

**RELATIONSHIP BETWEEN STUDENTS' MATHEMATICS FINAL GRADE
AT SECONDARY SCHOOL AND PRIMARY TEACHERS EDUCATION:
CASE OF THOGOTO TEACHERS COLLEGE, KIAMBU COUNTY, KENYA**

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DECLARATION

I confirm that this research thesis is my original work and has not been presented in any other university/institution for considerations of any certification. This thesis has been complemented by referenced sources duly acknowledged. Where text, data (including spoken words), graphics, pictures or tables have been borrowed from other sources, including internet, these are specifically accredited and references cited in accordance in anti-plagiarism regulations.

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DEDICATION

I dedicate this thesis to my wife Lucy Mwangi, my daughters: Joan Wathira, Beatrice Njeri, and Isabell Nyambura for their endless support and encouragements.

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My gratitude to the almighty God for the wisdom and chance He has provided me with to pursue a Master Degree. I am grateful to Kenyatta University, particularly to my supervisors Dr. Marguerite Miheso O'Connor and Dr. Nasibi M. Were for guiding me through my thesis and to the Department of Educational Communication and Technology for the knowledge I acquired during my two years study period at Kenyatta University. I would also like to most sincerely thank all respondents and especially members of staff of Thogoto Teachers College for their cooperation, if it were not for them this work would not have been complete. Lastly I pass my regards to my classmates for their tireless support and encouragements to carry on to the end of our Master of Mathematics' Education degree.

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LIST OF ABBREVIATION AND ACRONYMS

APU	-	Assessment of Performance Unit
CEMASTEIA	-	Centre for Mathematics Science and Technology Education in Africa
CPE	-	Certificate of Primary Education
GCSE	-	General Certificate of Secondary Education
GPA	-	Grade Point Average
KCE	-	Kenya Certificate of Education.
KCPE	-	Kenya Certificate of Primary Education
KCSE	-	Kenya Certificate of Secondary Education
KICD	-	Kenya Institute of Curriculum Development
MCEETYA	-	Ministerial Council on Education Employment Youth Affairs
MCK	-	Mathematical Content Knowledge
MOEST	-	Ministry of Education Science and Technology
NACOSTI	-	National Commission for Science Technology and Innovation
NAPLAN	-	National Assessment Programme - Literacy And Numeracy
NCTM	-	National Council for Teachers of Mathematics
PCEA	-	Presbyterian Church of East Africa
PCK	-	Pedagogical Content Knowledge
PISA	-	Programme for International Students Assessment
PST	-	Pre-Service Teacher
PTE	-	Primary Teachers' Education
PTTC	-	Primary Teachers' Training College
SMASE	-	Strengthening Mathematics And Science Education
TEAS	-	Teachers Education Application Services
TSC	-	Teachers Service Commission

ABSTRACT

The importance of a teacher's mastery of subject matter for effective teaching of Mathematics has long been recognized. Questions have been raised regarding adequacy of teachers' knowledge of facts, concepts, theories and principles in Mathematics. This, in turn has focused attention upon the quality of Teacher Education Programs. This study, therefore set out to evaluate the relationship between students' Mathematics final grade at secondary school (Mathematics content masterly) and at Primary Teachers Education (Mathematics pedagogical skills and knowledge masterly): case of Thogoto Teachers College, Kiambu County, Kenya. The objectives of this study were: (i) To establish the difference in students' performance by gender in Kenya Certificate of secondary school Mathematics among Pre-primary School teachers. (ii) To establish the difference in students' performance by gender in Primary Teachers Education Mathematics among Pre-primary School. (iii) To compare the time allocated to Mathematics content knowledge versus Mathematics pedagogical knowledge and skills, and (IV) To determine the extent to which prospective teachers' KCSE Mathematics' grades predicts PTE Mathematics grade. The study was conducted at Thogoto Teachers' Training College. The study adopted correlation survey research design based on ex-post facto research methodology where secondary data of KCSE and PTE Mathematics scores of 160 randomly selected students from two consecutive academic years were obtained from examination archives. The study also adopted a descriptive survey research design to collect data by use of a guided questionnaire to interview 6 purposively selected Mathematics lecturers at Thogoto TTC. The data collected was sorted, coded and analyzed with the aid of SPSS software version 22. Data was analyzed using both descriptive and inferential statistics; Pearson Product Moment Correlation Coefficient and multiple regression analysis. The results were presented in terms of tables, graphs and charts. The study revealed that performance in Mathematics among female students is low compared to male students. The study also revealed that the PTTC Mathematics syllabus is designed for the purpose of teaching pedagogical knowledge among the Pre-Service teachers as opposed to subject matter content knowledge. It was also revealed that KCSE Mathematics performance predicts PTE Mathematics at 30-50%. The study recommends that PTTC lecturers should put into consideration Pre-service teachers entry grade in order to accommodate poor students in Mathematics subject matter during classroom instructions. The study also recommends that PTTC placement board should revise their selection criteria and include a minimum requirement of C- in Mathematics for admission to PTTC. The study also recommends that Centre for Mathematics and Technology Education in Africa (CEMASTE) should particularly target the newly recruited teachers for the in-service courses to improve their mathematical skills and finally the study recommends that the ministry of education, TTC administrators and parents should in conjunction provide incentives to female students to boost their performance in Mathematics.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter looks at the background to the study, problem statement, objectives, research hypotheses, significance, and limitations, scope of the study, theoretical frameworks, conceptual framework and operational definition of terms.

1.1 Background to the study

There are various forms of reasoning, altogether Mathematics has stood out to be a reliable form of reasoning since it employs logic through its mode of formulating and realistically testing its assumptions and coming up with a justifiable deductions for everyday problems affecting human beings (Boyd et al., 2009). It influences all facets of human life in different ways and at different levels. It is critical in many aspects of the society, including but not limited to economics, financial services, masonry and carpentry, it is the base to all science subjects. There has never been a more critical era of teaching Mathematics than the current era where nations, both developing and developed seek to deepen their technological skills and expertise; such teaching must be done from primary phase of education through the secondary to the tertiary level of education (Burghes, 2011).

The present day educators programs are streamlined with an aim to produce virtuous educators for both basic and secondary education (Burrill & Biehler, 2011). It is therefore crucial for admittance process to be able to handpick aspiring educators who have the capability of succeeding in the preliminaries educators programs to emerge as respectable teachers of the present day learners (Bekdemir, 2010). However, the relationship of admissions criteria to the knowledge, skills, and attitudes beginning

teachers need and to the preparation provided by the programs are rarely made explicit. Across the world, a range of admission policies have been established in an attempt to select teacher candidates who can function in the dynamic environment of Education. The admissions process should be viewed as a gateway to professional practice, and not just a process. As such, it must support the integrity of the teaching profession by ensuring the selection of individuals who have the potential to become effective teachers.

Majority of educators programs around the globe rely on Grade Point Average (GPA) as an admittance standard to educators training institutions (Burrill & Biehler, 2011). There are some institutions which are however going a step further to include aspiring educators personal profile and reasons why they think they can succeed in teaching profession with other institutions keen on the applicants performance in their pre-designed interview before admittance (Krauss et al., 2008). Scholars have also revealed that the GPA criterion fits to the conservatives' educational norms and the applicants are made to believe that their past achievement in secondary educations displays their successfulness as future educators. This school of thought have faced minimal opposition in many parts of the world including the developed ones (Peker & Mirasyedioğlu, 2008).

Applicant profile is another criterion that is gaining ground in a good number of educators training institutions. According to Schmidt et al. (2011) the criterion is gaining favour due to its ability to stretch further and seek for individual applicant sincere interest in teaching and their suitability as teachers (Peker & Mirasyedioğlu, 2008). This criteria is especially popular in majority of North America states where

many of teacher education programs are adopting profile or written response for selecting applicants. (Stronge et al., 2011)

Interview ratings have also been found to be of limited value for predicting student teaching performance (Byrnes et al., 2000). However, Shechtman (1992) found that ratings of applicants' performance in a group interview predicted student teaching performance and that this type of interview was a better predictor than academic criteria. Similarly, several researchers have presented evidence that ratings on individual interviews can be good predictors of future teaching success (Denner et al, 2001). The interview process can be particularly time consuming and costly both for programs and applicants. Because of this, some programs invite to be interviewed only applicants who have met other admission criteria. Even so, interviews have been criticized as an unnecessary barrier for applicants who live at a distance from the program and also because they may reward interviewees' personal characteristics such as confidence, sociability, appearance, and attitude which might be in congruence with those of the interviewers (Caskey et al, 2001).

The other currently developed criterion for admission into teachers training colleges is letter of reference. Many programs require letters of reference (Caskey et al., 2001); Caskey et al found that written recommendations were required by all of the 147 U.S. programs they surveyed. These letters vary in content from a discussion of the applicant's academic competencies to descriptions of personal characteristics. Some programs pose specific questions to which referees respond in prose or using a rating scale (Jacobowitz, 1994). However, because the applicant usually selects the referees, it is expected that the letters will be favorable to the applicant.

Many teacher education programs in the U.S. use results from standardized tests in their selection processes. For example, 28 states and the District of Columbia require applicants to pass the Praxis I: Pre Professional Skills Assessments (Educational Testing Service, 2006), which tests basic skills in reading, writing, and Mathematics knowledge. This is not a consistent protocol for the use of or selection of standardized tests in the United States, and none are used in Canada as the mandate for Education falls under the jurisdiction of provincial governments.

In some concurrent teacher education programs, applicants are admitted directly into the program in their first year of university. Other programs, however, require students to apply after the first or second year of undergraduate courses. Some of these programs require students, who wish to apply, to take pre-requisite courses in pedagogical methods, child psychology, or educational psychology and use performance in these courses as an admission criterion. Riggs and Riggs (1991), analyzing the records of 437 elementary pre-service teachers found that marks in two prerequisite education courses correlated .24 and .37 with subsequent student teaching performance (GPA correlated $>.28$). Based on this findings they recommended that teacher education programs consider postponement of formal admission to their programs until students have successfully completed at least one pedagogical methods course. No literature was retrieved that investigated the use of pre-requisite education courses at Canadian institutions.

Applicants for consecutive programs who wish to train to be elementary school teachers are often assumed to have adequate subject matter knowledge if they have a Bachelor's degree (although some programs will require them to also pass tests of reading, writing, and Mathematics). Applicants for preparation as high school

teachers, however, typically must provide proof of adequate knowledge of the subject areas they intend to teach. Often, this requirement is met by providing a university transcript showing completion of the required numbers of courses in the specialization areas (Marks, 1990). Marks recommended that high school teachers have a minimum requirement of six semester courses in their major teaching area. Stotsky (2006) suggested that the content of the course should be considered and that University academic departments should be held responsible for the content knowledge of elementary and high school teachers in their disciplines.

In other institutions and regions selection boards employ multiple criteria to admit students in teachers training colleges. For example, only those applicants to Queen's University's program who pass the first round of screening are asked to complete a profile that consists of a personal statement describing life experiences, employment and training, volunteer or service experiences, work with diverse groups, languages spoken, special skills, and leadership roles (Smith & Pratt, 1996). In some jurisdictions there are multiple pathways to primary teacher certification. For example, New York State has five (Boyd et al., 2009). Similarly there is a range of Mathematics prerequisite requirements prior to teacher education entry. Most primary school teachers in Australia complete an undergraduate degree, usually full time over four years. This pathway is common across many countries including China (Li, Zhao, Huang, & Ma, 2008). The alternative pathway in Australia is a graduate diploma usually completed in one year subsequent to the completion of an undergraduate degree. The Australian study focuses on the Graduate Diploma in Education Primary pathway, a one year pre-service Teacher Education Program usually undertaken by students who have completed a Bachelor degree. Students

throughout Australia increasingly favour the one-year graduate diploma pathway with proportional enrolments increasing at the expense of four-year undergraduate degrees (Commonwealth of Australia, 2008).

Unlike the New York State process of gaining registration as a teacher reported by Boyd et al., (2009), Australian Primary Teachers are not required to undertake registration examinations. Instead, state-based accrediting bodies review university course structures and students are accredited on the basis of their university assessments. The added criterion is that the student demonstrates ‘reasonable classroom practice’, a judgment made by the primary school in which the pre-service teacher gains classroom experience. There is thus no external assessment of the prospective teacher’s knowledge of Mathematics. A major challenge in primary Teacher Education is, primary school teachers are generalists who usually teach a cohort of students most of the subjects in the curriculum as Commonwealth of Australia (2008) posited. For this reason pre-service teacher education courses look to ensure that graduate teachers have content and pedagogical content knowledge across a range of disciplines as well as curricular knowledge, knowledge of learners and their characteristics, and knowledge of educational contexts for teaching students from the early years of learning to middle school learning. The importance of teacher education programs providing a cohesive model that accommodates content, pedagogical content, and curriculum knowledge has been widely acknowledged (Ball, et al., 2005; Boyd, et al., 2009; Osana et al., 2006; Warren, 2009).

It is however important to note that, instructions in teacher training colleges focuses on the “how” of teaching pedagogical knowledge and pedagogical skills (Shulman, 1987), not the “what” to teach and consists of both formal instruction and supervised

practice. Teachers need to understand how children learn and how to teach children with a variety of needs. Pedagogical knowledge may include “how to” lesson planning approaches, instructional strategies, and assessment techniques (Shulman, 1989). While pedagogical knowledge is knowing what to do in a situation, pedagogical skill is being able to do it. Particularly important is skill in communication, with research showing that students taught by teachers with excellent verbal ability and communication skills learn more than those taught by Teachers with weaker skills (Darling-Hammond, 2001).

