BOTSWANA TEACHERS' LEVEL OF NEEDS SATISFACTION AS PREDICTORS OF STUDENTS' MATHEMATICS PERFORMANCE IN 2015 TIMSS

By

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Declaration of originality

I declare that this project is my own work and has not been copied in part or in whole from any other source except where duly acknowledged. The previously published work such as books, journals, magazines, internet and so forth have been acknowledged within the main report and in the reference list.

Signed:…….. Date: ……

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Abstract

For any nation, poor and deteriorating performance in mathematics by her learners in an age where skills in Science and Technology are necessary for economic growth spell doom to her development hopes and efforts. Countless factors have been analyzed to explain why some students attain higher levels of academic achievement than other students. The decline of Math performance in senior secondary schools in Botswana has been of a great concern to the nation at large. Among the attributory factors to this poor Math performance, scrutinizing teachers' influence have lagged behind. The purpose of this study therefore, was to determine how the Maslow's hierarchy of needs theory acted on teachers to predict students' Math performance in Botswana. The four driving objectives of the study were; firstly to establish the influence of teacher's characteristics, secondly to find the relationship between Maslow's Hierarchy of needs on teachers and thirdly the extent at which the needs predict students' performance when teacher's characteristics are controlled and finally to find out the best predictor of teacher's needs on students math performance.

The study was quantitative in nature and adopted a correlation research design. Secondary data analysis was used from the Botswana data of 2015 Trends in Mathematics and Science Study. TIMSS employed a two-stage random sampling method and the sample was made up of 160 schools, 169 teachers and 5964 students. TIMSS teacher questionnaires were used as a method of data collection. Consent from relevant authorities, confidentiality and privacy were assured and data was used for the intended purpose. The Statistical Packages for Social Sciences was used to analyze data. Validity as well as the Reliability was assured from the Cronbach' test. Factor analysis was used to derive the independent variables (teacher's needs) whilst the Pearson product moment correlation coefficient, One Independent T-Test, One-Way ANOVA and the Hierarchical multi regression methods were used to test the hypotheses.

The findings of this study showed that Teacher's background characteristics positively influenced students' performance except teachers' gender. Teachers' needs had a positive

statistical significant relationship with students' Math performance. As they all predicted performance, the basic needs were the best predictors of students' Math performance. Based on these results, appropriate discussions and recommendations were made.

Abbreviations

ANOVA	Analysis of Variance
BEC	Botswana Examinations Council
BISE	Board of Intermediate and Secondary Education,
DPC	Data Processing and Research Center
HLM	Hierarchical Linear Modeling
IEA	Evaluation of Educational Achievement
IRT	Item Response Theory
IMU	International Mathematics Union
NCES	National Center for Education Statistics
NRC	National Research Coordinator
OECD	Organization of Economic Co-operation and Development
PISA	Program for International Student Assessment
RNPE	Revised National Policy on Education
SACMEQ	The Southern and Eastern African Consortium for Monitoring Educational Quality
SDC	Statistical Disclosure Control
SPSS	Statistical Package for Social Science
TIMSS	Trends In Mathematics and Science Study
U.S.	United States
UNESCO	The United Nations Educational, Scientific and Cultural Organization
UNICEF	The United Nations Children's Fund

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Introduction and the Problem of study

1.0. Introduction

For any nation, poor and deteriorating performance in mathematics by her learners in an age where skills in science and technology are necessary for economic growth, spell doom to her development hopes and efforts. Globally, due to advancement in science and technology, the need to advance the field of Mathematics has become of paramount necessity. In the rapidly changing world and in the development of science and technology, Mathematics plays a vital role. Education systems throughout the world place high importance on the teaching and learning of Mathematics, and lot of resources are put to maintaining and improving efficiency and effectiveness in these activities. Math is essential in public decision-making and for participation in the knowledge economy. It equips pupils with uniquely powerful ways to describe, analyze and change the world. It can stimulate moments of pleasure and wonder for all leaners when they solve a problem for the first time, discover a more elegant solution, or notice hidden connections. Though that's the case, poor Math performance remains a termite to most of the education bodies from pole to pole.

Investing in education therefore will yield significant economic returns for individuals, communities, and for the nation. However, such returns disappear when the quality of education is poor. The declining performance of the education system has far reaching implications for the country. Beyond the obvious fact that the poor performance means that the country may not be able to produce the human resources robust enough to drive economic development, there are national security implications for the position of education as the greatest equalizer (Boko 2015).

Math performance in Asian countries mostly Taiwan, Japan, Korea, China and Singapore have for a long time topped the latest global school rankings in science and math conducted by the Organization of Economic Co-operation and Development (OECD), (Wei & Dzeng, 2014). However, United States of America as one of the developed countries has been seen to be

experiencing the problem of poor performance in Mathematics. According to Kerr (2016), the latest global snapshot of student performance showed a declining math scores in the U.S. and stagnant performance in science and reading. Hence Math been labeled as a stubborn concern. From the previous assessment studies like the 2015, Program for International Student Assessment (PISA) study, the American students are underperforming compared to their peers in several Asian nations. Everything is just going down as noted by Kerr (2016). This is evidenced by the U.S performing below international average in math. It is evident from these global assessments therefore, that Math performance is of a great concern.

Africa's Mathematics education also is currently facing numerous problems at all levels, despite the strong mobilization of governments and international support (International Mathematics Union (IMU), 2014). The performance of African countries participating in international benchmark tests is a major concern amongst educators and policymakers. This abysmal performance raises questions about the effectiveness of the periodical curriculum and educational reforms in most of these countries (Ndlovu & Mji, 2012). Countries like Ghana, Kenya, South Africa and Egypt continue to experience low performance in Mathematics. This was evident from their results in 2003 TIMSS participation as all these countries had an average score below an international average (Mullis, Martin, Smith & Garden, 2003). Botswana also, was opportuned to take part in the same study and it was ranked third from the bottom in both Mathematics and Science.

In Botswana, Mathematics is a compulsory subject at both primary and secondary levels. It is also used as a basic entry requirement into any of the prestigious courses such as medicine, architecture and engineering among other degree programs. Despite the important role that Mathematics plays in society, there has always been poor performance in the subject at national examinations. Performance in Mathematics as reflected by the Botswana Examinations Council (BEC) results has remained poor over the years. For example, the proportion of candidates awarded Grade C or better in Mathematics just from 2008 to 2011 showed a decline from 21.8%

to 21.1% respectively. From 2012 a drastic decline happened from 33.3% to 24.4% in 2015 and currently standing at 26.2% in 2017 (Botswana Examinations Council, 2011, 2017). This is an indication that each year the mathematics results drop by approximately 5% which is of a concern to the country's education system.

According to the Botswana Junior certificate results for Mathematics 2017, the majority of students (33.7%) got grade E followed by 20.1% and 19.8% of grade D and U respectively. This performance shows a large proportion of candidates obtaining lower grades compared to proportion of candidates obtaining grade A to C in Mathematics. This signifies a low performance in mathematics. Ganetsang (2008) reported that Nkate who was the Minister of Education that time stated that the country has persistently been very poor in academic performance and this has been a major concern for the government and the society. When comparing Botswana to other countries therefore, Trends in mathematics and science study (TIMSS) revealed that competitiveness of Botswana leaners' achievement levels in Science and Maths is poor as compared to their counterparts from around the world (Ganetsang, 2008).

The 2011 TIMSS results show that Botswana's Grade 6 students perform far below their Grade 4 counterparts in countries beyond Sub Saharan Africa. Botswana students scored 396.68 in Mathematics and 404.44 in Science, both of which were below the TIMSS scale average of 500. Botswana participated at the grade of Form Two, out of 45 countries it was ranked third from the bottom in both Mathematics and Science (BEC, 2014).

In 2011, 50% of the students from Botswana failed to reach even the lowest benchmark in mathematics. The implication is that Form Two students cannot handle materials that could be handled with ease by students of a lower grade (lower age) from other countries. Therefore, these results of poor performance in Botswana are of a concern to the country's educationists, teachers, researchers as well as policy makers and consequently, there is an interest in finding factors behind this poor performance. On that note it is important to embrace the idea that even though there are lot of factors contributing to the decline of Mathematics performance in Botswana, the

classroom performance of teachers is indeed a critical factor for student academic performance (Darling-Hammond, 2008). Moreover, it is becoming increasingly clear that teacher quality or lack thereof, impacts students for years to come long after their direct contact with an individual teacher (Sanders, 1998). Mathematics is the language of, and drives technological and scientific development. Hence, finding out that to which learners attribute their performance in the subject, basing on their teachers' needs satisfaction, might yield good inputs and implications for policy makers, stakeholders and researchers for the improvement of the education system.

1.2. Background of the study

1.2.1. Botswana's Education system

Botswana is a landlocked country located in Southern Africa with just over two million people. Since independence, Botswana has had one of the fastest growth rates in per capita income in the world and has transformed itself from one of the poorest countries in the world to a middle-income country. With the discovery of diamonds and the increase in government revenue that this brought, there was a huge increase in educational provision in the country. The Government identified education as a vehicle for national development and declared education as a basic human right, essential for both social and individual development. Since then the country has made great strides in educational development. This was through the help of policies like that of Education for Kagisano (Social Harmony) which was anchored on four national principles of democracy, development, self-reliance and unity. The policy provided framework for the development of education in the country from 1977 to 1993 (UNESCO, 2015). In 1994, the Revised National Policy on Education and the Vision 2016 were developed to provide direction for Botswana's educational system. From 1995, Botswana's education system structure comprises of seven years of primary education, three years of junior secondary education, and two years of senior secondary education (UNESCO, 2015).

1.2.2. Teaching of mathematics

The students Math performance cannot be discussed without pointing out some of the contributory partakers like that of teachers. The role of teachers is to support and sustain the school curriculum building on the supportive structures of mathematics teacher preparation and development programmes. Mathematics teacher preparation is offered in colleges of education as well as Universities in Botswana. The colleges train teachers for junior secondary schools and offer diploma programmes, whereas the Universities offer the degree programmes and their graduates qualify to teach at both junior and senior secondary school levels. The University of Botswana also offers in-service degree training for those with a college diploma. All these programmes include subject content matter, courses on pedagogy and practicum (Ramatlapana, 2009). One of the important goals of Botswana is to produce competent apprentice teachers and according to Palmer (1998), we teach who we are. The best teachers know their students and their subjects well, because they themselves are grounded by self-knowledge.

1.2.3. The curriculum and assessment of Mathematics

The mathematics syllabus in the primary grades is divided into a lower primary syllabus (Grades 1 to 4) and an upper primary syllabus (Grades 5 to 7). In Grade 4, students take national attainment tests in three subjects; English, Science and Mathematics. The lower primary school mathematics syllabus (Grades 1 to 4) is organized around modules, which are divided into topics and then subdivided into general and specific objectives. The specific objectives outline the breadth and depth of teaching required in a particular topic. Five modules covered in the lower primary syllabus are; numbers and operations, Geometry, measures, problem solving and statistics. Upper primary mathematics syllabus (Grades 5 to 7) is designed to help students develop further numeracy and computational skills as well as problem solving skills. The upper primary syllabus covers the same modules covered in the lower primary grades. When students complete Grade 7, they proceed to Grade 8 and begin studying toward the Junior Certificate Examinations (JCE). At the end of the JCE curriculum, students should be able to apply

computational skills in everyday life for commercial and social purposes. The JCE, or lower secondary school mathematics syllabus (Grades 8 to 10), has the same organizational structure as the primary school syllabus. Generally, lower secondary school extends primary school learning and students are expected to begin applying concepts to solving practical problems (Masole, Mmoloki, Guga & Pharithi, 2015).

In assessing the student achievement in Mathematics, methods of monitoring student progress include classroom-based assessment, school-level assessment, and external national examinations. Classroom assessments are more formative and related to the ongoing process of learning in the classroom, while higher-level assessments like national examinations are summative. Teachers and schools monitor the progress of individual students through quizzes, topic tests, end-of-term tests, and mock examinations. Teachers use these classroom-based assessments to make decisions about instruction, and to assist student learning. At the end of each term, schools administer end-of-term tests, and prepare reports on subjects and share them with parents. Occasionally, parents are invited to schools to review the reports and discuss their child's progress with teachers. Remedial programs are offered under school supervision

For national examinations, Mathematics results for Botswana Junior Secondary Education Programme, the Mathematics Assessment Procedures (MAP) are designed to provide a framework for assessing candidates who have completed a three-year course based on the Junior Secondary Mathematics Education Teaching Syllabus (BEC, 2013). The examination aims to assess the knowledge and skills acquired through instruction in the content prescribed for the JC programme. The assessment is designed in a way that encourages candidates to show what they know and can do, and their level of understanding. For purposes of assessment, the behavioral outcomes of instruction in the prescribed content have been classified into two broad skill areas called dimensions. The first dimension is that of Knowledge and Understanding which includes ability to perform calculations with and/or without a calculating aid, recall definitions, vocabulary, units, facts, procedures, notations and concepts among others. The second dimension

is that of Application and Reasoning which includes selecting and applying rules, relationships, methods, concepts and procedures to solve routine mathematical, including real-life, problems; presenting information in different forms as well as formulating methods, equations and diagrams among others (BEC, 2013).

1.2.4. Botswana's involvement in TIMSS

To monitor the progress of Maths performance however, apart from the national results, countries participate in different international studies such as; The Programme for International student Assessment (PISA), the Southern and Eastern Africa Consortium for Monitoring of Education Quality (SACMEQ) and Trends in International Mathematics and Science Studies (TIMSS). The mandate of TIMSS is to analyze the countries' academic performance mostly in Maths and Science subjects. TIMSS is the first global assessment of mathematics and science to provide data about trends over time. It has been measuring the achievement in these subjects every four years at the fourth and eighth grades since 1995. There is also a TIMSS Advanced study which is the only international assessment that provides essential information about students' achievement in advanced mathematics and physics.

Botswana participated in TIMSS in 2003, 2007, 2011, and 2015 and the rationale for the participation in it has not changed from the 2003 and 2007 cycles. It is a national desire to be competitive and to use Mathematics and Science as vehicles for industrial growth. Since it participated, Botswana has always performed below the target mark. This indicates the poor performance of Botswana in Mathematic over the years.

The main objective of TIMSS is to assess what students around the world know and can do in Mathematics and Science. Botswana remains committed to improving qualitative aspect of the educational attainment to supplement the quantitative success that has been scored in sending children to school. TIMSS is viewed as one project used for monitoring performance of education. Information obtained from the student and teacher questionnaires that are included in the content of TIMSS exam for example, is used for informing curricula reviews and planning

and implementing educational initiatives. Comparing the performance of Botswana students with the best around the world is a challenge that the country proudly undertakes because it provides the direction for channeling efforts into making Botswana a competitive country in the global economy.

According to Chepete (2003), Botswana views TIMSS surveys as nationally representative of the schooling system in the country as well as one of the dependable means through which the country can acquire reliable evaluations of the efficacy of its educational practices from an international perspective. Achievement by Botswana's eighth grade students in the first two TIMSS cycles was not satisfactory, with a mean performance of approximately 364 in mathematics and 354 in science, and with approximately 68 percent of eighth grade students failing to reach the low international benchmark. According to 2015 TIMSS , Botswana's standing in Science, Mathematics and Reading achievement (measure of quality) is below average. The results shows that half of Botswana's Grade 9 learners reached low international benchmark while only 1% of the learners reached advanced benchmark. This implies that according to international standards, 50% of Botswana learners could not reach the lowest standard in Mathematics (UNESCO, 2015).

1.3. Theoretical framework

The main theory guiding this study is the Abraham Maslow's (1943) hierarchy of needs. This theory organizes human needs from basic to sophisticated levels. In order of increasing importance, the clusters of needs included in Maslow's hierarchy are physiological needs, safety needs, belongingness and love needs, esteem needs, and the need for self-actualization. According to Maslow, "all people in our society have a need or desire for self-esteem that is soundly based upon real capacity, achievement, and respect from others. It is important to note therefore that Maslow postulate that once needs on one level are satisfied, needs at higher levels emerge and dominate the organism's thoughts and behaviors. Therefore, according to Maslow's hierarchy, the need or desire for achievement will not drive a person's thoughts and behaviors

until needs on the lower levels have been satisfied. As a result, the cognitive processes and behaviors associated with the more sophisticated levels on the hierarchy cannot be achieved; great academic performance cannot be expected from students experiencing basic needs deprivation (Yildiz, 2004).

Maslow's hierarchy explains human behavior in terms of basic requirements for survival and growth. These requirements, or needs, are arranged according to their importance for survival and their power to motivate the individual. The most basic physical requirements, such as food, water, or oxygen, constitute the lowest level of the need hierarchy. These needs must be satisfied before other, higher needs become important to individuals. Needs at the higher levels of the hierarchy are less oriented towards physical survival and more toward psychological well-being and growth. Maslow's hierarchy continues to specify the following levels:

Safety needs: Once the individual's basic physical needs are met, his or her needs for safety emerge. These include needs for a sense of security and predictability in the world. The person tries to maintain the conditions that allow him or her to feel safe and avoid danger. Maslow thought that inadequate fulfillment of these needs might explain neurotic behavior and other emotional problems in some people.

