PRACTICES AND CHALLENGES OF PRIMARY TEACHER EDUCATION IN ADDIS ABABA CITY GOVERNMENT: FOCUS ON MATHEMATICS EDUCATION

By

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This is to certify that the thesis prepared by ______________________________
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and submitted in partial fulfillment of the requirements for the degree of **Doctor of Philosophy in Curriculum Design and Development** complies with the regulations of the University and meets the accepted standards with respect to originality and quality signed by Examinining Board Comittee.

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LIST OF ACRONYMS

AAEB	Addis Ababa Education Bureau
AGFI	Adjusted Good of Fit Index
AIC	Akaike Information Criteria
ANOVA	Analysis of Variance
ATMI	Attitudes towards Mathematics Inventory
B Ed	Bachelor of Education
B El Ed	Bachelor for Elementary Education
B Sc	Bachelor of Science
BA	Bachelor of Art
BYOD	Bring your Own Device
CEE	Civics and Ethical Education
CFA	Confirmatory Factor Analysis
CK	Content Knowledge
COC	Center of Certification
CPD	Continuous Professional Development
CTE	College of Teacher Education
DIET	District Institute of Education and Training
ECCE	Early Child hood Care and Education
EGSECE	Ethiopian General Secondary Education Certificate Examination
EHEE	Ethiopian Higher Education Entrance Examination
EMIS	Educational Management Information System
EPRDF	Ethiopian People Revolutionary Democratic Front
ERGESE	Evaluation Research on the General Education System of Ethiopia

ESDP	Education Sector Development Program
ESR	Education Sector Review
FSMAS	Fennema-Sherman Mathematics Attitudes Scale
GEC	General Education Curriculum
GEQIP	General Education Quality Improvement Program
GFI	Goodness of Fit Index
GPA	General Point Average
GTP	Growth and Transformation Plan
HDP	Higher Diploma Program
ICT	Information and Communication Technology
IQPEP	Improving Quality of Primary Education Program
ITT	Initial Teacher Training
KCTE	Kotebe College of Teacher Education
KUC	Kotebe University College
MA	Master of Art
MAT	Management and Administration Program
MEd	Master of Education
MEXT	Ministry of Education Culture, Sports, Science, and Technology
MLC	Minimum Learning Competence
MoE	Ministry of Education
MOEFA	Ministry of Education and Fine Arts
MOFED	Ministry of Finance and Economic Development
MSc	Master of Science
NCF	National Curriculum Frame work
NCFTE	National Curriculum Frame work of Teacher Education

NCTM	National Council of Teachers of Mathematics
NEAEA	National Educational Assessment and Examination Agency
NFI	Normed Fit Index
NGO	Non Government Organization
NPST	National Professional Standards for Teachers
PCK	Pedagogical Content Knowledge
PGDT	Post Graduate Diploma for Teaching
PK	Pedagogical Knowledge
PNFI	Parsimony Fit Index
PTA	Parent- Teacher Association
RMR	Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
RTE	Right To Education
SIP	School Improvement Program
SMASE	Strengthening Mathematics and Science Education
SPSS	Statistical Package for Social Science
SRMR	Standardized Root Mean Square Residual
TCK	Technological Content Knowledge
TDP	Teacher Development Program
TE	Teacher Education
TESO	Teacher Education System Overhaul
TGU	Tokyo Gakugei University
TIMSS	Third International Mathematics and Science Study
TK	Technological Knowledge
TLI	Tucker-Lewis Index

TPACK	Technological Pedagogical and Content Knowledge
TPCK	Technological Pedagogical Content Knowledge
TPK	Technological Pedagogical Knowledge
UNESCO	United Nations Educational, Scientific, and Cultural Organization
UNICEF	United Nations International Children’s Emergency Fund
USAID	United States Agency for International Development

ABSTRACT

The main purpose of this study was to investigate the practices and challenges of primary teacher education program focusing on mathematics education. Hence this study examined the practices of pre-service program in KUC, and Induction and CPD programs in 18 public primary schools of Addis Ababa City Government. To select these schools multi-stage cluster sampling was employed. The study used mixed research design specifically convergent/concurrent design and the data used in the study were obtained through prospective mathematics teachers' attitude scale, interview, questionnaire, observation checklists, and documentary analysis/review. Participants of the study were 143 prospective mathematics teachers, 12 teacher educators; department head and faculty dean of KUC, 144 primary school mathematics teachers, 18 primary school directors, 54 primary school students, 36 parents, one teacher education directorate director, and three senior experts. The data were analyzed using Confirmatory factor analysis (CFA), correlation, regression, ANOVA, t-test, descriptive statistics, and text analysis. The result of the study indicates that there is feelings of anxiety and fear and feelings of discouragement and depression among prospective mathematics teachers in learning mathematics. The items prepared in Amharic to test the attitude of prospective mathematics teachers was found to be reliable ($\alpha = 0.842$) and valid (CFA result). In addition to these negative attitude and belief towards mathematics and teaching mathematics found among primary school mathematics teachers. This exacerbates teachers' unenthusiastic practices. However there is strong correlation between University College GPA and entrance exam result (.862**, $p< 0.01$), between University College GPA and high school transcript average (.701**, $p<0.01$), and between University College GPA and EGSECE GPA (.447**, $p<0.01$). This indicates that 2012/2013 entrants of prospective mathematics teachers entrance exam result, EGSCE GPA and high school transcript result contributed for the trainees University College achievement. Similarly College GPA is correlated to their COC result (.570**, $p<0.01$). The result of the study on practices of pre-service primary mathematics education program unveil that there is a gap between prospective mathematics teachers attitude and mathematics education. In addition to these no paradigm shift is observed in the practices of the program from the previous trends of teaching mathematics to TPACK activities. Furthermore cooperative learning among prospective mathematics teachers was not observed, there is no smart classroom, and no adequate reference books. This study also asserted that some courses are found to be beyond the level of prospective primary school mathematics teachers. However there is a good match between primary mathematics teacher education curriculum and primary school mathematics syllabus and both are found to be at the standard level. The practices of the aggregate mean of teachers' professional development (CPD) is 2.47, which is not satisfactory. Induction program also need to update the old modules. This implies that practices of Induction and CPD programs in Addis Ababa public primary schools need more progress towards proficiency. Moreover 87.8% of primary school mathematics teachers study different disciplines different from the teaching profession. Thus the need of center of excellence for teachers training and the need of upgrading primary school prospective mathematics teachers at degree level are some of the recommendations.

Chapter I: Introduction

The first chapter of this study is divided into the following sections: Background and Rationale of the Study, Statement of the Problem, Significance of the Study, Delimitation of the Study, Limitation of the Study, Definitions of terms, Theoretical and Conceptual Framework of the Study, Purposes and Objectives of the Study and Basic Research Questions. The background discusses the historical back ground of the problem, relevant information and previous studies. The conceptual framework comprises primary teacher education programs (dependent variables) and teacher education documents, practices of teacher educators, prospective mathematics teachers' attitude, recruitment and selection criteria, and primary school mathematics teachers' attitude and practices (independent variables).

1.1. Background and Rationale of the Study

Teacher education in Ethiopia is a relatively recent phenomenon. It is albeit more than half a century old. Regarding the history of teacher education in Ethiopia, Marew (2000) noted it in four periods as follows:

> Period I (1944-1964): Modern western education began in 1908. At this time teachers were expatriates. During this period the Ministry of Education and Fine Arts (MOEFA) opened its first teacher training Institution at Menelik II School and soon after transferred to Police officers Club in 1945/46. At the time the curriculum and educational materials used were adopted from the west. During this period the teacher training institution which had been transferred to Police officers club in 1945/46 transferred to Harer in 1952 and began its work by admitting a four year program selecting from grade 8. A year earlier the Hailesilassie I day school in Addis Ababa had begun a new 8+4 year teacher training program (p.179).

Related to period I of history of teacher education Tilahun (1990) also wrote that:

> The beginning of pre-service teacher training program dated back to 1940, and that since then there had not been established system of teaching up to 1953. However in 1953 a long term planning committee was established to evaluate the existing program and then to design a ten year plan for controlled expansion study for education sector in general and teacher education in particular (pp. 90-91).

Sharing Tilahun's view Marew (2000) emphasized this point that there had not been any serious attempt until 1953, to measure the effectiveness of the curriculum accordingly the committee came up with the following recommendations that Prospective primary school teachers should have a minimum of eight years academic education and one year teacher training, and teachers should be trained at 8+1 level to teach grades 1- 4 and teachers should be trained at 8+4 level to teach grades (5- 8) or middle schools.

Similarly Marew (2000) explains period II of history of teacher education as follows:

> Period II (1963-1974): Based on the recommendations of the long term planning committee MOEFA started a 12+1 teacher training program at Hailesilasie I Day School for middle level schools. Other programs such as 10+2, 10+1 and 11+1, levels trainings were also started for grades 5and 6. Moreover the need for having a four year teacher training program to prepare teachers for secondary schools was suggested (p. 185).

Related to period II Marew (2000) and Tilahun (1990) noted that in this period the curriculum was influenced by Swedish, American and Canadian education systems.

Furthermore Marew (2000) explicits period III and IV as follows:

> Period III (1975-1990): This was a period of Socialist oriented Education. In this period the teacher education and training program in the preceding period was changed and between 1974/75 up to 1977/78 all pre-service teacher training program for primary schools were interrupted. Untrained students from grades 9, 10, 11 and 12 were employed as teachers to meet the demands of the increasing number of primary schools in the country. In addition to this In 1978/1979 a 12+1 level of pre-service teacher training program was initiated in eleven institutes. And Period IV (1991 to date): In 1991 the Ethiopian People Revolutionary Democratic Front (EPRDF) came to power and in 1994 a new education and training policy was developed. In the policy document it is stated that the strategy for the realization of the new education policy focused primarily on developing a new national curriculum, restructuring teacher training programs, reforming a career structures for teachers and recognizing educational management. A pre-service curriculum for training teachers at 12+1 level for 1st cycle (1-4) primary was designed in 1996/97. The policy document stipulated the use of mother tongues as the media of instruction in the teacher training institutions and in their respective localities (pp. 186-187).

Moreover the writer reported that after 1981 curricula for the general polytechnic education had been designed; the teacher training institutes had also improved their curriculum in the same direction.

The above four mentioned periods of Marew's historical view of Teacher Education Programs from 1944 to 1991 to date leads us to know the present situation of primary Teacher Education program. Hence in A National Curriculum Guideline for Pre-service Teacher Education Program document indicates that:

> The Ethiopian Government has called for a complete Teacher Education System Overhaul (TESO). In the response to a study conducted into "The Quality and Effectiveness of the Teacher Education System in Ethiopia", the Ministry of Education has produced a framework specifying strategies for the overhaul. This vision presents a paradigm shift and it conceptualizes the basic ideas of knowledge and learning first introduced in the Education and Training Policy of Ethiopia (1994). Hence this helps to promote rote passive learning to learner focused education which requires a teacher education system overhaul that develops higher order thinking skills in prospective teachers. In addition to these TESO program comprises the vision, mission, and list of courses appropriate to the level of trainings, practicum courses, professional studies and integrated subject teaching. Primary school teachers are recommended to train at 10+1 and 10+3 levels for first cycle (1-4) and second cycle (5-8) respectively (MoE, 2003, p.2).

Moreover Teacher Education System Overhaul (TESO) program was a working document from 2003 to 2007. However the TESO program was replaced by TDP (Teachers Development Program) from 2007 onwards due to the problem of balance of credit hours between professional studies and subject courses and MoE need to change the level of trainings from 10+1 to 10+3 cluster for first cycle (1-4) and from the previous 10+3 cluster to 10+3 linear for second cycle (5-8) (MoE, 2007). In addition to these in the TDP program primary school teachers training system is changed and teachers began to be trained at 10+3 level to teach at grades 1-4 and graduated with cluster diploma and teachers began to be trained at 10+3 level with Linear diploma for grades 5-8, Furthermore Addis Ababa City Government Education Bureau (AAEB, 2016) indicates that the current diploma training program changed to be generalist and specialist after completion of general secondary education and selection criteria is based on the students (a) Academic qualities, (b) Personal qualities, and (c) Physical qualities. The criteria are presented in detail in chapter two of this study (see pages 65 - 66).

The above mentioned historical views of teacher education are essential sources to discuss the developmental and historical overview of Kotebe University College as follows:

Kotebe College of Teacher Education began its teacher education program in the first period mentioned above, more specifically in 1959/60 with the aim of training teachers for junior high schools for grades 7and 8 (KCTE, 2012). As it is mentioned in its 2012 graduation bulletin the College started degree programs in six fields of study in 1989 and had run only up to 1996 then the degree program was discontinued due to the new higher Education structure introduced by MOE. Then in 2007/08, the degree program was re-launched in ten fields of study. Currently the College is running three training programs at degree, diploma and pre-school level (certificate and diploma). In the year 2012, the College graduated 2102 students in all programs of whom 1429 were diploma and certificate and the rest were degree graduates. This would make the total number of KCTE's graduates so far to 44,145.

