.42*
	Disagree	146	46.00	373.08(30.05)	127.38	

**Statistically significant at 5% level*

About 11% of pupils were taught Mathematics and about 7% of pupils were taught Science by teachers who used computers for teaching. And yet about 82% pupils for Mathematics and 93% pupils for Science were taught by teachers who indicated that they were comfortable in using computers for teaching. Nevertheless, pupils whose teachers were comfortable in using

computers for teaching, receiving technical support and other kinds of support, performed significantly higher than their counterparts, in both Mathematics and Science.

Teacher collaboration and pupils' performance

Collaboration is an integral aspect of effective instructional strategy. It allows sharing of ideas on how best to approach a particular content, thus employing other strengths to eliminate other weaknesses. The ultimate result is better understanding of the content by pupils and higher achievement of the educational goals. Teachers‟ collaboration involved aspects such as: discussing how to teach a particular topic; collaborate in planning and preparing instructional materials; sharing what they have learned about their teaching experiences; visiting another classroom to learn more about teaching; and working together to try out new ideas. An index was formed with four categories using teachers responses, ranging from „Never or almost never‟ to „Daily or almost daily‟.

Table 4. 14: *Teacher collaboration and pupils' performance in Mathematics and Science*

Subject	Frequency	N	%	Mean(SE)	SD	Diff
Mathematics	Never Or Almost Never	340	10.04	439.39 (21.72)	94.27	1,2: 21.25
	2 Or 3 Times Per Month	1 782	42.28	418.14 (6.78)	91.69	1,3: 24.96
	1-3 Times Per Week	1 333	33.13	414.43 (5.05)	82.70	1,4: 14.28
	Daily Or Almost Daily	563	14.56	425.11 (11.69)	87.79	2,3: 3.71
						2,4: -6.97
						3,4: -10.68
Science	Never Or Almost Never	220	6.64	383.87 (51.43)	148.68	1,2: 4.46
	2 Or 3 Times Per Month	1 461	36.82	379.41 (11.76)	136.34	1,3: 25.05
	1-3 Times Per Week	1 825	44.89	358.82 (7.41)	123.61	1,4: 9.97
	Daily Or Almost Daily	449	11.65	373.90 (14.14)	117.13	2,3: 20.59
						2,4: 5.51
						3,4: -15.08

**Statistically significant at 5% level*

It appears that there is no effect of teacher collaboration on pupils‟ performance. In fact, pupils whose teachers never collaborate had higher mean scores, than those who attempted to collaborate in both Mathematics and Science, though the differences are not statistically significant. Teaches collaboration was not effective. It seemed they did not implement what they collaborated in and continued doing things the way they have been doing them.

Teachers' motivation and Pupils' Performance

The level of motivation can affect how teachers perform their duties. The expectation is that the more teachers are motivated, the more they are likely to carry out their duties efficiently and effectively, which may have a positive effect on pupils‟ performance. Teacher motivation is an index whereby teachers were responding to a set of statements which include; I am content with my profession as a teacher, I am satisfied with being a teacher at this school, I had more enthusiasm when I began teaching than I have now, I do important work as a teacher, I plan to continue for as long as I can, and I am frustrated as a teacher. The results are captured in Table 4.15.

Table 4. 15: *Teachers' motivation and Pupils' Performance in Mathematics and Science*

Subject	Level of motivation	N	%	Mean(SE)	SD	Diff
Mathematics	High Motivated	2 984	72.62	423.69 (5.10)	89.63	
	Disagree	1 069	27.38	411.58 (6.91)	85.77	1,2: 12.11
Science	Agree	3 122	77.15	375.71 (7.06)	130.52	1,2: 24.11
	Disagree	868	22.85	351.60 (13.54)	125.45	

**Statistically significant at 5% level*

The majority of the pupils were taught by motivated teachers, and their mean scores were higher than those taught by unmotivated teachers. However, the difference in mean scores was not statistically significant at 5% level.

Teachers Enthusiasm towards teaching

The teachers were responding to a question that wanted them to indicate the things they do in class that demonstrated that they were enthusiastic towards teaching. The questions were related to ways of teaching, interaction with the learners and motivating the learners, and they include; summarise what pupils should have learned from the lesson, relate the lesson to pupils‟ daily lives, use questioning to elicit reasons and explanations, encourage all pupils to improve their performance, praise pupils for good effort, and bring interesting materials to class. The teachers needed to indicate the frequency at which they did the things that are listed above. Incidentally, those teachers who said they did the things only in some of the lessons have the mean score of their learners greater than those that said they did the things about half the lessons. The comparison will be confined to those who did the things every or almost every lesson and those that said about half the lessons.

Table 4. 16: *Teachers Enthusiasm towards teaching and Pupils' Performance in Mathematics and Science*

Subject	Frequency of Enthusiasm	N	%	Mean(SE)	SD	Diff
Mathematics	Every or almost every lesson	1 532	49.98	424.93(8.43)	90.66	1,2: 8.91
	About half the lessons	1 412	45.79	416.02(7.05)	89.82	1,3: -28.09
	Some lessons	131	4.23	453.02(17.59)	76.09	2,3: -37.00
Science	Every or almost every lesson	1 500	51.95	381.76(12.15)	131.42	1,2: 22.27
	About half the lessons	1 355	47.09	359.49(10.24)	128.72	1,3: 11.21
	Some lessons	30	0.96	370.55(6.57)	104.23	2,3: -11.06

**Statistically significant at 5% level*

Almost half the pupils were taught by teachers who indicated that they were enthusiastic „every or almost every lesson" and the other half was taught by teachers who were enthusiastic „about half the lesson". However, there was no significant difference in pupils" performance between the two groups.

The Extent to Which Pupil Factors Limit Teaching and Pupils' Performance

Pupils" factors which were considered to limit teaching and their performance include: lack of prerequisite knowledge or skills; lack of basic nutrition; not enough sleep; special needs (e.g., physical disabilities, mental or emotional/psychological impairment); disruptive pupils; and uninterested pupils. The extent to which these factors tended to limit teaching is presented in Tables 4.17 and 4.18.

Table 4. 17: *The Extent to Which Pupil Factors Limit Teaching and Pupils' Performance in Mathematics*

Limiting factor	Extent of application	N	%	Mean(SE)	SD	Diff
Lacking prerequisite knowledge	Not applicable	78	2.87	516.89 (39.94)	77.37	1,2: 46.11
	Not at all	86	2.90	470.78 (32.89)	77.37	1,3: 88.63*
	Some	2 368	56.27	428.26 (4.90)	86.17	1,4: 118.43*
	A lot	1 484	37.96	398.46 (5.46)	85.81	2,3: 42.52 2,4: 72.32* 3,4: 29.80*
Suffering from lack of basic nutrition	Not applicable	1 085	27.69	435.72 (10.08)	93.22	1,2: 0.96
	Not at all	946	25.17	434.76 (8.53)	84.28	1,3: 31.41*
	Some	1 727	42.97	404.31 (4.81)	85.19	1,4: 30.41
	A lot	173	4.17	405.31 (20.28)	89.25	2,3: 30.45* 2,4: 29.45 3,4: -1.00
Suffering from not enough sleep	Not applicable	939	23.47	430.38 (8.54)	87.38	1,2: 2.03
	Not at all	560	13.92	428.35 (11.56)	87.15	1,3: 16.76 1,4: -5.27
	Some	2 311	57.52	413.62 (5.49)	88.15	2,3: 14.73 2,4: -7.30
	A lot	206	5.08	435.65 (23.80)	97.88	3,4: -22.03
Special needs	Not applicable	1 262	32.35	429.87(8.36)	88.98	1,2: 14.16
	Not at all	537	13.57	415.71(13.69)	92.20	1,3: 16.21 1,4: -5.16
	Some	1 910	46.86	413.66(6.14)	87.52	2,3: 2.05 2,4: -19.32
	A lot	307	7.22	435.03(12.85)	83.55	3,4: -21.37
Disruptive pupils	Not applicable	359	9.94	410.91 (6.67)	84.20	1,2: -20.75
	Not at all	280	8.12	431.66 (28.31)	98.46	1,3: -9.89 1,4: -8.64
	Some	2 812	69.20	420.80 (5.01)	87.56	2,3: 10.86
	A lot	536	12.74	419.55 (11.97)	90.81	2,4: 12.11 3,4: 1.25
Uninterested pupils	Not applicable	233	7.25	464.02 (24.58)	84.57	1,2: 29.50
	Not at all	204	5.65	434.52 (18.97)	88.94	1,3: 43.23

	Some	2 771	67.65	420.79 (4.92)	87.35	1,4: 63.65* 2,3: 13.73
	A lot	808	19.46	400.37 (8.88)	88.48	2,4: 34.15 3,4: 20.42*

*Statistically significant at 5% level

Table 4. 18: *The Extent to Which Pupil Factors Limit Teaching and Pupils' Performance in Science*

Limiting Factor	Extent of limit	N	%	Mean(SE)	SD	Diff
Lacking prerequisite knowledge	Not applicable	100	3.59	511.86 (43.06)	99.48	1,2: 106.11*
	Not at all	158	4.05	405.75 (27.71)	106.64	1,3: 125.36*
	Some	2 310	57.42	386.50 (7.70)	126.69	1,4: 183.65*
	A lot	1 316	34.94	328.21 (8.74)	123.11	2,3: 19.25 2,4: 77.54* 3,4: 58.29*
Suffering from lack of basic nutrition	Not applicable	1 266	33.42	396.34 (13.13)	136.09	1,2: 7.07
	Not at all	1 000	26.19	389.27 (10.75)	122.75	1,3: 59.09*
	Some	1 414	36.54	337.25 (7.44)	121.87	1,4: 29.50
	A lot	148	3.85	366.84 (28.33)	127.14	2,3: 52.02)* 2,4: 22.43 3,4: -29.59
Suffering from not enough sleep	Not applicable	1 049	28.50	393.66 (12.95)	133.52	1,2: 19.74
	Not at all	531	12.35	373.92 (11.67)	119.33	1,3: 34.67*
	Some	2 052	54.73	358.99 (8.85)	128.43	1,4: 27.08
	A lot	180	4.43	366.58 (33.91)	137.37	2,3: 14.93 2,4: 7.34 3,4: -7.59
Special needs	Not applicable	1 231	32.95	394.33(13.02)	129.20	1,2: 33.86
	Not at all	540	14.19	360.47(20.27)	130.25	1,3: 37.72
	Some	1 855	46.85	356.61(8.54)	128.85	1,4: 7.11
	A lot	258	6.01	387.22(21.47)	120.66	2,3: 3.86 2,4: -26.75 3,4: -30.61
Disruptive pupils	Not applicable	305	8.95	371.82 (12.80)	127.56	1,2: -7.30
	Not at all	479	13.39	379.12 (26.25)	135.14	1,3: -2.12
	Some	2 639	67.81	373.94 (7.62)	128.60	1,4: 27.49
	A lot	395	9.85	344.33 (19.67)	130.92	2,3: 5.18 2,4: 34.79 3,4: 29.61
Uninterested pupils	Not applicable	184	5.74	450.47 (45.09)	125.04	1,2: 64.37
	Not at all	236	6.50	386.10 (26.38)	128.85	1,3: 74.83

	Some	2 735	70.13	375.64 (7.11)	128.52	1,4: 123.84*
	A lot	695	17.63	326.63 (10.48)	120.90	2,3: 10.46 2,4: 59.47* 3,4: 49.01*

*Statistically significant at 5% level

The majority of pupils (at least 50%) were taught Mathematics and Science by teachers who indicated that factors considered to limit teaching and ultimately pupils performance were prevalent to at least „some" extent, with the exception of „pupils suffering from basic nutrition".

However, it is worth noting the severity of some factors. At least 92% of pupils were taught Mathematics and Science by teachers who indicated that pupils lacked pre-requisite knowledge in the subject at least to „some" extent. For „disruptive behaviour" and „lack of interest" at least 77% and 87% of pupils respectively were taught by teachers who reported at least „some extent" of prevalence.

Generally, pupils affected by the limiting factors to at least „some extent" performed significantly lower than those not affected, particularly with regards to; pupil lacking pre-requisite knowledge, pupils suffering from basic nutrition, and uninterested pupils, in both the subjects.

Teacher-Parent Interaction

Learning is not confined to school per se, but the most important learning takes place at home. As a consequence, it is important that teachers and parents meet often to discuss individual pupil"s learning progress during the course of the year, followed by sending the pupil progress report as per the school policy. The frequency of teacher-parent interaction is presented in Table 4.19, and related to pupils" performance.

Table 4. 19: *Teacher-parent interaction and Pupils' Performance in Mathematics and Science*

Subject	Frequency of meetings	n	%	Mean(SE)	SD	Diff
Mathematics	At least once a week	172	5.01	434.92 (19.96)	85.79	1,2: 0.07
	Once or twice a month	1 157	30.37	434.85 (9.89)	89.20	1,3: 27.59
	4-6 times a year	862	21.16	407.33 (5.90)	80.85	1,4: 14.17
						1,5: 58.11*
	1-3 times a year	1 611	39.55	420.75 (6.95)	90.78	2,3: 27.52*
						2,4: 14.10
	Never	150	3.90	376.81 (12.19)	83.89	2,5: 58.04*
						3,4: -13.42
						3.5: 30.52*
						4,5: 43.94*
Science	At least once a week	206	5.57	370.53 (33.49)	140.49	1,2: -21.76
	Once or twice a month	1 345	34.37	392.29 (13.09)	127.96	1,3: 15.92
	4-6 times a year	816	20.48	354.61 (10.06)	119.86	1,4: 3.20
						1,5: 44.19
	1-3 times a year	1 398	35.84	367.33 (11.40)	132.59	2,3: 37.68*
						2,4: 24.96
	Never	123	3.75	326.34 (24.46)	120.56	2,5: 65.95
						3,4: -12.72
						3,5: 28.27
						4,5: 40.99

*Statistically significant at 5% level

Table 4. 20: *Teacher Sends a Progress Report Home*

Subject	Frequency	N	%	Mean(SE)	SD	Diff
Mathematics	At least once a week	132	4.57	479.33 (38.83)	93.13	1,2: 64.00
	Once or twice a month	417	10.74	415.33 (14.11)	84.40	1,3: 72.12
						1,4: 59.48
	4-6 times a year	437	10.28	407.21 (12.40)	87.89	1,5: 62.47
	1-3 times a year	2 802	70.24	419.85 (4.71)	88.31	2,3: 8.12
						2,4: -4.52
	Never	176	4.17	416.86 (13.02)	81.93	2,5: -1.53
						3,4: -12.64
						3,5: -9.65
						4,5: 2.99
Science	At least once a week	23	1.34	559.92 (13.32)	61.71	1,2: 193.77* 1,3:
	Once or twice a month	536	14.13	366.15 (18.47)	129.03	187.08*
						1,4: 190.58* 1,5:
	4-6 times a year	495	11.87	372.84 (15.29)	123.55	187.54*
	1-3 times a year	2 730	69.74	369.34 (6.70)	129.78	2,3: -6.69
						2,4: -3.19
	Never	104	2.92	372.38 (19.88)	110.64	2,5: -6.23
						3,4: 3.50
						3,5: 0.46
						4,5: -3.04

**Statistically significant at 5% level*

There was good interaction between teachers and parents. The majority of pupils were taught by teachers who indicated that they met parents at least „1-3 times a year" to discuss their children"s learning progress individually. It is encouraging to note that at least 30% of the pupils in both Mathematics and Science, were taught by teachers who met parents at least „once a month" (collapsing „at least once a month" and „once or twice a month"). The proportion of pupils taught by teachers who „never" met parents was too small and could not be comparable. The frequency of teacher-parent interaction was positively related to pupils" performance in both Mathematics and Science.

Similarly, the majority of pupils (70.2% for Mathematics and 69.7% for Science) were taught by teachers who sent pupils report 1-3 times a year. A sizeable proportion (more than 25% for both subjects) was taught by teachers who sent the reports more frequently. The proportion of pupils taught by teachers who „never" and those who sent pupils progress report „at least once a week"

was too small for comparison purposes. Although the frequency of sending pupils progress report was positively associated with performance, there were significant differences between levels of frequency.

Confidence in performing instructional practices

Teachers are trained on both instructional methodology and subject content. Instructional methodologies enable teachers to confidently answer questions, show pupils a variety of problem solving strategies (Mathematics) or explain science concepts or principles by doing experiments (Science), providing challenging tasks to capable pupils, adapting teaching to engage pupils‟ interest, and helping pupils appreciate the value of learning the subject in question. An index was formed with two categories of „confident‟ and „not confident‟. Table 4.21 presents the teachers confidence and pupils‟ performance.