Love and belonging needs: When the individual's physiological and safety needs are met, needs for love and belongingness emerge. These needs include longings for an intimate relationship with another person as well as the need to belong to a group and to feel accepted. Maslow emphasized that these needs involve both giving and receiving love.

Esteem needs: Esteem needs include both self-esteem and the esteem of others. Self-esteem is the feeling that one is worthwhile, competent, and independent. The esteem of others involves the feeling that other people respect and appreciate the person. Once the person has satisfied his or her basic needs, concerns about worthiness emerge. The focus becomes not just surviving, but doing well according to meaningful communal standards. The final level is the self-actualization needs. These are the needs associated with realizing one's full potential. As

these needs emerge, the person focuses on development and believe of reaching the full potential (Maslow, 1943).

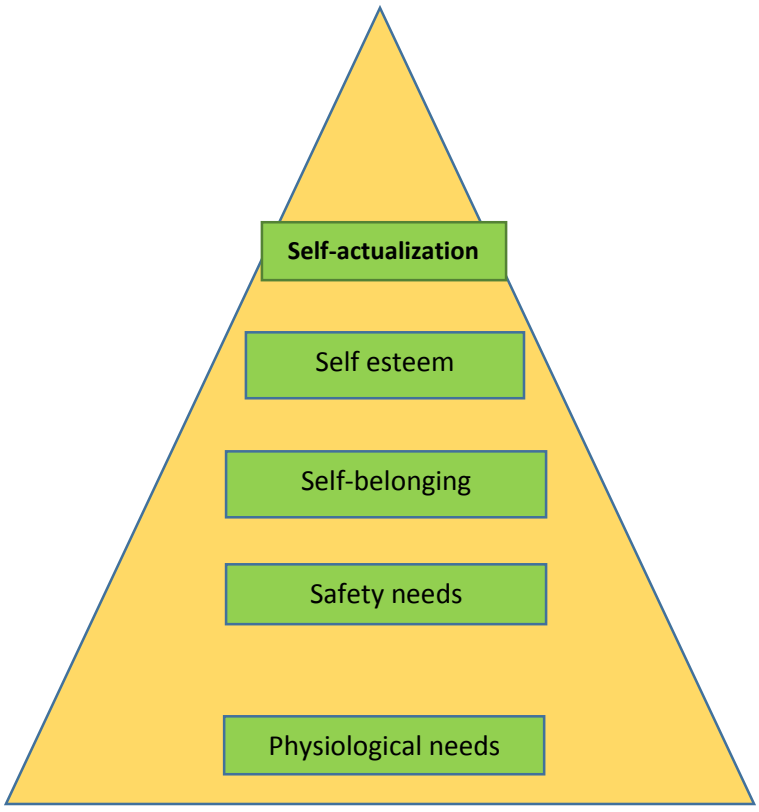

Figure 1. Maslow's hierarchy of needs diagram

1.4. Conceptual framework

The basic importance of the conceptual framework is that it is used to understand the place of and inform the direction of this research project. Figure 2 therefore depicts the guide of concepts for this research being guided by the Maslow's hierarchy of needs.

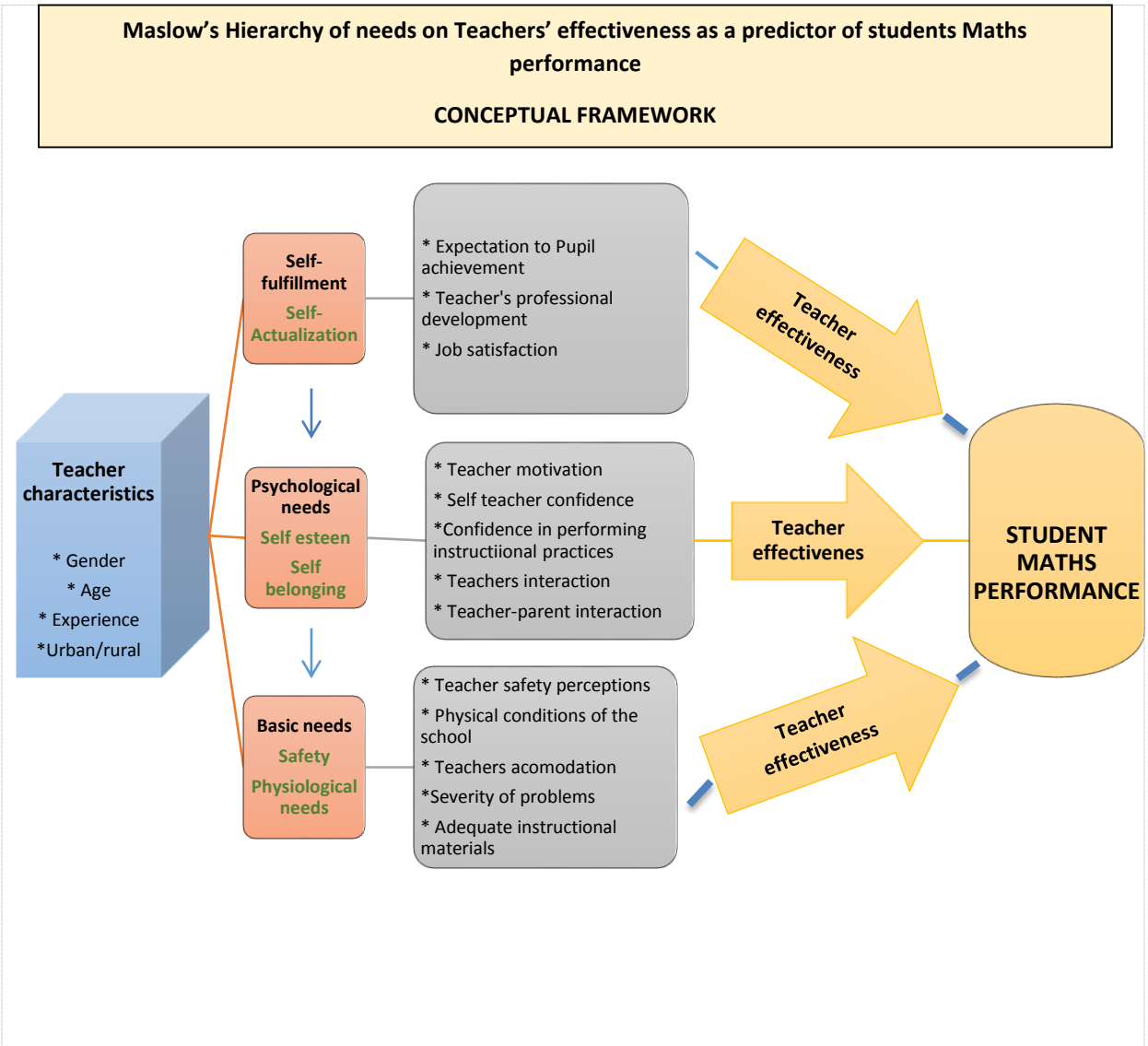

Figure 2. Conceptual framework applying the teacher's needs on students Math performance

As the most significant resource in schools, teachers are critical to raise education standards. Improving the efficiency of schooling depends, in large measure, on ensuring that teachers are highly skilled, well resourced, and motivated to perform at their best. Raising teaching performance is perhaps the policy direction most likely to lead to substantial gains in student learning (OECD, 2005). One of the important factors in realizing educational objectives in mathematics as a subject is the role of the teachers` motivation within the educational set up. The negative performance of student towards an educational aims and objectives could be associated to the low motivation of teachers most especially in the area of mathematics.

Therefore, the effective monitoring and evaluation of teaching is central to the continuous

improvement of the effectiveness of teaching as well as students' Math's performance in schools. It is essential to know the strengths of teachers and those aspects of their practice which could be further developed. The learning environment and teachers` motivation upon knowledge development relatively need attention in the field of mathematics teaching and learning.

The conceptual framework divided the Maslow's hierarchy of needs into three factors. The Basic needs (Physiological and Safety needs), then the Psychological needs made up of the self-esteem as well as love and belonging needs. Then the self-fulfillment needs made up of self-actualization needs.

The framework postulates that the availability of teaching/learning resources enhances the effectiveness of teachers as these are basic things that can bring about good academic performance in the students. A well resource classroom breeds an effective teacher who will use all instructional resources for the benefits of students (Ryan & Deci, 2008). For the conceptual framework, the basic need variables has been adopted from an item which sought teachers to indicate their views in the severity of problems which included among others the issues of shelter, working environment as well as adequate instructional materials. From this perspective, the institution of teacher needs assessments is a vital step in the drive to improve the effectiveness of teaching and learning and raise Mathematical standards and performance of students.

Teachers need the psychological needs for them to be effective. From the conceptual framework, this needs include teachers' motivation, attitude of being a teacher, confidence, teachers' interactions as well as teacher-parent collaboration among others. This goes along with what to Ryan and Deci (2008) said on the issue of psychological needs. They indicated that the satisfaction of the needs of autonomy, efficacy and having relationship positively affects individuals' subjective well-being. Satisfying these needs is among the main factors in order to be able to function at an optimal level. Heckert (2000) defined the need for dominance as social needs in addition to the need for relationship, success and autonomy in self-regulation theory.

They defined the need for success as the individual's desire to be superior and successful to move his/her previous performance forward and they defined the need for relationship as the desire to interact socially and being accepted by others. While they defined the need for autonomy as desiring to do something for themselves like self-development.

It is evident from the conceptual framework that this has been applied to be the measures of the psychological needs of teachers as per the Maslow's hierarchy. What happens in the classroom between psychological implication of teachers concerning their motivation and the student ability to study well has an impact on students' opportunity to learn and perform well. On the other hand, more effective social environments such as parents, teachers and administrators can be created by understanding the functions of these needs (Deci & Ryan, 2011). Because the social environment and the society in which the people live are effective in satisfying their basic psychological needs. The classroom teacher's need for belonging is often overlooked in schools. Sometimes this is the unintended result of a perspective that teachers are paid to do a job and it is up to them to make their work fulfilling. In addition, school administrators occasionally and incorrectly assume that because teachers are granted considerable autonomy within the walls of their classrooms, they don't have a professional need for collegiality and community. This study conceptualized that to analyze its predictive power on student performance.

Lastly the framework shows the need of self-fulfillment which is made up of self-actualization needs. According to Maslow (1970) the ultimate goal of an individual is to attain personal growth and understanding. Indeed, not only could one do this, one should do this. Maslow believed that the individual can only be truly happy through constant self-improvement and greater self-understanding. One of the steps along the way was the cognitive level, where individuals intellectually stimulate themselves and explore.

Maslow explicitly defines self-actualization to be "the desire for self-fulfillment, namely the tendency for him (the individual) to become actualized in what he is potentially. This

tendency might be phrased as the desire to become more and more what one is, to become everything that one is capable of becoming." Maslow used the term self-actualization to describe a desire, not a driving force that could lead to realizing one's capabilities. Maslow did not feel that self-actualization determined one's life; rather, he felt that it gave the individual a desire, or motivation to achieve budding ambitions (Gleitman, Fridlund & Daniel, 2004)

The concept of self-actualization became more prominent after Abraham Maslow introduced the hierarchy of needs theory. People try to achieve the basic needs first gradually leading towards the final level of psychological development. Self-Actualization is but self-discovery, self-reflection, self-realization and self-exploration. It refers to the state where one has attended the perfection (Gleitman, Fridlund & Daniel, 2004). Self-actualization is a process of differentiating good qualities from the bad in themselves. It is also exploring the best qualities in oneself that would be beneficial to help others. Self–actualization is entails using one's potentials, to become everything one is capable of. To actualize is to understand one's own potentials and make use of it for the betterment of others (Maslow, 1954). Work value, has significant influence on the self-actualization of teachers. When teachers' needs are satisfied, it promotes their psychological well-being and enables optimal functioning and performance (Alder, 2016). Teachers are also human beings. They will also have various needs to be satisfied in their lives and the failure to satisfy their needs would lead to frustration, lack of interest towards work. The performance level increases with the increase in the satisfaction level of the teachers. Higher the satisfaction levels, better the performance of the teachers and breeding a good result in student performance

That is why the framework posed the self-actualization variables as the job satisfaction, teachers' expectation of pupil's achievement as well as teachers' professional and personal development. All this therefore, are needs met with the basic as well as the psychological needs having been met. At the end of the day, teachers become effective in the classroom hence leading to a good performing student in a mathematics class.

1.5. Statement of the Problem

Various factors influence the teaching and learning of Mathematics in secondary schools. Mathematics performance continues to be of a great concern in Botswana. Botswana also, took part in the TIMSS study whose major aim has been to provide 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. The study also depicts how the various factors surrounding the learners relate to learning achievement. The media in Botswana continues to report the discomfort of Botswana in performing low even though there are lots of improvements in place in trying to improve the performance.

There are studies which have been conducted in Botswana in order to find out the factors influencing mathematics performance in Botswana. However, no study has focused on the application of the Maslow's hierarchy of needs on teachers to predict students' mathematics performance in Botswana. This therefore forms the bases of this study. The issue is that when teachers are not adequately taken care of, their attitude to work automatically changes. They would just come to work but no meaningful work or effective teaching and learning will be done. This study is therefore directed to examine the teacher's needs as they relate to teaching effectiveness and how they predict mathematics performance. This will be based on Maslow's hierarchy of needs theory.

Significance of the study

The assessment of students' performance is very essential since it serves as a basis on which education decisions concerning students are made. It is for this reason that knowledge of factors that influence the outcome of academic achievement are to be clear to the educators, parents and students so that standards of academic performance could be enhanced. This study is significant for the fact that it measures the relationship of Maslow's hierarchy of needs factors on

teachers and the Mathematics achievement of students and provides an insight from the perspectives of the teachers on the issues of Maths performance.

The findings of this study will be a great contribution in the solution of the theoretical problem. The Maslow's hierarchy of needs in most cases has been explored and adapted in the studies like business and job satisfaction. However, relating the theory to the education system will be of a great benefit to the advancement of knowledge. Consulting with teachers about what their needs is a critical factor to bring about needed change to the education system. It is of importance to note that recommendations of the study will lead to the development strategies that will be aimed at facilitating change in the classroom. Also, the results will be beneficial to other stakeholders including the teacher trainers to make sure that aspects of the psychology are instrumental to those planning and implementing the curricular. Not only confining it to students but to teachers as well. Greater understanding of how lack of needs in teachers influences performance would facilitate the development of training curricular and enrichment programs that complement the cognitive aspect of knowledge acquisition.

On the part of policy makers, the study will provide an insight on the gaps that may be existing in the education system as far as the teachers' needs are concerned. It will provide valuable information about the teachers needs satisfaction on the academic performance of students.

Little has been done in terms of assessing teachers' needs vis a vis predicting students' performance. The findings of this study therefore will add to that knowledge. So, the study will be beneficial to teachers themselves as they will assess the predictor factors of their needs for effectiveness. Also, students will benefit in the sense that attending to the problem mentions will breed in making the assumption s as well as contributions to the effectiveness of teachers in leading to the student performance. These are so because teachers are prepared and supported within the school system and are critical elements of higher student achievement and retention.

Effective teachers tend to have confidence in their ability to teach, care about teaching and their students, and cooperate with each other. However, classrooms where teachers lack general subject mastery and confidence in their ability to teach, the development of positive teacher attitudes are often hindered. Therefore, the results of this study will show those implications for the policy personnel.

Students, particularly secondary school students will benefit from the findings of this study since it provides basis for awareness and better understanding of how their current teachers' needs affect their academic performance. Likewise, giving them a more focused and clear perspective on how the specific behaviours due to lack of certain needs related to their teachers, might affect their learning in the classroom setting. Hence research will be beneficial to the advancement of knowledge.

The study will give a result of the most predictor need of teachers to the performance of students. This will help the policy makers to strategize in making well informed decisions in trying to control the negative influence of that variable or factor to the performance of students.

1.6. Purpose of the study

The main purpose of the study was to examine how Maslow's Hierarchy of needs interact with teachers and their characteristics to predict mathematics performance. On the basis of this aim, four specific objectives were formulated.

1.7. Objectives of the study

The objectives that guided this study sought to;-

1. establish the influence of teacher's characteristics (gender, age, experience) on secondary students' mathematics performance.
2. find out the relationship between Maslow's Hierarchy of needs of teachers and students Math performance.
3. assess the extent to which the Maslow's hierarchy of needs of teachers predict students' performance when teacher's characteristics are controlled

4. find out the best predictor of teacher's needs on students mathematics performance and its implications.

1.8. Research Questions

On the basis of the study objectives outlined above, four questions were formulated. These were:

1. Does students' mathematics performance differ significantly by their teacher's characteristics (gender, age, experience)?
2. Is there a significant relationship between Maslow's Hierarchy of needs level of teachers and students Math performance?
3. Does the Maslow's hierarchy of needs of teachers predict students' Math performance when teacher's characteristics are controlled?
4. Which of teachers' needs is the best predictor of students' mathematics performance?

1.9. Hypothesis

The hypotheses to be tested for this study therefore were:

$H_{a1:}$ Students' mathematics performances differ significantly by the teacher's characteristics (gender, age, experience).