In 2013/14 KCTE became a University College (KUC). The University College has been organized to comprise one college, four faculties, one institute and one school (Human Resource Support Process Office of KUC; May 16, 2016). These include: (a) College of Teacher Education, (b) Faculty of Natural and Computational Sciences (Mathematics is one of the departments in this faculty), (c) Faculty of Social Sciences (d) Faculty of Languages and Humanities, (e) Faculty of Business and Economics , (f) Institute of Urban Development Studies and (g) Graduate School program.

The staff profile of the University College is presented in table 1.1 below.

Table 1: Number of Academic and Administrative Staff of KUC with respect to sex and Education Level:

Human Resource	Sex			Academic Qualification											
	M	F	T	Diploma			1st degree			Masters			PhD		
				M	F	T	M	F	T	M	F	T	M	F	T
Academic Staff	176	49	225	16	3	19	10	4	14	129	38	167	21	4	25
Administrative Staff	122	254	376	104	227	331	18	27	45	-	-		-	-	
Total	298	303	601	120	230	350	28	31	59	129	38	167	21	4	25

Source: From Human Resource Support Process office, May 16, 2016.

According to the graduation bulletin of Kotebe College of Teacher Education the vision and mission of Kotebe College of Teacher Education (KCTE) is explained as follows:

> Vision: Striving to establish it as a model and center of Excellence committed to the preparation of the best teachers and professionals who prove to perform the highest academic and ethical competence and to generate innovative and appropriate educational experiences. Mission: The mission of KCTE is to prepare teachers and other professionals who can satisfy the highest academic professional and ethical competence and to generate innovative and appropriate educational experiences for schools of different cycles in Addis Ababa using the most effective methods of teaching and research through pre service and in service programs (KCTE, 2012, p.22).

In addition to the above points historical overview of Kotebe College of Teacher Education; the practices of teacher education program; and its characteristics will be discussed in general as follows:

The quality and extent of learner achievement are determined primarily by teacher competence, sensitivity and teacher motivation (MOE, 2003). In addition to this MOE document suggests that the academic and professional standards of teachers constitute a critical component of the essential learning conditions for achieving the educational goals and the length of academic preparation, the level and quality of subject matter knowledge, the inventory of pedagogical skills teachers possess to meet the needs of diverse learning situations.

Related to teacher education Ogunyinka, Okeke, and Adedoyin (2015, p.111) suggest that:

> Teacher Education refers to the policies and strategies designed to equip prospective teachers with the knowledge, attitudes, values, and skills they require to perform their tasks effectively in the classroom, school and wider community. Teacher education program is often divided into the following stages: Initial teacher education (a pre-service course before entering the classroom as a fully responsible teacher; Induction (the process of providing training and support during the first few years of teaching or the first year in particular school); and Teacher development or continuing professional development (CPD), (an in-service process for practicing teachers).

The above mentioned teacher education programs need to equip prospective teachers and teachers with the following required competences:

> Balanced academic knowledge and professional value acquired through sound knowledge frameworks of school curricula, education theories, practicum activities and assessment. This will be practical on the ground through effective knowledge of management strategies; a deep knowledge of how to teach specific subjects using digital competencies/technology; learner-centered that is activity based (participatory learning experiences, play, projects, discussion, dialogue, observation, visits etc.) by integrating academic learning with productive work; and interpersonal reflective and research skills for cooperative work in schools as professional communities of practice. These are also some of the requirements for prospective teachers and teachers (Francesca, 2014, pp.2-3).

From the foregoing discussions on the required competences of teacher education I can discern that a teacher education program has to equip the prospective teachers with the profession required them for doing the job on the ground. The need for teachers to develop the necessary academic and professional competencies seems obvious and desirable as they are the ones who took the lion's share of the responsibility of producing who can support themselves, their families and the country.

Similarly Williamson and Clevenger (2008) indicate Initial teacher education core curriculum areas as follows:

> Foundational knowledge in education related aspects of philosophy of education, history of education, educational psychology, and sociology of education; skills in assessing student learning, supporting English Language learners, using technology to improve teaching and learning, and supporting students with special needs; content-area and methods knowledge and skills-in assessment techniques and classroom management; as well as practices at classroom teaching or at some other form of educational practice-usually supervised and supported in some way, though not always (Practice can be held in the form of field observations, student teaching, or internship) (p.134)

The trend of Ethiopian teacher education curriculum is also follows the above mentioned curriculum structure. (See the detail review in the literature part of this study from pages 51-56). Similarly Ingersoll and Smith strengthen Williamson and Clevenger (2008) statements that trainees involved in the teaching profession should pass through the following training activities:

> (I) Field observations**:** It includes observation and limited participation within a classroom under the supervision of the classroom teacher; (II) Student teaching**:** It includes a number of weeks teaching in an assigned classroom under the supervision of the classroom teacher and a supervisor (e.g. from the university); and (III) Internship: teaching candidate is supervised within his or her own classroom (Ingersoll and Smith, 2004, p.29).

Moreover Ingersoll and Smith (2004) identify that Induction is different from both pre-service and in-service teacher training programs. Hence they suggest that it is additional training designed for those who have already completed basic training and it refers to a variety of different activities such as class workshops, orientations, seminars and mentoring.

In addition to the above mentioned areas teachers need to be equipped with Continuous Professional Development (CPD) while they are on the profession.

Related to CPD UNESCO (2003, p.11) explains that: " Continuous Professional Development of teachers is the professional growth a teacher achieves as a result of gaining increased experience and maintain them update".

Furthermore UNESCO (2003, pp. 13-15) suggests that the main characteristics of CPD are: " It is perceived as a long-term process as it acknowledges the fact that teachers learn overtime; it needs to be collaborative/use active learning; needs to be delivered to groups of teachers; it needs to include periods of practice, coaching, and follow-up; should promote reflective practice; encourage experimentation, and respond to teachers' needs."

Hence UNESCO indicates that the quality of CPD can be determined by duration (time span and contact hours), collective participation, active learning, coherence, and content focus. This being the general conceptualization of CPD, the view of CPD in Ethiopian context is no exception. For example MOE (2007, p.18) defined CPD as: "a program designed for teachers to be successful in their life career. It helps to improve the reflection of teachers' knowledge, skill and attitude in their daily teaching activities."

Related to CPD MOE (2009b) also identified that the high turnover of CPD facilitators; shortage of resources to run CPD (time, material, money, etc.); absence of structure of CPD and Lack of coordination and benefactor relationship between CPD as some of the main factors that affect CPD practices. Similarly Tsion (2013) in her Master's thesis pointed out that 93.5% of Cluster Resource Center coordinators in Addis Ababa public primary schools were not adequately trained to run well organized, inspiring and transforming CPD activities .These problems had been identified in 2009 and 2013. The above mentioned problems need some improvements /

solutions in the latest time. Hence CPD also needs current investigation at school levels to know the new practices and challenges.

In Ethiopian context Continuous Professional Development program of teacher education is delivered at 4 levels, ESDP V (MOE, 2015, p.58), these are:

> (a) External expertise: School networks and clusters and school based training; (b) Other external expertise: inspectors, supervisors and master trainers; (c) Within school net work (cluster): Interaction between teachers, work shop, face to face meetings within cluster; and (d) Within school: Study groups receive feedback on their classroom teaching within the school environment.

The above mentioned in-service trainings (Induction and CPD) contribute for effective practices of teachers. However the attitude and beliefs of teachers affect their practices. For instance Stipek, Givvin, Salmon and MacGyvers (2001) from Stanford University, assessed mathematics teachers' beliefs and practices related to their mathematics teaching through sixth grade teachers, at the beginning and the end of the school year.

Stipek et al (2001, p.213) assessed grade 6 mathematics teachers based on the following assessment criteria:

> (a) Teachers' beliefs about the nature of mathematics i.e. procedures to solve problems versus a tool for sought); (b) Mathematics learning i.e. Focusing on getting correct solutions versus understanding mathematical concepts; (c) who should control students' mathematical activity; (d) the nature of mathematical ability i.e., fixed versus malleable; (e) the value of extrinsic rewards for getting students to engage in mathematics activities ; and (f) teachers self-confidence and enjoyment of mathematics and mathematics teaching.

Moreover the above mentioned researchers explained that data on practices of mathematics teaching were collected through classroom observations. Apart from these a set of self reported evaluation criteria was developed. Then the research was held to examine the relationship between teachers' beliefs, their practice and their self reported criteria. Accordingly, the findings indicates that teachers' beliefs about mathematics teaching significantly correlated with both their observed mathematics teaching practices, and their self reported evaluation criteria. In addition to this the researchers stated that teachers' observed classroom teaching practices correlated significantly with their self-reported evaluation criteria and teachers' self-confidence (attitude) and teachers as mathematics teachers were also significantly associated with their students' self-confidence (attitude) as mathematical learners.

Related to attitude on practices of mathematics Relich, Way, and Martin, (1994) argue that beliefs, confidence, motivation, value, and expectations of prospective mathematics teachers towards mathematics and mathematics teaching will have some impact on the success of their teaching and achievement of their future students

Furthermore Relich, et al (1994) found that high proportions of pre-service teachers hold negative attitude towards mathematics. In addition to this Martha and Marsh II (2004) identified that success or failure of prospective mathematics teachers' performance and mathematics teachers' practices mainly determined by their attitude (Confidence, Value, Motivation, Enjoyment, Anxiety, and Teachers expectation).

Similarly Mensah, Okyere, and Kuranchie (2013) noted that the concepts students hold about mathematics and teaching mathematics determine how they approach the subject and in many cases, students have been found to approach mathematics as procedural and rule oriented. According to these authors this prevents the students from experiencing the richness of mathematics and not to develop knowledge and skill due to their negative attitude towards the subject.

Moreover; Tsao (2014) found that some pre-service student teachers have developed negative attitudes towards mathematics because of their weak mathematics background, their experiences with mathematics, lack of support from their families and effect of their previous mathematics classes and this also affects mathematics teacher educators' practices.

Concerning attitude Tesfaye and Getachew (2012, p.67) wrote that: "the attitudes towards Mathematics Inventory (ATMI) was first developed by Tapia (1996) by confirming six dimensions of math attitude; these are: (a) confidence, (b) anxiety,(c) value, (d) enjoyment, (e) motivation and (f) parent teacher expectation". In addition to this Andres, Victor and Benito (2014) states that Tapia and Marsh (2004) have made great contributions to improve attitude towards Mathematics Inventory (ATMI), and now ATMI is doubtless one of the most extensively used instruments to measure attitudes towards mathematics.

Furthermore Andres, et al (2014) pointed out that ATMI final version is made up of 49 items that attempt to assess six aspects of these attitudes: Confidence-self concept, Anxiety, and Utility-value of mathematics, Enjoyment of mathematics, Motivation and parents and Teachers' expectations. Related to this Robin and Sally (2011) stated that prospective mathematics teachers attitude towards mathematics can be measured by 72 items based on the factors: Confidence, Anxiety, value, Enjoyment, motivation and Teacher expectation.

Thus I also used the above mentioned items to measure the attitudes of prospective mathematics teachers' Self-confidence, Anxiety, Value, Motivation, Enjoyment and Teacher expectation of Mathematics in Ethiopian context. Since the study mainly assesses the practices of learning and teaching mathematics; measuring the attitude of prospective teachers helps me to identify their: (a) interest of learning and teaching mathematics; (b) confidence of learning and teaching mathematics; (c) motivation and expectation towards the profession; (d) anxiety in learning mathematics; and (e) the value they give for mathematics

If I find a result that indicates a negative attitude of prospective teachers' and teachers' towards Mathematics and teaching mathematics in my study, then this can be taken as one of the challenges that hinder the effective practices of primary teacher education. Thus to practice any activity effectively and to achieve good results it needs self-confidence, motivation, expectation, enjoyment (needs willingness to do the job), value (should internalize the usefulness of doing the job) for the country, community and for oneself. Related to students' Mathematics achievement Tilaye (2004) asserted that there is a wide gap among primary school students Mathematics achievement that indicates the existence of attiude differences towards Mathematics among the students.

Dawit (2007) also found that Teachers’ awareness and capacity of developing and solving a problem is highly depart from instructional elements of problem solving. According to him the development of problem solving capacity does not therefore seem to be properly met by text books, teachers’ awareness and their practices. This research finding indicates that there is a gap between teachers capacity of problem solving and curriculum materials that help them to develop problem solving. It means mathematics curriculum materials lack to meet the problem solving capacity of teachers.

In addition to this Teklehaimanot (2000) wrote that the 1999/2000 academic year was a crisis year for teacher education. According to him; Universities students of Ethiopia who joined to study different discipline areas (Mathematics, Physics Chemistry, Biology, Geography etc.), demanded the following questions: (1) The reduction as much as possible or total elimination of the pedagogical courses and (2) After graduation, nomenclature of the degree should not be B.Ed., but BA/ B.Sc. As Teklehaimanot (2000) mentioned to fulfill their demands forcefully the students broke windows, boycotted classes, and different forms of violence were observed.

Teklehaimanot's study is highly supported by the study of Tesfaye and Demewoz carried out in Dilla College of Teacher Education and Health sciences (2004, p.75). Thus their study indicates that: "College or would- be College students do not seem to join the teaching profession with interest due to that high proportion (78.3%) of the candidates did not want to be teachers but joined the profession". Similarly Yalew (2004) pointed out that teachers tend to employ mostly the traditional teacher-centered approach of teaching.