Table 4. 21: *Teachers' Confidence in Performing Certain Professional Duties and Pupils' Performance in Mathematics and Science*

Subject	Confidence level	n	%	Mean(SE)	SD	Diff
Mathematics	Very confident	3 006	84.08	418.53(4.53)	89.13	
	Somewhat confident	565	15.92	420.35(8.53)	81.87	1,2: -1.82
Science	Very confident	2 885	81.17	379.54(6.46)	128.42	
	Somewhat confident	682	18.83	350.69(16.36)	132.26	1,2: 29.00

**Statistically significant at 5% level*

The majority of pupils for both Mathematics (84.1%) and Science (81.8%) were taught by teachers who indicated that they were very confident in performing instructional practices. However, there was no significant differences in performance between pupils taught by teachers who were confident and those taught by teachers who were somewhat confident.

The Extent to which Teachers ask their Pupils to Employ Various Learning strategies

The teachers were asked to provide information on how often they ask pupils to employ various strategies that could enhance their learning. Such strategies include, listen when teacher explains how to solve problems, memorize rules, procedures and facts, work problems with teacher‟s guidance, etc. The results are summarized in tables 4.22 and 4.23 below.

Table 4. 22: *The Extent to which Mathematics Teachers ask their Pupils to Employ Various Learning Strategies, and Pupils' Performance in Mathematics*

Learning Strategies	Frequency	N	%	Mean (SE)	SD	Diff
Listen to me explain how to solve problems	Every or almost every lesson	2 962	82.54	420.46(4.52)	87.92	1,2: 11.51
	Some lesson	644	17.46	408.95(10.60)	88.47	
Memorise rules, procedures, and facts	Every or almost every lesson	2 166	59.09	416.79(5.67)	88.97	1,2: -7.89
	Some lesson	1 383	39.42	424.68(7.38)	85.53	1,3: 60.26*
	Never	49	1.49	356.53(29.60)	77.25	2,3: 68.15*
Work problems (individually or with peers)with my guidance	Every or almost every lesson	2 395	67.51	417.40(4.96)	89.66	1,2: -0.39
	Some lesson	1 217	32.49	417.79(5.81)	82.96	
Work problems together in the whole class with direct guidance from me	Every or almost every lesson	2 375	64.06	414.64(4.63)	86.03	1,2: -11
	Some lesson	1 257	35.94	425.64(7.69)	90.85	
Work problems (individually or with peers)while I am occupied by other tasks	Every or almost every lesson	1 268	36.87	425.37(6.01)	87.01	1,2: 9.37
	Some lesson	2 018	53.86	416.00(6.20)	87.16	1,3: 18.65
	Never	346	9.28	406.72(15.69)	93.93	2,3: 9.28
Explains their answers	Every or almost every lesson	2 444	70.73	423.20(4.680	86.16	1,2: 14.67
	Some lesson	1 044	29.27	408.53(7.82)	91.91	
Relate what they are learning in Maths to their daily lives	Every or almost every lesson	2 007	57.28	420.42(5.71)	90.32	1,2: 4.4
	Some lesson	1 593	42.72	416.02(5.02)	84.74	
Take a written test or quiz	Every or almost every lesson	1 168	33.07	420.61(5.75)	85.41	1,2: 3.02
	Some lesson	2 464	66.93	417.59(5.65)	89.16	

**Statistically significant at 5% level*

Table 4. 23: The Extent to which Mathematics Teachers ask their Pupils to Employ Various Learning Strategies, and Pupils‟ Performance in Science

Leaning Strategy	Frequency	N	%	Mean (SE)	SD	Diff
Observe natural phenomena such as the weather or a plant growing and describe what they see	Every or almost every lesson	873	25.65	395.34(16.76)	131.77	1,2: 29.37
	Some lessons	2 664	73.52	365.97(7.09)	128.05)	1,3: -42.58*
	Never	30	0.84	437.92(2.71)	109.22	2,3: 71.95*
Watch me demonstrate an experiment or investigation	Every or almost every lesson	776	22.48	391.44(18.81)	131.55	1,2: 22.61
	Some lessons	2 760	77.52	368.83(6.50)	128.73	
Design or plan experiments or investigations	Every or almost every lesson	716	21.07	390.45(19.85)	132.81	1,2: 19.85
	Some lessons	2 763	77.14	370.60(6.34)	128.67	1,3: 68.31*
	Never	57	1.79	322.14(22.76)	111.29	2,3: 48.46*
Conduct experiments or investigations	Every or almost every lesson	840	24.38	383.13(17.37)	131.32	1,2: 12.19
	Some lessons	2 632	73.33	370.94(7.17)	129.52	1,3: 12.13
	Never	64	2.30	371.00(38.18)	112.89	2,3:- 0.06
Read their textbook or other resource materials	Every or almost every lesson	2 340	66.43	370.38(8.08)	127.70	1,2: -9.19
	Some lessons	1 187	33.57	379.57(11.95)	133.40	
Have pupils memorise facts and principles	Every or almost every lesson	1 540	42.83	372.69(11.28)	127.79	1,2: -4.58
	Some lessons	1 937	55.67	377.27(8.35)	130.38	1,3: 107.64*
	Never	49	1.50	265.05(20.34)	104.04	2,3: 112.22*
Give explanation about something they are studying	Every or almost every lesson	2 758	77.69	377.64(6.69)	129.68	
	Some lessons	809	22.31	361.79(14.16)	128.74	1,2: 15.85
Relate what they are learning in Science to their daily lives	Every or almost every lesson	2 426	66.74	379.94(8.11)	132.49	1,2: 17.55
	Some lessons	1 141	33.26	362.39(9.16)	122.87	
Do field work outside the class	Every or almost every lesson	526	14.25	393.94(24.22)	124.45	1,2: 23.18
	Some lessons	2 813	80.28	370.76(6.87)	130.35	1,3: 25.85
	Never	197	5.47	368.09(28.41)	129.02	2,3: 2.67
Take a written quiz	Every or almost every lesson	1 194	33.94	362.64(10.10)	125.55	
	Some lessons	2 373	66.06	380.00(8.42)	131.30	1,2: -17.36

**Statistically significant at 5% level*

The results showed that almost all teachers asked their pupils to employ various strategies to enhance their learning. Consequently, there seemed to be no distinction in the performance of

the pupils in relation to how often their teachers ask them to employ such learning strategies.

There were some pupils who were taught by teachers who „never" employed some of the learning activities, although this is a small number.

Time of Content Coverage for each Main Topic in Mathematics and Science

Teachers were asked to state when they covered most content in different subject domains of Mathematics and Science.

Table 4. 24: *Time of Content Coverage for each Main Topic in Mathematics and Pupils' Performance*

Content	Extent of coverage	n	%	Mean (SE)	SD	Diff (SE)
Number	Mostly taught before this year	1 762	50.55	419.51 (5.35)	87.34	1,2: 3.77
	Mostly taught this year	1 780	49.11	415.74 (6.22)	88.25	1,3: -24.35*
	Not yet taught or just introduced	8	0.35	443.86 (8.02)	41.75	2,3: -28.12*
Geometric Shapes and Measures	Mostly taught before this year	1 185	34.55	415.59 (5.66)	84.87	1,2: -1.34
	Mostly taught this year	2 313	63.76	416.93 (5.41)	88.77	1,3: -76.88*
	Not yet taught or just introduced	52	1.69	492.47 (22.08)	70.12	2,3: -75.54*
Data Display	Mostly taught before this year	1 368	39.62	416.42 (5.71)	84.11	1,2: -80.0
	Mostly taught this year	2 085	57.57	417.22 (5.52)	89.71	1,3: -30.65
	Not yet taught or just introduced	97	2.81	447.07 (33.70)	90.60	2,3: -29.85

**Statistically significant at 5% level*

Table 4. 25: *Time of Content Coverage for each Main Topic in Science and Pupils' Performance*

Content	Extent of coverage	n	%	Mean (SE)	SD	Diff (SE)
Life Science	Mostly taught before this year	717	20.89	373.14 (13.88)	126.93	1,2: -1.86
	Mostly taught this year	2 729	76.63	375.00 (7.71)	129.09	1,3: 18.40
	Not yet taught or just introduced	121	2.49	354.74 (93.75)	163.09	2,3: 20.26
Physical Science	Mostly taught before this year	908	26.25	376.00 (16.54)	129.68	1,2: 2.65
	Mostly taught this year	2 519	70.22	373.35 (7.18)	128.22	1,3: -10.21
	Not yet taught or just introduced	116	3.53	386.21 (77.55)	154.11	2.3: -12.86
Earth Science	Mostly taught before this year	886	25.35	363.32 (16.20)	127.12	1,2: -24.05
	Mostly taught this year	2 218	61.99	387.37 (8.34)	127.77	1,3: 29.42
	Not yet taught or just introduced	439	12.66	333.90 (19.94)	133.07	2,3: 53.47*

**Statistically significant at 5% level*

The results showed that generally there was no significant difference in the performance of pupils as regard to when they were taught particular content domain in Mathematics. However, in science pupils who were taught in content domains in the year they took the examination have higher means than those taught the previous year and those who were not yet taught. The difference is significant particularly in Earth Science, as shown in table 4.25.

Frequency of Engaging Pupils with different Learning Activities

Pupil-centred encourages pupils to learn by doing. In so doing, they create knowledge of their own which helps understand concepts better. Pupils have different styles of learning and learn at different rates. Tables 4.26 and 4.27 present the frequency of engaging pupils in different activities to enhance learning. Such activities were giving pupils homework; correcting assignments and giving feedback; discussing homework in class; and monitoring the completion of homework. Most pupils were taught Mathematics and Science by teachers who engaged pupils on different activities more frequently. Generally almost all teachers corrected assignments and gave feedback to pupils, discussed homework in class and monitored homework completion.

Table 4. 26: *Frequency of Engaging Pupils in different activities and Pupils' Performance in Mathematics*

Activity	Frequency of engaging pupils	n	%	Mean (SE)	SD	Diff (SE)
Assigning reading as part of homework	No homework	24	0.84	426.91 (7.66)	84.24	1,2: 43.99* 1,3: 7.17 1,4: 10.03 1,5: -9.68 2,3: -36.82* 2,4: -33.96* 2,5: -53.67* 3,4: 2.86 3,5: -16.85 4,5: -19.71
	Less than once a week	158	4.39	382.92 (14.02)	80.97	
	1 or 2 times a week	926	27.55	419.74 (8.06)	85.22	
	3 or 4 times a week	1 602	48.50	416.88 (6.61)	89.31	
	Every day	59	18.72	436.59 (14.83)	90.12	
Time spend on reading homework	15 minutes or less	435	11.98	419.05 (11.61)	85.26	1,2: -2.26 1,3: -4.96 1,4: 23.56 2,3: -2.70 2,4: 25.82 3,4: 28.52
	16-30 minutes	1 718	49.18	421.31 (6.42)	88.05	
	31-60 minutes	991	31.70	424.01 (6.65)	87.73	
	More than 60 minutes	222	7.13	395.49 (25.64)	96.30	
Correcting assignments and giving feedback	Always or almost always	3 309	97.73	420.65 (4.22)	88.44	1,2: 41.66*
	Sometimes	86	2.27	378.99 (4.44)	78.89	
Discussion of homework in class	Always or almost always	3 094	91.37	417.84 (4.54)	88.54	1,2: -21.68
	Sometimes	301	8.63	439.52 (13.57)	84.93	
monitoring completion of homework	Always or almost always	3 395	100	419.71 (4.21)	88.45	

**Statistically significant at 5% level*

Table 4. 27: *Frequency of Engaging Pupils with different activities and Pupils' Performance in Science*

Activity	Frequency	n	%	Mean (SE)	SD	Diff
Frequency of assigning reading as part of homework	No homework	32	1.22	363.59 (35.34)	113.57	1,2: 6.28 1,3: -9.38 1,4: 0.5 1,5: -81.52* 2,3: -15.66 2,4: -6.23 2,5: -87.80* 3,4: 9.43 3,5: -72.14* 4,5: -81.57*
	Less than once a week	165	5.10	357.31 (60.14)	163.47	
	1 or 2 times a week	2 512	74.48	372.97 (7.47)	128.84	
	3 or 4 times a week	505	17.44	363.54 (23.27)	129.83	
	Every day	58	1.76	445.11 (9.10)	90.91	
Time pupils are expected to spend on reading homework	15 minutes or less	395	11.06	383.12 (25.20)	137.25	1,2: 0.90 1,3: 18.34 1,4: 72.93 2,3: 17.44 2,4: 72.03 3,4: 54.59
	16-30 minutes	1 661	48.51	382.22 (10.95)	128.64	
	31-60 minutes	1 306	38.03	364.78 (9.13)	124.74	
	More than 60 minutes	83	2.40	310.19 (39.89)	143.43	
Frequency of correcting assignments and giving feedback	Always or almost always	3 185	93.49	377.54 (6.88)	129.94	1,2: 36.38*
	Sometimes	266	6.51	341.16 (16.34)	115.13	
Frequency of discussion of homework in class	Always or almost always	3 126	90.09	374.69 (6.62)	129.27	1,2: -3.30
	Sometimes	351	9.91	377.99 (23.05)	128.79	
Frequency of monitoring if homework was completed	Always or almost always	3 328	96.73	373.87 (6.22)	128.42	1,2: -39.73
	Sometimes	123	3.27	413.60 (72.63)	149.01	

**Statistically significant at 5% level*

In Mathematics, most pupils are taught by teachers who give assignments 3 to 4 times a week. However, there seem to be no significant difference in the performance of the pupils who are given assignments 3 to 4 times a week and those given 1 to 2 times. On the other hand, pupils who are given assignments every day perform significantly higher than others as shown in table 4.18. Most pupils are given 16 to 30 minutes assignments (about 49%), followed by those given 31 to 60 minutes assignments (about 32%). Although pupils given 31 to 60 minutes assignments have higher means (424), followed by those given 16 to 30 minutes assignments (421), the difference in the means is not significant. Generally almost all teachers corrected

assignments and gave feedback to pupils, discussed homework in class and monitored whether or not the homework was completed.

In Science, most teachers give assignments 1 to 2 times a week (about 48% of pupils are given) followed by 3 to 4 times (about 38% of pupils given). Only an insignificant 2% of the pupils are given assignments every day, yet with significantly higher mean scores. Generally there is no significant difference in the mean scores of pupils given assignments between 1 to 2 times and 3 to 4 times a week. However, these groups perform higher than those given assignments less than 1 times a week, as shown in table 19. As in Mathematics, most pupils are given 16 to 30 minutes assignments (about 49%) followed by those given 31 to 60 minutes assignments (about 38%). The mean scores of those given 15 minutes or less assignments (383) and those given 16 to 30 minutes assignments (382) are higher than those given 31 to 60 minutes assignments (364) and those given more than 60 minutes assignments (310). However the difference in the means is not statistically significant.

Also, generally almost all teachers correct assignments and give feedback to pupils, discuss homework in class and monitor whether or not the homework was completed.

Teacher Emphasis of different kinds of assessment methods and Pupils' Performance

To understand what each and every pupil what can do, it is important that a holistic assessment be conducted employing different assessment strategies such as evaluation of pupils‟ on-going work, classroom tests, and national or regional achievement tests. Tables 4.28 and 4.28 summarize the results.

Table 4. 28: *Teacher Emphasis of different kinds of assessment methods and Pupils' Performance in Mathematics*

Assessment method	Emphasis	N	%	Mean (SE)	SD	Diff
Evaluation of pupils' ongoing work	Major emphasis	2 960	84.03	419.83(4.61)	89.05	1,2: 7.33
	Some emphasis	608	15.97	412.50(7.22)	83.31	
Class tests	Major emphasis	3 083	86.96	416.89 (4.40)	87.86	1,2: -13.58
	Some emphasis	485	13.04	430.47 (11.16)	89.57	
National or regional achievement tests	Major emphasis	2 519	69.94	415.23 (5.10)	88.77	1,2: -13.28
	Some emphasis	929	26.21	428.51 (8.68)	86.33	1,3: 1.37
	Little or no emphasis	120	3.85	413.86 (21.46)	85.12	2,3: 14.55

**Statistical significant at 5% level*

Table 4. 29: *Teacher Emphasis of different kinds of assessment methods and Pupils' Performance in Science*

Assessment method	frequency	N	%	Mean (SE)	SD	Diff
Evaluation of pupils' ongoing work	Major emphasis	3 052	87.26	366.78 (6.81)	128.84	1,2: -57.51*
	Some emphasis	515	12.74	424.29 (20.25)	123.86	
Class tests	Major emphasis	3 027	84.22	368.44 (6.75)	129.39	1,2: -35.00
	Some emphasis	566	15.78	403.44 (17.18)	126.27	
National or regional achievement tests	Major emphasis	2 677	74.47	367.23 (6.81)	127.74	1,2: -20.20
	Some emphasis	724	20.23	387.43 (16.72)	130.38	1,3: -52.67
	Little or no emphasis	166	5.29	419.90 (49.94)	139.64	2,3: -32.47

**Statistically significant at 5% level*

Generally most pupils were taught by teachers who put major emphasis in all methods of assessments in both Mathematics and Science. For example, with regard to evaluation of pupils‟ on-going work, 84% of pupils were taught by teachers who put a major emphasis on this aspect of assessment, and their mean score was 419.83, compared to 16% of pupils whose teachers put some emphasis and had a mean score of 412.50 in Mathematics. In Science, strangely pupils who were taught by teachers who put „some emphasis‟ on evaluation of pupils on going work, performed significantly higher than those whose teachers put a major emphasis (with mean scores of about 424 against 366.78) on evaluation of pupils‟ work. Probably Science teachers were not well trained to evaluate on-going work, as evidenced by abundant literature.