$H_{a2:}$ There is a significant relationship between Maslow's Hierarchy of needs of teachers and students Math performance?

$H_{a3:}$ The Maslow's hierarchy of needs of teachers significantly predicts students' Maths performance when teacher's characteristics are controlled.

$H_{a4:}$ The best predictor of Student Math performance is Teachers' psychological needs factor.

Chapter 2

Literature Review

2.1 Introduction

This chapter is an overview of available literature related to the Maslow's hierarchy of needs and academic performance. The review is divided into different themes aligned to the research questions. The review gives an overview of why teacher influence is vital in the academic arena. Themes also cover the concepts of teachers' physiological needs (basic and safety precautions), psychological needs (sense of love and belonging and self-esteem) then the self-actualization needs in relation to academic performance.

In research, studies are conducted with an in-depth analysis, insight and intensive logical thinking. The contributions of the earlier researches are of great help to define the scope of the current research as well as to provide an input to the researcher about all the areas which have been studied and to examine the gaps in the existing practices applicable to the problem under study.

2.2. Teacher characteristics and student performance

Armstrong (2015) conducted a research that made use of hierarchical linear modeling to investigate which teacher characteristics are significantly associated with student performance. Using data from the SACMEQ III study of 2007, an interesting and potentially important finding is that younger teachers are better able to improve the mean mathematics performance of their students. Furthermore, younger teachers themselves perform better on subject tests than do their older counterparts. When identical models are run for sub-Saharan countries bordering on South Africa and for Kenya, the strong relationship between teacher age and student performance is not observed. Similarly, with the model run for South Africa using data from SACMEQ II (conducted in 2002), the relationship between teacher age and student performance is also not observed. According to Armstrong (2015), changes in teacher education in the late 1990s and early 2000s may explain the difference observed in the later data set in the performance of

younger teachers relative to their older counterparts. Teacher's age as one of the characteristics of teachers in influencing student performance is so vital even for the current study.

Ewetan and Ewatan (2015) on the other hand, investigated the influence of teachers' teaching experience on the academic performance of public secondary school students in Mathematics and English Language in Ado-Odo/Ota and Ifo Local Government Areas in Ogun State. The study adopted descriptive research design. Study population comprised all the 31 Senior Secondary Schools in the selected two local government areas. A sample of 20 Schools was drawn from the population through the process of simple random sampling technique, made up of 14 schools in Ado-Odo/Ota, and 6 schools in Ifo Local Government Areas. An inventory schedule was the instrument used for data collection. Questionnaires per school were administered and content analysis was the method of data analysis. The regression analysis and t-test were used in the study. Findings revealed that teachers' teaching experience significantly influence students' academic performance in Mathematics and English Language as measured by their performance. Schools having more teachers with above 10 years teaching experience achieved better results than schools having more teachers with 10 years and below teaching experience.

Teachers' gender is one of the factors that have been studied under teacher characteristics and student performance. Robert, Owiti and Ongato (2013) conducted a descriptive causal comparative study that examined the relationship between teachers' gender and primary schools pupils' performance in mathematics in Kenya. The study objective was to investigate the effect of teachers' gender on primary schools pupils' mathematics achievement in Vihiga district Kenya. The study was conducted through an ex-post facto research design. A total of 46 mathematics teachers were sampled from 153 schools. Data was collected using a Mathematics Teacher's Questionnaire (MTQ). Results of a Mathematics Achievement Test (MAT) were used as a measure of teachers' contribution towards pupils' academic achievement. Mathematics education experts reviewed the MTQ for content, face and construct validity. Chi square statistic

was then used to establish whether there was a relationship between teachers' gender and contribution towards pupils' achievement in mathematics. The findings of the study showed that there was a significant relationship between teachers` gender and pupils` achievement in primary mathematics. The results of this study suggest that more female teachers be trained and deployed to teach mathematics at upper primary school levels since their contribution towards pupils' performance is profound

2.3. Teacher's physiological needs and students' performance

According to Maslow, the physiological needs are the most basic human needs such as hunger, thirst and shelter. In this research the safety needs are operationally depicted by teacher's perceptions on the school facility states. Physical learning environments or the places, in which formal learning occurs, range from relatively modern and well-equipped buildings to open-air gathering places. According to UNICEF, (2000), the quality of school facilities seems to have an indirect effect on learning which involves an Interaction between school infrastructure and other quality dimensions. The quality of school buildings therefore, may be related to other school quality issues, such as the presence of adequate instructional materials and textbooks, working conditions for students and teachers, and the ability of teachers to undertake certain instructional approaches. Such factors as on-site availability of bathrooms and a clean water supply, classroom maintenance, space and furniture availability all have an impact on the critical learning factor of time on task. When pupils have to leave school and walk significant distances for clean drinking water (UNICEF, 2000). Multiple researchers therefore have empirically studied the school facility/ environment state on the academic performance of students.

Smith (2002) conducted a study to identify and analyze the safety concerns of the staff and students of an urban middle school and their impact upon the learning environment at one urban middle school in New Jersey. A purposive, nonrandom sampling of participants was used. The survey was given to 50 students, 25 staff, and 3 administrators. It emphasized school safety with regard to hallways and common areas. Analysis showed that students, staff and

administrators agreed on issues of safety concern. The study had objectives to; identify the safety concerns of the staff and students of the school; to determine effective strategies for improving safety; to ascertain ways to implement strategies for improved safety; and to determine ways to evaluate the strategies and decide their effectiveness. The study was based on the assumption that safety affects the learning environment. From the study, it was concluded that safety issues in a school encompass the everyday activities that make up the learning environment, and that making schools safe is a joint responsibility that requires a broad-based team approach.

McWherter (2012) conducted a study on the effects of teacher and student satisfaction on student achievement. The study designed to examine factors contributing to both teacher and student satisfaction and to determine if a relationship existed between the satisfaction levels and student achievement. The contributing factors identified consisted of items that could be influenced or controlled in the school environment. Maslow's (1943) hierarchy of needs was used to help identify factors that could contribute to teacher and student satisfaction. The use of the theory was greatly in line with the current study which used the theory as its basis. The subjects for this quantitative study came from a rural high school in the southern part of the United States. This study employed the use of electronic surveys to determine influencing factors of satisfaction and overall satisfaction levels for both teachers and students which insured anonymity for the participants. An analysis of the data did not reveal any relationship between the satisfaction levels of either teachers or students to student achievement. Although this study did not identify whether higher levels of satisfaction attributed to higher levels of achievement on end-of course exams, many influencing factors to both teacher and student satisfaction were identified. However, more research involving multiple schools is needed to support both a universal satisfaction level and a relationship between satisfaction and achievement which this current study will attempt to bridge the gap using the TIMSS data.

Working environment has a great impact in coordination with the mental and physical capacity of teachers, in performing their tasks. A good working environment includes the entire

working environment such as class size, disciplinary conditions and availability of teaching materials positive relationship among colleagues, principals and supervision (Alemayehu, 2014).This are the basic needs in the classroom. So in order to perform well in their teaching activities, teachers need to be motivated with the availability of resources. Regarding the effect of work situational factors on teacher motivation, Nyakundi (2013) conducted a study on the factors affecting teacher motivation in public secondary schools in Thika West District, Kiambu County. He found that 47% of the respondents strongly agreed that inadequacy of teaching and learning resources in schools de-motivates teachers. Yet quality teaching depends greatly on adequate teaching and learning resources. Nyakundi (2012) concurs with the findings of a study by Wanyama (2013) that school – based factors which affected performance were inadequate instructional materials and other related resources such as reference books and guides for teacher.

Ige (2017) also investigated the perceived potential of motivational strategies operating in school to impact teacher effectiveness in public secondary schools in Ondo State, Nigeria. Descriptive-survey design was adopted. Main population consisted of 304 public secondary schools in the state while teachers in the 304 schools constituted the target population. Ten public secondary schools and 200 teachers were selected through multi-stage, stratified and simple-random sampling techniques and used for the study. Data were gathered using a questionnaire and data were analyzed using (SPSS). It was found that provision of instructional materials, improvement of school environment, assignment of additional responsibilities, among others, had impact on teacher effectiveness. Ige (2017)'s hypothesis corroborates well with that of the current study.

2.4. Psychological needs and Math performance

According to Maslow, after a person meets the basic physiological needs required for living, next come the psychological needs which include motivation from confidence, love/belonging, esteem and self-actualization in the latter. From the reviewed literature therefore,

it is evident from the empirical studies that these needs are vital for the development and performance of teachers for students' performance. The psychological needs reviewed includes the motivation, self-esteem as well as love and belonging respectively.

2.4.1. Motivation

One of the important factors in realizing educational objectives in mathematics as a subject is the role of the teachers` motivation within the educational set up. The negative performance of student towards an educational aims and objectives could be associated to the low motivation of teachers most especially in the area of mathematics. Adeyinka, Asabi and Adedotun (2013)'s general objective of their study was to examine the effect of teachers` motivation on students` performance in mathematics. This study adopted both descriptive and ex post factor research design. The study population comprised of the teachers and a self-administered questionnaire was used to collect data teachers who were selected by the use of simple random sampling while the four schools were selected through purposive sampling. The study results revealed that majority of the teachers (61.0%) under study were not satisfied with their condition of service. It was observed that the condition of service of teachers, teachers` Fringe benefit payment, and teachers` promotion of in-service training had a direct influence on the student`s performance in mathematics.

Teacher motivation is one of the factors that affect the realization of the teaching objectives, motivation and academic achievement of student according to Abazaoğlu and Aztekin (2016). They conducted a study which aimed to answer to the question "How is the relation between the students' academic (sciences and mathematics) achievement and teachers' morale/motivation in Singapore, Japan, Finland and Turkey?" by using PISA 2012 data and TIMSS 2011 data. The researchers used descriptive statistics and hierarchical linear modeling (HLM) in order to study the effects of the morale and motivation qualities of the sciences and mathematics teachers on students' academic achievement. This study's design is similar to the current study as they both use the secondary data and regression for analysis. The results showed

that the teacher factor was more effective in countries with different income balance while the teacher morale and motivation generally had a positive effect according to both PISA and TIMSS data.

2.4.2. Self esteem

The esteem needs are psychological ego needs or status needs develop a concern with getting recognition, status, importance, and respect from others. Teachers' esteem needs are one of the important elements guiding the current study. Studies like that of Mbuva (2017) depict the impact of self-esteem on performance. His study was to explore the teacher's self-esteem and its effects on teaching and student's learning and self-esteem. The study provided the contextual framework of the study, defined self-esteem, showed positive and low self-esteem, demonstrated how we can enhance the self-esteem of teachers in schools and how teachers' self-esteem enhances students' self-esteem, showed why self-esteem matters. The study showed that teachers' self-esteem is important for their success in teaching and that teachers' positive and high esteem positively affects students' self-esteem and learning processes. The findings of this study will be used in the professional development of teachers.

Hartley and Chesworth (2000) conducted a study whose purpose was to examine the effect of the level of teachers' self-esteem on student achievement. This study analyzed factors of teachers' self-esteem. Its results were based on a review of the literature to develop an understanding of historical perspectives and research, the factors involved in the development of self-esteem, the role of the parents, and the role of the teacher. Forty-three teachers of grades three and five in North Central Texas completed the Gordon Personal Profile-Inventoiy to assess their levels of self-esteem and students' Texas Learning Index scores on the Texas Assessment of Academic Skills were matched with the appropriate teachers' scores. The findings of the study indicate that the students with teachers in the high level of self-esteem category scored an average of 5.67 points higher than those students with teachers in the low level of self-esteem category. Findings resulting from the study led to the conclusion that teachers with high levels of

self-esteem have a positive influence on the achievement of their students. This study's finding is in line with one of the hypothesis of the current study.

2.4.3. Belonging

Another psychological need is that of interpersonal which involves feelings of belongingness. For teachers therefore, this includes the belongings from the interaction of teacher and student, teachers' collaboration as well as teacher-parent relationship among others. Armstrong (2015) conducted a study which used hierarchical linear modeling to investigate which teacher characteristics are significantly associated with student performance. Using data from the SACMEQ III study of 2007, an interesting and potentially important finding is that younger teachers are better able to improve the mean mathematics performance of their students. Furthermore, younger teachers themselves perform better on subject tests than do their older counterparts. Similarly, the model was run for South Africa using data from SACMEQ II (conducted in 2002), and the relationship between teacher age and student performance was also not observed.

The relationship between teacher characteristics and student performance is surprisingly elusive. Researchers have found it difficult to find aspects of teacher training that correlate with student performance in a statistically significant way (Chingos & Peterson, 2011). Conflicting or indeterminate results occur often. For example, Summers and Wolfe (1977) found a negative relationship between teacher score and student performance in the United States (US). Anderson (2000) found a positive association between teachers using an interactive approach to teaching in mathematics and language and the performance of their students. She also found evidence of a positive relationship between hours spent teaching and performance in both subjects.

Ronfeldt, Farmer and Grissom (2015) conducted a study that examined teacher collaboration practices in 336 Miami-Dade Public Schools between 2010 and 2012 and involved over 9,000 teachers. This study used a great base of a large sample size. This is very advantageous for the generalization ability of their study. Researchers used teacher surveys to

collect descriptive data about teachers' collaboration practices. Through statistical analyses using district- and school-level data about teacher characteristics, teacher value added test results, school characteristics, and student achievement, researchers explored the interactions among multiple variables using multiple models to identify findings and explore appropriateness of alternative explanations. Researchers used multiple models and analyses to examine and dispute alternative explanations for their findings. Through statistical analyses of the survey results, researchers determined the types, extent, and degree of helpfulness of teacher collaboration. Four types of collaboration were identified: general (e.g. classroom management) and three instruction specific ones (instructional strategies and curriculum; students; and assessment). Quality of teacher collaboration is measured as teacher perception of the extent and helpfulness of collaboration. Results of this study suggest that teacher collaboration has positive effects on teachers and their students. The majority of teachers surveyed (84%) indicated that they were a part of a team of colleagues that works together on instruction. Instruction-focused and assessment-focused collaboration were perceived as more helpful and extensive. Collaboration about student work and classroom management was perceived to be less helpful and extensive. School and teacher factors influence the quality and type of collaboration (Ronfeldt, Farmer & Grissom, 2015).

Brit (2013) analyzed the effect of teacher-student relationships on the Virginia Standards of Learning (SOL) math scores for grades six and seven. Data were studied to determine if an increase in student achievement was related to the often-overlooked interpersonal human relationships between teachers and students. The researcher expected to find a correlation between positive teacher-student relationships and an increase in standardized test scores. This study was in line with the current study. Maslow's indicated that social belonging have an impact on the satisfaction and performance of individuals. Hence, Brit (2013)'s study was good for the review of this study. The researcher analyzed the data of student scores to determine if a relation existed between student achievement and positive teacher-student relationships. The participants

were sixth and seventh grade students who answered questions about the mathematics teacher. This differs with the current study as teachers were the one asked about their relationship with students. In review of the overall percentages, it appeared that the students found the teachers in this mathematics-teaching group to have strong skills in leadership, helpfulness, dissatisfaction, and uncertainty. In the teacher categories, leadership, helpfulness, dissatisfaction, and uncertainty, there was a significant correlation between the Virginia Standards of Learning passing test scores and teacher categories.

2.5. Self-Actualization and Math performance

Schools should be vehicles for self-actualization. Self-actualization is the state where one is able to accept and express of one's inner core or self and begin to actualize those capacities and potentialities found there. According to Jena and Dorji (2016), today teachers suffer from many problems like anxieties, insecurity and frustrations in work spots. Due to that they are dissatisfied a lot. They are disturbed. So in such situation, their concentration and interest in teaching would fade away. They won't be able to focus much on teaching. In order to attain self-actualization, one needs to be self-satisfied. Self-satisfaction means having positive perception of what you do. Job satisfaction is another factor contributing towards self-actualization. Some of the variables contributing to job satisfaction are age, gender, marital status, qualification, teaching experiences, position, workloads, income, working environment, social relationship and management and policies of the school. If the teacher does not have job satisfaction, he would never attend self-actualization, which clearly shows that the particular teacher cannot give his 100% effort in his job (Jena & Dorji, 2016).

Research studies proved that teachers' self-actualization is directly related to students' academic achievement and overall learning. The study by Gulistan, Hussain and Mushtaq (2017) was conducted to explore relationship of mathematics teachers' self-efficacy and actualization with students' academic achievement at secondary level. A sample of 576 respondents from six districts of the Punjab province was used. Such diversity of sample was good as the data gave a

good clear representation of the population under study. Academic score of the Students in the subject of mathematics was collected from relevant (BISE) documents. Pearson correlation was used to determine association between self-efficacy and academic achievement. Math male and math female teachers' self-actualization was also compared on t-test assuming two sample having equal variances. No significant difference was found between mean scores of male teachers' self-actualization y and female teachers' self-actualization. The findings of the study reflected a strong correlation between mathematics teachers' self-actualization and their students' academic achievement. Recommendations were made to build higher level efficacy beliefs of teachers during in-service training programs and promotion link training programs. It is of important therefore to note that self-actualization which is the highest level of needs by Maslow's this need affects the performance of individual.

