IN-SERVICE TRAINING AND SCIENCE TEACHERS' PERFORMANCE IN SELECTED GOVERNMENT AIDED SECONDARY SCHOOLS IN MUKONO DISTRICT

MAYEMBA ROBERT
15/U/14497/GMED/PE

A RESEARCH DISSERTATION SUBMITTED TO GRADUATE SCHOOL IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THEDEGREE OF MASTERS OF EDUCATION IN POLICY, PLANNING AND MANAGEMENTOF KYAMBOGO UNIVERSITY

OCTOBER, 2020

DECLARATION

I, Mayemba Robert, declare that this dissertation titled "***In-Service Training and Science Teachers' Performance in Selected Government Aided Secondary Schools in Mukono District***" is my original work and has never been submitted to any university or institution for award of a degree or any other award.

Signature: ..... Date: 29th/09/2020

MAYEMBA ROBERT

15/U/14497/GMED/PE

APPROVAL

This is to certify that this dissertation titled *"**In-service Training and science teachers' performance in selected government aided secondary schools**"* carried out by Mayemba Robert, was done under our supervision and has been submitted with our approval in partial fulfillment of the requirements for the award of degree of Masters of Education in Policy, Planning and Management of Kyambogo University.

Signature: ..... Date: 29/9/2020

DR. JOHN S. MAANI

SUPERVISOR

Signature: ..... Date: 29th/09/2020

DR. LYDIA NAMATENDE-SAKWA

SUPERVISOR

DEDICATION

I dedicate this work to my dear wife, children, my beloved mummy and daddy who have encouraged, prayed and facilitated me at all times. May God bless and reward them abundantly.

ACKNOWLEDGEMENTS

I wish to extend my sincere appreciation to everyone who facilitated the completion of my dissertation without whom this work would not be in its present form. I acknowledge the Almighty God whose endless provision endowed me with wisdom, strength and knowledge that enabled me complete my studies.

I thank my supervisors, Dr. John S. Maani, Dr. Lawrence Kasule and Dr.Lydia Namatende-Sakwa for their guidance. This study would not have been successfully carried out without their invaluable support in terms of professional guidance, advice, encouragement and time accorded to me.

Special thanks go to staff of Educational Planning and Management in the Faculty of Education, for providing an enabling environment that made me attain this Master's Degree. I am indebted to the Graduate School of Kyambogo University for the work done in transforming and imparting the required knowledge and skills to facilitate my progress.

I am grateful to my friends especially Kapere Philip, Aisha Kyagaba, Agwaro Jenifer, Iga Charles and others for always sparing their time whenever I needed their guidance. I am also grateful to all the categories of respondents who provided data and information.

I whole-heartedly appreciate my beloved wife for the support, patience and encouragement during the pursuit of my studies. I am indeed grateful. My gratitude goes to my sons Emmanuel, Eddy, Enock, Erick, Elijah and my daughter Esther. May God bless you.

I further appreciate the efforts of earlier researchers, scholars, authors, who provided a foundation for my study. Finally, I appreciate the services of the secretaries at P.K Computer Centre for their tireless efforts in typesetting this report with due care.

GOD BLESS YOU ALL

TABLE OF CONTENTS

COVER PAGE i
DECLARATION ii
APPROVAL iii
DEDICATION iv
ACKNOWLEDGEMENTS v
LIST OF TABLES ix
LIST OF FIGURE x
ABBREVIATIONS/ACRONYMS xi
ABSTRACT xii

CHAPTER ONE 1
INTRODUCTION 1
1.0 Background 1
1.1.1.Historical Perspective 1
1.2. Statement of the Problem 10
1. 3. Purpose of the Study 12
1. 5. Research Questions 12
1.7. Scope of the Study 13
1. 8. Significance of the Study 13
1.9. Conceptual Framework 15

CHAPTER TWO 17
LITERATURE REVIEW 17
2. 0. Introduction 17
2. 1. Review of Related Literature 17
2. 1. 1. In-service Training and Teachers' Planning and Preparation 17
2. 1. 2. In-Service Training and Science Teaching Methods 21
2. 1. 3 In-service Training and Assessment of Learners in Sciences 26
2. 2. Summary 32

CHAPTER THREE **33**
METHODOLOGY **33**
3. 0. Introduction 33
3. 1. Research Design 33
3. 2. Population and Sampling Techniques 33
3. 3. Data Collection 35
3. 5. Data Analysis 38
3. 6. Validity and Reliability 38
3. 7. Study Limitations and Delimitations 40
3. 7. 1. Limitations 40

CHAPTER FOUR **42**
DATA PRESENTATION, ANALYSIS AND INTERPRETATION OF RESULTS **42**
4. 0. Introduction 42
4. 1. Response Rate 42
4. 2. Demographic Information 43
4. 4. In-service Training and Science/Mathematics Teachers' Teaching Methodologies 56
4. 5. In-Service Training and Science/Mathematics Teachers' Assessment of Learners 64

CHAPTER FIVE **72**
DISCUSSION, CONCLUSION AND RECOMMENDATIONS **72**
5. 0. Introduction 72
5. 1. Discussion of the Key Findings 72
5. 1. 1. In-service Training and Science/Mathematics Teachers' Preparation and Planning 72
5. 1. 2. In-service Training and Science/Mathematics Teachers' Teaching Methodologies 75
5. 2. Conclusions 81
5. 3. Recommendations 83
5. 4. Areas for Further Research 85
REFERENCES 86

Appendix A: Questionnaire For Science Teachers 97

Appendix B: Focus Group Discussion With Sessemat Staff 101
Appendix C: Interview Guide For Headteachers, Deputies, Dos And Deo 102
Appendix D: Observation Guide 103
Appendix F: Format Of A Lesson Plan And Unit Plan For Sesemat-Trainers 105
Appendix G: Bloom's Taxonomy 106
Appendix H: Introductory Letter 107

LIST OF TABLES

Table 3. 1: Sample Size Description 34

Table 4.1: Rate Responses 42

Table 4. 2: Experience of Trainers 47

Table 4. 3: Teachers' attitudes towards teaching of mathematics and sciences in secondary 48

Table 4.4: Descriptive Statistics on In-service training and science/mathematics teachers' planning and preparations 50

Table 4.5: Correlation between in-service training and science/mathematics teachers' planning and preparation 55

Table 4.6: Descriptive Statistics on In-service Training and Science/Mathematics Teachers' Teaching Methodologies 57

Table 4.7: Descriptive statistics on In-Service Training and Science/Mathematics Teachers' Assessment of Learners 65

LIST OF FIGURE

Figure 1: Conceptual Framework 15

Figure 4. 1: Gender Distribution 43

Figure 4. 2: Age bracket of the respondents 44

Figure 4. 3: Education level of the respondents 45

Figure 4. 4: Management Level in the Secondary Schools 46

Figure 4. 5: A pie chart showing the length of service in Mukono District 47

ABBREVIATIONS/ACRONYMS

ADB	:	African Development Bank
ALEI	:	Activity, Learner-Centered, Encouragement and Improvement.
ASEI	:	Activity-Student-Experiment-Improvisation
B.Ed	:	Bachelor of Education
BST	:	Basic Science and Technology
CAG	:	Comptroller and Auditor General
CEMASTEA	:	Centre for Mathematics, Science and Technology Education in Africa
CVI	:	Content Validity Index
DEO	:	District Education Officer
DES	:	Directorate of Education Standards
DfE	:	Department for Education
EFA	:	Education for All
HCT	:	Human Capital Theory
ICT	:	Information Communication Technology
IJESS	:	International Journal of Education and Social Sciences
INSET	:	In-service Education and Training
KyU	:	Kyambogo University
MoES	:	Ministry of Education and Sports
NCDC	:	National Curriculum Development Centre,
NCHE	:	National Council for Higher Education,
NTCs	:	National Teachers Colleges
ODeL	:	Open, Distance and e-Learning
PDSI	:	Plan-Do-See-Improve
PIEI	:	Planning, Implementation, Evaluation and Improvement
SACMEQ	:	Southern and Eastern Africa Consortium for Monitoring Educational Quality
SESEMAT	:	Secondary Science and Mathematics Teachers programme
SMASE	:	Strengthening Mathematics and Science Education
SMT	:	Science and Mathematics Teachers
SPSS	:	Statistical package for Social Scientists
TLR	:	Teaching and Learning Resources
TTA	:	Teacher Training Agency
UK	:	United Kingdom
UNEB	:	Uganda National Examinations Board,
UNESCO	:	United Nations Educational, Scientific and Cultural Organization

ABSTRACT

The purpose of the study was to establish the relationship between in-service training and science teachers' performance in selected government-aided secondary schools of Mukono district. The researcher employed a descriptive cross-sectional design covering both qualitative and quantitative research approaches to elicit data. Both simple random sampling technique and purposive technique were used to select respondents that included one DEO, headteachers, deputy headteachers, directors of studies, SESEMAT trainers and teachers (n= 86). The data collection tools used included interviews, focus group discussion, observation guide and questionnaires. The study established that: There is a positive relationship between in-service training and science teachers planning and preparations (Pearson (r)= .246**) sig value P(value) being 0.01>.000. The result showed that the calculated r-value (.246) is greater than t-critical value (0.05) at $p<0.05$ is significant. Hence, the alternate hypothesis (Ha) was accepted while the null hypothesis (Ho) was rejected. Findings indicated that there was a significant relationship between in-service training and science teachers' teaching methodologies (Pearson (r)= .276**) sig value P(value) $P < 0.05$=000. The result showed that the calculated r-value (.276) is greater than t-critical value (0.05) at $p<0.05$ is significant. Hence, the alternate hypothesis (Ha) was accepted while the null hypothesis (Ho) is rejected. Finally, the result showed that the calculated r-value (.476) is greater than t-critical value (0.05) at $p<0.05$ is significant. Hence, the null hypothesis (Ho) is rejected while alternate hypothesis (Ha) is accepted. This implied that there is a significant relationship between in-service training and science teachers' assessment of learners in secondary schools of Mukono District. The study concluded that; SESEMAT did not conduct successful training of Science Mathematics Teachers(SMT) to build capacity for adequate planning and preparation. Additionally, gaps in planning and preparation remained evident within the practices among SMT. SMT used more of teacher-centered methods of teaching science and mathematics rather than the student-centered methods as INSET did not equip them adequately to use more progressive/modern methods. INSET did not adequately equip teachers in terms of adopting proper assessment, specifically diagnostic techniques to help them understand their students' learning needs. The study recommends that; Science teachers are advised to use the format of modern lesson planning to write their lesson notes in order to teach science and mathematics concepts by adopting and adhering key principles taught to them during INSET. SESEMAT trainers should advocate against memorization of concepts and knowledge, urging science teachers to instill in students' critical minds through questioning and discussion. SMT's must make use of continuous assessment, coupled with diverse methods of assessing skills and application of knowledge to encourage deep learning and as such understanding. Further research should be conducted to explore is the appropriateness of the science teachers SESEMAT Training Curriculum.

CHAPTER ONE
INTRODUCTION

1.0 Background

In-service training is concerned with the activities and courses in which a serving teacher participates for the purpose of upgrading professional skills, knowledge and interest, subsequent to initial teacher training (Osamwonyi, 2016). This study particularly focused on science teachers' in-service training, which informs their performance. Science teachers' performance as operationalized in this study is the way in which science teachers in a school perform the duties assigned and/or expected of him/her in order to realize the science goals and objectives (Abdulkadir, 2015). Science teachers are part of human resource managed by schools on behalf of the Ministry of Education and Sports in Uganda. Hence in this study situated in Educational Policy Planning and Management, science teachers' performance is a core, coherent and strategic aspect in realization of education quality and standards. In bid to achieve best science teachers' performance, in-service training was instituted, implemented and monitored as part of the continuous professional development required by educational and science policies.

This chapter presents the historical, conceptual, contextual and theoretical background of the study. It also highlights the statement of the problem, purpose, objectives, research questions, scope, significance and limitations of the study.

1.1.1. Historical Perspective

The importance of in-service education and training (INSET) was recognized in the UK back in late 1960s (Altun, 2011). The British Broadcasting Corporation (BBC) first documented an in-service education project for teachers in 1972. This was later followed by the establishment of the Open University in 1974, which provided opportunities for teacher training through regular television and online educational broadcasts, enriching teachers' professional development (Udofia& Ikpe, 2014). INSET-providing bodies in the UK included (1) Central government (Department for Education- DfE) and the Teacher Training Agency (TTA); (2) local education agency; (3) school governing bodies; (4) head-teachers; and (5) the individual teachers concerned. Her Majesty's inspectorate also provided INSET with the aim of bringing teachers

together, in order to discuss teaching and learning strategies, techniques and new approaches to education. Until the formation of the TTA, the government's strategy to influencing the competences of serving teachers was centrally planned, but largely workplace-centered and curriculum-led (Zhang, Parker, Koehler & Eberhardt, 2015).

In several African countries, in-service training for science teachers was introduced at the start of the 2000sto Strengthen Mathematics and Science Education (SMASE). SMASE focused on providing meaningful teaching activities mainly experimental/practical work and improvising resources (Adama, 2012).SMASE established a system for training of district trainers in mathematics and sciences at the national levels, which extended to in-service training centers and district in-service centers as resource centers. Approximately 20,000 teachers have been trained for around 1,000,000 student beneficiaries. SMASE has been extended to Kenya, Uganda, Malawi, Nigeria, Zambia, Senegal, Niger, Rwanda, among other nations (Junaid & Maka, 2015).

In East Africa, Japan has played a significant role in promoting in-service initiatives by strengthening mathematics and science education to enhance learners' ability through improved teachers' content mastery and pedagogical skills (Nyakwama & Mbati, 2014). In addition, Japan has positively enhanced both teachers and learners' attitudes towards sciences through secondary science and mathematics teachers project (SESEMAT-Uganda).

In Uganda, SESEMAT programme was introduced in 2005 with the purpose of improving the teaching ability of science and mathematics teachers as well as learners' performance at secondary level (Agwot, 2014). SESEMAT is under the Ministry of Education and Sports with technical support from Japan International Cooperation Agency (JICA). The goal of SESEMAT is to improve teaching ability of teachers of mathematics and science. Science teachers' teaching ability is to be achieved by promoting better teaching and learning methods (pedagogical improvements), creating an active, motivating and supportive teaching/learning environment and ensuring sustainable professional growth among teachers.

In-service Teacher/Instructor/Tutor Education Policy (2008) acknowledges that in-service training for teachers provides the most important avenue through which teachers,

instructors/tutors in the field can be exposed to rapid change in technology and science as well as innovation in curricular and teaching methods. The science policy recognizes that Secondary Science and Mathematics Teachers Programme (SESEMAT) is an initiative under the Ministry of Education and Sports (MoES) to enhance the teaching of science and mathematics in secondary schools, National Teachers Colleges, Primary Teachers Colleges and primary schools. The SESEMAT programme aims at improving students' performance in science and mathematics through In-Service Education and Training (INSET). The science policy further provides the specific objectives for SESEMAT, including: to promote a pedagogical paradigm shift through INSET, to create an enabling classroom environment for classroom teachers and to institutionalize a sustainable INSET system (MoES, 2010).

Both in-service and pre-service trainings are conducted to enhance capacity and skills for science and mathematics teachers. Tutors are trained by Kyambogo University (KyU) and are now required to have a Bachelor's degree in Education. The Open, Distance and e-Learning (ODeL) Center is a Center mandated to manage and administer the Bachelor of Education Degree program through a blended distance mode, which currently includes the use of print materials and quality assurance through on-line media. Secondary school teachers are trained at National Teachers Colleges (NTCs) for two years for a diploma in secondary education.

At University level, Bachelors of Education (B.Ed) and Bachelors of Teacher Education (BTE) takes two years while Bachelors science with Education (Bsc. with Educ), Bachelors of Vocational studies take three years. Though the MoES and KyU are responsible for the quality of education and competence for degrees and postgraduate degrees, majority of the science teachers have demonstrated inadequate performance in as far as teaching is concerned, necessitating the need for in-service training (M0Es, 2017).

Although SESEMAT was introduced in Uganda in 2005, this study was situated in Mukono district in Uganda, in which SESEMAT training was introduced in 2010. The study sought to establish the relationship between in-service training and science teachers' performance in selected government-aided secondary schools.

1.1. 2. Theoretical Perspective

The study was guided by the Human Capital Theory developed by Adam Smith (1776) and reinvigorated by Schultz (2016), in his book titled *Investment in Human Capital*. Schulz (2016) states that knowledge and skills are a form of capital, and investments in human capital lead to an increase in both economic output and workers' earnings. Although Schultz advocates for investment in health, internal migration, and on-the-job training, his main focus is on improving education in order to increase productivity and consequently opportunities available to individuals in order to better their economic situations.

In taking up the theory of Human capital, this study recognizes that in-service training is a form of investment in science and mathematics teachers to facilitate performance improvement (Fantom, 2009). In-service training adds both knowledge and skill as a form of capital to stimulate productivity. The concept of human capital theory recognizes that not all teachers are equal and that the quality of science teachers can be improved by investing in them through in-service training (Netcoh, 2016). This helps to recast their educational experiences, expertise, skills and abilities that have educational value to students learning sciences. Human capital theory would as such advocate for investment in education to improve the level of performance of science teachers as well as education quality and standards (Olaniyan & Okemakinde, 2008). This investment would therefore inform the enhancement of science teachers' planning and preparation for teaching, their teaching methodology and assessment of learners, thereby raising the efficiency of science teachers by helping them develop useful knowledge and practical skills. As informed by Human Capital Theory then, spending on on-job training like in-service training in the case of this study is costly and should be considered as an investment (Petrushenko, 2017). Human Capital Theory is therefore applicable to this study because it influences in-service training decisions undertaken in educational policy planning and management (Gallies, 2015). Encouraging science teachers to attend in-service training provides an opportunity to enhance their abilities, heightening their level of performance. This theory postulates development of

skills as an important factor in instituting new teaching methodologies, enhancing practical skills and promoting hands on service delivery that builds content mastery and adequate knowledge transfer (Netcoh, 2016).

Informed by Schultz's Human Capital Theory therefore, this study affirms that by instituting staff development programs such as in-service training, individual science teachers can enhance job performance to achieve the required educational quality and standards (Mulongo, 2012; Ombati, 2014). This study therefore investigated the effect of in-service training on science teachers' performance in selected government aided secondary schools in Mukono district, which is located in the central region in Uganda, where in-service for science teachers has been undertaken since 2005.

1.1. 3. Conceptual Perspective

In-service training is accepted as an effective method of improving the knowledge, skills and beliefs of teachers. It is a process used to continue teachers' education once they have received their certification in teaching and are employed unprofessional positions (Khatoon, Tayyab, Maqsud & Mushtaq, 2014).The Education Information Network in the European Union (Eurydice) defines in-service training as a variety of activities and practices in which teachers become involved in order to broaden their knowledge, improve their skills, assess and develop their professional approaches. In-service training is the term used to describe a set of activities and requirements generally falling under professional development (Altun, 2011).

Operationally, an in-service program is a professional training or a staff development effort, where teaching skills are enhanced through hands on experiments, methods including discussion of their work with others in their peer group. It is a key component of continuing science and mathematics education. Similarly, in-service for science teachers broadly refers to any learning opportunity for practicing teachers. It is designed for science and mathematics teachers who are registered and certified by Ministry of Education and Sports and are already teaching in a classroom, in contrast to a pre-service teacher education, which is the process of preparing to become a fresh teacher. Under SESEMAT, in-service training simply entails providing relevant courses and activities in which serving science teachers participate to upgrade their professional

knowledge, skills, and competences in the teaching profession of science and mathematics (Alabi&Ige, 2014; Osamwonyi, 2016).

Suryawati*et.al* (2010) reveal that in-service training includes practical training such as short courses as well as formalized long-term programs aimed at upgrading skills and qualifications of the science teachers in order to increase their efficiency in job performance. In-service education of teachers refreshes techniques, activities and learning experiences, which are organized to increase their professional effectiveness (Khatoon, *et al.,* 2014). These may range from regular courses of study, workshops, lectures, refresher courses, orientation courses, conferences, interviews, supervision as well as individual study of the professional literature by teachers.

Adnyani (2015) noted that the focus of in-service training programs is on: skills empowerment which entails skill upgrading for higher qualifications; attitude development; knowledge content mastery; management; pedagogical, life skills and values. In-service training programs are usually offered during normal working hours. In-service training activities are designed to improve the knowledge and skills of science teachers. Indeed, as Maklad (2008) adds, in-service teacher training enhances the performance of science teachers, enriching them with new ideas, concepts and activities, and eventually leading to improvement of teacher personality as well as aspects of overall performance. It is therefore necessary for a science teacher to continually develop professionally, in order to keep up with advances in subject matter as well as in the theory and practice of teaching.

Performance is an act of accomplishing or executing a given task and the ability to combine skillfully the desired or expected behaviors towards the achievement of educational goals and objectives (Adu & Adeyemi, 2013). Poor performance of science teachers can be measured from low pass rate of students in science subjects, low enrollment of learners in advanced level, rampant late coming, frequent dodging of classes, failure to prepare schemes of work and lesson plans, as well as improper use of instructional materials.

Adejumobi and Ojikutu(2013) assert that teacher job performance is measured in terms of teacher's lesson presentation which ranges from introduction of lesson to mastery of the subject,

class participation, class control, assessment of learners' understanding as well as learners' performance. This means that the variables of science teachers' performance encompasses effective teaching, use of schemes of work, lesson notes preparation, supervision, monitoring of students' work and disciplinary ability. In this regard, science teachers' performance can be measured through annual reports of their activities in terms of performance in teaching, lesson preparation and planning, lesson presentation methodology, regular assessment and evaluation, mastery of subject matter, competence, teachers' commitment to job and level of involvement in outside classroom environment activities such as extra-curricular activities (Adu & Adeyemi, 2013). Therefore, teacher job performance is the teacher's ability to integrate the experience, teaching methods, instructional materials, knowledge and skills in delivering subject matter to students in and outside the classroom (Armstrong, Brown & Reilly, 2011).

Furthermore, Thafer (2014) reveals that performance of teachers comprises the use of different capabilities and competencies that influence results or outcomes of learners. Rotich (2014) further explains teacher performance as observable behaviors, both verbal and non-verbal. Rotich further reveals that for the attainment of a high level of efficiency, secondary school science teachers are expected to participate regularly in professional development activities. These activities are intended to help teachers learn new teaching methods, broaden their subject matter content knowledge and remain informed about changing policies, among other purposes.

Faislat and Ojikutu, (2013) identified several features of professional development (in-service training) that have been correlated with change in teacher knowledge and instructional practices. These features include (a) a focus on teachers' subject matter content or the teaching methods (b) duration in terms of the number of hours of training and the number of weeks or months over which training is provided, and (c) an activity format that is integrated into the daily work of teachers rather than removed from the context of direct public school teaching. Those in-service training activities mentioned above are expected to increase teachers' efficiency. Indeed, as Akiri and Ugborugbo (2008) assert, the quality of education depends on the teachers, necessitating in-service training in order to equip them in ways that optimize their performance in the sciences.

Both in-service training and science teachers' performance are part and parcel of Human Resources Management (HRM). HRM in education is a managerial attempt to influence employees' ability, commitment, motivation and opportunities to perform to their best (Runhaar, 2016). It is, however, only recently that HRM has been acknowledged as key in raising schools' performance (Vekeman et al., 2014). More specifically, by increasing teachers' competence and commitment, HRM holds the potential of increasing teacher performance and, consequently, of yielding higher student outcomes (DeArmond et al., 2009). There is a continuous stream of new psychological insights concerning pedagogy and learning that infuses schools (OECD, 2009, 2014). Teachers are the ones who have to be willing to continuously professionalize themselves by incorporating these new insights into their daily practices, and HRM can be seen as a way for schools to offer their teachers opportunities for continuous in-service programs. This study conceptualizes how exactly science teacher performance might profit from in-service as an education policy planning and management.

1.1. 4. Contextual Perspective

This study was conducted in Uganda, one of the developing countries in Africa with a population of 42,729,036 people (World Population Prospects, 2019). The education system comprises pre-primary (3-6 years); primary (P. 1-P. 7); lower secondary (S. 1-S. 4); upper secondary (S.5-S.6). This then leads to tertiary and/or higher education at tertiary institutions and universities. The education curriculum at all levels comprises both Arts as well as Science disciplines—of which the latter is the focus of this study.

Science teachers' job performance in Uganda has been rated below the expected standard. The quality of teaching methodology, teaching materials such as audio-visual aids as well as the application of effective assessment techniques have declined among in-service trained science teachers in secondary schools. This is evidenced through poor performance in science subjects (Ministry of Education & Sports, 2017) as well as limited pedagogical, supervisory and assessment skills (Agwot & Osuu, 2014). In fact, 60% of the candidates were unable to demonstrate the minimum competency required to be graded due to declined performance in the mathematics, biology, physics and chemistry (UNEB, 2015).

mindset of the learners have continuously curtailed the science teachers' performance in teaching sciences in Uganda (Olong, 2017).