Teacher Participation in Professional Development Activities

Teachers were asked whether they had participated in professional development activities, which include; content development, pedagogy/instruction development, curriculum development, integrating information technology, assessment methods development, and addressing individual pupils‟ needs. The results are summarized in table 4.30 below.

Table 4. 30: *Teacher Participation in Professional Development Activities and Pupils' Performance in Mathematics and Science*

Subject	Development Activity	Participation status	n	%	Mean SE)	SD	Diff
Mathematics	Mathematics content	Yes	524	16.31	441.78 (11.14)	87.07	1,2: 27.96*
		No	2 973	83.69	413.82 (4.55)	87.57	
	Mathematics pedagogy/instruction	Yes	280	8.47	449.64 (18.01)	90.15	1,2: 33.28
		No	3 205	91.53	416.36 (4.26)	87.35	
	Mathematics curriculum	Yes	429	13.65	468.63(15.88)	86.72	1,2: 57.95*
		No	3 050	86.35	410.68(3.96)	85.82	
	Integrating information technology into Maths	Yes	440	11.69	439.79(14.81)	89.93	1,2: 24.53
		No	2 977	88.31	415.26(4.51)	87.60	
	Mathematics assessment	Yes	956	27.42	430.58(9.08)	89.28	1,2: 16.26
		No	2 550	72.58	414.32(4.81)	87.22	
	Addressing individual pupil's needs	Yes	1 825	51.38	430.62(6.82)	87.87	1,2: 24.36*
		No	1 681	48.62	406.26(5.09)	86.58	
Science	Science content	Yes	836	25.80	394.60 (17.31)	135.38	1,2: 27.65
		No	2 635	74.20	366.95 (6.69)	127.13	
	Science pedagogy/instruction	Yes	579	15.77	389.70 (12.34)	124.93	1,2: 18.54
		No	2 892	84.23	371.16 (7.30)	130.57	
	Science curriculum	Yes	705	19.99	388.85(19.98)	136.26	1,2: 18.65
		No	2 771	80.01	370.20(7.02)	128.07	
	Integrating information technology into Science	Yes	666	18.47	387.81(15.10)	124.10	1,2: 17.24
		No	2 838	81.53	370.57(7.10)	130.89	
	Science assessment	Yes	1 139	33.07	403.72(14.01)	129.34	1,2: 44.27*
		No	2 332	66.93	359.45(7.35)	127.62	
	Addressing individual pupil's needs	Yes	1 686	48.18	393.41(10.68)	128.69	1,2: 37.83*
		No	1 818	51.82	355.48(8.28)	128.21	

**Statistically significant at 5% level*

Generally the results reveal that most teachers do not have opportunities to participate in the development of their profession in all areas outlined. However, the results also reveal that pupils who were taught by teachers who participated in the development of their profession performed higher than their counterparts. For instance, only 16% of the pupils were taught by teachers who participated in Mathematics content development against 84%, and their mean score is 441.78

against 413.82. This difference is statistically significant. In Science, the pattern is the same, though the difference is not statistically significant. The same is observed in curriculum development.

Nonetheless there is an improvement in the number of teachers in relation to addressing individual pupils" needs in both Mathematics and Science. The performance of pupils is even better where teachers are more involved in addressing individual pupils" needs.

Teacher's Preparedness in teaching Different Mathematics Topics and Pupils' Performance

Teachers were asked to respond to how well they are prepared to teach particular content domains in Mathematics, which include; number, geometric shapes and measures, and data display. Table 4.31 provides the summary of the results.

Table 4. 31: *Teacher's Preparedness in teaching Different Mathematics Topics and Pupils' Performance*

Topic	Extent of preparedness	N	%	Mean (SE)	SD	Diff (SE)
Number	Somewhat prepared	141	79.25	402.59(12.15)	77.29	1,2: -27.58*
	Not well prepared	28	20.75	430.17(3.06)	72.81	
Geometric Shapes and Measures	Somewhat prepared	340	91.38	421.60(9.89)	82.52	1,2: 20.71
	Not well prepared	35	8.62	400.89(9.55)	68.05	
Data Display	Somewhat prepared	261	100	404.54(8.88)	86.71	

**Statistically significant at 5% level*

The results shown in table 4.31 reveal that teachers were at least „somewhat prepared" to teach each topic. They were more prepared to teach *Data Display* than any other content. Most pupils (about 79%) were taught by teachers who were „somewhat prepared" to teach *Numbers*. Furthermore pupils who were taught by teachers who were „somewhat prepared" performed significantly higher than those whose teachers were not well prepared. For *geometric shapes and measures*, the majority were „somewhat prepared" and pupils" mean scores were higher than those whose teachers were „not well prepared" though the difference was not statistically significant.

Teacher's Preparedness in teaching Different Science Topics

Trained teachers should be adequately armed and prepared to teach any topic in their subject. Content domains in Science include; Life Science, Physical Science, and Earth Science. Table 4.32 presents the extent of teachers‟ preparedness to teach each content domain.

Table 4. 32: *Teacher's Preparedness in teaching Different Science Topics and Pupils' Performance*

Topic	Extent of preparedness	N	%	Mean (SE)	SD	Diff
Life Science	Somewhat prepared	234	100.00	374.21(52.26)	161.26	
Physical Science	Somewhat prepared	499	95.00	360.85(19.54)	133.58	1,2: 46.99*
	Not well prepared	16	5.00	313.86(12.73)	97.43	
Earth Science	Somewhat prepared	820	100	364.53(16.94)	137.36	

**Statistically significant at 5% level*

Results shown in table 4.32 reveal that teachers were „somewhat prepared‟ to teach science content. For physical science, pupils taught by teachers who were „somewhat prepared‟ performed significantly higher than their counterparts (mean score of 360.85 against 313.86).

Summary

The importance of the teacher in the learning of the pupils cannot be overemphasized. The characteristics or quality of teachers in terms of individual characteristics and professional dexterity go a long way in ensuring that quality education is provided to pupils, particularly at elementary level.

It has been revealed that generally pupils who are taught by teachers with a significant number of years of experience performed better. This might be so because, teachers have matured with age and are parents themselves and such they are able to attend well to needs of the pupils, more so that they still young children. This is even emphasized by the higher performance of pupils taught by older teachers compared to those taught by younger ones.

Most pupils are taught by teachers who have acquired at least a degree in Education (about 80%), and just around 17% for diploma holders. However, pupils who are taught by diploma

holders perform better than degree holders. Nevertheless, this could be because most diploma holders are an older generation, as such experience becomes the winner.

The results revealed that most pupils are taught by teachers who are concerned by the conditions or school environments within which they work. As such it affects the performance of the pupils. Furthermore, availability of computers and associated assistance to teachers seem to enhance the performance of the pupils, yet all few pupils have teachers with such kind of resources.

Attitudes and behaviours of teachers towards their profession play a role in the performance of teachers thus of the pupils. The more teachers are satisfied with their profession (general conditions within their profession), the higher possibility of efficiency and effectiveness in teaching, thus the higher performance of the pupils.

General lack of resources, lack of participation in professional development, lack of confidence and preparedness to teach certain content domains hamper teacher efficiency and effectiveness, consequently affecting pupils‟ performance. As such, these issues need to be addressed for the betterment of the overall performance of pupils in examinations

Recommendations

There is a need to come up with mitigating factors which could arrest the overall poor performance of pupils attributable to teacher variables. From the results, the outstanding factors that could have to be addressed include:

- General working coditions of teachers (classroom state, school safety, etc)
- Strengthen teacher-parent collaboration
- Improve ICT in schools (use of computers)
- Improve teacher participation in provesional development
- Increase the number of teachers to improve pupil-teacher ratio

CHAPTER FIVE

SCHOOL BACKGROUND VARIABLES AND PUPIL PERFORMANCE

The school heads for the schools whose pupils were sampled to take part in the Trends in Mathematics and Science Study and Progress in International Reading and Literacy Survey (TIMSS / PIRLS) were requested to fill a questionnaire which provided some background information about the schools on some of the variables. The information was mainly on; School Enrolment and Characteristics, Instructional Time, Resources and Technology, Involvement of Parents in School, School Climate, Teachers in School, Leadership Activities, School Readiness and Reading in School. The questions under each variable were analysed against the pupils" performance in Mathematics and Science.

School enrolment and characteristics

The questions under school enrolment were mainly focused on finding out; the total number of pupils enrolled in the school, the total number of standard 6 pupils, the economic status of pupils in the school, the location of the school, and the average income level of the locality of the region where the school is.

School Enrolment and Pupils' Performance

In this section, the relationship between pupils" performance and school overall enrolment is explored. The results of the analysis are shown in Table 5.1.

Table 5. 1: *School Enrolment and Pupils' Performance*

Enrolment	N	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
0-200	326	9.8	394.46(11.72)	85.67	1,2: -32.07 1,3:-12.36	325.61(16.81)	119.69	1,2: -48.35 1,3: -22.35
201-400	749	21.87	426.53(13.43)	97.63	1,4:-33.18*	373.96(19.85)	142.68	1,4: -54.67*
401-600	1 096	25.83	406.82(6.38)	88.38	1,5: -52.07* 1,6:-19.71*	347.96(9.53)	127.91	1,5: -61.15* 1,6: -88.60*
601-800	953	21.53	427.64(6.83)	85.35	2,3:1.11 2,4:-0.76	380.28(10.87)	126.43	2,3: 26.00 2,4: -6.32
801-1000	927	19.32	427.29(7.35)	83.39	2,5:- 0.76	386.76(11.06)	122.73	2,5:-12.80
1001-1200	74	1.64	446.53(11.30)	71.38	2,6: - 20.00 3,4:-20.82* 3,5:-20.47* 3,6:-39.71* 4,5: 20.47* 4,6: -39.71* 5,6: 39.71*	414.21(19.38)	107.98	2,6: -40.25 3,4:-32.32* 3,5:-38.80* 3,6:-66.25* 4,5: -6.48 4,6: -33.93 5,6: -27.45

* Statistically significant at 5% level

The sampled schools had an enrolment ranging from 0-200 to 1001-1200. The majority of the pupils were from schools with an enrolment that ranged from 401 to 600. There were very few pupils coming from schools with 1001-1200 pupils. The overall mean performance for Mathematics and Science is below the scale mark score of 500 which is considered the minimum performance for benchmarking purposes. The performance of the pupils in most of the categories was almost similar in both subjects except for two categories of schools, 0-200 and 401-600. The schools with an enrolment of 401-600 had the largest percentage of pupils and also they performed lower than the other categories of sampled schools. Generally, pupils from high enrolment schools performed significantly better than those from low school enrolment.

Standard Six School Enrolment and Pupils' Performance

The school heads also provided information on the number of standard six pupils in the schools. The number of the pupils was categorised into six and each category was correlated to the performance of the pupils and the results are presented in Table 5.2.

Table 5. 2: *Standard Six School Enrolment and Pupils' Performance*

Enrolment	N	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
0-20	141	4.23	418.46(18.88)	87.65	1,2: 35.84	365.79(24.15)	117.23	1,2: 62.09
					1,3: -11.72			1,3: -15.97
21-40	260	7.54	382.62(23.83)	100.18	1,4: 13.25	303.70(34.14)	139.62	1,4: 21.22
					1,5: -0.98			1,5: -4.36
41-60	828	22.86	430.18(10.77)	94.57	1,6: -7.20	381.76(16.02)	139.5	1,6: -14.26
61-80	685	14.58	405.21(11.03)	90.88	2,3: -47.56	344.57(17.08)	130.92	2,3: -78.06*
					2,4: -22.59			2,4: -40.87
81-100	896	21.81	419.44(6.03)	82.42	2,5:-36.82	370.15(9.21)	120.96	2,5: -66.45
					2,6: -43.04			2,6: -76.35*
100+	1 380	28.98	425.66(5.26)	82.24	3,4: -24.97	380.05(8.32)	122.39	3,4: 37.19
					3,5: 10.74			3,5: 11.61
					3,6: 4.52			3,6: 1.71
					4,5: -14.23			4,5: -25.58
					4,6: -20.45			4,6: -35.48
					5,6: -6.03			5,6: -9.90

* Statistically significant at 5% level

The performance of pupils by standard six enrolment does not vary greatly across the schools except for the schools with 21 to 40 standard six pupils where the performance is much lower than the performance of all the other schools in both subjects.

Economic Background and Pupils' Performance

The School head gave information on the approximate percentage of pupils in the school that he/she thought were economically disadvantaged or economically affluent. The performance of the two categories of pupils in both Mathematics and Science is shown in Table 5.3.

Table 5. 3: *Economic Background and Pupils' Performance*

	Category	N	%	Mathematics			Science		
				Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
	0 - 10%	775	19.41	451.48 (12.38)	94.22	1,2; 25.14	418.41 (17.99)	136.5	1,2: 35.52
	11 - 25%	989	24.39	426.34 (5.71)	79.44	1,3: 47.98*	382.89 (8.97)	115.91	1,3:77.22*
	26 - 50%	1 087	25.13	403.50 (6.05)	85.87	1,4: 58.60*	341.19 (9.37)	124.13	1,4: 94.52*
	>50%	1 131	31.08	392.88 (5.53)	83.44	2,3: 22.84*	323.89 (8.36)	120.29	2,3: -41.70*
Attitudent	0 - 10%	1 206	31.66	387.49 (5.32)	85.4	2,4: 33.46*	317.94 (7.91)	122.64	2,4: -59.00*
	11 - 25%	705	19.29	412.15 (5.45)	79.63	3,4: 10.62	356.42 (8.14)	116.95	3,4: -17.30
						1,2: -24.66*			1,2: -38.48*
	26 - 50%	998	25.27	434.47 (8.78)	88.89	1,3: -46.98*	390.48 (12.75)	129.57	1,3: -72.54*
	>50%	976	23.78	452.22 (10.21)	88.23	1,4: -64.73*	419.31 (15.26)	128.94	1,4: -101.37*
						2,3: -24.66*			2,3: -34.06*
						2,4: -40.07			2,4: -62.89*
						3,4: -17.75*			3,4: -28.83

* Statistically significant at 5% level

The performance of pupils where school heads felt that the majority of the pupils in the school were economically disadvantaged decreased with an increase in the percentage i.e. the more the percentage of the disadvantaged pupils the lower the performance of the pupils in all the subjects. Conversely, an increase in the percentage of pupils from affluent homes is associated with high performance of the pupils.

Percentage of Pupils who had English as Native Language and their Performance in Mathematics and Science

The performance of the pupils was analysed against the number of pupils in the school who had English as their native language. The results are summarised in Table 5.4.

Table 5. 4: *Percentage of Pupils who had English as Native Language and Their Performance in Mathematics and Science*

Pupil's Proportion	n	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
> 90%	210	4.67	392.80 (12.48)	82.2	1,2: -29.60	323.64 (21.12)	119.66	1,2: -58.42
76 - 90%	87	2.06	422.40 (15.81)	84.09	1,3: -129.12	382.06 (33.52)	115.15	1,3: -186.21*
51 - 75%	51	1.59	521.92 (55.96)	82.68	1,4: -25.67	509.85 (77.61)	109.58	1,4: -42.88
< 25%	3 514	91.69	418.47 (4.10)	88.65	2,3: -99.52	366.52 (5.95)	129.51	2,3: -127.79
					2,4:3.93			2,4: 15.54
					3,4: 103.45			3,4: 143.33

* Statistically significant at 5% level

The majority of the pupils sampled (91.69%) did not have English as their native language. The other three categories had very few pupils with each category having a percentage lower than 5. The performance in both subjects of pupils who are mostly non-native English is relatively higher than pupils who come from schools where at least 90% of the pupils are native English speakers. The 51-75% category has the highest mean performance but the proportion of pupils that falls in this category is too small to make an inference about the general performance of the pupils.