The implication of the above mentioned research works in Ethiopian education institutions leads me to question: "Is this trend still existing? "Is there any improvement of attitude and practices towards the teaching profession currently?" " If not what is the cause of this attitude? How do we reduce or avoid this? "To answer these questions it needs further study. Ofcourse Teklehaimanot's study was conducted 16 years ago. However the existence of change of attitude and good practices in the current situation needs a study, hence my study gives some hints for the existence of attitudinal change and good practices among the current teachers or not towards the profession in general and towards mathematics and teaching mathematics in particular.

Based on the above previous studies and relevant background information of teacher education program the rational of my study will be presented as follows:

a) Works of other scholars like Teklehaimanot (2000) and Tesfaye and Demewoz (2004) on the subject would suggest the need for further studies on prospective teachers' and teachers' attitude towards mathematics and teaching mathematics. When I read these articles I was highly initiated to know the current condition of teachers' attitude and practices.

b) I was a coordinator of cluster schools from 2007/8 till 2012/13 who have linkage with Kotebe University College which was run by United States Agency for International Development with a project named "Improving Quality of Primary Education Program" (USAID IQPEP). USAID IQPEP is an international NGO that works to improve the quality of primary education in Ethiopia. Hence one of my duties was to observe and report to USAID IQPEP the need of schools related to training areas. In my observation I found that newly assigned teachers had given a full responsibility of teaching without passing through induction program, this program is also designed to be implemented in the TDP blue print. Hence I was highly motivated to know how the induction program is being implemented currently and to forward a feedback for MOE and Education bureau of Addis Ababa for better practices of Induction program.

c) Nowadays schools are required to practice CPD program, however during my school observation (2012/2013) teachers told me that the modules used for training were not compatible to the subject they teach, the time schedule was highly tight, its duration was not known, in general they said that it lacks coherence/ integration. Hence CPD practices are also one of my study areas.

d) When I was a cluster schools coordinator, I discussed the problems of primary school mathematics teachers with kotebe University College Mathematics department head and she told me that students assigned in Mathematics department lack interest and they don't want to work to the maximum in the college and finally they face problems when they will be assigned in the actual teaching activities. This indicates the existence of a problem/s. Hence I plan to investigate the practices of primary mathematics teacher education.

e) Mathematics teacher educators told me that the prospective teachers achievement in the university College is not as expected since those students are recruited and selected from grade 10 who failed to qualify for preparatory level (see their Academic and Professional license written exam result/COC in Appendix L). This information also motivated me to assess the recruitment and selection criteria.

f) During recruitment and selection, there are no selection criteria for each discipline. Then I initiated to study and answer the question "To what extent the selection criteria contribute to prospective mathematics teachers' college achievement?"

g) As I read from the literature and heard from teachers; courses had been revised frequently. However the basic reasons for the revision of primary mathematics teacher education courses and the relationship/match of these courses to the primary school mathematics syllabus has not yet known by teachers and MOE officers. Then I planned this also to be my area of study.

h) I collected data from the registrar of the College that the attrition rate of mathematics diploma trainees from 2010/11-2013/14 academic year is with an average of 24.75% (Seen on the table in page 62). This implies the existence of a problem/s which needs a study. Thus the above mentioned rationales motivated me to study the practices of pre-service, Induction and CPD programs as well as trainees and teachers attitude towards mathematics and teaching mathematics.

1.2. Statement of the Problem

Needless to say that the quality of education given in a given country determine the quality of development the country shows in most; if not at all, of the sectors. This indicates that low development brings about scarcity of well qualified teachers in many of the sectors which is susceptible to poor quality education (Perraton, Creed and Robinson, 2007). According to Perrraton et al (2007), in the countries who have scarcity of well qualified teachers; many teachers are either assigned to teach without their qualification or not trained at all in the teaching profession.

Concerning teacher education UNESCO (2005) reported that the attention given to teacher education and Continuing Professional Development (CPD) program is very little. The report indicates that some countries lack a policy for it and some have implementation problems. On this ground the report also suggests the need for further study on the success and limitations of teacher education program.

Related to teacher education program Solomon (2008, p.143) states that: "Teacher education training program in Ethiopia now appears to be one of the major factors affecting the implementation of the school curriculum". Similarly Kedir (2006) also argued that there is a clear contradiction between the official curriculum of teacher education and the actual process of the implementation. And he suggests that the curriculum of teacher education and that of primary school education need to be revised and designed so that they would correlate with each other with the curriculum designed for each level of school system.

Moreover (MOE, 2010) criticized teacher education curriculum for lack of relationship with the curriculum of primary schools. This indicates further investigation on the relationship/match between primary mathematics teacher education and primary school mathematics curriculum. For instance for the content “Set” in grade 6 Mathematics syllabus there needs to be a course “Set theory” in teacher education Colleges by increasing its scope and depth. Hence it needs to assess primary mathematics syllabus in relation to the courses provided in the college.

Related to revision in ESDP V (MOE, 2015, p.64) indicates that “a full curriculum revision was conducted. However it lacks to confirm the match between teacher education curriculum and primary school curriculum". In addition to this the document explains that subject teachers need to be introduced with the new curriculum otherwise problems may occur in the implementation process.

From the above statement I understand that curriculum revision is necessary to relate the nexus between the curriculum of teacher education and primary schools.

Regarding to teachers training program Bridges (1995) raises the following crucial questions to be considered during the policy design and also during the practices/ policy implementation of teacher education which can be seen as the main problems of teacher education program. Thus Bridges (1995) suggests the following questions as the central ingredients of teacher training:

> (1) How do we recruit and select good quality students? (2) How much and what kind of subject knowledge is necessary for teaching at different levels? (3) What is the right balance (in the time available) between subject knowledge teaching and professional education and training? (4) How much of what type of educational theory do students need- and how do you relate theory to practice? (5) What is the right balance between pre-service and In-service training? (6) How can students’ best be helped to make the transition between initial training and their first job in school? What induction and support can we provide? (7) How can we most effectively provide continuing professional development for teachers throughout their careers? (pp. 362-365).

In a similar issue Bridges (1996) explains that quality in the professional education of teachers requires a genuine partnership between the tertiary education institutions and expert practitioners in the schools. In addition to this the author gave United Kingdom's experience that institutions train teachers based on the need of schools.

I can say that the above mentioned questions are the main challenges of teacher education program. Teacher educators and those responsible for teacher education in any part of the institution would be addressing or need to address these questions in way or another.

Thus the above mentioned questions suggested by Bridges awaked me to recall my experiences of Kotebe University College (KUC) and I would like to present it in short as follows:

I was coordinator of cluster schools run by KUC and USAID/IQPEP from 2007/8 till 2012/13. One of my duties was to supervise primary school teachers, mainly observing classroom activities of teachers and assessing their needs and report to USAID/ IQPEP in order to assist those teachers through trainings. During that time I had observed the following common errors of mathematics teachers in grades 4, 5, 6 and 7:

(1) 0.1+0.01=0.02; (Grade 4), **(2)** ½+1/8= 2/10; (Grade 6), **(3)** 1/8 >1/4; (Grade 5), **(4)** 7/10<7/12; (Grade7)), **(5**) 5/10>4/8; (Grade 5), **(6)** 2/8÷8/2=1; (Grade 6) **(7**) 0.5/0.25= 0.1/0.5; (Grade 7).

Moreover I observed that methods of teaching were mainly traditional/formal lecture method and they wrote too much note on the black board and the students were in trouble to copy due to legibility problem and taking too much time to copy. I also observed similar problems of content and professional knowledge among science teachers who teach at grade 8 and who failed to answer the questions raised by their students.

The Topic in one class was "Density". The teacher wrote on the blackboard that 'Air has weight and occupies space" One of the students Asked In Amharic. And when I translate his question into English “How can we measure Air?” The teacher gave many examples of air, but he could not answer the question raised by the student and other students raised the same question. However at the end of the class I discussed with the teacher and I told him that he would have demonstrated simple experiment using balloon and filling air in the balloon and can use spring balance. Using the balance; first you can get the weight of the empty balloon and fill air in the balloon and measure the weight of the filled balloon. Then subtract the weight of the empty balloon from the balloon filled with air and then possible to get the weight of the air. This is a very simple demonstration to be displayed in the classroom but no one demonstrated this except telling theoretically to the students which will be abstract for them.

In a different school I observed two physics teachers repeating similar methods as the previous teacher. And the other topic I observed in the same grade but the lesson was Chemistry “Physical change and Chemical change” The teacher wrote too much note and the students asked him to explain about the topic and he repeated what was written on the black board and no demonstration was displayed.

At the end of the lesson I used to discuss the problems teachers faced in the class room and their needs of trainings related to their area. Science teachers are always asking “Manual/ guide line for Experiments and adequate materials essential to practice the experiment”. They don’t try to use local materials for instance to demonstrate physical change they can use paper, candle, ice, etc, to demonstrate chemical change they can burn a paper or stick and tell the students that the paper/wood can be changed into something new (ash) after burnt.

Of course I reported all these situations to USAID/ IQPEP and they arranged trainings. After the provision of trainings only few teachers applied what they learned. For instance science kits were delivered for all cluster schools to apply simple experiments in the classroom. However, only few teachers were observed to use the kits.

When I discussed the problems teachers faced in primary schools and why they lack preparation; almost all of them answered that they are busy in additional tasks. That is teaching other students at their home in order to get additional money and they are learning also other fields other than the teaching profession in different Universities in distance/extension programs.

In addition to this I often observed KUC student teachers during teaching practice and most of them were making a lot of errors particularly in mathematics and even teachers assigned as mentors are doing similar errors. I often observed grades 1- 4 (self contained classroom teachers) and during feedback most of the teachers were complaining that they do not have good mathematics background in the high school and they said that they are obliged to teach without their interest because the classroom is self-contained

All the above observed statements imply the existence of a problem either in the program, practices, or scarcity of resources.

Thus the problems I observed during teachers' implementation in the classroom and my long experience of supervision on practicum courses in Addis Ababa primary schools as well as articles I read about the challenges of learning Mathematics that I included in my literature motivated me to study "The practices and Challenges of Primary Teacher Education in Addis Ababa City Government: Focus on Mathematics Education".

Related to teachers' practices Amera (2008) carried out a research in Bahirdar town schools and remarked that less qualified and less experienced teachers tend to utilize instructional materials relatively better than teachers with a higher qualification and a larger teaching experience. The researcher's finding indicates that lack of training and administrative problems were the main obstacles of utilizing instructional materials/teaching aids.

Furthermore in a related study Amera (2012) found that Ethiopian public University teachers' utilization of active learning strategies is in its minimal position and there is no significance difference between in teachers' active learning strategies utilization as the function of their HDP training status and professional course dosage level.

Regarding teacher training UNESCO (2014) emphasizes that developing countries should involve 21st century teacher training strategies in their teacher education program and need to introduce how teachers practice using recent technologies in schools. Moreover UNESCO reported that Information and communication Technology supports cost effective delivery of both basic and higher education, widens access, improves quality and aids in teacher training and professional development.

Similarly Koehler and Mishra (2009) suggests that, teacher education courses such as Mathematics and Science should be assisted by modern strategy of learning using computer. For instance, Technological Pedagogical and Content knowledge (TPACK) emphasizes a teacher's understanding of how technologies particularly information and communication technology (ICT), can be used effectively as a pedagogical tool.

According to Koehler and Mishra (2009) TPACK comprises seven knowledge areas forinstance some of them are: (1) Pedagogical content knowledge, (2) technological content knowledge (knowing what kind of technology tools is available for teaching what), and (3) technology pedagogical knowledge (able to choose an ICT tool based on its provision to address a particular teaching/learning need). To develop TPACK, teacher not only needs to know how to use computer and software, but also be aware of the strategies to incorporate ICT tools to enhance student understanding of a particular subject's content. (Detail information about TPACK is written in the literature part of this paper (on pages 61-65).

Concerning TPACK in ESDP V (MOE, 2015, p.58) reveals that "ICT will be fully integrated in teacher's training courses and supported with practice so that teachers better equipped to use technology and to teach and assist their students with technology".

Furthermore General Education Quality Improvement Project II (GEQIP II) assigned a huge budget for the following proposed Projects:

> (i) Curriculum, Textbooks, Assessment, Examinations and Inspection; (ii) Teacher Development Program (TDP); (iii) School Improvement Plan (SIP), including school grants; (iv) Management and Capacity Building, including EMIS; (v) Improving the Quality of Learning and Teaching through the use of Information and Communications Technology (ICT); and (vi) Program Coordination, Monitoring and Evaluation, and Communication". Equity is addressed through mainstreaming of a number of cross cutting issues, including gender; special education needs, and school health and nutrition. Attention has also been paid to focusing more support on the four most under-served regions. The base cost estimated for the six components, excluding contingency is US$520.2 million (World Bank, 2013, p.8).

The above statement indicates that MOE has given more emphasis for TPACK to assert the quality of Education.