This situation been compounded by the exam-oriented nature of Uganda's school curriculum, which focuses on testing a candidate's ability to comprehend, rather than apply knowledge to novel situations; demonstrate logical reasoning skills; perform scientific experiments; interpret results and draw conclusions. Uganda National Examination Board (UNEB) results and reports evidence that in many examination centers, candidates showed misunderstanding of questions, leading to wrong answers, failure to handle questions requiring explanation, interpretation or original answers (Nangonzi, 2019). The poor exam scores and high repetition in physics, biology, chemistry, and mathematics, recur in spite of the government's intervention of SESMAT.

Uganda's education system, developed from colonialists and driven by examination curriculum, does not address Uganda's educational challenges. Additionally, the lack of continuous monitoring and supervision of science teachers by the Directorate of Education Standards Agency, NCDC and MoES is another contributory factor to science teachers' diminished effectiveness in discharge of their duties and responsibilities. The Government of Uganda (GoU) together with development partners like JICA is initiating interventions such as SESEMAT to improve the teaching of sciences among other interventions. It remains unclear whether these initiatives are creating the intended impact, more specifically whether SESEMAT has improved the teaching of sciences at secondary school level.

This study is therefore an intervention that seeks to investigate the relationship between in-service training by SESMAT and science teachers' performance in selected government aided secondary schools of Mukono district.

1.2. Statement of the Problem

In-service (INSET) training enables science teachers to acquire more knowledge and skills of teaching science and mathematics (Norlia *et a.,l* 2015). INSET enhances improved planning and preparation strategies, enriching assessment approaches for science and mathematics, which in

turn lead to new directions in teacher attitudes as well as performance (Osamwonyi, 2016). Teachers who professionally benefited from SESEMAT are expected to use science-related approaches of teaching, which basically require that a student formulates a problem, performs an experiment (or any other form of searching) and comes up with a solution/an answer. Such teachers should regularly assess learners to help determine learners' interests, achievements and hence recast teaching plans. Effective science teacher performance contributes to effective science policy implementation.

Despite SESEMAT in-services programs since 2005, science teachers' performance has continued to decline (SMASSE, 2014) as evidenced for instance, through poor student performance. Out of the 500 science teachers trained by SESEMAT in Mukono district for example, 73.3% performed poorly; only 10% can accurately prepare lesson plans; only 30% utilize appropriate teaching methodology while only 40% assess learners formatively (SESEMAT, 2018). Indeed, since the introduction of the science policy in 2004, performance in science subjects has continued to drop and few students are now pursuing the sciences at advanced levels (Ahimbisibwe, 2017). Muyingo(2017) reveals that the percentage of students failing mathematics and sciences is unacceptably high and he attributes this to poor science teachers' performance. Measures such as equipping schools with laboratory equipment (apparatus and reagents) as well as increasing science teachers' salaries have failed to deliver results especially in mathematics, chemistry, biology and physics (Auma, 2014; Kiyaga, 2013). Several interventions such as the recruiting of 1,900 science teachers, providing science textbooks, intensifying in-service training for over 6,000 science teachers under SESEMAT have hardly improved the quality of teaching. Science teachers have continued to use poor methods of teaching, demonstrating low analytical and critical thinking skills, coupled with failure to integrate theory and practical learning, thereby retarding performance in science subjects (Auma, 2014; Kiyaga, 2013). If performance of science teachers continues to decline, ultimately unemployment in Uganda will escalate because it will lead to shortage of science-related skills needed in many sectors of life such as construction industry, health, and agriculture among others.

This study is an intervention aimed at establishing the relationship between SESEMAT INSET and science/mathematics teachers' performance in order to inform more effective implementation of in-service programs.

1. 3. Purpose of the Study

The study seeks to establish the effects of SESMAT in-service training program on science teachers' performance in selected secondary schools in Mukono district in Uganda, in order to finds ways of effectively developing teachers' human capital to optimize their performance.

1. 4. Objectives of the Study

The study was guided by the following specific objectives:

i) To examine the relationship between in-service training and science teachers planning and preparations in secondary schools of Mukono District.

ii) To establish the relationship between in-service training and science teachers' teaching methodologies in secondary schools of Mukono District.

iii) To assess the influence of in-service training on science teachers' assessment of learners in secondary schools of Mukono District.

1. 5. Research Questions

The following research questions guided the study:

i) What is the relationship between in-service training and science teachers planning and preparations in secondary schools of Mukono District?

ii) What is the relationship between in-service training and science teachers' teaching methodologies in secondary schools of Mukono District?

iii) How does in-service training influence science teachers' assessment of learners in secondary schools of Mukono District?

1.6. Hypothesis

H_a: There is a significant positive relationship between in-service training and science teachers planning and preparations in secondary schools of Mukono District

H_a: There is a statistically significant relationship between in-service training and science teachers' teaching methodologies in secondary schools of Mukono District

H_a: There is significant relationship between in-service training and science teachers' assessment of learners in secondary schools of Mukono District.

1.7. Scope of the Study

1.7. 1. Content Scope

The study focused on examining the relationship between in-service training and performance of science teacher's in secondary schools of Mukono District in Uganda. The study assessed how in-service training affects planning and preparation, teaching methods as well as assessment among trained science teachers of biology, chemistry, physics and mathematics.

1.7. 2. Geographical Scope

The study focused on government-aided secondary schools in Mukono district, which lies in the central region of Uganda. The western border of Mukono district is 21km east of Kampala, which is the capital city of Uganda.

1.7.3. Time Scope

The study was undertaken for a period of 2 years, starting from 2017-2019.The main issues covered in the study lie in the period 2004 -2019. These include the science policy which made sciences compulsory and the SESEMAT intervention.

1. 8. Significance of the Study

The Ministry of Education and Sports can utilize the study findings to design mechanisms of working hand in hand with SESMAT to enforce adoption of a blended teaching approach/methodological approach in the teaching of science subjects not only in secondary schools but across all levels of education. This would aid in balancing teachers' personal strengths and interests with students' learning needs and curricular requirements to achieve inclusive approach of combining teaching clusters that tailor teachers' teaching to student needs and subject matter.

Head teachers and deputies can make use of the study results to ensure that they supervise curriculum implementation and syllabus coverage in order to ensure that science teachers cover content in accordance with the intended year of study. This would curb the practice of wasting time during the lower classes and over loading students in the upper classes.

Science Teachers can use the study results to enable them improve their teaching methodologies by incorporating remedial teaching for the poorly performed topics in the tests as well as re-teaching using better methodology in order to help learners understand the concepts better.

The Directorate of Education Standards can make use of the study recommendations to institute tight supervision and enforce monitoring of the teaching of sciences and SESEMAT in-service training programmes and suggest a review of the education sector strategic plan to incorporate teachers' capacity development.

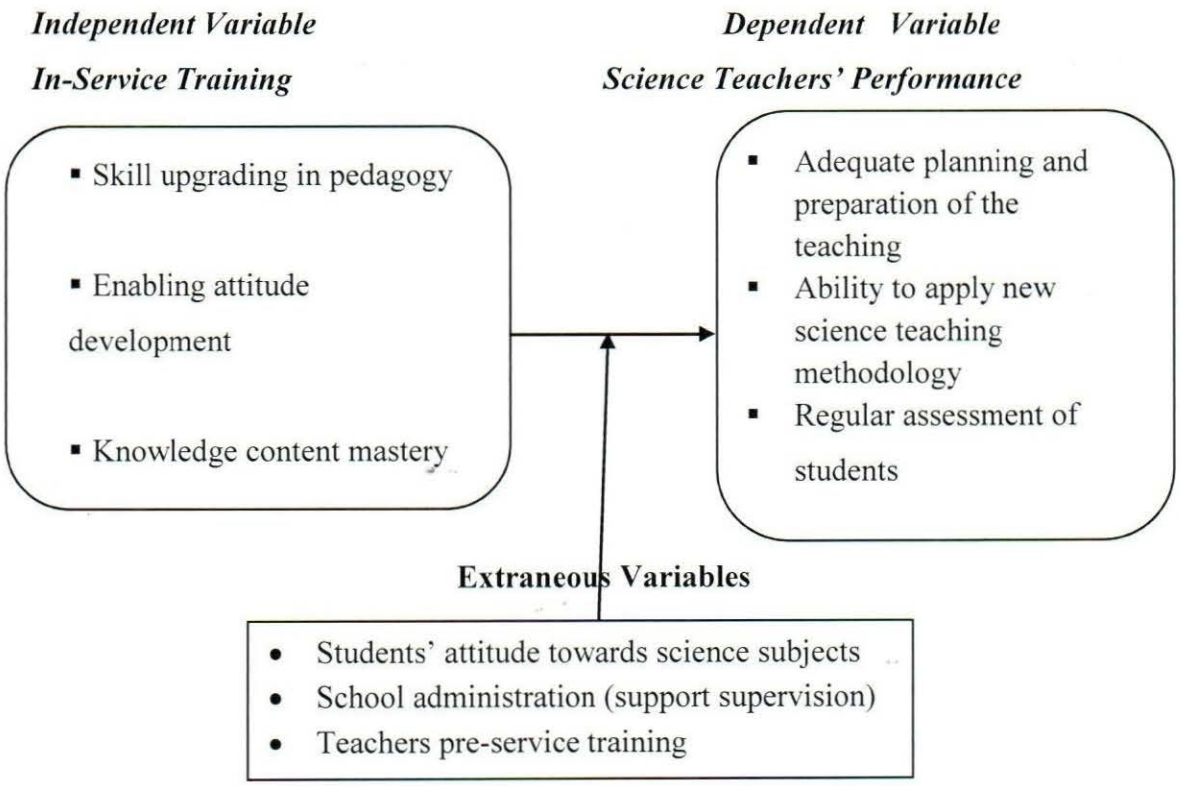
District Education Officers may make use of the study findings to administer the practice of formative assessment to grant head teachers consistent and regular monitoring of students on a day-to-day basis and modify science teaching based on learners need. This can accurately be implemented through organizing regular quiz, brainstorming, observation, and maintenance of attendance records, records of learner participation.

Using this study, parents can find insights to support schools by providing extra funding for administering regular tests possibly per topic taught. Frequent tests, exercises, assignments and homework help to assess science learning abilities and understanding of the content by learners.

Finally, SESEMAT trainers can take up recommendations to review and evaluate science teachers' training needs, aligning them with the ministry requirements and education standards requirements for quality.

1.9. Conceptual Framework

The figure below shows the study's conceptualization of the relationship between in-service science teachers' training and their performance



Source: *Adapted from* Agwot & *Osuu, (2014), Chikweru & Anaemeotu (2013), Chebet (2012)*

Figure 1: Conceptual framework illustrating the relationship between in-service training and science teachers' performance.

The conceptual framework (fig.1), illustrates that the dependent variable is science teachers' performance while the independent variable is in-service training. The dimensions of in-service training used in the study were: skills upgrading in pedagogy, enabling-positive attitude development as well as knowledge content mastery. This is supported Tayyab *et al.* (2014) who note that in-service training is an effective method of increasing science teachers' knowledge, skills and positive beliefs and attitudes to performance. The basic assumption is that they were

trained and are now serving (teaching). There is still a big room to enhance their performance through in-service training arrangement.

On the other hand, the performance of science teachers was measured by assessing their abilities to: use acceptable teaching preparation that inadequate teaching preparation (schemes, lesson plans and lesson notes), apply science teaching methodology covering demonstration of learner centeredness (hands on and minds on methods), use instructional management system (IMS), undertake regular assessment which entails exercises, homework, tests as well as examinations. This is in tandem with Adeyemi & Adu (2013) who demonstrated that science teachers' performance permits a teacher in school to perform the duties assigned to him/her or expected of him/her in order to realize the curriculum.

Figure 1 also shows that the extraneous variables which are other factors that affect both the dependent and independent variable are: students' attitude towards compulsory science subjects (bias that sciences are hard), school administration (enabling science teachers' identify needs, funding, experimental facilities, evaluation of training outcome) and teachers' pre-service training (quality of knowledge and skill developed in their initial training) which do influence in-service training as well as the performance of science teachers. The researcher used a descriptive cross sectional design to uphold extraneous variables constant (McLead, 2019).

In summary, this chapter has provided a background in regard to this study on in-service training and science/mathematics teachers' performance in secondary schools in Mukono district, which is located in Uganda. The next chapter focuses on a review of the relevant literature that informed the study.

CHAPTER TWO

LITERATURE REVIEW

2. 0. Introduction

This chapter presents a review of literature related to in-service teacher training. The review illuminated the gaps and informed the methods of this study. The review was informed by the research questions of the study, which focus on in-service planning and preparation, teaching methodologies and assessment.

2. 1. Review of Related Literature

2. 1. 1. In-service Training and Teachers' Planning and Preparation

The review of literature in this section provides a discussion in regard to planning and preparation. It focuses on planning documents such as syllabi, schemes of work and lesson plans, informing the current study, to establish to what extent the in-service teachers use these to plan their lessons.

Okai (2010) describes syllabi as brief outlines of lessons, or aspects of the curriculum that list topics to be taught in a given course or program. These outlines of syllabi guide teachers on the extent of work involved in given classes. A syllabus is part of the curriculum and not the curriculum itself (Musingafi, et al., 2015). Thus the curriculum and the national syllabus can be seen as broad and general statements of what is to be learned during the course study period. The scheme of work is derived from the syllabi and therefore more specific and detailed. Musingafi, et al. (2015) posit that the lesson plan is a further breaking down of work to be done. The lesson plan is derived from schemes of work and is also more detailed and specific than the scheme of work. Curricula, syllabi, schemes of work and lesson plans are policies and documents necessary for effective teaching to occur at any level of our educational system. While the authorities in national government offices usually prepare the curriculum and syllabus, the schemes of work and lesson plans are prepared by the teacher (Twoli, 2006).

Okai (2010) noted that a successful formal teaching and learning process requires proper selection and arrangement of the teaching items or materials. The selection and the sequencing of

learning content and methodologies thereof take place in the curriculum, syllabus, scheme of work and lesson plan stages. Nevertheless, the difference among them is not usually clear to a significant number of teachers. The failure to distinguish between curriculum and syllabus shows that they are inadequately prepared, trained, supervised and supported in their work (Thijs & Akker, 2009).

Kirisoi et al. (2008) assert that a scheme of work is a written, modifiable document that guides the overall direction of a teaching activity with each group of students and provides a context and resources for the development of detailed lesson plans. The scheme of work is aimed at serving the following purposes: guide to the teacher; organize the lesson; and keep records of what is taught and what ought to be taught (Okai, 2010). Oskai (2007) provides a structure comprising headings under which in-service teachers can make schemes of work: topic, Objectives, content and methods, Use of questioning strategies, explanations, use of resources, management of the class and assessment procedures. Additionally Schemes of work can be made to cover a week, a month, one term or even one year, and, must be prepared before classes begin. Teachers must understand the curriculum in order to achieve the stated objectives and arrange the content in logical teaching order, considering the proceeding and succeeding syllabus content (Walport, et. al., 2010; Wright & Trevor, 2005).

The unit plan can be described as the organized sequence of content and learning experience derived from an analysis of the scheme of work designed to be covered by the class within a period of a week (Okai, 2010). These studies guided the current study, which established whether in-service teachers had competences in regard to developing both schemes of work and lesson plans.

Lesson planning is an important activity for a teacher (Attaran, 2012). A lesson plan gives guidance to the teacher and helps him or her to be confident. If lessons are pre-planned well, both learning and teaching becomes simplified (Athanases, Abrams, Jack, Kwock & McCurdy, 2008). Muchwe, (2014) states that a lesson plan is the instructor's road map regarding what students need to learn and how it will be done effectively during the class time. Before a teacher plans for a lesson, he/she will first need to identify the learning objectives for the class meeting,

before designing appropriate learning activities and developing strategies to obtain feedback on student learning (CAG- Audit report, 2009).

Cicek, (2013) argues that planning and preparation is the first step in the teaching and the learning process. In essence, lesson planning is the teacher production of an evaluation document which demonstrates that they have a structure of the lesson that they are going to teach (Damavandi, 2012). A notion of a planning process refers to what a teacher does on a cognitive level while developing a lesson plan in the context of a course that they are actually teaching (Heidarinejad, Bahrami & Azmsha, 2011). It was important then, to use the current study to establish to what extent the in-service teachers actually develop meaningful lesson plans.

According to Okai (2010), a lesson plan is useful for the following reasons: the teacher follows correct steps and procedures in teaching; time is not wasted in the class since the period of one lesson must be used to cover the day's lesson topic; meaningful objectives are pursued in the lesson; activities are related to the content and objective instructional materials are adequately selected and utilized; proper evaluation procedures and tools are used; a substitute teacher can use the lesson plan to hold on the class; and the most important content is identified for learners (Thijs&Akker, 2009). The current study established whether the teachers' lesson plans reflect the reasons illuminated in the scholarship on lesson plans.

Mbati (2014) noted that each teacher guide provides advice on how to plan. They demonstrate how teachers can cover the whole curriculum content for each stage, providing guidance on long-term, medium-term and short-term planning. Resources include detailed guides on different planning approaches, and teacher training activities to develop planning skills further. This information is supplemented by sample schemes of work, sample lesson plans and planning templates that teachers can adapt and use (Milkova, 2016). It was also interesting to find out whether in-service teachers had additional resources to enhance the development of their lesson plans.

Heidarinejad, Bahrami and Azmsha, (2011) point out that INSET encourages science teachers to rethink the usefulness of lesson plans as critical tools for lesson delivery based on the general and specific objectives outlined in the sciences teaching syllabi. During planning science teachers take into consideration the learners' backgrounds such as learning difficulties, needs interests, misconceptions and previous experience in relation to the topic. INSET prominence is given to how instructional activities will enable learners to understand concepts, appreciate what they learn and apply what is learnt in real life contexts. Additionally, Nyanchoka (2015) explains that implementing the planned lesson activities must be focused on lesson delivery, the teaching and learning process. This includes lesson introduction where science teachers are guided on how to move from the traditional question and answer sessions in review of previous lessons to interactive and innovative options such as games, role play, story-telling and skits.
These studies informed the current study, which sought to establish how the in-service teachers planned their lessons, the criterion they used to develop the lessons, as well as the sequence followed in the lesson plan.

In-service training aids science teachers to learn best how conduct lesson development by drawing lesson plans with detailed activities, methodology and assessment methods as highlighted in the teaching syllabi. Ekpoh, Oswald and Victoria (2013) observe that the lesson is designed to have sufficient, varied and interesting learner activities to motivate and engage learners and facilitate meaningful experiences. The activities provide opportunities for learner growth in knowledge through discussions, reporting, asking and answering questions; and process skills through observing, drawing, manipulating as well helping the teacher deal with learners' questions and misconceptions. Teacher performance will be attained when teaching and learning objectives are achieved (Ball, Thames & Phelps, 2008).

In-service training enables science teachers to be equipped with knowledge to adequately select and utilize proper instructional materials. Inadequate provision of relevant instructional materials militates against effective teaching and learning of science and mathematics (Islami, Noruzi, Badiei, 2011). Osuu (2014) submits that despite Africans' wealth, her educational institutions still suffer from inadequate teaching aids. The author stresses that the present state of affairs where science and mathematics teaching is mainly a blackboard and chalk affair does not make

for proper understanding of the subjects. The use of appropriate teaching aids is essential for subject matter conceptualization and concretization in mathematics. SESEMAT has advocated for effective planning and preparation and the establishment of mathematics and science laboratories, libraries, for the effective teaching and learning of science and mathematics (Komakech & Osuu, 2014). This informed the current study which established the variety in teaching aids used to teach science subjects. However, based on the study findings, SESEMAT intervention in regard to advocating for laboratories as teaching materials did not exceed the traditional methods. In that teachers could not use locally available materials and laboratories could not adequately be stocked to enhance teacher performance.

Bloom's taxonomy has been taken up by studies to aid in developing clear and specific lesson-learning objectives (Bloom et al., 1956). The taxonomy provides verbs aligned with different levels of cognitive dimensions towards the formulation of SMART objectives. This informed the current study, which sought to establish whether the objectives within the plan and preparation phase were SMART. The study results indicated that the objectives of the lesson plans for the teaching of science were not specific, measurable, achievable, and realistic nor time bound.

On the whole planning and preparation entails an engagement with the curriculum and syllabi, which inform the scheme of work, and, subsequently the lesson plan. The documents comprise the resources, activities, sequencing and assessment plans of the lesson. The studies emphasized that planning and preparation are the most important dimensions of the teaching-learning process, as they greatly affect its effectiveness. The findings from the review of literature in this section informed the study's focus on how the in-service teachers enacted planning. The study results indicated that science teachers did not prepare schemes of work and lesson plans, which diversely affected their performance.

2. 1. 2. In-Service Training and Science Teaching Methods

The review of literature in this section offers a discussion on methods for teaching science, illuminating the possibilities that in-service teacher training can take up to improve performance.

M'kiambi (2013) reveals that teaching methods comprise principles and methods used for instruction. The choice of an appropriate teaching method depends largely on the information provided during in-service training or skill that is being taught. It may also be influenced by the aptitude and enthusiasm of the students. In addition, it is common in a class to have a variety of teaching methods in any particular/specific science subject. Teachers need to use different teaching methods in order to reach all students effectively. This should be part of the main objective of in-service training (M'kiambi, 2013).

Nuangchalerm (2011) notes that in-service training entails the use of direct instruction as a method of teaching sciences in secondary schools. This is the lecturing method of teaching. Many teachers use this teaching method almost exclusively, as it is considered the simplest and the teacher can cover large amounts of work in a short period of time. However, this is not an effective teaching method to reach all students especially the time takers (slow learners) at the lower secondary school levels. These young students often need a more engaging hands-on strategy in order to learn effectively (Udofia & Ikpe, 2012). Additionally, Atav and Altunoglu (2010) state that in-service training does not recommend use of lecture method in the teaching of science subjects. Evidence from a number of disciplines suggests that oral presentations to large groups of passive students contribute very little to real learning. In physics, standard lectures do not help most students to develop conceptual understanding of fundamental processes in electricity and in mechanics. Similarly, Ayier (2009) revealed that student grades in a large general chemistry lecture course do not correlate with the lecturing skills and experience of the instructor.

In-service training requires science teachers when using lecture methodology to keep students engaged by pausing periodically, assessing student understanding and/or initiating short student discussions. Calling on individual students to answer questions or offer comments can also hold student attention. However, some students prefer a feedback method with more anonymity. If they have an opportunity to discuss a question in small groups, the group can offer an answer, which removes any one student from the spotlight. Another option is to have students write their answer on an index card, and pass the card to the end of the row; the student seated there can

select one answer to present, without disclosing whose it is (Nabi, Rahman, Akhter, Saeed & Ajmal, 2011).

Indeed, Otieno (2013) reveals that in-service training helps science teacher to adopt peer-to-peer teaching methodology. Traditionally, pre-service science teachers used the lecture format to teach students science. One of the drawbacks to the lecture format is that it does not engage students in their learning. This teaching technique encourages note taking instead of practical engagement with the world of science. Peer-to-peer teaching is when the students actually get involved in teaching each other about science. This is an active learning method that encourages students to discuss scientific topics, develop questions about the material, and work in teams to learn new information (Abong'o, 2013). Buzz groups, solution and critic groups, as well as affinity groups are just three of the ways to use peer-to-peer teaching in the classroom. All of these techniques help students develop research and presentation skills that help them in the science classroom as well as to gain real life experiences (Kebaso, 2012).

Faize and Dahar (2011) states that in-service training advocates for use of demonstration as a very effective method for illustrating concepts in class, but can result in passive learning if attention is not given to student engagement. Demonstration can provoke students to think for themselves and is especially helpful if the demonstration has a surprise, challenges and assumptions or illustrates an otherwise abstract concept or mechanism (Faize & Dahar, 2011). Demonstrations that use everyday objects are especially effective and require little preparation on the part of faculty. Many science education periodicals contain one or more demonstrations in each issue. Similar volumes of physics demonstrations have been published by the American Association of Physics Teachers (Faize & Dahar, 2011).

According to Essel, et al. (2009) in-service training allows science teachers to apply demonstration as a teaching methodology. Demonstration is the process of teaching through examples or experiments. For example a science teacher may teach an idea by performing an experiment for students. A demonstration may be used to prove a fact through a combination of visual evidence and associated reasoning. Demonstrations are similar to written story-telling and examples in that they allow students to personally relate to the presented information. Yiğit &

Altun, (2011) notes that demonstrations help to raise students' interest and reinforce memory retention because they provide connections between facts and the real world application of those facts. Hanushek & Wosmann (2010), reveal that demonstration method is commonly used in mathematics lessons particularly by teachers who have attended in-service training conducted by SESEMAT in handling topics such as surface area of solids using models. If the teacher finds the best teaching method for a particular group of students, the students are likely to learn more quickly and be more engaged. In addition, using a variety of teaching methods will keep children from being bored, and help them encounter information in new and exciting ways (Kasirye, 2009).

Rahmati, Hosseini and Alimadadi (2014) reveal that another method advocated for in the teaching of sciences is the inquiry-based learning methods. This is a method which is rapidly gaining popularity. Based on the scientific methods, this teaching method can be used for virtually all science subjects. Inquiry-based method of teaching is effective though it requires a lot of time, energy and planning. Students practice problem solving and critical thinking skills to arrive at a conclusion. This teaching method is student-centered and student-directed and can be modified for students at any level. The method should be highly used in teaching/learning mathematics and is particularly used by teachers who have undergone in-service training (Botha and Reddy, 2011).