In the United Kingdom, those aspiring to teach Mathematics in the primary schools must have a bachelor’s degree and must have obtained a mean grade of C in General Certificate of Secondary Education (GCSE) with at least C in both Mathematics and English (UK Department of Education, 2015).

In Uganda, a candidate for elementary school teacher training is required to obtain an Ordinary Level certificate with a pass in six subjects including Mathematics, English and two more Sciences. The trainees do not specialize in any subject but are expected to teach all subjects including Mathematics. The same trend is replicated in several African countries, such as Senegal, Ghana, Tanzania and Mali (University of Sussex, 2016).

Bali et al.. (1984) investigated the relationship between performances in Certificates of Primary Education (CPE) with Kenya certificate of Education (KCE) and found a correlation of .62 which by then was an indication of a significant relationship. A similar survey by Amburo (2011) compared Kenya Certificate of Primary Education (KCPE) and Kenya Certificate of Secondary Education (KCSE) and found a strong relationship between the two grades by the same students, this postulate that present

success can be used to predict future success. (Gatumu, 1989) investigated how well ordinary level grade (O-level) predicts performance in Primary Teachers Training College (PTTC). The predictor variable for this case was O-level aggregate while the criterion variable was mean aggregate of all the ten subjects offered in primary teachers colleges that time. The results showed a strong correlation between O-level performance and performance in Teachers Training Colleges by that time, however individual subjects were not considered.

Following this body of knowledge it is important to note that for a teacher to be effective she/he must be equipped with both pedagogical knowledge and content knowledge. The content knowledge is not taught in Teachers Training Colleges and therefore, trainees are assumed to have acquired it from the previous levels of education. Teachers need to understand the subject matter they are to teach (Monk, 1994, Casey, 2005). Monk found that the pre-service teachers who had performed well in their secondary schools performed equally better in their college education. It is important to distinguish which of the knowledge, skills and attitudes that beginning teachers need, can be learned in Teachers Training Colleges. Those that cannot be learned in the training colleges must already be possessed by applicants prior to entry into the Teachers Training Colleges.

The focus of Teachers' Training Colleges is to provide instruction and practice to build pedagogical knowledge and skills, with a lesser focus on content knowledge (Casey, 2005). The expectation is that, at completion of the programme, the pre-service teachers will have the knowledge, skills, and attitudes needed to be good beginning teachers (Stronge, 2002). Simply put, the minimum requirements for admission to a teacher education program can be determined by putting in mind what

the teacher trainees have achieved, what can be termed as good content mastery in all subjects on board.

Primary Teachers' Training Colleges in Kenya use students' mean grade as a criterion for admission. The revised criterion requires that every applicant must have attained a mean grade of C (plain) with an exception of the special needs' students who must have attained C- (minus) in their KCSE exam (MoEST, 2016). These applicants who aspire to train to be primary school Teachers are however, assumed to have adequate content matter knowledge in all the subjects. This assumption may however be misleading as in some instances, an applicant with D- in Mathematics but have the minimum mean grade for the College, qualifies to be a Pre-service teacher. Such teachers would be very difficult to train to become effective Mathematics teachers. This study therefore sought to find out the relationship between Students' Mathematics final grade at Secondary school and at Primary Teachers Education a case of Thogoto Teachers' Training College in Kiambu County.

1.2 Statement of the problem

Pupils have consistently recorded increasingly low results in Mathematics in national examinations when compared to other subjects. During the (2010-2015) years' examinations, the maximum mean score that was achieved in KCSE Mathematics is 28.70 (KNEC, 2016). Various researches have been done to establish the causes of low score at KCPE and KCSE (Amburo, 2011). It's pertinent to note that virtually no research has been done to establish the relationship between pre-service teacher's mastery of Mathematics content and proficiency in Mathematics pedagogical skills/knowledge in Kenya.

To qualify for a considerations to admission to Primary Teachers' Training Program the minimum entry requirement is a mean grade of C (plain) in the Kenya Certificate of Secondary Education (MoEST, 2016). This is an aggregate of all eight subjects the candidate was examined in including Mathematics. Performance in individual subjects is not considered, this means that the entry requirement for teaching Mathematics is not important. This study, sought to evaluate the relationship between Pre-Service Teachers' KCSE Mathematics' performance and final performance in Primary Teachers' Education (PTE) Mathematics' grade.

1.3 Purpose of the Study

Pre-service teachers admitted into Primary Teachers 'Training Colleges are subjected to pedagogical knowledge and skill training in their first year of study according to PTE syllabus. This is an uphill task for those trainees with poor Mathematical content knowledge background. Some trainees are forced by circumstances to drop science and Mathematics after sitting for mid-course examinations which is administered at the end of first year's studies while others performs decimally in PTE Mathematics and ends up been referred.

The purpose of this study was to evaluate the relationship between students' Mathematics final grade at Secondary School (KCSE) and Primary Teachers Education (PTE) among pre-service Teachers in Teachers Training College.

1.4 Objectives of the study

- i. To establish the difference in students' performance by gender in Kenya Certificate of secondary school Mathematics among pre-primary School teachers.

- ii. To establish the difference in students' performance by gender in Primary Teachers Education Mathematics among pre-primary School teachers.
- iii. To compare the time allocated to content knowledge versus pedagogical knowledge and skills in PTE Mathematics syllabus in order to establish the balance.
- iv. To determine the extent to which pre-primary school teachers' KCSE grade in Mathematics predicts the PTE grade in Mathematics.

1.5 Research hypotheses

The study sought to test the following null hypotheses;

H₀₁: There is no significant difference in students' performance by gender in Kenya Certificate of Secondary School Mathematics among the pre-service primary teachers.

H₀₂: There is no significant difference in students' performance by gender in Primary Teachers Education (PTE) Mathematics among Pre-primary school teachers.

H₀₃: There is no significant difference in time allocated for Mathematics' content knowledge and pedagogical knowledge and skills in PTE Mathematics syllabus.

H₀₄: Pre-Primary School teachers (KCSE) Mathematics' grade cannot predict their (PTE) grade in Mathematics.

1.6 Significance of the study

The findings from the study will be useful to the following stake holders. The Ministry of Education Science and Technology may find this study useful in their future development of entry criteria for Teachers Training Colleges. The Kenya Institute of Curriculum Development (KICD) may also find this study useful as they prepare the curriculum for pre-service teachers. The study will act as a foundation for

other scholars who will be interested in carrying out a study on the relationship between pre-service teachers KCSE Mathematics performance and the final grade in Mathematics at Teachers Training Colleges.

1.7 Limitation and Delimitation

1.7.1 Limitations of the study

This study was limited by various factors which include: The teachers' trainees whose grades in Mathematics were under scrutiny had already left the institution by the time the research was carried out. Their presence would have enabled the researcher to interview them about their performance at both secondary school and at Primary Teachers College. The other limitation was distance, Proximity to public teachers Colleges would have enabled the researcher to use more colleges. The use of one of the Teachers Training College allowed for an in-depth study and results could be generalized since all students admitted to Primary Teachers Colleges in the country were subjected to same admission requirements. Again all Pre-Primary teachers' trainees sit for a common examination prepared and administered by Kenya National Examination Council (KNEC).

1.7.2 Scope of the study

The study focused on the relationship between the students' final grade in secondary school as recorded in (KCSE) and final grade in PTE Mathematics among pre-service teachers in Thogoto TTC. The study was limited to Mathematics only, other subjects offered in the Kenyan Teachers' Training Colleges were not included. The study was also delimited to public Primary Teachers Training Colleges. This is due to the reason that there are privately sponsored Teachers Training Colleges which follow the same

curriculum. The target group was regular students and not in-service and holiday based students.

1.8 Study assumptions

The study assumed that:

- i. The Teachers trainees covered all the topics in Mathematics syllabus as per the course requirements before sitting for end of course examinations.
- ii. The PTTC lecturers are competent to implement the first and second year's syllabus appropriately
- iii. All respondents would cooperate and give correct information.
- iv. The teachers trainees did not suffer external challenges in pursuance of the course and during examinations periods.

1.9 Theoretical and Conceptual framework

1.9.1 Theoretical framework

This study adopted systems approach to teaching and learning theory developed by Ayot and Patel (1987). The theory argues that teaching and learning is a dynamic process which is coherent and individualistic whole that can be distinguished from its surrounding. This being open system, the society supplies the input and receive the end product. Bertalanffy, (1968) explains a system as a set of discrete elements that interacts to attain a particular goal. The model theory consists of three basic elements namely input, process and output. In this case, Pre-service teachers' Mathematical facts and principles acquired by the time of admission into Teachers' Training College represent the input. The process is the act of training/transforming the trainees to become qualified Mathematics teachers. The trainer chooses the teaching methods, teaching/learning resources, activities to inform the teaching and the

evaluation procedures. The trainee teachers are expected to exit colleges as a qualified primary school teacher who can teach subjects offered by the Primary school curriculum. The training exposes student teacher to pedagogic knowledge and skills on basis of Mathematics' concepts and principles learnt before joining College. Feedback from assessments both practicum and theory reflects the quality of the product or output (fig 1.1).

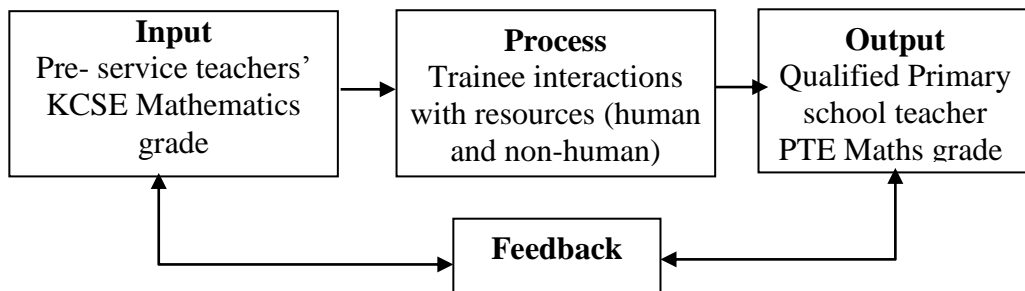


Figure 1.1: Theoretical framework model

Source: Adopted from Ayot & Patel (1987).

1.9.2 Conceptual framework

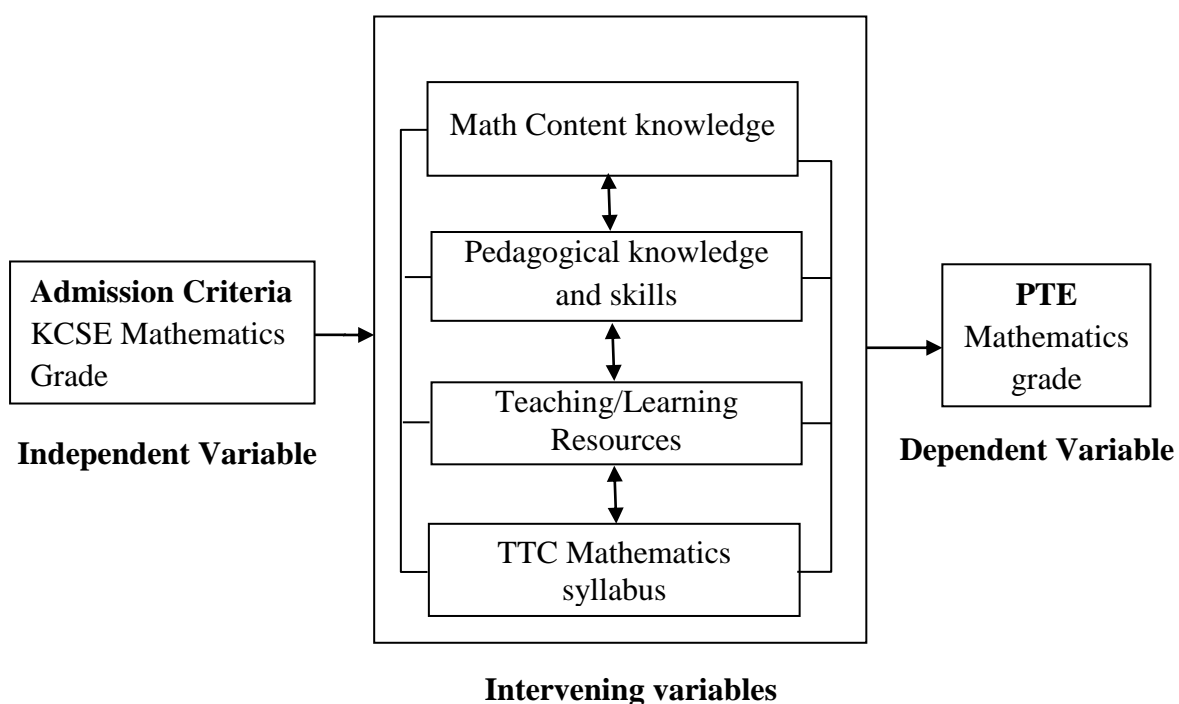


Figure 1.2: Conceptual framework

Source: Researcher 2016

In this study, the prospective teacher's KCSE Mathematics' grade was the independent variable. Mathematical content, pedagogical content and teaching/learning resources, Teachers Training College Mathematics Syllabus were the mediating/intervening variable which may influence the relationship between the independent and dependent variables. PTE Mathematics' grade is the dependent variable that was correlated with the KCSE Mathematics' grades.

1.10 Operational definition of terms

The following words were used to mean the following in the study:

Admission criteria – Reviewed admission standards for a freshman applying for Teachers Training College.