Teachers continue to experience an increased sense of responsibility as it relates to job performance while still being required to produce at the same level with relation to student performance. This can cause an increase in personal stress and result in lowered feelings of self-worth, having a negative impact on service delivery to children and overall job performance. Self-efficacy which is one factor for self-actualized individual was also linked to performance. Bandura (1997) defined self-efficacy as a judgment of one's ability to organize and execute given types of performances. Furthermore, he suggests that the outcomes people anticipate depend largely upon their judgments of how well they will be able to perform in given situations. The same can be said for teachers in relation to their beliefs and attitudes toward their students' overall performance. Eberle (2011)'s quantitative study was conducted to determine whether a relationship exists between teachers' feeling of self-efficacy and their students, overall achievement with respect to North Carolina Reading and Math End-Of-Grade tests.

Surveys were administered to teachers and data collected focused on teachers' feeling of self-efficacy. This study employed qualitative data gathered from participant surveys. Six of the 14 comparisons within the study did not reveal a significant relationship between perceived

teacher self-efficacy and North Carolina End-of-Grade reading and math test scores. However, a relationship between perceived self-efficacy within gender did reveal that female participants tended to have higher perceived self-efficacy than that of the male participants. It was also discovered that a relationship existed between teacher respondents with lower perceived self-efficacy scores and math test scores.

In addition, teacher efficacy beliefs, a teacher's perception of how effectively they can affect student learning, have also been found to have a great impact on the self-efficacy, and therefore the achievement, of their students. Johnson (2008)'s, study was to investigate the link between teacher practices, their self-efficacy, and their students' mathematics self-efficacy. Teachers, and their students, from several school districts in northeastern Ohio participated in the study. Participants included 582 students nested within 30 classrooms. The factor analysis identified five dimensions of students' and four dimensions of teachers' mathematics self-efficacy. A two-level hierarchical linear model revealed that teachers' perceived mathematics competency, their ability to engage students, flexibility, teacher gender, and years of teaching experience were significant predictors of all five dimensions of students' mathematics self-efficacy. The study recommended regular professional development activities to help teachers implement teacher practices that can positively impact students' mathematics self-efficacy. Through enhancing students' mathematics self-efficacy, students' mathematics achievement is likely to improve (Johnson, 2008). Johnson's study's methodology was great as it incorporated even the factor analysis. However, it differs with the current study method as already the researcher is aware of the factors under study.

2.6. Summary

The literature reviewed different sources on teacher factors as per the Maslow's needs with respect to the performance of students in Mathematics. A satisfied and motivated teacher breeds excelling students. Teachers therefore should have high expectations of students in terms of both their standard of learning and their behavior, but they also have high expectations of

themselves and their own learning development. Teachers constantly self-evaluate critique and reflect on how well they are getting through to their students, and search for better ways of teaching, new tools, materials and methodologies especially for those who are not achieving learning as well as others. In addition, Teacher professional development has high influence on student motivation, teaching methodologies, communication skills, and organization of content and planning of lessons and very high influence on students' participation during lessons, teacher confidence and knowledge of subject matter (Maende, 2012). In a nut shell, limited literature that link the Maslow's need levels of teachers and students performance was found. This is a gap therefore that this study is trying to fill in the education system.

Chapter 3

Methodology

3.1. Introduction

This Chapter outlines the manner in which the study was conducted. It covers among other things the research design, population, sample, sampling procedures, instruments, reliability and validity of instruments, data collection, data analysis, and ethical analysis, and ethical consideration.

3.2. Research Design

A Correlation research design was adopted for this study. According to Willis (2007) a correlation research design finds out whether and to what degree variables are related. The design has two main purposes which the first one is that of explanation. This is where by there is a description of the direction and strength of relationships between and among variables within a group. This study explains the direction and strength of the Maslow's hierarchy of needs factors in its relationship to the students' Mathematics performance. The second purpose of correlation is that of prediction. This involves the estimation of the degree to which a change in one variable (the predictor variable) will account for the change in another variable (the criterion variable) for subjects in a group (Stangor, 2011). This is appropriate for this study as the ability of teachers' needs to predict students' Mathematics performance is of interest.

This design is supported by the Positivist paradigm. Positivism emerged as a philosophical paradigm in the 19th century with Auguste Comte's rejection of metaphysics and his assertion that only scientific knowledge can reveal the truth about reality. The positivist paradigm asserts that real events can be observed empirically and explained with logical analysis. The criterion for evaluating the validity of a scientific theory is whether our knowledge claims (i.e., theory-based predictions) are consistent with the information we are able to obtain using our senses (Kaboub, 2008).This paradigm and design are really appropriate for this study. This is so because

Maslow's Hierarchy of teachers' needs related to students' mathematics performance were examined.

3.3. Population and Sample of the study

According to Best and Kahn (2006), population is any group of individuals with one or more characteristics in common which are of interest to the researcher. It is of importance to note that the study used TIMSS data. In 2015 TIMSS, 57 countries and 7 benchmarking entities (regional jurisdictions of countries such as states or provinces) participated. In total, more than 580,000 students participated in 2015 TIMSS. The target population figures are derived from the sampling frame used to select the 2015 TIMSS samples while the sample figures are based on the number of sampled schools and students that participated in the assessments (LaRoche & Foy, 2016). Though that is the case, this study only focuses on Botswana and therefore, only Botswana data was used. In 2015 TIMSS, Botswana participated at the advanced level which entailed the use of the eighth grade or form 2 data. The total population was made up of 160 schools, 169 teachers and 5964 students.

The sample of the study was derived from the TIMSS Advanced 2015 population which includes students of eighth grade (equivalent to Form 1 in Botswana) and mathematics teachers enrolled in schools of secondary education in Botswana during the 2015 educational year. The sample of the study includes 160 schools made up 5964 students who took TIMSS in 2015 (LaRoche, Joncas & Foy, 2016).

3.4. Sampling procedure

TIMSS employed a two-stage random sample design. In the two-stage sampling design, the population is partitioned into groups, like cluster sampling, but in this design new samples are taken from each cluster sampled. The clusters are the first stage units to be sampled, called primary or first sampling units. The second-stage units are the elements of those clusters, called sub-units or second sampling units. When selecting a two-stage cluster sample, two conditions

are desirable. The first one is the geographic proximity of the elements within a cluster and then the cluster sizes that are convenient to administer (LaRoche, Joncas & Foy, 2016).

For the first sampling stage, schools were sampled with probabilities proportional to their size from the list of all schools in the population that contain eligible students. The schools in this list (or sampling frame) may be stratified (sorted) according to important demographic variables. Schools for the field test and data collection were sampled simultaneously using a systematic random sampling approach. School sampling is conducted for each country by Statistics Canada with assistance from the IEA DPC, using the sampling frame provided by the country's National Research Coordinator (LaRoche, Joncas & Foy, 2016).

The second sampling stage consists of the selection of one or more intact class from the target grade of each participating school. Class sampling in each country is conducted by the National Research Coordinator using the within-school sampling software WinW3S developed by the IEA DPC and Statistics Canada. Having secured the sampled school's agreement to participate in the assessment, the NRC requests information about the number of classes and teachers in the school and enters it in the WinW3S database. All students in each sampled class participate in the assessment. Sampled classes that refuse to participate may not be replaced (LaRoche, Joncas & Foy, 2016).

3.5. Data Collection Instrument

Secondary data from 2015 TIMSS advanced was used for this study. Data about the contexts for learning were collected through questionnaires completed by students, as well as their parents, teachers, and principals. Questionnaires were used to allow for feedback from a large number of respondents (Burgess, 2001). Also, it allowed each respondent the opportunity to provide anonymous feedback on their views. It is of importance to note that the sample size of the study was large, hence questionnaires helped in the collection of large number of respondents at a short time.

Teachers of the assessed students responded to the teacher Questionnaire. The questionnaire asked teachers about their education background, professional development, experience in teaching and their coverage of the mathematics and science curriculum. It also asked about the instructional activities as well as materials used in the class under TIMSS assessment. That is why in this study we report students with teacher data.

TIMSS mathematics and science achievement items are similar from one assessment cycle to another. However, it is of importance to note that each assessment cycle tends to have some unique characteristics that influence the instrument development approach. However, the achievement tests also need to be updated with each cycle to prevent the assessments from becoming dated and no longer relevant to current learning goals. It is important for the content to "keep up with the times" and to be innovative.

In the 2015 TIMSS teacher questionnaire, there were seven questions which focused on the safety and adequacy of resources like instructional materials and supplies. For example an item like" teachers do not have adequate workspace, the school building needs significant repairs". The questionnaire also had questions that measured the social belonging need like items on "collaboration in planning and preparing instructional materials, work with other teachers from other grades to ensure continuity in learning". Items making up this variable were seven. Teachers' self-esteem was measured by items which checked their motivation as well as confidence in their profession. Some of the items included among others "I am content with my profession as a teacher, my work inspires me, I am proud of the work I do" Self-actualization items consisted of those that measured the teacher's expectation to pupil achievement, teacher's development as well as satisfaction. Some of the items included "In teaching advanced mathematics to this class, how would you characterize your confidence in; inspiring students to learn.

3.6. Data Collection Procedure

For the TIMSS data, in order to ensure the consistency and uniformity of approach necessary for high-quality, internationally comparable data, all participants are expected to follow a set of standardized operations procedures (Johansone, 2016). These procedures have been developed over successive cycles of TIMSS through a partnership involving the TIMSS & PIRLS International Study Center, the IEA Data Processing and Research Center (IEA DPC), the IEA Secretariat, Statistics Canada, and National Research Coordinators (NRCs) Following the development of the draft achievement items and context questionnaires, all countries conducted a full-scale field test of all instruments and operational procedures .The field test allowed the National Research Coordinators and their staff to become acquainted with the operational activities, and the feedback they provided was used to improve the procedures for the data collection.

As expected, the field test resulted in some enhancements to survey operations procedures and most definitely contributed to ensuring the successful execution of TIMSS 2015.In ensuring that data was collected the National Research Coordinators had to be responsible for certain operational activities like Contacting schools and sampling classes, overseeing translation and preparing assessment instruments, managing the administration of the 2015 TIMSS assessments, scoring of the constructed response items as well as creating the 2015 TIMSS data files (Johansone, 2016).

3.7. Data preparation for analysis

Data analysis is a process through which data collected from the research field is processed in order to deduce conclusions (Cohen, Manion & Morrison, 2000). Data was collected and analysed using a computerized data analysis package known as Statistical Package for Social Science (SPSS). It is of importance to note that for the 2015 TIMSS, the database includes student mathematics and science achievement data as well as the student, teacher, school, and curricular background data for the 39 participating countries and 6 benchmarking

entities. The 2015 TIMSS International Database also includes data from the TIMSS Numeracy 2015 assessment, with the participation of 7 countries and 1 benchmarking entity. The student, parent, teacher, and school data files are in SAS and SPSS formats (TIMSS 2015 User Guide, Foy, 2017). For the purpose of this study, only the Botswana data was used. Data from both the students and the teachers' questionnaires were merged together for easy analysis.

In preparing data for analysis, certain steps were followed. Firstly the researcher familiarised herself with the data. Checking the data coding and scoring which entailed the conversion of raw data from questionnaires into numbers for data entry. This was followed by data cleaning which involved reviewing data for consistencies. Note that the inconsistencies in data may arise due to error in typing, as well as faulty logic, out of range or extreme values. According to Oppenheim (1992), continuous checks and crosschecks are a critical part of data preparation and quality assurance protocols. This is mainly done in order to certify that some findings are not simply due to mistakes in data entry. Common practices such as running frequency distributions on the main variables, range checks for each variable and internal consistency checks help identify inconsistencies within datasets (Oppenheim, 1992). Once the data was checked, edited and recoded, analysis began.

For this study, the dependent variable used was Students' Mathematics performance which was measured in scores and the independent / predictor variables were teachers' needs being basic, safety, belonging, self-esteem and self-actualization. The composite scores were constructed for the independent variables. This means that items measuring a single concept or construct like basic needs were combined to make that particular variable of interest. The factor analysis output (see Table 9) depicts the items composited to make the independent variables.

3.8. Operationalization of the variables in the study

Senese (1997) defines operationalization as the process of putting the concepts of interest into operation or of operating on those concepts in order to measure them, both individually and/or in relation to other concepts. The importance of this step in the research process cannot be

overestimated as it yields the final versions, so to speak, of what our concepts are thought to look like, how they are thought to act and function, and to a great extent what we are to do with or about them. Operationalization therefore, is the process of strictly defining variables into measurable factors (Senese, 1997). The researchers operationalize by providing a clear definition and designating a particular measurement instrument to represent the concept. Through the operationalization process, a construct is an imaginative or abstract entity, purposely created to provide a guide, a foothold, for further study and understanding of the concept it represents (Kerlinger & Lee, 2000). According to Nenty (2009), it is in this stage that owing to lack of understanding of numerical logic by many readers, the report often loses some audience within the section of analysis.

3.8.1. Operational definitions

For the purpose of this study, the following variables were operationalized as follows: Math performance measures the mathematical literacy of students to formulate, employ and interpret mathematics in a variety of contexts to describe, predict and explain phenomena. The results were reported as average scores.

Basic needs (basic issues of survival) attempts to define the absolute minimum resources necessary for long-term physical well-being. This includes the basic resources a teacher cannot survive or be effective without. This included among others the shelter being availability of workplace/classroom as well as availability of teaching resources.

Safety Needs: defined in terms of a safe environment which is not limited to physical parameters.. This has been measured by the teachers' clear rules, respect of property, safe neighborhood as well as student behavior.

Belonging Needs (social acceptance issues such as friendship or cooperation on the job).Teacher's needs of belongings' have been measured by teachers' ability of discuss topics, their collaboration, working together as a group as well as teachers 'visits among others.

Self Esteem needs are needs of positive self-image and self-confidence. It is at this level that the teacher is most receptive to teaching and wants to achieve a good level of self-esteem through recognition and achievement. The needs have been measured by teachers' confidence in the ability to inspire students, challenging tasks, math appreciation, and confidence in engaging students' interests as well as asking math relevant.

Self-Actualization Needs are needs defining achievement issues such as workplace autonomy, challenging work, and subject matter expert status on the job. These have been measured by teacher's contentment in the profession, teacher satisfaction, teacher's meaning and purpose and desire to continue as a teacher.

3.9. Procedure for testing Hypothesis

The level of significance of the relationship between the variables was evaluated and interpreted at the significance level of $p < .05$. When the p-value was 0.05 or less it meant that the relationship between the two variables was statistically significant and the null hypothesis is rejected.

Table 1

Procedure for testing the hypothesis

	Null Hypothesis	Type of variable	Scale of Measurement	Type of statistical analysis/test
1	Students' mathematics performance does not differ significantly by the teacher's characteristics (gender, age, experience).	Dependent : Mathematics Performance Independent: Teacher Gender, age, experience	Continuous Categorical, Continuous	Independent t-Test One-way ANOVA Pearson's correlation
2	A significant relationship between Maslow's Hierarchy of needs on teachers and students Math performance does not exist	Dependent : Mathematics Performance Independent: Physiological, psychological & self-actualization needs	Continuous Continuous	Factor analysis Pearson's correlation-p-value approach
3	The Maslow's hierarchy of needs of teachers does not significantly predict students' Maths performance when teacher's characteristics are controlled.	Dependent : Mathematics Performance Predictors : Maslow's needs Control:Teacher characteristics	Continuous	Hierarchical multiple regression
4	The best predictor of Student Math performance is Teachers' psychological needs factor	Dependent : Mathematics Performance Predictors : Maslow's needs	Continuous Continuous	Hierarchical multiple regression

Before running the techniques however, it is important to assure that the assumptions like that of normality, independence and homogeneity of variances among others for the techniques were not violated (See Chapter 4 for results). First of all, factor analysis was run to extract the independent variables of this study. This is a technique that is used to reduce a large number of variables into fewer numbers of factors. This technique extracts maximum common variance from all variables and puts them into a common score. Five factors of the Maslow's hierarchy of

needs were the ones put under subjection of the test. For the first research question, the Independent T test and One way ANOVA were used. This enabled the researcher to find the differences in performance of students by teachers' characteristics mainly gender, age as well as experience.

Secondly, after extracting the composite variables guided by the results from factor analysis, the relationship between Maslow's Hierarchy of needs of teachers and students Math performance was determined using the correlation analysis technique. A correlation is simply defined as a relationship between two variables (Hsieh & Lio, 2008). The whole purpose of using correlations in research is to figure out which variables are connected. This simple definition is the basis of several statistical tests that result in a correlation coefficient, defined as a numerical representation of the strength and direction of a relationship. Based on the correlation coefficient obtained as a result of the correlation analyses the level of significance of the relationship between the variables was evaluated and interpreted at the significance level of .05.