Schneider and Plasman (2011) posit that in-service teacher training is important in building appropriate teaching methodologies and competencies more especially in the formation of teacher skills, attitudes and values collectively referred to as teacher competence. This aids science teachers' professional development rather than overburdening students with unnecessary content. Achieving appropriate teaching methodologies and competencies requires in-service trainers' educators who are committed and skilled to provide high quality in-service training and to contribute to curriculum development. It also requires the opportunities and resources for the trainee (science teachers) to benefit from being mentored, school-based teaching practice and for the development of partnerships between schools and teacher education institutions (Kebaso, 2012). Such teaching methodologies transform science-teaching attributes such as clear teaching

skills and content knowledge, which positively influence their classroom practices (Kebaso, 2012).

Several methods of teaching science subjects within the traditional formats including lectures, discussion sessions and laboratories. However, there is no universal best way of teaching science subjects. Arunga, (2007) advocates for adoption of teaching methodologies that provide scientific ways of thinking, actively involving students in their own learning, helping students to develop a conceptual framework as well as to develop problem solving skills, promoting student discussion and group activities, helping students experience science in varied, interesting, and enjoyable ways and assessing student understanding at frequent intervals throughout the learning process, more especially after undergoing in-service training (SMASSE INSET, 2014).

Ganyaupfu (2013) stated that teaching methods are classified into three: teacher-centered methods, where students simply obtain off information from the teacher without them building their engagement level with the subject being taught; student-centered methods which encourages discovery since it does not centralize the flow of knowledge from the teacher to the student is not centralized and teacher interactive method- which uses both strategies of teacher-centered and student –centered methods. In addition, Gituthu (2013) reveals that learner-centered approaches through the activity-student-experiment-improvisation (ASEI), pedagogic paradigm and the plan-do-see-improve (PDSI) approach are the focus of SMASSE in-service training. All these strategies are geared towards promoting good performance in national examinations (Akiri & Ugborugbo, 2009). Teachers design, use locally available resources and students' real life situations to improvise teaching/learning materials that enhance learner participation and scientific skills. One of the main objectives in starting SMASSE project was to change the teacher centered lessons to student centered lessons and enhance improved performance in science and mathematics in which students learn more autonomously (Makhdoom et al., 2011).

Otieno (2013) states that in-service training aids science teachers to adopt the new methods of teaching sciences. This is known as the "Shift to child-centered education" in science, which helps to develop student scientific attitude and temperament, technological competence and skills, self-reliance, use of traditional skills and capabilities and making them future scientists

Centre for Mathematics, Science and Technology Education in Africa, (CEMASTEA, 2008). This tends towards promoting and nurturing science talents, involving the students in constructive science works and exposing the students to real life situation such as science exhibitions, science-club activities, designing and performing experiments with locally available materials, using and improvising teaching aids (Makewa et al., 2011). This facilitates the teaching-learning process, designing activities for classroom teaching and effective utilization of laboratory for the continuous learning of the students (Kebaso, 2012).

On the whole methods such as lecture, demonstration, inquiry-based learning were discussed in the literature. Additionally, studies recommended the use of learner-centered as opposed to teacher-centered methods in teaching science subjects, which encourage student engagement, thereby facilitating learning. Finally, the emphasis was placed on inculcating scientific ways of thinking, regardless of the methods used to teach. These findings from the review of literature in this section informed the study's focus on establishing what kinds of method had been dominantly taken up in the in-service teachers' classes, how they had taken them up, whether there were gaps in the uptake, and how these gaps can be plugged to ensure best practices in the teaching of science.

2. 1. 3 In-service Training and Assessment of Learners in Sciences

The review of literature in this section offers some insights into best practices in regard to assessment within science subjects. This informed the current study in establishing the extent to which such methods were taken up.

Assessment is a method of determining whether pre-determined educational goals have been achieved. There are three types of assessment: diagnostic, formative, and summative. Although the three are generally referred to simply as assessment, there are distinct differences between the three in regard to what to teach and how to teach it (Özlem, 2010).

Marete (2012) suggests that teachers should strive to develop a range of assessments strategies that match all aspects of their instructional plans. Instead of trying to differentiate between formative and summative assessments, it may be more beneficial to begin planning assessment

strategies to match instructional goals and objectives at the beginning of the term and implement them throughout the entire instructional experience. The selection of appropriate assessments should also match course and program objectives necessary for accreditation requirements. Heritage and Wylie, (2018) corroborates this asserting that the various dimensions of learning activities should indeed be assessed by various methods. The variety in assessment strengthens the quality of education and mitigates the weaknesses of each assessment technique. However, the practice of continuous assessment in most secondary schools specifically for science and mathematics is limited.

Diagnostic assessment can help science teachers identify their students' current knowledge of a subject, their skill sets and capabilities, and to clarify misconceptions prior to teaching (Eyup & Özlem, 2017). Knowing students' strengths and weaknesses can help science teachers better plan what to teach and how to teach it. Some types of diagnostic assessments include: pre-tests (on content and abilities), self-assessments (identifying skills and competencies), discussion board responses (on content-specific prompts) and interviews (brief, private, 10-minute interview of each student). Gituthu, (2014) adds that diagnostic tests should be brief, ungraded and anonymous. The diagnostic pretest might include a list of key concepts, facts and figures, or major ideas. Teachers should ask students to indicate their familiarity with each topic and finally during the term, frequent diagnostic mini-quizzes can help identify which students are keeping up and which need help. These quizzes also help students to identify the areas on which they need to work. Reading the quizzes will give the instructor a good indication of where to start the next class.

Formative assessments provide feedback and information during the instructional process, while learning is taking place. Formative assessment measures student progress but can also assess the instructor's progress (Yeşilpinar & Karakuş, 2017). For example, when implementing a new activity in class, science teachers can, through observation determine whether or not the activity should be used again or modified. A primary focus of formative assessment is to identify areas that may need improvement. These assessments typically are not graded and act as a gauge to students' learning progress and to determine teaching effectiveness (implementing appropriate methods and activities). In another example, at the end of the third week of the term, science

teachers can informally ask students questions which might be on a future exam to see if they truly understand the material. An exciting and efficient way to survey students' grasp of knowledge is through the use of clickers. Clickers are interactive devices that can be used to assess students' current knowledge on specific content (Saxe, Franke, Gearhart, Howard & Crockett, 1997). For example, after polling, a teacher sees that a large number of students did not correctly answer a question or seem confused about some particular content. At this point in the course, a science teacher may need to go back and review that material or present it in such a way as to make it more understandable to the students. Formative assessment allows a science teacher to "rethink" and then "redeliver" that material to ensure students are on track. It is good practice to incorporate this type of assessment to "test" students' knowledge before expecting all of them to do well on an examination.

Wiliam (2011) identifies some types of formative assessment including observations during in-class activities, students' non-verbal feedback during lecture, homework exercises, class discussions, reflective journals, question and answer sessions, conferences between the instructors and students, in-class activities, student feedback and self-evaluation of performance and progress.

Summative assessment has been dominantly taken up within science (Norwani, Wan, Mahaliza, &Yusof, 2017). Summative assessment takes place after the learning has been completed. It provides information and feedback that sums up the teaching and learning process. Typically, no more formal learning is taking place at this stage, other than incidental learning which might take place through the completion of projects and assignments. Rubrics often developed around a set of standards or expectations that can be used for summative assessment. Rubrics can be given to students before they begin working on a particular project so they know what is expected of them (precisely what they have to do) for each of the criteria. Rubrics also can help you to be more objective when deriving a final, summative grade by following the same criteria students used to complete the project. High-stakes summative assessments typically are given to students at the end of a set point during or at the end of the term to assess what has been learned and how well it was learned. Grades are usually an outcome of summative assessment. They indicate whether the

student has an acceptable level of knowledge-gain and whether the student is able to effectively progress to the next part of the class.

Birungi & Onyango (2017) provide some examples of summative and formative assessment including examinations (major, high-stakes exams), final examination (a truly summative assessment), term papers (drafts submitted throughout the term would be a formative assessment), projects (project phases submitted at various completion points could be formatively assessed), Portfolios (could also be assessed during it's development as a formative assessment), performances, student evaluation of the course (teaching effectiveness) and instructor self-evaluation. Additionally, given the diversity of learner styles (M'kiambi, 2013), Opit (2014) suggest the efficacy of informal modes of assessment as a possibility in determining whether students are learning the material throughout the term.

Goldhabes and Brewer (2007) provide that in-service training helps science teachers to adopt desirable assessment techniques and evaluation skills for teaching and learning. Desirable assessment techniques include: obtaining frequent feedback on science teachers' teaching, getting regular insights on student learning, soliciting students' opinions during the term and assessing a course at the end of the term. Educational researchers have found that effective science teachers frequently assess and what they do in the classroom and whether their students are really learning (Ajaja, 2007). They also anticipate the topics and concepts that will be difficult for their students and to develop teaching strategies that present these topics in ways their students will best understand. These teachers make a special point of becoming familiar with their students' preparation, knowledge, and abilities, and adjust their teaching to maximize the class' learning. Yet, teachers, especially new teachers, may sometimes be too overwhelmed by all that is involved with teaching to assess student knowledge and learning. Creating a syllabus, preparing assignments, developing lessons, designing laboratories, structuring discussions, and writing test questions all take time, thought, and planning (Gituthu, 2014).

Nwachukwu (2010) suggests some strategies in-service trained science teachers should uphold when conducting assessment and evaluation of learners in sciences. At the beginning of every course, science teachers should try to gauge the students' prior knowledge of the subject: What

are the prerequisites for the course? Have all students taken the prerequisites? There are several ways to identify what students already know; one of the simplest is introduce a topic and then ask a question which brings out their knowledge such as "What's going on here? How do we know that?" If student answers are recorded, the same questions can be posed again at the end of the topic or term to evaluate students' progress.

Migwi (2012) notes that teachers evaluate the teaching and learning process by reflecting on performance and the effectiveness in achieving lesson objectives. The teacher makes use of feedback to modify the lesson as it progresses in order to eliminate misconceptions as well as improve subsequent instruction (CEMASTEA, 2012). However, as Yiğit and Altun, (2011) affirms, in-service training should aid science teachers to evaluate both the cognitive (knowledge) as well as the affective domains of learning, in order to promote analytical thinking and critical assessment in the understanding of science.

Some studies have illuminated the obstacles in effective assessment (Hamilton et al., 2007; Suurtam et al., 2016; Wiliam, 2007). In classroom assessments, a national curriculum may be viewed as an assessment framework, although a framework might also be provided by the local school or local school authorities that include standards and goals for science and mathematics teachers. However, science teachers rarely interpret these frameworks and standards to decide on what to teach and how best to assess this content. They often use a range of teacher-selected or teacher-made assessment instruments that are closely linked to what the students have been learning which hinder efficiency and effectiveness of the assessment practice (Suurtam et al., 2016; Wiliam, 2007). Assessment is also affected by science teachers' failure to interpret and validate assessment outcomes, both from internal as well as external. If the tasks used for instruction and assessment are too similar for example, then there is a danger of overestimating what students have achieved, because the curriculum and instruction might be narrowed towards testing (Hamilton et al., 2007).

Previous research has revealed that teacher-made tests often assess what might be termed lower-order skills (Palm et al., 2011). Even established large-scale assessments might test only certain aspects of science and mathematical competence (Mullis et al., 2016). This lack of rigor might be

a common issue shared at all levels of educational assessment. According to Niss (2007), very little progress has been made as regards the assessment of essential ingredients in science and mathematical competencies, such as asking questions, conjecturing, posing problems, constructing argument, including formal proofs, making use of and switching between representations, communication and such like. Not only is research lacking, assessment instruments are largely lacking as well. Much assessment and testing is still focused on students' solving of already formulated problems, thereby illuminating gaps in assessment. The quality of teacher questions is also important in assessing learners specifically in science and mathematics. In checking students' understanding, science teachers should ask open-ended questions that allow students to express their own understanding and conceptions, and put less emphasis on recalling facts that reduce opportunities for students to be creative and critical in their thinking (Schulz, & Fitz Patrick, 2016). Stanny (2016) argues that open-ended questions require students to apply, analyze, synthesize, and evaluate information, which were considered as 'high order thinking skills' in Bloom's Taxonomy of educational objectives.

The NCDC syllabi hint on the suggested mode of assessment and recommends that teachers carry out continuous assessment on each topic. The strategies for assessment include: oral questions, observation of individuals/group activities, short answer questions, practical test assignments, project work, field trips/excursions, science fairs, quizzes and simple research from the library (MoES, 2017). Additionally, Benjamin Bloom' model providesstructure for planning, designing, assessing and evaluation, training and effectiveness (Sydoruk, 2018). This is aligned to cognitive dimension of learning such as knowledge, comprehension, application, analysis, synthesis and evaluation (Armstrong, 2017). Bloom's taxonomy for educational assessment is used in order to ensure that students are assessed on a variety of knowledge and skills. At different levels, students are often asked questions of varying and increasing levels of complexity and difficulty. The use of taxonomies for assessment has been illuminated (Butler, 2012; Liu, Frankel & Roohr, 2014). Specifically, DeCaro and Rittle-Johnson, (2012) strongly encourage the operationalization of taxonomies when designing assessment, which can be used in guiding adequate science and mathematics learning as well as in ensuring a comprehensives assessment.

On the whole, the review of literature from this section provided the different types of assessment, examples, benefits as well as obstacles to assessment. The studies recommended that teachers make use of a variety of assessment measures to cater for diversity and to leverage the advantages of the different methods. They also encouraged the assessment of both higher order and lower order thinking skills, as well as the use of both open and close ended questions. Assessment according to the literature should also be continuous, and it should be informed by frameworks such as Bloom's taxonomy to ensure more comprehensive assessment. This informed the current study in ascertaining the kinds of assessment taken up, whether a variety of measures were used, whether assessment involved both higher order and lower order thinking skills.

2. 2. Summary

In addressing the first research question, the review of literature on planning and preparation focused on engagement with the curriculum and syllabi, which inform the scheme of work, and, subsequently the lesson plan. The studies emphasized that planning and preparation are the most important dimensions of the teaching-learning process. These studies also informed the current study's focus on how tools such as lesson plans and schemes of work were used planning and preparation. In addressing the second research question, the studies illuminated some teaching methods and highlighted the constraints to teaching sciences. They also recommended the use of learner-centered methods and periodic assessment, putting emphasis on inculcating scientific ways of thinking, regardless of the methods used to teach. These studies informed the current study's focus on establishing the kinds of methods taken up as well as their efficacy in teaching sciences. Finally, in addressing the third research question, the study illuminated the diverse forms, benefits and obstacles to assessment, recommending that teachers make use of a variety of assessment measures to continuously assess of both higher order and lower order thinking skills, using both open and close ended questions as informed by frameworks such as Bloom's taxonomy to ensure more comprehensive assessment. This informed the current study's focus on the nature of assessment conducted by the in-service teachers.

CHAPTER THREE
METHODOLOGY

3. 0. Introduction

This chapter presents the methodology used to conduct this study about "In-Service Training and Science Teachers' Performance in Selected Government-aided Secondary Schools in Mukono District". It covers the research design, population, sampling techniques, data collection methods, quality control, data analysis, study limitations and delimitation and ethical considerations.

3. 1. Research Design

The cross-sectional design was considered appropriate for the study due to the fact that it is used to gather data from a sample of a population at a particular time in order to obtain information about preferences, attitudes, practices, concerns or interests of a group of people (Kothari, 2008). Both qualitative and quantitative techniques were used for the triangulation of findings (Udo, 2006).The qualitative approach particularly, gave a voice to participants and ensured that study findings were grounded in participants' experiences, while the quantitative approach provided insights into the magnitude of the problem.

3. 2. Population and Sampling Techniques

3. 2. 1. Population

The study used a target population of 101 respondents, including teachers, directors of studies, deputy head teachers, head teachers of secondary schools, district education officers and SESEMAT trainers in Mukono District, as illustrated in Table 3.1. The aforementioned categories of participants were considered appropriate for this study because they have first-hand information regarding in-service training and science teachers' performance, given their role as key actors in the instructional process in secondary schools in Mukono District.

3. 2. 2. Sample

A sample is a part of the targeted population that is systematically selected to represent the whole population (Kothari, 2008). The formula for selecting the number of schools to participate in the study was determined by taking 20-30% of the population as being adequate for the study results

to be relevant and reliable(Amin, 2005). Hence the researcher selected 6(30%) of the 20 government-aided secondary schools in Mukono district.

Table 3. 1: Study Population and Sample Size Description

Category of Respondent	**Population [N]**						**Total (N)**	**Sample Size(n)**	**Sampling Technique**
	Schools								**Cluster**
	A	**B**	**C**	**D**	**E**	**F**			
Science teachers	12	10	15	11	10	12	70	59	Stratified sampling
Head teachers	01	01	01	01	01	01	06	06	Purposive
Deputy head teachers	01	01	01	01	01	01	06	06	Purposive
Directors of studies	01	01	01	01	01	01	06	06	Purposive
SESEMAT- staff							12	10	Purposive
District Education Officer							01	01	Purposive
Total							**101**	**88**	

Source: District Education Office (2017).

Krejcie and Morgan's (1970) sample size determination table was used to obtain a sample of 59 science teachers out of the 70 science teachers in the six schools. The researcher provided for equal gender representation among the participants.

3. 2. 3. Sampling Technique

Stratified sampling was used to select six out of twenty government aided secondary schools in Mukono District to participate in the investigation. The schools were of the same status/grade and are located within the urban and peri-urban setting in Mukono district. Stratified sampling

was used to select teachers while purposive sampling was used to select head teachers, deputy head teachers, directors of studies, SESEMAT staff and district education officers. This sample provided relevant and adequate data for the study.

3. 3. Data Collection

A number of instruments were used to collect both primary and secondary data.

3. 3. 1. Research Methods

The research methods included survey, observation, focus group discussions, and documentary analysis.

3. 3. 1. 1. Survey

The survey, conducted using a questionnaire (Appendix A) consisted of close-ended questions designed for the respondents to elicit respondents' perceptions, opinions, views, and feelings about in-service training and science teachers' performance. Thisinstrumentused to collect information from science teachers, was considered appropriate because it is less expensive to administer (Willem, *et.al,* 2017) and convenient for the literate respondents who were able to complete it objectively and within a short time. The questionnaire items were rated using a likert scale, which required respondents to indicate their responses on a scale including Strongly Disagree (SD), Disagree (D), Not Sure (NS), Agree (A) and Strongly Agree (SA).

3. 3. 1. 2. Observation

Observations were conducted using an observation guide *(*Appendix D) to observe lessons in four subjects. The researcher observed at least one lesson of a science teacher per subject (i.e. Biology, Chemistry, Physics and mathematics) in four of the six schools sampled. This helped to triangulate the quantitative data.

3. 3. 1. 3. Focus Group Discussions

The researcher held two Focus Group Discussions (Appendix B), each with five members of SESEMAT trainers. This provided data on the training skills used to equip science teachers with new teaching methodologies.

3. 3. 1. 4. Interviews

A structured interview guide (Appendix C) was used to interview the District Education Officer, head teachers, deputy head teachers and directors of studies of secondary schools. The respondents were selected because they hold administrative positions and have experience in regard to INSET and teacher performance in the respective secondary schools in Mukono district. Interviewing aided in obtaining detailed and in-depth qualitative informationto supplement on the quantitative data (Mugenda, 2003).

3. 3. 1. 5. Documentary Analysis

The main sources of secondary data which were obtained from the field included SESEMAT in-service training manuals, sample tests set by SESEMAT, science teachers' performance reports, teachers' schemes of works and lesson plans, Uganda National Examination Board (UNEB) syllabi, the National Curriculum Development Center (NCDC) science curriculum as well as the UNEB results which show the science performance. These documents provided insights into the nature of the science curriculum as well as the performance of students in national examinations.

3. 4. Research Procedure

Upon peer review, pretesting and supervisors' approval of the study tools, the researcher obtained an introduction letter (Appendix H) from the Head of Department, Education Planning and Management in the Faculty of Education as required by the Graduate School board on behalf of the Academic Registrar of Kyambogo University. The researcher used this letter to introduce himself to the District Education Officer Mukono (DEO) as well as the head teachers of secondary schools in Mukono district seeking permission to carry out the study in their respective secondary schools.

The DEO authorized the researcher (Appendix G) to conduct the study within six secondary schools in Mukono district. The researcher thereafter travelled to schools A to F respectively introducing himself to the head teachers and science teachers explaining the aim of conducting the study and seeking their full consent to participate voluntarily.

From the DEO's office, the researcher made prior visits to secondary schools A to F respectively using the authorization letter. He was able to introduce himself and interact with the various head teachers, seeking audience to interact with the head of science department to organize science teachers. The researcher made schedules to collect data at intervals of two days after every school at an appropriate time, suitable to school activities. The researcher with permission from the head teacher was assisted by heads of science department to meet science and mathematics teachers who were recruited to participate in the study through answering questionnaires.

The researcher made phone calls a day in advance to remind the head teachers and heads of science department about the data collection schedule. On arrival at school for data collection, the head teacher together with the head of science department provided the procedure to follow while collecting data. The science teachers were informed about the purpose of the research and their consent to participate in the study was sought. The questionnaires, interviews and lesson observations were accomplished within two weeks (14 days).

The schedule for conducting data collection using FGD was made after visiting SESEMAT office. The SESEMAT coordinator received the authorization letter from the DEO and granted permission to the researcher to attend a workshop that was slated for 14thOctober, 2017 under the theme "*Promoting effective assessment for learners' achievement in science and mathematics*". The Focus group discussions (FGD) were organized in such a way that, the coordinator SESEMAT invited the interviewer on the day for trainers' general assembly where discussions on promoting science education in Mukono district was the main theme. The researcher was included as part of the day's agenda (Sauders, 2007). The FGDs were carried out in such a way that all the trainers sat at a round table while the researcher chaired the session. He welcomed all SESEMAT trainers, introduced himself, explained the purpose of the FGD and finally opened the discussion as guided by the questions in the FGD one by one. The researcher worked together with the coordinator for SESEMAT trainers of Mukono district to effectively conduct the FGDs. The researcher was also provided with SESEMAT training manuals to analyze and evaluate the effectiveness of in-service training in relation to science teachers' performance.

3. 5. Data Analysis

The quantitative and qualitative was analyzed in order to address the research questions of the study.

3. 5. 1. Quantitative Data Analysis

The raw data from the questionnaires was cleaned, sorted and entered using the Statistical Package for Social Scientists (SPSS), to generate descriptive and inferential statistics. Descriptive analysis was applied to describe the primary variables and associated indicator items related to the study objectives by generating percentages, mean and standard deviations. Pearson correlation coefficient was used to analyze the relationship between the variables. The results were presented in form of tables and charts, and then discussed in relation to existing literature as well as the objectives of the study.

3. 5. 2. Qualitative Data Analysis

This involved the analysis of the qualitative data, including the interviews, FDGs, observation as well as documentary data. The audio interviews and FDGs were transcribed to produce written transcripts. This data was inductively coded as informed by the research questions. The codes were categorized into broader themes, thereby using thematic analysis to analyze this data.

3. 6. Validity and Reliability

3. 6. 1. Validity

Validity is the extent to which an instrument tests or measures what it is supposed to measure (Creswell, 2014). Both quantitative and qualitative research tools were first prepared and presented to the supervisors who checked their suitability. The supervisors' comments were used to improve the questionnaire by eliminating all errors. Pretesting of questionnaires also was done by administering questionnaires to 10 respondents within the target population but outside the sample of the study (Bolarinwa, 2015). This helped to identify the gaps and make modifications accordingly. The researcher ensured that questions were relevant in order to have meaningful and reliable results represented by variables in the study (Mugenda & Mugenda 2008). The researcher used the formula below to establish validity of the research tool:

$$\text{Content validity index (CVI)} = \frac{\text{agreed items by all judges as suitable}}{\text{Total number of the items judged}} = \frac{25}{33} = 0.758$$

If the overall content validity index of the instrument is equal 0.70 and above, it is regarded as valid instrument (Mugenda, 2003). Therefore the instruments with a CVI of 0.758 were regarded as being valid and therefore suitable for data collection.

The validity of the qualitative data was addressed in terms of trustworthiness, authenticity, and credibility as recommended by Creswell & Miller (2000) as well as Lincoln, Lynham, &Guba, (2011). The researcher also used triangulation of different data obtained from both secondary and primary sources to ensure validity by checking the data from different sources against each other. The researcher used rich and thick descriptions to convey the detailed meaning of the study findings to the readers, making it possible for the readers to understand and replicate the study. The researcher also spent extended time with science teachers and SESEMAT staff in order to develop an in-depth understanding of the phenomenon under study and to convey detailed credibility to the study narrations. The researcher was able to gain more experience with respondents in their settings. This helped to obtain more accurate and valid findings.