Content knowledge- The facts, concepts, theories, and principles that are taught and learned in specific academic courses, rather than to related skills such as reading, writing, or researching that students also learn in school.

Mathematical knowledge- knowledge of Mathematics principles and facts.

Pedagogic knowledge – What the teachers know about teaching and what they know about what they teach.

Pre-service teachers- Students teachers undergoing training in Teachers Training Colleges.

Self-efficacy- It one's belief in one's ability to succeed in specific situations or accomplish a task

Trainee-refers to a Pre-service teacher admitted to Thogoto.

Primary Teacher Education –Course taken by students aspiring to become Primary School teachers in Kenya.

Primary Teachers Education Exam (PTEE) -This is the final exam undertaken after two years of training at the Teachers Training Colleges. The exam is graded using a scale of 1 to 8, with 1 being a distinction and 8 a fail

Mid-course Examinations—Examination taken by all trainees after one year and which informs the placement in second year.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter reviews available literature related to study on relationship between students' Mathematics final grade in secondary school and in Primary Teachers Education. It is sub-divided into the following areas; Gender and Mathematics performance at secondary schools and colleges/Universities, Pre-service Teachers Mathematics Content Knowledge and their Pedagogical Skills Acquisition, and Balance of Content in Mathematics Syllabus in Teachers Training Colleges globally, continentally, and regionally and in Kenya. The researcher then identified and filled the gaps in the previous studies on the subject.

2.1 Gender and Mathematics' performance at institution of learning.

Primary School Teachers all over the world are expected to teach a number of subjects in the curriculum. This includes Arithmetic in every day and in every class, implying that Mathematics is a subject that is taught every day in Primary schools. Mathematics' teacher is duty bound to help boys and girls to recognize the power, beauty and relevance of Mathematics in their daily life, hence appreciate and enjoy learning Mathematics (Neyland, 1994). This prepares boys and girls towards breaking the chain of low confidence which translates to low achievements in both secondary schools and Teachers Training Colleges. Various researchers provides varied views regarding gender and academic performance in Mathematics.

Perie, Moran and Lutkus (2005) indicates that researchers from Britain, United States and Russia have not been consistence in their findings on sex-related differences in Mathematical abilities. However in Britain, little difference in Mathematics abilities

of 11 years primary school children indicated boys been superior to girls, though survey by Assessment of Performance unit (APU, 1994) seemed to down play the finding terming them as minimal when compared to differences of same children 5 years later. In Russia sex- difference in ability to solve arithmetic problems seemed not to exist (Kruteskii, 1976). Contrary to finding from Europe in New Zealand girls out performed boys in some aspects of Mathematics during early years in primary school (Neyland, 1994).

At post primary level gender performance have similar patterns (Forbes et al., 1990), more boys than girls succeed in public examinations taken at age of 16 years. Documented record from graduates' school examinations in United States indicate clearly that men out performed women overall though difference was greater on items requiring spatial skills, shot cuts, or multiple solutions paths as compared to mastery of classroom based content (Gaugher, 2000). The same pattern was replicated in New Zealand where boys in mixed secondary schools performed better than girls in the same schools (Neyland, 1994). Reasons for the discrepancies in performance between boys and girls varies from one country to the other, type of secondary schools (mix or same sex), and Mathematics teacher to some extent. Basically these gender differences were attributed to biological constraints, pressure imposed by social and cultural stereo types about cognitive skills and occupation according to Forbes et al (1990).

Contrary to APU (1994) finding noted earlier studies conducted in European countries indicate that boys perform better than girls in Mathematics (Fennema, 2000; Kaiser-Messmer, 1994; Muthukrishna, 2010). Asante (2010) also noted that boys generally achieve higher than girls in standardized Mathematics tests. Other international

studies are however of a contrary view where they suggest that female students perform better than male students in Mathematics (Hydea & Mertz, 2009). Hydea & Mertz conducted a large scale study in USA where they revealed that girls are at par with boys when it comes to performance in Mathematics. Their study revealed that girls are performing better than boys even for tasks requiring complex problem solving.

In yet another body of research, it has been revealed that gender difference in Mathematics score is diminishing (Frost, Hyde, & Fennema, 1994). According to Perie, Moran, and Lutkus (2005) the gap between performance of boys and girls is narrowing in USA. In Australia research indicates that gender difference in Mathematics performance is shifting and reducing (Forgasz, Leder, & Vale, 2000). Vale (2009) revealed that various studies conducted in Australia between 2000 and 2005 indicated that there is no significance difference between male and female students performance in Mathematics, even though male students were more likely to record higher mean score in the subject.

Researchers have conducted studies in various contexts to establish factors that influence gender difference in Mathematics performance. Majority of these studies have focused on facts associated with difference in the performance of girls and boys in Mathematics (Abiam & Odok, 2006; Mahlomaholo & Sematle, 2005; Opolot-Okurut, 2005; Zhu, 2007). Feminist researchers have tried to study the experiences of girls and boys in Mathematics classroom, and interpret their findings based on male-female relations (Jungwirth, 1991; Waiden & Walkerdine, 1985). The findings of their studies indicate that girls in many instance are marginalized and given subordinate status in a mathematical class. Their findings implies that the teachers

perceptions regarding girls performance in Mathematics are dependent on perseverance and hard work rather than natural talent, risk taking and flexibility which are the learning styles for boys.

Gender difference in Mathematics learning and achievement has also been explained based on gender difference in brain lateralization and cognition (Fennema & Leder, 1990). In a similar view, Paechter (1998) argues that male and female students experience the world in different ways. Firstly they differ in their learning style and their perception and procession of reality. Secondly, they are differently positioned in the society. This group of researchers emphasize that majority of Mathematics classroom discourse is structured to accommodate male learning patterns, a facts that explains high achievement of male students in Mathematics.

According to Boaler, (1997) the differing learning goals of boys and girls, inconveniences girls in a competitive environment. Girls are viewed to prefer to Mathematics curriculum that allow them to work at their own pace as their reasoning is different. They also prefer experiences that enable them to think and develop their own ideas since their main goal is to gain understanding. Boys on the other hand are driven by accuracy and speed as they view these as indicators of success. They are therefore able to perform well in a competitive environment of textbook based Mathematics learning.

Other essential factors that have emerged in research on gender difference in Mathematics performance are socio-economic status of parents, family influences and traditional and cultural influences (Kaino & Salani, 2004). Asante (2010) revealed that schools have put in place symbolic oppositions between female and male students by the way of gendering of knowledge and labeling certain subjects as masculine.

These have resulted to conditioning of female students to believe that Mathematics is a male subject and it is permissible for them to drop it. In the studies conducted in Botswana, they indicated that cultural expectations of society could result into gender difference in Mathematics performance (Duncan, 1989; Marope, 1992 and Kaino, 2004). In Nigeria it has been revealed that the way children are nurtured by their parents and the society strengthens male dominance over the female gender (Bassey, Joshua & Asim, 2007).

Social cultural attitudes and expectations in many countries and especially Africa lead to discrimination against girls in Mathematical Education. (Hyde, Fennema, and Lamon, 1990) opined the consequences of discriminating girls in term of Mathematical Education as follows-;

- Females lack confidence in Mathematics abilities and when given option they drop.
- Girls do not persist in Mathematics like boys and so they are filtered where Mathematics is used.
- Women without Mathematics confidence are usually filtered in decision making.

In a survey conducted by International Institute for Educational Planning (IEP) - UNESCO (2004) it revealed that there was no significant difference between performance of boys and girls in Mathematics among students in South Africa. The survey further revealed that girls scored significantly higher than boys only in Seychelles. On the other hand the survey indicated that in Malawi, Mozambique, Kenya, Zanzibar and Tanzania, boys performed significantly better than girls. The study by UNESCO cannot be used to conclude that boys performs better than girls in

Africa or the contrary. It is like these differences are narrowing down in African countries.

In Kenya like the rest of the world, boys performed better than girls in Mathematics and Science subjects at KCPE level while girls out performed boys in English, Kiswahili, and Kenyan sign language (KNEC, 2016). However the difference was minimal and the number of girls who sat for KCPE in 2015 and 2016 was higher than that of boys who sat the same examinations. The gender difference in performance was more pronounced at KCSE level where boys registered better performance than girls in Mathematics and Science subjects (KNEC, 2015). The trend exhibited at both KCPE and KCSE levels may manifest itself at PTE level with serious repercussions on the quality of Mathematics Teacher produced by PTTC. Teachers with low Mathematics confidence are likely to create low students achievers in Mathematics leading to vicious circle of gender differences. This study evaluated the differences in Mathematics by gender at KCSE and PTE respectively among the Pre-service teachers at Thogoto TTC.

2.2 Pre-service Teachers' Mathematics Content Knowledge and their Pedagogical Skills acquisition.

The relationship between Teachers' Mathematical content knowledge and their ability to teach has been well researched and there is clear evidence on the relationship between them (Ball, Hill, & Bass, 2005). Teaching knowledge is not a single dimensional variable. Rather, at the very least, teacher knowledge ought to include: Content knowledge, Pedagogical Content Knowledge (PCK), general pedagogical knowledge, curriculum knowledge, knowledge of learners and their characteristics, knowledge of educational contexts and knowledge of educational ends, purposes and

values (Shulman, 1999). The concept of (PCK) is described as an intersection of subject knowledge and pedagogical knowledge (Shulman, 1987). High levels of a teacher's subject content knowledge do not necessarily imply that individuals understand the material in a way that enables them to impart or teach it to students (Ma, 1999). Ma describes what is needed for teaching as profound understanding of fundamental Mathematics.

What is required is that Teachers understand the material and ways of representing it to students. This has recently been described as Mathematical Knowledge for Teaching (MKT) (Silverman & Thompson, 2008). However, both PCK and MKT pedagogical knowledge are dependent upon a fundamental understanding underlying Mathematical structures (Silverman & Thompson, 2008). Banner and Cannon (1997) summed up the critical importance of Teachers' content knowledge as follows; In order to teach, teachers must know what they teach and know how to teach it; and in order to teach effectively, they must know deeply and well. The importance of teachers' content knowledge was also articulated by the United State Department of Education (2008), which stated that teachers must know in detail the mathematical content they are responsible for teaching and its connections to other important Mathematics, both prior and beyond the level they are assigned to teach.

Masters (2009), in his report on the 2008 Queensland National Assessment Program- Literacy and Numeracy (NAPLAN) tests performance by Ministerial Council on Education, Employment and Youth Affairs [MCEETYA], (2008), similarly noted that highly effective teachers have a deep understanding of the subjects they teach. These teachers have studied the content they teach in considerably greater depth than the level at which they currently teach and they have high levels of confidence in the

subjects they teach. Their deep content knowledge allows them to focus on teaching underlying methods, concepts, principles and big ideas in a subject, rather than on factual and procedural knowledge alone.

It is widely acknowledged that teachers with more explicit and better connected knowledge are more likely to teach with a variety of representations and in a dynamic manner (Commonwealth of Australia, 2008; Sowder, 2007; Warren, 2009; Miheso, 2009). As important as they are, general pedagogical knowledge, curriculum knowledge, knowledge of learners and their characteristics, knowledge of educational contexts and knowledge of educational ends, purposes and values (Shulman, 1999), these cannot be effectively drawn upon unless the teacher has deep content knowledge. Ma (1999) noted that it was possible to pass advanced courses in Mathematics without understanding how they might inform the teaching of primary Mathematics, none the less, a deep conceptual knowledge of Mathematics plays a vital role on Mathematics teaching and learning. This observation has almost universal support among Mathematics education researchers and so this study focused on the depth of pre-service teachers' content knowledge which is embedded in secondary school Mathematics at the entry point to Primary Teachers Training College (PTTC).

Byrne et al (2000) summarized the results of thirty studies relating teachers' subject matter knowledge to student achievement. The teacher knowledge measures were either a subject knowledge test (standardized or researcher-constructed) or number of college courses taken within the subject area. The results of these studies were mixed, with 17 showing a positive relationship and 14 showing no relationship. However, many of the "no relationship" studies, Byrne noted, had so little variability in the

Teacher knowledge measure that insignificant findings were almost inevitable. Ashton and Crocker (1987) found only 5 out of 14 studies they reviewed exhibited a positive relationship between measures of subject matter knowledge and teacher performance.

It may be that these results were mixed because subject matter knowledge is a positive influence up to some level of basic competence in the subject but is less important thereafter (Ma,1999). For example, a controlled study of middle school Mathematics 4 out of 44 teachers, matched by years of experience and school setting, found that students of fully certified Mathematics teachers experienced significantly larger gains in achievement than those taught by teachers not certified in Mathematics. The differences in student gains were greater for algebra classes than general Mathematics (Hawk, Coble, & Swanson, 1985). However, Begle and Geeslin (1972) found in a review of Mathematics teaching that the absolute number of course credits in Mathematics was not linearly related to teacher performance.

It makes sense that knowledge of the material to be taught is essential to good teaching, but also that returns to subject matter expertise would grow smaller beyond some minimal essential level which exceeds the demands of the curriculum being taught. This interpretation is supported by Monk (1994) study of Mathematics and science achievement. Using data on 2,829 students from the Longitudinal Study of American Youth, Monk found that teachers' content preparation, as measured by coursework in the subject field, is positively related to student achievement in Mathematics and Science but that the relationship is curvilinear, with diminishing returns to student achievement of teachers' subject matter courses above a threshold level (e.g., five courses in Mathematics).