School Locality and Pupils' Performance

Another category which was looked at was the locality of the school. Table 5.5 presents the results showing the association between the school locality with pupils" performance.

Table 5. 5: *School Locality and Average Income of the Area and Pupils' Performance*

Locality	N	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Urban	545	12.57	452.88 (9.41)	80.35	1,2:16.61	425.38 (14.21)	117.97	1,2: 32.61
					1,3:28.85			1,3: 41.15
Suburban	481	11.35	436.27 (15.05)	93.07	1,4:-29.80*	392.77 (22.27)	133.87	1,4: 52.96*
Large Town	271	6.32	424.03 (11.02)	82.51	1,5: 66.99*	384.23 (17.38)	119.29	1,5: 112.34*
Village	1 902	44.1	423.08 (6.52)	88.39	2,3: 12.24	372.42 (9.74)	129.16	2,3: 8.54
Remote Rural	963	25.66	385.89 (6.50)	83.83	2,4:13.19	313.04 (9.71)	120.39	2,4: 20.35
					2,5:50.38*			2,5: 79.73*
					3,4: 0.95			3,4: 11.81
					3,5: 38.14*			3,5:71.19*
					4,5: 37.19*			4,5: 59.38*

* Statistically significant at 5% level

The majority of the pupils (44.10%) were from schools which are in villages. Pupils in urban areas performed better than pupils in sub-urban areas (on the outskirts of urban areas) who in turn performed better than those in large towns etc. The lowest performance in all the subjects was for pupils in Remote Rural areas.

Average Income of the Area and Pupils' Performance

Table 5.6 presents the results of the association between the average income of the area with pupils" performance.

Table 5. 6: *Average Income of the Area and Pupils' Performance*

Level of income	**N**	**%**	**Mathematics**			**Science**		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
High	53	1.53	539.92(13.97)	50.24	1,2: 96.52*	560.50(6.99)	62.57	1,2: 154.45
Medium	1870	44.1	443.40(6.08)	85.91	1,3: 144.52*	406.05(9.03)	125.84	1,3:231.21*
Low	2173	54.37	395.40(4.28)	84.59	2,3: 48.00*	329.29(6.15)	121.34	2,3: 76.76*

* Statistically significant at 5% level

The majority of the pupils were from schools which were located in medium or low income areas with a combined percentage of 98.47%. The percentage of pupils from schools located in high income areas was very low but the mean performance of the pupils in both subjects is significantly different between the high, medium or low income categories.

Resources and technology

Meaningful learning can only take place where pupils have unlimited resources available to them. Pupils should have an environment which is conducive for learning and which allows them to explore their surroundings without any limits. Some of the resources which were looked at are availability of computers for instructional purposes, availability of a science laboratory and availability of a school library. Though the availability or non-availability of the resources might not be directly linked to the performance of the pupils, they do play a very crucial role in the development of the pupils.

Availability of Computers and Pupils' Performance

In modern times, computers are used to promote efficiency and accuracy. It is therefore necessary for pupils to learn computers hardware and software so that they will be relevant for the current markets. The availability of computers in school is a problem. Many schools especially in Africa have no computers at all and that usually disadvantages their learning. In this section the relationship between pupils‟ scores and availability of computers is explored. The results are presented in Table 5.7.

Table 5. 7: *Availability of Computers and Pupils' Performance*

Number of computers	**n**	**%**	**Mathematics**			**Science**		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
0-10	2 730	65.6	410.45 (4.06)	85.87	1,2: -50.47*	353.82 (5.82)	125.34	1,2: -77.52*
					1,3:-35.34			1,3: -56.52
11-20	362	9.27	460.92 (22.40)	93.06	1,4:-40.39*	431.34 (32.28)	131.9	1,4: -56.79*
21-30	313	7.74	445.79 (26.59)	106.39	1,5:-13.57	410.34 (40.51)	157.68	1,5: -19.74
					1,6: 6.35			1,6: 8.65
31-40	152	3.67	450.84 (16.39)	73.44	2,3:15.13	410.61 (27.27)	110.55	2,3: 21.00
41-50	55	1.69	424.02 (42.87)	79.09	2,4:10.08	373.56 (68.07)	115.71	2,4: 20.73
					2,5:36.90			2,5:-57.78
51+	578	12.04	404.10 (8.46)	81.11	2,6:56.82	345.17 (13.94)	119.55	2,6: -86.17*
					3,4:-5.05			3,4: -0.27
					3,5:21.77			3,5: 36.78
					3,6: 41.69			3,6: 65.17
					4,5: 26.82			4,5: 37.05
					4,6:46.74			4,6: 65.44*
					5,6: 19.92			5,6: 28.39

* Statistically significant at 5% level

The majority of the pupils (65.60%) are from schools where there were 0-10 computers available for instruction. There is no correlation between the performance of the pupils and the number of computers available for instruction. The performance is even lowest for schools with 51+ computers available. It seems the availability of computers for Mathematics and Science instruction does not have an impact on performance at the lower levels. This is not conclusive though since in some instances the percentages were low and it was not clear how the computers were used for instruction.

Availability of Laboratory and Library and Pupils' Performance

The availability of a library in schools is a sign that the school encourages and provides for reading. Libraries are repository for a wide range of educational materials either in print or audio form. The pupils who are keen to learn may be motivated when the schools have libraries. It is not common to have laboratories in lower level of basic education in Botswana in public schools. The results are presented in Table 5.8.

Table 5. 8: *Availability of Laboratory and Library and Pupils' Performance*

Infrastructure	Availability	n	%	Mathematics			Science		
				Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Library	Yes	2,044	49.83	429.24(7.05)	93.42	1,2:19.56	383.65(10.54)	136.57	
	No	2,050	50.17	409.44(4.55)	84.06		351.67(7.08)	122.7	1,2:31.98
Laboratory	Yes	296	6.81	473.39(27.74)	98.11	1,2:58.33	450.05(40.19)	139.92	
	No	3,863	93.19	415.06(3.38)	87.07		360.87(5.00)	127.68	1,2;89.18

* Statistically significant at 5% level

Findings showed that pupils from schools that have a Science laboratory performed lower than pupils from schools with a school laboratory. This should not be viewed as a causative factor as there might be other primary underlying factors which contributed to the performance and also the percentage of pupils from schools with a science laboratory is very low. Normally schools that have science laboratories are privately owned and they tend to perform better than government schools.

How Shortage or Inadequacy of School Resources Affected Schools Capacity to Provide Instruction

The School heads were asked to indicate their views on how they feel the shortage or inadequacy of some resources affected the capacity of the school to provide instruction. Their views were encapsulated under four main sub headings namely, general school resources, resources for reading instruction, resources for mathematics instruction and resources for science instruction.

Inadequacy of School Resources and Pupils' Performance

The general school resources were grouped into an index which was formed by; instructional materials (e.g. textbooks), supplies (e.g. papers, pencils), school buildings and grounds, heating/cooling and lighting systems, instructional space (e.g. classrooms), technological competent staff and computers for instruction. The performance of the pupils was analysed by the index and the results are as shown in table 5.9.

Table 5. 9: *Inadequacy of School Resources and Pupils' Performance*

Resources' inadequacy	**N**	**%**	**Mathematics**			**Science**		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Not at all	67	2.32	540.88 (10.35)	63.12	1,2: 175.26*	533.80 (7.19)	48.52	1,2: 115.76*
A little	1 174	28.09	365.62 (11.29)	126.46	1,3: 192.39*	418.04 (7.62)	85.6	1,3: 126.54*
Somewhat	2 368	56.81	348.49 (6.38)	123.54	1,4: 118.31*	407.26 (4.14)	85.12	1,4: 80.37*
A lot	529	12.78	422.57 (26.93)	140.23	2,3: 17.13	453.43 (18.26)	97.23	2,3: 10.78
					2,4: -56.95			2,4: -35.39
					3,4: -74.08*			3,4:- 46.17*

* Statistically significant at 5% level

The majority of the pupils (56.81%) were from schools where the school head felt that the shortage or inadequacy of the resources *somewhat* affected the school"s capacity to provide instruction. The performance of the pupils is lower than that of pupils who were in schools where the school head felt the shortage or inadequacy of resources affected the school"s capability *a lot*. It might be possible that the head teacher did not understand the questions properly and this resulted in illogical results as seen in Table 5.9.

How Shortage or Inadequacy of Mathematics Resources Affected Schools Capacity to Provide Instruction

An index was formed for Mathematics using the following items; teachers with specialisation in mathematics, computer software for mathematics instruction, library materials relevant to mathematics instruction, audio-visual resources for mathematics instruction and calculators for mathematics instruction. The results of the pupils" performance are shown in Table 5.10.

Table 5. 10: *Inadequacy of Mathematics Resources and Pupils' Performance*

Resource's inadequacy	n	%	Mean (SE)	SD	Diff
Not at all	618	15.4	423.01 (8.73)	84.41	1,2: 10.25
A little	1 340	31.91	412.76 (6.30)	85.21	1,3: -36.36*
Somewhat	695	17.62	459.37 (13.80)	90.95	1,4: 20.03
A lot	1 485	35.07	402.98 (5.77)	87.91	2,3: -46.61*
					2,4: 9.78
					3,4: 56.39*

* Statistically significant at 5% level

The majority of pupils belong to schools where the head teachers believe that inadequacy of Mathematics resources affect delivery of instruction *a lot* (35.07%). The performance of pupils in this category is smaller than *somewhat* with (31.91%) of pupils believed to be affected and the performance is highest in this category.

How Shortage or Inadequacy of Science Resources Affected Schools Capacity to Provide Instruction

An index was formed for Science using the following; teachers with specialisation in science, computer software for science instruction, library materials relevant to science instruction, audio-visual resources for science instruction and science equipment and materials. The results of the pupils‟ performance are shown in Table 5.11.

Table 5. 11: *Inadequacy of Science Resources and Pupils' Performance*

Resource's Inadequacy	n	%	Mean (SE)	SD	Diff
Not at all	285	7.45	350.77 (16.23)	128.79	1,2: -15.41
A little	1 584	37.48	366.18 (8.57)	121.78	1,3: -23.56
Somewhat	875	21.63	374.33 (16.79)	140.63	1,4: -16.01
A lot	1 367	33.43	366.78 (12.04)	133.99	2,3: -8.15
					2,4: -0.60
					3,4: 7.55

* Statistically significant at 5% level

Most of the pupils were from schools where the school heads responded that inadequacy of resources was „*a little*‟ or „*a lot'.* Pupils where the school head felt the inadequacy of the resources was „*somewhat*‟ performed well.

Parental Involvement in School Activities

Parents play an important role in the child"s development and learning either informally or formally. Parents can greatly influence their children"s view of their future, particularly when the children are not mature enough to make independent decisions. For effective learning to take place, parents should be involved in one way or another in the education of their children. Schools should also be willing to involve parents in the learning of the children and where possible the parents should be actively involved in the learning of their children. The results associating pupils" performance and parental involvement in school are presented in Table 5.12, Table 5.13 and Table 5.14.

The Frequency at Which School Informs Parents about Issues Concerning Pupils

In this section, heads of school were asked to indicate how often the schools inform and/or discuss the behaviour of their children with parents, inform parents about pupils learning progress and inform parents about parents" concerns or wishes. Their responses were analysed in connection to pupils" performance to investigate how parents support aids pupils" achievements in Mathematics and Science. The results are shown in Table 5.12.

Table 5. 12: *Frequency at which the school informs parents about pupils' performance and Pupils' Performance*

Frequency	n	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Never	26	0.73	384.88 (7.77)	77.85	1,2: 0.07	294.33 (11.88)	106.4	1,2: -10.41
Once a year	80	2.11	384.81 (40.91)	94.33	1,3:-38.75*	304.74 (44.52)	129.8	1,3: -80.36*
2-3 times a year	1 994	48.68	423.63 (6.72)	90.92	1,4: -30.75*	374.69 (10.01)	132.3	1,4: -67.74*
> 3 times a year	2 063	48.48	415.63 (4.85)	86.84	2,3: -38.82	362.07 (7.62)	127.9	2,3:-69.95
					2,4: -30.82			2,4: -57.33
					3,4: 8.00			3,4: 12.62

* Statistically significant at 5% level

Pupils from schools where the school head indicated that the frequency of informing parents about performance of pupils is at least 2 times a year performed better than the schools where the information was shared on fewer occasions. While the percentages of pupils where the school heads reported that they never inform parents about pupils" performances are very low, it is worrying that schools where pupils" performances is not shared with the parents still exists.

The Frequency at Which a School Informs Parents about School Issues in General and Pupils' Performance

Table 5.13 shows the frequency of informing parents about pupils" issues and how it relates to overall performance, school accomplishments in tournament, educational and pedagogical principles, inform parents about rules of school and so on. These items were combined to form an index representing pupils" issues at school.

Table 5. 13: *The Frequency at Which School Informs Parents about School Issues in General and Pupils' Performance*

Extent of consultation	n	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Never	62	1.61	438.80 (28.37)	73.65	1,2:10.73	394.69(41.26)	112.06	1,2: 16.79
Once a year	855	21.61	428.07 (8.82)	90.99	1,3: 21.78	377.90(12.99)	132.1	1,3: 29.69
2-3 times a year	2 291	55.55	417.02 (6.25)	90.21	1,4:24.62	365.00(9.26)	131.89	1,4: 33.42
> 3 times a year	916	21.23	414.18 (7.45)	84.86	2,3: 11.05 2,4: 13.89 3,4: 2.84	361.27(11.72)	125.38	2,3: 12.90 2,4: 16.63 3,4: 3.73

* Statistically significant at 5% level

Most of the pupils, 55.55%, attended schools where it was reported that the parents were informed about school issues 2 - 3 times a year. Only a small proportion of pupils (1.61%) belong to schools which have *never* informed the parents about school issues. This category has the highest mean than other categories. However, the test of significance suggests that the performance difference of pupils is not significant.

School climate

The school climate or school environment must be conducive for learners to fully benefit from their learning. The school climate is very complex and can be made uncomfortable for learners by a number of issues including interaction with other pupils, teacher behaviour and parental support. Currently very few pupils leave school without completing their primary studies or are not able to perform to their full potential due to reasons related to school climate. There are a number of reforms which focused mainly on creating an environment which is conducive for learning.

Two issues related to school climate were investigated, namely: Positive school climate such as teachers‟ job satisfaction, their competency, understanding of school goals and so on as outlined in Table 5.14, issues relating to pupils problematic behaviour such as late coming, absenteeism, cheating, vandalism, theft and so on, as outlined in Table 5.15.

School Climate and Pupils' Performance

School heads indicated degree to which these issues or factors were taking place in their schools. The results are presented in Table 5.14.