3. 6. 2. Reliability

Reliability is the measure of the degree to which a research instrument yields consistent results after repeat (Crewell, 2014). Cronbach's Alpha coefficient was used to measure reliability of the questionnaire. According to Amin (2005) an alpha of 0.7 or higher is sufficient to show reliability. The closer it is to 1, the higher the internal consistency in reliability (Sekaran, 2003).The questionnaire was pre-tested using respondents within Mukono district secondary schools and reliability was computed using statistical package for social scientists (SPSS) and scores were evaluated.

To ensure reliability of quantitative data, the Cronbach's Alpha Reliability Coefficient for likert-type scales test was performed. It is commonly used as a measure of the internal consistency or reliability of a psychometric test score for a sample of examinees. According to Sekaran (2003) some professionals, as a rule of thumb, require a reliability of 0.70 or higher (obtained on a substantial sample) before they use an instrument. Upon performing the test, the results that were above 0.7 were considered reliable. The alpha coefficient was computed as 0.78 over and above 0.7 and hence the instrument results were dependable.

In order to ensure reliability of qualitative data, the researcher adhered to the qualitative reliability procedures described by Gibbs (2007). The researcher checked questions and interview records to ensure that they do not contain mistakes made while in the field. The definition of codes was reviewed during coding process to accomplish data comparison with codes. The researcher regularly coordinated with SESEMAT trainers and shared the analysis with them regarding in-service training effectiveness.

3. 7. Study Limitations and Delimitations

3. 7. 1. Limitations

Time factor: The research was affected by time constraints since the researcher carried out the study while simultaneously working full time. The researcher thus designed a work plan to apportion the available time appropriately for the different activities, which he adhered to the as much as possible.

Information: Some of the respondents were not willing to give complete information as they looked at research as a threat and wastage of their time. The researcher however explained the clear purpose of the research and asked them to freely participate in the study as the information was to be used for academic purposes only and kept confidential. Further still the study questions and interviews were made as objective as possible to avoid misleading questions. Teachers too were reluctant to provide information regarding their personal weaknesses in teaching sciences. The researcher promised that the information they would provide was confidential, and, that he would use pseudo names instead of the real names of the respondents or their schools.

Weather: For unfavorable weather conditions like rainy seasons, the researcher used a raincoat or an umbrella to overcome the effect of heavy down pours.

3. 7. 2. Delimitations

Area scope: SESEMAT training is carried in the entire country. However, the researcher narrowed down the geographical scope to only in-service training by SESEMAT in Mukono

district. Narrowing down the study was not an easy task. The researcher however, used an appropriate sampling technique to make it possible to undertake the study.

Conceptualization: The concept of in-service is wide covers informal and formal trainings. This was delimited by only covering INSET by SESEMAT in Mukono district.

3. 8. Ethical Considerations

The researcher sought informed consent from the respondents before engaging them in administration of tools. The consent forms indicated that the study would be conducted for academic purposes, that pseudonyms would be used instead of the participants' real names, and, that the researcher would keep all information with confidentiality. Additionally, the researcher did not force participants to sign the informed consent form. Participation in the study was voluntary where the researcher explained all the instructions for the consent form to enable respondents freely decide whether to or not to participate in the study. It is also ethical for researchers to explain the purpose and nature of studies for participants to understand before they enroll for the study. This was undertaken by the researcher, who clearly explained the purpose of the study to the respondents (Leavy, 2011). The researcher also took time to have informal conversations with the participants in order to build rapport, trust and respect, before he could take up time in their spaces. Furthermore, the assessed and perceived risk so as not to harm the respondents, avoiding language that would harm esteem of the intended respondents.

In summary, this chapter focused on the methodology used to investigate the relationship between in-service training and teachers of science and mathematics performance. The study took up a mixed methods approach, specifically using questionnaires, interviews, focus group discussions and documentary analysis to collect data from respondents including science and mathematics teachers, head teachers, deputy head teachers, directors of studies as well as in-service trainers.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION OF RESULTS

4. 0. Introduction

This chapter presents the analysis and interpretation of the findings of the study. The chapter begins with presenting the descriptive results followed by analysis and interpretation of findings from both primary and secondary data sources. The study was guided by the following research objectives:

i) To examine relationship between in-service training and science teachers' planning and preparations in secondary schools of Mukono district.

ii) To establish the relationship between in-service training and science teachers' teaching methodologies in secondary schools of Mukono district.

iii) To assess the influence of in-service training and science teachers' assessment of learners in secondary schools of Mukono District.

4. 1. Response Rate

Table 4.1: Rate Responses

Category of respondents	Target sample	Actual sample	Response rate
Science teachers	59	57	96.6
Head teacher	06	06	100
Deputy Head teachers	06	06	100
Director of studies	06	06	100
SESEMAT- staff	10	10	100
District Education Officer	01	01	100
Total	**88**	**86**	**97.7%**

Source: *Primary Data (2017)*

As illustrated in Table 4.1, the researcher administered questionnaires to 88 respondents out of which 86fully answered and returned to the researcher. This indicates that the overall response rate was 86 (97.7%). This is an adequate response rate, following Mugenda and Mugenda (2003), who noted that a response rate above 70% is satisfactory for a study.

4. 2. Demographic Information

The demographic information of the respondents constituted: gender, age, highest qualification, management level as well as teaching experience of the science teachers. Questions 1-5 were administered and the following was revealed:

4. 2. 1. Gender

The respondents were requested to indicate their gender. The results of the study are presented in the figure below.

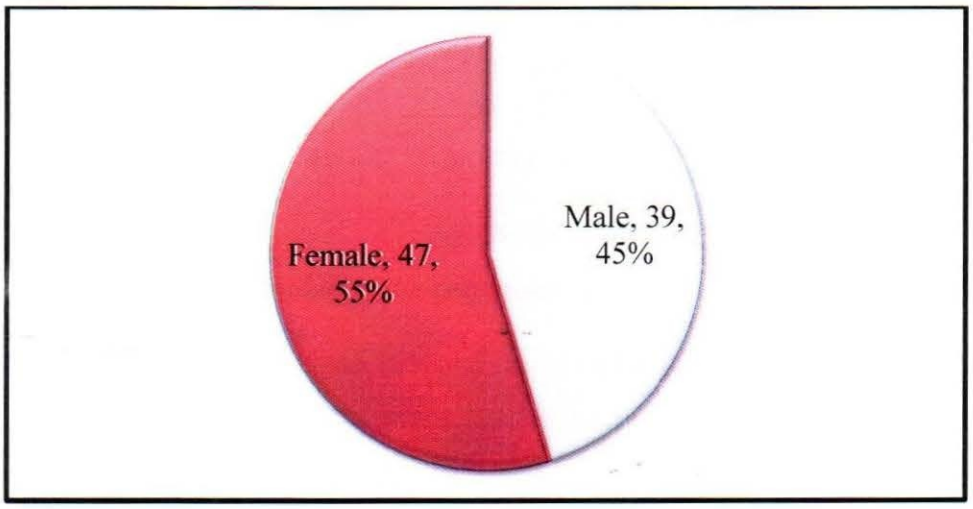


Figure 4. 1: Gender Distribution

The results as shown in figure 4.1 reveal that the majority of the respondents were female, representing by 47 (55%) while the maleswere39 (45%). The results indicate a progressive picture in which women are well represented in sciences, despite dominant research that shows the under-representation of women within the sciences in Uganda (Namatende, 2018). This notwithstanding, obtaining data from both sexes is indicative of more objective data.

4. 2. 2. Age Bracket

The researcher sought to discern the age category of the respondents. This was expected to guide the researcher in understanding the most active age group in the teaching of sciences. The data on age is presented in figure 4. 2 below.

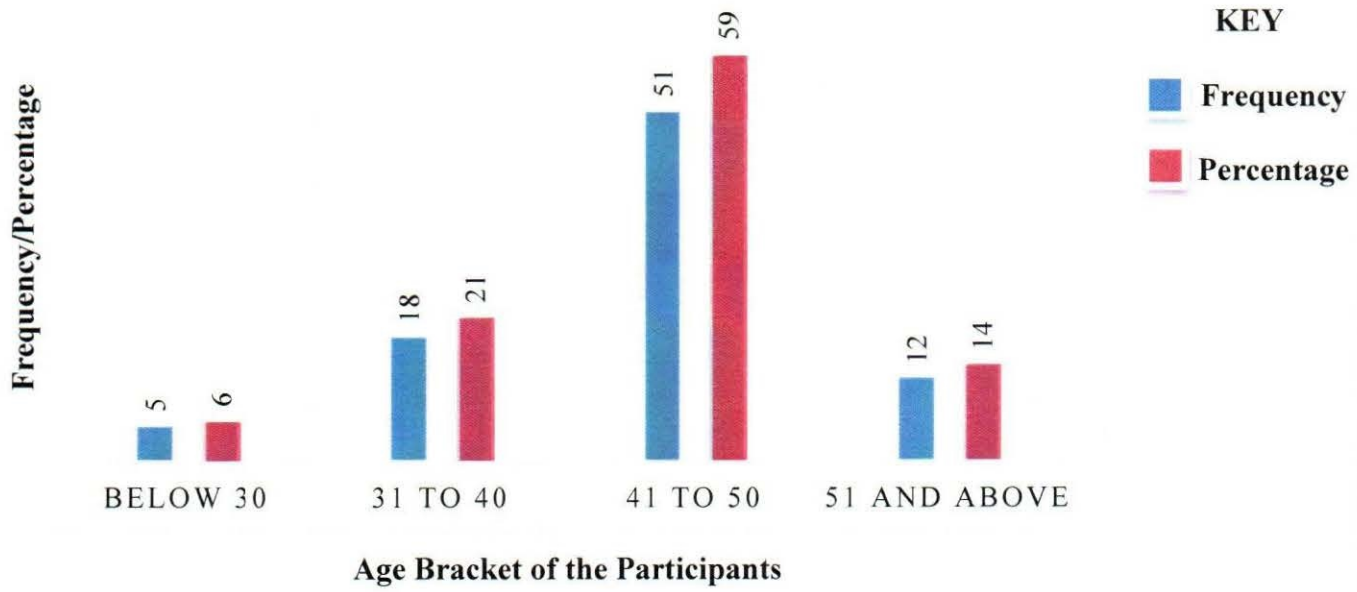


Figure 4. 2: Age bracket of the respondents

Figure 4.2 illustrates that5 (6%) of respondents were aged 30years and below, 18(21%) were aged 31-40years, 51(59%) were aged between 41-50 years and the rest of the respondents 12(14%) were 51years and above. The implication of this finding is that most of the science teachers in Mukono secondary schools were mature enough to adequately conceptualize the study questions.

4. 2. 3. Highest Qualification

In bid to elicit data about the educational level of the respondents, the researcher administered research tools, which revealed their qualifications as presented below.

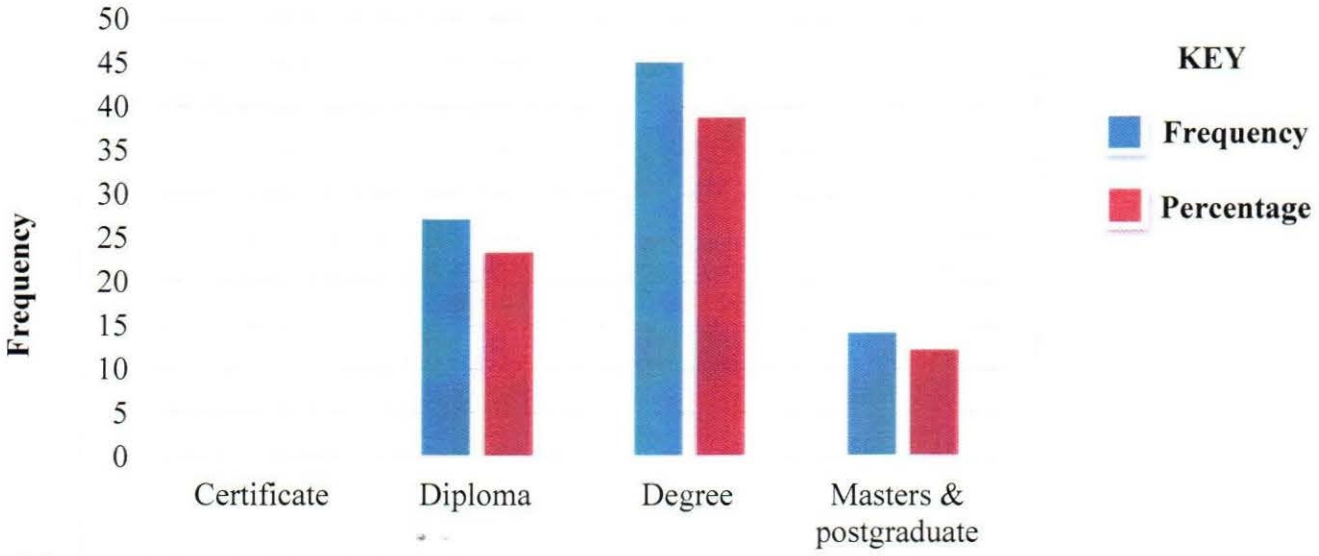


Figure 4. 3: Education level of the respondents

The study findings in Figure 4.3 indicate that the majority 45(52.5%) of the respondents were degree holders, 27(31.4%) were diploma holders while Master's degree holders were 14(16.1%) whereas none of the respondents had only a certificate qualification. All the members of staff were therefore qualified science teachers with the potential to benefit from the SESEMAT training in order to improve their performance.

4. 2. 4. Management Level in the Secondary Schools

The researcher further administered research tools to ascertain the level of managerial skills science teachers held /possessed in secondary schools. The results are presented as follows:

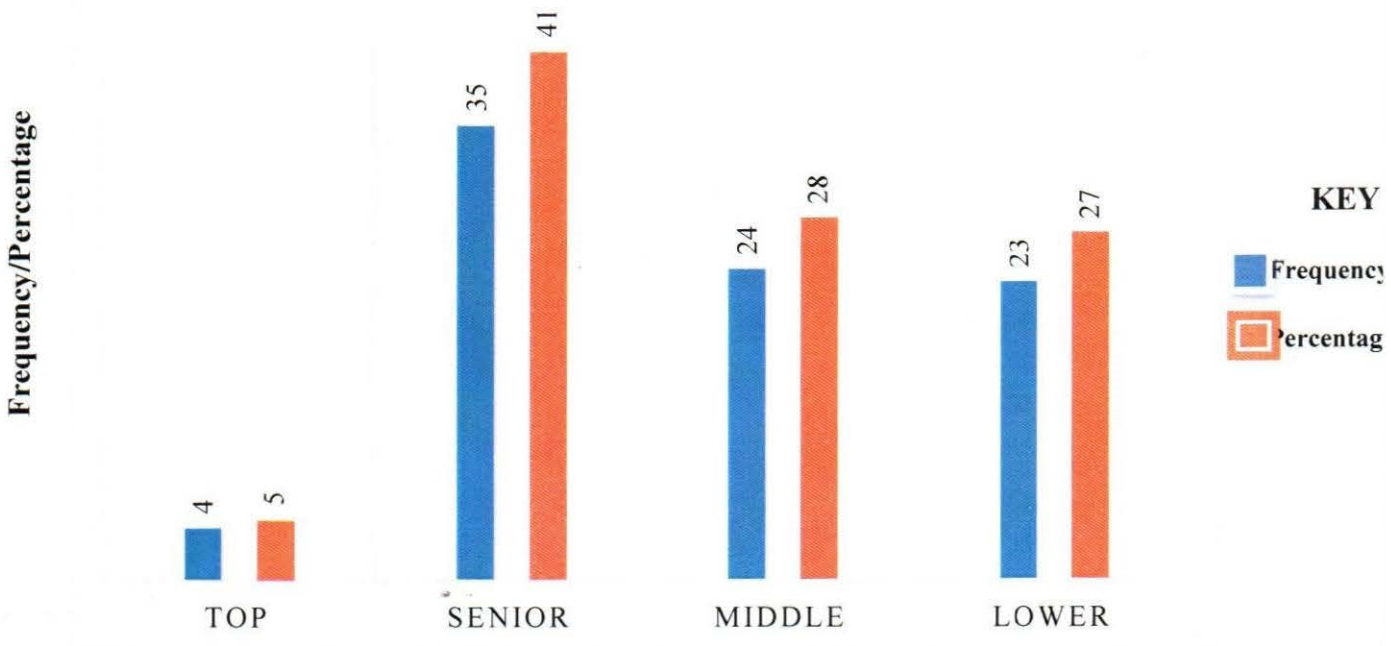


Figure 4. 4: Management Level in the Secondary Schools

Figure 4.4illustrates that 23(27%) of the respondents belonged to lower level management, 24(28%) were part of the middle managerial level, 35(41%) were members of the senior management while 4(5%) were part of the top management. By including the management positions of the respondents, the researcher was able to demonstrate that very few science teachers were involved in managerial positions. This minimized their influence not only in regard to controlling the number of in-service training opportunities but also in terms of supervising as well as following up the results from the training, in order to improve their science teaching performance in schools.

4. 2. 5. Experiences as a Secondary School Science Teacher

The respondents were asked to indicate the number of years they had worked as science teachers in selected government aided secondary schools in Mukono district. This was expected to illuminate the science teachers' teaching experience and capability of gaining from the SESEMAT training. The results are shown in figure 4.5:

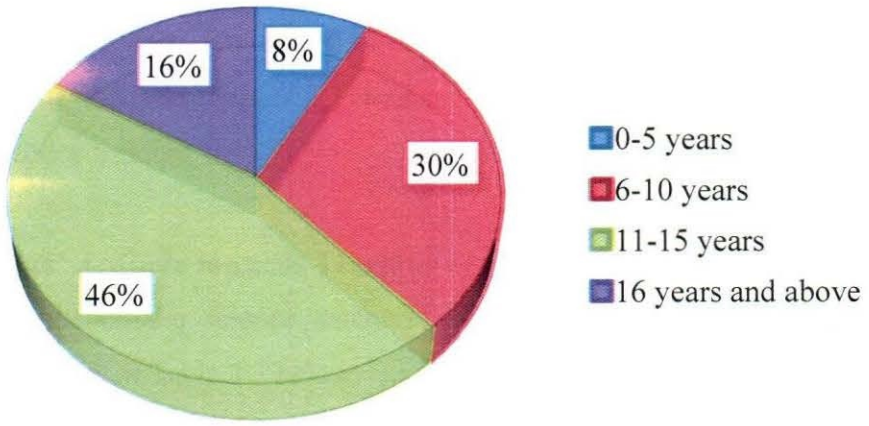


Figure 4. 5: A pie chart showing the length of service in Mukono District

According to figure4.5,8% of the respondents have served for a period of 0-5years, 30% for 6-10 years, 46% for 11 to 15 years and 16%for over 16 years. This indicates that the majority had worked for a considerable period of time, were well experienced in the field of science teaching and, had undergone INSET from SESEMAT. These science teachers were as such eligible to provide relevant information for the study.

4. 2. 6. Experiences as SESEMAT Trainers

In bid to ascertain the level of expertise and capabilities of SESEMAT trainers in equipping science and mathematics teachers in order to improve their performance, the researcher administered a FGD in which they indicated the number of years they had served as SESEMAT trainers in Mukono. The results were presented in table 4.2 as follows:

Table 4. 2: Experience of Trainers

Years of Experience	**Frequency**	**Percentage (%)**
0-5years	03	30
6-10years	07	70
11-15years	0	0
16 Years and Above	0	0
Total	**10**	**100**

Table 4.2 shows that 30% of the science teachers' in-service trainers had experience of a minimum period of 5 years while 70% of the trainers had 10 years experience. The implication of this finding is that most in-service trainers had the desired experience to handle science teachers' in-service training.

4. 2. 7. Teachers' Attitude towards Teaching of Mathematics and Sciences

The study established the science teachers' attitudes towards teaching of mathematics and sciences as presented in Table 4.3 below:

Table 4. 3: Teachers' attitudes towards teaching of mathematics and sciences in secondary

n = 86

No	**Responses on teachers' attitude towards teaching of mathematics and sciences**	SA		A		NS		D		SD	
		F	%	F	%	F	%	F	%	F	%
1	Before undergoing INSET, mathematics and sciences were easy to teach.	17	19.8	10	11.6	02	2.3	32	37.2	25	29.1
2	After undergoing INSET, mathematics and sciences are now easy to teach.	22	25.6	15	17.4	00	00	25	29.1	24	27.9
3	Before undergoing INSET, teaching of mathematics and sciences were interesting.	11	12.8	05	5.8	02	2.3	32	37.2	36	41.9
4	After undergoing INSET, teaching of mathematics and sciences are now interesting.	17	19.8	11	12.7	03	3.4	24	27.9	31	36.0
	Overall frequency(344)	**67**		**41**		**7**		**113**		**116**	

Source: *Primary Data*

Table 4.3 shows responses on teachers 'attitudes towards teaching of mathematics and sciences as follows: Before undergoing INSET, 27(31.4%) of the mathematics and sciences teachers found it easy to teach while 57(66.3%) found it difficult to teach. This implies that the majority of science and mathematics teachers found it hard to teach sciences before INSET. After undergoing INSET,37 (43%)of the mathematics and sciences teachers found it easy while

39(45.3%)still found it difficult to teach mathematics and science. While there is an increase in the number of teachers whose difficulty in teaching the subjects reduced, the numbers remain high.

Further, before undergoing INSET, teaching of mathematics and sciences was interesting for 16(18.6%) science and mathematics teachers while it was not interesting to 68(79%) of the science and mathematics teachers. After the training however, 28 (32.6%) of the science and mathematics teachers revealed that, teaching of mathematics and sciences became interesting while 55(69.3%) had no gain in interest for the teaching. The implication here is that there was slight increase in teachers' interest in teaching sciences.

On the whole, while 108 (32.3%) found the teaching of science and mathematics easier and more interesting after INSET, 229(66.6%) as illustrated in Table 4.3still found the teaching of mathematics and science both difficult and uninteresting to teach after INSET. This demonstrates that the majority of teachers still found it difficult and uninteresting to teach science and mathematics even after INSET.

4. 3. The Relationship between In-Service Training and Science and Mathematics Teachers' Planning and Preparations

In addressing the first objective of the study, the science and mathematics teachers provided their view in regard to the relationship between in-service training and science teachers' planning and preparation in secondary schools through responses to questions showing the extent to which they: strongly disagree (1), Disagree (2), Not sure (3), Agree (4), strongly agree (5). This is presented and analyzed based on the frequencies and percentages as shown in Table 4.4:

Table 4.4: Descriptive Statistics on In-service training and science/mathematics teachers' planning and preparations

n=86

No	Responses on In-service training and science/mathematics teachers' planning and preparations	SA		A		N S		D		SD	
		F	%	F	%	F	%	F	%	F	%
1	INSET process follows proper selection and arrangement of the teaching items or materials.	16	18.6	07	8.1	0	0	30	34.9	33	38.4
2	INSET trains science teachers to select and sequence content and methodologies in line with the curriculum, syllabus, scheme of work and lesson plans	10	11.6	12	13.9	06	6.9	25	29.1	33	38.4
3	INSET reveals that science teachers cannot distinguish curriculum and syllabus hence they are inadequately prepared, trained, supervised and supported in teaching sciences	14	16.3	10	11.6	02	2.3	39	45.3	21	24.4
4	Through INSET science teacher no longer find challenges with splitting the year's work into portions to be studied per term, month or week/ lesson (schemes of work)	15	17.4	13	15.1	08	9.3	30	34.9	20	23.3
5	INSET helps science teachers to draft brief outlines of lessons from curriculum &syllabi to simplify teaching of a specific topic	17	19.8	14	16.3	05	5.8	32	37.2	18	20.9
6	Science teachers can now utilize schemes of work as a guide in planning daily lessons with the time available for each topic in the term	13	15.1	10	11.6	06	6.9	31	36.0	26	30.2
7	INSET has made science teachers gain confidence in simplifying lesson plans to improve both learning and teaching	10	11.6	04	4.6	03	3.4	32	37.2	37	43.0

8	Deriving lesson plans from the analysis of the scheme of work / unit plan has been softened through INSET to effect science teachers performance	15	17.4	14	16.3	01	1.2	24	27.9	32	37.2
9	The science teachers follow correct steps and procedures in teaching	18	20.9	14	16.3	03	3.4	20	23.3	31	36.0
10	In-service training requires science teachers to make schemes of work under well-defined and structured headings	14	16.3	10	11.6	02	2.3	25	29.1	35	40.7
11	A successful lesson plan addresses and integrates planning, methods and evaluation skills	15	17.4	15	17.4	05	5.8	31	36.0	20	23.3
	Overall total (946)	**157**		**123**		**41**		**319**		**306**	

Source: *Primary Data (2017)*

Table 4.4 provides the summary of the findings regarding the extent to which in-service training affects science teachers' planning and preparations in secondary schools in Mukono district. The majority, 625 (319+306 which is 66.07%) out of 946disagreed that in-service training of science/mathematics teachers in planning and preparations was adequate enough to influence desirable science teachers' performance in Mukono District government aided secondary schools.

The study results in table 4.4 show that majority67.5% (29.1+38.4) disagreed that INSET enhanced science teachers with adequate skills to select and sequence content and methodologies in line with the curriculum, syllabus, schemes of work and lesson plans. This implies that SESEMAT did not conduct successful training of SMT to build capacity in teaching and learning. To a smaller extent, 25.5% (11.6+13.9) agreed that careful planning and preparation were observed in practice to be employed in the classroom by SMT.