Thus the general problems to be studied in this research are: (a) practices of pre-service teacher education program; and (b) practices of induction and CPD program. Moreover the specific problems to be studied are: (a) Prospective mathematics teachers' attitude towards mathematics; (b) Teachers' Selection and recruitment criteria; (c) Application of TPACK in pre-service, Induction and CPD programs; (d) The relationship/match of primary schools mathematics syllabus to University College Mathematics courses; (e) Primary school teachers' practices, attitude and beliefs, challenges; and (f) Teacher educators practices. These problems affect students, because the students are the product of their teachers, some contents are not learnable or beyond the level of the students this is assessed and displayed in the syllabus analysis/review. What will happen if the answer you told for your child and the teacher's answer are different for the same question? Your child will be disappointed and in this case you will be also in doubt for the competency of teachers. Hence it is essential to research teachers' practices in schools and their problems.

1.3. Significance of the Study

Studying practices of primary teacher education related to Mathematics in Addis Ababa city government has the following importance:

a) The findings provide a useful piece of information for policy makers, teacher educators, teachers, student teachers and administrators.

b) The findings of primary teacher education program practices help the University College administrators, Teacher Educators, Education Bureau Officers and experts of MOE to improve the training practices and develop new ways of training strategies by using modern technologies, such as TPACK.

c) It also helps to lay the ground for more detailed and accepted teacher education program practices related to Mathematics Education.

d) Since this study attempts to focus on the current practices of mathematics primary teacher education program, it identifies crucial problems and suggests practical solutions for the problems encountered during practices. Then the schools and institutions will be initiated to solve the problems before hand.

e) It helps to find current ways of implementation strategies and practices related to technology and suggest courses to be involved in the curriculum of teacher education that enable prospective teachers to teach effectively in primary schools.

f) It helps to motivate other researchers for further investigation.

1.4. Delimitation of the study

This study mainly focuses on practices of primary teacher education emphasizing: (a) Trainee teachers attitude towards mathematics and teaching mathematics; (b) Teachers' Selection and recruitment criteria; (c) Application of TPACK in pre-service and in-service programs as well as in schools; (d) The relationship/match of primary schools mathematics syllabus to University College Mathematics courses; (e) Primary school teachers' beliefs and practices; and (f) Teacher educators practices in Addis Ababa City Government. Hence the scope of the study is restricted to pre-service, induction and CPD teacher education programs focusing on mathematics education and the depth of analysis is confined with the research questions.

1.5. Limitations of the Study

Some of the informants or participants in my study were education officers at federal level and experts at federal and Education bureau level. The education officers were busy due to different commitments and I spent too much time to get them. Some teachers 8 (5.3%) from 152 did not return the questionnaires. The budget assigned for this study was not enough. Some primary school classrooms were not appropriate for observation, due to large class size. This study was conducted at Kotebe University College and Addis Ababa primary schools; hence the findings may not be generalized for other teacher education institutions and primary schools out of Addis Ababa. I tried to manage the limitations through planned and effective use of resources.

1.6. Definition of Terms

Continuous Professional Development (CPD): is considered as an essential mechanism for deepening teachers' content knowledge and developing their teaching practice. As a result it could be a corner stone of systematic reform efforts designed to increase teachers' capacity to teach to high standards (Smith & O' Day, 1991). It is on job training by arranging school program to CPD training. Hence in this study it is assessed by the duration of the training, coherence, relevance, content focus, methods and techniques of assessment and classroom management trainings. Recent technologies like TPACK are also expected to be involved in the program.

Technology, Pedagogy and Content Knowledge (TPACK): is a system of training prospective teachers using technology/computer to curriculum course content & specific pedagogical skills. For instance by using cloud computing students can solve math problems, by applying collaborative models they construct knowledge from other student teachers, teachers, related materials available through the internet using smart phones, I pads, tablets etc. And it helps teachers' understanding of technology, pedagogy, & content, which can interact with other teachers of the world to produce effective content based teaching with educational technologies. Koehler & Mishra (2009) suggest that TPACK consists of TK, CK, PK, PCK, TPK, TCK and TPCK knowledge areas. In this study It is assessed how teachers and students practice TPACK related to Mathematics Education using computer

Proficiency of Teaching Mathematics: It describes expert teachers' knowledge of school mathematics in both broad and deep. It is broad in that such teachers have multiple way of conceptualizing the current grade-level content, can represent it in a variety of ways, understand the key aspects of each topic, and see connections to other topics at the same level. It is deep in that such teachers know the curricular origins and directions of the content where the mathematics had been taught and where it leads to, and they understand how the mathematical ideas grow conceptually (Ball, Thames, & Phelps, 2007; Hill, Rowan, & Ball, 2005). It is assessed in the study based on teacher's academic background and their practices.

Teacher Education Policy: The Oxford Dictionary of Current English defines policy as a plan of action, statement of aims, and ideals especially are made by a government, political party, business company, etc. Teacher education Policy in this study assessed based on recruitment and selection criteria, management, career structure, the nature of the training, Curriculum, license and re license, facilities available to implement the courses, and certification criteria.

Attitude towards Mathematics: is a function of the emotions that trainees/teachers associate with Mathematics, and their beliefs towards Mathematics and a belief that Mathematics is simple or difficult, good or bad as well as a belief that mathematics is useful or useless. Related to this Kalder and Lesik (2011) stated that prospective mathematics teachers attitude towards mathematics can be measured by 72 items based on the factors: Confidence (measure students' self concept of their performance in mathematics), Anxiety (measure feelings of apprehension), value (measure usefulness/worth), Enjoyment (measure like/dislike), Motivation (Desire to pursue studies) and Teacher expectation (expectations teachers have on their students ability/vice-versa). Similarly in this study the above mentioned factors are tested to know the attitude of prospective teachers using 71 items.

1.7. Theoretical and Conceptual Frame work of the Study

This section discusses the theoretical and conceptual frame of the study based on the theories and philosophies related to the issue as follows:

1.7.1. Theoretical frame work of the study

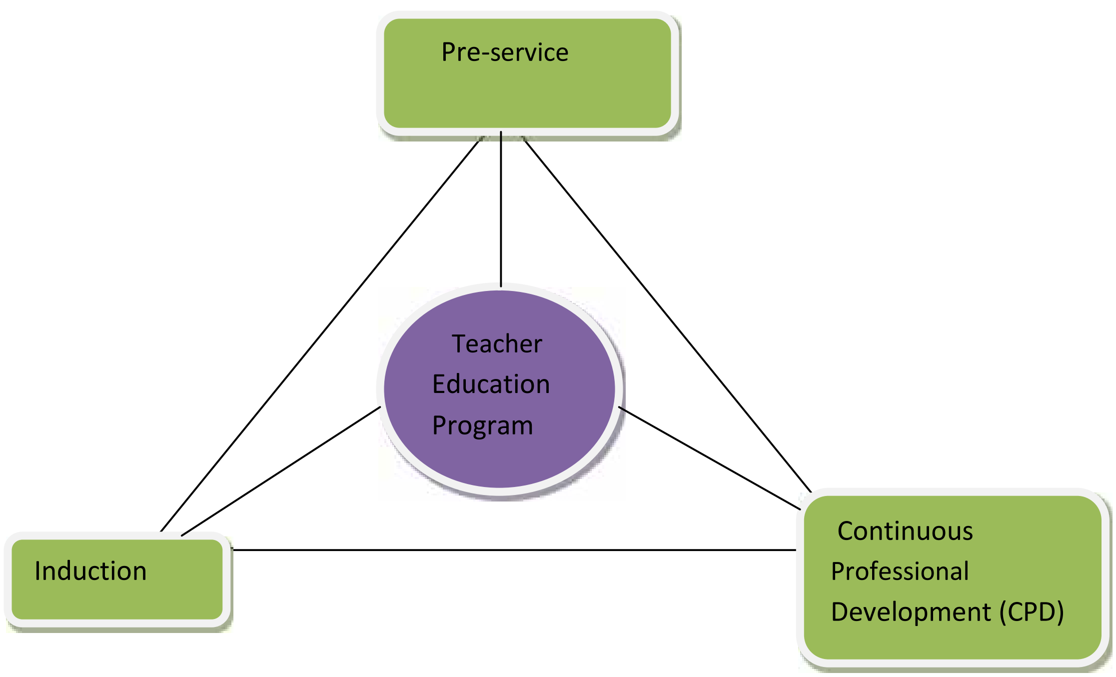
Heilbronn and Foreman- Peck (2015) view teacher education philosophical perspectives in terms of practical knowledge, practical wisdom, and educational virtuosity as follows:

> Philosophical view of teacher education indicated by the formula: Good teaching= Competencies + Judgment. And competency is defined as an integrative approach to professional action that high lights the complex combination of knowledge, skills, and understandings, values, and purposes. It is essential to answer the question "How a competent teacher might become a good teacher?" In philosophical perspective, education can therefore be seen as a teleological practice, that is a practice constituted by a telos, this provides a reason why judgment is needed in education (pp.1-22).

Moreover the above mentioned authors state that the difference between a competent and a good teacher lies in the ability to bring judgment to the task of teaching. Hence the authors suggest that to answer the question what kind of judgments teacher need is a case for a virtue-based rather than a competence-based or evidence-based conception of teaching and teacher education.

Similarly my study investigates the practices of teacher education program by focusing on the implementation strategies and practices with respect to the three components of teacher education; pre-service, induction and CPD programs which are focused on mathematics education practices and hindrances; hence I used the fidelity perspective implementation model from the positivists' theory. The fidelity perspective model is a model which focuses on measuring the degree to which a particular innovation is implemented as planned, and identifying hindering or supportive factors (Marew, 2000). Thus the theoretical frame work of this study is based on positivists' theory because in the Ethiopian context any education programs are supposed to be implemented based on the education policy of the country. However whether the actual practices in the implementation are in conformity with the policy or not needs to be assessed and hindrances and supportive factors of the practices should be identified. Sometimes the word model is used instead of, or interchangeably with theory (Louis, Lawerence and Keith, 2000*)*. According to Louis et al (2000) both model and theory can be seen as explanatory devices or schemes having a broadly conceptual framework, though models are often characterized by the use of analogies to give a more graphic or visual representation of a particular phenomenon. Thus related to teacher education practices Tatto, Schwillie, Senk, Ingvarson, Pec, and Rowley (2008); Stanulis and Ames (2009) views emphasize that practices of teacher education program envisages with the components and integrative activities of Pre-service, Induction and Continuous professional development programs as a theoretical frame work. To relate this view to my work I changed the authors' view in diagram form as follows:

Figure 1: A diagram depicting Teacher Education Program



The above diagram indicates that practices of mathematics education that executes through pre-service, induction and CPD programs.

Related to mathematics education Anthony and Walshaw (2009) underlined that mathematics is a discipline that plays a key role in shaping how individuals deal with the various spheres of personal, social, and family life. However these writers also comment that many students struggle with mathematics and become in trouble as they continually confront obstacles to solve math problems. In order to help students to learn mathematics effectively and to reduce their learning difficulties of mathematics the following ten principles are asserted as effective pedagogy of mathematics:

> Principle 1: An Ethic of Care (focus on Mathematics Goals that develop students' Mathematical proficiencies); Principle 2: Arranging for Learning (teachers create opportunities for students to work independently and collaboratively); Principle 3: Mathematical communication (effective teachers are expected to facilitate classroom discussion focused towards Mathematical Argumentation); Principle 4: Mathematical Language (teachers communicate mathematical terminologies in a way that students understand); Principle 5: Worthwhile Tasks (effective teachers understand that selected tasks and examples influence how students come to view, develop, use and make sense of mathematics); Principle 6: Making connections (effective teachers support students to create connections between different ways of solving problems); Principle 7: Tools and representations (effective teachers carefully select tools and representations to provide support for students' thinking); Principle 8: Teacher's knowledge (effective teachers develop and use sound knowledge to initiate learning and to act responsively towards the mathematical needs of all their students); Principle 9: Assessment for Learning (effective teachers apply scientific assessment techniques such as self-assessment, peers assessment, self-reflective, continuous assessment, problem solving assessment techniques etc.); and Principle 10: Building on students thinking (teachers give emphasis on building on students' existing proficiencies, rather than remediating weaknesses and filling gaps in students' knowledge, hence effective teachers are able to be both responsive to their students and to the discipline and they understand that learners make mistakes for many reasons (Anthony and Walshaw, 2009, p. 148).

The above mentioned principles mainly emphasize mathematics teachers' preparation, presentation and personality. Thus the main purpose of the principles is to make mathematics learnable to the students. The above principles are confirmed by the authors as effective pedagogy of mathematics. Hence it will be vital if mathematics teachers apply these principles for effective practices.

As mentioned in the introduction part the TPACK frame work that is the Technological Pedagogical and Content knowledge (TPACK) emphasizes a teacher's understanding of how technologies particularly information and communication technology (ICT), can be used effectively as a pedagogical tool to teach Mathematics (Koehler and Mishra,2009). In my conceptual framework TPACK is also one of the variables to be examined in the study with respect to the curriculum implementation model.