In a study conducted on South African pre-service teachers' knowledge of functions and its relation to their pedagogical content knowledge, Even (1993) made use of questionnaires which were completed by 152 Pre-service teacher and interviewed 10 of them. Her study revealed that Pre-service teachers had a tendency of relying on previous learning about functions and blending them with new ideas learned in college. In yet another study Even and Tirosh, (1995) examined teachers' presentation of certain contents in terms of subject matter knowledge. Their study was based on an argument that to generate suitable presentations and explanations of a concept, teachers need not only to know the facts, procedures and rules but also know why they are true. They went further to give an example of one of their respondent who knew 4 divided by 0 is undefined but did not know why. They therefore argued that this respondent would tell students that it is one of the mathematical axioms that should be memorized. In addition Even and Tirosh found out that the pre-service teachers were unable to address the learners' misconception effectively. They illustrated this by giving two cases of incorrect solutions for 4 divided by zero (e.g., $4 \div 0 = 0$ and $4 \div 0 = 4$), the pre-service teachers preferred to suggest their own answer instead of trying to understand the learners reasoning. Even and Tirosh thus concluded that Teachers' knowledge of subject matter is strongly related to their pedagogical decision.

In a similar study in Algeria Kinach, (2002) noted that pre-service teachers' inability to unpack Mathematical ideas affect their ability to teach them effectively. Kinach noted this after she requested Pre-service teachers to explain subtraction and addition operations with integers in three contexts: algebra line, self-chosen and number line. She thus noted that the Pre-service teachers gave rules, state how to execute them but

failed to explain why the algorithm works. Kinach (2002) therefore concluded that pre-service teachers' subject matter knowledge and pedagogical are instrumental since teaching is viewed as giving rule, showing learners how to use them and making learners practice with them.

A study carried out in Kenyan secondary schools, found that Mathematics teachers require specialized skills and knowledge that persons in other careers but with same grade in Mathematics may not require (Miheo, 2009). This is an indication that pedagogical knowledge needs a certain level of Mathematics principles and concepts as its basis. Following this school of thought it necessitates that all prospective teachers willing to teach Mathematics should have a certain threshold in Mathematics content knowledge. This inquiry investigated the pre-service teacher KCSE Mathematics at the time of admission and the PTE Mathematics grade at time of certification.

2.3 Balance of Content of the Mathematics Syllabus in Teachers Training

Colleges

The preparation of elementary teachers in Mathematics is an increasingly critical topic for teacher preparation programs (Matthews, Rech, & Grandgenett, 2010). Preparing teachers to teach Mathematics effectively is one of the most urgent problems facing those who wish to improve students' learning (Morris, Hiebert, & Spitzer, 2009). Unfortunately it cannot be assumed that Pre-service primary teachers entering Colleges will be competent in Mathematics (Hamlett, 2009). Hutchinson (1997) extends this notion, reporting how graduate teachers faced many problems which were largely due to their inadequate preparation in primary school Mathematics content knowledge. A survey of eight major universities across Australia carried out by the common wealth

of Australia (2008) reviewed common program structures by examining their online descriptions. Taking an academic learning time approach (Berliner, 1990), it appeared that in Australia, a typical graduate diploma program has two semesters with four units in each semester; where one of these involves practicum or professional experiences, occupying 25% of all scheduled learning time. Learning how to teach Mathematics (or literacy) might occupy one course, equivalent to 10 to 12 credit points (12.5% of scheduled learning time).

It was difficult to establish exactly how many hours are allocated for lectures and workshops since this information was not generally published on university programs or course outlines (Common Wealth of Australia, 2008). Berliner study on one of campus in Australia found that the teaching time was condensed into two, nine week semesters, with lectures confined to six weeks, except for Mathematics, which was permitted to extend the delivery of lectures over nine weeks. Still in Australia at an alternative Queensland based campus contact time was 24 hours over six weeks. Against this context, the question one ought to ask: Is the time allocated to for Mathematics in PTTC sufficient to enable graduates to exit with high levels of content knowledge in the subjects they will teach? The answer to this question necessitated a study of Primary Teacher colleges Mathematics syllabus. The content knowledge was compared with pedagogical contents with a bias on time allocated to each topic of the syllabus. Results from this comparison guided the researcher to find out if Pre-service teachers' training provides adequate opportunities for students to develop the necessary content knowledge upon which to base effective teaching of Mathematics.

In a longitudinal study conducted in South Africa, which aimed at investigating the nature and the extent of changes in Pre-service elementary teachers knowledge

regarding Mathematics teaching and learning as a result of a series of innovative Mathematics content course, a Mathematics methods course and curriculum (Schram, Wilcox, Lanier, & Lappan, 1988). The researchers collected data from 24 Pre-service teachers during their two years teachers training program and in their first year of teaching. The Pre-service teachers had taken three content courses which were particularly oriented to looking at ideas about geometry, numbers, statistics and probability. The instructor created a learning environment for Pre-service teachers to work in groups to discuss solutions, explore ideas and discuss the solutions to the problems, generate different representations, and make connections among Mathematical ideas. At the end of the course, the researchers noted that the Pre-service teachers' view of Mathematics had changed. At first the Pre-service teachers viewed Mathematics as meaningless series of rules and symbols but at the end of the course, they appreciated the value of conceptual understanding of Mathematics. However, an interesting finding of this study revealed that the Pre-service teachers were unable to transfer what they experienced in the course to their own instruction. They were found to emphasize on procedural knowledge rather than conceptual knowledge when teaching Mathematical facts and procedures.

In another study, Feiman-Nemser and Buchmann, (1987) revealed that pre-service teachers had difficulty making inferences from their learning experience during the teacher training program and applying them when teaching in classroom. Although the Pre-service teachers were found to keep the student engaged, they were unable to assess the student's needs and adjust their instructional method accordingly. Ball (1988) indicated that Teachers Training Colleges should provide opportunities for Pre-service teachers to evaluate their own understanding and knowledge of teaching and

learning Mathematics during their teachers' preparation programs. She designed her introductory methods course for elementary Pre-service teachers with that intention. She assigned a permutation project for the Pre-service teachers in which they first tried to learn about permutations themselves, then watched a teacher (Deborah Ball) helping a student to explore the idea, and finally tried to help a child or an adult learn about permutations. She asked Pre-service teachers to pay attention to what they were thinking, doing, and feeling during each phase of the project. In the end, she noted that the Pre-service teachers became aware that knowing Mathematics for themselves is different from knowing it to teach others, and they learned that there is more than one way to represent or explain a Mathematical concept.

Ball and Wilson (1990) analyzed data from the TELT study, which investigated what teachers are taught and what they learn in 11 different Pre-service, in service, induction, and alternative-route programs. Ball and Wilson investigated the nature of pedagogical content knowledge and perceptions about Mathematics of beginning teachers enrolled in an alternative route program and a standard Teacher Education program. They explored the teachers' ideas and understanding about Mathematics, teaching and learning Mathematics, and students in the specific contexts of place value, fractions, division multiplication, proportion, theory and proof, area and perimeter and variables. None of the students in either program was well prepared for unpacking meanings of Mathematical ideas they had studied. The participants' Mathematical knowledge was mostly procedural, and their conceptual understanding of some concepts such as division by zero was weak. Furthermore, most of them conceived of teaching as telling and showing how to perform operations or apply the rules. In fact, many of them lacked a repertoire of different representations of

Mathematical concepts. Therefore, Ball and Wilson concluded that teacher education courses had little impact on prospective teachers' knowledge and skills. They suggested that teacher educators must pay attention to the content and pedagogy of teacher education.

Philipp and his colleagues (Philipp et al., 2007) investigated whether Pre-service elementary teachers' content knowledge and beliefs improved if they were given opportunities to learn about students' Mathematical thinking as they were learning the Mathematics they would teach. They collected data from 159 Pre-service teachers enrolled in their first Mathematics content course, which focused on whole number and rational number concepts and operations. The instructional materials were designed to support Pre-service teachers' conceptual understanding of those topics, and the Pre-service teachers were given some examples of students' ways of solving problems. Philipp et al. randomly assigned the Pre-service teachers to one of four treatment groups, each with a different way of interacting with children's Mathematical knowledge, and a control group. The Pre-service teachers' beliefs about teaching and learning Mathematics changed, but there were no significant changes in their knowledge. However, the treatment group in which the Pre-service teachers watched and analyzed videos of students solving problems and then worked with a student themselves was the most effective one in contributing to Pre-service teachers' knowledge of students' thinking. The Pre-service teachers expressed positive feelings about working with students, even though some of them found it challenging. Philipp et al. suggested that pre-service teachers should be given opportunities to work with children in the early years of their training.

The literature on teacher education programs reveals that the coursework and field experiences have an impact on Pre-service teachers' conceptions about knowledge of content, teaching, learning, and students (Borko & Putnam, 1996) but in different ways and to different degrees. Most of the research leads to the conclusion that teacher training colleges should be revised to better support the development of knowledge bases for effective teaching. The courses offered in teacher education programs should enable Pre-service teachers to improve their knowledge in a specific knowledge base and provide opportunities to relate or apply what they learn in these courses to the practice of teaching. This study sought to find out whether the content both academic and pedagogic as prescribed by the college syllabus are well distributed to complement each other to enable the trainee exit with adequate competencies to teach Mathematics in all Primary School classes as prescribed by the curriculum.

2.4 Summary

The chapter evaluated different studies by various scholars related to teacher training globally, continentally, and regionally and in Kenya. The focus was on gender and Mathematics performance at KCSE and PTE, Pre-service teacher content knowledge of Mathematics, pedagogical knowledge, and balance of content in both first and second year of PTTC syllabus.

All authors agreed unanimously that admission criterion in any Teacher Training College depends on goals and objectives of the institution more than any other factor. Research has also shown that teachers' mastery in teaching Mathematics is affected by several factors including the previous grades in Mathematics in various levels of Education, Mathematics content knowledge and nature of teachers' training.

However, research particularly in the Kenyan context is being silent on how these factors relate to teachers' mastery in teaching Mathematics in Primary Schools.

The researcher evaluated the relationship between students' Mathematics final grade in secondary school and in Primary Teachers Education.

CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

3.0 Introduction

This chapter describes the various methodological procedures that were employed in the study. The chapter presents the study design, area of the study, the population, sample sizes and sampling procedures, data collection procedures, research instruments, data analysis, validity and the reliability of the instruments. The sub-headings will be discussed and highlighted as mentioned above.

3.1 Research Design

This study employed a correlation survey research design, investigating and establishing the relationship between two main variables. The two variables were KCSE Student's Mathematics grade and PTE student's Mathematics grade. The design was based on ex-post facto and descriptive surveys. The ex-post facto design is a systematic empirical inquiry in which researcher doesn't have control of variables under the study because their manifestations had occurred (Kerlinger, 2000). In this inquiry the Mathematics grade of pre-service teachers in Secondary School and PTE examination had occurred by the date data was collected, thus that data could not be manipulated.

A descriptive survey was used to explore the existing status of two or more variables under scrutiny, by enabling the researcher to collect sampled original data for the purpose of describing a population which is large to observe directly (Kombo and Tromp, 2006). Descriptive survey utilized qualitative and quantities approaches. Qualitative method allows researchers to describe in rich detail a phenomenon as it is situated and embedded in local contexts based on individual case information (Crotty,

1998). The design was chosen because of its appropriateness to this study, which aimed at gathering facts, knowledge, opinions and judgements from Lecturers on the effects of PTTC syllabus in relationship between prospective teachers' KCSE grade in Mathematics and their performance in Mathematics at Teachers Training Colleges. The lecturers were also asked to give their opinion on the best practice that would enhance performance in Mathematics at PTTC.

3.1.1 Variables

- The dependent variable in the study was PTE Mathematics grade among pre-service teachers in Thogoto TTC.
- The independent variable was KCSE Mathematics' grade attained by each respondent, which forms basis for admission criteria into Primary Teachers Training Colleges.
- The intervening variables in the study were Mathematical content knowledge, pedagogical knowledge, TTC Mathematics syllabus and teaching and learning resources. These variables were viewed to affect the strength of the relationship between the independent and dependent variables.

3.1.2 Research methodology

The study relied on both Primary and Secondary data. Primary data was obtained through interviewing Mathematics Lecturers at Thogoto TTC. The interviews were conducted with guidance of a semi-structured questionnaire prepared by the researcher. The interviews were aimed to collect information on whether the time allocation on the PTTC syllabus is balanced in providing subject matter knowledge and pedagogical knowledge. The interviews also enabled the researcher to gather in-depth information regarding the adequacy of the PTTC syllabus in equipping the

primary pre-service teachers with sufficient subject matter and pedagogical knowledge and skills. The interviews were necessitated by the fact that the time for practicum and projects was not specified by the syllabus.

Secondary data was obtained from scholarly books, journals and theses related to relationship between Mathematics subject matter knowledge and pedagogical knowledge among pre-service teachers. The researcher also obtained information regarding Mathematics performance of pre-service teachers at Secondary School- (KCSE) and at Primary Teachers College (PTE) using a record analysis schedule. The record analysis schedule enabled the researcher to gather needed information regarding pre-service teachers' prior Mathematics performance at Secondary school and Mathematics score in PTE Examinations. The researcher checked the admission registers and PTE final results list from the College Examinations archives to obtain grades achieved by the pre-service teachers in Mathematics at Secondary school and at Teachers Training College.

3.2 Location of Study

The study was conducted at Thogoto Teachers Training College one of the 22 public Primary Teachers Training Colleges. Thogoto Teachers College is located in Kikuyu sub-county neighbouring PCEA University about 18 km from city of Nairobi in Kiambu County. The College was founded in 1949 at Kambui Mission in Kiambu County by the Church of Scotland Mission (now PCEA) to train primary school teachers initially who were primary school leavers. The College now trains primary school teachers who are 'Form 4 leavers. The College is sponsored by the Presbyterian Church of East Africa (PCEA). The college is used as center for training

trainers in SMASE programs by CEMASTEAs thus provision of adequate teaching and learning resources for Mathematics and Sciences has been enhanced.