The test of the third and fourth hypothesis was Hierarchical multiple regression method. Researchers are often interested in testing theoretical assumptions and examining the influence of several predictor variables in a sequential way, such that the relative importance of a predictor may be judged on the basis of how much it adds to the prediction of a criterion, over and above that which can be accounted for by other important predictors (Stangor, 2011). Cohen, Manion and Morrison (2000) noted that hierarchical regression has been designed to test such specific, theory-based hypotheses. The Hierarchical regression analysis technique was employed to test predictor values or the relative effects of the independent variables on the dependent variables. The analysis also helped in finding the best predictor of students' Math performance putting into subjection all the five predictors at play

To perform hierarchical multiple regression, a variant of the basic multiple regression procedure is done and it allows one to specify a fixed order of entry for variables in order to

control for the effects of covariates or to test the effects of certain predictors independent of the influence of others. This is a framework for model comparison rather than a statistical method. In this framework, one build several regression models by adding variables to a previous model at each step; later models always include smaller models in previous steps. In many cases, our interest is to determine whether newly added variables show a significant improvement in R^2 (Stangor, 2011). Using a model involves a process of adding or removing predictor variables from the regression model in steps. For instance in this study, students' Math performance (dependent variable) is predicted based on Maslow's hierarchy of needs of teachers (independent variable) over and above the teachers' characteristics. The basic needs were entered in the first model, followed by the psychological needs and lastly the self-actualization needs.

3.10. Ethical Considerations

According to Creswell and Garrett (2008), ethical considerations should be seriously taken into account by scholars when they are proposing research that involves going out to the field in order to collect some form of data for analysis. So, for this study, because the researcher used a secondary data from TIMSS, permission was sought from Botswana Examinations Council to use the TIMSS data. The data collected was the one needed for the purpose of the study. Also, the findings and interpretation from the data were made honestly and objectively.

Moreover, all 2015 TIMSS participants were assured that their data would be confidential. Data security and confidentiality were maintained throughout all phases of the study, including data collection, data creation, data dissemination, and data analysis and reporting. The Statistical disclosure control (SDC) measures that were implemented on the TIMSS national data included the identifying and masking of potential disclosure risks for TIMSS schools and adding an additional measure of uncertainty of school, teacher, and student identification through random data swapping.

3.11. Validity and Reliability

The TIMSS achievement tests were prepared according to the principles of modern test construction. The content fit of the test items was empirically tested and inappropriate items were deleted. The curricular validity of the tasks could be confirmed using ratings of experts and teachers. In order to build a common achievement metric for all students with different test forms, item response techniques were applied to the data. In assuring the quality of the data, 2015 TIMSS made every effort to attend to the quality and comparability of the data through careful planning and documentation, cooperation among participating countries, standardized procedures, and rigorous attention to quality control throughout. The assessments were administered to nationally representative and well-documented probability samples of students in each country.

Moreover, The IEA Data Processing Center (DPC) was responsible for checking the data files from each education system, applying standard cleaning rules to verify the accuracy and consistency of the data, and documenting electronically any deviations from the international file structure. Queries arising during this process were addressed to national research coordinators. With the assessment data, the DPC subsequently compiled background univariate statistics and preliminary test scores based on classical item analysis and item response theory (IRT). All education systems were provided their univariate and reliability statistics, along with data almanacs containing international univariate and item statistics. This sharing allowed countries to review the statistics and data almanacs to ensure the data validity.

Chapter 4

Data Analysis and Interpretation of results

4.1. Introduction

This chapter presents the findings and analysis derived from the TIMSS data. The findings relate to the research questions that guided the study. Data were analysed to identify, describe and explore the relationship between Maslow's hierarchy of needs factors of teachers and students Mathematics performance. Note that 2015 TIMSS data was used to study student factors associated with student achievement in mathematics and science at the fourth and eighth grades.

4.2. Description of Sample

Descriptive statistics are used to describe the basic features of the data in a study. They provide simple summaries about the sample and the measures. They describe the size of the sample, the centre and average of the sample as well as the spread of the data. A total of 160 schools were presented and only 169 teachers participated in the study. Students made a sample size of 5964 for the study.

Note that for assessment studies like TIMMS, their fundamental purpose is established towards leaners. Table 2 therefore, portrays the teachers' background data as interpreted using students' data (showing how the 169 teachers were divided amongst the 5964 students). The results depicts that the majority (57.7%) of the leaners in schools was taught by Male teachers in Mathematics. On average, the majority (45.4%) of students were taught by teachers whose age ranged from 40-49. A higher (56.8%) proportion of students were taught by teachers who had a Short-cycle tertiary qualification. Only 69.1% of the students were taught by teachers who majored in Mathematics. Almost $2/5^{th}$ of the students were taught by teachers who had 1 to 5 years of teaching experience.

Table 2

Frequency table for background information of teachers

Characteristics	**N**	**%**
Gender		
Male	2323	57.7
Female	3173	42.3
Total	*5496*	
Mathematics measure		
Yes	3621	69.1
No	1618	30.9
Total	*5239*	
Level of Formal Education completed		
Upper secondary	161	5.2
Short-cycle tertiary	1761	56.8
Bachelor's or equivalent	1095	35.3
Master's or equivalent	82	2.6
Total	*3099*	
Age of teacher		
Under 25	287	5.2
25–29	1259	23.0
30–39	2485	45.4
40–49	1219	22.3
50–59	172	3.1
60 or more	48	.9
Total	*5470*	
Years of experience		
1-5	2172	40.1
6-10	987	18.2
11-15	936	17.3
16-20	917	16.9
21-25	176	3.3
26-30	39	0.7
31+	188	3.5
Total	*5415*	

Student Mathematics performance which is the dependent variable of this study showed a normal distribution of scores. Skewness with a value of .010 is an indication of a normal data set. This is so as the skewness is very close zero. Kurtosis is a measure of whether the data are peaked or flat relative to a normal distribution, the data showed a kurtosis value of -.215. The result suggested the deviation of data from normality was not severe as the value of skewness

and kurtosis index were below 3 and 10 respectively (Kline, 2011).This gives it a good statue of being used in almost all the tests in the study.

4.2. Research question 1: Does students' mathematics performance differ significantly by their teacher's characteristics (gender, age, experience)?

Hypothesis: Students' mathematics performances do not differ significantly by the teacher's characteristics (gender, age, experience).

H_0: $\mu b_{1} = \mu_{b2}$ H_{null}: $\mu_{male\ teachers} = \mu_{female\ teachrs}$

4.2.1. Teacher sex and Students' Math performance

The mean difference on Gender and mathematics performance was sought through the Independent T-Test technique. The purpose of using the Independent T-Test is to find the mean differences between the two independent groups (Gerald, 2018). Therefore, an independent T test was run to find the mean difference of students who were taught by Male and female teachers in their Mathematics performance.

Assumptions were tested to check the suitability of the data. There was a normal distribution of the randomly selected data and Math performance was in a continuous scale. The p-value of the Levene's test indicates that the assumption of no difference or equal variance is not met F= (4.376), p=.036. As the equal variance was not assumed, the Independent Sample t-test using the Alpha level of .05, results showed that there is no a significant difference in performance of students taught by Male Teachers (M=398.49, SD=83.43) and those who were taught by female teachers (M=400.5, SD=86.34), t (5097) = -.868, p=.386.This means retaining the null hypothesis and concluding that the performance of students taught by male and female teachers does not differ significantly.

4.2.2. Teachers' Education level and Math performance

One way ANOVA was run to find out the mean differences of students Math performance by their teacher's highest level of education completed. The assumptions of normality, independence as well as variables measurement scale were met. Only the assumption

of homogeneity of variance was not met. This is so because the Leven's test showed a $p = .001$ which is < .05 hence making the null hypothesis of equal variances to be rejected.

The One-way ANOVA results showed that we reject the null hypothesis and conclude that there is a statistical significant difference in Maths performance of students who are taught by Upper secondary teachers (M=352.39, SD=70.33), Short cycle tertiary (M=390.57, SD=79.26), Bachelor's (M=407.40, SD=90.28), and Masters Teachers (M=473.02, SD=85.48), $F(3, 3095) = 47.59$, $p = .001$. This indicates that students taught by different teachers of different level of education completed perform significantly from each other in Mathematics.

Given that the results were significant, a post hoc test was conducted to find out where the differences were. The Post Hoc results from Table 3 show that the significant difference of students' performance in Mathematics was across all the groups by different teachers' level of highest qualification. In other words, the more the teacher is qualified, the higher the student's Math performance.

Table 3.

Post Hoc results of teachers' level of education and student Math performance

Multiple Comparisons

Dependent Variable: Student Math Performance

Tukey HSD

(I) Level of formal education completed	(J) Level of formal education completed	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Upper secondary	Short-cycle tertiary	-38.17508*	6.83964	.000	-55.7559	-20.5943
	Bachelor's or equivalent	-55.00488*	7.01171	.000	-73.0280	-36.9818
	Master's or equivalent	-120.62725*	11.27022	.000	-149.5966	-91.6580
Short-cycle tertiary	Upper secondary	38.17508*	6.83964	.000	20.5943	55.7559
	Bachelor's or equivalent	-16.82980*	3.19699	.000	-25.0474	-8.6122
	Master's or equivalent	-82.45217*	9.38481	.000	-106.5751	-58.3292
Bachelor's or equivalent	Upper secondary	55.00488*	7.01171	.000	36.9818	73.0280
	Short-cycle tertiary	16.82980*	3.19699	.000	8.6122	25.0474
	Master's or equivalent	-65.62238*	9.51094	.000	-90.0696	-41.1752
Master's or equivalent	Upper secondary	120.62725*	11.27022	.000	91.6580	149.5966
	Short-cycle tertiary	82.45217*	9.38481	.000	58.3292	106.5751
	Bachelor's or equivalent	65.62238*	9.51094	.000	41.1752	90.0696

*. The mean difference is significant at the 0.05 level.

4.2.3. Teachers' age, teaching experience and Math performance

Table 4.

Student Math performance by teachers' age and years of experience correlation results

		Student Math Performance	Years of teaching experience	Age of teacher
Student Math Performance	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	5964		
Years of teaching experience	Pearson Correlation	.177**	1	
	Sig. (2-tailed)	.000		
	N	5415	5415	
Age of teacher	Pearson Correlation	.173**	.819**	1
	Sig. (2-tailed)	.000	.000	
	N	5470	5347	5470

**. Correlation is significant at the 0.01 level (2-tailed).

Pearson's correlation is a measure of the strength and direction of association that exists between two continuous variables. Correlation was run to find the relationship between students' Math performance, years of experience and age of teachers. All the variables were in a continuous scale and Math performance was normally distributed. The linearity of the relationship was hardly visible. This can be explained by the weak strength of the relationships shown by the results in Table 4. Teachers' age (p=.001, r=.173) and years of teaching experience (p=.001, r=.177) positively influenced the students' performance. The positive relationship means that students who were taught by older teachers performed better than those taught by young teachers. Also, those taught by teachers with more years of experience performed better than those having few years in service respectively. The relationship however, is of a small degree for both factors.

In a nutshell, for the relationship between teacher characteristics and student math performance, there was a positive significant relationship between Teachers age, level of education completed, years of teaching experience and Student Math performance. However, students' Math performance did not differ by gender of teachers.

4.3. Research question 2: Is there a significant relationship between Maslow's Hierarchy of needs of teachers and students Math performance?

H_{null}: r=0

In order to test this hypothesis Factor analysis was run to extract the five factors of Maslow's Hierarchy of needs. Confirmatory Factor Analysis (CFA) was used as it sought to determine if the number of factors and the loadings of measured (indicator) variables on them conform to what is expected on the basis of pre-established theory (Maslow's Hierarchy of needs theory). The suitability of this type of factor analysis was that the indicator variables were selected on the basis of prior theory, and factor analysis is used to see if they loaded, as predicted, on the expected number of factors which in this case is five (5). The factors were further subjected to the Hierarchical Regression method to further test the remaining hypotheses.

4.3.1. Factor analysis results

The 38 items in the questionnaire that measured Maslow's Hierarchy of needs of teachers on were subjected to the Principal Component Analysis. This analysis was used because the primary purpose was to identify and compute composite scores for the factors underlying the Maslow's Hierarchy of needs of teachers. The preliminary tests were made to ensure that no violations of assumptions were made. Assumptions tested included that of the sample size, homogeneity, factorability, No perfect multicollinearity, Homoscedasticity as well as linearity. This was done to check the suitability of data for factor analysis.

Firstly, the sample size of 5496 was appropriate. According to Wolf, Harrington, Clark and Miller (2013), sample size should be more than 200 and in some cases, sample size may be considered for 5 observations per variable. The sample size should be large enough to yield reliable estimates of correlations among the variables. This was not violated. Reliability analysis was conducted to check the homogeneity between variables.

Cronbach's alpha results showed the presence of the internal validity of the data. For the five factors thereof, the reliability index ranged from .830 to .857 which showed a good consistency of data (See Table 5).

Table 5.

The reliability index of the five needs of the Hierarchy theory

Variable	Cronbach's Alpha	Number of items
Self-Actualization	.857	7
Self Esteem	.856	9
Love and belonging	.830	7
Safety	.855	8
Basic	.851	7

The assumption of factorability was tested to indicate that there are at least some correlations amongst the variables so that coherent factors can be identified. Basically, there should be some degree of collinearity among the variables but not an extreme degree or singularity among the variables. The factorability of the 38 items was examined again by correlating the variables to check the linearity. It was observed that almost all the items correlated at least .3 with at least one other item, suggesting reasonable factorability.

Factorability was also examined by the measures of sampling adequacy (MSAs) for suitability of data for structure detection. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is a statistic that indicates the proportion of variance in variables that might be caused by underlying factors. High values (close to 1.0) generally indicate that a factor analysis may be used. If the value is less than 0.50, the results of the factor analysis probably won't be very useful. For this study, the result was .816 which indicates the suitability of data. On the other hand, Bartlett's test of sphericity tests the hypothesis that the correlation matrix is an identity matrix, which would indicate that the variables are unrelated and therefore unsuitable for structure detection. Small values (less than 0.05) of the significance level indicate that a factor analysis may be useful with your data. The results therefore, showed that the Bartlett's test of sphericity was significant, p=.001. The significant value therefore means that samples are from populations with unequal variances, hence rejecting the null hypothesis of the test (samples are from populations with equal variances), and concluding that a principal component analysis is appropriate.

Finally, in detecting the suitability of factor analysis, the communalities were all above .3 (see Table 7); further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was deemed to be suitable with all 38 items measuring the Maslow's needs.

The Principal components analysis was used as the primary purpose was to identify and compute composite scores for the factors underlying the Maslow's needs factors. The results therefore showed that the Initial eigenvalues indicated that the five factors explained 23.7%, 10.9%, 7.9%, 6.5% and 4.4% of the variance respectively (Table 6). For the final stage, a principal components factor analysis of the remaining 38 items, using oblimin rotations, was conducted, with five factors explaining 53.4 % of the variance. An oblimin rotation provided the best defined factor structure. Majority of the items in this analysis had primary loadings over .5.

Table 6.

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
	Total	% of Var	Cum %	Total	% of Var	Cum %	Total
1	9.006	23.700	23.700	9.006	23.700	23.700	5.439
2	4.125	10.855	34.556	4.125	10.855	34.556	4.993
3	3.017	7.939	42.495	3.017	7.939	42.495	4.165
4	2.474	6.511	49.006	2.474	6.511	49.006	5.457
5	1.684	4.431	53.437	1.684	4.431	53.437	5.538

Extraction Method: Principal Component Analysis.

Table 7.

Factor loadings and communalities based on a principal components analysis with oblimin rotation for 38 items

	Components					
	Self Esteem	**Safety**	**Love & Belonging**	**Self-Actualization**	**Basic**	**H^2**
	α=.856	α=.855	α=.830	α=.857	α=.851	
SAFE NEIGHBORH		-.783				.633
FEEL SAFE		-.807				.700
SECURITY POLICIES		-.625				.521
STUD BEHAVE		-.535				.584
STUD RESPECT		-.500				.565
RESPECT PROPERTY		-.525				.568
CLEAR RULES		-.453				.318
RULES ENFORCEMENT		-.513				.444
BUILDING REPAIR					-.694	.609
INADEQUATE WRKSPACE					-.751	.575
MATERIAL UNAVAILABLE					-.685	.642
CLASSRMS NOT CLEANED					-.503	.476
MAINTENANCE WORK					-.690	.567
INADEQUATE TECH RESOURCES					-.787	.684
INADEQUATE SUPPORT FOR TECH					-.634	.492
DISCUSS TOPIC			.814			.666
COLLABORATE			.727			.584
SHARE LEARNING			.718			.521
VISITS			.691			.512
WORK TOGETHER			.789			.637
WORK AS A GROUP			.587			.463
CONTINUITY IN LEARNING			.421			.286
CONTENT PROFESSION				-.696		.524
SATISFIED TEACHER				-.508		.424
MEANING AND PURPOSE				-.673		.528
ENTHUSIASTIC				-.695		.568
INSPIRES				-.689		.635
PROUD				-.746		.661
CONTINUE AS A TEACHER				-.73		.524
INSPIRE STUDENTS	.504					.313
VARIETY PROBLEM SOLVINGSTRATEGIES	.592					.421
CHALLENGING TASKS	.696					.453
ENGAGE STUDENTS INTEREST	.610					.489
APPRECIATE MATH	.645					.451
ASSESS COMPREHENSION	.639					.491
IMPROVE UNDERSTANDING	.677					.580
\MAKE MATH RELEVANT	.661					.546
DEVELOP HIGHER THINKING	.804					.653

Extraction Method: Principal Component Analysis.
Rotation Method: Oblimin with Kaiser Normalization.

a. Rotation converged in 13 iterations.