In regard to whether science teachers could distinguish curriculum and syllabus, Table 4.4reveals that 14(16.3%) strongly agreed, 10(11.6%) agreed, and 2(2.3%) were not sure. On the other hand, 39(45.3%) disagreed and 21 (24.3%) strongly disagreed with the idea. This implies that the majority of the SMT could not distinguish curriculum from syllabus, and yet each of these is a

primary tool for planning and preparation for teaching. These findings were corroborated by the head teacher of School B who explained:

> Although many science teachers undergo in-service training, they experience difficulty in planning and preparations. Science teachers cannot distinguish curriculum and syllabus, or lesson plans and schemes of work...Lesson plans do not address and integrates planning, methods and evaluation skills.

The failure for the majority of SMT to distinguish curriculum and syllabus, which are primary planning and preparation resources provides an insight into the gaps in the teachers' knowledge and skills in this regard, which is likely to curtail their scheming and lesson planning potentials.

Further on, the findings in table 4.4 revealed that minority (33.7%) of the respondents agreed that deriving lesson plans from the scheme of work / unit plan was softened through INSET while 65.1% of the respondents disregarded with this view. This means that the majority SMT did not appreciate that the training through SESEMAT added value in regard to their lesson planning and preparation. One of the deputy head teachers re-affirmed this during interviews, asserting:

> SMT need to master the content through consulting reference materials recommended by NCDC, scheming the content, breaking work into a unit maps and unit plans, writing lesson notes, checking the apparatus/teaching aids which include trial experiments and preparing them plus lesson planning.

The findings illuminate therefore, that there are still gaps in regard to lesson planning and preparation of SMT even after INSET to conduct proper lesson planning. This is further corroborated in the classroom observations, which showed gaps in the use of lesson plans and schemes of work. During one of the biology lessons for example, there was no scheme of work or lesson plan in S. 2 Blue. The topic for the lesson was "Nutrition in Animals" while the subtopic was "Food Tests". The teacher wrote the procedure for the lesson onto the blackboard, rather than let students develop their own procedures as recommend by SESSMAT, in order to develop practical skills as well as enable application of concepts from science. He also provided inauthentic teaching materials such as test tubes, food extracts and reagents for identifying food substances rather than providing authentic materials, which should have been included in the lesson plan as recommended by SESSMAT. While the researcher observed the use of several hands-on activities as well as a demonstration of adequate knowledge of the subject matter, there was inadequate evidence of lesson planning and preparation through the presentation of relevant

lesson planning materials. This provides insights into the gaps in planning and preparing student-centered lessons using local materials to develop practical application of scientific knowledge. The lesson observations generally indicated a failure by SMT to introduce the lessons using the initial question, which connect the past lesson to the present lesson hence making it difficult for learners to understand the subject matter. Additionally, SMT could neither clearly, explain, describe the body of the lesson, which was likely to affect learners' acquisition of knowledge and skills from the lesson.

Contrary to the findings from the interviews and lesson observations, the findings from the FGD of SESEMAT trainers revealed that the trainers had adequately trained the teachers in regard to preparation and planning. Tasked to explain the steps used in training science teachers to adhere to effective lesson planning for example, one of trainers asserted:

> Six techniques of developing a good lesson plan are normally imparted in teaching science teachers during SESEMAT training. These include: achieving lesson objectives, introducing the lesson, questioning technique, choosing learners' responses to questions, dealing with learners' ideas and concluding the lesson.

This interview shows that the trainers impart relevant planning and preparation skills to the science and mathematics teachers. This is supported by yet another trainer stating:

> When preparing lesson plans, SMT are encouraged to develop initial and key questions for the lesson. The initial question relates previous/perquisite knowledge to what is to be taught. The key question includes the how, why, what; to elaborate on the skills and knowledge required from the lesson.

The trainers also trained the teachers regarding how to integrate assessment into planning and lesson preparation. They generally cautioned that any approach that relies on a sequence of pre-structured questions does not provide students with adequate time to explore their own responses. They added that in teaching sciences and mathematics, pre-structured questions should allow enough time to organize students' exploration of their own responses to situations. Moreover, such questions must be structured to inspire students' wonder and interest, which enhance participation and self-confidence.

On the whole, while the responses from the trainers in the FDGs indicate the imparting of relevant skills, the evidence from the interviews and classroom observations largely contravene this, as they demonstrate gaps in teachers' planning and preparation

Further still, in response as to how challenges to planning and preparation could be overcome, the Directors of studies from school A, B,C D, E and F suggested that schools should introduce departmental and/or team working during planning and preparation. This is particularly well illustrated in the interview of one Director of Studies who affirmed:

> There is need to introduce departmental scheming and notes-making so that through team work, experienced SMT can collectively spare time and collaboratively accomplish the tasks, adopt the use of ICT to obtain reference materials and videos, encouraging use of networking using SESEMAT plat forms for SMT to exchange ideas, improving on support supervision by HODs, administrators and SESEMAT staff.

These suggested interventions articulate what was generally perceived of as adequate mechanisms for improvements in the teaching of science and mathematics.

Additionally, the findings in table 4.4 indicate that majority of the respondents (59.3%) said that science teachers did not at all follow correct steps and procedures in teaching. This implies that most science lessons lack proper structure in form of introduction, body and conclusion. This was confirmed during the lesson observation in which the researcher observed that while there was a scheme of work and lesson plan in S. 2 West in School C, the teacher was not certain of the number of students he had planned for. The teaching methods were neither clear nor appropriate. For example, while the teacher included "illustration" as a method of teaching, he did not specify whether the illustration would for example take the form of demonstrations and/or role-play. The lesson flow was also silent on students' activities especially at development level of the lesson, making the lesson largely teacher centered rather than student centered. And finally, assessment was not planned for in the lesson plan.

This contravenes the SESEMAT training, which emphasizes structure in the lesson, as well as selection, description and justification of materials and methods to be used for teaching. Indeed during the FDGS the trainers explained that science teachers should be able to use the format of

modern lesson planning to write their lesson notes in order to teach science and mathematics concepts by adopting and adhering key principles taught to them during INSET;

> Teachers should build on students' natural interest in the subjects, and on their intuitive and informal science knowledge; teachers should encourage inquiry and exploration to foster problem-solving and mathematical reasoning; teachers are expected to use both formal academic lessons and everyday life activities as natural vehicles for developing children's mathematical knowledge; Providing a mathematically rich environment and incorporating the language of mathematics throughout the school day could be effective; teachers are also advised to use literature to introduce both science and mathematical concepts, and then reinforce them with hands-on activities.

The findings seem to indicate that while SESEMAT trainers affirm that INSET is adequate for improving science and mathematics teachers' practice, the SMT abused it by failing to implement what they had been taught and hence failing the realization of SESEMAT goals and objectives as well as achievement of educational goals.

The correlation between in-service training and science/mathematics teachers' planning and preparation was established and the findings are illustrated in Table 4.5 below.

Table 4.5: Correlation between in-service training and science/mathematics teachers' planning and preparation

		in-service training	**science teachers planning and preparations**
in-service training	Pearson Correlation	1	.246(**)
	Sig. (2-tailed)		.000
	N	86	86
science teachers planning and preparations	Pearson Correlation	.246(**)	1
	Sig. (2-tailed)	.000	
	N	86	86

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

The relationship between in-service training and science/mathematics teachers' planning and preparations is statistically significant since .000 is less than 0.05(95% confidence level). The table shows that there is a positive relationship between in-service training and science teachers planning and preparations because the two variables are moving in the same direction (Pearson

(r)= .246**) sig value P (value) being 0.01>.000,N is the sample size (86) with a sig value .000. This means that the relationship between in-service training and science teachers planning and preparations is weak since .000 is less than 0.05(95% confidence level). This would imply that as in-service training is improved, the science teachers' planning and preparations would also be enhanced therefore in-service training should be improved to enhance science teachers' performance in terms of planning and preparations.

The result on table 4.5 showed that the calculated r-value (.246) is greater than t-critical value (0.05) at $p<0.05$ is significant. Hence, the alternate hypothesis (H_a) is accepted while the null hypothesis (Ho) is rejected. This implied that there is a significant positive relationship between in-service training and science teachers planning and preparations in secondary schools of Mukono District. This suggests that improving in-service training would enhance the teachers' planning and preparations. Therefore in-service training should be improved in order to heighten science teachers' performance in terms of planning and preparation.

4. 4. In-service Training and Science/Mathematics Teachers' Teaching Methodologies

In addressing the second objective, which was to analyze the relationship between in-service training and science/mathematics teachers' teaching methodologies in secondary schools in Mukono District, respondents completed a five point Likert scale [i.e. strongly agree (5), Agree (4), Not sure (3), Disagree (2) Strongly disagree (1)]. Quantitative data was gathered using a questionnaire and merged with qualitative data from the interview results and FGD. Information from science teachers was presented and analyzed using frequencies and percentages summarized Table 4.6 below:

Table 4.6: Descriptive Statistics on In-service Training and Science/Mathematics Teachers' Teaching Methodologies

No	In-service Training and Science/mathematics Teachers' Teaching Methodologies	SA		A		N S		D		SD	
		F	%	F	%	F	%	F	%	F	%
1	In-service training addresses content mastery by teachers	12	14	10	12	02	2	25	29	37	43
2	INSET aids science/mathematics teachers to design and use of locally available resources to build students' real life situations	8	9	13	15	03	3	33	38	29	34
3	INSET develops skills in science/mathematics teachers to improvise teaching/learning materials that enhance learner participation and scientific skills	15	17	08	9	04	5	31	36	28	33
4	INSET advocates for use of direct instruction (lecturer method) as a method of teaching sciences/mathematics as most effective teaching methods for slow learners	11	12.7	09	10.5	03	3.5	31	36	32	37.2
5	INSET requires science/mathematics teachers to use inquiry-based method, where learning takes a lot of time, energy and planning but it is often very effective	17	20	14	16	06	7	22	26	27	31
6	INSET trains science teachers on the use of student-centred and student-directed teaching methods for extreme conceptualisation of science subjects and mathematics	6	7	8	9	5	5.8	38	44	29	34
7	INSET has enabled science teachers to apply cooperative Learning method (Peer-to-Peer methodology) of teaching mathematics and science subjects.	7	8.1	6	7	2	2	40	47	31	36
8	In-Service training allows science teachers to apply demonstration (teaching through examples or experiments) to promote sciences/mathematics	17	20	12	14	1	1	24	28	32	37

9	Demonstrations help to reinforce students' memory retention for the real-world application of those facts.	20	23	12	14	03	3	21	24	30	35
10	INSET equips science/mathematics teachers with appropriate teaching pedagogy and competencies (teacher skills, attitudes and values) that improve their performance.	11	13	05	6	03	3	41	48	26	30
11	When students work in buzz groups (brain storming/ discussion, question &answer Method), they spend approximately 20 minutes studying a topic and gathering information	13	15	09	10	05	06	33	38	26	30
	Overall total (946)	**137**		**106**		**37**		**339**		**327**	

Source: *Primary Data (2017)*

Table 4.6 above provides the summary of the findings on in-service training and science /mathematics teachers' teaching methodologies. The teaching methodologies were measured in terms of content mastery, development of science teachers' use of inquiry-based method, use of student-centered methods, use of cooperative learning and teacher demonstration resulting from in-service training.

Based on the overall response 666 (339+327 which is 70.6%) out of 946 disagreed with the view that in-service training by SESEMAT positively influenced science teachers' teaching methodologies while only 243 (137+106) which is 25.7% agreed the with the view. This implies that majority of the respondents disagreed that in-service training and science teachers' teaching methodologies were sufficient/significant to influence desirable science teachers' performance in Mukono district government secondary schools.

Further, Table 4.6 shows that 38(44%) of the respondents disagreed, 29(34%) strongly disagreed that INSET equipped science teachers on either the use of student-centred and student-directed teaching methods as well as on the conceptualisation of science subjects and mathematics while

6(7%) agreed and 8(9%) strongly agreed with the idea. This indicates that the majority of the teachers did not appreciate SESSMAT's training in regard to equipping them with students cantered and student directed teaching methods (as supported by 78% combined disagreement response).

In addition to the quantitative data, the interview with the DEO held on 27thOctober 2017 about the teaching methods mostly used by Science and Mathematics Teachers (SMT) revealed that:

> Some SMT ask questions and guide learners how to answer them; others use demonstration method for instance to explain how the periodic time for an oscillation of a pendulum bob is obtained. Some SMT use experiments to teach practical following the written practical manuals and guides whereas fewer SMT used field trips to teach learners about the process of soap manufacturing in the industry.

This qualitative data supports the quantitative data, affirming that the science/mathematics teachers use more of teacher-centered methods of teaching science and mathematics rather than using student centered methods as recommended by SESSMAT. This was corroborated by the classroom observation which illuminated the dominant use of questions and answer, dictating notes, teacher trying out experiments on behalf of learners and persistent use of recycled experiments which seem to deny learners creativity, contrary to the teaching methodologies as advocated for by INSET.

Furthermore, Table 4.6 above illustrates that 62 (72%)of the respondents revealed that INSET did not aid science teachers to design or use locally available resources to build students' real-life situations whereas only 22 (26%) agreed with the opinion. This means that teachers were not equipped to improvise in using local materials to support teaching and learning. This contravened the interview with some of the key informants. The Directors of Studies for example, when interviewed on how in-service training had improved the teaching methodology used by Science and Mathematics Teachers on 23rd October 2017, revealed that:

> INSET has helped SMT to improvise teaching-learning aids, make use of modern methods of teaching such as ICT in teaching which includes the use of projectors and YouTube videos. INSET has also provided exposure to SMT in different methods of teaching to increase their confidence but this has not facilitated teachers' paradigm shift from the use of pre-service traditional-teacher centered methods to more practical hands on learners-based methods.

Unlike the questionnaires, the FGDs held on 14th October 2017, with SESEMAT trainers indicated similar results to the interviews with the Director of Studies on the appropriate methods of teaching sciences, stating that "though they provide training on how to apply the different methods, science teachers often use each technique in their courses differently depending on their respective levels of conceptualization".

Additionally, the findings in Table 4.6 further indicated that 63 (73.2%) of the respondents said that INSET advocates for use of direct instruction (lecturer method) as a method of teaching sciences/mathematics as the most effective teaching method for slow learners. This was refuted by 20(23.2%) of the respondents. This implies that the use of lecture method dominated the teaching of science and mathematics. This is corroborated in the qualitative data obtained from the deputy head teacherson 4th October 2017, when asked about the teaching methods SMT use. As an example, one of the deputy head teachers asserted:

> Most SMT use teacher centered approaches by dictating and explaining notes while students listen as they take notes. It also worsens as students just see the teacher carrying out the experiment in form of teaching practical.

This is corroborated in the lesson observations as observed for example during a physics lesson in S. 3 East in School A where the researcher observed a lesson on the topic "Light and the subtopic "Reflection on Curved Surfaces." The teaching methods employed were teacher centered, including demonstration as well as chalk and talk. The lesson plan did not reflect the teaching aids even if some were used during the lesson. Not only were the learning objectives not SMART but the lesson flow depicted teacher-centeredness, in which the teacher was more active than the students. Additionally, assessment was not integrated within the lesson plan.

SMT seem to have used lecturer method for such a long time, such that the INSET has seemly done little to change their classroom practices in terms of taking up more progressive methods of teaching for sciences and mathematics as recommended by SESSMAT.

The quantitative result agrees with qualitative results from the interviews, FGDs and lesson observation, which indicate more use of teacher-centered methods than learner-centered

methods. The use of teacher-centered methods has made SMT master the subject matter themselves rather than equipping learners. The lesson plans are also devoid of well-planned learner centered methods, which can be used to improve performance.

Additionally, the findings in Table 4.6 further indicate that 49 respondents out of 86 (57%) disagree that INSET requires science teachers to use inquiry- based methods where learners take a lot of time and energy while37 (36%) of the respondents agreed. This implies that learners are not required to plan and carryout investigations, engage in arguments from evidence, analyze and interpret data and/or construct explanations.

The above is not in line with trainers' emphasis during FGD conducted on 14th October 2017 regarding how in-service training affects science teachers' teaching methodologies in secondary Schools of Mukono District, indicating that "SESEMAT trainings divulge quality education and enforce use of modern pedagogical methods rather than traditional, teacher-centered techniques to secondary school science teachers". Indeed, one of the trainers advised SMT asserting that:

> Instead of memorizing concepts and knowledge, science teachers should instill in students' critical minds through questioning and discussion, and through early learning. Information should be made meaningful to students in order to establish permanent learning, added the SESEMAT staff.

Additionally, yet another trainer, during an FDG conducted on 14th October 2017 provided some advice regarding the adoption of modern teaching methods as imparted during in-service:

> Science teachers cannot attain or reach this goal without employing effective pedagogical methods attained during SESEMAT training that cover; problem solving, inquiry-based teaching, discovery, games, lecturing, and case studies, among others and to draw attention to effective teaching and learning processes.

The respondents also provided insights into the characteristics of modern teaching methods used in the teaching of science and mathematics. Results for example from FGDs conducted on 14th October 2017with SESEMAT trainers explain: "the mixed method (student-centered together with teacher-centered) plus proper planning and learners readiness are ideal for modern teaching."

In regard to what interventions can be embraced to facilitate SMTs' utilization of modern teaching methods, deputy head teachers generally indicated the importance of integrating ICTS, the use of modern methods of teaching as well as vigilance in supervision. Specifically, one of the deputy head teachers interviewed on 18thOctober, 2017 had this to say:

> The major issue is provision of ICT equipment especially projectors to schools, coupled with more training on the use of ICT equipment and materials as well as more sensitization of SMT on the rationale for using modern teaching methods, enforcing strict lesson observations, supervision and monitoring as well as regular follow up of the SESEMAT training needs and outcomes.

Similarly, the DEO provided some suggestions regarding interventions to improve SMT performance in Mukono District, asserting that "SMT need to integrate ICT in the teaching and learning of science and mathematics to encourage learners appreciate and uphold hands on. For instance, through inquiry-based methods, field trips and group discussions" This was supported by some interviews such as the head teacher who emphasized the importance of INSET affirming:

> Science teachers are able to adapt the new and modern teaching methods, which improve the teaching of science and mathematics by imparting science, and mathematical skills, which learners apply in their social life such as overcoming difficulties that require the establishment of an effective learning environment.

The head teachers also suggested some interventions to improve SMT performance in Mukono District including instilling confidence in science teachers through inculcating positive attitudes. This as they explained is likely to motivate teachers and boost their morale towards their profession as teachers of science and mathematics. The head teachers also recommended that science and mathematics teachers carry out action research, using it to explore methods of teaching in order to take up best practices for teaching science and mathematics as informed by research. Teachers should collaborate to plan, observer and project on the lessons; Innovate through for example carrying out experiments; promoting student voice, through which students are given the opportunity to give feedback on teaching and take action to improve learning.

Overall, the findings indicate that SMT did not put in practice the use of new teaching methodologies learnt during INSET. There was inadequate provision and use of equipment such as computers and projectors, which are likely to compromise the adoption of modern methods of teaching. Such equipment can aid research and networking among in-service trained science and

mathematics teachers. Nonetheless, this can be improved through feedback from different stakeholders such as SESEMAT trainers as well as education managers to collectively work with teachers towards embracing modern pedagogical skills to support teaching and learning of science and mathematics.

The correlation between in-service training and science/mathematics teachers' planning and preparation was established and the findings are illustrated in Table 4.7 below:

Table 4.7: Correlation between in-service training and science/mathematician teachers' teaching methodologies

Correlations

		in-service training	science teachers' teaching methodologies
In-service training	Pearson Correlation	1	.276(**)
	Sig. (2-tailed)		.000
	N	86	86
Science teachers' teaching methodologies	Pearson Correlation	.276(**)	1
	Sig. (2-tailed)	.000	
	N	86	86

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

Source: Primary data

The relationship between in-service training and science/mathematics teachers' teaching methodologies is weak relationship since .000 is less than 0.05(95% confidence level). The above table shows that there is a positive relationship between in-service training and science teachers' teaching methodologies because the two variables are moving in the same direction (Pearson (r)= .276**) sig value P(value) P < 0.05=000,N is the sample size (86)with a sig value .000. This means that the relationship between in-service training and science teachers' teaching methodologies is weak since .000 is less than 0.05(95% confidence level). This implies that improving in-service training enhances effective and efficient science teachers' teaching methodologies, which in turn would lead to, increased science teachers' performance.

Therefore, there is a statistically significant relationship between in-service training and science teachers' teaching methodologies in secondary schools of Mukono District. In Hypothesis testing, if the significance value of the test is greater than the predetermined significance level (0.05), then we accept the null hypothesis. If the significance value is less than the predetermined value, then we reject the null hypothesis. For example, to see the degree of relationship between in-service training and science teachers' teaching methodologies, the significance value of the correlation coefficient if greater than the predetermined significance level, then was accept the null hypothesis and conclude that there was no relationship between the in-service training and science teachers' teaching methodologies.

The result in table 4.7 showed that the calculated r-value (.276) is greater than t-critical value (0.05) at $p<0.05$ is significant. Hence, the alternate hypothesis (H_a) is accepted while the null hypothesis (Ho) is rejected. This implied that there is a statistically significant relationship between in-service training and science teachers' teaching methodologies in secondary schools of Mukono District

4. 5. In-Service Training and Science/Mathematics Teachers' Assessment of Learners

The third objective of the study was to examine the influence of in-service training on science/mathematics teachers' assessment of learners in secondary schools in Mukono District. Respondents provided their views in regard to the extent to which they strongly disagree (1), Disagree (2), Not sure (3), Agree (4), strongly agree (5) with statements that address the relationship between in-service training and science/mathematics teachers' assessment of learners in secondary schools in Mukono district. This is presented and analyzed based on frequencies and percentages as illustrated in the Table 4.8 below:

Table 4.7: Descriptive statistics on In-Service Training and Science/Mathematics Teachers' Assessment of Learners

No	Responses on In-Service Training & Science/Mathematics Teachers' Assessment of Learners	SA		A		N S		D		SD	
		F	%	F	%	F	%	F	%	F	%
1	In-service training helps science teachers to adopt desirable assessment techniques and evaluation skills for teaching and learning sciences	15	17	13	15	2	2	21	24	35	41
2	Science teachers frequently obtain feedback on lessons taught	17	20	10	12	2	2	23	27	34	40
3	INSET evaluates trained teachers through getting regular insight on student learning of sciences	14	16	14	16	4	5	29	34	25	29
4	Through frequent assessment and feedback, effective teachers regularly assess what they do in the classroom and whether their students are really learning	10	12	18	21	4	5	24	32.6	30	34.9
5	School administrators assess and evaluate the performance of science teachers ability to perform before and after INSET	12	14	15	17	5	6	26	30	28	33
6	INSET asks science teachers to try and anticipate the topics and concepts that are difficult for their students and to develop teaching strategies that present these topics in ways their students will best understand	15	17	12	14	7	8	22	26	30	35
7	In-service training helps science teachers to determine what students know.	11	13	6	7	3	3	33	38	33	38

8	Assessment and evaluation helps science teachers to know if the students' preparation is spotty or incomplete or if they find it harder to grasp the new material.	18	21	10	12	1	1	23	27	34	40
9	Administering tests homework, exercise, end of term exams, and mini-quizzes can help identify which students are keeping up and which need help	15	17.4	10	11.6	3	3.5	28	32.5	30	34.8
10	Assessment helps science teachers identify students with a range of academic abilities, interests, skills, and goals in preparation, abilities and learning styles for effective teaching	14	16	10	12	2	2	25	29	35	41
11	In-service training requires science teachers to try to sample how well their students are learning.	10	12	20	23	3	3.5	31	36	22	26
12	In-service training aids science teachers to study the evaluation programmes that consist of evaluating the cognitive and knowledge parts only	13	15	18	21	4	5	25	29	26	30
	Overall total (1032)	**164**		**156**		**40**		**310**		**362**	

Source: *Primary Data (2017)*

The overall summary of the findings in Table 4.8 shows that 672 (310+362) responses out of 1032 representing 65.1% compared to 31%[(164+156)/1032 *100%] disregarded with the view that in-Service training enhanced science/mathematicians teachers' assessment of learners in secondary schools in Mukono district. This implies that the majority of the respondents disagreed that in-service training enhanced or developed science teachers assessment potentials in Mukono district..

Table 4.8 shows that the majority56 (65%) of the respondents disagreed that in-service training helped science teachers to adopt desirable assessment techniques and evaluation skills for teaching and learning sciences/mathematics while only 28(32.5%)agreed with the view. This

implies that Mukono science/mathematics teachers were not aided to conduct proper assessment of sciences and mathematics, which is an indicator of poor teacher performance.

Interviews with the Directors of Studies in Schools A, B, C, D E and F, in regard to the methods SMT use to assess and evaluate the teaching and learning in Mukono, revealed that most SMT use test questions (for the beginning of term, exercises at both the end of lesson or topic, mid-term and end of term examinations) that encourage cram work rather than critical thinking. They rarely assess practical or project work. This contravenes INSET's recommendations to use continuous assessment, discussions, group tests, practical lessons through experiments, project work and unit tests. The findings generally reveal that SMT hardly implement what they are taught during workshops, seminars and conferences organized by SESEMAT.