Table 5. 14: *Positive School Climate and* Pupils‟ *Performance*

School factor	Extent	n	%	Mathematics			Science		
				Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Teachers' job satisfaction	High	179	4.67	466.14 (39.70)	95.98	1,2: 387.76*	434.30 (58.40)	141.25	1,2: 53.69
	Medium	1 403	35.99	427.46 (7.79)	95.67	1,3: 371.01*	380.61 (11.68)	140.16	1,3: 80.49
	Low	2 497	59.34	410.71 (3.52)	82.84	2,3: 402.92*	353.81 (5.21)	121.41	2,3: 26.80*
Teachers' understanding of the school's curricula goals	High	529	13.13	452.81 (18.46)	97.88	1,2: 53.69	419.49 (27.77)	145.94	1,2: 55.80
	Medium	2 327	55.8	416.76 (5.24)	86.63	1,3: 80.49*	363.69 (7.56)	125.93	1,3: 71.21*
	Low	1 304	31.06	407.04 (5.98)	86.12	2,3:26.80	348.28 (9.60)	125.4	2,3: 15.41
Teachers' degree of success in implementing the school curriculum	High	390	9.27	468.57 (21.76)	91.37	1,2: 46.01*	443.72 (31.91)	135.37	1,2: 71.59*
	Medium	1 611	40	422.56 (6.59)	90.01	1,3: 61.89*	372.13 (9.64)	131.42	1,3: 95.64*
	Low	2 143	50.73	406.68 (4.73)	84.42	2,3: 15.88	348.08 (7.26)	123.14	2,3: 24.05
Teachers' expectations for pupil achievement	High	853	22.57	443.92 (12.94)	91.54	1,2: 25.12	403.84 (19.80)	136.29	1,2: 35.32
	Medium	2 216	53.04	418.80 (4.95)	87.64	1,3: 48.29*	368.52 (7.17)	127	1,3: 74.75*
	Low	1 031	24.39	395.63 (6.46)	84.28	2,3: 23.17*	329.09 (9.35)	122.14	2,3: 39.43*
Parental support for pupil achievement	High	91	3.33	510.06 (36.59)	79.84	1,2:66.75	498.02 (54.13)	117.18	1,2: 1.56
	Medium	553	14.07	443.31 (14.73)	93.47	1,3: 95.32*	406.70 (22.07)	135.12	1,3: 2.52*
	Low	3 162	82.6	414.74 (3.78)	86.67	2,3: 28.57	360.82 (5.46)	127.2	2,3: 2.02*
Parental involvement in school activities	High	75	1.8	437.43 (12.86)	79.24	1,2: 9.04	392.78 (18.52)	119.71	1,2: 11.60
	Medium	630	15.44	428.39 (13.98)	95.39	1,3: 20.00	381.18 (20.74)	137.38	1,3: 27.95
	Low	3 218	82.76	417.43 (4.22)	87.72	2,3: 10.96	364.83 (6.22)	128.72	2,3: 16.35
Pupils' regard for school property	High	61	2.43	536.26 (34.88)	83.82	1,2:106.22*	529.92 (52.86)	117.61	1,2: 145.22*
	Medium	670	17.58	430.04 (12.65)	96.34	1,3:123.94*	384.70 (20.01)	142.92	1,3: 173.04*
	Low	3 216	79.98	412.32 (3.66)	85.44	2,3: 17.72	356.88 (5.50)	125.03	2,3:27.82
Pupils desire to do well in school	High	144	4.63	472.11 (37.92)	90.14	1,2: -12.81	448.98 (55.87)	130.25	1,2: 20.65
	Medium	770	19.27	459.30 (11.73)	88	1,3: 64.07	428.33 (17.18)	126.61	1,3: 98.89
	Low	3 019	76.1	408.04 (3.53)	84.94	2,3: 51.26*	350.09 (5.38)	124.76	2,3: 78.24*

Teachers‟ job satisfaction, teachers‟ understanding of the school‟s curricula goals, teachers‟ degree of success in implementing the school curriculum and teachers‟ expectations for pupil achievement were found to be taking place moderately to low. Parental support for pupil achievement, parental involvement in school activities, pupils‟ regard for school property and

pupils desire to do well in school were characterised as being *low* and performance is very low when all these factors are low. These factors were regarded as *High* only with low percentages lower than 5. However, in this scenario when they are *high* the pupils‟ performance is higher than when it is low and medium. This suggests that if parents and pupils can improve on these factors the benefits will be greater. Generally, in primary schools it seems a lot needs to be done to ensure that learning is offered when all factors at school are satisfactory for both teachers and pupils.

Pupils Problematic Behaviour and Pupils' Performance

The relationship between pupils‟ performance and negative attributes usually associated with pupils is presented. School heads were asked to indicate the extent to which problematic behaviour were prevalent in their school. These are: arriving late at school, absence from school with no apparent reason, class room disturbances, cheating, profanity, vandalism, theft, intimidation among pupils, physical fights and intimidation of teachers.

Table 5. 15: *Pupils Problematic Behaviours and Pupils' Performance*

Behaviour	Severity	n	%	Mathematics			Science		
				Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Arriving late at school	Not a problem	730	19.55	450.36	89.12	1,2:34.82* 1,3: 45.58* 1,4: 101.38* 2,3: 10.76 2,4: 66.56* 3,4: 55.80	415.17 (19.14)	130.94	1,2: 53.71* 1,3:69.51* 1,4:152.09* 2,3:15.80 2,4:98.38 3,4:82.58
	Minor problem	2 365	55.88	415.54 (4.80)	86.71		361.46 (7.45)	126.4	
	Moderate problem	1 017	22.95	404.78 (8.39)	86.79		345.66 (13.16)	127.19	
	Serious problem	78	1.61	348.98 (31.85)	90.93		263.08 (48.95)	128.19	
Absenteeism	Not a problem	887	21.28	457.87 (11.44)	88.16	1,2:43.83* 1,3:57.21* 1,4:81.77* 2,3:13.38 2,4:37.94* 3,4:24.56	427.43 (17.00)	128.47	1,2: 68.36* 1,3:88.63* 1,4: 125.22* 2,3:56.86* 3,4: 36.59
	Minor problem	2 408	57.78	414.04 (4.71)	85.58		359.07 (7.06)	124.86	
	Moderate problem	571	13.77	400.66 (9.18)	84.92		338.80 (14.79)	124.37	
	Serious problem	324	7.17	376.10 (10.29)	87.51		302.21 (15.08)	125.82	

Classroom disturbance	Not a problem	1 195	30.93	428.02(9.11)	88.28	1,2:6.93 1,3:26.59 1,4:32.66 2,3:19.66 2,4:25.73 3,4:6.07	380.06(13.43)	129.71	1,2:9.97 1,3:39.97 1,4: 41.21 2,3:30.00 2,4:-31.24 3,4:-1.24
	Minor problem	2 128	49.79	421.09(5.66)	87.98		370.09(8.54)	128.57	
	Moderate problem	630	14.94	401.43(10.87)	90.51		340.09(17.06)	132.78	
	Serious problem	191	4.34	395.36(17.94)	90.74		338.85(26.43)	127.58	
Cheating	Not a problem	1 685	44.47	426.77(7.20)	90.76	1,2:14.37 1,3:-3.50 1,4:50.75* 2,3:-17.87 2,4:36.38* 3,4:54.25*	377.57(10.97)	134.45	1,2:20.55 1,3:-9.50* 1,4:77.58* 2,3:-30.05 2,4:-57.03* 3,4:87.08
	Minor problem	1 749	42.42	412.40(4.95)	87.33		357.02(7.55)	126.13	
	Moderate problem	436	8.78	430.27(11.73)	84.46		387.07(18.62)	123.1	
	Serious problem	202	4.33	376.02(11.87)	84.41		299.99(20.05)	125.56	
Profanity	Not a problem	1 460	46.12	431.52(7.98)	90.48	1,2:14.97 1,3:38.72* 1,4:-53.91* 2,3:23.75 2,4:38.94* 3,4:15.19	385.95(11.99)	133.47	1,2: 22.69 1,3: 56.23* 1,4:76.80* 2,3:54.11* 2,4: 54.11* 3,4:20.57
	Minor problem	1 419	41.35	416.55(7.15)	87.28		363.26(10.63)	127.69	
	Moderate problem	345	8.86	392.80(11.99)	90.71		329.72(17.35)	126.49	
	Serious problem	155	3.67	377.61(14.07)	84.26		309.15(23.70)	123.82	
Vandalism	Not a problem	1 477	38.57	425.20(8.34)	91.09	1,2:0.92 1,3: 22.57 1,4:42.36* 2,3:23.49* 2,4:43.28* 3,4:19.79	375.04(12.16)	132.17	1,2: -3.64 1,3: 31.66 1,4: 63.97 2,3: 35.30* 2,4:67.61* 3,4:32.31*
	Minor problem	1 625	39.78	426.12(6.29)	86.69		378.68(9.65)	128.56	
	Moderate problem	665	14.87	402.63(7.68)	85.69		343.38(12.01)	123.25	
	Serious problem	320	6.79	382.84(9.29)	86.27		311.07(15.79)	127.74	
Theft	Not a problem	1 422	36.41	426.28(9.08)	94.29	1,2: 6.57 1,3: 15.03 1,4: 58.54* 2,3: 51.97* 2,4: 51.97* 3,4:43.51*	377.92(13.52)	137.86	1,2: 10.01 1,3:21.64 1,4:90.08* 2,3:11.63 2,4:80.07* 3,4:68.44*
	Minor problem	1 920	45.33	419.71(4.94)	83.93		367.91(7.56)	123.3	
	Moderate problem	618	13.95	411.25(8.25)	88.56		356.28(13.04)	127.46	
	Serious problem	194	4.31	367.74(14.20)	83.27		287.84(22.37)	123.4	
Intimidation or	Not a problem	1 184	32.05	422.20(9.07)	91.21	1,2:-5.68	370.95(13.62)	135.27	1,2: 9.59

verbal abuse among pupils	Minor problem	2 101	48.86	427.88 (5.67)	86.95	1,3:29.59* 1,4:32.42 2,3:35.27* 2,4:38.10* 3,4:2.83	380.54 (8.51)	126.26	1,3:39.37* 1,4:51.85 2,3:-48.96* 2,4:61.44* 3,4:12.48
	Moderate problem	546	11.95	392.61 (7.69)	85.32		331.58 (12.51)	122.49	
	Serious problem	299	7.14	389.78 (14.55)	86.55		319.10 (22.95)	128.85	
Physical fights among pupils	Not a problem	672	18.06	446.24 (13.86)	89.61	1,2: 29.56* 1,3:36.30* 1,4:64.29* 2,3:6.74 2,4:34.73* 3,4:27.99	407.00 (20.87)	132.86	1,2: 43.75 1,3: 50.38* 1,4: 99.07* 2,3: 6.63 2,4: 55.32* 3,4: 48.69
	Minor problem	2 426	58.65	416.68 (4.96)	86.96		363.25 (7.53)	126.76	
	Moderate problem	829	17.76	409.94 (8.83)	88.02		356.62 (13.66)	127.92	
	Serious problem	233	5.52	381.95 (16.19)	90.29		307.93 (24.88)	134.18	
Intimidation or verbal abuse of teachers or staff	Not a problem	2 892	70.97	425.90 (5.40)	89.32	1,2: 24.55* 1,3:19.93* 1,4:57.68* 2,3:-4.62 2,4:33.13* 3,4:37.75*	377.67 (8.06)	131.65	1,2:38.18* 1,3:28.27 1,4:92.27* 2,3:-9.91 2,4: 54.09* 3,4: 64.00*
	Minor problem	1 034	23.69	401.35 (6.24)	86.42		339.49 (9.14)	124.33	
	Moderate problem	217	5.03	405.97 (7.90)	85.16		349.40 (13.83)	119.73	
	Serious problem	17	0.31	368.22 (13.00)	80.36		285.40 (20.71)	116.21	

** Statistically significant at 5% level*

Most of the responses from the school heads indicated that the behavioural problems are either „*minor problem*" or „*not a problem*". There were very few responses for „*moderate problem*" and „*serious problem*". In all the categories the performance of the pupils decreases with an increase in the severity of the problem. It is worth noting that only absenteeism, vandalism, intimidation or verbal abuse among pupils and physical fights among pupils had percentages which were slightly higher than 5 at the „*serious problem'* category. This might indicate that generally primary schools in Botswana do not have problems with pupils" behaviour.

Teachers' Problem Behaviours and Pupils' Performance

Table 5.16 shows some of the behavioural problems of teachers which were analysed against the performance of pupils. Some teachers‟ may have a tendency of coming late to work or of being absent from school.

Table 5. 16: *A Degree of Teachers' Problem Behaviours against Pupils' Performance*

Behaviour	Severity	n	%	Mathematics			Science		
				Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
late or leaving early	Not a problem	1 206	31.74	427.50(10.22)	95.72	1,2:11.62	380.57(15.40)	141.09	1,2: 19.81
	Minor problem	2 284	52.77	415.88(4.72)	86.15	1,3:12.45	360.76(6.77)	125.71	1,3: 13.79
	Moderate problem	617	14.93	415.05(7.47)	83.61	1,4:41.08*	366.78(11.40)	120.37	1,4: 70.75*
	Serious problem	28	0.55	386.42(3.79)	73.88	2,3: 0.83	309.82(13.30)	103.43	2,3: -6.02
Absenteeism	Not a problem	1 126	28.12	441.41(10.86)	91.35	2,4:29.46*	400.77(16.46)	134.83	2,4:50.94*
	Minor problem	2 043	50.18	410.67(5.13)	87.75	3,4: 28.63*	353.54(7.32)	127.79	3,4: 56.96*
	Moderate problem	768	16.84	405.93(7.75)	84.36	1,2: 30.74*	349.97(12.82)	122.91	1,2: 47.23*
	Serious problem	198	4.86	426.44(12.04)	81	1,3: 35.48*	383.30(18.07)	116.09	1,3: 50.80*
						1,4: 14.97			1,4: 17.47
						2,3: 4.74			2,3: 3.57
						2,4: -15.77			2,4: -29.76
						3,4: -20.51			3,4: -33.33

** Statistically significant at 5% level*

The views of the school heads on teachers undesirable behaviours were similar to their views on pupils since the responses were mainly in the categories of *„not a problem‟* and *„minor problem'*. The performance of the pupils decreases when moving from *„not a problem‟* to *„minor problem'* in both subjects. Though the percentage of pupils where absenteeism of teachers was a *serious problem* is low, it is surprising to note that the pupils under the category performed better compared to *„minor problem‟* and *„moderate problem‟* categories.

Teachers in school

There are different ways which can be employed to monitor the performance of the teachers, such as internal monitoring, external monitoring and system performance. Table 5.17 shows the extent of monitoring by each method.

Table 5. 17: *Evaluation Method for Teachers and Pupils' Performance*

Evaluation Method		n	%	Mathematics			Science		
				Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Observation by the principal	Yes	4 169	99.25	417.61 (3.56)	88.28		365.15 (5.26)	129.53	
	No	21	0.75	577.75 (5.78)	45.41	1,2: -160.14*	579.05 (6.51)	47.44	1,2: -213.90*
Observation by inspectors	Yes	2 840	66.43	411.99 (4.21)	86.04		357.46 (6.26)	127.01	
	No	1 350	33.57	432.30 (9.11)	93.45	1,2: -20.31	385.12 (13.68)	135.05	1,2: -27.66
Pupil achievement	Yes	4 091	98.49	419.10 (3.74)	89.2		367.21 (5.57)	130.59	
	No	69	1.51	413.57 (69.86)	87.6	1,2: 5.53	357.00 (96.76)	123.59	1,2: 10.21
Teacher peer review	Yes	2 946	71.24	422.56 (5.04)	89.91		372.35 (7.56)	131.59	
	No	1 244	28.76	409.50 (7.21)	86.44	1,2:13.06	352.87 (11.05)	126.43	1,2: 19.48

* Statistically significant at 5% level

Observations by the senior management and pupil achievements are the two methods which are widely used methods to monitor the teachers‟ performance. While teachers can initiate the peer review method, they are still some teachers who are not willing to use this method. The performance of the pupils was better where peer review was employed. About 66% of pupils attended schools where class observations were made by officers external to the school. Observation by inspectors was only 66.43% and it needs to be increased to strengthen the delivery of instruction by teachers. The performance of pupils in both subjects was better in schools not observed by inspectors. The mean performance is much high when the evaluation is not done by principal /senior teacher compared to when the senior teacher or principal is evaluating. However, the proportion of pupils when observation is not done by the principal is too low (0.75%) to make a meaningful comparison. The results indicate that the mean scores are higher where there is teacher peer review than where it is not used.

School Leadership and Pupils' Performance

School heads were asked to give the approximate time which they do spend on some leadership activities. The activities were grouped together into an index which comprised; promoting the school‟s educational vision or goals, developing the school‟s curricular and educational goals, monitoring teachers‟ implementation of the school‟s educational goals in their teaching, monitoring pupils‟ learning progress to ensure that the school‟s educational goals are reached, keeping an orderly atmosphere in the school, ensuring that there are clear rules for

pupil behaviour, addressing disruptive pupil behaviour, creating a climate of trust among teachers, initiating a discussion to help teachers who have problems in the classroom, advising teachers who have questions or problems with their teaching, visiting other schools or attending educational conferences for new ideas, initiating educational projects or improvements and participating in professional development activities specifically for school principals. The results of the analysis are shown in Table 5.18.

Table 5. 18: *School Leadership and Pupils' Performance*

Time spent	n	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
No time	53	1.49	413.32 (29.73)	75.63	1,2: -14.22	338.16 (43.96)	114.57	1,2: -41.30
Some time	1 939	48.78	427.54 (6.98)	93.54	1,3: 3.59	379.46 (10.54)	136.4	1,3: -15.82
A lot of time	2 141	49.74	409.73 (4.43)	84.36	2,3: 17.81*	353.98 (6.45)	123.58	2,3: 25.48*

* Statistically significant at 5% level

Almost all the school heads (98.52%) were involved in leadership activities at least sometimes.

The mean score for Mathematics is even higher for „*no time*" than for „*a lot of time*". However, pupils" performance was found to be necessarily influenced by the involvement of the school head in leadership activities.

School Readiness and Pupils' Performance

School readiness aimed at finding out the extent to which beginners were equipped to do things like writing, reading and counting. The categories were grouped into an index comprising; recognise most of the letters of the alphabet, reading some words, reading sentences, writing letters of the alphabet, writing some words, counting up to 100 or higher, recognising all 10 written numbers from 1-10 and writing all numbers from 1-10. The results of school readiness performance are shown in Table 5.19.