Jeasik (1998) explains the curriculum implementation models as follows:

> (a) In the Fidelity Curriculum Implementation model teachers use the curriculum as its developers originally intended. Hence it is firmly expected that a specified program developed by experts will be actualized in practice as exactly as possible without any modification. Thus the paradigm of this perspective roots in behaviorists and positivists theory. (b) The Mutual Adaptation perspective model stresses a process that permits implementation that is rooted in the paradigms of post positivists' theory. (c) In the enactment perspective model meaningful educational experiences and the curriculum is shaped by the evolving constructs of teachers and students. This model is rooted in constructivists' theory (pp. 2-10).

From the above mentioned models the model I used for my conceptual frame work is the Fidelity perspective model. I selected this model due to that curriculum is designed and developed based on the education policy by the curriculum experts and implemented by teachers without any modification. Thus similar practices are done in our schools and institutions.

Based on the fidelity perspective model my conceptual frame work will be as follows:

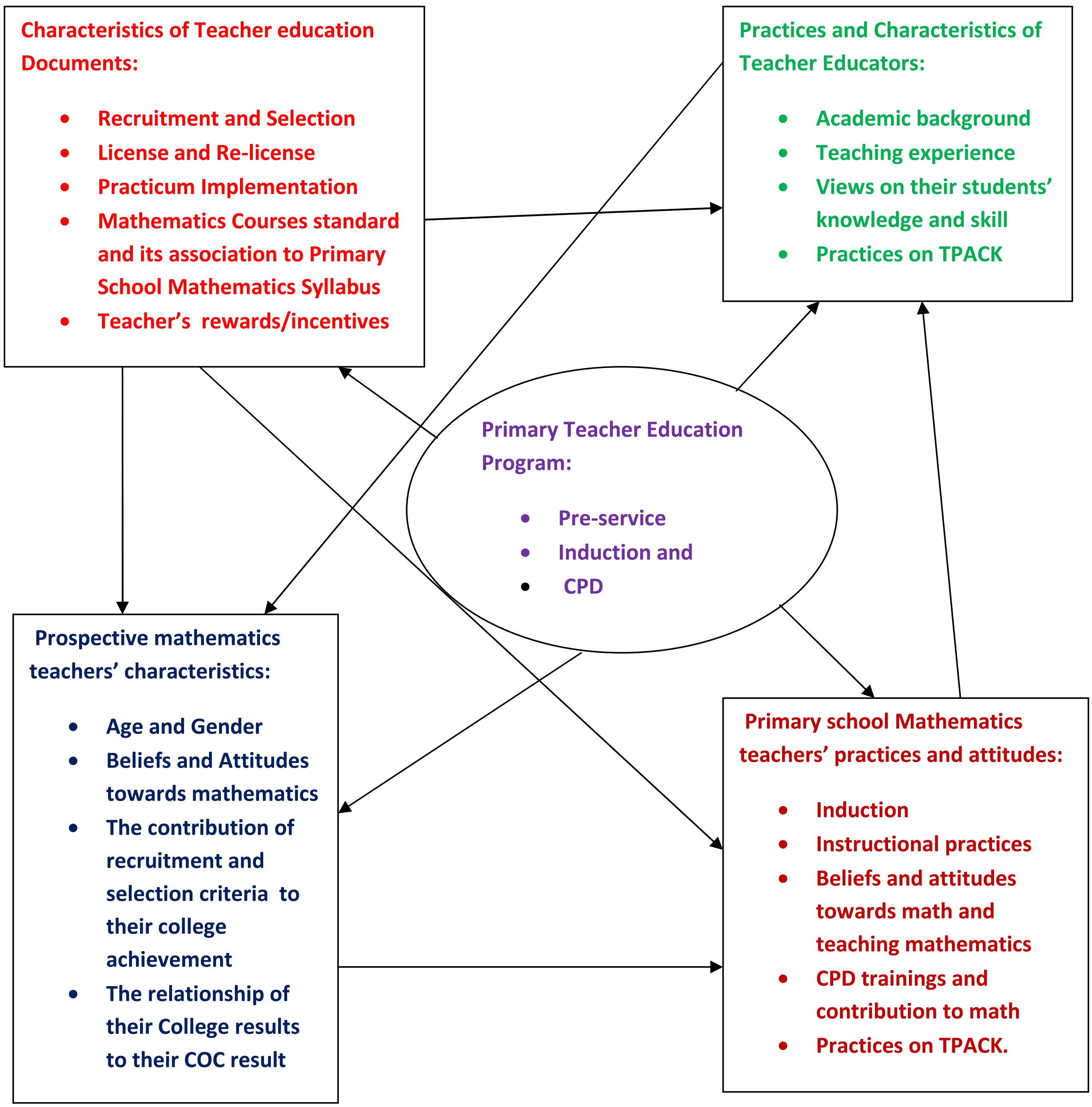
1.7.2. Conceptual Frame Work of the Study

My Conceptual Framework of the study Comprises Teacher Education Documents, Characteristics of Teacher Educators, Primary Teacher Education Program, Attitudes of prospective teachers, and primary school mathematics teachers' beliefs, practices and attitudes. The frame work comprises both dependent and independent variables of the study and the conceptual frame indicates the relationships between dependent and Independent variables. The independent variable are recruitment and selection criteria, courses, syllabus, academic background of teacher educators, TPACK activities, attitudes, rewards, teachers' career structures, school and college facilities, etc. The Dependent variables are: Pre-service, Induction and CPD programs. In addition to this the diagram indicates that to put the programs into practice policy guidelines are essential for effective practices of the policy.

Hence the frame work indicates the integrated relationship of teacher education documents, teacher educators' characteristics and prospective mathematics teachers' charactristics for efective practices of pre- service teacher education program. And Induction and CPD programs also need the cooperative activities of teacher education institution and school practices. To this end best practices occur with better opportunities and relationships of the above mentioned variables.

My conceptual frame work is adapted from Tatto et al (2008, p.14) and modified and depicted in the diagram as follows:

Figure 2: Conceptual Frame Work of the Study.



The arrows of the above diagram indicate the relation ship between dependent and independent variables. Thus the middle variables are dependent and the others are independent as mentioned in page 32.

1.8. Purposes and Specific Objectives of the Study

The main purpose of the study is to investigate the practices and challenges of primary teacher education program related to different perspectives and suggest practical solutions for the observed problems.

The specific objectives of the study are to:

1) Explore the strategies, and practices of pre-service, Induction, and CPD programs in terms of the curriculum and TPACK knowledge areas (i.e., TK, CK, PK, PCK, TCK, TPK, and TPCK) related to mathematics education.
2) Investigate prospective mathematics teachers' attitude (Self confidence, Anxiety, Enjoyment, Value, Motivation and Teacher expectation) towards Mathematics.
3) Examine the contributions of the selection and recruitment criteria to the trainees' University college achievement.
4) Examine practices of primary school mathematics teachers and their attitude and belief towards mathematics and teaching mathematics.
5) Explore the relationship/match of primary mathematics teacher education curriculum to primary school mathematics curriculum and their standards.
6) Identify major factors that affect teachers during the practices of teacher education program related to Mathematics and suggest practical solutions.

1.9. Basic Research Questions

The major research questions of my study are the following:

1) How are the strategies and practices of pre-service, Induction, and CPD programs in terms of the curriculum and TPACK knowledge areas (i.e., TK, CK, PK, PCK, TCK, TPK, and TPCK) related to mathematics education?
2) How is prospective mathematics teachers’ attitude towards mathematics?
3) To what extent the recruitment and selection criteria contribute to the trainees’ mathematics achievement in the University College?
4) How are the practices of primary school mathematics teachers? And how is their attitude towards mathematics and teaching mathematics?
5) How is the relationship/match of primary mathematics teacher education curriculum to primary school mathematics curriculum? And how is their standard?
6) What are the major factors that affect teacher educators and primary school teachers during mathematics curriculum practices? And what possible interventions can be employed?

Chapter II: Review of Related Literature

This chapter reviews the existing theoretical and empirical studies related to the study under investigation. It comprises policy of teacher education; practices of primary teacher education in Ethiopia; practices of teacher education curriculum; practices of primary mathematics teacher education curriculum; practices and challenges of primary teacher education of Ethiopia vis-à-vis mathematics; challenges of learning and teaching mathematics; profile of novice primary school teachers after graduation; and the need of Prospective Mathematics Teachers' and Teachers' Attitude towards Mathematics.

2.1. Policy of Teacher Education

Policy is defined as a set of plans or actions established on by a government, political party, business or other groups (University of Sydney, 2016; Bell and Stevenson, 2006; and Miller, 2010). In addition to this the University and the authors state that the central features common to all good policy are: (a) It presents entities of principle; (b) It is focused on action, emphasizing what is to be done and by whom; and (c) It has strong statement, made by a person or body with power to do so. Moreover Liddicoat (2014) states that the macro level policy of teacher education interacts with the micro-level of institutional practices. In addition to this Liddicoat asserts that pedagogy becomes a concern for macro-level policy when micro level practice is given emphasis as an action plan to implement the policy.

Liddicoat's statement indicate that macro level policy is designed by MoE where as micro level policy is an action plan made by institutions, hence this is clear that as far as teacher education is concernred macro level policy is prepared at the national level and micro level policy is prepared and practiced at the institutions (Colleges/Universities) level.

Similarly Mark, Joseph and Remy (2005) present the Macro and Micro-level Policy of Teacher Education as follows:

> (a) Macro-level policy of teacher education comprises the activities that will be apprehended in Teacher Education Institutions such as the need for funds into the teacher education institutions for the purpose of upgrading facilities, training and retraining of teacher educators, training of classroom teachers as mentors and supervisors, designing recruitment and selection criteria and activities which will be held in Ministry of Education such as designing core-curriculum for pre-service teacher preparation and preparing training guide lines for Induction and CPD programs, budgetary provisions which will be paid for practicum activities, internships and other activities that will be practiced in teacher education institutions, and also establishment of an accreditation/Licensing/Certification, remuneration, Salary, etc. (b) At the Micro-level policy of teacher education primary level teachers should be knowledgeable and competent in all the subjects of the primary school curriculum, should be effective in professional knowledge (Psychology, Sociology, Pedagogy, Classroom management, Assessment, Teaching methodology, etc.), competent in internship which facilitates the development of competence and confidence required for novice teachers (pp. 33-34).

Furthermore Jeroen (2012) classifies teacher education policy into macro, meso and micro level in which the macro level part of the research plan is to investigate on teacher attrition/retention, evaluation of the teacher education system, remuneration and license which is held at the national level; the micro level research is setup in relation to the implementation of innovative teaching strategies, such as collaborative learning, ICT in education and in relation to shaping characteristics of prospective teachers which is held at the institutions level; and at the meso/intermediate level the research emphasis is on systematic models for teacher education such as new models for internship, theory-practice relationships during practicum and classroom activities which is held at the regional or district level.

European Agency (2010) also explains teacher education policy at the macro and micro-level as follows:

> (a) The macro-level of teacher education policy consists of enhancing the attractiveness of teaching as a profession, enabling all beginning teachers to benefit from Induction and CPD by intensifying their impact on the quality of school education, expanding opportunities for teachers to continue their education and training, acquire additional work experience and develop their foreign language skills; (b) The micro-level teacher education comprises; teacher education curricula and practice such as to draw up a comprehensive syllabus for the education of teachers to work in culturally diverse setting. Hence several basic teaching skills are particularly important in this context such as classroom research skills and the ability to engage with academic research, monitoring the effectiveness of their class room interventions, reflecting critically on their own practice, working collaboratively and in addition to these initial teacher education program should also equip teachers with the skills to examine and reassess their attitudes towards other cultures, develop empathy, treat all the students as individuals, promote the success of all students and the strategies to deal appropriately with prejudice at school (pp. 11-19).