Overall, both qualitative and quantitative information above indicate that while SESEMAT recommends use of diagnostic, formative and summative assessments, which SMT are sensitized about during the training, SMT dominantly use summative assessment.

Results in Table 4.8 show that17 (20%) of the respondents accepted that in-service training helped science/mathematics teachers to determine what students know while 66(72%) refuted the idea. The implication of this finding is that SMT acquired less knowledge from INSET specifically in terms of adopting proper assessment techniques in regards to diagnostic assessment, which would help them understand their students' learning needs. This was corroborated during the lesson observation of a physics lesson in S. 3 East within in School A in which the teacher taught "Reflection in curved surfaces". Although the teacher had a lesson plan and demonstrated adequate knowledge of the subject matter, assessment was not integrated into the lesson plan since it was not reflected in the introduction, body and conclusion.

Overall, the lesson observations illuminated that the teachers did not follow SESEMAT approach of stating the rationale of the lesson, improvisation as well as learner centered activity-based approaches such as experimentation were ignored and skills that learners would achieve by the end of the lesson undefined. The use of initial and key questions were also overlooked leading to

.a more theoretically conceptualized rather than practically conceptualized grasped of content, which is likely to inform inadequate assessment, compromising teachers' performance.

The findings in Table 4.8 also indicate that 57(67%) of the responses stated that there were no frequent assessment and feedback. This was refuted by 17 (32%) of the respondents. This meant that SMT in Mukono District secondary schools did not dominantly use formative assessment as recommended by SESEMAT during INSET. Therefore, the use of formative assessment which informs both teachers and students about student understanding at a point when timely adjustments can be made could not be achieved. Additionally the lesson observations generally revealed that classroom assessment techniques which include sets of specific activities like observation of learners' behavior and participation, brainstorming, goal setting, peer assessment, which as recommended by SESSMAT, can be used to quickly gauge students' understanding of content were overlooked within the selected schools in Mukono district.

The above findings contradict the FGDs in which SESEMAT trainers were asked to discuss the impact of INSET in preparing SMT in regard to assessment. Some of the responses are highlighted below:

> The introduction of "Assessment by Testing" as a SESEMAT Activity Region Based (SARB) activity for Mukono area has provided tests for senior two and senior three, administered and marked jointly, marking guides made and results analyzed after marking. The students' misconceptions are identified and there after remedial lessons carried out.
>
> The training has encouraged the ideology of continuous assessment through administering senior two pre-test and senior three post-tests.
>
> Questioning techniques have also been improved upon where SESEMAT encouraged asking specific questions relating to the objectives for instance initial questions when introducing a lesson and key questions when building the body of the lesson. However, we note that SMT have not embraced the modern and efficient means of assessment such as use of local materials, remedial lessons, adjusting questioning techniques which is very disappointing.

Assessment by testing, a SARB for Mukono SESEMAT region plus use of initial and key questions during teaching are examples of formative ways of assessment emphasized by SESEMAT INSET which, if implemented would enhance teachers' performance in science and mathematics. Through this approach SMT have been encouraged to analyze learners'

performance from tests and examinations where remedial lessons are conducted upon identifying misunderstandings.

Further still, the findings in Table 4.8 above show that 58(67%)of the respondents disregarded with the view that administering tests, homework, exercises, end of term exams, and mini-quizzes helped identify which students were keeping up and needed help while 25(29%) were in support of the view.

This finding is supported by interview results from the key informants in which they revealed that, SMT did not conduct formative assessments periodically to determine at a particular point in time what students know and do not know. Such tests as recommended by SESSMAT can be conducted for example at the end of topic or unit test, end of term, as well as the end of year. In-service training guides science/mathematics teachers to focus on lesson evaluation both as lesson progresses and at the end of the lesson. The lesson observations also showed that the science/mathematics teachers did not monitor learner progress continually through questions, explanations and ability to follow procedures in bid to allow learners grow in knowledge and skills, making necessary instructional adjustments where possible.

Contrary to the above, is a chemistry lesson observation in School C in which the teacher taught "Acids, Bases and Salts" to in S. 2 Red. The lesson plan followed the desired SESEMAT format where rationale was provided in relation to content, value, strategy and position. The lesson objectives were SMART and clearly spelt out, appropriate methodologies involving hands-on activities were used and assessment was well done. This however was not a dominant performance within schools in Mukono district. ,

During interviews the Head teachers, deputies, Directors of Studies and DEO provided some suggestions in regard to interventions to improve SMT's performance in terms of assessment, some of which are included below:

> SESEMAT need to improve on their INSET training methodology such as improvisation, inquiry approach, group work and peer teaching in bid to entice SMT to map content with assessment.
>
> Continuous assessment should be encouraged and other methods of assessing skills and application of knowledge to encourage deep learning.

SESEMAT was a JICA project drawn from Japan but not suitable for Uganda's education system. There is need to conduct benchmarking from developing countries to establish better ways of transforming the teaching and learning of science other than over reliance of SESEMAT as the only sole approach for improving science and mathematics teaching.

The above outcome implies that some of the stakeholders are not comfortable with the methodology and implementation of SESEMAT INSET, necessitating training needs assessment.

The correlation between in-service training and science/mathematics teachers' assessment of learners in secondary schools in Mukono district is illustrated in Table 4.9 below:

Table 4.9: Correlation between in-service training and science/mathematics teachers' assessment of learners

		in-service training	assessment of learners
in-service training	Pearson Correlation	1	.476(**)
	Sig. (2-tailed)		.000
	N	86	86
assessment of learners	Pearson Correlation	.476(**)	1
	Sig. (2-tailed)	.021	
	N	86	86

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

Source: Primary data

The relationship between in-service training and science/mathematics teachers' assessment of learners is statistically significant since .000 is less than 0.05(95% confidence level). Science/mathematics teachers' assessment of learners in secondary schools in Mukono District (Pearson (r) = .476**) sig value P(value) P = 0.021 being less than 0.05=000, N is the sample size (86). According to table 4., in-service training had an r-value of .476 indicating a moderate relationship between in-service training and science teachers' assessment of learners in secondary schools of Mukono District. In addition, the relationship between in-service training and science teachers' assessment of learners in secondary schools in Mukono District was positive. Therefore, in-service training is positively correlated to science teachers' assessment of learners in secondary schools of Mukono District.

In summary, this chapter illuminated the findings reflecting the relationship between in-service training and science/mathematics teachers' performance in secondary schools in Mukono district. The findings generally reveal the science and mathematics teachers' gaps in terms of planning and preparation, teaching methodologies and assessment. They also generally reveal that the in-service training had hardly impacted these teachers' skills. This contradicts the trainers, who generally affirmed that the teachers had adequately been equipped in terms of planning and preparation, teaching methodologies as well as assessment in order to improve their performance in this regard.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

5. 0. Introduction

The study focused on investigating the relationship between in-service training and science teachers' performance. Specifically, the study sought to establish the effects of SESMAT in-service training program on science teachers' performance in selected secondary schools in Mukono district in Uganda, in order to find ways of effectively developing teachers' human capital to optimize their performance. This chapter presents the discussion of the major findings, conclusions and recommendations as drawn from the study objectives.

5. 1. Discussion of the Key Findings

The investigation was guided by three objectives including: to examine the relationship between in-service training and science teachers planning and preparations in secondary schools of Mukono District; to establish the relationship between in-service training and science teachers' teaching methodologies in secondary schools of Mukono District and, to assess the influence of in-service training on science teachers' assessment of learners in secondary schools of Mukono District.

5. 1. 1. In-service Training and Science/Mathematics Teachers' Preparation and Planning

This section discusses the findings on the first objective of the study, which focused on investigating the relationship between in-service training and science teachers' planning and preparation in secondary schools.

As shown in Table 4.1, the majority, 66.07% disagreed that in-service training of science/mathematics teachers in planning and preparations was adequate enough to influence desirable science teachers' performance in selected schools in Mukono District. Likewise, the majority 67.5% disagreed that INSET enhanced science teachers with adequate skills to select and sequence content and methodologies in line with the curriculum, syllabus, schemes of work

and lesson plans. Moreover, 69.6% could not distinguish curriculum from syllabus, and yet each of these is a primary tool for planning and preparation for teaching. Additionally, 65.1% reported an inability to derive lesson plans from the schemes of work. The lesson plans also showed gaps in the structure of the lesson, with the absence for example, of initial questions to introduce and connect the previous lesson to the current one. The body of lessons was also generally described with inadequate detail to reflect students' activities, making the lesson largely teacher centered rather than student centered. This contravenes the SESEMAT training, which emphasizes structure in the lesson, as well as selection, description and justification of materials and methods to be used for teaching. And finally, assessment was not planned for in the lesson plan. The qualitative data generally corroborated the quantitative data as stakeholders expressed concern that despite the in-service training, SMT continued to experience difficulty in planning and preparation in addition to presenting lesson plans which reflected inauthentic rather than authentic/local teaching materials as well as more teacher-centered rather than leaner centered methods as recommended by SESSMAT.

Despite INSET therefore, there are gaps as indicated by the failure for the majority of SMT to distinguish curriculum and syllabus which are primary planning and preparation resources and educational policies; inability to select and sequence content and methodologies in line with the curriculum, syllabus, schemes of work and lesson plans; failure to derive lesson plans from the schemes of work; gaps in the structure/development of lesson plans which reflected more teacher centered rather than learner centered lessons, absence of lesson plans in some of the lesson and, finally, the absence of assessment within lesson plans.

As Akker's (2009) study established for example, the failure to distinguish between curriculum and syllabus shows that science and mathematics teachers are inadequately prepared, trained, supervised and supported in their work. Similarly, Thijs & Akker (2009) provided that the selection and the sequencing of learning content and methodologies thereof take place in the curriculum, syllabus, scheme of work and lesson plan stages. Indeed other studies have emphasized the importance of lesson plans and schemes of work as very important planning tools, which guide teachers in planning the units of instruction and consequently the daily lessons in line with the school timetable (Attaran, 2012; Okai, 2010; Okobia, 2013). As Thijs &

Akker (2009) explain, curriculum, syllabus, schemes of work and lesson plans are important planning and preparation resources. Nevertheless, the difference among them is not usually clear to a significant number of teachers, and, the failure to distinguish between these documents, which are evident from the current study, shows that teachers are inadequately prepared, trained, supervised and supported in their work.

The gap in the teachers' knowledge and skills therefore, implies that SESEMAT did not conduct successful training of SMT to build capacity for adequate planning and preparation. These findings concur with CEMASTEA (2010) who revealed that INSET programs had not greatly impacted on SMT performance. This was attributed to the misalignment between the content covered during teacher training in Uganda and the subject matter a teacher is going to teach in the classrooms.

Contrary to these findings however, the SESEMAT trainers revealed that they had adequately trained the teachers in regard to preparation and planning. They had for example, equipped the teachers with some techniques of developing a good lesson plan, which include: achieving lesson objectives, introducing the lesson, questioning technique, choosing learners' responses to questions, dealing with learners' ideas and concluding the lesson. The trainers also explained that they had trained the teachers regarding how to integrate assessment into planning and lesson preparation, advising them to use it to inspire students' wonder and interest, which enhance participation and self-confidence.

There mismatch between the teachers outcomes in terms of planning and preparation, and the SESSMAT trainer's assertion regarding the training provided to equip the teachers with requisite skills is evident. The implication is that while SESEMAT trainers had trained the teachers, the teachers failed to implement what they had been taught, hence failing the realization of SESEMAT goals and objectives as well as achievement of educational goals. This according to CEMASTEA (2010) can be attributed to incompatibility between SESEMAT programs, which are based on a model from Japan, and the Ugandan classroom context.

However, the significant positive relationship between in-service training and science/mathematics teachers' planning and preparations in secondary schools of Mukono District nonetheless, suggests that improving in-service training would enhance the teachers' planning and preparations. Therefore in-service training should be improved in order to heighten science teachers' performance in terms of planning and preparation. This is supported by Kariisa (2015) whose study established that SESMAT, if adequately implemented, has the potential of strengthening teacher's competence in planning and preparation through the activities related to content and objectives of the curriculum.

5. 1. 2. In-service Training and Science/Mathematics Teachers' Teaching Methodologies

This section discusses the findings on the second objective of the study, which focused on the relationship between in-service training and science/mathematics teachers' teaching methodologies in secondary schools in Mukono district.

The majority, 70.6% as illustrated in Table 4.6 disagreed with the view that in-service training by SESEMAT positively influenced their teaching methodologies. Further, 78% disagreed that INSET equipped science teachers on the use of student-centred and student-directed teaching methods as well as on the conceptualisation of science subjects and mathematics. Additionally, 72% revealed that INSET did not aid them to design or use locally available resources to build students' real-life situations. Further, 73.2% of the respondents said that INSET advocates for use of direct instruction (lecturer method) as the most effective teaching method for slow learners.Additionally, 57% disagreed that INSET requires science teachers to use inquiry-based methods, which provide opportunities for learners to learn in a more practical way. This was corroborated by some of the deputy head teachers who explained that most SMT use teacher centered approaches by dictating and explaining notes while students listen and take notes. This was corroborated by the classroom observation which illuminated the dominant use of question and answer, dictating notes, teacher trying out experiments on behalf of learners and persistent use of recycled experiments which seem to deny learners creativity, contrary to the teaching methodologies advocated for by INSET. This qualitative data generally supports the quantitative data, affirming that the science/mathematics teachers use more of teacher-centered methods of

teaching science and mathematics rather than using student centered methods as recommended by SESSMAT.

These findings however contravened the interviews with some of the key informants. The Directors of Studies for example, explained that in fact, in-service training had improved the teaching methodology used by SMT. It had helped them to improvise teaching-learning aids, make use of modern methods of teaching such as ICTs including the use of projectors and YouTube videos. INSET had also exposed SMT to different methods of teaching thereby increasing their confidence. The Directors of Studies generally explained however, that this has not facilitated teachers' complete paradigm shift as some of them continued to use pre-service traditional teacher centered methods instead of more practical hands-on learners-based methods. The SESEMAT trainers indicated similar results to the Director of Studies explaining that they had equipped SMT with appropriate methods of teaching and how to apply them to enhance comprehension and application of concepts. The trainers generally explained that the in-service training had emphasized the use of modern pedagogical methods rather than traditional, teacher-centered techniques to secondary school science/mathematics teachers. They provided some examples of methods that the teachers had been equipped with, including problem solving, inquiry-based teaching, discovery, games, lecturing, and case studies, among others.

Overall, the findings indicate that SMT did not put in practice the use of new teaching methodologies learnt during INSET. While Gituthu (2013) for example commends the use of learner-centered methodology, conducted through the activity-student-experiment-improvisation (ASEI), pedagogic paradigm and the plan-do-see-improve (PDSI) as also recommended by approach by SESEMAT, this was not evident in SMT's teaching methodologies. This is arguably attributable to SMT's preference of methods requiring less preparation and effort, such as question and answer and demonstration, rather than methods requiring greater preparation and materials, such as scenario and case study methodologies. This is supported by studies, which criticize the use of direct instruction, and/or lecture method, which are considered simplest for the teacher to cover large amounts of work in a short period of time (Nuangchalerm, 2011; Udofia & Ikpe, 2012). However, this is not the most effective teaching method to reach all

students especially the slow learners and the lower secondary students, who often need more engaging hands-on strategies in order to learn effectively.

As scholars recommend, in-service training should enhance a variety of teaching strategies/methodologies, which science/mathematics teachers should use to build students' competences in science and mathematics (Almani, 2007; Kasirye, 2009; Makhdoom, Khalid, Ziarab & Ishtiaq, 2011; Udofia & Ikpe, 2012). Indeed, Makewa, Role and Biego, (2011) advocate for cooperative learning as effective for teaching science subjects as students work in small mixed ability groups, which the teacher periodically monitors, to ensure that all students participate and remain focused on tasks. Demonstration has also been advocated as one of the methods that can be used in the science/mathematics classrooms to support learning as they help to raise students' interest and reinforce memory retention because they provide connections between facts and the real world application of those facts (Essel, Badu, Owusu and Saah, 2009; Hanushek and Wosmann, 2010; Yiğit and Altun, 2011). Similarly, inquiry-based learning has been recommended as a method that is often effective for problem solving and critical thinking, although it takes a lot of time, energy and planning. It is extremely student-centered and student-directed and can be modified for students at any level (Botha and Reddy, 2011; Rahmati, Hosseinifard and Alimadadi, 2014).

The contradiction between the SESMAT trainers' assertions that the SMT had been equipped with relevant methodology and the assertions by the SMT that they had not been adequately equipped is evident. While it can be partly attributed to the teachers' lack of appreciation and/or failure to implement the imparted methodological skills, it can also be arguably attributed to gaps in the trainers' competences. As some scholars explain, achieving appropriate teaching methodologies and competencies requires in-service trainers who are committed and skilled to provide high quality in-service training and contribute to curriculum development (Kebaso, 2012; Schneider and Plasman, 2011). It also requires the opportunities and resources for the trainees (science teachers) to benefit from being mentored, school-based teaching practice and for the development of partnerships between schools and teacher education institutions, in order to transform science teaching and meet educational goals attribute.

SMT seem to have used lecturer method for such a long time, and as such internalized it so much that the INSET has seemly done little to change their classroom practices in terms of taking up more progressive methods of teaching for sciences and mathematics. The use of teacher-centered methods has made SMT master the subject matter themselves rather than equipping learners. This implies that learners are not availed adequate opportunities to plan and carry out investigation, engage in arguments from evidence, analyze and interpret data and/or construct explanations. Nonetheless, this can be improved through feedback from different stakeholders such as SESEMAT trainers as well as education managers to collectively work with teachers towards embracing modern pedagogical skills to support teaching and learning of science and mathematics.

The failure by SMTs to use proper science teaching methods as conducted by SESEMAT is one of the indicators of ineffective human resource development in field of science /mathematics and therefore the need for more interventions if science and other related policies and innovations such as skilling Uganda are to succeed.

Indeed, the significant positive relationship between in-service training and science teachers' teaching methodologies implies that improving in-service training can enhance effective and efficient science teachers' teaching methodologies, which in turn would lead to, increased science teachers' performance.

5. 1. 3. In-Service Training and Science/Mathematics Teachers' Assessment of Learners

This section discusses the findings on the third objective of the study, which focused on the relationship between in-service training and science/mathematics teachers' assessment of learners in secondary schools in Mukono district.

The majority, 65.1% disregarded with the view that in-service training had enhanced science/mathematics teachers' assessment of learners in secondary schools in Mukono district. Additionally, 65% of the respondents disagreed that in-service training helped SMT adopt desirable assessment techniques and evaluation skills for teaching and learning sciences/mathematics. Additionally, 67% of the responses stated that there were no frequent

assessment and feedback. This meant that SMT in Mukono District secondary schools did not dominantly use formative assessment as recommended by SESEMAT during INSET. In-service training guides science/mathematics teachers to focus on lesson evaluation both as lesson progresses and at the end of the lesson. The lesson observations also showed that the science/mathematics teachers did not monitor learner progress continually through questions, explanations and ability to follow procedures in bid to allow learners grow in knowledge and skills, making necessary instructional adjustments where possible. Therefore, the use of formative assessment which informs both teachers and students about student understanding at a point when timely adjustments can be made could not be achieved. Additionally the lesson observations generally revealed that classroom assessment techniques which include sets of specific activities like observation of learners' behavior and participation, brainstorming, goal setting, peer assessment, which as recommended by SESSMAT, can be used to quickly gauge students' understanding of content were overlooked within the selected schools in Mukono district.

This was corroborated by qualitative data from the Directors of Studies in Schools which revealed that most SMT use summative questions for assessment, which encourage cram work rather than critical thinking. They rarely assess practical or project work. This contravenes INSET's recommendation to use continuous assessment, discussions, group tests, practical lessons through experiments, project work and unit tests. The findings generally reveal that SMT hardly implement what they are taught during workshops, seminars and conferences organized by SESEMAT. 72% disagreed that in-service training helped them learn how to diagnose their students' learning needs. The implication of this is that INSET did not adequately equip teachers in terms of adopting proper assessment, specifically diagnostic techniques to help them understand their students' learning needs. This was corroborated by some of the lesson observations in which the lesson plans were devoid of assessment.

However, the above findings contradict the SESEMAT trainers' perspectives in regard to equipping MST with assessment skills. The trainers explained that through SESEMAT's Activity Region Based (SARB) activity for Mukono area, tests were administered and marked, analyzed and remedied jointly. They explained that their training had encouraged the ideology of

continuous assessment through administering pre-tests as well as post-tests. Questioning techniques were also improved upon with SESEMAT encouraging the use of specific questions related to the objectives when introducing a lesson and the use of key questions when building the body of the lesson. The trainers acknowledged nevertheless, that SMT had not embraced the modern and efficient means of assessment such as use of local materials, remedial lessons, adjusting questioning techniques as recommended by SESEMAT.

Overall, both qualitative and quantitative information above indicate that while SESEMAT recommends use of diagnostic, formative and summative assessments, which SMT are sensitized about during the training, SMT dominantly use summative assessment. The use of initial and key questions were also overlooked leading to .a more theoretically conceptualized rather than practically conceptualized grasped of content, which is likely to inform inadequate assessment, compromising teachers' performance.

Such tests as recommended by SESSMAT can be conducted for example at the end of topic or unit test, end of term, as well as the end of year. According to Nwachukwu (2010), assessment should be done regularly and timely feedback provided. Indeed, as Goldhabes and Brewer (2007) as well as Barak and Mesika (2007) advise, in-service training should help science/mathematics teachers to adopt desirable assessment techniques and evaluation skills for teaching and learning—some of these include: obtaining frequent feedback on science teachers' teaching, getting regular insight on student learning, soliciting student opinion during the term and assessing a course at the end of the term. Additionally, Yara, (2009) as well as Yiğit and Altun, (2011), noted that in-service training allows science teachers to assess and evaluate whether students effectively learn what they teach. Most students with a range of academic abilities, interests, skills, and goals have differences in preparation, abilities, and learning styles are likely to be more noticeable when new information is abstract and complex. M'kiambi (2013) noted that individual students do not make uniform progress; sometimes a student reaches a plateau after a burst of learning. In-service training requires science teachers to try to sample how well their students are learning. Similarly Ajaja (2007) appeals to educational researchers to not only use of frequent assessment and feedback but also anticipate topics that are likely to be difficult

for students and develop teaching strategies that present topics in ways their students will best understand.

5. 2. Conclusions

Despite the in-service training, gaps in planning and preparation remain evident within the practices of the science and mathematics teachers. These were indicated by the failure for the majority of SMT to distinguish curriculum and syllabus which are primary planning and preparation resources; inability to select and sequence content and methodologies; failure to derive lesson plans from the schemes of work; gaps in the structure/development of lesson plans which reflected more teacher centered rather than learner centered lessons, absence of lesson plans in some of the lesson and, finally, the absence of assessment within lesson plans. This implies that SESEMAT did not conduct successful training of SMT to build capacity for adequate planning and preparation. However, the SESEMAT trainers revealed that they had in fact adequately trained the teachers in regard to preparation and planning. The contradiction between the teachers' gaps in terms of planning and preparation, and the SESSMAT trainer's assertion that they had adequately trained the teachers, equipping them with requisite skills, is evident. The implication is that while SESEMAT trainers had trained the teachers, the teachers failed to implement what they had been taught, hence failing the realization of SESEMAT goals and objectives as well as achievement of educational goals. This according to CEMASTEA (2010) can be attributed to incompatibility between SESEMAT programs, which are based on a model from Japan, and the Ugandan classroom context. Nevertheless, the significant positive relationship between in-service training and science/mathematics teachers' planning and preparations in secondary schools of Mukono District suggests that improving in-service training would enhance the teachers' planning and preparations. Therefore in-service training should be improved in order to heighten science teachers' performance in terms of planning and preparation.

As regards teaching methodologies, the qualitative data generally supports the quantitative data, affirming that the science/mathematics teachers use more of teacher-centered methods of teaching science and mathematics rather than the student centered methods. Moreover, the teachers also claim that INSET did not equip them adequately to use more progressive/modern

methods in teaching science and mathematics. These findings were however contravened by some of the stakeholders such as the Directors of Studies explaining that in fact, in-service training had improved the teaching methodology used by SMT, through exposure to diverse modern methods thereby increasing their confidence. The SESEMAT trainers corroborated this, explaining that they had equipped SMT with appropriate methods of teaching to enhance comprehension and application of concepts. The contradiction between the teachers' gaps in terms of teaching methodologies and the SESSMAT trainer's assertion that they had adequately trained the teachers is evident. The implication is that while SESEMAT trainers had trained the teachers, the teachers failed to implement what they had been taught, hence failing the realization of SESEMAT goals and objectives as well as achievement of educational goals. This is arguably attributable to SMT's preference of methods requiring less preparation and effort, and, which are considered simplest for the teacher to cover large amounts of work in a short period of time. Yet such methods are usually the least effective in reaching all students especially the slow learners who often need more engaging hands-on strategies in order to learn effectively. The contradiction between the SESMAT trainers' assertions that the SMT had been equipped with relevant methodology and the assertions by the SMT that they had not been adequately equipped is evident and can be also be attributed to gaps in the trainers' competences. As some scholars explain, achieving appropriate teaching methodologies and competencies requires in-service trainers who are committed and skilled to provide high quality in-service training and contribute to curriculum development. Well-trained trainers can create possibility for better-trained science and mathematics teachers, who take up adequate teaching methodologies. Indeed, the significant positive relationship between in-service training and science teachers' teaching methodologies implies that improving in-service training can enhance effective and efficient science teachers' teaching methodologies, which in turn would lead to, increased science teachers' performance.