3.3 Target Population

The target population was all the pre-service teachers and Mathematics lecturers of Teachers Training Colleges in Kenya. The college has a total population of 720 students and 58 teachers.

Therefore the accessible population of the study was 778 respondents.

3.4 Sampling techniques and sample size

This study mainly used probability sampling techniques. This is when the probability of each member being selected is known. It is best used with a definite population i.e. where the population is known. Gay (1991) has shown that a sample size of 10% - 30% of the total population is adequate for a study in descriptive research. The researcher randomly selected 80 pre-service teachers from each of the selected successive groups of students. I.e. 2012/2014 and 2013/2015 academics year groups. The 2012/2014 academics year group was comprised of 474 students while 2013/2015 group was consisted of 398 students. Not all students in the said groups sat for Mathematics in their final year. In 2012/2014 academic year group only 230 students sat for Mathematics in their final year while for 2013/2015 group 207 students studied Mathematics in their final year. Those students who did opt for Mathematics in their final year were not included in the study. The study further purposively selected 6 Mathematics lecturers at Thogoto Teachers Training College. This made a total sample size of 166 respondents.

Table 3.1: Distribution of samples

	Total population	Sample Size	Percentage
Pre-service teachers (2012/214 group)	230	80	34.8
Pre-service teachers (2013/2015 group)	207	80	38.6
Lecturers	58	6	10.34

3.5 Data Collection Instruments

Researchers prefer using methods that provide high accuracy, generalizability and explanatory power, with low cost, rapid speed and maximum management demands and administrative convenience (Mugenda and Mugenda, 2007). Basing on this fact interview schedules and record analysis schedule were used for this study.

3.5.1 Interview Schedules

Interview schedules were adhered to when interviewing Lecturers. This method calls for direct contact between the researcher and the study respondent (Kothari, 2004) it involves presentation of oral-verbal stimuli and reply in terms of oral-verbal responses. Face to face interview was carried out. The interview method, therefore, allowed the researcher to get in-depth information from Lecturers and head of departments on topics of syllabus, time allocation for lessons/periods, pre-service teachers' readiness to learn Mathematics, beliefs and attitude of pre-service teachers on gender and Mathematics. Responses from interviewed lecturers were recorded in summary form. Reports from all the lecturers interviewed were classified according to themes, interrogated and then analysed and summarised according to themes.

3.5.2 Record analysis schedule

Record analysis schedule was used to gather relevant data needed in the research such as prior performance- (KCSE) and PTE scores. The admission registers which

contains the students' grades in KCSE Mathematics and official results of PTE grades in Mathematics were checked to identify the score in the two examinations for the pre-service teacher. Mathematics score was extracted from the list for further interrogations. Mathematics syllabus of the Primary Teachers Education was examined to establish the balance between Mathematics pedagogical content and subject matter content (Appendix II).

3.6 Pilot study

The instrument was discussed with the guidance of supervisors and then a pilot study carried out in Muranga Teachers' College, a public Teachers Training College which is located approximately 108 km from Thogoto TTC in Muranga South Sub County, Muranga County in Kenya. It has a population of about 760 students and 60 lecturers. The target population total is 820. This makes it most ideal for the pilot study because it has similar characteristics to the study college. According to Mugenda and Mugenda, (2007), it is necessary to pre-test the instruments to ensure that the items are clearly stated and can be understood by the respondents. The main purpose of the piloting was to determine validity and reliability of the research instruments. Instruments were administered to the same group of respondents after a period of two weeks. Results were analyzed and, the instruments were modified to enhance clarity.

3.6.1 Reliability

Mugenda and Mugenda, (2007), define reliability of the research instrument as its level of internal consistency over time. A reliable instrument therefore is the one that constantly produces the expected results when used more than once to collect data from two samples drawn from the same population. To establish the reliability of the instruments therefore, a pilot study was carried out in Muranga Teachers' Training

College. Six Mathematics lecturers at Muranga Teachers Training college were interviewed following the study interview schedule. This college was selected because it has similar characteristics as the study college. The procedure used in pre-testing was identical to that used during the actual. The researcher also relied heavily on secondary sources of data from the college archives. The Mathematics KCSE results used as entry marks for students who joined college in the years 2012 and 2014 and respective pre-service teachers PTE Mathematics score in the years 2013 and 2015.

3.6.2 Validity

Validity is the degree to which results obtained from the analysis of the data actually represent the phenomenon under study (Orodho, 2005). It is the accuracy and meaningfulness of inferences, which are based on the research results (Kombo, 2006). Therefore, an instrument is said to be valid when it actually measure what it claims to measure. To establish instrument validity of the interview schedule, the researcher was careful when constructing the items by ensuring they embrace all the research objectives. As recommended by Kombo (2006), the researcher used experts and professionals in the field of education to establish content validity of the instrument and their judgment was used to review the items in the questions.

3.7 Data Collection Procedure

The researcher obtained a letter from Graduate School of Kenyatta University to assist in obtaining a research permit from the National Commission for Science, Technology and Innovation (NACOSTI). After this, the researcher visited the college and booked an appointment with the principal and lecturers for the interview. On the appointed day, the researcher used interview guide to collect data from Lecturers. The

researcher also visited the Deans of Curriculum and requested to be allowed access to 2012/2014 and 2013/2015 academic years' students' scores for both KCSE and PTE from the College archives. The 80 students randomly selected for each year's group, grades in KCSE Mathematics were correlated with their grades in PTE examinations. KCSE grades were categorized according to points which ranged from 1-12 whereas the grades in PTE examination were categorized according to credits ranging from 1-8.

3.8 Data analysis

Both descriptive and inferential statistics were used to analyze the data. Pearson Product Moment Correlation (r) was used in the analysis to show the degree of relationship between students KCSE Mathematics grade and PTE Mathematics grade at the end of the training. The data collected was analyzed using Statistical Package for Social Sciences (SPSS) version 22. The analysis included computation of the mean for KCSE Mathematics grades and PTE Mathematics grade of pre-service teachers. It also included computation of standard deviation for KCSE Mathematics grades and PTE Mathematics grades. Standard deviation gives an overall measure of variability for a set of test scores hence characterizes a distribution of scores or grades. The correlation coefficient (r) was computed using the Pearson-Moment correlation formula. The pre service teachers KCSE Mathematics grades were correlated with their PTE Mathematics grades so as to obtain the indices of relationship. This technique was adopted because the grades were considered as continuous variables. Independent t-tests were done to determine the gender difference in means of KCSE Mathematics grades and PTE Mathematics grades. Data obtained in the open-ended items in the interview schedule were categorized

according to the theme relevant to the study and were presented in narrative form using descriptions and quotations.

3.9 Logistical and ethical consideration

According to Mugenda and Mugenda, (2007), ethical considerations are important for any research. Ethical issues that were taken into consideration include brief explanation of the purpose of the study, assurance of confidentiality of the information obtained from the respondents and that research was for academics purpose only.

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION AND DISCUSSION

4.1 Introduction

This chapter presents an analysis, interpretation, presentation and discussion of the research findings. Both descriptive and inferential statistics were used to analyze the data. The results were analyzed based on respondents back ground information, evaluation of the difference in Mathematics performance by gender at KCSE and PTE levels respectively among the pre-service teachers in Thogoto TTC, Classifications of topics of PTTC Mathematics syllabus into content knowledge and pedagogical knowledge and comparing them by hours allocated to each and determination of the extent to which prospective teacher's KCSE grade in Mathematics predict the PTE grade in Mathematics. The results given in this chapter are from an analysis of two successive groups of students. i.e 2012/2014 academic year group and 2013/2015 academic year group.

4.2 Demographic information

4.2.1 Demographic Background of Students

Figure 4.1 and figure 4.2 shows the gender of student respondents from sampled academic years. As shown in the figure 4.1, the gender representation of 2012/2014 academic year group sampled students indicated that 52.5% of them were males while 47.5% were females. In 2013/2015 academic year group, similar representation was revealed where 55% of the sampled students were males while 45% of them were females as shown in figure 4.2. The results reflects the low number of enrollment of female students at Thogoto Teachers Training College since according to college records, there were 32.7% females students enrolled in the college in 2012/2014

group while for the 2013/2015 group enrollment only 34.6% of the students were females. These results were attributed to the fact that majority of the female students drops Mathematics after their first year of the college since Mathematics is not a core subject in the Primary Teachers Education course therefore females students tend to drop Mathematics for the humanity subjects.

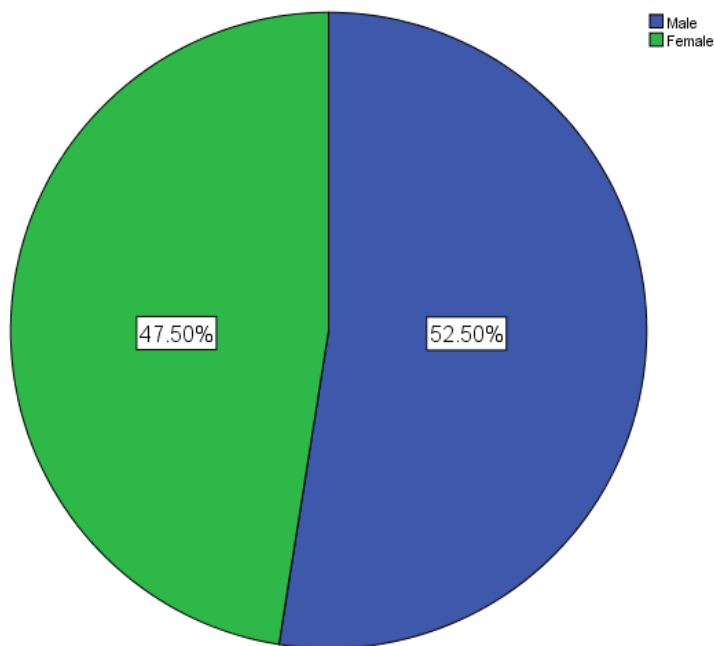


Figure 4.1: Gender representation of 2012/2014 academic year group sampled students

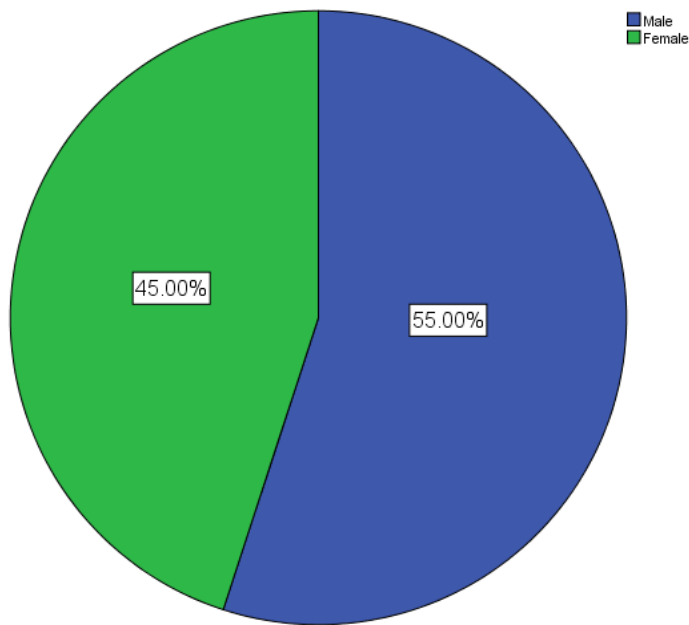


Figure 4.2: Gender representation of 2013/2015 academic year group sampled students

4.2.2 Demographic Background of Lecturers

Figure 4.3, 4.4 and 4.5 shows the background information (gender, level of education and years of experienced) of Lecturers. Analysis shows that 66.7% of the Mathematics Lecturers in the college were male while 33.3% of them were female. This result indicates that Mathematics remains a male dominated field.

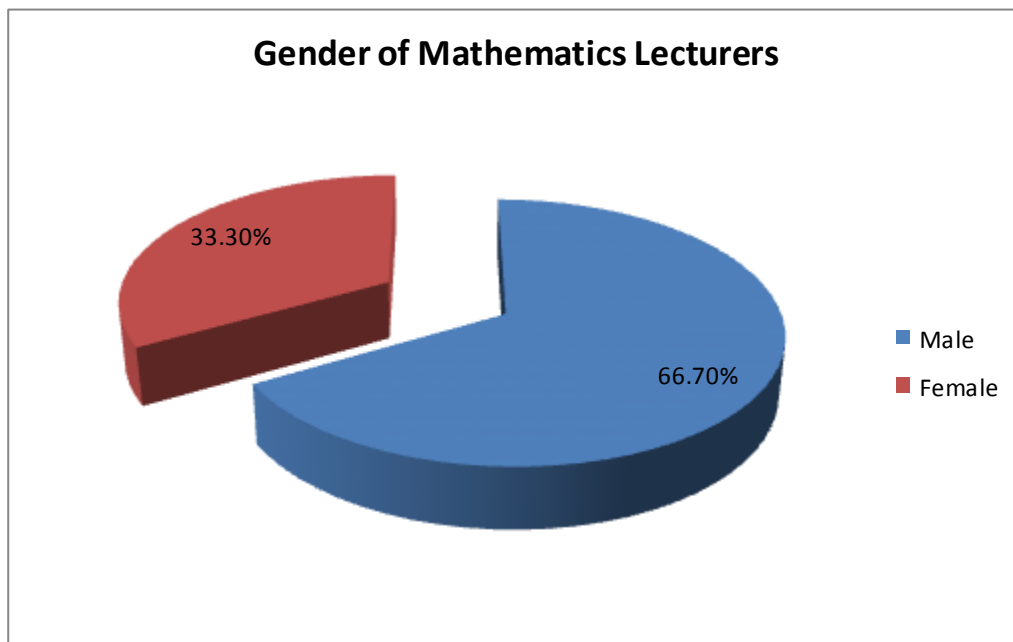


Figure 4.3: Gender of Mathematics lecturers

Regarding the teachers qualification the study indicates that 66.7% of Mathematics lecturers in the college were bachelor of education holders while 33.3% of them were masters of education holders. This result therefore indicates that mathematics lecturers at the college have adequate qualification for teaching Mathematics. Qualified teachers easily overcome teaching methodology challenges, which can influence performance in Mathematics. Moreover, higher education not only enriches one's knowledge but also reinforces the teacher's confidence, exposing him/her to various teaching pedagogies and/or strategies (Beswick, & Goos, 2012).