The main message of the policy explained by European Agency in the above quotation indicates that successful practices of teacher education programs in spite of its categories produces quality and effective teachers to achieve the goals of education effectively. In general the common analogy of the above teacher education statements indicate that policy at the macro level is treated through the government and Ministry of Education where as policy at the Micro-level is mainly implemented through Teacher Education Institutions and Schools. Hence accordingly my study mainly emphasizes the practices of teacher education programs at the micro level. Similarly Teacher Education Policy document of Portugal begins with the following questions as main issues of the policy:

> (1) What are the qualifications needed for teaching in schools? (2) Which institutions are suitable to ensure on education leading to these qualifications? (3) What characteristics should be held by the curriculum structure of programs in order to lead to professional teacher qualifications and what are the admission conditions? (4) What kind of state funding should be assigned to teacher education institutions? (5) How should authorization be granted to run teacher education programs? (6) How to promote and assure teacher education quality? (7) What is the articulation between teacher education, teaching activity and teaching career admission and advancement? (Campos, 2000, pp.1-14)

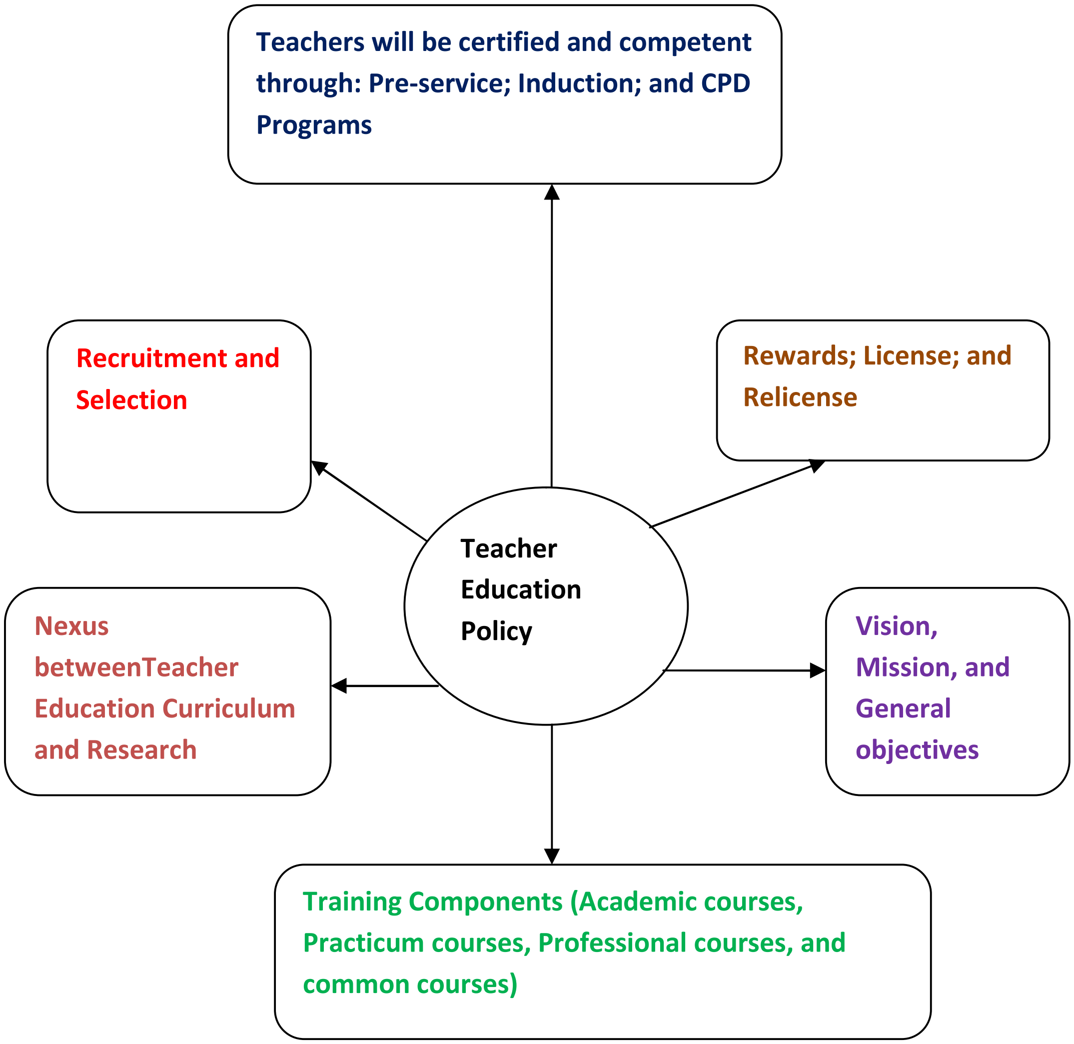
According to Campos (2000) to answer the above questions teachers training programs (Initial, In-service, and CPD) need to be practical and teachers need to be qualified in academic subjects compatible to PCK which is integrated with assessment techniques and skills of classroom management and methods of teaching.

Moreover Bridges and Marew (2000) assert that Teacher Education Policy, in most cases, clearly state recruitment and selection criteria, management, career structure, the nature of the training, curriculum, finance, location, national distribution and certification criteria. According to Bridges & Marew (2000) the development of proper educational policy and planning in Ethiopia considered as part of national development which can be linked with the beginning of national planning in Ethiopia. In addition to this the above mentioned authors wrote that the first, second, and third development plans during socialist oriented education period (1975-1990) main issue was to answer the question; what should be the policy of Education and Teacher Education of Ethiopia at the macro and micro-level? In the first and second development plans; Education policy was addressed by stating the general objectives/aims of education; whereas teacher education policy was treated in the third plan that mainly involves recruitment and selection criteria, management, and career structure, the nature of the training, curriculum, finance, location, national distribution and certification criteria. Related to teacher education The Education and Training Policy Document of Ethiopia states as follows:

> Create a mechanism by which employers, training institutions and the teachers association participate in the recruitment of trainees. Teacher education and training components will emphasize basic knowledge, professional code of ethics, methodology and practical trainings. Teachers starting from kindergarten to higher education will be required to have the necessary teaching qualification and competency in the media of instruction, through pre-service and in-service trainings (MOE, 1994, pp.20-22).

The above mentioned teacher education statements are some of the statements which mainly explains about teachers' recruitment and training, training components, teaching qualification and competency. However other statements like teachers professional interest, physical and mental fitness, certification of teachers, professional development of teachers, career structure, teacher education program, attention for recruitment of women, and teachers' motivation are also included in the policy document. In addition to this TDP (2007) document comprises vision, mission, and general objectives of Teacher Education program in Ethiopia, as well as profile for the graduate teacher, primary and secondary teacher education program, program breakdown, competencies for Ethiopian teachers, teachers' rewards, teachers' license and relicense, teachers' certification and promotion. Thus the above policy statements of teachers can be depicted in the diagram as follows:

Figure 3: Teacher Education Policy Structure of Ethiopia



Adapted from Education and Training Policy (MoE, 1994, pp. 20-22)

The above diagram depicts how teachers will be selected and recruited, trained, and then upgrade their profession after assigned in their regular teaching activities.

2.2. Practices of Primary Teacher Education in Ethiopia

According to Mark, Joseph and Remy (2005, p.7) Teacher Education is concisely defined as "The components of the education system which encompasses all activities that relate to and support the professional development and growth of teachers throughout their careers". The authors' definition indicates how teachers can be trained and develops their profession in order to be efficient in their regular teaching activities.

Moreover Mark et al (2005, p.12) explain the philosophical perspective of teacher education as paradigm shift of teacher development that requires: "(1) An explicit understanding of the purposes to be served by it, or else leads to raise a question; why is a focus of teacher development desirable? And (2) A re-examination of the philosophical orientation of teacher education curriculum and the particular approaches that is implicit in the various programs".

The implication of the statements taken as a paradigm shift by the authors indicates teacher education as a process which refers to the complement of practices based on the purpose and programs to achieve the objectives by implementing the appropriate teacher education curriculum.

Related to teacher education program and practices Nardos (1999, p.189) states that: " the practices of teacher education program needs to be compatible to the education structure hence the current education structure of Ethiopia changed from 6-2-4 to 4-4-2-2".

The above education structure indicates that the previous structure (1974-1990) was 6 years of elementary education, 2 years of junior secondary education and 4 years of senior secondary education; whereas the current structure is 4 years of first cycle primary education, 4 years of second cycle primary education, 2 years of general secondary education, and 2 years of preparatory education. In the education and training policy (1994) primary education is also classified into first cycle (grades 1-4) and second cycle (grades 5-8). Hence this study mainly emphasizes the practices of primary teacher education which includes the two cycles.

Thus to review the practices of primary Teacher Education in Ethiopia, first it needs to analyze the practices of the three programs, which are asserted by Ogunyinka, et al (2015) and the free encyclopedia (2016) of teacher education; these are Initial teacher training (pre-service teacher education), Induction and Continuous Professional Development (CPD). Before I discuss the practices of teacher education in Ethiopia it is important to see some experiences of other countries to know where we are.

The National Curriculum Framework for Teacher Education of India states that:

> Teacher Education Policy includes mission, vision, objectives, selection and recruitment, course catalogs, resources, requirement of trainer teachers, License and etc. In addition to this qualified elementary school teachers train with a bachelor degree and after they assigned to schools beyond their teaching activities they participate in the construction of syllabus, text books and teaching materials (NCF, 2009, p.9).

To promote innovative teacher education in India; United Nations International Children Emergency Fund (UNICEF, 2015) states the needs of strong collaboration between the diverse sectors. To put this into practice UNICEF recommended the following visions and five year goals to be implemented by Indian government and teacher education institutions.

According to UNICEF (2015, p.1) Visions of Teacher Education are:

(1) Professionalization of the teaching profession by establishing stronger linkages with the higher education sector and promoting longer duration (four- or five- years) pre-service courses for teachers, along with continuous in-service professional development opportunities that nurture teachers through a process of personal transformation and growth; (2) A strong cadre of teacher educators who have a clear vision and understanding of National Curriculum Frame Work (NCF) and Right to Education Act (RTE), practical experiences in applying these in classrooms, and strong facilitation and mentoring skills; (3) Training programs that use modern methodologies that enable teachers to reflect on their beliefs, attitudes and classroom experience, and to discuss together to plan the innovations they want to bring into their own classrooms; (4) A culture of continuous collaboration with Teacher Resource centers having a variety of reading materials and resources regularly used by trainers and teachers and Teacher Mentors who offer regular on-site support to teachers; (5) Teachers that are empowered to become reflective practitioners, equipped with the vision, attitudes, knowledge and skills required to design effective classroom strategies to meet diverse learners needs, along with the freedom and support needed to implement these.

Similarly UNICEF (2015, p.1) recommends the following as Five-year Goals of Teacher Education:

(1) To offer hands-on support to help states develop and successfully implement comprehensive roadmaps for Teacher Education reform under the new TE Scheme/ Mission; (2) To work towards strengthening of District Institute of Education and Trainings (DIETs) and capacity-building of DIET Teacher Educators in selected states, through partnerships with other Resource Organizations; (3) To generate resources to strengthen TE programs and methodologies, to translate the vision of NCF 2005/ NCF TE 2009 into a reality in classrooms; (4) To explore quality options for Training Untrained Teachers, and help states implement these solutions for meeting RTE goals without compromising quality; and (5) To work collaboratively with states and selected universities to develop six Schools of Education to become Centers of Excellence in Teacher Education and conducting innovative TE programs (B.El.Ed, M.Ed.) as well as interdisciplinary research on elementary education.

The policy of Teacher education of India and UNICEF’s suggestions of Visions and Goals can share a good experience for Ethiopian Teacher Education Policy. Similarly Teacher Education Program of Japan can be seen as follows:

According to Judith (1998) all current Japanese teachers train under the Educational Personnel Certification Law of 1949 which needs to hold relevant teaching certificates. The author explains that there are three classes of teaching certificate: advanced, first and second and there are two routes into teaching: the first is by a 2-year course at a junior college, and the second is by a 4-year course at a university. In addition to these, trainee teachers must have at least 2 weeks of teaching practice in a local school. To fulfill this requirement students often go back to the school in which they were themselves educated.

Finally the author asserts that Japanese teachers today, like any teachers, are the product of their own education and training. As the author states the focus in initial teacher training is firmly on the theory (the majority of which is traditional), with limited practical experience.

To this end Haruo, Hiroki, and Akira (2013, p.8) state that:

> The present condition of teacher education in Japan and the development of the training program with experiment study are introduced. Beginning in March 2009, The Ministry of Education, Culture, Sports, Science and Technology (MEXT) enforced a system of 'certificate renewal course' that required educators to acquire the advanced knowledge and skills every 10 years in cooperation with a university.

Furthermore Haruo et al, (2013, p.2) states:

> Teacher training needs 180 hours in the inside of a school plus 16 days in the outside of a school for the first year teacher, 30 hours plus 1.5 days rehearsal activity with colleagues for the second year teacher, 30 hours plus 1 day rehearsal activity with colleagues for the third year teacher, and 16-24 units of training guide line for every 10 year teacher. In addition to this they asserted that Optional training is also set up for professional training as like the themes of "Development of teaching materials," and they wrote that Tokyo Gakugei University (TGU) is one of the national universities of independent administrative agency in Japan and has a reputation of Japan's center of teacher education in which curriculum of teacher training course of bachelor's degree consists of liberal arts subjects, foundation subjects, content subjects, and graduation research positioning as a compilation (goal) of an educational program.

From Japanese Teacher Education program I compare Induction program of Ethiopia based on the data collected from primary schools of Addis Ababa in which four modules are prepared to be performed by the novice teacher within two years under the guidance of the mentor. Japanese experience indicates novice teacher should cover 180 hours in the class and 16 days practices out of the class in the Induction program and this program continues till third year. This indicates that Japanese induction program is more practical than induction program of Addis Ababa public schools because all the activities of novice teachers are held by applying their knowledge and skill in the actual teaching learning process under the feedback and guidance of mentors.

When we see the experience of teacher education program in America, Tom (1997) suggests that pre-service teacher education programs emphasize more on application of theory model where prospective teachers learn theories at the university and practice what they learned in schools. On the basis of Tom's suggestion Zeichner (2010) comments the program that prospective teachers don't always have opportunities to observe, practice and receive feedback on the particular teaching practices in which the teacher education program wants them to acquire.