Finally, in regard to the assessment of learners, the findings indicate that INSET did not enhance science/mathematicians teachers' assessment of learners nor equip SMT to adopt desirable assessment techniques and evaluation skills for teaching and learning sciences/mathematics or use frequent assessment and feedback. SMT used more summative rather than continuous/formative assessment. The implication of this is that INSET did not adequately equip teachers in terms of adopting proper assessment, specifically diagnostic techniques to help them understand their students' learning needs. This was corroborated during the by some of the

lesson observations in which the lesson plans were devoid of assessment. However, this contradicts the SESEMAT trainers' perspectives in regard to equipping SMT with assessment skills. The trainers explained that their training had encouraged the ideology of continuous assessment through administering pre-tests as well as post-tests. The trainers acknowledged nevertheless, that SMT had not embraced the modern and efficient means of assessment such as use of local materials, remedial lessons, and adjusting questioning techniques as recommended by SESEMAT.

5. 3. Recommendations

In light of these findings, the study advocates for the following interventions as guided by the objectives of the study:

First, in providing some recommendations in regard to in-service training and science/mathematics teachers' planning and preparation, SMT were encouraged to master the content through consulting reference materials recommended by NCDC, practicing scheming and lesson planning as well as diligently making lesson notes, checking the apparatus/teaching aids which include trial experiments.

It was also suggested that schools should introduce departmental and/or team working during planning and preparation, so that experienced SMT can mentor more junior SMT. ICTs should be used to obtain reference materials and videos as well access SESEMAT platforms for SMT to network and exchange ideas. This should be coupled with the improvement of the support supervision by HODs, administrators and SESEMAT staff in order to enhance performance of SMT.

Science teachers were advised to use the format of modern lesson planning to write their lesson notes in order to teach science and mathematics concepts by adopting and adhering key principles taught to them during INSET. The teachers were generally advised to build on students' natural interest in the subjects, and on their intuitive and informal science knowledge; encourage inquiry and exploration to foster problem-solving and mathematical reasoning; use both formal academic lessons and everyday life activities as natural vehicles for developing children's mathematical knowledge; provide a scientifically and mathematically rich

environment and, incorporate the language of science and mathematics throughout the school day as well as use literature to introduce both science and mathematical concepts, and then reinforce them with hands-on activities.

School administrations should carry out regular support supervision to help science and other teachers, plan and prepare effectively implement scheme of work and lesson plans

Second, in providing some recommendations in regard to in-service training and science/mathematics teachers' teaching methodologies, the SESEMAT trainers generally advocated against memorization of concepts and knowledge, urging science teachers to instill in students' critical minds through questioning and discussion. Information should be made meaningful to students in order to establish permanent learning.

The trainers also encouraged teachers to employ effective pedagogical methods attained during SESEMAT training, which covered problem solving, inquiry-based teaching, discovery, games, lecturing, and case studies, among others and to draw attention to effective teaching and learning processes. They generally recommended that teachers take up the mixed approach, which entails an integration of student-centered and teacher-centered methods.

The importance of integrating ICTS to encourage learners appreciate and uphold hands-on activities was encouraged, coupled with the use of modern methods of teaching such as through inquiry-based methods, field trips and group discussions, as well as vigilance in supervision to inform adequate use of teaching methodologies. Action research was also recommended as one of the ways to explore methods of teaching in order to take up best practices for teaching science and mathematics as informed by research. Also recommended were teachers' efforts towards innovation as well as the promotion of student voice, through providing opportunities for them to give feedback in regard to teaching and to take action in order to improve learning. Teachers should collaborate during lesson planning, teaching as well as assessment in order to improve their own performance.

The importance of instilling confidence in science teachers through inculcating positive attitudes was also pointed out. This as they explained is likely to motivate teachers and boost their morale towards their profession as teachers of science and mathematics.

Finally, the training of teacher trainers using refresher courses and/or Training of Trainer courses can create the possibility to improve their skills, which would then inform the ways in which they equip teachers with adequate teaching methodologies.

Third, in order to improve SMT's performance in terms of assessment, some of the stakeholder recommended the use of continuous assessment, coupled with diverse methods of assessing skills and application of knowledge to encourage deep learning and as such understanding. Teachers were advised to assess theoretical as well as practical and project work as well as assess both lower order and higher order thinking skills such as application, analysis, evaluation and synthesis.

5. 4. Areas for Further Research

Further research should be conducted in effective science and mathematics teachers' classrooms. This will provide insights into the best practices in planning and preparation, teaching methodologies as well as assessment, in order to inform in-service programs such as SESEMAT. Further, benchmarking should be conducted with other developing countries, in order to establish alternative and/or complementary, possibly more context specific ways of transforming the teaching and learning of science and mathematics other than over reliance of SESEMAT, which is based on a Japan science and mathematics teaching model. Additionally, there is need to conduct an investigation into the appropriateness of the science/mathematics teachers' SESEMAT training curriculum, in order to establish its strengths as well as weakness—which can be then be used to improve the program. Further still, research should also examine the competencies of INSET teacher trainers in the process of imparting knowledge and skills during the program. This is likely to plug some of the gaps that have negatively affected the outcomes from the program.

REFERENCES

Abell, S. K. (2007).*Research on Science Teacher Knowledge*. In S. K. Abell& N. G. Lederman (Eds.), Handbook of research on science education (pp. 1105–1149). Mahwah, NJ: Lawrence Erlbaum Associates.

Abell, S. K. (2008). Twenty Years Later: Does Pedagogical Content Knowledge Remain a Useful Idea? *International Journal of Science Education, 30* (10), 1405-1416.

Abong'o, J. O., (2013). *Effect of SMASSE In-service Education and Training on Biology Teachers' pedagogical skills and attitudes towards teaching biology in rachuonyo south* district, Homabaycounty

Adama, A (2012), Niger INSET Country Report. UNESCO-IICBA, Addis Ababa& Commonwealth Secretariat, London

Adnyani, D. P. D. P. (2015). Professional Development for Pre-service Teacher : A Case Study of Professional Development Program for Pre-service Teacher in State University in Central Indonesia (Dissertation). Retrieved from http://urn.kb.se/resolve?urn=urn:nbn:se:su:diva-117800

Adu, E. T. &Adeyemi, T. O. (2013).Headteachers' leadership styles' and teachers job satisfaction in primary schools in Ekiti State, Nigeria. International Journal of Academic Research in Economics and Management Sciences, 2(2), 26 – 79.

Adejumobi, F. T. and Ojikutu, R. K. School climate and teacher job performance in Lagos State Nigeria. Discourse Journal of Educational Research, Vol. 1(2), pp. 26-36.

Agwot, K. R. &Osuu. R.J., (2014).*Uganda SESEMAT Programme:* Impact and Challenges in its Implementation

Ahimbisibwe, P.,(2017). *Science teachers betraying the country, says Muyingo;* The daily Monitory, Friday, March, 31st, 2017

Aidah, N. (2013), *Thesis on Effects of training on Employee performance*-Evidence of Uganda,

Ajaja, O. P., (2007). Evaluation of science teaching in secondary school in Delta State in Nigeria. *Journals/IJES/IJES 01-09. Available from http:// www.krepublishers*.Com/01.

Akiri, A. A. &Ugborugbo, N. M. (2009).*Teachers' Effectiveness and Students' Academic Performance in Public Secondary Schools in Delta State*, Nigeria.*Stud Home CommSci,* 3(2),107-113.

Akiri, A. A. &Ugborugbo, N. M. (2008). An Examination of Genders Influence on Teachers productivity in Secondary Schools. J. Soc. Sci, 17(3): 185-191.

Alabi, F. O. and Ige, A. M. (2014) issues in in-service education provision for teachers in Nigeria. The way forward in this decade and beyond.*International Journal of Humanities, Social Sciences and Education (IJHSSE)*1(12),126-132

Almani, A. S., (2007). Comparative Study of the Effects of the In-Service Training on the Motivational Techniques and Teacher Content Knowledge of Secondary School Teachers of Pakistan. *Journal of Education, (36),* 13-32.

Altun, A. &Gok, B. (2010). "Determining in-service training programs characteristics given to teachers by conjoint analysis". *Procedia Social and Behavioral Sciences*, 2(2), 1710-1714.

Altun, T. (2011). *In-Service Education and Training and Professional Development of Teachers*: A Comparison of British and Turkish Case.US-China Education Review A 6 (2011) 846-858.

Alupo, J. (2015).*Government providing laboratory equipments, developing new science Laboratories and infrastructure, unacceptably high percentage of students fail mathematics, chemistry, physics and biology.*

Amin M.E, (2005). ***Social Science Research***: conception, methods and analysis. Kampala: Makerere University printer.

Anderson, L. and Sosniak,L. (1994). *Bloom's Taxonomy: a forty-year retrospective.* Chicago: National Society for the Study of Education

Armstrong, M., Brown, D. and Reilly, P. (2011) Increasing the Effectiveness of Reward Management: An Evidence-Based Approach. Employee Relations, 33, 106-120. https://doi.org/10.1108/01425451111096668

Armstrong, P. (2017). Bloom's taxonomy. Retrieved from https://cft.vanderbilt.edu/guides-subpages/blooms-taxonomy

Arunga, H. N. (2007). *The impact of SMASSE project on the teaching and Learning of Biology in secondary schools: a case of in Mombasa District.* (Unpublished Master's Project). Kenyatta -University. Nairobi.

Athanases, S. Z., Abrams, J., Jack, G., Johnson, V., Kwock, S., McCurdy, J., et al. (2008). Curriculum for mentor development: problems and promise in the work of new teacher induction leaders. *Journal of Curriculum Studies*, 40(6), 743-770.

Attaran, A., (2012). The effect of in-service training on employee performance in engineering design and supplying parts of Iran Khodro company, M.A thesis, Islamic Azad University, Tehran Branch.

Attwood, T. (2014). Why are Some Students so Poor at Maths?

Auma, W. S. (2014).Influence of In-Service Training On Public Secondary School Principals' Management of Finances and Human Resources in Busia County, Kenya

Ayier, J. O. (2009).*Factors affecting the Implementation of strengthening of Mathematics and Science in Secondary Education Program in Public Secondary Schools in Rongo Division.*(Unpublished Masters Project). Kenyatta University. Nairobi.

Ball, D., Thames, M. and Phelps, G. (2008).*Content Knowledge for Teaching*: what make it special?. Journal of Teacher Education, *59* (5), 389-407.

Barak, M. and Mesika, P. (2007). *Teaching methods for inventive problem solving in high school.* Available from http://www.sciencedirect.com/science/article

Bausmith, J. M. and Barry, C. (2011). *Revisiting Professional Learning Communities to Increase College Readiness:* The Importance of Pedagogical Content Knowledge. Educational Researcher, *40* (4), 175-178.

Bennell, P. &Akyeampong, K. (2007) Teacher Motivation in Sub-Saharan Africa and South Asia. Department for International Development.

Birungi,D. &Onyango, J. (2017). Teacher training and capacity development strategy Burundi Refugee Response Kigoma Tanzania.

Bolarinwa, O.A. (2015). Principles and methods of validity and reliability testing of

questionnaires used in social and health science researches. Niger Postgrad Med J 2015;22:195-201

Bolyard, J. J., & Moyer-Packenham, P. S. (2008). A review of the literature on mathematics and science teacher quality. *Peabody Journal of Education*, *83*(4), 509-535.

Botha, M. L. and Reddy, C.P.S. (2011). In-service Teachers' Perspectives of Pre-Service Teachers' Knowledge Domains in Science.*South African Journal of Education*, *31*(3) , 257-274.

Borich, G. D. (2007. Effective teaching Methods, Unit and Lesson Planning, six edition, Pearson, Merrill Prentice Hall, Ohio.

Botha, L. & Reddy, C. 2011. In-service teachers' perspectives of pre-service teachers' knowledge domains in science. South African Journal of Education, 31(2):257-274, doi:10.15700/saje.v31n2a354.

Butler, H. A. (2012). Halpern Critical Thinking Assessment predicts real-world outcomes of critical thinking. Applied Cognitive Psychology, 25(5), 721–729.

CAG Audit report (2009), *Causes of poor performance in sciences and mathematics subjects,* Ministry of Education and vocational training.

CEMASTEA, (2012). Effective implementation of SMASE primary activities, CEMASTEA, Kenya.

CEMASTEA. (2010). Report on monitoring and evaluation of regional INSET. Unpublished. Nairobi.

Cemastea, (2008). *Hand Book on Management of District SMASSE Programmes*.Nairobi.

Chebet. S. I. (2012). *Influence of strengthening mathematics and science education training on teaching / learning of mathematics in public primary schools in bomet-central division, bomet County, Kenya.*

Chikweru, A. E., &Anaemeotu, P. (2013). *Professional Development on Teachers' Academic Performance in Secondary Schools inEtche Local Government Area.* International Journal of Education Learning and Development.*1*(2). 19-23, December 2013

Cicek, V. (2013) Effective Use of Lesson Plans to Enhance Education International Journal of Economy, Management and Social Sciences, 2(6): 334-341

Cinedu, C., Olabiyi, O., &Kamin, Y. (2015) Strategies for improving higher order thinking skills in teaching and learning of design and technology education. Journal of Technical Education and Training, 7(2)

Damavandi, M, A., (2012). Examined the relationship between in-service training, work experience and educational empowerment of women teachers, Educational Technology (Technology and Education), Vol. 7, No. 3, pp 229 - 238.

DeArmond, MM, Shaw, KL, Wright, PM (2009) Zooming in and zooming out: Rethinking school district human resource management. In: Goldhaber, D, Hannaway, J (eds) Creating a New Teaching Profession. Washington, DC: The Urban Institute, pp.53–80

DeCaro, M. S., &Rittle-Johnson, B. (2012). Exploring mathematics problems prepares children to learn from instruction. Journal of Experimental Child Psychology, 113, 552–568.

Desak, P. D., &Adnyani, D., (2015) Professional Development for Pre-Service Teacher: A Case Study of Professional Development Program for Pre-service Teacher in State University in Central Indonesia

Desimone, L. M. (2009). *Improving impact studies of teachers' professional development:*

Towards better conceptualizations and measures. Washington, DC: American Educational Research Association. Retrieved from www.det.nsw.educ,au/../desimone.pdf. onoctober 23rd,2013.

Dzana, E. N, (2012).*Poor Performance in Science Subjects in Malawi,* University of Malawi.

Education Abstract (2016). The education abstract is a statistical report detailing the findings of the Annual School Census 2016. Education Policy and Planning Department Ministry of Education and Sports.

Ekpoh,V.I., Oswald,A., & Victoria (2013). Staff Development Programmes and Secondary School Teachers' Job Perfomance in Uyo Metropolis, Nigeria, *Journal ofEducation& Practice*, Vol.14, No.12

Essel, R. Badu, E., Owusu, W. B. & Albert A. Saah (2009). *In-Service Training*: An Essential Element in the Professional Development of Teachers.*Malaysian Journal of Distance Education 11*(2), 55- 64 (2009)

Eyup, I. and Özlem, G. (2017). Assessment of in-service training activities for junior high mathematics teachers. Educational Research and Reviews. Vol. 12(24), pp. 1220-1229, 23 December, 2017 DOI: 10.5897/ERR2017.3412

Faize, F.A. and M.A. Dahar, (2011). Physics teachers teaching competency in Pakistan. Available from http:// www.eurojournals.com/ajsr.htm

Fagil, M. (2016).*Science Teachers lack Interest and seem to have qualified with a Bachelor's degree as a last resort*. National Association Of Science Teachers in Uganda 2nd Annual Science Teachers' Conference Held At Food Science And Technology Conference Hall Makerere University, Kampala Uganda, 20-21 September 2012 Theme: Uganda At 50years: Teachers As Drivers Of Science And Technology Led Development

Fantom, A. K., (2009).*Human Capital Development Theory*: Implications for Education – Comparison of Influential Twenty-First Century Economists Samuel Bowles and Gary S. Becker

Fink, D. L. (2009).*Integrated Course Design*. Manhattan, KS: The IDEA Center.

Gallies, D. (2015). *"Human Capital Theory in Education"*. Encyclopedia of education philosophy and theory. Springer science + business media, Singapore.

Ganyaupfu, M.E. (2013). Teaching Methods and Students' Academic Performance. *International Journal of Humanities and Social Science Invention ISSN (Online):* 2319-7722.

Gituthu, M. M., (2013). *Influence of learner-Centred Strategies on Students' Biology performance in Kenya Certificate of Secondary Education in*Kinangop sub-county.

Gituthu, M. W. (2014). Influence of learner-centred strategies on learners Biology performance in KCSE in Kinangop sub county, Nyandarua County, Kenya. UON. Unpublished

Goldhabes, D. and Brewer. D. (2007). "Can Teacher Quality be effectively assessed, Seattle, University of Washington Press.

Hamilton, L. S., Stecher, B. M., Marsh, J. A., McCombs, J. S., Robyn, A., Russell, J. L., et al. (2007). *Standards-based accountability under no child left behind: Experiences of teachers and administrators in three states*. Santa Monica: RAND Corporation.

Hanif, (2010). Teacher Stress, Job Performance and Self Efficacy Among Women Teachers (2010), Lap Lambert Academic Publishing

Hanushek, E. &Wosmann, L. (2010). *Education and economic growth.*In D. Brewer & P. McEwan (Eds.) Economics of Education (pp. 60-67). San Diego, CA: Elsevier.

Hassard, J. and Dias, M. (2009). *The Art of Teaching Science*. 2nd Edn., New York: Routledge. pp: 47-48.

Heidarinejad, S., Bahrami, M., Azmsha, T., (2011), The effect of in-service training course on empowerment of teachers of physical education, Vol 1, No 2, pp81-88.

Heidarinejad, S., Bahrami, M., Azmsha, T., 2011, The effect of in-service training course on empowerment of teachers of physical education, Vol 1, No 2, pp81-88.

Heritage, M., & Wylie, C. (2018). Reaping the benefits of assessment for learning: Achievement, identity and equity. *ZDM Mathematics Education*, *50*(4), 1–13.

Islami, Y., Noruzi, T., Badiei, H., (2011), The effect of in-service training on empowerment of Islamic Azad University staff, Journal of Islamic Azad University of Garmsar, No. 4, pp. 9-22.

Junaid, M. I. &Maka, F. (2015). *In Service Teacher Education in Sub-Saharan Africa*: A Synthesis Report, Commonwealth Secretariat.

Kariisa, H.A. (2015).Perceptions of secondary school mathematics teachers towards secondary. Science and mathematics teachers (sesemat) programme in Mbarara district, Uganda.*International Journal of Recent Advances in Multidisciplinary Research Vol. 02, Issue 12, pp.1092-1096, December, 2015* V. T ChoksiSarivjanik College of Education, Veer Narmad South Gujarat University, Surat, India

Kasirye, I. (2009). *Determinants of Learning Achievement in Uganda*. Uganda: Economic Policy Research Centre.

Kebaso, K. N. (2012). *Effects of strengthening mathematics and science programmes on teachers' pedagogical skills in public secondary schools in Nyamira District.*(Unpublished Masters project).University of Nairobi.Nairobi.

Kebaso, K. N. (2012). *Effects of strengthening mathematics and science programmes on teachers' pedagogical skills in public secondary schools in Nyamira District.*(Unpublished Masters project).University of Nairobi.Nairobi.

Khatoon,Z. ,Tayyab A,M. Bukhari,M.A. &Mushtaq, M. (2014). In-Service Teachers' Perception About Their Competencies In Delivery Of Biology Lessons. International Journal of Asian Social Science, 2014, 4(7): 820-834

Kirisoi, N. et. al. (2008). Distinction Education for PTE. Nairobi: Kenya Literature Bureau

Kothari, C.R, (2008), *Research Methodology Methods and Techniques,* New Delhi, new age International(P) Ltd.

Komakech,A.R. &Osuu, J.R (2014). Uganda SESEMAT Programme: Impact and Challenges in Its Implementation Teaching Assistant in the Department of Business Studies Faculty of Social Sciences and Management Studies, Kumi University.

Kyoko, I. (2017). Active Learning and Teacher Training: Lesson Study and Professional Learning Communities. Scientia in education 8(1), 101–118.

Liu, O. L., Frankel, L., &Roohr, K. C. (2014). Assessing critical thinking in higher education: Current state and directions for next-generation assessment. Research Report. ETS RR14-10. ETS Research Report Series

Marete, J.K. (2012). The implementation of strengthening mathematics and science education on

the teaching and learning of mathematics in primary schools in Nkrueni Division, Meru. (UON Unpublished Masters project). Nairobi

Makewa, L. N., Role, E., Biego, S. (2011). Teachers' Attitude towards Strengthening Mathematics and Science in Secondary Education through In-service Education And Training (SMASSE-INSET) Project in Nandi Central District, Kenya. In the *International Journal of Education and Social Sciences (IJESS) Volume* 1 (4).

Makhdoom, S. S., Khalid, M. K., Ziarab, M., &Ishtiaq, H. (2011). In-Service Training of Secondary Level Teachers: a Follow up of Teachers' Performance in Comparative Perspective Journal of Education and Practice, Vol 2, No 11&12, 2011. www.iiste.org ISSN 2222-1735 (Paper) ISSN 2222-288X (Online)

Maklad, A. S. (2008). In-Service Teacher Training Programme: A Comparative Study between Egypt and Japan. *NUE Journal of International Educational Cooperation, (3)*, 107-112.

Mbabaali, D. (2019). Why do students continue to fail sciences? The daily monitor, MONDAY March 11 2019

Mbati, R. (2014).Influence of strengthening Mathematics and Sciences in Secondary Education (SMASSE) project on students performance in mathematics in Nyakach Sub – County, Kisumu Kenya

Milkova, S. (2016). Strategies for Effective Lesson Planning Center for Research on Learning and Teaching.

Migwi, P. W. (2012). The impact of SMASSE project on teaching and learning of Biology in Gatanga District, Muranga County, Kenya. (Unpublished Masters project). Kenyatta University. Nairobi.

Ministry of Education and Sports and UNESCO (2014).*Needs assessment framework of teacher training and development to ensure Education for All* (EFA). "Enhancing Teacher Education for Bridging the Education Quality Gap in Africa"

Ministry of Education and Sports(2008). Uganda Certificate of education teaching Syllabi by NCDC: S.1-S.4.

Ministry of Education and Sports (2017). The Education and Sports Sector Annual Performance Report Financial Year 2016/17. SME Division, Education Planning and Policy Analysis Department, Ministry of Education & Sports, Floor 6, Embassy House, Kampala.

Ministry of Education and Sports (2017). Education and Sports Sector Strategic Plan 2017/18 – 2019/2020

M'kiambi, K. J. (2013).*Contribution of SMASSE in-service project on students' performance in Mathematics in KCSE examination* in Nkuene Division, Meru County, Kenya.

MoES& UNESCO (2014).*Teacher Issues in Uganda: a shared vision for an effective teachers policy, Ugandan Ministry of Education and Sport*, UNESCO - IIEP Pôle de Dakar, 2014. ISBN : 978-92-803-1378-9.

Muchwe, J. K., (2014). Factors contributing to poor performance of science subjects: a case of secondary schools in Kawe Division, Kinondoni municipality.

Mugenda, A. G., (2008), Social Science, Research: Theory and Principles Applied.

Mugenda, O. and Mugenda, A.C. (2003), *Research Methods, Quantitative and Qualitative* Approaches.Nairobi Acts Press.

Mulongo, G. (2012).*"The Human Capital Theory in Education":* Principles, critiques and current thinking.

Musingafi, M., Mhute,I., Zebron , S., Kaseke, W.S., (2015). Planning to Teach: Interrogating the

Link among the Curricula, the Syllabi, Schemes and Lesson Plans in the Teaching Process. Journal of Education and Practice www.iiste.org ISSN 2222-1735 (Paper) ISSN 2222-288X (Online) Vol.6, No.9, 2015

Nabi, B. J., Rahman, F., Akhter,F., Saeed, U. H., Ajmal, M. (2011). *Relationship between Training of Teachers and Effectiveness Teaching*

Nakabugo,G.M, Bisaso,R., and Masembe,C.S (2014).*The Continuum of Teacher Professional Development:* Towards a coherent approach to the development of secondary school teachers in Uganda.Makerere University Uganda.