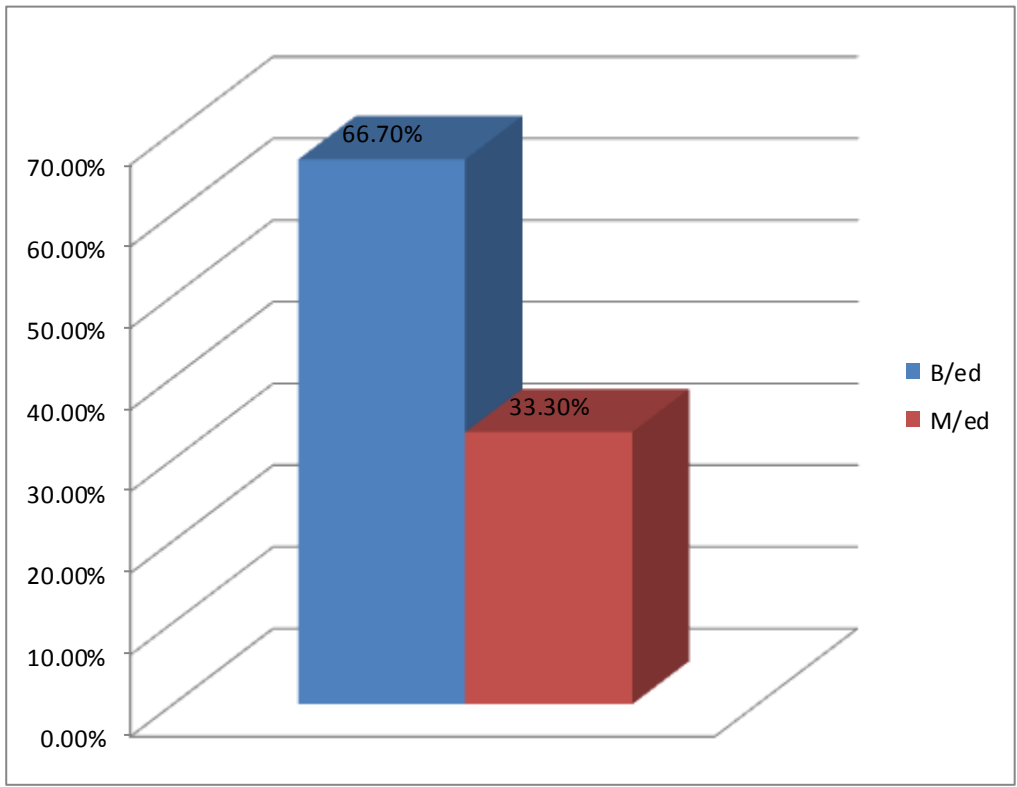


Figure 4.4: Academic qualification of Mathematics Lecturers

Regarding years of teaching experience in a TTC, the study revealed that 50% of the Mathematics Lecturers in the college had over 10 years of experience in teaching TTC while the other 50% indicated that they had below 10 years of experience in teaching in TTC. According to these results, it is evident that Mathematics Lecturers in Thogoto TTC were well experienced in teaching Mathematics in TTC.

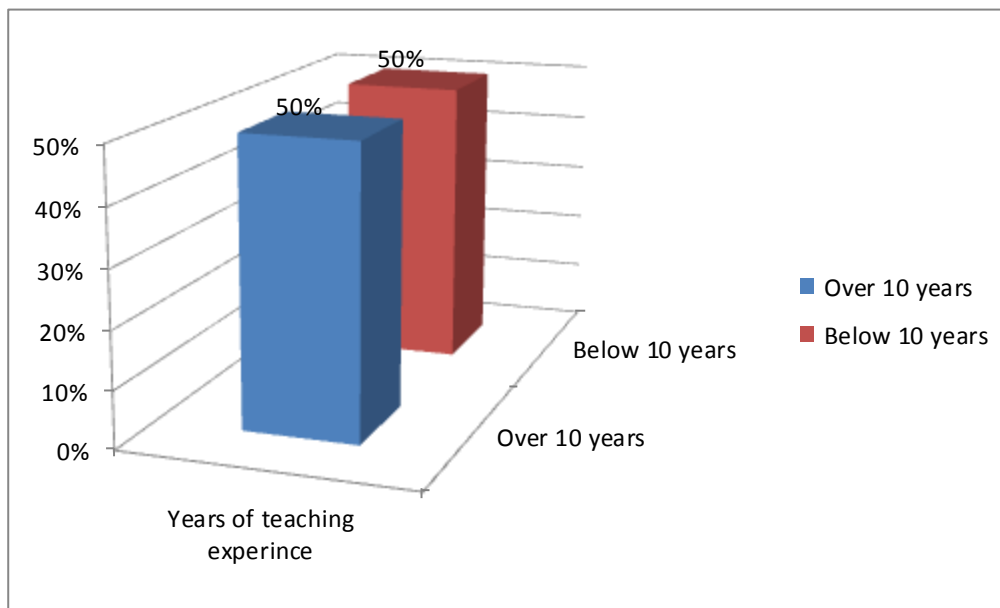


Figure 4.5: Teaching experience of Mathematics Lecturers

4.3 Mathematics Performance by Gender at KCSE and PTE Levels among the Pre-service teachers

Gender differences in KCSE Mathematics and PTE Mathematics performance were examined using the average results for the national examination in two consecutive groups of student's i.e. 2012/2014 and 2013/2015 academic years. Mean and standard deviation and independent t-test were calculated and results presented in table 4.1 and 4.2.

Table 4.1: Mathematics Performance by Gender for 2012/2014 group

	Gender of the student	N	Mean	Std. Deviation	Std. Error Mean
Students performance in KCSE Mathematics	Male	42	5.0238	2.14690	.33127
	Female	38	4.2632	1.36924	.22212
Students performance in PTE Mathematics	Male	42	5.0000	1.60791	.24811
	Female	38	4.5526	1.32945	.21566

Based on the mean, males posted a mean score of 5.02 and 5.0 at KCSE and PTE respectively while females posted a mean score of 4.3 and 4.5 at KCSE and PTE respectively. It appears that the mean for both gender are consistent. The comparison of the mean by gender, the results shows that the mean for female students' Mathematics performance at KCSE (4.3) is less than for male students (5.0) who sat the same examination that year. The maximum possible score for KCSE examination is 12 point which is a grade A. However, the scores for males students were more spread away from the mean than those of females' students with a standard deviation of 2.1 as compared to 1.4 for the female students.

Similar trends were revealed when the same group of students undertook PTE final Mathematics examination. The results revealed that males' students had a mean of 5.0 as compared to the females who had a mean of 4.5. These results thus revealed that males students performed better than females in Mathematics.

Further analysis using-t-test revealed that the difference in performance by gender is very significant. The summary of T-test findings are represented in table 4.2, significant ($p=0.01$). Therefore males students performed better than the females students in both examinations.

Table 4.2: T-test for males and females performance in KCSE and PTE Mathematics Examinations for 2012/2014 academic year group.

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
Lower					Upper	
Students performance in KCSE Mathematics	22.562	79	.000	4.66250	4.2512	5.0738
Students performance in PTE Mathematics	28.739	79	.000	4.78750	4.4559	5.1191

To further ascertain these findings the study conducted a comparative of the performance of male and female students in Mathematics in both the KCSE and PTE examinations for the 2013/2015 academic year group. The study found out that (table 4.3) male students had a mean of 5.1 as compared to female students who had a mean of 4.2 in KCSE out of the possible 12 points. In PTE examinations similar results were recorded where the males students had a mean score of 5.1 as compared to females students who had a mean score of 4.5. According to this results, it is evident that males students outperformed their females counterparts in both KCSE and PTE Mathematics Examinations.

Table 4.3: Difference in Mathematics Performance by Gender for 2013/2015 academic year group.

	Gender of the student	N	Mean	Std. Deviation	Std. Error Mean
Student performance in KCSE Mathematics	Male	39	5.0513	2.10199	.33659
	Female	41	4.2195	1.38766	.21672
Students performance in PTE Mathematics' examination	Male	39	5.1538	1.56505	.25061
	Female	41	4.5366	1.20618	.18837

To further ascertain whether the difference between the two means is zero, the researcher conducted a T-test. The results revealed (Table 4.4) that the difference in performance is significant ($p=0.01$). Thus, better performance in Mathematics is not by a chance.

Table 4.4: T-test for males and females performance in KCSE and PTE Mathematics examination for 2012/2015 group

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Student performance in KCSE Mathematics	22.858	79	.000	4.62500	4.2223	5.0277
Students performance in PTE Mathematics	30.509	79	.000	4.83750	4.5219	5.1531

Based on these findings the study rejects the null hypothesis that, there is no significant difference in Mathematics performance by gender at both KCSE and PTE levels among pre-service teachers in Thogoto TTC and adopt the null hypothesis. Thus it is evident that there is a significant difference in Mathematics performance by gender at both KCSE and PTE Examinations.

These findings are in consistence with other findings where Forbes et al., (1990) indicated that, more boys than girls succeed in public Mathematics examinations taken at age of 16 years. Other documented record from graduates' school examinations for pre-service teachers in United States indicated clearly that men out performed women overall though the difference was greater on items requiring spatial

skills, short cuts, or multiple solutions paths as compared to mastery of classroom based content (Gaughan, 2000). The same pattern was replicated in New Zealand where boys in mixed secondary schools performed better than girls in the same schools especially in Mathematics and sciences (Neyland, 1994).

4.4 Time allocation to Mathematics content knowledge versus Mathematics pedagogical knowledge and skill in Teachers Education programmes.

The study further classified the topics of PTE Mathematics syllabus in content knowledge and pedagogical knowledge and skills and then compared the hours allocated to each. This was done to establish whether there is a balance between subject matter content and pedagogical matter content according to the Teachers Training Colleges Mathematics syllabus. This was done using data obtained from revised syllabus and an interview conducted to the lecturers. Review of syllabus indicates that PTE Mathematics syllabus is very wide as compared to the time allocated to the topics .Most of the time is allocated to pedagogical content. The summary of the findings are shown on table 4.5.

The introduction of Mathematical pedagogical knowledge to the first year students who have low Mathematical content knowledge presents a conflict which results to low absorption of pedagogical knowledge been taught as opined by one of the lecturer (L₂) interviewed . The majority of the Lecturers interviewed indicated that students in the college finds second year's syllabus more interesting since it is short and contain Mathematical content topics which they had already covered in secondary schools.

Table 4.5: Summary of PTTC Mathematics Syllabus.**Course Summary Year One**

	Topics	Time (Hours)
1.0	Number Concepts	10
2.0	Numeration Systems	6
3.0	Whole Numbers	30
4.0	Operations and Whole Numbers	24
5.0	Squares and Square Roots	6
6.0	Methodological Skills	8
7.0	Preparations for teaching	21
8.0	Problem solving techniques	5
9.0	Fractions, Decimals and Percentages	31
10.0	Geometry	24
11.0	Algebra	8
12.0	Measurements	20
13.0	Statistics	10
14.0	Ratio and Proportions	7
15.0	Business Arithmetic	7
16.0	Postal Rates	6
17.0	Scale Drawing	10
Total		234

Course Summary Year Two

	Topic	Time(Hous)
1.0	Integers	10
2.0	Indices	8
3.0	Geometry	17
4.0	Algebra	17
5.0	Statistics	13
6.0	Measurements	11
7.0	Ratio and Proportion	8
8.0	Business Arithmetic	17
9.0	Scale Drawing	9
Total		110

Lecturers (L₁, L₄, and L₆) indicated that the syllabus seems adequate and with right content to ensure the pre-service teacher is well equipped with enough knowledge to make them better Mathematics teachers. However the same Lecturers reported that they do not have adequate time to cover the syllabus especially when teaching students with low subject matter knowledge. These students with low Mathematical contents require extra time to bridge the existing gaps. It came out clearly that those students who perform poorly in KCSE Mathematics (below C minus) experiences some difficulties going through the PTE Mathematics syllabus since it is made of more of pedagogical knowledge as compared to content knowledge with some lecturer indicating they take a ratio of 3:2 respectively. This means that of all the hours allocated to Mathematics in the PTE, 60% of them are used to teach pedagogical knowledge and skills. A good number (83.3%) of the Mathematics Lecturers at the college were of the opinion that reference to KCSE Mathematics grades may be important in revealing entry behavior especially critical to individual attention of Lecturers.