According to Zeichner & Gonklin (2005), the University coordinators asserts that this approach creates a gap for teacher's academic and practicum skill and knowledge that are performed to support the learning of new teachers by integrating theory and practice. Finally Zeichner (2010) concludes that in the elementary and secondary teacher education programs University of Washington and Seattle have moved content area methods courses into the field in order to bring academic and practicum together, and thus better support prospective teachers learning to integrate the theories with practice. In addition to this the writers suggest that it reduces the time spent for theoretical methods courses that better satisfies the need of public schools; because in

America teachers training is conducted with the consensus training programs of the Universities and Schools.

What experiences Ethiopian Teacher Education program shares from India, Japan, and North America?

(1) Teacher education program of Ethiopia can share the following strong practices from India: (a) The practices of teachers' license and re-license; (b) Primary school teachers certified with a bachelor degree; (c) Primary school teachers participate in the development/construction of curriculum; (d) The visions and goals of teacher education policy of India is designed based on UNICEF's visions and goals recommended for all teacher education program.

(2) From Japan teacher education program Ethiopian teacher education program can share the following practices: (a) Primary school teachers complete a-4 year course at a University; (b) completion of courses at that level helps to renew teachers certificate; (c) A novice teacher needs 180 hours training inside the school plus 16 days training outside the school; (d) A second year teacher needs 1-5 days rehearsal activity with colleagues and 16-24 units of training guideline for every 10 year teacher.

(3) From north America teacher education program Ethiopian teacher education program can share the following practices: (a) Subject area methodology courses are practiced in the schools practically instead of learning theories in the Universities; (b) Prospective teachers learn theories at the universities based on the need of public schools and practice the theories in the respected schools in which they will be assigned to teach.

When I infer the above points knowing the factors that affect teacher education program in advance helps teachers how to handle and perform accordingly without being negatively affected by these factors. Thus Ethiopian teacher education program can share the above mentioned experiences and practices based on the environment and availability of resources. In addition to these I review Ethiopian Teacher Education practices by considering different related documents as follows.

The Growth and Transformation Plan (GTP 2) document of Ethiopia states about education and curriculum of Ethiopia as follows:

> One of the objectives of GTP2 is to expand and ensure the qualities of education. The previous document (GTP1) indicates the increment of participation rate of primary school from 82% (2010) to 92% (2015). On the basis of this GTP2 document underlined that to make the quality of education in a better condition, the programs '(a) Teacher Development (TDP); (b) School Improvement (SIP); (c) General Education Curriculum (GEC); (d) General Education Management and Administrative Program (MAT); and (e) Information and Communication Technology (ICT)' will have a great contribution to quality of education (MoFED, 2015, p.16).

On the basis of GTP2; Education Sector Development Program ESDP V (MoE, 2015, p.20) indicates the practices of primary education and teacher education as follows:

> Within College of Teacher Educations (CTEs) there remain weaknesses in the practical experience of teacher educators and in the subject knowledge of teacher trainees. In addition, teacher pedagogical skills – which now receive greater emphasis in the diploma program, are still below the level needed to apply the active teaching and student-centered methods required by the new curriculum. To overcome these challenges, bridging courses for new teacher trainees are now included to ensure that all candidates entering from Grade 10 hold the necessary subject knowledge. To improve in practice experience among teacher educators, CTEs and Universities that train teachers are encouraged to establish partnerships with nearby primary schools which will be strengthened during ESDP V period.

The above mentioned problems will be one of the parts to be studied in this study. Of course bridge courses have already started to be offered in teacher education colleges, but these courses may not be the only solution to promote quality of teacher education. These and other teacher education quality issues will be assessed in this study.

After the establishment of Education and Training Policy (1994) the subsequent Teacher Education document of Ethiopia was Teacher Education System Overhaul (TESO) which was a working document from 2003 up to 2007.

TESO was a paradigm shift within pre-service Teacher Education program, because it was established based on the research findings conducted by MoE, Addis Ababa City Administration Education Bureau, Oromia Region Education Bureau and Ethiopian Teachers' Association and the findings were:

> (a) The professional competence of teachers is deficient; (b) the content knowledge of teachers is unsatisfactory; (c) the teaching skills and techniques are not basic; (d) teachers do not match up to the standards and expectations of their profession; (e) there are failures in school management and administration including luck of knowledge of the ETP and proper implementation of the career structure; (f) there is a mismatch between Teacher Education and school education Curriculum; (g) there is lack of professionalism, and ethical values in the Teacher Education Program; (h) the quality of courses and methods of teaching are theoretical and teacher centered; (i) the practicum receives inadequate emphasis and is inefficiently implemented at all levels of teacher education; (j) student assessment does not adequately identify difficulties and potential in order to enhance students' learning; (h)action research is given little or no attention at all levels of teacher education; and (k) Teacher Education Institutions, schools and communities have insufficient links between them (MoE, 2003, pp.10-11).

According to TESO document the above mentioned findings was taken as major principles to change the previous (1974-1990) primary and secondary Teacher education program and Curriculum of Ethiopia. However TESO document is replaced by Teachers' Development Program (TDP) in 2007. The Ministry of Education explains that TESO document had been replaced by TDP due to the following points:

> (1) The credit hours allotted for professional courses are beyond the academic courses; (2) In the TESO document breakdown of the courses had been listed based on the program areas of: a) Practicum, b) Professional studies, and c) Integrated subject teaching; (3) In the new program TDP (2007) subject content courses will be offered by balancing the credit hours of professional courses and practicum to Subject area courses; (4) In the TDP document courses to be offered for primary teacher education are: (a) Academic courses, (b) Professional courses, (c) Practicum courses, and (d) Common courses; and (5) In the TDP document practices of components like licensing policy, Rewards, SIP, ICT, CPD, MAT, CEE, and GEC are also included (MOE, 2007, pp. 1-4).

Thus the practices of the above mentioned components needs empirical study and I can say that TESO is the bases for primary teacher education programs still integrated courses to be offered for training teachers for first cycle primary education is similar. Courses to be offered for second cycle primary education have improved in the TDP document. For instance KUC is now training diploma candidates through two programs since 2012/2013 these are: (a) Generalist (for grades1-4) teaches all subjects except language after the complet6ion of their trainings. However English language will be offered separately as a specialization for first cycle primary education. (b) Linear mathematics/Specialist (for grades 5-6), integrated natural science (for grades 5-6), non-academic streams (for grades 1-6).

Furthermore teacher education documents after TESO such as Supporting policy documents like Ethiopian teachers' Development program (2007) blue print and General Education Quality Improvement Packages (GEQIP, 2007) blue print started to be implemented from 2012/2013 onwards, particularly by giving more emphasis for integrated subjects of first cycle primary teacher trainees. Bridge courses will be provided for trainees who would be assigned to teach in grades 5-6, (Kotebe College of Teacher Education course catalog 2012).

Hence it is essential to review the current working document vis-à-vis the practices on the ground as follows: Teachers' Development Program (TDP) document Amharic version states the following as mission statements of Teacher Education:

(a)The Ethiopian Teacher Education Program is committed to produce competent teaching staffs that have the desired academic knowledge, sufficient professional skill, appropriate citizen ship, attitude and skill, and those ethical values enshrined in the Ethiopian constitution; (b) The Ethiopian Teacher Education Program also strives to achieve gender equity, undertakes relevant research, creates and leads transparent, democratic and cost effective institutional behavior; and (c) Above all, the Ethiopian Teacher education Program aims at the implementation of Ethiopia's short and long term plans of providing quality universal primary education for all of its citizens and producing staff both in quality and quantity for the entire education system (MOE, 2007, p.3).

Based on the above mentioned mission statements the current teacher education Curriculum of Ethiopia comprises the following components:

(I) Academic courses: A student teacher who specialize any discipline will be obliged to learn academic courses related to her/his field. Teacher education training program should consist of 50% academic courses; (II), Practicum courses: These courses will help the trainees to reflect, integrate, practice, etc what they learned in the classroom and apply practically in schools. They also observe and share experiences from mentors and apply the theoretical aspects of classroom activities through practical situation. It consists of 11% of the credit hours of the courses. Practicum courses offered in CTEs are: school observation (prac-201), Working under the mentor (prac-202), assisting the mentor (prac-301), and independent Teaching (prac-302); (III) Professional courses: These are courses that help the trainees to develop values, skills, attitude, wisdoms and behaviors. It comprises 25% of the training contents; and (IV) Common courses: These are courses which strengthen the all rounded personality of student teachers. Some of these courses are ICT, Civic and Ethical education, Language, etc. It covers 14% of the trainings (MOE, 2007, pp.15-16).

The above mentioned lists of courses are attached in Appendix K. But the three components of TESO document (MOE, 2003) were: (a) Practicum courses which comprise 17.3% of the trainings, (b) Professional studies which comprise 31.2% of the trainings and (c) Integrated subjects' courses which consist of 51.6% of the trainings and in the document it was stated as follows:

> There will be four streams of academic subjects, namely Natural sciences, Social sciences, languages and Aesthetics and Physical education. Each stream will cover four academic subjects. Student teachers will choose to study one of these streams. Natural science students will study, Biology, Chemistry, Physics, a language, Mathematics or Civics and ethical education. Social science students will study History, Geography, Civics and ethical education and a language or Mathematics. Language students will study English, Amharic, Nationality language, and Civics and ethical education or Mathematics. Aesthetics and Physical education will study, Art, Music, Physical education, and a language, Mathematics or civic and ethical education. These academic subjects will be given for the 1st two years. Year one each stream has 28 hours (7 hours for each subject area). Year two each stream has 24hours (6 hours for each subject area. Methods of teaching Natural sciences, Social science, etc. will be given as a course to enable student teachers to teach a maximum of four subjects in grades 5-8. Methods that are all common to the sciences and Mathematics, a language or civics and ethical education, and methods that are specific to each subject, will be practiced (MoE, 2003, p.45)

My comment on this program is that the credit hours given for mathematics were 13 credit hours to teach in grades 5-8 which was not sufficient, because the standard of training suggested by MoE to teach primary mathematics education is revised to be 33 credit-hours (Appendix-K). In addition to this Mathematics was studied by option, it means that if the student teachers are not interested in the subject no one selects it to study as the fourth major of other streams. However students who have low grade will be assigned to study it at the end. Moreover student teachers who enforced to study mathematics will be susceptible to additional capacity building and their attitude towards mathematics and teaching mathematics may not be positive and this creates minimum performance among novice teachers.

In the TDP program (2007) the above mentioned four components are also provided for student teachers who specialize mathematics; concerning academic courses the student teachers who specialize mathematics are taking mathematics courses for three years.

Related to teacher education ESDP IV document reveals that a teacher development program was launched in order to improve teacher qualifications and professional development. In the document amongst the major achievements of the program, the following are mentioned:

> (a) The required qualification level of primary school teachers has been increased from a one year certificate course to a three year diploma course after grade 10; (b) A special practicum program was introduced in pre-service teacher training; (c) A curriculum revision has been undertaken to adapt the different teacher training curricula to the new teacher qualification; (d) A Higher Diploma Program (HDP) was created to enhance the quality of teacher educators in both CTEs and Universities; and (e) Continuing Professional Development (CPD) for teachers was introduced in most schools, employing weekly sessions, drawing on either school-based, cluster-level expertise (MOE, 2010, p. 17).

The above statements indicate that ESDP IV contributes for the effective practices of teacher education, however some school directors need more knowledge about different policy guide lines Like GEQIP and consecutive ESDP programs.

On the basis of ESDP IV (MoE, 2015) Education Sector Development Program V explains Teacher's professional Development as follows:

> During the implementation of ESDP IV, it was planned to fill all levels of general education with academically qualified, motivated and ethically fit teachers, in accordance with the teacher development policy. Accordingly the share of primary teachers with a diploma was expected to increase from 38% to 100% by 2014/15. By 2013/14, 70% of primary level teachers held the required qualification (55% in first cycle, 92% in second cycle (pp.19-20)

The above statements are indicating the general status of teachers' qualification in all regions; however the statistical data of Addis Ababa City Government Education Bureau (2015/2016) indicates different from this. In the ten sub-cities there are 203 public primary schools; from these my sample schools are 18 in these schools 100% of my informant teachers are at the level of diploma and above. There are also first degree level teachers who teach at grade 7 and 8, some of them have trained through PGDT program some did not. This is more confirmed in the demographic data of the study.

2.2.1. Practices of Teacher Education Curriculum

On the basis of teacher education policy; Teacher Education Program, Curriculum, and its modes of delivery needs a review in order to determine the extent to which the achievement of expected outcomes meet its final target or not.

Related to curriculum practices Schwab (1983, p.243) raised a question "What is the true nature of theory and practice?" In addition to this question Schwab suggested that:

> The thesis and arguments have not however evidently transformed curricular theorists into practitioners. Discussants, including myself, have suggested three reasons for this failure: that Curriculum experts are unfamiliar with the arts of deliberation and eclectic unprepared to master them, that the practical is not particularly respectable academically and professors of education desperately pursue academic respectability; that the bureaucratic structure of American educators provides no path way for exercise of the arts of practice by professors of education (Schwab, 1983, p.243)

Schwab forwarded the following statement as a solution for the above mentioned problems:

> The first of this unfamiliarity with the practical and eclectic arts is being dealt with by groups of involved friends and colleagues. The second reason, pursuit of academic respectability is dealt with only indirectly. I deal with the third a path for professional involvement in the practical. I shall do so by first describing the character and usefulness of a new role or office to be installed in individual schools or small school systems. I shall then indicate the initial higher education which would prepare men and women to fill this office and the professorial scholarly activity which would continuously refresh those who fill this office. Such preparation and refreshment would be practical functions of professors of curriculum (Schwab, 1983, p. 244)

Moreover Schwab (1983) suggested that curriculum needs to be implemented by persons who designed the curriculum. Hence he suggested for the establishment of curriculum groups of eight to ten members composed of teachers, students, the principal, and a school board or community member.