Table 5. 19: *School Readiness and Pupils' Performance*

Proportion ready	n	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Less than 25%	2 612	62.68	399.84 (4.49)	86.26	1,2:-38.02*	336.64 (6.61)	124.74	1,2: -62.44*
25 – 50 %	830	20.05	437.86 (6.31)	77.66	1,3: -49.06*	399.08 (10.19)	114.44	1,3: -78.46*
51 – 75 %	535	11.71	448.90 (12.30)	87.85	1,4: -102.84*	415.10 (18.86)	129.03	1,4: -154.27*
More than 75 %	177	5.56	502.68 (25.57)	83.24	2,3: -11.04	490.91 (37.23)	120.8	2,3: -16.02
					2,4: -64.82*			2,4: -91.83*
					3,4: -53.78			3,4: -75.81

* Statistically significant at 5% level

The variation of the pupils‟ performance was proportional to the percentage of pupils who were able to at least to do one of the activities listed. The majority of the pupils were from schools where only less than 25% of the pupils were able to read, write or count when they started their schooling. The performance of the schools where more than 75% of the pupils were ready to start school, was high, exceeding the international benchmark mean for Mathematics.

Summary

The analysis of pupils‟ achievements in relation to school background information can be summarized as follows;

1. Most pupils in the study were from schools which had enrolments ranging from 201 to 1000. The performance of the pupils does not vary much by enrolment categories. However, there were statistical differences in pupils mean performance between some enrolment categories both in Mathematics and Science. In Standard Six enrolment, the statistical difference was observed only in Science.
2. The majority of the pupils were from schools where most pupils come from economically disadvantaged families. The pupils‟ performance varies significantly between economically affluent pupils and economically disadvantaged pupils.

3. The majority of the pupils in the sample were from the villages followed by remote rural. The performance of the pupils varied with the locality of the school with pupils from urban areas performing better than pupils from other localities in the sample.

4. The results indicate that the performance of pupils was not affected much by the availability of resources like computers, science lab and other resources needed to carry out instruction.

5. The majority of the pupils are from schools where school heads indicated high or medium teacher job satisfaction, teacher understanding of the curricula, teachers‟ degree of success in implementing curriculum. Parental support and pupils‟ desire are medium and low.
6. The performance of the pupils was low where parental support and pupil desire are low.

7. Generally, primary schools in Botswana do not have a serious problem with problem behaviours that can impact on the learning of pupils. Most of the responses from school heads were either *not a problem* or *minor problem*.

8. The majority of pupils were from schools where evaluation of teachers work was mainly through observation by the principal or senior staff and pupil achievement only. Teacher peer review and observation by inspectors can still be improved.

9. The majority of the pupils started their primary school whilst they were still unable to count, read and write basic letters and/or numbers. Pupils from schools with a higher percentage of those who could read, write or count performed better than the pupils from schools where the percentage was lower.

Recommendations

(1) Pupils‟ performance varies by school locality, with schools from rural areas performing lower than schools in the urban areas. This variability in performance could be brought by differences in the socio-economic status of the places the pupils come from and pupils‟ lifestyles in both areas. It is difficult to provide amenities in rural areas but the government should make sure that the basic amenities are available in rural parts because they are indicators of quality of life for people in those places.

(2) School heads should encourage parental involvement in schools and pupils issues. Parents must always be involved in all activities carried out in schools because that will

help monitor pupils‟ performance and undesirable behaviours of pupil can be realized earlier on and be solved immediately by both parents and teachers.

(3) Evaluation of teachers should be undertaken through the peer review method because it involves teachers reviewing each other. Teachers may benchmark on each other during the process and this will encourage teacher collaboration. Evaluation by head teachers does not bear fruits because pupils‟ performance was low when the method was applied.

(4) Parents should be encouraged to enrol their children in pre-schools before starting primary schools. In pre-schools, pupils will learn elements required in standard one like how to count and how to write some basic sentences or their names.

CHAPTER SIX
PARENT BACKGROUND VARIABLE AND PUPIL PERFORMANCE

IEA studies have found a positive association between a supportive home environment and pupils‟ performance. The environment can only be provided by the biological parents, guardians or caregivers who are staying with the child by providing the necessities needed by the child for development and learning. Thus parents play an important role in shaping the child"s future from birth. However, in this study the parents were not differentiated into these categories, they were all treated as one.

Parents or guardians provided information about the pupils‟ early home experiences with numeracy and literacy-type activities, as well as information about the parents‟ occupation, experiences and attitudes towards reading activities by completing a questionnaire. This chapter covers the responses of the parents and how they relate with pupils‟ achievement in Mathematics and Science.

Activities performed before the child starts school

Activities performed before the child starts school included; non-formal pre-school activities, language spoken at home and pre-school attendance. These are discussed below.

(i) Non-formal pre-school activities

Parents or guardians were asked how often they participated in particular activities with their child before the child began formal schooling. The activities were:

(a) Early literacy activities: Read books, tell stories, sing songs, play with alphabet toys, talk about things you had done, talk about things you had read, play word games, write letters or words, and;

(b) Early numeracy activities: Say counting rhymes or sing counting songs, play with number toys, count different things, play games involving shapes, play with building blocks or construction toys, and play board games or card games.

An index was created with three categories of "*often, sometimes, never or almost never*" to depict the frequency with which parents or guardians performed these activities with the child before starting school, Table 6.1 shows that the majority of the parents or guardians (74%) carried out the above activities *sometimes* with their children. Learners whose parents *often* subjected them to these non-formal pre-school activities before schooling performed significantly better in Mathematics and Science than those who did the activities *sometimes* or *never* did the activities. Thus engaging the learners in non-formal pre-school activities is associated with high academic performance in future years.

Table 6. 1: *Frequency of Performing Non-formal Pre-school Activities against Mathematics and Science Achievement*

Frequency of activities	**n**	**%**	**Mathematics**			**Science**		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Often	381	10.40	457.32(8.83)	94.54	1,2:40.34*	436.35(11.20)	136.89	1,2: 69.56*
Sometimes	2735	74.04	416.98(3.91)	90.91	1,3:71.97*	366.79(5.57)	130.06	1,3:122.37*
Never/almost never	553	15.56	385.35(6.57)	86.55	2,3:31.63*	313.98(10.17)	124.01	2,3:52.81*

* Statistically significant at 5% level

(ii) *Language spoken at home before beginning school*

Botswana is a multilingual country but Setswana (the national language) is l the language of instruction from standard one and English (the official language), is used from standard two. Table 6.2 shows how pupils performed in relation to the language spoken at home.

Table 6. 2: *Performance by Language Spoken at Home*

Language spoken	**Is it spoken**	**n**	**%**	**Mathematics**			**Science**		
				Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
English	Yes	925	26.06	443.19(6.77)	94.63	1,2:4.72*	409.90(9.39)	137.12	1,2:59.49*
	No	2678	73.94	406.79(3.67)	89.78		350.41(5.19)	128.58	
Setswana	Yes	3121	84.65	413.25(3.65)	90.35	1,2:-20.38	361.85(5.37)	130.42	1,2:-27.24
	No	527	15.35	433.63(12.20)	100.67		389.09(16.10)	145.90	
Other	Yes	751	22.29	417.98(7.05)	94.57	1,2:1.70	364.87(10.60)	136.22	1,2:-2.08
	No	2738	77.71	416.28(4.34)	91.99		366.95(6.28)	133.04	

* Statistically significant at 5% level

The majority of the learners (85%) spoke Setswana before beginning school. About 26% of the pupils spoke English before beginning school and were performing significantly better than those who did not speak English. Speaking English was positively associated with Mathematics and Science achievement. This was probably due to the fact that tests were in English as such advantaged those who spoke the language.

(iii) Pre-school attendance

In Botswana pre-school is mostly offered by private individuals and is paid for. The curriculum followed is not standardised. Table 6.3 and 6.4 shows the percentage of pupils who attended pre-school, and length of stay in pre-school in relation to their performance.

Table 6. 3: *Pre-schooling and Performance*

Attended preschool	**n**	**%**	**Mathematics**			**Science**		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Yes	1607	45.11	444.52(6.20)	92.85	1,2:49.29*	414.84(8.07)	132.68	1,2:85.80*
No	1974	54.89	395.23(4.06)	85.17		329.04(6.06)	120.24	

* Statistically significant at 5% level

About forty five percent of the parents had children who attended pre-school and their children performed significantly better in both Mathematics and Science, than those who did not attend. Since pre-school is not standardised, the number of years spent in preschool depends on many factors, the main ones being financial ability, and contextual factor.

Table 6. 4: *Length of Stay in Pre-school and Performance*

No of years in preschool	**n**	**%**	**Mathematics**			**Science**		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
3 years or more	531	34.18	442.24(8.24)	93.43	1,2:-15.66	417.96(10.79)	136.50	1,2:-14.17
between 2 and 3 years	268	17.09	457.90(9.02)	90.82	1,3:-16.99 1,4:-2.44	432.13(12.59)	132.25	1,3:-13.96 1,4:3.74
2 years	372	24.29	459.23(7.73)	89.69	1,5:10.04	431.92(9.82)	121.53	1,5:22.44
between 1 and 2 years	147	9.40	444.48(8.63)	86.37	2,3:-1.33 2,4:13.42	414.22(11.58)	125.25	2,3:0.21 2,4:17.91
1 year or less	234	15.04	432.20(7.70)	89.92	2,5:25.70* 3,4:14.75	395.52(10.59)	124.46	2,5:36.61* 3,4:17.70
					3,5:27.03* 4,5:12.28			3,5:36.40* 4,5:18.70

* Statistically significant at 5% level

About 34% of parents had children who spent a minimum of three years in pre-school. Parents whose children spent less than one year in pre-school performed significantly lower than all other groups in both subjects. Parents whose children spent between two and three years in pre-school and two years were performing at the same level. This could be indicating that effectively the curriculum is covered in two years after which there is just repetition.

Years beginning schooling

The Revised National Policy on Education stipulates that for public schools, children should be six years by June of the year they start school. It allows those attending private schools to start much earlier, at five years. The age of the children at beginning school is presented in Table 6.5.

Table 6. 5: *Age at Schooling versus Performance*

Age	**n**	**%**	**Mathematics**			**Science**		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
5 years or younger	295	8.74	459.21(11.07)	99.33	1,2:39.79*	431.72(13.25)	140.43	1,2:57.27*
6 years old	1 296	36.88	425.42(5.65)	90.69	1,3:50.59*	380.45(7.97)	131.73	1,3:79.51*
7 years old	1 740	47.98	408.62(3.60)	87.28	1,4:92.12*	352.21(5.59)	125.75	1,4:134018*
8 years old or older	230	6.40	367.09(8.61)	89.45	2,3:16.80*	297.54(10.66)	128.17	2,3:28.24*
					2,4:58.33*			2,4:82.91*
					3,4:41.53*			3,4:54.67*

* Statistically significant at 5% level

About 48% parents indicated that their children started school when they were seven years old, while those whose parents indicated that they started school at five years or younger constituted about 9% and performed significantly better in both subjects, than those who started school older than 5 years. The proportion of these pupils is small yet research has shown that age is negatively associated with performance. This calls for the review of the policy to align with research findings.

Activities performed before beginning primary school

This section covers the age of the child, their literacy and numeracy abilities before they started primary school

Literacy competency before schooling

The following were the activities the parents said their children could perform before starting primary school; recognise most of the letters of the alphabet, read some words, read sentences,

write letters of the alphabet and write some words. An index of the activities was formed with four categories, namely: *very well, moderately well*, *not very well* and *not at all.* Table 6.6 shows the extent of literacy competence before schooling.

Table 6. 6: *Literacy Competence versus Performance*

Performance of activities	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Very well	1122	30.11	441.83(4.50)	85.28	1,2:16.80*	404.82(6.46)	122.64	1,2:25.31*
Moderately well	1503	40.89	425.03(5.07)	90.21	1,3:62.24*	379.51(6.70)	131.03	1,3:91.50*
Not very well	775	21.20	379.59(5.73)	91.36	1,4:69.46*	313.32(7.47)	129.18	1,4:118.52*
Not at all	266	7.80	372.37(8.54)	86.44	2,3:45.44*	286.30(12.04)	120.06	2,3:66.19*
					2,4:52.66*			2,4:93.21*
					3,4:7.22			3,4:27.02

* Statistically significant at 5% level

About 70% of the parents indicated that their children could at least moderately read and write before beginning primary school and these children were performing significantly better than all other groups in that order.

Arithmetic ability before school

Counting up to 100

Parents were asked to indicate whether their children could count up to 100. Their responses were related to performance as shown in Table 6.7.

Table 6. 7: *Counting Numbers versus Performance*

Ability to Count	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Up to 100 or higher	1040	28.54	444.06(7.44)	91.84	1,2:20.82*	411.59(9.46)	130.67	1,2:35.07*
Up to 20	1382	37.21	423.24(4.44)	88.88	1,3:52.15*	376.52(6.30)	128.75	1,3:86.37*
Up to 10	1021	28.63	391.91(4.40)	86.50	1,4:79.71*	325.22(6.87)	124.12	1,4:129.52*
Not at all	197	5.61	364.35(9.25)	85.96	2,3:31.33*	282.07(10.54)	116.86	2,3:51.30*
					2,4:58.89*			2,4:94.45*
					3,4:27.56*			3,4:43.15*

* Statistically significant at 5% level

About 29% of the parents indicated that their children could count up to 100 or higher when beginning primary school and these children performed significantly better than all other groups. Only 6% of the parents said their children could not count at all by themselves and they obtained the lowest mean scores of 364 and 282 in Mathematics and Science respectively as shown in Table 6.7.

Recognising different shapes

Parents were asked to indicate whether their children could recognise different shapes and their response were related to performance as shown in Table 6.8.

Table 6. 8: *Recognising Shapes versus Performance*

Recognising shapes	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
More than 4 shapes	998	27.83	452.81(7.08)	89.85	1,2:29.29*	423.65(9.09)	129.60	1,2:12.48*
3-4 shapes	1090	29.66	423.52(4.42)	88.80	1,3:57.34*	381.17(5.99)	127.37	1,3:93.98*
1-2 shapes	896	24.53	395.47(4.69)	87.90	1,4:73.45*	329.67(6.95)	124.19	1,4:118.79*
None	640	17.98	379.36(6.22)	83.65	2,3:28.05*	304.86(7.88)	117.85	2,3:15.50*
					2,4:44.16*			2,4:76.31*
					3,4:16.11*			3,4:24.81*

* Statistically significant at 5% level

About 28% of the parents indicated that their children could recognise more than four shapes and were performing significantly better than all groups in both subjects. Parents whose children could not recognise any shape had the lowest mean scores of 379 and 304 in Mathematics and Science respectively.

Recognising written numbers

Parents were asked to indicate whether their children could recognise written numbers from one up to ten and their responses were related to performance as shown in Table 6.9.

Table 6. 9: *Recognising written numbers*

Recognising numbers	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
All 10 numbers	2555	70.21	429.57(4.66)	90.01	1,2:32.17*	388.28(6.09)	129.33	1,2:50.18*
5-9 numbers	380	10.39	397.40(6.40)	91.95	1,3:14.91*	338.10(8.77)	131.30	1,3:76.55*
1-4 numbers	390	10.92	387.66(5.89)	89.27	1,4:55.69*	311.73(9.92)	128.04	1,4:94.74*
None	285	8.48	373.88(8.88)	89.33	2,3:9.74 2,4:23.52* 3,4:13.78	293.54(11.39)	124.01	2,3:26.37* 2,4:44.56* 3,4:18.19

* Statistically significant at 5% level

About 70% of the parents reported that their children recognised all ten written numbers. Parents whose children could recognise all written numbers up to ten performed significantly better than all the groups in both subjects. About 8% of the parents reported that their children could not recognise any written number and they obtained the lowest mean scores of 374 and 294 in Mathematics and Science respectively.

Writing Numbers

Parents were asked to indicate whether their children could write numbers from one up to ten and their response were related to performance as shown in Table 6.10.

Table 6. 10: *Writing Numbers and Performance*

Writing numbers	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
All 10 numbers	2507	70.60	429.27(4.51)	89.71	1,2:26.46*	387.22(5.83)	129.09	1,2:47.39*
5-9 numbers	347	10.03	400.81(7.35)	96.40	1,3:44.07*	339.83(10.63)	138.08	1,3:71.09*
1-4 numbers	343	10.15	385.20(7.18)	90.70	1,4:47.06*	316.13(12.07)	127.51	1,4:83.39*
None	312	9.23	382.21(7.90)	86.57	2,3:15.61 2,4:18.16 3,4:2.99	303.83(9.91)	124.57	2,3:23.70 2,4:36.00* 3,4:114.37*

* Statistically significant at 5% level

About 71% of the parents indicated that their children could write all numbers up to 10 and these children performed significantly better than all groups while less than 10% of the parents

reported that their children could not write. The children who could not write obtained the least scores of 382 and 304 in Mathematics and Science respectively as shown in Table 6.10.