Namatende-Sakwa, L. (2018). Networked texts: Discourse, power and gender neutrality in Ugandan physics textbooks. *Gender and Education*. http://dx.doi.org/10.1080/09540253.2018.1543858

Namutebi, V. (2019).The budget frame work paper for financial years 2019/2020-2023/2024, opposition MPs proposed that Advanced Level (A'level) should be scrapped, saying it is unnecessary. The New Vision 22nd January 2019 10:17 AM

Nangonzi,Y. (2019). Students failing Museveni's science dream. The observer, March 7, 2019

Netcoh, S., (2016).*The Strengths and Limitations of Human Capital Theory in Educational Research and Policy Making*

Njoki, M. N. (2015).*Influence of In-service Training on Employee Performance; a case of Judiciary's Lower Courts in Nairobi County,* Kenya

Norlia, M.N., Khalid, I., Mahaliza .M., Hamidah .Yusof., Tamby, I. (2015*). Relationship Between In Service Training and Teaching Skills With Student Achievement* 2-4 February 2015- Istanbul, Turkey Proceedings of INTCESS15- 2nd International Conference on Education and Social Sciences.ISBN: 978-605-64453-2-3.

Norwani,M.N. Wan M. N.W. D., Mahaliza, M., and Yusof,R. (2017).The Relationship between In-Service Training and Teaching Skills with Student Achievement International *Journal of Academic Research in Business and Social Sciences* 2017, Vol. 7, No. 12 ISSN: 2222-6990

Nuangchalerm, P. (2011*). In-service Science Teachers' Pedagogical Content Knowledge*. Vol. 2, No. 2, 2011, pp. 33-37 DOI:10.3968/j.sss.1923018420110202.034

Nwachukwu, P.O., (2010). *Methodological competencies of teachers*: A study of Nigeria. Available from www.academicleadership.or/-MethodologicalCompetencies

Nyanchoka D. M.(2015). Strategy Implementation Practices at center for mathematics, science and technology education in africa (cemastea) in kenya. A research Project submitted in partial fulfillment of the requirements for the award of the degree of master of business administration school of business, University of Nairobi

Nyakwama, J. K. (2012). Application of SMASSE'S asei/pdsi principles when teaching Mathematics in Secondary schools of NakuruDistrictNyandaruacounty, Kenya of Nairobi. Nairobi.

Odongo,D. (2018). The UNEB executive secretary, raised the same issue during the release of

UACE 2018 examination results.

OECD (2013c) Synergies for Better Learning: An International Perspective on Evaluation and Assessment. OECD reviews on evaluation and assessment in education, OECD Publishing, Parish

OECD (2014) TALIS 2013 Results.An International Perspective on Teaching and Learning. Paris: Organisation for Economic Cooperation and Development.

OECD (2009). Creating Effective Teaching and Learning Environments: First Results from TALIS. Paris: Organisation for Economic Cooperation and Development.

Ojimba, D. P. (2012). Strategies for Teaching and Sustaining Mathematics as an Indispensable Tool for Technological Development in Nigeria.

Okai, A. U. (2010). Science Methods. Lagos. National Open University of Nigeria.

Okobia, E. O. (2013). The Effects of In-service Education on Teachers' Knowledge of Junior Secondary School Social Studies Curriculum and Instruction in Delta State, Nigeria. *IOSR Journal of Research & Method in Education (IOSR-JRME) e-ISSN: 2320–7388,p-ISSN: 2320–737X Volume 2, Issue 6 (Jul. –Aug. 2013), PP 01-08* www.iosrjournals.org

Osamwonyi, E.F.(2016). In-Service Education of Teachers: Overview, Problems and the Way Forward. *Journal of Education and Practice www.iiste.org ISSN 2222-1735 (Paper) ISSN 2222-288X (Online) 7(26), 83 -87*

Osamwonyi, E. F. (2016).In-Service Education of Teachers: Overview, Problems and the Way Forward.*Journal of Education and Practice*, v7 n26 p83-87 2016

Olaniyan, D. A., &Okemakinde, T. (2008). Human Capital Theory: Implications for Educational Development. *European Journal of Scientific Research.* Retrieved November 8, 2010 from http://www.eurojournals.com/ejsr_24_2_01.pdf.

Olong,S. (2017). The head of Biology Department at the government aided Kololo Secondary School in Kampala

Ombati, P. K. (2009). *The impact of in-service education and training(INSET) of mathematics teachers on the quality of teaching learning in public secondary schools in Kisii central district;* A case of ASEI-PDSI approach of SMASSE project.(unpublished master' project).University of Nairobi. Nairobi.

Ombati, P. K. (2014). *The impact of In-service Education and Training (INSET)* of mathematics teachers on the quality of teaching learning in public secondary schools in Kisii central district; A case of ASEI-PDSI approach of SMASSE project.(unpublished master'project).University

Opit, E., (2014).*Impact of Uganda Government Science-based University Sponsorship Policy*

on girls' participation in the Sciences at a-level in mukono and wakiso districts

Osaki, K. M, (2007).*Science and Mathematics Teaching Preparation in Tanzania*: Lesson from teacher's improvement project in Tanzania 165-2006 Dar es Salaam. NUE Journal of international co-operation, vol 2.

Otaala,J., Maani,J.S. and Bakaira,G.G (2013). Effectiveness of university teacher education curriculum on secondary school teacher performance in Uganda; the case study of Kyambogo University. CICE Hiroshima University. *Journal of International Cooperation in Education*, 15(3), 95-112

Otieno, J. A. (2013*).Effect of SMASSE In-Service Education and Training On Biology Teachers' Pedagogical Skills And Attitudes Towards Teaching Biology* In Rachuonyo South District, Homabay County.

Özlem B.Ö. (2010).*Identifying the in-service training needs of the social studies teachers within the context of lifelong learning.*Published by Elsevier Ltd.Procedia Social and Behavioral Sciences 2 (2010) 3036–3042

Palm, T., Boesen, J., &Lithner, J. (2011). Mathematical reasoning in Swedish upper secondary level assessments. *Mathematics Thinking and Learning, 13*(3), 221–246.

Petrushenko, Y. (2017). The Human Capital Theory.Encouragement and criticism. Socio Economic Challenges, Volume 1, Issue 1, 2017

Rahmati H.M., Hosseinifard S.M., Alimadadi, A., (2014). Investigating Effectiveness of In-Service Training in the Public Sector. *Iranian Journal of Management Studies (IJMS) Vol. 7, (2), July 2014 pp: 305-327*

Rotich, D. K. (2014). Factors influencing head teachers' instructional supervision practices in public primary schools in Longisa division, Bomet District. (Unpublished M.Ed. project) University of Nairobi.

Rotich, A. K. (2012). *Effects of SMASSE INSET on students' attitude, teaching approaches and performance in biology in secondary schools in Bomet District.*(Unpublished Masters Thesis) Moi University. Eldoret

Runhaar, P.(2016). How can schools and teachers benefit from human resources management? Conceptualising HRM from content and process perspectives. First Published May 26, 2016 Research Articlehttps://doi.org/10.1177/1741143215623786

Saad, T. U. &Usman, R. (2014). The Causes of Poor Performance in English Language Among Senior Secondary School Students in Dutse Metropolis of Jigawa State, Nigeria

Sahan, A., (2009).Teacher's competence and students" achievement. Available from http://anselsahans.blogspof.com/2009/02teachers-competence.html

Sami, M., (2007). Assessing human resources for science and technology: the 3Ds framework. Science and Public Policy 34 (7), 489–499.

Saunders et al (2007), "***Research Methods for Business Students***" (7th edition), Pearson Education Limited, England, UK. Pp.356

Sax, G. (2007). *"Empirical Foundation of Education in an Urban school system theory into practice".* London Pres INC.

Saxe, G. B., Franke, M. L., Gearhart, M., Howard, S. & Crockett, M. (1997). Teachers' shifting assessment practices in the context of educational reform in mathematics.

Schneider, R. M., &Plasman, K. (2011). *Science teacher learning progressions:* A review of

science teachers' pedagogical content knowledge development. Review of Educational Research, 81,530–565

Schulz, H. W., &FitzPatrick, B. (2016). Teachers' understandings of critical and higher order thinking and what this means for their teaching and assessments. Alberta Journal of Educational Research, 62(1), 61–86.

Sekaran .B, (2003). *Basic Research for Social Scientists* 2nd edn London: Macmillan Publishing

Shahkaramipour, Z., 2012, the relationship between in-service training and empowerment among staff, Educational strategies, Vol 5, No 4.

Spooner, F. (2007) Effects of Training in Universal Design for Learning on Lesson Plan Development, Remedial and Special Education, 28, 108-116

SMASSE INSET- Fact Findings Report. (12th AUGUST, 2014)

Suryawati, E., K. Osman and Meerah, T., (2010). *The effectiveness of contextual teaching and learning on students" problem solving skills and scientific attitude*. Available from www.sciencedirect.com.

Stanny, C. J. (2016). Reevaluating Bloom's taxonomy: What measurable verbs can and cannot say about student learning. Education Sciences, 1–12

Suurtamm, C., &Neubrand, M. (2015). Assessment and testing in mathematics education.In S. J. Cho (Ed.), *Proceedings of the 12th International Congress on Mathematical Education* (pp. 557–562). Cham: Springer.

Suurtamm, C., Thompson, D. R., Kim, R. Y., Moreno, L. D., Sayac, N., Schukajlow, S., et al. (2016). *Assessment in mathematics education: Large-scale assessment and classroom assessment*. Cham: Springer.

Sydoruk, P.D.,(2018). "An Analysis of the Higher Order Thinking Requirements of a Grade 8 Online-Based English Language Arts Skills Program" (2018). Seton Hall University Dissertations and Theses (ETDs). 2495

Thafer, A. A., (2014). *Investigating Factors Affecting Science Teachers' Performance and Satisfaction toward their Teaching Process at Najran University for Girls*'. International Journal of Higher Education

Thijs, A., &Akker, J. Van den (2009).*Curriculum in Development.Enschede*: SLO.

Tshabalala, T. &Ncube, A. C. (2013). Causes of Poor Performance of Ordinary Level Pupils In Mathematics in Rural Secondary Schools in Nkayi District: Learner's Attritions.

Twoli, N.W. (2006).*Teaching Secondary School Chemistry*. Nairobi: Nehema Publisher.

Udofia, U. I. &Ikpe, U. N.(2012).Administration of In-Service Training and Teachers Attitude to Work in Private Secondary Schools in Cross River State of Nigeria. *International Journal of Academic Research in Business and Social Sciences October 2012, Vol. 2, No. 10 ISSN: 2222-6990*

UNEB (2015). Sixty percent (60%) of the candidates were unable to demonstrate the minimum competency required to be graded due to declined performance at distinction and credits in the mathematics, biology, physics and chemistry.

Umameh, M. A. (2011). A Survey of Factors Responsible for Students' Poor Performance in

Mathematics in Senior Secondary School Certificate Examination (SSCE) in Idah Local Government Area of Kogi State, Nigeria.Reteieved on 4th November, 2014

Wiliam, D. (2011). What is assessment for learning? Studies in Educational Evaluation 37(1): 3–14.

Wiliam, D. (2007). Keeping learning on track. In F. K. J. Lester (Ed.), *Second handbook of research on mathematics teaching and learning* (pp. 1053–1098). Charlotte: Information Age.

Vaselinovska, S., Gudeva, L.G.andDjokie, M. (2011). The effect of teaching methods on cognitive achievement in biology studying. Available from www.sciencedirect.com [

Vekeman, E, Devos, G, Tuytens, M (2014). The influence of teachers' expectations on principals' implementation of a new teacher evaluation policy in Flemish secondary education.Educational Assessment, Evaluation and Accountability 27(2): 129–151.

Yara, P. O. (2009). Relationship between Teachers, Attitude and Students" Academic Achievement in Mathematics in some selected Senior Secondary Schools in Southwestern Nigeria. European Journal of Social Science, 11(3), 364-369.

Yeşilpinar, M.U.,&Karakuş,F. (2017).Teachers' In-service Training Needs towards Project Tasks: A Comparative Case Study. Universal Journal of Educational Research and Social Studies. 5(12): 2137-2148.

Yiğit, N., &Altun, T. (2011). Effectiveness of an in-service training course: Teaching methods and techniques. Journal of National Education, 189,

Zhang, M., Parker, J., Koehler, M. J., Eberhardt, J. (2015). Understanding In-service Science Teachers' Needs for Professional Development

APPENDIX A: QUESTIONNAIRE FOR SCIENCE TEACHERS

Dear Respondent,

I am Robert Mayemba, a student of Kyambogo University conducting a study on; *"**In-Service Training and Science Teachers' Performance in Selected Secondary Schools in Mukono District**"*. You have been chosen as one of the participants. I therefore request you to spare some time and help me to fill in these questionnaires. This study is a requirement for partial fulfilment for the award of the degree of Masters of Education in Policy, Planning and Managementof Kyambogo University and is purely for academic purposes. Therefore, the information given will be treated with utmost confidentiality. Your response is highly appreciated.

Thank you for your cooperation.

SECTION A: PERSONAL DATA

Please tick where appropriate. ( )

1. Gender: Male ( ) Female( )
2. Age (Yrs): Below 30 ( ) 31-40 ( ) 41-50 ( ) 51 and above ( )
3. Highest qualification
   Certificate ( ) Bachelor Degree ( )
   Diploma ( ) Masters Degree & above ( )
4. Management Level in your Secondary schools
   Lower ( ) Middle ( ) Senior ( ) Top( )
5. Experience as a Secondary school teacher
   0-5 years ( ) 11-15 years ( ) 6-10 years ( ) 16 years and above( )

From Question 6, SEC B to E, Please tick where appropriate, that is accurate choice of your opinion. [√] Key; Strongly agree(5), Agree (4) Not sure (3), Disagree (2) Strongly disagree (1)

No	**Teachers attitude towards teaching of mathematics and sciences**	**Responses**				
		SD	**D**	**NS**	**A**	**SA**
1	Before undergoing INSET, mathematics and sciences were easy to teach.					
2	After undergoing INSET, mathematics and sciences are now easy to teach.					
3	Before undergoing INSET, teaching of mathematics and sciences were interesting					
4	After undergoing INSET, teaching of mathematics and sciences is now interesting					

Section b: In-Service Training and Science Teachers' Teaching Methodologies in Secondary Schools of Mukono District.

No	In-service training and science teachers' teaching methodologies	Responses				
		SD	D	NS	A	SA
1	In-service training addresses content mastery by teachers					
2	INSET aids science Teachers to design, use locally available resources to build students' real life situations					
3	INSET imparts skills in science teachers to improvise teaching/learning materials that enhance learner participation and scientific skills					
4	INSET advocates for use of direct Instruction(lecturer method) as a method of teaching sciences as most effective teaching method for slow learners					
5	INSET requires science teachers to use inquiry-based method, where learning takes a lot of time, energy and planning but it is often very effective					
6	INSET trains science teachers on the use of student-centred and student-directed teaching methods extreme conceptualisation of science subjects and mathematics					
7	INSET has enabled science teachers to apply cooperative Learning method (Peer-to-Peer methodology) of teaching mathematics and science subjects.					
8	In-Service training allows science teachers to apply demonstration. (teaching through examples or experiments) to promote sciences					
9	Demonstrations help to reinforce students' memory retention for the real world application of those facts.					
10	INSET equips science teachers with appropriate teaching pedagogy and competencies (teacher skills, attitudes and values) that improve their performance.					
11	When students work in buzz groups (Brain storming/ Discussion Question & Answer Method), they spend approximately 20 minutes studying a topic and gathering information					

Section C: In-Service Training and Science Teachers Planning and Preparations in Secondary Schools of Mukono District

No	In-service training & science teachers planning and preparations	Responses				
		SD	D	NS	A	SA
1	INSET process follows proper selection and arrangement of the teaching items or materials.					
2	INSET trains science teachers to select and sequence content and methodologies in line with the curriculum, syllabus, scheme of work and lesson plans					
3	INSET reveals that science teachers cannot distinguish curriculum and syllabus hence they are inadequately prepared, trained, supervised and supported in teaching sciences.					
4	Through INSET science teacher no longer find challenges with splitting the year's work into portions to be studied per term, month or week/ lesson (schemes of work)					
5	INSET helps science teachers to draft brief outlines of lessons from curriculum & Syllabi to simplify teaching of a specific topic					
6	Science teachers can now utilise scheme of work as a guide in planning daily lessons with the time available for each topic in the term					
7	INSET has made science teachers gain confidence in simplifying lesson plans to improve both learning and teaching					
8	Deriving lesson plans from the analysis of the scheme of work / unit plan has been softened through INSET to effect science teachers performance					
9	The science teachers follow correct steps and procedures in teaching					
10	In-service training requires science teachers to make schemes of work under well-defined and structured headings					
11	A successful lesson plan addresses and integrates planning, methods and evaluation skills					

Section D: In-Service Training and Science Teachers' Assessment of Learners in Secondary Schools of Mukono District

No	In-Service Training and Science Teachers' Assessment of Learners	Responses				
		SD	D	NS	A	SA
1	In-service training helps science teachers to adopt desirable assessment techniques and evaluation skills for Teaching and Learning sciences					
2	Science teachers frequently obtain feedback on lessons taught					
3	INSET evaluates trained teachers through getting regular insight on student learning of sciences					
4	Through frequent assessment and feedback, effective teachers regularly assess what they do in the classroom and whether their students are really learning					
5	School administrators assess and evaluate the performance of science teachers ability to perform before and after INSET.					
6	INSET asks science teachers to try and anticipate the topics and concepts that are difficult for their students and to develop teaching strategies that present these topics in ways their students will best understand					
7	In-service training helps science teachers to determine what students know.					
8	Assessment and evaluation helps science teachers to know if the students' preparation is spotty or incomplete or if they find it harder to grasp the new material.					
9	Administering tests homework, exercise, end of term exams, and mini-quizzes can help identify which students are keeping up and which need help					
10	Assessment helps science teachers identify students with a range of academic abilities, interests, skills, and goals in preparation, abilities and learning styles for effective teaching					
11	In-service training requires science teachers to try to sample how well their students are learning. T					
12	In-service training aids science teachers to study the evaluation programmes that consist of evaluating the cognitive and knowledge parts only					

"Thank you for your cooperation"

APPENDIX C: INTERVIEW GUIDE FOR HEADTEACHERS, DEPUTIES, DOS AND DEO

1. What teaching methods are most used by science and mathematics teachers in Mukono Secondary Schools?

2. How has in-service training improved science teachers' teaching methodologies in Secondary Schools of Mukono District?

3. What can be done for science and mathematics teachers to embrace the INSET modern teaching methods?

4. What are the basic requirements INSET recommends for proper planning and preparation of science teachers in Mukono district?
5. What challenges do science teachers encounter in adhering to proper scheming, lesson planning, lesson notes making and choosing suitable instructional materials?
6. What measures can be adopted to assist science teachers' overcome the challenges of planning and preparations in Secondary Schools of Mukono District?

7. What types of assessment do science teachers use to assess learners in Mukono District?

8. How has INSET helped science teachers' to improve assessment of learners in Secondary Schools of Mukono District?

9. What strategies should be adopted to improve science teachers' performance in Mukono district?

"Thank you for your cooperation"

APPENDIX D: OBSERVATION GUIDE

Rating: 1 = satisfactory 2= unsatisfactory

		Schools Sampled											
		A		**B**		**C**		**D**		**E**		**F**	
		1	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
A	**Science Teachers' Teaching Methodologies**												
1	Science teachers encourage Learners participation												
2	Lessons articulate learning needs, interests & aspirations												
3	Promote student discussion and group activities												
4	Students experience science interesting and enjoyable ways.												
5	Teaching methods allow learners to develop problem solving skills												
6	Skills to use teaching aids effectively												
B	**Science Teachers Planning and Preparations**												
1	Schemes of work show effective period plans & syllabus coverage												
2	Lesson Plans show high degree of organization and a good track record												
3	Practical lessons are effectively taught												
4	Records of work												
5	making of schemes, lesson plans and implementing them												
6	Joint support supervision by headteacher												
7	Skills in preparing T&L plan												
8	Skills in selecting T&L content												
C	**Science Teachers' Assessment of Learners**												
1	Science teachers frequently give and mark exercise per lesson												
2	Classroom tests are provided per topic												
3	Science teachers provide revision assignments per topic taught												
4	Books are often marked and correction attended too												
5	Skills to assess the effectiveness of T&L.												
6	Skills to build assessment instruments												
7	Skills to test students based on evaluation form.												
8	Skills to evaluate lessons conducted												

APPENDIX E: TABLE FOR SAMPLE DETERMINATION

Population size	Sample size	Population size	Sample size	Population size	Sample size	Population size	Sample size	Population size	Sample size
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Krejcie, Robert V., Morgan, Daryle W., "Determining Sample Size for Research Activities", Educational and Psychological Measurement, 1970.

APPENDIX F: FORMAT OF A LESSON PLAN AND UNIT PLAN FOR SESEMAT-TRAINERS

LESSON PLAN

Subject			
Topic			
Sub-topic			
Name of Teacher			
Name of School			
Class		**Number of learners**	
Date		**Duration**	

RATIONALE
Content
Value
Strategy
Position
OBJECTIVES: By the end of the lesson learners should be able to:
1.
2.
3.
Prerequisite skills and Knowledge:
Teaching/learning materials /resources:

LESSON FLOW

Step (Time)	**Teaching/learning activities**	**Learning Points**	**Remarks**
Introduction(5 min)			
Development (30 min)			
Assignment:			

Unit Plan: .....
General Objective: .....
Total Number of periods: .....

Periods

	Lesson objectives	Learning activities, Teaching methods and materials	Relation with other learning contents in this Unit	Relation with other learning contents between units
1				
2				
3				
4				

(MC): Misconception ***(C):*** Confusion ***(LP)***: Learning Points
(AS): Advanced study ***(T)***: Treatment ***(LK):*** Linkage

APPENDIX G: BLOOM'S TAXONOMY

No	Level Name	Examples of questions	Remarks
1	Remembering	• State Pythagoras theorem • What is an Atom? • Identify the parts of an eye • Define momentum	To recallscientificfacts and key words
2	Understanding	• Explain Newton's first law of motion • Describe how carbon dioxide gas is prepared in the laboratory • Show the difference between a triangle and square • Discuss how photosynthesis occurs	To interpret information or link concepts like force and reaction
3	Application	• calculate the volumeoccupied by 0.5mole of oxygen gass.t.p • Make use of Pythagoras theorem to determine the diagonal of a field whose length is 5m and width is 3m • Sketch the structure of a heart	To apply to knowledge to solve daily problems
4	Analysis	• Simplify ½ -1/3 ÷ ¼ • Whyarecarnumber plates black on a white or yellow background? • Distinguish between mammals and invertebrates • Compare how metals and non-metals react with oxygen	Break knowledge in portions and inter-relate concepts. Draw conclusions based on facts
5	Evaluation	• Justify the characteristics of living things • Interpret the significance of Newton's first law of motion to a passenger in a moving vehicle • Suggest an experimentto show that reaction rate increases with concentration	Combine knowledge, Build relationships and create new situations. Form an opinion or idea
6	Creation	• In a class of 50 students, 20 like math, 30 like physics and 5 like both while 8 like none of the subjects.ConstructaVenn diagram to represent the information • Design a suitable diagram to illustrate that for a given ray of light, the angle of incidence is equal to the angle of reflection • Design an experiment to demonstrate the conditions for seed germination • Discuss why dams are constructed with wider bases	Judge the value of materials and methods for specific purposes. Use evidence to form a view

Source: Anderson and Krathwohl (2001)

APPENDIX H: INTRODUCTORY LETTER

KYAMBOGO UNIVERSITY

P. O. BOX 1 KYAMBOGO, KAMPALA - UGANDA
Tel: 041 - 285211 Fax: 220464
www.kyambogo.ac.ug

Department of Educational Planning Management

20th September 2017

TO WHOM IT MAY CONCERN

Dear Sir/Madam

RE: MAYEMBA ROBERT - 15/U/14497/GMED/PE

This is to certify that **Mayemba Robert, Reg. No. 15/U/14497/GMED/PE** is a student in our department pursuing a Master of Education in Policy Planning and Management. He is carrying out research as one of the requirements of the course. He requires data and any other information on this topic entitled:

In-service Training and Science Teachers' Performance in Selected Government Aided Secondary Schools in Mukono District.

Any assistance accorded to him is highly welcome. He is strictly under instructions to use the data and any other information gathered for research purposes only.

Thank you.

Komba

Leticia Komba Rwakijuma (Mrs.)
AG.HEAD OF DEPARTMENT

Held an interview with (DEO) :-

DISTRICT EDUCATION OFFICER
MUKONO DISTRICT

Kyambogo University
FACULTY OF EDUCATION
20 SEP 2017
HEAD OF DEPT.
EDUCATIONAL PLANNING & MGT.

ST. CHARLES LWANGA S.S
P.O. BOX 210047, KAMPALA
19 OCT 2017
HEADTEACHER

We have had a good interaction

SIR APOLLO KAGGWA S.S MUKONO
P.O. BOX 471, MUKONO
19 OCT 2017
HEADTEACHER

Received
HT
27/09/17

27 SEP 2017

He has been at this School

HEADTEACHER
BISHOP'S SENIOR SCHOOL
MUKONO
P. O. BOX 75, MUKONO

4/10/17

HEADTEACHER
KISOWERA SEC. SCHOOL
P. O. Box 429, MUKONO