The study noted that pre-service teachers are subjected to three months of practical teaching which is not indicated in the syllabus. This practicum is carried out in three phases (i) For first year students it takes place in second term and its mandatory for all first years students, (ii) For second year students, they have two sessions of teaching practice of one month duration each. Which are carried out in first term and third term of the second academic year. One of the lecturer (L₂) attached to teaching practice office intimated that some of the students teachers are not comfortable teaching class seven and six Mathematics. These are the students who join PTE having posted very poor grade in Mathematics from secondary school.

Burton (1990) points out that performance in tertiary education can be improved if entry behavior posted in secondary level is considered. Similar views are noted where Shulman (1987) described Pedagogical Content Knowledge (PCK) as an intersection of subject knowledge and pedagogical knowledge. That is, high levels of teacher subject content knowledge do not necessarily imply that the individuals understand the material in a way that enables them to impart or teach it to students (Ma, 1999). Ma describes what is needed as profound understanding of fundamental Mathematics. Other studies indicated that what is required is Mathematical knowledge of teaching where teachers understand the material and ways of representing it to students (Silverman & Thompson, 2008).

Banner and Cannon (1997) summed up the critical importance of Teacher content knowledge as follows; In order to teach, teachers must know what they teach and know how to teach it; and in order to teach effectively, they must know it deeply and well. The importance of teachers' content knowledge was also articulated by the United State Department of Education (2008), which stated that, teachers must know in detail the Mathematical content they are responsible for teaching and its connections to other important Mathematics, both prior and beyond the level they are assigned to teach. Banner and Cannon argument may be summed up by saying that those pre-service teachers who posted low Mathematics grades at secondary school need more time to bridge the existing gaps for them to develop appropriate PCK.

4.5 The extent to which prospective teachers' KCSE grades in Mathematics predicts the PTE grades in Mathematics.

The study was interested in determining the extent to which prospective teacher's KCSE grade in Mathematics predicts the PTE final grade in Mathematics for two

consecutive groups of students that's 2012/2014 and 2013/2015 academic years. The study used mean and standard deviation to determine if there is any significant difference in the same individual student's performance in KCSE Mathematics and their performance in PTE Mathematics.

The means of KCSE and PTE Mathematics performance for the sampled group of students in 2012/2014 and 2013/2015 academic years were calculated as shown in table 4.6 and table 4.7

Table 4.6: Comparison of Means and Standard Deviation in Mathematics of KCSE and PTE (2012/2014)

	N	Minimum	Maximum	Mean	Std. Deviation
Students performance in KCSE Mathematics	80	2.00	10.00	4.6625	1.84832
Students performance in PTE Mathematics	80	2.00	8.00	4.7875	1.49000
Valid N (list wise)	80				

The study found out that there is a significant difference in the means, where the same group of student had a mean of 4.66 in KCSE and a mean of 4.78 in PTE examination. Having only the means, it is not possible to tell whether there is any significant difference in performance between KCSE and PTE. The researcher conducted a T-test at 0.05 confidence level to examine whether the means are significantly different. The findings are presented in table 4.7.

Table 4.7: T-test for the 2012/2014 academic year sample

Paired Samples Test										
Paired Differences										
95% Confidence Interval of the Difference										
Std. Error Mean										
	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)		
Pair 1	Students performance in KCSE Mathematics - Students performance in PTE Mathematics	-.12500	1.55388	.17373	-.47080	.22080	-.720	79	.474	

The results indicate that there is no significant difference between the means since the p value (0.47) is greater than 0.05 ($p > 0.05$). Therefore we reject the study null hypothesis that KCSE Mathematics grade cannot predicts PTE Mathematics grade, and adopt the alternative hypothesis that prospective teacher's KCSE Mathematics grade predicts PTE Mathematics grade in Teachers Training Colleges.

In a similar context, the researcher compared the Mathematics mean in KCSE and PTE for the 2013/2015 academic year group and the result of the calculation are indicated in table 4.8

Table 4.8: Comparison of Means and Standard Deviation in Mathematics of KCSE and PTE (2013/2015) academic year.

	N	Mean	Std. Deviation	Std. Error Mean
Student performance in KCSE in Mathematics	80	4.6250	1.80978	.20234
Students performance in PTE Mathematics examination	80	4.8375	1.41818	.15856

The two means are different with the PTE mean been higher at 4.8 as compared to the KCSE mean which stood at 4.6. The researcher further carried out more tests to ascertain whether there is any statistical difference between the two means. The results are indicated in table 4.9.

Table 4.9: T-test for the 2013/2015 sample

		Paired Samples Test							
		Paired Differences							
				95% Confidence Interval of the Difference					
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Students performance in KCSE Math and Students performance in PTE Math examinations	-.21250	1.25983	.14085	-.49286	.06786	-1.509	79	.135

The results indicate that there is no significant difference between the means since the p value (0.135) is greater than 0.05 ($p > 0.05$). Therefore we reject our 4th null hypothesis and adopt the alternative hypothesis that prospective teachers KCSE Mathematics grade predicts PTE Mathematics grade in Teachers Training Colleges.

The researcher went further to establish the nature of relationship between the performance in KCSE Mathematics and PTE Mathematics. This was done by conducting a correlation test between the said variable using Pearson Product Moment Correlation. The findings are illustrated in table 4.10.

Table 4.10: Correlation between KCSE and PTE performance in Mathematics 2012/2014 academic year group

		Students performance in KCSE mathematics	Students performance in PTE mathematics
Students performance in KCSE Mathematics	Pearson Correlation	1	.585**
	Sig. (1-tailed)		.000
	N	80	80
Students performance in PTE Mathematics	Pearson Correlation	.585**	1
	Sig. (1-tailed)	.000	
	N	80	80

** . Correlation is significant at the 0.01 level (1-tailed).

The result indicated that there is a fairly strong relationship between KCSE Mathematics performance and PTE Mathematics performance with a correlation coefficient of 0.585. To ascertain this finding the researcher conducted a similar correlation test to 2013/2015 academic year group. The results are illustrated in table 4.11.

Table 4.11: Correlation between KCSE and PTE performance in Mathematics 2013/2015 academics year group

		Student performance in KCSE performance in mathematics	Students performance in PTE examination
Student performance in KCSE Mathematics	Pearson Correlation	1	.721**
	Sig. (1-tailed)		.000
	N	80	80
Students performance in PTE Mathematics	Pearson Correlation	.721**	1
	Sig. (1-tailed)	.000	
	N	80	80

** . Correlation is significant at the 0.01 level (1-tailed).

The result revealed that there is a strong relationship between performance in KCSE Mathematics and performance in PTE Mathematics with a correlation coefficient of 0.721. Based on this results it is evident that pre-services teachers who attain low grades in Mathematics in their KCSE examinations eventually perform poorly in PTE Mathematics. This is supported by what three lecturers reported in an interview when they said:

Most pre-service teachers who join PTE with low Mathematics grade at KCSE require extra time to bridge the existing gaps. They further indicated that the same students experience difficulties going through PTE Mathematics syllabus since it's made up of more of pedagogical knowledge as opposed to content knowledge and were on the opinion that C- in Mathematics is the most appropriate for those students who aspire to pursue Mathematics at PTTC (L₁, L₃, and L₅).

Therefore this study rejects the 4th null hypothesis and adopt the alternative hypothesis that prospective teachers KCSE Mathematics grade predicts PTE Mathematics grade in TTCs. Rudolf S, (2011) argued that in a system the pattern of energy exchange is cyclical, the product is exported to the environments and is a source of energy for repetition of the cyclical activities, this implies that poor grades posted by pre-service teachers at KCSE are exported to PTE. This may eventually affect pre-service teacher's effectiveness and efficiency while teaching Mathematics to the primary school learners.

The study further conducted more analysis to determine the extent to which KCSE Mathematics performance predicts PTE Mathematics performance. The researcher conducted a linear regression analysis on the two variables of the study for the 2012/2014 academics year group. The findings are represented in table 4.12 and 4.13.

Table 4.12: Model summary regression for 2012/2014 academics year group

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.585 ^a	.342	.334	1.21623

a. Predictors: (Constant), Students performance in KCSE mathematics

The results revealed out that, the adjusted R² value of 0.334 implies that KCSE Mathematics performance predicts 33.4% of PTE Mathematics performance. This therefore means the remaining 67.6 is caused by other factors not considered in this study. Further analysis was done to examine whether R value occurred due to chance (Table, 4.13).

Table 4.13: Summary ANOVA for 2012/2014 academics year

Model		Sum of Squares	df	Mean Square	f	Sig.
1	Regression	60.009	1	60.009	40.568	.000 ^b
	Residual	115.378	78	1.479		
	Total	175.388	79			

a. Dependent Variable: Students performance in PTE mathematics

b. Predictors: (Constant), Students performance in KCSE mathematics

The results indicates that F-ratio of the regression analysis is significant (F (1) 78) = 1.479: p<0.05). This shows that the R value is not due to chance. The researcher conducted a similar regression analysis for the successive group of students 2013/2015. The results are indicated in table 4.14 and table 4.15.

Table 4.14: Model summary regression for 2013/2015 group

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.721 ^a	.519	.513	.98947

a. Predictors: (Constant), Student performance in KCSE performance in Mathematics

The results show that the adjusted R^2 value is 0.513 which implies that KCSE Mathematics performance predicts 51.3% of PTE Mathematics performance. Thus the remaining 48.7 is caused by other factors not considered in this study. Further analysis was done to examine whether R value occurred due to chance (Table, 4.15).

Table 4.15: Summary ANOVA for 2013/2015 academics year

Model	Sum of Squares	Df	Mean Square	F	Sig.
1 Regression	82.522	1	82.522	84.288	.000 ^b
Residual	76.366	78	.979		
Total	158.887	79			

a. Dependent Variable: Students performance in PTE examination

b. Predictors: (Constant), Student performance in KCSE performance in Mathematics

The results indicates that F-ratio of the regression analysis is significant ($F(1, 78) = 0.979$; $p < 0.05$). This shows that the R value is not due to chance. The findings indicate the importance of acquiring Mathematics content knowledge.

Predictive ability of entry behavior on performance at higher levels has been corroborated by other authors. Findings by Burghes, (2011) confirmed the validity of the number and grades of passes in the Scottish certificate of education in predicting first year and final year university performance. Similarly, Bryan (1999), found out that the GCE and secondary Certificate examination result have provided the best predict of university performance. The basics acquired in secondary Mathematics are important in understanding pedagogical concepts in PTE. Burton (1990) points out that Mathematics is best taught in a hierarchical manner which means that Mathematics tends to be taught in a hierarchical way. This means that pre-service teachers, who have missed or failed to learn earlier on in their secondary school, may

have difficulty with Mathematics pedagogical knowledge based on attempts to build on earlier information.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents a summary of the research findings, the conclusion, recommendations and suggestions for further research as observed by the researcher during the study.

5.2 Summary of Key Findings of the Study

The purpose of this study was to evaluate the relationship between students' Mathematics final grade at secondary schools and at Primary Teachers Education among pre-service teachers in Teachers Training Colleges. The study was based on the following objectives: (i) To establish the difference in students' performance by gender in Kenya Certificate of secondary school Mathematics among Pre-primary school teachers. (ii) To establish the difference in students' performance by gender in Primary Teachers Education Mathematics among Pre-primary school teachers. (iii) To compare the time allocated to content knowledge versus pedagogical knowledge and skills in PTE Mathematics syllabus in order to establish the balance. (iv) To determine the extent to which Pre-primary school teachers' KCSE grade in Mathematics predicts the PTE final grade in Mathematics.

This study employed a correlation survey research design, investigating and establishing the relationship between two main variables. The two variables were KCSE Student's Mathematics grade and PTE student's final grade in Mathematics. The design was based on ex-post facto and descriptive surveys

Ex-post facto survey was adopted because the grades under scrutiny had already been posted and certified by KNEC. The performance of 160 students teachers in KCSE Mathematics was correlated with in their performance in PTE examinations. Descriptive survey research was adopted where the researcher purposively selected six Mathematics Lecturers from Thogoto Teachers College and interviewed them regarding the relationship between the students' KCSE Mathematics performance and PTE Mathematics performance. A thorough interrogation of PTTC Mathematics syllabus was conducted. The key findings are summarized below based on the objectives of the study.

5.2.1 Difference in Mathematics performance by gender at KCSE and PTE Examinations respectively among the pre-service teachers in Thogoto TTC

The study found out that the mean grade for the females students was lower than the grade for the males counter parts in the two selected samples (2012/2014 and 2013/2015) for the both KCSE and PTE examinations. For the 2012/2014 group the study established that females students had a mean of 4.3 as compared to their males counterparts who had a mean of 5.0 in KCSE. The follow up for the same group of students indicated that the male students outperformed the female counterparts registering a mean of 5.0 as compared to 4.5 for the female students in the PTE Examinations.

Similar findings were revealed for the 2013/2015 academic year group where the males students had a mean of 5.0 as compared to the females students who had a mean of 4.2 in KCSE. For the PTE examinations males students' altogether outperformed their females counterparts by recording a mean of 5.1 as compared to a mean of 4.5 for the females students. A T-test for the obtained results indicated that

there is a significant difference between them with all the test giving a $p < 0.05$. Thus male students performed better than the female students in Mathematics.

5.2.2 Comparison of the time allocated to content knowledge versus pedagogical knowledge and skills in Teachers Education Programme.

Classification of PTTC Mathematics syllabus revealed that, the syllabus captures more of pedagogical knowledge as compared to Mathematical content knowledge. The study found out that 60% of the time allocated for Mathematics in the PTTC was used to teach pedagogical knowledge while the remaining 40% was used to teach Mathematical knowledge which is viewed as a recap of what the pre-service teachers learned in their secondary schools. This time is not adequate for those pre-service teachers who posted low grades at KCSE Mathematics.