Addition and subtraction

The four basic operations of numeracy are addition, subtraction, division and multiplication. Parents were asked whether their children could do the first two operations before beginning school. The results are shown in Tables 6.11 and 6.12.

Table 6. 11: *Simple Addition and Performance*

Ability to Add	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Yes	2869	78.64	424.14(4.24)	90.94	1,2:33.75*	378.23(5.87)	131.11	1,2:54.72*
No	751	21.36	390.39(6.09)	91.40		323.51(8.53)	132.71	

** Statistically significant at 5% level*

Table 6. 12: *Simple Subtraction and Performance*

Ability to subtract	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Yes	2414	67.30	428.23(4.38)	89.47	1,2:32.68*	384.06(6.02)	129.37	1,2:51.47*
No	1155	32.70	395.55(5.02)	92.56		332.59(7.44)	133.44	

** Statistically significant at 5% level*

Children whose parents indicated that they could do simple addition and subtraction performed significantly better than those who could not perform the operations. The majority of the children (33%) could not perform simple subtraction compared to 22% who could not perform simple addition as shown in Tables 6.11 and 6.12.

The Child's school work

The child"s school work is comprised of the time spent on homework and home support for learning.

Time spent on homework

Homework is a means of interaction between the school and the parents and it is a diagnostic for the teacher as it shows how well the child has mastered the topic. For the child it facilitates independent learning. Table 6.13 shows the time pupils spent on homework against performance.

Table 6. 13: *Time Spent Doing Homework and Performance*

Time	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
	235	6.39	367.10(7.16)	87.10	1,2:-32.23*	297.73(10.37)	123.19	1,2:-45.09*
					1,3:-62.60*			1,3:-87.33*
15 minutes or less	743	20.64	399.33(5.32)	86.62	1,4:-72.66*	342.82(7.92)	125.09	1,4:-95.88*
					1,5:-36.86*			1,5:-56.06*
16-30 minutes	1333	36.97	429.70(4.66)	88.67	2,3:-30.37*	385.06(6.65)	129.23	2,3:-42.24*
					2,4:-40.43*			2,4:-50.79*
31-60 minutes	749	21.22	439.76(6.72)	91.60	2,5:-4.63	393.61(10.43)	135.45	2,5:-10.97
					3,4:-10.06			3,4:-8.55
more than 60	527	14.77	403.96(6.94)	93.11	3,5:25.74*	353.79(10.37)	133.54	3,5:31.27*
minutes					4,5:35.80*			4,5:39.83*

** Statistically significant at 5% level*

About 6% of the parents said their children were not given homework and this group had the lowest mean scores, while 21% of the parents said their children spent 31-60 minutes on homework and had the highest mean scores which were significantly better than all the groups.

Home support for learning

"Parental involvement takes many forms including good parenting in the home, the provision of a secure and stable environment, intellectual stimulation, parent-child discussion, good models of constructive social and educational values and high aspirations relating to personal fulfilment and good citizenship; contact with schools to share information; participation in school events; participation in the work of the school; and participation in school governance" (Desforges & Abouchaar, 2003).

Parents were asked how often they help their children to learn at home. An index was formed with four categories namely; *Every day or almost every day, once or twice a week, Once or twice a month,* and *Never or almost never.* Table 6.14 shows the frequency of help and pupils performance.

Table 6. 14: *Home Support Rendered to Pupils and Performance*

Support given	**n**	**%**	**Mathematics**			**Science**		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Every day or almost everyday	1 451	39.37	433.62(4.43)	87.75	1,2:18.50* 1,3:51.73*	392.62(6.46)	126.77	1,2:30.64* 1,3:76.49*
Once or twice a week	1 672	45.77	415.12(4.87)	92.20	1,4:82.38*	361.98(6.71)	134.39	1,4:109.77*
Once or twice a month	441	12.01	381.89(6.53)	91.65	2,3:33.23* 2,4:63.88*	316.13(10.25)	131.05	2,3:45.85* 2,4:79.13*
Never or almost never	100	2.85	351.24(12.36)	86.73	3,4:30.65*	282.85(14.54)	114.69	3,4:33.28

** Statistically significant at 5% level*

The majority of the parents (39%) indicated that they help their children in their learning *every day or almost every day* and their children perform significantly better than all the other groups.

Perception about the child's school

The school is where the child interacts with other peers and it is expected that it should provide a conducive environment for learning. Parents responded to questions on how they perceived their children"s school. An index was created with two categories of agree and disagree. Table 6.15 shows the results linked to pupil performance.

Table 6. 15: *School Perception and Performance*

Positive perception	**n**	**%**	**Mathematics**			**Science**		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Agree	3485	95.78	419.41(4.17)	91.44	1,2:70.01*	369.83(5.89)	132.42	1,2:94.13*
Disagree	155	4.22	348.40(10.36)	91.77		275.70(14.64)	128.73	

** Statistically significant at 5% level*

The majority of the parents (96%) had a positive perception about the school, and these parents" children were performing significantly better than those who had a negative perception.

Literacy in the home

Literacy in the home was considered to be constituted by time spent in reading for self -development, time spent reading for enjoyment, parents reading perception, number of books in the home, children"s books in the home and language of communication at home.

Research has shown that the most important thing that a parent can do to help their child acquire language, prepare them for school, and instil a love of learning in the child, is to read to them (http://www.pvschools.net/speced/pdfs/Importance-of-Reading.pdf) quoting (Russ et al., 2007). Research has found that there is a strong correlation between reading and academic success, reading and vocabulary knowledge thus good readers widen their knowledge, comprehend texts better leading to better achievement. Parents were asked to indicate the amount of time they spend reading for self-development and the results were correlated to performance as shown in Table 6.16.

Table 6. 16: *Time Spent by parents in Reading for Self-development and Performance*

Time	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Less than one hour a week	1 530	42.82	407.06(3.92)	87.25	1,2:-18.02* 1,3:-25.83*	349.10(5.53)	126.03	1,2:-34.43* 1,3:-36.80*
1-5 hours a week	1 291	36.74	425.08(5.72)	91.61	1,4:-20.71*	383.53(7.42)	132.63	1,4:-34.55*
6-10 hours a week	355	10.13	432.89(8.35)	99.94	2,3:-7.81	385.90(12.22)	144.47	2,3:-2.37
More than 10 hours a week	365	10.31	427.77(7.31)	98.82	2,4:-2.69 3,4:5.12	383.65(10.55)	138.49	2,4:-0.12 3,4:2.25

** Statistically significant at 5% level*

About 43% of parents spent less than one hour a week reading for self -development and their children obtained the lowest mean scores in both subjects compared to all other groups.

Reading for enjoyment

Parents were asked to indicate how often they read for enjoyment and the responses were related to pupil performance as shown in Table 6.17.

Table 6. 17: *Time Spent Reading for Enjoyment and Performance*

Time	**n**	**%**	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Every day or almost every day	1 429	39.63	434.90(4.39)	89.45	1,2:15.88* 1,3:45.95*	392.32(6.10)	129.28	1,2:21.74* 1,3:68.42*
Once or twice a week	1 585	43.67	419.02(4.64)	87.72	1,4:77.58*	370.58(6.10)	127.82	1,4:117.98*
Once or twice a month	307	8.61	384.95(8.47)	98.36	2,3:34.07*	323.90(10.71)	139.58	2,3:46.68*
Never or almost never	280	8.10	357.32(6.89)	87.09	2,4:61.70* 3,4:27.63*	274.34(9.90)	119.87	2,4:96.24* 3,4:49.56*

** Statistically significant at 5% level*

Forty percent of the parents read for enjoyment *every day or almost every day* and their children performed significantly better than all the groups in both subjects. Children whose parents never read for enjoyment had the lowest mean score.

Perception about reading

Parents were asked various questions to determine their perception about reading. An index was created which showed whether they agreed or disagreed with the statements. Table 6.18 shows the results.

Table 6. 18: *Perception about Reading and Performance*

Positive perception	**n**	**%**	**Mathematics**			**Science**		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Agree	3345	91.70	421.97(4.25)	91.09	1,2:63.06*	373.92(6.10)	132.14	1,2:89.94*
Disagree	297	8.30	358.91(7.71)	85.77		283.98(8.86)	118.08	

** Statistically significant at 5% level*

The majority of the parents (92%) had positive perceptions about reading and their children performed significantly better than those whose parents had negative perceptions about reading.

Number of books in the home

Parents were requested to indicate the number of books in the home, not including magazines and children"s books. The results are presented in Table 6.19.

Table 6. 19: *Number of Books in the Home and Performance*

No. of books	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
0-10	1913	52.80	397.33(4.21)	87.06	1,2:-26.33* 1,3:-59.28* 1,4:-70.61* 1,5:-38.15* 2,3:-32.95* 2,4:-44.28* 2,5:-11.82 3,4:-11.33 3,5:21.13 4,5:32.46	335.12(5.95)	124.19	1,2:-45.52* 1,3:-94.22* 1,4:-107.59* 1,5:-56.82* 2,3:-48.70* 2,4:-62.07* 2,5:-11.30 3,4:-13.37 3,5:37.40 4,5:50.77*
11-25	899	24.56	423.66(3.96)	87.82		380.64(5.53)	125.84	
26-100	540	15.32	456.61(7.76)	94.02		429.34(10.78)	137.41	
101-200	135	3.71	467.94(12.30)	93.43		442.71(17.41)	131.87	
More than 200	129	3.60	435.48(11.36)	96.89		391.94(17.52)	143.46	

** Statistically significant at 5% level*

About 53% of the parents had less than ten books in the home and their children performed significantly lower than all the groups.

Children's books in the home

Parents were asked to indicate the number of children"s books in the home excluding children"s magazines and school books. They also indicated whether the books were in English or not. The results were related to performance as shown in Tables 6.20 and. 6.21.

Table 6. 20: *Children's Books in the Home and Performance*

No. of books	N	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
0-10	2322	64.24	407.15(4.05)	88.14	1,2:-28.16*	350.84(5.91)	127.22	1,2:-47.22*
					1,3:-37.01*			1,3:-54.88*
11-25	770	21.43	435.31(6.28)	92.67	1,4:-7.91	398.06(8.22)	134.56	1,4:-20.45
					1,5:-24.60			1,5:-33.04
26-50	332	9.08	444.16(9.42)	94.68	2,3:-8.85	405.72(13.37)	132.61	2,3:-7.66
51-100	116	3.16	415.06(15.98)	110.64	2,4:20.25	371.29(21.49)	157.44	2,4:26.77
					2,5:3.56			2,5:14.18
More than 100	71	2.10	431.75(19.52)	100.65	3,4:29.10	383.88(29.29)	155.54	3,4:34.43
					3,5:12.41			3,5:21.84
					4,5:16.69			4,5:12.59

** Statistically significant at 5% level*

About 64% of the parents had less than ten children"s books in the home and their children performed significantly lower than all the groups.

Table 6. 21: *Children's Books in English and Performance*

Books in English	N	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Yes	2662	75.03	428.02(4.93)	92.32	1,2:39.38*	384.53(6.76)	133.57	1,2:64.09*
No	892	24.97	388.64(5.04)	83.68		320.44(5.65)	118.55	

**Statistically significant at 5% level*

The majority of the parents (75%) had children"s books in English and their children performed significantly better than those whose books were not in English.

Language of communication at home

Parents were asked to indicate the language they used for communicating with their children and this was related to performance as shown in Tables 6.22.

Table 6. 22: *Parents Language of Communication with Child and Performance*

Parent	Language	n	%	Mathematics			Science		
				Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Father	English	381	16.23	469.73(9.02)	91.96	1,2:57.80*	449.15(12.28)	131.39	1,2:89.32
	Setswana	1 731	68.90	411.93(4.25)	89.82	1,3:40.43*	359.83(6.55)	131.41	1,3:72.12*
	Other	280	12.17	429.30(8.60)	88.69	2,3:-17.37	377.03(11.67)	126.17	2,3:-17.20
Mother	English	331	12.68	461.46(10.36)	92.52	1,2:48.43*	438.10(13.78)	130.69	1,2:77.45*
	Setswana	2 007	74.04	413.03(4.48)	89.92	1,3:38.34*	360.65(6.57)	130.67	1,3:67.54*
	Other	320	12.66	423.12(8.76)	93.09	2,3:-10.09	370.56(11.94)	133.47	2,3:-9.91

** Statistically significant at 5% level*

The majority of parents communicate to their children in Setswana, fathers constituting 69% and mothers 74%. About 16% of the fathers and 13% of the mothers communicated in English to their children. Children whose parents communicated to them in English performed significantly better than those who spoke Setswana or other languages.

Additional Information

The parents were asked to provide information on their educational background, expectation on child"s education, employment status and occupation. The responses were related to pupils" performance as shown in Tables 6.23 and 6.24.

Table 6. 23: Highest *Level of education of the father and performance*

Level of education	n	%	Mathematics			Science		
			Mean(Se)	SD	Diff	Mean(se)	SD	Diff
Never attended school	723	20.7	378.48(4.08)	75.45	1,2:-10.44	377.24(5.81)	104.69	1,2:-16.96*
Did not complete primary education	358	10.3	388.92(3.76)	73.27	1,3:-15.3* 1,4:-23.13*	394.20(5.43)	101.66	1,3:-21.99* 1,4:-34.21*
Completed primary education	622	18.3	393.78(3.61)	73.23	1,5:-54.15* 2,3:-4.86	399.23(4.56)	96.82	1,5:-79.31* 2,3:-5.03
Completed secondary education	989	28.6	401.61(3.72)	73.39	2,4:-43.71* 2,5:-7.83*	411.45(5.33)	98.72	2,4:-17.25* 2,5:-62.35*
Completed post-secondary education	775	22.2	432.63(5.16)	74.05	3,4:-38.85* 3,5:-31.02* 4,5:-31.02	456.55(6.54)	90.74	3,4:-12.22 3,5:-57.32* 4,5:-45.01*

** Statistically significant at 5% level*

About 21% of the fathers had never attended school and their children had the least scores in both subjects. The majority of the fathers (29%) had completed secondary education while 22% went beyond post-secondary. Children whose fathers reported that they had post-secondary education performed significantly better than all. Thus the father"s educational attainment is positively associated with pupil performance.

Table 6. 24: *Highest Level of education of the mother and performance*

Level of education	n	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
Never attended school	437	11.4	368.40(6.00)	76.79	1,2:-19.46*	366.11(8.54)	106.42	1,2:-23.16*
Did not complete primary education	384	10.2	387.86(4.23)	72.00	1,3:-15.14* 1,4:-38.26*	389.27(5.15)	99.70	1,3:-19.52* 1,4: -53.34*
Completed primary education	893	23.8	383.54(2.97)	73.17	1,5:-74.98* 2,3:4.32	385.63(4.95)	101.15	1,5:-102.45* 2,3:3.64
Completed secondary education	1 326	35.7	406.66(2.80)	70.56	2,4:-18.80* 2,5:-55.52*	419.45(3.74)	93.74	2,4:-30.18* 2,5:-79.29*
Completed post-secondary education	708	18.9	443.38(5.30)	74.93	3,4:-23.12* 3,5:-59.48* 4,5:-36.72*	468.56(6.35)	89.84	3,4:-33.82* 3,5:-83.93* 4,5:-49.11*

** Statistically significant at 5% level*

About 11% of the mothers had never attended school and their children had the least scores in both subjects. Majority of the mothers (36%) had completed secondary education while 19% had post-secondary education. Children whose mothers reported that they had post-secondary education performed significantly better than all. The mother"s educational attainment was positively associated with pupil performance.

Expectation of child's education

Children are the future leaders thus each and every parent has an expectation for their children to be educated and become better in society. Table 6.26 shows the responses of parental expectation of the child"s education and pupil performance.

Table 6. 25: *Parental expectation of child's education and pupil performance*

Parent expectation	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
Finished secondary	515	14.41	374.79(4.84)	82.71	1,2:-20.32*	302.97(7.35)	113.60	1,2:-30.62*
Finished diploma/technical level	689	19.22	395.11(5.37)	87.72	1,3:-59.60*	333.59(7.86)	123.39	1,3:-89.85*
Finished degree/post graduate	2305	66.37	434.40(5.30)	90.75	2,3:-39.29*	392.82(7.37)	132.79	2,3:-59.23*

**Statistical significant at 5% level*

The majority of the parents (66%) would like their children to finish at least first degree. Children whose parents expect them to finish at least their first degree performed significantly better than all other groups. The results showed a positive correlation between the expectation of the child"s education and the child"s performance.