H^2= Communality

Table 8.

Inter-correlations between the Maslow's needs variables and students' performance

		STUDENT MATH PERFORMANCE	BASIC	SAFETY	BELONGING	CONFIDENCE	ACTUALIZATION
Pearson Correlation	**STUDENT MATH PERFORMANCE**	1					
	BASIC	.289*	1				
	SAFETY	.192*	.526*	1			
	BELONGING	.034*	-.239*	-.237*	1		
	CONFIDENCE	.167*	.334*	.136*	-.334*	1	
	ACTUALIZATION	.083*	.324*	.380*	-.306*	.363*	1

* p< .05 *(significant*

Table 8 shows that there is a statistical significant relationship between teachers' needs as per Maslow as well as student math performance. Even though that's the case the strength for the relationship is very weak and positive. Students' mathematics performance weakly correlated with the basic needs, $r = .29$, $p < .05$. Students who were taught by teachers with basic needs performed better than those whose teachers had no or less of the basic needs. Safety as well had a weak positive relationship with students' performance, r=.19, p< .05. The safer the teachers were, the higher their students' likelihood of performing better. Students, whose teachers were confident, performed better than those whose teachers were less confident. This was shown by the positive correlation between the two variables, r =. 17, p<.05. Belonging had the weakest relationship r =. 034, p<.05 and actualization related to student performance positively yet very weak, r=.083, p<.05.

4.4. Research question 3: Does the Maslow's hierarchy of needs of teachers predict students' Math performance when teacher characteristics are controlled?

Hierarchical multiple regression was run to test the hypothesis. It is of importance to note that prior to conducing a hierarchical multiple regression, the relevant assumptions of this statistical analysis were tested. Firstly, a sample size was deemed adequate given the five predictor variables to be included in the analysis (Tabachnick & Fidell, 2001). The assumption of singularity was also met as the predictor variables (were not a combination of other independent

variables. An examination of correlations (see Table 8) revealed that no independent variables were highly correlated. Also, the collinearity statistics (i.e., Tolerance and VIF) were all within accepted limits hence the assumption of multicollinearity was deemed to have been met. If the value of tolerance is less than 0.2 or 0.1 and, simultaneously, the value of VIF 10 and above, then the multicollinearity is problematic (Coakes, 2005). Multicollinearity is a state of very high intercorrelations or inter-associations among the independent variables. It is therefore a type of disturbance in the data, and if present in the data the statistical inferences made about the data may not be reliable. An examination of the Mahalanobis distance scores indicated no multivariate outliers. Residual and scatter plots indicated the assumptions of normality, linearity and homoscedasticity were all satisfied.

Therefore, a four model Hierarchical multiple regression was conducted with student Mathematics performance as the dependent variable. Teacher's experience (characteristic) was entered at stage one of the regression model as a controlled teacher characteristic. The next model included Actualization. Self-esteem/confidence and Social belonging (Psychological needs) were entered in the third model. Lastly the final model comprised of the Physiological needs (safety and basic). The needs variables were entered in this order as it is chronologically plausible as stated by Maslow. Intercorrelations between the multiple regression variables were reported in Table 8 and the regression statistics are in Table 9.

From the model table, (*see appendix*) R is interpreted as the correlation between the predicted values of Y and the actual values of Y. In this case, correlation between Math performance (predicted) and Maslow's needs (predictors). The R value represents the simple correlation and the results show a low degree of correlation. The R^2 value indicates how much of the total variation in the dependent variable-student Mathematics performance, can be explained by the predictor variables. R^2 is interpreted as the percentage of variance in Y accounted for by X. Here, it shows that teacher's characteristics (experience) explained 3.4% of total variance in Students performance. Model 2 explained 4.0% of total variance. Model 3

further accounted for 7.4% and lastly the 4th model explained 13.2% of total variance in Student, Math performance.

The ANOVA results show the statistical significance of the regression model that was run. Here, All the models have a p =.01 which is less than .05, indicating that in overall, the regression models statistically significantly predicts the outcome variable (our data fits the model very well). The linear regression's F-test had the null hypothesis that there is no linear relationship between the Maslow's hierarchy of needs and Students Math performances (in other words $R^2=0$). However, the results showed otherwise hence rejecting the null hypothesis and concluding that there is a linear relationship between the variables in our model.

Table 9.

Summary of Hierarchical regression analysis for variables predicting Math performance

Variable	**β**	**t**	**R**	**R^2**	**ΔR^2**
Model 1			.183	.034	.034
Experience	1.875	13.600*			
Model 2			.200	.040	.006
Experience	1.861	13.542*			
Actualization	1.520	5.912*			
Model 3			.273	.074	.035
Experience	1.896	14.034*			
Actualization	.929	3.349*			
Confidence	3.986	13.101*			
Belonging	2.388	8.318*			
Model 4			.364	.132	.058
Experience	1.388	10.375*			
Actualization	-.516	-1.806			
Confidence	2.958	9.600*			
Belonging	2.982	10.624*			
Safety	1.273	4.930*			
Basic	3.354	13.904*			

* Note. N = 5334; *p< .05,

The hierarchical multiple regression was calculated to find out the extent to which the Maslow's hierarchy of needs of teachers predict student's Mathematics performance controlling teachers' characteristics (years of experience). The results revealed that in Model 1, teachers experience contributed significantly to the regression model, $F(1,5333) = 184.957$, $p < .001$ and accounted for 3.4% of the variation in Student Math performance. In model 2, introducing the self-actualization variable (self-fulfilling needs) explained an additional 4% of variation in performance and this change in R^2 was significant, $F(2,5332) = 110.545$, $p < .001$. Adding the psychological needs (Belonging and self-esteem/confidence) to the regression model explained an additional 7.4% of the variation in performance and this change in R^2 was also significant, ($F(4, 5330) = 107.028$, $p < .001$). Lastly the addition of the Physiological needs (Safety and Basic needs) to the regression model explained an additional 13.2% of the variation in student performance and this change in R^2square was also significant, F (6.5328) = 135.628, $p < .001$).

When all five independent variables were included in the final stage of the regression model, Actualization as a predictor variable was no longer significant in predicting performance.

Therefore, the general form of the equation to predict Student Math performance after controlling for their teaching experience from Actualization, Self-esteem, Social and belonging, Safety and basic needs is:

Predicted Student Math Performance = 1.388 (Experience) + -.516 (Actualization) + 2.958 (Confidence) +2.982 (belonging) +1.273(Safety) + 3.354(Basic)

4.4. Research question 4: What is the best predictor of teacher's needs on students' mathematics performance and its implications?

Table 9 shows that the best predictor of Student Math performance when the Maslow's needs are predictors is: The basic needs. Even though it was added to the model last, it showed a greater significance in prediction, Model 4 (β=3.354, p= .001). This is so because including it in the model added more percentage to the prediction level of Mathematics performance. Together the five predicting variables as per Maslow's hierarchy accounted for 21% of the variance in

students Math performance. However, the Physiological needs uniquely explained 13.2 % of the variation in performance. This indicates that out of the total variance explained by Maslow's needs, the psychological needs accounted for more than half of that variance. Meaning a higher proportion is accounted for by the physiological factors which are the basic needs.

This implies that applying the Maslow's hierarchy of needs theory to the work of the classroom teacher is very important and eye opening. This is so as it can give a clear picture of the status quo of teachers in regard to their influence to the mathematics performance of their students. Before an individual's cognitive needs can be met, they must first fulfill their basic physiological needs. Teachers with enough and adequate basic needs produce students who perform much better than those whose teachers don't have resources. Also, there is a need for safety in the classroom as well as in school. With this satisfied within the classroom, students will be able to progress and reach their full potential.

Chapter 5

Discussion, Summary, Conclusions and Recommendations

5.1. Introduction

Maslow's (1962) hierarchy of needs theory has made a major contribution to teaching and classroom management in schools. Maslow looked at the complete physical, emotional, social, and intellectual qualities of an individual and how they impact on learning. This study sought to find out how the Maslow's hierarchy of needs of teachers predicts student performance. This chapter therefore, discussed the major findings of the study. The discussion is in themes guided by the objectives of the study. Furthermore, a summery, conclusion and the recommendation of the study follow after.

5.2. Discussion

5.2.1. Teacher characteristics and performance

Teacher experience, age, education attained had a significant relationship with the performance of the students. Teacher gender however, acted otherwise. On the issue of teacher experience, newly hired teachers are less effective than teachers with some experience (Rice, 2013). According to Boyd, Grossman, Lankford, Loeb and Wyckoff (2008) an instructor's teaching ability increases dramatically in their first year of teaching. However, after the first year of teaching, there are diminishing returns on subsequent years of teaching, with there being no returns after approximately 4 years of teaching. The results of this study however showed otherwise. Even though the significance was at a low strength for this study, students taught by experienced teachers performed much better than their counterparts. This is not surprising at all. As teachers gain more experience their standard of teaching changes for the better. The experienced teachers might have benefited from regular in service trainings and therefore come up to date with the current trends in their respective teaching areas. The less experience teachers on the other hand, might still be in need of a lot of guidance and direction on the best

strategies to apply in order to maximize their output from the students. The teachers with longer teaching experience are described as "competent as they have better mastery of content and possesses a variety of skills that enables them to assist students perform well in examinations. The results of this study concur with those of Odumbe, Simatwa and Ayodo (2015) study. They found that high teacher experience was one of the factors that enhance performance in day secondary schools. These findings also agree with those of Maende (2012) who established that teacher professional development has high influence on student motivation, teaching methodologies, communication skills, organization of content and planning of lessons and very high influence on students participation during lessons, teacher confidence and knowledge of student matter.

Teachers' qualification is one of the critical factors that drive students' academic performance. This was observed in this study. The positive relationship indicated that students who were taught by teachers with higher qualification, performed better than their counterparts. The issue here is that teachers' profession relates to competence in instruction, management of students and materials in the classroom . Teachers' qualifications, therefore, might not only be the certificate someone is holding as erroneously conceived by some people. Teachers' qualifications are more than just holding a certificate of any institution. The issue is whether teachers are able to transfer the knowledge they have to students.

Teachers' gender is a factor influencing the educational processes with regard to teacher and student interactions. Research on this topic has shown that teacher's gender affects the quality and quantity of interactions in the classroom. Teacher's gender is an issue that has theoretical and pedagogical implications in education. Though that's the case, gender of the teacher did not significantly influence students' Math performance. This means that teacher gender did not have any influence on the students Math performance. In other words, students taught by both females and males have an equal likelihood of performing the same level. One of the factors that might be behind this result is that with the issue of teacher quality both men and

women are striving to produce results. Mathematics as a subject that was more regarded as a male area has changed in Botswana to be appreciated by women as well. Hence the result of this study on this aspect is not surprising. Holmlund and Sund (2008) also found no evidence to show that teacher gender improves student outcomes. Thus, the available empirical evidence does not allow an accurate determination of the correlation between teacher's gender and student's academic performance in secondary education.

5.2.2. Maslow's needs and their relationship/prediction of students Math performance

All the Maslow's factors showed a great importance of their relevance in student performance. The basic needs output by the TIMSS study involved factors which included workplace adequacy, availability of teaching materials, adequacy of teaching resources as well as teaching aides among others.

Basic needs are needs that one cannot survive without. Therefore, in education, basic needs are factors that the teacher or students cannot survive without. It wasn't surprising for basic needs to be positively related to student Math performance. It is of importance to note that for this study, in operationalizing the basic needs of students, teaching resources is one of the basics a teacher needs for effecting teaching. Therefore, teaching and learning aids contribute to achievement in mathematics. However, sometimes there are insufficient mathematics text books in secondary schools. Schools have poor chalk boards which affects teaching and learning of mathematics, since the subject involves a lot of calculations, which has to be on the chalk board. This has negative results on performance of the students. Adaralegbe (1985) pointed out that the availability of adequate school buildings, number of classrooms, toilets and other facilities are also necessary for the attainment of any educational objective. Giving an example of his study, he found out that 33% of the schools in Ebonyi State did not also have any teaching aids for mathematics. This affected the schools' results negatively. Therefore, resources must be sufficiently available so as to enhance performance in the acquisition of relevant skills, knowledge and attitude for the improvement of student's Math performance.

Just like the basic needs, safety needs incorporated issues on safety of neighborhoods, rules enforcements; security policies just to mention a few. Teachers having a good safe school had students performing better than their counterparts. Therefore, the perceptions of school safety can be affected by a myriad of factors. The presence of gangs and drug problems can negatively affect students' perceptions of school safety (Schreck & Miller, 2003). This study also has a positive correlation between safety and performance. According to Bosworth, Ford and Hernandez (2011), for instance, neighborhood surroundings have a very influential effect on students' perceptions of safety. Schools that are located in neighborhoods that have high poverty and high crime rates have been shown to have a negative influence on perceptions of school safety thus affecting students' results.

In terms of safety needs therefore, there are several factors that teachers and group leaders can consider to help make learners feel safe. A feeling of safety can be derived from a routine or a predictable world. As teachers, it is important to establish a certain routine in the learning environment built. Clearly defining procedures and rules for the learners is very important. By so doing, learners will feel they have more control over the learning environment by simply being aware of what to expect during instruction. In addition, learners should feel psychologically and emotionally safe within the learning environment. Students taught under a safe environment might be more attentive and efficient in the classroom. Also, a safe environment reduces the symptoms of depression, such as feeling unhappy and having difficulty enjoying themselves. Making sure that students are engaged and attentive in the classroom can contribute to long-term success above and beyond intellectual capacities such as reading or math skills. Therefore, with the results of the study having shown a positive relationship between the two factors, safety it's important for the academic performance of the students.

Social and belonging showed a small predictory influence on the students' performance. Even though the influence was minor, it was positive. This means that students who are taught by teachers whose social and belonging antennas are satisfied, are likely to perform better than

those whose teachers are not satisfied in that aspect. The social and belonging factors involves the teachers' collaboration, discussions of the topic, learning share, visits as well as working together. It is of importance to note that individual teachers are able to increase math student achievement if they were engaged in better general collaboration in a school. Teachers working in schools with better collaboration about students are better able to raise student math achievement. This is because teachers benefit from the quality of collaboration within their school.

The reason why student performance is affected by collaboration is because there is a creation of an active environment which involves exploratory learning. Also belonging to a group of teachers builds a team approach to problem solving while still maintaining individual accountability. The results of this study may be supported by researchers like Doebler and Smith (1996) who recommended that team teaching as a model of collaborative teaching is effective for teaching mathematics and producing good results.

The more the teacher is confident the more the students achievement. The Self-esteem needs factors for this study included confidence in problem solving strategies, challenging tasks, improving understanding as well as engaging student interest among others. The positive relationship between the teacher's confidence and student Math performance was not by mistake. This is so because the teachers provide opportunities to apply problem-solving skills to relevant, everyday experiences. Manipulatives, computers, and calculators are part of math instruction at all levels to assure understanding of concepts. Also, the daily math drills provide practice in mathematical communication and use of algorithms. Integration with other curricular areas is managed through thematic units and projects. Students use a variety of measuring, estimating, graphing, and problem-solving techniques. So a teacher who is confident in these factors becomes an asset in the classroom. Teachers are a driving force and main resource in the development and academic growth of students as they are sources of knowledge and agents of

change (Lyimo, Too & Kipng'etich, 2017).So if the teacher is not confident in all this, and then there will be a problem in the classroom.

In TIMSS one of the self-esteem needs factors was that of being confident in making Math relevant. The teachers who are able to show students that the subject is used every day by "real" people give it new importance. They may never be excited about algebra but if they see how it applies to them, they may be motivated to learn attentively hence producing good results and being motivated to learn more. The specific difficulty of mathematical knowledge for students lies in its abstract nature. So, students often find it difficult to associate mathematics learned in the classroom with real situations, and also have difficulty in connecting between the mathematical knowledge they already possessed and what they have learned in school.

In addition, a teacher inspires students by trusting them, challenging them, expecting them to achieve and of course never calling him/herself the reason of their achievements. Students who are not motivated will not learn effectively. Students look to teachers for approval and positive reinforcement, and are more likely to be enthusiastic about learning if they feel their work is recognized and valued.

According to Maslow**,** Self-actualization is at the top of Maslow's hierarchy of needs-becoming "'fully human"...maturity or self-actualization -and is considered a part of the humanistic approach to personality. In this study the factors that measured it were content profession, satisfaction level of a teacher as well as an enthusiastic feel of continuing as a teacher. Self-actualization refers to the desire for self-fulfillment, namely, the tendency to become actualized in what one has potential. For teachers therefore, a self-actualized teacher may be a role model to students to encourage them to work to the best of their abilities. Students who were taught by self-actualized teachers performed better than their counterparts. Teachers may use assessment for learning; engage in ongoing staff development to improve their own effectiveness, and plan with one another to ensure consistency and high expectations. Teachers

may also analyze the data available to them and make adjustments as necessary to be sure students are learning what is necessary to meet standards.