5.2.3 The extent to which prospective teachers' KCSE grade in Mathematics predict the PTE final grade in Mathematics.

The study found out that the mean score of 2012/2014 academic year group in KCSE Mathematics and PTE Mathematics was 4.66 and 4.78 respectively. A T-test to test whether the two means were different indicated there was no significant difference between the two mean with a value of $P > 0.05$. Pearson product moment correlation revealed a fairly strong relationship ($r = 0.585$) between the performance in KCSE Mathematics and PTE Mathematics.

Similar results were revealed for the 2013/2015 academic year group where KCSE Mathematics mean was 4.6 and PTE Mathematics mean was 4.8. A T-test to ascertain whether the two means were significant different indicated that there was no significant difference between the two mean $P > 0.05$. Pearson product moment

correlation between performance in KCSE Mathematics and PTE Mathematics indicated that there was a strong relationship ($r=0.721$) between the two variables.

Linear regression further revealed a predictive validity of 33.4% which according to F-test is significant ($F(1, 78) = 1.479; p < 0.05$) for the 2012/2014 academic year group. The 2013/2015 academic year group exhibited similar findings where linear regression revealed a predictive validity of 51.3% which according to F-test is significant ($F(1, 78) = 0.979; p < 0.05$).

5.3 Conclusion

The study concluded that females students' performance in Mathematics is still low as compared to males students. This has contributed to female Pre-service teachers dropping Mathematics in their second year at the college. This pose a great risk of transferring this problem to primary school learners who they are assigned to teach Mathematics. The study also concluded that the PTTC Mathematics syllabus is skewed towards instilling Mathematical pedagogical knowledge and skills among the pre-service teachers as opposed to Mathematical content knowledge since it is assumed that the later was well covered in their secondary School Education. The study further concluded that KCSE Mathematics performance predict PTE Mathematics at 30-50%. Thus confirmed that students who performs poorly in KCSE Mathematics also performs poorly in PTE Mathematics.

5.4 Recommendations

Based on the findings the study recommends that:

- (i) Mathematics Lecturers in PTTC should use KCSE Mathematics performance as one of the indicator of entry behavior so as to put in consideration of individual differences while conducting classroom instruction.

- (ii) The MOEST should revise their selection criteria and include a minimum requirement of C- in Mathematics for the PTTC entry since Mathematics is fundamental subjects for the primary school learners.
- (iii) Centre for Mathematics and Technology Education in Africa (CEMASTE) should particularly target the newly recruited teachers for the in-service courses to improve their Mathematical skills.
- (iv) The Ministry of Education, TTC administrators and parents should in conjunction provide incentives to female students to boost their performance in Mathematics.

5.5 Recommendation of further research

The researcher recommends that a study should be conducted to:

- (i) Examine the effects of pre-service teachers' poor performance in PTE Mathematics on their efficiency and effectiveness in teaching Mathematics to primary school learners.
- (ii) Evaluate the effectiveness of the Universities in training secondary school teachers and PTTC lecturers for Mathematics.

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APPENDICES

Appendix I: Interview Schedules for Mathematics Lecturers

INTRODUCTION

This study seek to evaluate the relationship between Pre-service teachers KCSE Mathematics grade and PTE performance in Mathematics .The information you give will be used for the purpose of this study and will be treated with utmost confidentiality.

1. Gender_____
2. Academic and professional qualifications_____(B,Ed,Diploma,M Ed)
3. Years of service _____
 - a) Teaching first years students_____
 - b) Teaching second years students_____
4. Is Mathematics compulsory to all students in PTTCs?
5. Do students admitted have adequate Mathematics content knowledge?
Yes/No.Why?
6. Do you enjoy teaching Mathematics? Yes/No. Why?
7. Do your students enjoy learning Mathematics? Yes/No. Why?
8. How do you rate Mathematics performance for first year's students and second year's students? Give reasons.
9. Do you think Mathematics syllabus has adequate content to prepare trainees to face challenges in primary schools? Give reasons.
10. What suggestions would you recommend to improve students' performance in Mathematics?
11. What challenges in Mathematics do pre-service students face?
12. As mathematics Lecturer what challenges do you experience when teaching?

Appendix II: Record Analysis Schedule

Respondent code			
Item	What to check	Source of the data	Entry made
1	2012/2014 Academic year group KCSE Mathematics grade	Admission register	
2	2013/2015 Academic year group KCSE Mathematics grade	Admission register	
3	2012/2014 Academic year group PTE Mathematics score	Graduates record	
4	2013/2015 Academic year group PTE Mathematics score	Graduates record	
5	PTTC Mathematics syllabus	Department of Mathematics	

Appendix III: TTC Mathematics Syllabus

GENERAL OBJECTIVES

At the end of the course the learner should be able to:-

1. Display a knowledge of primary school Mathematics curriculum
2. Show evidence of understanding of mathematical concepts
3. Apply Mathematical skills in problem.
4. Communicate to the pupils using mathematical language
5. Identify appropriate teaching approaches for the relevant content
6. Vary teaching approaches according to the opportunities that may arise during the lesson.
7. Identify and use appropriate and locally available Teaching/Learning resources
8. Diagnose pupils strength and weaknesses and respond to their individual needs
9. Relate Mathematical concepts to real life situations including emerging issues.

COURSE SUMMARY

YEAR ONE

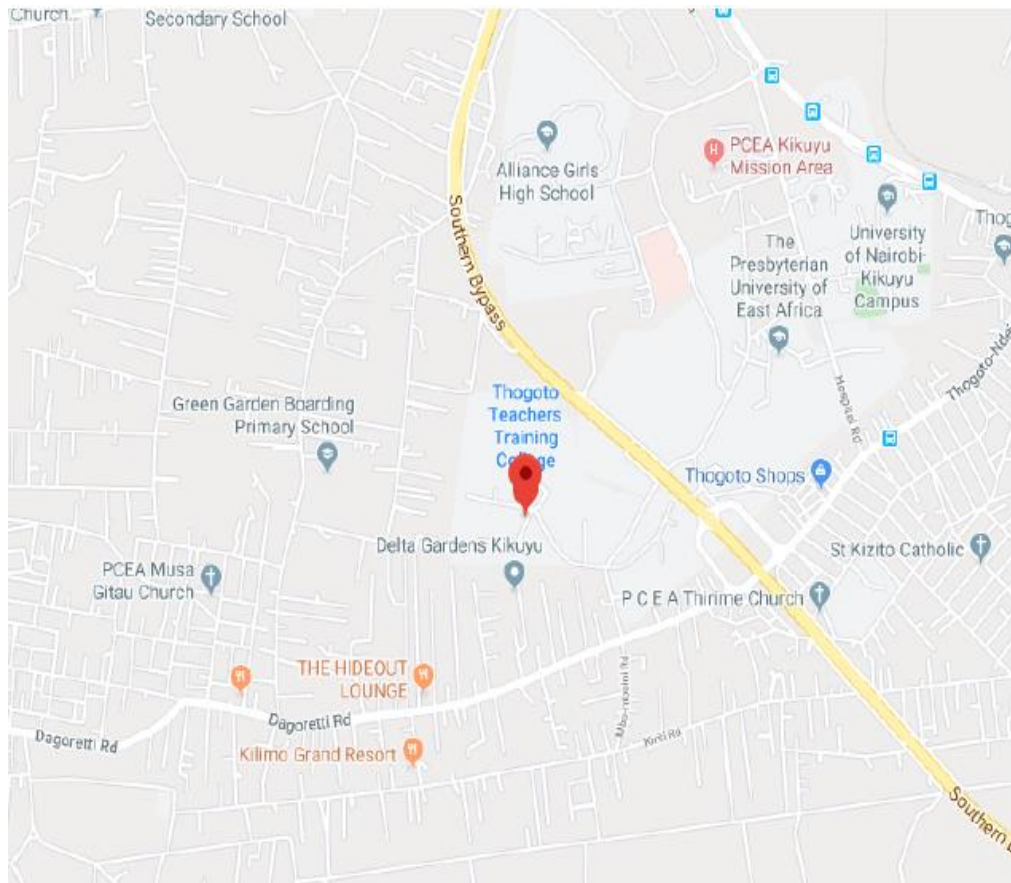
	TOPICS	TIME/LESSONS
1.0	NUMBER CONCEPTS	10
2.0	NUMERATION SYSTEMS	6
3.0	WHOLE NUMBERS	
3.1	PLACE VALUE	8
3.2	CLASSIFICATION OF WHOLE NUMBERS	8
3.3	NUMBER PATTERNS	6
3.4	DIVISIBILITY TESTS	4
3.5	ROUDING OFF	4
4.0	OPERATIONS ON WHOLE NUMBERS	
4.1	ADDITION AND SUBTRACTION	12
4.2	MULTIPLICATION AND DIVISION	12
5.0	SQUARES AND SQUARE ROOTS	6
6.0	METHODOLOGICAL SKILLS	8
7.0	PREPARATION FOR TEACHING	
7.1	TEACHING /LEARNING RESOURCE	6
7.2	SCHEMES OF WORK	7
7.3	LESSON PLAN	6
7.4	CLASS ORGANISATION	4
8.0	PROBLEM SOLVING TECHNIQUE	5
9.0	FRACTIONS, DECIMALS AND PERCENTAGES	12
9.1	FRACTIONS	8
9.2	DECIMALS	
9.3	SQUARES AND SQUARE ROOTS OF FRACTIONS AND DECIMALS	6
9.4	PERCENTAGES	5
10.0	GEOMETRY	
10.1	LINES AND ANGLES	6
10.2	PYTHAGOREAN RELATIONSHIP	5
10.3	PLANE FIGURES	7
10.4	SPACE FIGURES	6
11.0	ALGEBRAE	8

	TOPICS	TIME/LESSONS
12.0	MEASUREMENTS	
12.1	LENGTH AND PERIMETER	3
12.2	AREA AND SURFACE AREA	4
12.3	VOLUME AND CAPACITY	4
12.4	MASS	2
12.5	TIME AND SPEED	3
12.6	MONEY	2
12.7	TEMPERATURE	2
13.0	STATISTICS	10
14.0	RATIO AND PROPORTION	7
15.0	BUSINESS ARITHMETICS	7
16.0	POSTAL TABLES	6
17.0	SCALE DRAWING	10
	TOTALS	234

YEAR TWO

	TOPICS	TIME/LESSONS
1.0	INTEGERS	10
2.0	INDICES	8
3.0	GEOMETRY	17
4.0	ALGEBRA	17
5.0	STATISTICS	13
6.0	MEASUREMENTS	11
7.0	RATIO AND PROPORTION	8
8.0	BUSINESS ARITHMETICS	17
9.0	SCALE DRAWING	9
	TOTAL	110

Appendix IV: Locational Map of Thogoto Teachers Training College



Appendix V: Research Authorization Letter



NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471,
2241349, 3310571, 2219420
Fax: +254-20-318245, 318249
Email: dg@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No. **NACOSTI/P/18/88662/21151**

Date: **8th February, 2018**

Stephen Mwangi Karanja
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on *“Relationship between students mathematics grade in secondary school and primary teachers education case of Thogoto Teachers College Kiambu County Kenya,”* I am pleased to inform you that you have been authorized to undertake research in **Kiambu County** for the period ending **8th February, 2019.**

You are advised to report to **the County Commissioner and the County Director of Education, Kiambu County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

G.P. Kalerwa

**GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO**


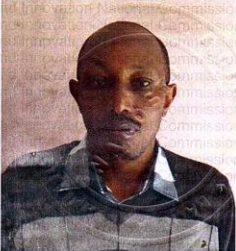
Copy to:



The County Commissioner
Kiambu County.

The County Director of Education
Kiambu County.

National Commission for Science, Technology and Innovation is ISO9001: 2008 Certified

Appendix VI: Research Permit

<p>THIS IS TO CERTIFY THAT: MR. STEPHEN MWANGI KARANJA of KENYATTA UNIVERSITY, 97-1000 Thika, has been permitted to conduct research in Kiambu County</p> <p>on the topic: RELATIONSHIP BETWEEN STUDENTS MATHEMATICS GRADE IN SECONDARY SCHOOL AND PRIMARY TEACHERS EDUCATION CASE OF THOGOTO TEACHERS COLLEGE KIAMBU COUNTY KENYA</p> <p>for the period ending: 8th February, 2019</p> <p> Applicant's Signature</p>	<p>Permit No : NACOSTI/P/18/88662/21151 Date Of Issue : 8th February, 2018 Fee Recieved : Ksh 1000</p> <p></p> <p>JCP Kalewa Director General National Commission for Science, Technology & Innovation</p>
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<p>CONDITIONS</p> <ol style="list-style-type: none">1. The License is valid for the proposed research, research site specified period.2. Both the Licence and any rights thereunder are non-transferable.3. Upon request of the Commission, the Licensee shall submit a progress report.4. The Licensee shall report to the County Director of Education and County Governor in the area of research before commencement of the research.5. Excavation, filming and collection of specimens are subject to further permissions from relevant Government agencies.6. This Licence does not give authority to transfer research materials.7. The Licensee shall submit two (2) hard copies and upload a soft copy of their final report.8. The Commission reserves the right to modify the conditions of this Licence including its cancellation without prior notice.	<p> REPUBLIC OF KENYA</p> <p> National Commission for Science, Technology and Innovation RESEARCH CLEARANCE PERMIT</p> <p>Serial No.A 17405 CONDITIONS: see back page</p>
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