Employment status of the child's parents

Parents were asked to indicate their employment status and this was related to performance as shown in Tables 6.27 and 6.28 for fathers and mothers respectively.

Table 6. 26: *Employment status of the father and performance*

Employment status	n	%	Mathematics			Science		
			Mean(SE)	SD	Diff	Mean(SE)	SD	Diff
At least full-time	1 283	58.09	445.27(6.11)	91.51	1,2:35.61*	416.69(7.91)	132.02	1,2:69.35*
Part-time	310	13.89	409.66(6.84)	86.46	1,3:60.29*	347.34(9.53)	128.39	1,3:100.19*
Not working for pay	225	10.44	384.98(9.02)	86.62	1,4;0.75 2,3:24.68*	316.50(15.19)	124.25	1,4:23.09 2,3:30.84
Other	152	7.01	444.52(13.84)	91.63	2,4:-34.86* 3,4:-59.54*	393.60(17.27)	132.16	2,4:-46.26* 3,4:-77.10*

**Statistical significant at 5% level*

About 58% of the fathers were employed full time. Children whose fathers were employed on a full time basis performed significantly better than those whose fathers were employed part- time or do not work for pay in both subjects. Fathers not working for pay may not be able to cater for their children"s educational needs and this negatively affects performance.

Table 6. 27: *Employment status of the mother and performance*

Employment status	n	%	Mathematics			Science		
			Mean (SE)	SD	Diff	Mean (SE)	SD	Diff
At least full-time	1084	41.66	451.94(6.21)	89.24	1,2:48.30*	424.80(7.74)	128.52	1,2:84.88*
part-time	496	18.71	403.64(5.95)	89.35	1,3:58.34*	339.92(8.57)	128.46	1,3:93.52*
Not working for pay	446	17.46	393.60(7.30)	89.39	1,4:20.30	331.28(10.47)	127.06	1,4:42.67*
Other	240	9.34	431.64(9.87)	90.06	2,3:10.04	382.13(12.48)	131.07	2,3:8.64
					2,4:-28.00*			2,4:-42.21*
					3,4:-38.04*			3,4:-50.85*

** Statistical significant at 5% level*

About 42% of the mothers were employed full time. Children whose mothers were employed on a full time basis performed significantly better than those whose mothers were employed part-time or not working for pay. Mothers not working for pay may not be able to cater for their children"s educational needs as sometimes support is required in monetary terms thus negatively affecting performance as their children obtained the lowest significant mean scores.

Summary

The following are findings from the parental background variable chapter:

1. The study showed that learners engaged in non-formal pre-school activities like numeracy and literacy performed better in future years of schooling.

2. About 9% of the pupils started school when five years or younger and they performed significantly better than the majority (48%) who started school at seven years old. Performance further declined as the pupils get eight years or older.

3. About forty five per cent of the parents had children who attended pre-school and their children performed significantly better in both Mathematics and Science, than those who did not attend. This could be a sign of commitment on the side of the parents as they pay for the pre-school education service.

4. About 6% of the parents reported that their children were not given homework and this group had the lowest mean scores, while 21% of the children spent 31-60minutes on homework and had the highest mean scores. Homework should be encouraged as it allows for further learning at home as supported by 39% of the parents who help their children in learning every day.

5. Majority of the parents (75%) had children"s books in English and their children performed significantly better than whose books were not in English. This is further supported by majority of the parents (92%), had positive perception about reading and their children performed significantly better than those whose parents had negative perception about reading. This shows that parents provide an enabling reading culture.

6. Children whose parents communicated to them in English, about 13% performed significantly better than those who spoke Setswana or other languages.

7. Children whose parents were employed on a full time basis performed significantly better than those whose parents were employed on part- time or not working for pay.

8. Children whose parents had gone beyond post-secondary education performed significantly better than all groups, thus educational attainment is positively associated with the pupils performance.

Recommendations

1. Schools should provide effective childrens books in the library to compliment what the parents can provide, thus providing an enabling reading environment.

2. Parents should be encouraged to speak English to their chidren as it positively impacts on learning. The policy of teaching English from standard two should be revisited so as to enable the pupils to start communicating in English early

3. Early enrolment at primary that is five years or younger to be encouraged as the younger the pupils the better the performance.

4. Pre-school should be formalised so that majority of the pupils benefit as attendance of pre-school impacts positively on performance,

5. Each school should have an effective homework policy as pupils not doing homework had the lowest mean scores

CHAPTER SEVEN
SUMMARY

Botswana participated in TIMSS study to improve the quality of its education, by assessing the level of mathematics and science learning of pupils; identifying factors that impact on teaching and learning; and by comparing achievement and teaching and learning conditions amongthe participating countries. Assessment was based on a common international framework which mirrored at least 90% of the country"s curricular. The information obtained was used to inform curricula reviews and for planning and implementing educational initiatives. Information generated through TIMSS is intended to be used by educators to plan and execute activities that lead to improved learning of Mathematics and Science.

Botswana"s target population for the 2011 study was Standard Six (Grade 6) pupils. These were pupils who had six years of schooling. Botswana, Yemen and Honduras used Standard Six pupils while the rest of the countries used Grade Four pupils. This was because of the pilot results which showed low scores by our Standard Four pupils thus introduced a lot of measurement error in the international and national results.

TIMSS procedures were highly standardised to enable comparison between countries. As such, a lot of materials on the conduct of the study were sent by the study centre to individual countries. These included *Survey Operations Procedures* and Manuals. Some of the activities such as *Sampling* were done by the study centre itself to ensure similar outcomes. Twenty-five schools were sampled for pilot while 150 schools were sampled for Main Survey for Botswana using multi-stage stratified cluster with the probability of being sampled proportional to the school size (PPS) technique. Two classes were randomly selected in each school sampled for the pilot, while only one class was selected at random for the main survey.

Pupils" performance was reported based on four points on the scale used as benchmarks. The four benchmarks were low, intermediate, high and advanced. Items were of the select- format as well as problem-solving in an open-ended format which offered better insight into the analytical, problem-solving and inquiry skills pupils. More investigative and production-based tasks were set in order to be able to cater for the cognitive domains that had been identified.

After compiling the test booklets, cultural adaptation of the items which involved checking the items for any cultural aspect in the item that would make it unsuitable for the intended population was conducted. The process of cultural adaptation included translation from English to the language of instruction in countries that did not use English for instruction.

Background questionnaires were also developed and administered to School Heads, Mathematics and Science teachers, parents and pupils. The questionnaires were similarly subjected to cultural adaptation and translation as were the achievement instruments. Questionnaires were constructed according to themes. The items were grouped together to form one or more construct. The name of the construct was representative of the underlying construct. Indices were formed by calculating the mean response for that construct. Negatively worded items were reversed before analysis was done to align the item with the rest. A scale average w a s set at 500 (a s m e a n) and a standard deviation at 100. SPSS sitting on the International database Analyser (IDB Analyser) platform was used for analysing the data. Data analysis was mainly by means, standard deviation, and regression.

Pupils' performance

The analysis of TIMSS Grade 6 data gave an intriguing insight on the relationship between pupils‟ demographics and pupils‟ background variables on achievements. The results also suggest that older pupils perform poorly compared to younger pupils taking into account pupil life experience differences. Therefore, it is not a panacea to delay pupils to start school hoping that they will do well when they are older. This also applies to retaining pupils in school or making a pupil retake a year or two. This does not necessarily help in older pupils‟ performance in Mathematics and Science. So, any national policy in education that suggests that pupils who dropped out of school or who failed earlier on must go back to school most likely results in low average performance or a decline in performance.

The results also suggested that pupils‟ safety at school, involvement of parents in pupils‟ work and availability of basic amenities such as water, electricity, internet, and so on, are positive indicators for better performance. It is therefore paramount for any governing body to improve family socio-economic status so that the pupils‟ performance can be properly compared to the international pupils.

Botswana pupils overall performance for both subjects was lower than the international benchmark mean of 500. The overall mean achievement for mathematics was 419.22 while for science it was 367.33. Pupils performed better in Data Display compared to other content domains in mathematics, while in science pupils scored better in Physical Science. Pupils‟ performance was best in Knowing cognitive domain while their performance was low in Reasoning. Girls performed better than boys in both Mathematics and Science, even after controlling for background variables, although the difference was not significant. In science, girls performed much better than boys in all cognitive domains and all the content domains.

Comparison with other participating countries showed that Botswana was one of the lowest performing countries with an average performance of 419 in mathematics and 367 in science. The best performing countries had an average performance of 606 in mathematics and 587 in science. The percentage of Botswana pupils reaching each International Benchmark was incomparable to the best performing countries. Sixty per cent (60%) of Botswana pupils reached Low benchmark in mathematics and only 43% reached the Low benchmark in science, while the best performing countries achieved more than 99% in mathematics and 97% in science of the Low benchmark. This implied that Botswana‟s Standard Six pupils found test materials a bit difficult, which were handled with ease by pupils of lower grades (Standard Four equivalent) of other countries. Younger pupils performed better than older pupils when taking into account differences of pupil life experiences.

Given that performance was affected by other pupils‟ contextual factors, pupils‟ background variables were correlated with performance to check for association. Such variables were pupils‟ safety at school, parental involvement in pupils‟ work, and home possessions, pupils‟ perception about school, bullying, number of books at home, and pupils‟ attitudes, among others. The results suggest that pupils‟ age, home possession, home support, bullying, and pupils‟ attitudes were positive indicators for better performance. It is therefore paramount for the education system to improve family socio-economic status which will in turn improve pupils‟ performance for better comparison with the international pupils.

Teacher background variables

The importance of the teacher in the learning of the pupils cannot be overemphasized. The characteristics or quality of teachers in terms of individual characteristics and professional

competency go a long way in ensuring that quality education is provided to pupils, particularly at elementary level.

It has been revealed that generally most pupils were taught by teachers who had at least a degree in education qualification. However, pupils who were taught by diploma holders performed better than those taught by degree holders. Nevertheless, this could be because most diploma holders were an older generation, as such had more experience of how to handle pupils since delivering the content one has is of vital importance. Furthermore, experience also proofed to be vital as pupils who were taught by teachers with lot of experience performed better. Thus teachers had matured with age and were doubling as parents hence they were in a better position to articulate and handle pupils needs.

Most of the pupils were taught by teachers who were concerned by the conditions or school environments within which they worked. Furthermore, availability of computers and associated assistance to teachers seemed to enhance the performance of the pupils, yet few pupils were taught by teachers with such kind of resources.

Attitudes and behaviours of teachers towards their profession played significant role in teachers‟ ability to deliver lessons and imparting knowledge to the pupils. The more teachers were satisfied with their profession (general conditions within their profession), the higher their efficiency and effectiveness in teaching, translating to higher performance of the pupils.

General lack of resources, lack of participation in professional development, lack of confidence and preparedness to teach certain content domains hampered teacher efficiency and effectiveness, consequently affecting pupils‟ performance. As such, these issues needed to be addressed for the betterment of the overall performance of pupils.

School background variables

Most schools had enrolment of between 400 and 1200. However, there were a sizeable proportion of schools which had small enrolments of about 200 pupils. Majority of pupils attended schools in villages and remote rural areas where there were a lot of economically disadvantaged families. The performance of the pupils varied with the locality of the school, with pupils from urban areas performing better than pupils from other localities in the sample. Pupils from affluent families performed significantly better suggesting that better families tended to

support their children"s education better. However, the size of the school was not linked with performance.

The results indicates that the performance of pupils was not affected much by the availability of resources like computers, science lab and other resources needed to carry out instruction. Pupils were taught by teachers who had moderate to high job satisfaction, teacher understanding of the curricula, and teachers" degree of success in implementing curriculum.

Evaluation of teachers work was mainly through observation by the principal or senior staff and pupil achievement only. Teacher peer review and observation by inspectors can still be improved. Pupils started their primary school whilst they were still unable to count, read and write basic letters and/or numbers. Pupils from schools with a higher percentage of those who could read, write or count performed better than the pupils from schools where the percentage was lower.

Students started their primary school whilst they were still unable to count, read and write basic letters and/or numbers. This is because pre-primary education system is not well developed and offered commercially by private individuals. As a consequence, pre-primary education is predominantly found in developed towns and urban centres where investment in such could justify profitable undertaking. It was therefore not surprising that students from schools with a higher percentage of those who could read, write or count performed better than the students from schools where the percentage was lower.

Parent background variables

The analyses of parental background variables revealed some interesting findings. The study showed that learners engaged in non-formal pre-school activities like numeracy and literacy. It was found that non-formal pre-school activities were positively associated with performance. Pre-schooling attendance is not compulsory in Botswana, as such only slightly less than half (46.43%) of the children had their parents sending them to pre-schools. Such children were found to significantly perform better than those who did not attend pre-schooling. However, parents who did not have the means to send their children to pre-primary formal set-up, continued with informal teaching of their children at home, as evidenced by children"s high literacy rate (92.0%) and some arithmetic competence when they started school.

About 9% of the pupils started school when five years or younger. Cumulatively, 94.55% of Botswana children started school when they were 7 years or younger, as per the policy requirement and tended to perform better. Performance further declined for pupils who are eight years or older.However, either early schooling or the number of years spent in pre-school was also of paramount importance in the child learning and performance. About forty five per cent (45%) of the children had attended pre-school. A small proportion of children (27.5%) had parents who spoke English at homes with them before beginning schooling and that enhanced the children"s performance.

Learning is not confined to school set-up, parents must assist their children in doing schoolwork. Children who either spent some time doing their homework and/or being helped by parents tended to perform better than those who spent less time and/or did not do their homework at all. Majority of parents went as far as attaining some junior secondary education (40%). Thus children whose parents had higher educational level seemed to benefit from them in terms of assistance with homework. However, there are some schools which still do not give pupils homework (9%), yet learning can be done anywhere and anytime.

Likewise, more books and interest in reading were related to educational level of the parents which were in turn positively related to children"s performance. Despite high proportion of parents with low levels of education, their expectation of children achieving higher levels of education was high, and children whose parents had high expectation of them performed better. Parents communicated with their children in English, thus ensuring that their children learn English at an early stage since it is used as a medium of instruction. Thus children would understand the teacher when teaching and therefore perform better. Parents were therefore found to take an active role in their children"s learning.

CHAPTER EIGHT
RECOMMENDATIONS

Based on the findings of the study, the following recommendations are made:

1. Pre-Primary education should be formalised

Pre-primary education should be formalised just like any level of education in Botswana. It should be made free and compulsory to all children under the age of five. The initial cost of a project of such magnitude will be huge, but in the long run, the benefits will outweigh the capital investment. Children who attend pre-primary schools get accustomed to learning early, and make learning part of their culture. Since children who attended formal set-up of pre-primary education and those who were taught informally at homes performed better than those who did not have formal pre-primary or informal one.

Internationally, the ISCED considers pre-primary to be an integral part of the education structure, hence when TIMSS was conceived, it was to be administered to pupils who have ten years of exposure to education (eighth graders or Form Two). Pupils starting early will learn English at pre-primary and by the time they reach Standard 2, where English is used as a medium of instruction, they will not have any problem understanding the lessons and consequently comprehending the items which need more reading.

2. Establishment of fully fledged Support Service Department in schools

Although repetition is meant to give children a chance to prove themselves, it could also act against the intended objective because pupils made to repeat would be left behind their age mates and this may bother them and disturb learning. Repetition should be the last option when effective remedial teaching has failed to yield desirable results. As such, a fully-fledged Support Service Department should be established with the aim to assist those pupils who need accommodation during instruction. Given that pupils develop and learn at different rates and are talented in different ways, teachers cannot effectively unearth the different talents that pupils have with the current large class sizes and high pupil/teacher ratios. This will ensure that almost all, if not all, pupils attain the promotion to another level.

3. Homework policy

Since learning takes place anywhere anytime, schools should therefore give reasonable amount of homework almost every day. In fact some children learn better at home than at school. The education system should come up with homework policy which will compel parents to help their children with homework as well as schools to monitor homework. The homework policy should be realistic and enforceable. The policy should be explicated to the students at the beginning of the school year as well as explained to parents.

4. Safety of pupil at school

Schools are no longer a safe place for leaning. The school environment is changing and the situation needs to be tackled while it is still less severe. Learning can only take place in a safe environment. Teachers and parents need to work together in the moulding of the child. There is need to revisit the „Community Junior Schools" model taking into account changes that have occurred since it was stopped.

5. Teacher Development workshops

Teachers need to attend in-service courses regularly. Since curriculum is dynamic, new modern and advanced materials are always incorporated into the curriculum. Regular in-service course will not only serve imparting teachers with necessary skills to deliver the curriculum, but also motivate teachers to do their work.

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