Even though self-actualization showed a positive correlation to student math performance, after being subjected in one model with the other predictor variables, it lost its significance. The explanation of this behavior goes back to the issue that it is a final need. Hence in order for teachers to strive for it, they must first meet the lower needs; having resources, safe school environment, social and belonging and have high self-esteem (Melnic & Botez, 2014). It is with those factors that their significant strength was very weak that is why the upper need lost its significance.

5.2.3. The best Maslow's predictor of performance

The hierarchy that Maslow originally described was based on the concept that humans are motivated by the desire to fulfill needs. This study showed how the human needs are organized in order of relative importance. A need that is described as strong is the one that is greater in power or influence than others. In other words, it is most likely that the major motivation would be to fulfill the most important need before seeking to fulfill any others. Basic and safety needs are considered to be important in the hierarchy as shown by to the model results. Basic needs must be satisfied first. Once a need is satisfied, other needs that are higher on the hierarchy emerge which now dominate behavior. Once these needs are fulfilled, even higher needs on the hierarchy emerge and so on.

5.3. Summary

The purpose of this study was to find out the influence of teachers' needs on students Math performance as per the Maslow's Hierarchy of needs. The basic needs, safety, belonging, self-esteem (confidence) and self-actualization of teachers were put in scrutiny to determine how they behave in their student Math prediction. The major conclusion of this study was that teachers' years of experience affected the performance of students positively. The more teachers were experienced the higher their students performed. Another finding was that the teacher's

gender did not influence students' performance. Furthermore, for the teachers whose needs were satisfied, their students performed better than their counterparts. Among the five needs postulated by Maslow, for this study, indicated that the physiological needs (basic and safety) accounted from a major proportion in the variance of teacher needs predicting students Maths performance. This is an indication that indeed lower needs are to be satisfied first before the achievement of the higher level needs.

5.4. Conclusion

Maslow's hierarchy of needs theory is still important and relevant in today's institutions like that of education. The application of the theory therefore, is paramount. Maslow (1970) believed that basic needs are the ultimate goal of organization. The hierarchy of basic needs seems to be the most powerful instrument to describe human motivation. This study proved without a shadow of doubt that just as Maslow portrayed, the lower needs are to be satisfied first before the higher needs for great satisfaction. Teachers presumably have the same needs for support of competence as well as results accomplishment as students have. While there has been a lot of research documenting and analyzing student needs, research on teacher needs is scarce. However, providing supportive environments for teachers seems vital to the health of our educational systems. This study therefore stood as an example of a proof that indeed there is an urge of taking into consideration teachers' needs in relation to their effectiveness in teaching as well as students achievement. A teacher with the basics, who feels safe in the school environment, a teacher who collaborates well with the peers, students as well as parents, a motivated and confident teacher, a teacher who believes in his/herself has a very great impact on the performance of students. Therefore, it is important for the education system to take heed of these as far as teachers are concerned.

5.4.1. Limitations of the study

One of the main limitations of this study was that the researcher used secondary data hence not having much control of it more especially in the methodology used. This pertains to the sampling procedures as well as data processing procedures. The researcher who is analysing the data was not involved in the data collection process. So, there is an unawareness of the study's specific nuances or glitches in the data collection process that may be important to the interpretation of specific variables in the dataset. Also, the data used was the 2015 TIMSS which provides a snapshot of pupils' skills at one point in time, and do not provide information about pupil progress.

Applying Maslow's Hierarchy of needs on teachers to predict student performance is an area that has never been done in Botswana. Not only that, the literature is limited on it. Except that some studies only focused on one level of the hierarchy like motivation or self-actualization. With that therefore, literature was limited however, the researcher made it to a point of incorporating the available literature for the progression of her research.

Limitation of missing data could not be controlled by the researcher. The missing data more especially in some of the background variables limited the totals evidently seen in their inconsistencies seen in the background variables used (see Frequency totals in Table 2). However, the researcher just made conclusions based on the assumption of a complete data set.

5.4.2. Delimitations of the study

The study was delimited to 2015 TIMSS data only for Botswana. Maslow's hierarchy of needs guided the focus of the research and only four objectives were derived. The focus of the study was only in how the Maslow's needs (basic, safety, belonging, self-esteem and actualization) as they relate to teachers; predict students' performance. The attention was only in Mathematics.

5.5. Recommendations

With the findings stated, recommendations follow:

The teaching experience and teachers' age are positively related to students' Math performance. The researcher therefore, recommends that policymakers should focus on a program and investment strategies that will retain the value of service of retiring teachers in the teaching field. The strategy should be able to build an experienced teaching workforce of high-quality individuals who are continually learning as well as equipping new teachers. Accomplishing this goal will require the implementation of policies and practices to increase teacher retention and reduce turnover in schools.

Secondly teachers' needs were positively related to students' performance. Hence the researcher recommends education leaders to develop a safe schools planning process which relies on adaptive leadership strategies by collecting data on school climate, availability of basic needs in terms of resources, as well as student and staff needs. This will entail developing an individualized school action plan to address data-identified gaps and needs as well as implement and evaluate the impact of the plan. This could involve a complete school safety audit focusing on physical and non-physical aspects of campus security and student and staff safety.

Conditions for strong friendly relationships among school staff and a conducive professional working environment is highly recommended. This would build a high sense of belonging among staff. Among the most common reasons teachers give for leaving the classroom is an unsupportive principal or a lack of collegial support among the staff. Increasing opportunities for teacher collaboration and a more productive working environment is a smart policy as it holds the promise for increased teacher retention. Also, the benefits of experience are greater for teachers in strong professional working environments. It might be helpful if the teachers establish a good relationship with the students' family since collaboration from home is also essential for the students' performance.

The researcher recommends that teachers in schools imbibe teacher confidence building strategies that incorporates students' centered learning emphasis. With these teachers can adopt the right teaching strategies in order to increase their own motivation, self-confidence and students' performance.

Teacher development is important in education systems. Therefore, there is a need to train teachers on different motivation aspects like how to build their students' confidence in believing in themselves to academically succeed. Also, the school management should encourage teachers to contribute in decision making as well as sharing their new ideas. Developing teachers therefore, will help them feel empowered. This is likely to encourage the generation of more ideas from teachers to build their schools. School heads should therefore establish structures in their schools to ensure that teachers receive a regular feedback in the form of peer supervision, in-service training, school visits, formal and informal dialogue. Also, teachers' desires for the rewards of positive feedback and recognition will in large motivate them to perform satisfactorily in anticipation of such rewards.

The education system should develop school risk assessment teams or needs evaluation task teams. These teams would help with regular school assessments which might pinpoint the risks that might hinder academic excellence as much as the teachers, schools as well as students' needs are concerned. The assessments will also incorporate the school safety, availability of resources, collaboration as well as teachers competencies in delivering the subject matter concerned. As the basic needs were the best predictor of performance, the periodic assessments of schools will provide the school system with gaps which could hinder the achievement of an optimum level of performance.

Further research is required to find out how teacher's place of residence (rural/urban) influences students' Math performance.

Further research might need to incorporate the teachers' basic needs being measured by their accommodation status, eating habits as well as the availability of water and food at their homesteads not only availability of resources at school as shown in this research.

Further research is needed for primary data collection that will incorporate triangulation methods for rich and concrete findings that will complement each other and lead to great conclusions' to show how the Maslow's hierarchy of needs predict students' Math performance.

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Appendices

Appendix 1 : Tabulations from Hierarchical Regression results

Table 10. Model Summery

Model	R	R^2	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R^2 Change	F Change	df1	df2	Sig. F Change
1	.183[a]	.034	.033	83.46267	.034	184.957	1	5333	.000
2	.200[b]	.040	.039	83.19822	.006	34.956	1	5332	.000
3	.273[c]	.074	.074	81.70364	.035	99.429	2	5330	.000
4	.364[d]	.132	.132	79.11060	.058	178.567	2	5328	.000

Table 11 ANOVA results of the models

Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	1288415.153	1	1288415.153	184.957	.000[b]
	Residual	37149769.363	5333	6966.017		
	Total	38438184.516	5334			
2	Regression	1530377.549	2	765188.774	110.545	.000[c]
	Residual	36907806.967	5332	6921.944		
	Total	38438184.516	5334			
3	Regression	2857853.790	4	714463.447	107.028	.000[d]
	Residual	35580330.726	5330	6675.484		
	Total	38438184.516	5334			
4	Regression	5092969.734	6	848828.289	135.628	.000[e]
	Residual	33345214.782	5328	6258.486		
	Total	38438184.516	5334			

Appendix 2: Normal graphic distributions of Students Mathematics performance

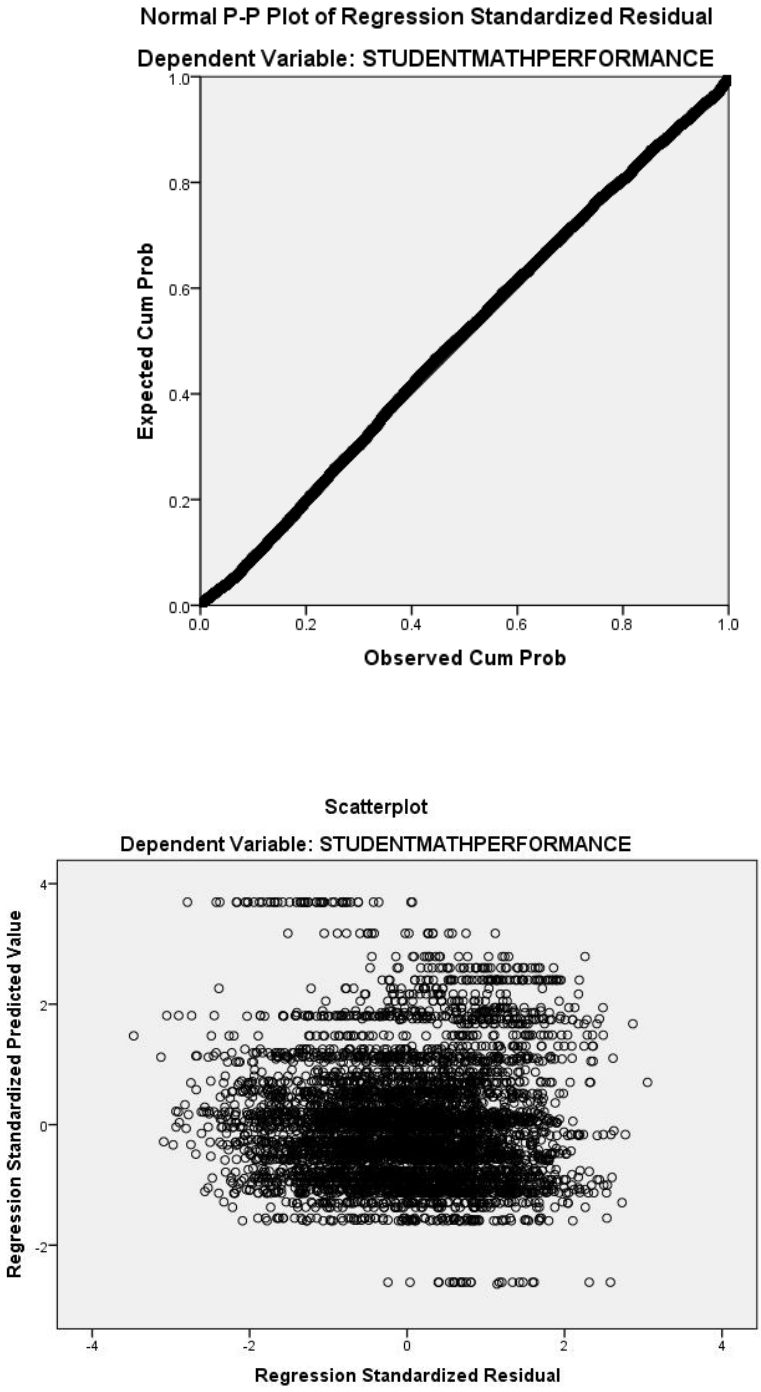

Figure 3. Normal P P Plot of the standardized residual and the scatter plot

Appendix 3 : Office of Research and Development request for research permission

Office of the Deputy Vice Chancellor (Academic
Office of Research and Development
Corner of Notwane and Mobuto Road
Private Bag UB00708
Gaborone
Botswana

Tel: (267) 355 9200
FAX: (267) 395 7573
Email: research@mopipi.ub.bw

05 May 2018

P.O Box 1348
Orapa

Onneetse Mokoya
Student number: 200703407
Department of Educational Foundations
University of Botswana
Masters of education (Research and Evaluation)

RE: PERMISSION TO CONDUCT RESEARCH

Herewith is my request for a research permit to conduct a research study at Botswana Examinations Council. The research permit will enable the researcher to approach the Botswana Examinations Council to seek their permission to access students' academic records from their database.

My research is titled: Botswana teachers' level of needs satisfaction as a predictor to students' mathematics performance as per TIMSS, 2015. The main purpose of the study is to examine how Maslow's Hierarchy of needs interact with Batswana teachers and their characteristics to predict students' mathematics performance. I have attached a copy of the proposal. Also attached is a copy of my updated curriculum vitae (CV) as proof of my competence to carry out the study.

Thank you in advance for your consideration.

Yours Faithfully,

Onneetse Mokoya
Mobile: 71837722
Email:mokonny@gmail.com

Appendix 4 : Botswana Examination Council request for permission to conduct research

P O Box 1348

Orapa

04 May 2018

The Executive Secretary
Botswana Examination Council
P/Bag 0070
Gaborone
Botswana

RE: PERMISSION TO CONDUCT RESEARCH

Herewith is my request for a permission to conduct a research study that seeks to use the Trends in International Mathematics and Science Study Advanced, 2015 data from your organization.

My research is titled: Botswana Teachers' level of Needs Satisfaction as a Predictor to Students Mathematics Performance as per TIMSS, 2015. The main purpose of the study is to examine how Maslow's Hierarchy of needs interact with teachers and their characteristics to predict students' mathematics performance. This captures the teachers' characteristics, their safety, motivation, self-esteem, social interaction with students and other teachers as well as their self-actualization which includes among others their development. The main question is how this teacher's needs interact to predict Maths performance.

I specifically request for the TIMSS Advanced 2015 data that will enable me to analyze it for valid conclusions of the study.

Yours Faithfully,

Onneetse Mokoya (Miss)

Mobile:71837722
Email: mokonny@gmail.com
Student number: 200703407
Department of Educational Foundations
University of Botswana
Masters of education (Research and Evaluation)

Appendix 5: Data Extraction form to Botswana Examination Council

DATA EXTRACTION FORM

FROM BOTSWANA TIMSS 2015 DATA

The main purpose of the study is to examine how Maslow's Hierarchy of needs interact with teachers and their characteristics to predict students' mathematics performance. The flowing data therefore, is needed for the achievement of this goal of the study.

Variables	Items on…
Dependent variable Student Maths performance	• Students Maths scores
Teacher's characteristics	• Region/District • Teacher's Sex • Teacher Age • Years of Experience • Teachers' highest level of education
Basic Needs	• Teacher's accommodation • Availability of in structural resources
Safety	• Teachers' safety perceptions • Physical condition of the school • Severity of problems
Love and belonging	• Teachers' collaboration/interaction • Teacher-student interaction • Teacher-Parent interaction
Self Esteem	• Teacher's motivation • Confidence in performing instructional practices
Self-Actualization	• Teacher's enthusiasm towards teaching • Job satisfaction • Teacher participation in Professional Development Activities

Onneetse Mokoya
71837722
mokonny@gmail.com

Appendix 6 : Botswana Examination Council permission response

DATA APPROVAL RESPONCE FROM BEC

Gmail **Onny Mok <mokonny@gmail.com>**

TIMSS 2015 data

Mmoloki Gabalebatse <MGabalebatse@bec.co.bw> Mon, Jun 18, 2018 at 10:25 AM
To: "mokonny@gmail.com" <mokonny@gmail.com>
Cc: Warona Rambwawasvika <WRambwawa@bec.co.bw>

Good day,

This serve to request you to come to BEC offices for TIMSS 2015 data that you have requested.

Please bring a memory stick or compact disk with you for this exercise.

Regards.

Mmoloki Gabalebatse (MR)

Research Officer

Botswana Examinations Council

Tel: +267 365 0861
Fax: +267 318 5011
email: mgabalebatse@bec.co.bw or

molkigabs@hotmail.com

"Sa mosima se jewa ke yo o thata." ***–Setswana sa borre***

Appendix 7:Teacher questionnaire

TIMSS 2015

Identification Label

TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY

Teacher Questionnaire Mathematics

<Grade 4>

<TIMSS National Research Center Name>

<Address>

TIMSS & PIRLS
International Study Center
Lynch School of Education, Boston College

TIMSS 2015

Identification Label

TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY

Teacher Questionnaire Mathematics

<Grade 4>

<TIMSS National Research Center Name>
<Address>

TIMSS & PIRLS
International Study Center
Lynch School of Education, Boston College

Teacher *Questionnaire*

Your school has agreed to participate in TIMSS 2015 (Trends in International Mathematics and Science Study), an educational research project sponsored by the International Association for the Evaluation of Educational Achievement (IEA). TIMSS measures trends in student achievement in mathematics and science and studies differences in national education systems in almost 60 countries in order to help improve teaching and learning worldwide.

This questionnaire is addressed to teachers of <fourth grade> students, and seeks information about teachers' academic and professional backgrounds, classroom resources, instructional practices, and attitudes toward teaching. Since your class has been selected as part of a nationwide sample, your responses are very important in helping to describe primary/elementary education in <country>.

Some of the questions in the questionnaire refer to the "**TIMSS class**" or "**this class**". This is the class that is identified on the front of this booklet, and which will be tested as part of TIMSS in your school. If you teach some but not all of the students in the TIMSS class, please think only of the students that you teach when answering these class-specific questions. It is important that you answer each question carefully so that the information that you provide reflects your situation as accurately as possible.

Since TIMSS is an international study and all countries are using the same questionnaire, you may find that some of the questions seem unusual or are not entirely relevant to you or schools in <country>. Nevertheless, it is important that you do your best to answer all of the questions so comparisons can be made across countries in the studies.

It is estimated that you will need approximately 35 minutes to complete this questionnaire. We appreciate the time and effort that this takes and thank you for your cooperation and contribution.

When you have completed the questionnaire, please place it in the accompanying envelope and return it to:

<Insert country-specific information here>.

Thank you.

TIMSS 2015

G1

By the end of this school year, how many years will you have been teaching altogether?

_____ years

*Please **round** to the nearest whole number.*

G2

Are you female or male?

*Check **one** circle only.*

- Female ---
- Male ---

G3

How old are you?

*Check **one** circle only.*

- Under 25 ---
- 25–29 ---
- 30–39 ---
- 40–49 ---
- 50–59 ---
- 60 or more ---

G4

What is the highest level of formal education you have completed?

*Check **one** circle only.*

- Did not complete <Upper secondary education—ISCED Level 3> ---
- <Upper secondary education—ISCED Level 3> ---

(If you have not completed <post-secondary or tertiary education>, go to #G6)

- <Post-secondary, non-tertiary education—ISCED Level 4> ---
- <Short-cycle tertiary education—ISCED Level 5> ---
- <Bachelor's or equivalent level—ISCED Level 6> ---
- <Master's or equivalent level—ISCED Level 7> ---
- <Doctor or equivalent level—ISCED Level 8> ---

G5

A. During your <post-secondary> education, what was your major or main area(s) of study?

*Check **one** circle for each line.*

	Yes	No
a) Education—Primary/Elementary	◯	◯
b) Education—Secondary	◯	◯
c) Mathematics	◯	◯
d) Science	◯	◯
e) <language of test>	◯	◯
f) Other	◯	◯

B. If your major or main area of study was education, did you have a <specialization> in any of the following?

*Check **one** circle for each line.*

	Yes	No
a) Mathematics	◯	◯
b) Science	◯	◯
c) Language/reading	◯	◯
d) Other subject	◯	◯

G6

How would you characterize each of the following within your school?

*Check **one** circle for each line.*

	Very high	High	Medium	Low	Very low
a) Teachers' understanding of the school's curricular goals	○	○	○	○	○
b) Teachers' degree of success in implementing the school's curriculum	○	○	○	○	○
c) Teachers' expectations for student achievement	○	○	○	○	○
d) Teachers working together to improve student achievement	○	○	○	○	○
e) Teachers' ability to inspire students	○	○	○	○	○
f) Parental involvement in school activities	○	○	○	○	○
g) Parental commitment to ensure that students are ready to learn	○	○	○	○	○
h) Parental expectations for student achievement	○	○	○	○	○
i) Parental support for student achievement	○	○	○	○	○
j) Parental pressure for the school to maintain high academic standards	○	○	○	○	○

*Check **one** circle for each line.*

	Very high	High	Medium	Low	Very low
k) Students' desire to do well in school	○	○	○	○	○
l) Students' ability to reach school's academic goals	○	○	○	○	○
m) Students' respect for classmates who excel in school	○	○	○	○	○
n) Clarity of the school's educational objectives	○	○	○	○	○
o) Collaboration between school leadership and teachers to plan instruction	○	○	○	○	○
p) Amount of instructional support provided to teachers by school leadership	○	○	○	○	○
q) School leadership's support for teachers' professional development	○	○	○	○	○

G7

Thinking about your current school, indicate the extent to which you agree or disagree with each of the following statements.

*Check **one** circle for each line.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) This school is located in a safe neighborhood	○	○	○	○
b) I feel safe at this school	○	○	○	○
c) This school's security policies and practices are sufficient	○	○	○	○
d) The students behave in an orderly manner	○	○	○	○
e) The students are respectful of the teachers	○	○	○	○
f) The students respect school property	○	○	○	○
g) This school has clear rules about student conduct	○	○	○	○
h) This school's rules are enforced in a fair and consistent manner	○	○	○	○

G8

In your current school, how severe is each problem?

*Check **one** circle for each line.*

	Not a problem	Minor problem	Moderate problem	Serious problem
a) The school building needs significant repair	○	○	○	○
b) Teachers do not have adequate workspace (e.g., for preparation, collaboration, or meeting with students)	○	○	○	○
c) Teachers do not have adequate instructional materials and supplies	○	○	○	○
d) The school classrooms are not cleaned often enough	○	○	○	○
e) The school classrooms need maintenance work	○	○	○	○
f) Teachers do not have adequate technological resources	○	○	○	○
g) Teachers do not have adequate support for using technology	○	○	○	○

G9

How often do you have the following types of interactions with other teachers?

*Check **one** circle for each line.*

	Very often	Often	Sometimes	Never or almost never
a) Discuss how to teach a particular topic	○	○	○	○
b) Collaborate in planning and preparing instructional materials	○	○	○	○
c) Share what I have learned about my teaching experiences	○	○	○	○
d) Visit another classroom to learn more about teaching	○	○	○	○
e) Work together to try out new ideas	○	○	○	○
f) Work as a group on implementing the curriculum	○	○	○	○
g) Work with teachers from other grades to ensure continuity in learning	○	○	○	○

G10

How often do you feel the following way about being a teacher?

*Check **one** circle for each line.*

	Very often	Often	Sometimes	Never or almost never
a) I am content with my profession as a teacher	○	○	○	○
b) I am satisfied with being a teacher at this school	○	○	○	○
c) I find my work full of meaning and purpose	○	○	○	○
d) I am enthusiastic about my job	○	○	○	○
e) My work inspires me	○	○	○	○
f) I am proud of the work I do	○	○	○	○
g) I am going to continue teaching for as long as I can	○	○	○	○

G11

Indicate the extent to which you agree or disagree with each of the following statements.

*Check **one** circle for each line.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) There are too many students in the classes	○	○	○	○
b) I have too much material to cover in class	○	○	○	○
c) I have too many teaching hours	○	○	○	○
d) I need more time to prepare for class	○	○	○	○
e) I need more time to assist individual students	○	○	○	○
f) I feel too much pressure from parents	○	○	○	○
g) I have difficulty keeping up with all of the changes to the curriculum	○	○	○	○
h) I have too many administrative tasks	○	○	○	○

G12

A. How many students are in this class?

_____ students
Write in the number.

B. How many of the students in #G12A are in <fourth grade>?

_____ <fourth grade> students
Write in the number.

G13

How many <fourth grade> students experience difficulties understanding <u>spoken</u> <language of test>?

_____ students in this class
Write in the number.

G14

How often do you do the following in teaching this class?

*Check **one** circle for each line.*

	Every or almost every lesson	About half the lessons	Some lessons	Never
a) Relate the lesson to students' daily lives	○	○	○	○
b) Ask students to explain their answers	○	○	○	○
c) Bring interesting materials to class	○	○	○	○
d) Ask students to complete challenging exercises that require them to go beyond the instruction	○	○	○	○
e) Encourage classroom discussions among students	○	○	○	○
f) Link new content to students' prior knowledge	○	○	○	○
g) Ask students to decide their own problem solving procedures	○	○	○	○
h) Encourage students to express their ideas in class	○	○	○	○

G15

In your view, to what extent do the following limit how you teach this class?

*Check **one** circle for each line.*

	Not at all	Some	A lot
a) Students lacking prerequisite knowledge or skills	○	○	○
b) Students suffering from lack of basic nutrition	○	○	○
c) Students suffering from not enough sleep	○	○	○
d) Disruptive students	○	○	○
e) Uninterested students	○	○	○
f) Students with physical disabilities	○	○	○
g) Students with mental, emotional, or psychological disabilities	○	○	○

M1

In a typical week, how much time do you spend teaching mathematics to the students in this class?

_____ minutes per week

Write in the number of minutes per week.
Please convert the number of hours into minutes.

M2

In teaching mathematics to this class, how would you characterize your confidence in doing the following?

*Check **one** circle for each line.*

	Very high	High	Medium	Low
a) Inspiring students to learn mathematics	○	○	○	○
b) Showing students a variety of problem solving strategies	○	○	○	○
c) Providing challenging tasks for the highest achieving students	○	○	○	○
d) Adapting my teaching to engage students' interest	○	○	○	○
e) Helping students appreciate the value of learning mathematics	○	○	○	○
f) Assessing student comprehension of mathematics	○	○	○	○
g) Improving the understanding of struggling students	○	○	○	○
h) Making mathematics relevant to students	○	○	○	○
i) Developing students' higher-order thinking skills	○	○	○	○

M3

In teaching mathematics to this class, how often do you ask students to do the following?

*Check **one** circle for each line.*

	Every or almost every lesson	About half the lessons	Some lessons	Never
a) Listen to me explain new mathematics content	○	○	○	○
b) Listen to me explain how to solve problems	○	○	○	○
c) Memorize rules, procedures, and facts	○	○	○	○
d) Work problems (individually or with peers) with my guidance	○	○	○	○
e) Work problems together in the whole class with direct guidance from me	○	○	○	○
f) Work problems (individually or with peers) while I am occupied by other tasks	○	○	○	○
g) Take a written test or quiz	○	○	○	○
h) Work in mixed ability groups	○	○	○	○
i) Work in same ability groups	○	○	○	○

M4

Are the students in this class permitted to use calculators during mathematics lessons?

*Check **one** circle only.*

- Yes, with unrestricted use ◯
- Yes, with restricted use ◯
- No, calculators are not permitted ◯

M5

A. Do the students in this class have computers (including tablets) available to use during their mathematics lessons?

*Check **one** circle only.*

- Yes ◯
- No ◯ → **(If No, go to #M6)**

If Yes,

B. What access do the students have to computers?

*Check **one** circle for each line.*

	Yes	No
a) Each student has a computer	◯	◯
b) The class has computers that students can share	◯	◯
c) The school has computers that the class can use sometimes	◯	◯

C. How often do you have the students do the following activities on computers during mathematics lessons?

*Check **one** circle for each line.*

	Every or almost every day	Once or twice a week	Once or twice a month	Never or almost never
a) Explore mathematics principles and concepts	◯	◯	◯	◯
b) Practice skills and procedures	◯	◯	◯	◯
c) Look up ideas and information	◯	◯	◯	◯

M6

The following list includes the main topics addressed by the TIMSS mathematics test. Choose the response that best describes when the students in this class have been taught each topic. If a topic was in the curriculum before the <fourth grade>, please choose "Mostly taught before this year." If a topic was taught half this year but not yet completed, please choose "Mostly taught this year." If a topic is not in the curriculum, please choose "Not yet taught or just introduced."

*Check **one** circle for each line.*

	Mostly taught before this year	Mostly taught this year	Not yet taught or just introduced
A. Number			
a) Concepts of whole numbers, including place value and ordering	○	○	○
b) Adding, subtracting, multiplying, and/or dividing with whole numbers	○	○	○
c) Concepts of multiples and factors; odd and even numbers	○	○	○
d) Concepts of fractions (fractions as parts of a whole or of a collection, or as a location on a number line)	○	○	○
e) Adding and subtracting with fractions, comparing and ordering fractions	○	○	○
f) Concepts of decimals, including place value and ordering, adding and subtracting with decimals	○	○	○
g) Number sentences (finding the missing number, modeling simple situations with number sentences)	○	○	○
h) Number patterns (extending number patterns and finding missing terms)	○	○	○
B. Geometric Shapes and Measures			
a) Lines: measuring, estimating length of; parallel and perpendicular lines	○	○	○
b) Comparing and drawing angles	○	○	○
c) Using informal coordinate systems to locate points in a plane (e.g., in square B4)	○	○	○
d) Elementary properties of common geometric shapes	○	○	○
e) Reflections and rotations	○	○	○
f) Relationships between two-dimensional and three-dimensional shapes	○	○	○
g) Finding and estimating areas, perimeters, and volumes	○	○	○
C. Data Display			
a) Reading and representing data from tables, pictographs, bar graphs, or pie charts	○	○	○
b) Drawing conclusions from data displays	○	○	○

Mathematics Homework for the TIMSS Class

M7

A. How often do you usually assign mathematics homework to the students in this class?

*Check **one** circle only.*

- I do not assign mathematics homework --- ◯ → **(Go to #M8)**
- Less than once a week --- ◯
- 1 or 2 times a week --- ◯
- 3 or 4 times a week --- ◯
- Every day --- ◯

B. When you assign mathematics homework to the students in this class, about how many minutes do you usually assign? (Consider the time it would take an average student in your class.)

*Check **one** circle only.*

- 15 minutes or less --- ◯
- 16–30 minutes --- ◯
- 31–60 minutes --- ◯
- More than 60 minutes --- ◯

C. How often do you do the following with the mathematics homework assignments for this class?

*Check **one** circle for each line.*

	Always or almost always	Sometimes	Never or almost never
a) Correct assignments and give feedback to students	◯	◯	◯
b) Discuss the homework in class	◯	◯	◯
c) Monitor whether or not the homework was completed	◯	◯	◯

Mathematics Assessment of the TIMSS Class

M8

How much emphasis do you place on the following sources to monitor students' progress in mathematics?

*Check **one** circle for each line.*

	Major emphasis	Some emphasis	Little or no emphasis
a) Assessment of students' ongoing work	◯	◯	◯
b) Classroom tests (for example, teacher-made or textbook tests)	◯	◯	◯
c) National or regional achievement tests	◯	◯	◯

M9

In the past two years, have you participated in professional development in any of the following?

*Check **one** circle for each line.*

	Yes	No
a) Mathematics content	◯	◯
b) Mathematics pedagogy/instruction	◯	◯
c) Mathematics curriculum	◯	◯
d) Integrating information technology into mathematics	◯	◯
e) Improving students' critical thinking or problem solving skills	◯	◯
f) Mathematics assessment	◯	◯
g) Addressing individual students' needs	◯	◯

M10

In the past two years, how many hours in total have you spent in formal <in-service/professional development> (e.g., workshops, seminars, etc.) for mathematics?

*Check **one** circle only.*

- None ◯
- Less than 6 hours ◯
- 6–15 hours ◯
- 16–35 hours ◯
- More than 35 hours ◯

M11

How well prepared do you feel you are to teach the following mathematics topics?
If a topic is not in the <fourth grade> curriculum or you are not responsible for teaching this topic, please choose "Not applicable."

*Check **one** circle for each line.*

	Not applicable	Very well prepared	Somewhat prepared	Not well prepared
A. Number				
a) Concepts of whole numbers, including place value and ordering	○	○	○	○
b) Adding, subtracting, multiplying, and/or dividing with whole numbers	○	○	○	○
c) Concepts of multiples and factors; odd and even numbers	○	○	○	○
d) Concepts of fractions (fractions as parts of a whole or of a collection, or as a location on a number line)	○	○	○	○
e) Adding and subtracting with fractions, comparing and ordering fractions	○	○	○	○
f) Concepts of decimals, including place value and ordering, adding and subtracting with decimals	○	○	○	○
g) Number sentences (finding the missing number, modeling simple situations with number sentences)	○	○	○	○
h) Number patterns (extending number patterns and finding missing terms)	○	○	○	○
B. Geometric Shapes and Measures				
a) Lines: measuring, estimating length of; parallel and perpendicular lines	○	○	○	○
b) Comparing and drawing angles	○	○	○	○
c) Using informal coordinate systems to locate points in a plane (e.g., in square B4)	○	○	○	○
d) Elementary properties of common geometric shapes	○	○	○	○
e) Reflections and rotations	○	○	○	○
f) Relationships between two-dimensional and three-dimensional shapes	○	○	○	○
g) Finding and estimating areas, perimeters, and volumes	○	○	○	○
C. Data Display				
a) Reading and representing data from tables, pictographs, bar graphs, or pie charts	○	○	○	○
b) Drawing conclusions from data displays	○	○	○	○

Thank You

Thank you for the thought, time, and effort you have put into completing this questionnaire.

TIMSS 2015

BOSTON COLLEGE

TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY

Teacher Questionnaire Mathematics

<Grade 4>

International Association for the Evaluation of Educational Achievement

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