Related to Schwab suggestion Hlebowitsh (2005) stated that Schwab however was not arguing simply to criticize. He also designed an alternative view that spoke directly to questions of curriculum practice; what curriculum scholars should actually do?

In addition to this Hlebowitsh (2005, p.76) stated that:

> Schwab undoubtedly gave us a new theoretical configuration for thinking about the curriculum, and was ultimately embraced by a good share of the curriculum community as an important departure from Tyler-a radical break, some might say, of almost paradigmatic proportions. In fact one of Schwab's complaints about the rational had to do with its commitment to the use of objectives in the curriculum. Far from seeing objectives as hopeless impositions on teachers, Schwab feared that they ultimately failed to offer enough concrete direction for the school. Yet Schwab, it should be said is certainly not obvious in the work of Tyler. This indicates a departure from Tyler than an improvement on Tyler.

Furthermore the argument of Reid (1993) who sees Schwab as different enough from Tyler states that even compatibility between the two is an issue. Hence Reid does not accept the separation drawn by Jackson (1992) between Tyler's vision –oriented view of curriculum and Schwab's problem-centered view.

From the above debate and counter debate I infer that Schwab needs the curriculum to work the ground of local practice. In fact Schwab did not want the field to be a theoretical, but he wanted it to recognize itself along the lines of its practice and the practical skills needed to help improve school learning environments. However Schwab's paradigm shift of curriculum practices needs to emerge from positivists' theory (Fidelity perspective) to post positivists (Mutual adaptation) and constructivists' theory (Enactment perspective). This leads to develop school based curriculum. In Ethiopian situation this trend of curriculum development and practices needs a paradigm shift from objective model to situational model of curriculum development. This needs further study on development and practices on Ethiopian Curriculum.

According to Mark et al (2005, p.32) elements of a core curriculum for pre-service teacher preparation are:

> (a) General knowledge: these are; Language and communication, Physical and Biological Science, Mathematics, Social science, Arts and Humanities; (b) Content area knowledge: primary level teachers should be competent and knowledgeable in all the subjects on the primary school curriculum; (c) Professional knowledge: apply knowledge of sociological, pedagogical, and psychological principles in the management of learning; (d) Teaching methodology; and (e) Internship.

Moreover ESDP IV document (MOE, 2010, pp.22-23) reveals that:

> All colleges of teacher education that train candidates will be strengthened based on the revised curriculum and the training standard while the existing practicum approach will also be strengthened by pre-service candidates of primary schools. Moreover, the higher diploma program (HDP) will be strengthened for teacher educators. Teacher education curriculum should be practiced based on the 21st century teaching –learning process and to put this into practice GEQIP has already designed ICT to be implemented as one of the packages. These are: (1) School improvement program (SIP); (2) Teachers' development program (TDP); (3) Civic and Ethical Education (CEE); (4) General Education Curriculum (GEC); and (5) General Education Management and Administrative Program (MAT) and (6) Information and Communication Technology (ICT).

In support of the above statement UNESCO (2008) emphasizes that teachers need knowledge to use ICT for supporting effective learning which involves knowledge construction and problem solving activities within appropriate contents. Koh, Chai, and Tsai (2014) state that Mishra and Koehler's (2006) TPACK frame work has been used as a theoretical basis for developing surveys to understand teacher's TPACK perception. In addition to this Mishra and Koehler (2006) assert that TPACK consists of 7 different knowledge areas these are: (i) Content knowledge (CK); (ii) Pedagogical knowledge (PK); (iii), Technology knowledge (TK); (IV) Pedagogical Content Knowledge (PCK); (v) Technological Content Knowledge (TCK); (vi) Technological Pedagogical Knowledge (TPK); and (vii) Technological Pedagogical Content Knowledge TPCK). All of these knowledge areas are considered within a particular contextual frame work.

Koehler and Mishra (2009) explain components of TPACK as follows:

> (1) Technology Knowledge (TK): refers to an understanding of the way that technologies are used in a specific content domain. For example, for mathematics teachers, it is an understanding of the range of technologies that mathematicians use in science and engineering. Within the context of technology integration in schools, it appears to most often refer to digital technologies such as laptops, the Internet, and software applications. TK does however go beyond digital literacy to having knowledge of how to change the purpose of existing technologies (e.g. wikis) so that they can be used in technologies enhanced; (2) Content knowledge (CK) may be defined as “a through grounding in college-level subject matter” or “command of the subject”. It may also include knowledge of concepts, theories, conceptual frame works as well as knowledge about accepted ways of developing knowledge; (3) Pedagogical knowledge (PK): includes generic knowledge about how students learn, teaching approaches, methods of assessment and knowledge of different theories about learning. This knowledge alone is necessary but insufficient for teaching purposes. In addition a teacher requires content knowledge; (4) Pedagogical Content Knowledge (PCK): PCK is knowledge about how to combine pedagogy and content effectively. It is knowledge about how to make a subject understandable to learners; (5) Technological Content Knowledge (TCK): refers to knowledge about how technology may be used to provide new ways of teaching content; (6) Technological Pedagogical Knowledge: it refers to the capacity and self control of knowledge as different teaching approaches; and (7) Technological Pedagogical Content Knowledge (TPCK): It refers to the knowledge and understanding of the interplay between CK, PK, and TK (pp.63-67).

Smilarly Archambault and Crippen (2009) report that PCK includes knowledge of what makes a subject difficult or easy to learn, as well as knowledge of common misconceptions and likely preconceptions students bring with them to the classroom.

Related to PCK Betule, Fatma, Esen and Ayesegul (2014) conduct a study that focused on the interactions among pre-service teachers’ pedagogical content knowledge (PCK) components throughout a 14 week content representation based mentoring enriched practicum course, and the nature of those interactions. They collected their data from three pre-service teachers Institutions, information rich cases, by the use of content representation (CoRe) and semi structured interviews and they explain that content analysis and the constant comparative method were employed in the data analysis and finally they conclude that the development of integrations was idiosyncratic and PCK integration moved from fragmented to a more integrated and coherent one by the end of the semester. In addition to this they state that Implications for science and math teacher education and research are discussed.

Regarding to TCK Niess (2005) analysis indicates that TCK is vital for the students to display using digital animation how electrons are shared between atoms when chemical compounds are formed.

Moreover Koehler and Mishra (2009) state that technology integration faced with the challenges how teachers integrate technology into their teaching? And they suggest that there is no one best way to integrate technology into curriculum; rather integration efforts should be creatively designed or structured for particular subject matter ideas in specific classroom contexts. In addition to this they propose that understanding approaches to successful technology integration requires educators to develop new ways of comprehending and accommodating this complexity. Similarly Archambault and Crippen (2009) support their idea that technology integration includes an understanding of the complexity of relationships between students, teachers, content, practices, and technologies.

In Ethiopian context MOE (2007) also gives more emphasis for TPACK. Hence MOE has designed a frame work that creates good opportunities to improve the quality of education. To strengthen the quality of education in Ethiopian schools MOE designed six major components (packages) that contribute a great deal for increasing quality of education one of these is Information and Communication Technology (ICT). The main question to be raised here is that "How is the practices of ICT in the teacher institutions and schools?"

ESDP IV (MOE, 2010) reveals that there is a gap in meeting the demand for more teachers, making the training curricula more relevant to schools; and also updating existing teachers using new technologies (ICT), like TPACK to effectively implement the new curricula and use child centered/learner centered methods of teaching so that the quality of education will be improved. Similarly in ESDP V (MOE, 2015, p.58) indicates that "ICT will be fully integrated in teacher's training courses and supported with practice so that teachers better equipped to use technology and to teach and assist their students with technology."

The Growth and Transformation Plan 2 document /GTP2 (MoFED, 2015) explains that to increase the training of education and to assert the quality of education one of the indicators involved in the document is ICT/ Technology.

Related to ICT Johnson, Adams, Cummins, Estrada, Freeman and Ludgate (2013) state that 21st century educational technologies will contribute to quality of education if teacher education colleges and schools implement it in rank order as follows:

> (1) Education paradigms are shifting to include on line learning, hybrid learning, and collaborative models. Students already spend much of their free time on the internet, learning and exchanging new information. Hybrid models when designed and implemented successfully enable students to travel to campus for some activities, while using the net work for others, taking advantage of the best of both environments; (2) Social media is changing the way people interact, present ideas and information, and communicate. More than one billion people use face book regularly. Hence it is not uncommon to see teachers using face book, twitter, Google handouts, and other platforms to connect with their students; (3) Openness: concepts like open content, open data, and open resources, along with notions of transparency and easy access to data and information is becoming a value. As authoritative sources lose their importance, there is need for more remedial and other forms of validation to generate meaning in information and media; (4) As the cost of technology drops and school districts revise and open their access policies, it is becoming more common for students to bring their own mobile devices. Then schools are launching a rule 'Bring your own device' (BYOD); (5) The abundance of resources and relationships made easily accessible via the internet. Institutions must consider the unique value that schools add to a world in which information is everywhere, and generally free; and (6) In addition to formal learning experiences cloud computing enables rich informal learning experiences using Smart phones, Tablets, I pads etc. to solve mathematics problems, and construct knowledge through cooperative learning, from different parts of the world by connecting computer devices to students of the world (pp. 7-11).

The authors present some challenges like internet access, computer access, interest and skill of teachers and learners to use the computer and their smart phones and to make one self ready to learn from other parts of the world.

Thus I selected this topic to investigate the practices of primary teacher education program related to mathematics in terms of TPACK/ 21st century teaching learning process, new strategies of practices to implement new designed policies and the correspondence between the primary education curriculum and the teacher education curriculum. In addition to this the contributions of Induction, continuous professional development and the curriculum of teacher education on the proficiency of teachers to teach mathematics will also be assessed.

2.2.1.1. Practices of Primary Mathematics Teacher Education Curriculum

According to Richards, Simco, and Twiselton (2005) in most countries of the world Mathematics is one of the core subjects of the National Curriculum due to its significance to learn new technologies. In addition to this the authors state that the subject matter of Mathematics involves several areas some of these areas are: subject knowledge, mental mathematics (the recall of simpler mathematical facts), diagnosis of errors (trainees must be taught to recognize children's errors i.e. avoiding methods which contribute to or exacerbate pupil's errors), classroom management, the search for a reliable standard (the concerns expressed by this area is that even with the basic qualification there seems to be a lack of knowledge or competence in mathematics on the part of intending teachers), assessment and record keeping. Concerning teacher education Mathematics courses Richards et al (2005) suggest the following courses to be at the standard.

> (1)Standards by content: The authors suggest that in the syllabus of primary school mathematics prospective teachers the following contents should be included: (a) Geometry of lines circles and simple solid bodies, but excluding conic sections; (b) Coordinate Geometry of lines and circles; (c) Algebra, progressions, The binomial theorem for positive integers; (d) Logarithms and their use, Probabilities; and (e) Plane trigonometry, The solutions of triangles, Mechanics, Friction, virtual work, Centre of gravity, Simple machines, Motions of pendulums and projectiles, Motion in a circle, Impulsive forces acting on elastic and inelastic particles. (2) Procedural concerns: It is a system of allowing trainees to follow their own procedures of solving Mathematical problems. For instance to add 45+65, a trainee can start to add from the right instead of starting to solve from the left. (3) Student Teachers: This procedure needs to consider students teachers capacity of solving different problems and since the ability of one differs from the other teacher educators/trainers need to consider how one learns from the other. (4) Algorithm: In this procedure what is expected from the student teacher is the correct answer, no need of worrying about how the student solved the problem (pp. 80-90).

Similarly Richards et al (2005) identify the fulfillment of Initial Teacher Training (ITT) National Curriculum for primary mathematics education as follows:

(a) It needs a rational to accompany the raw statements of required content. It should provide a clearly defined purpose of a set of goals appropriate to the future of mathematics education. (b) The expected breadth and depth of coverage of contents, the amount of mathematical materials, and workable model has to be involved, (c)It is important to stress that 'good' courses in primary mathematics for student teachers include all the elements that develops; competence in mathematics, effective teaching and assessment methods, high standard knowledge, skill and attitude (pp. 52-57).

Thus this study assesses the courses offered for prospective mathematics teachers based on the above standard and the professional standard of MoE (2013).

Table 2: Number of Regular student teachers of KUC who completed by attending the Courses attached in the appendix-K in the last four academic years.

(N.B: The data is organized from Mathematics Department of KUC, December 10, 2016)

Student teachers	2010/11	2011/12	2012/13	2013/14
Registered	54	55	115	53
Graduated	40	46	78	40
Attrition rate	25.9%	16.4%	32.2%	24.5%

One can observe from the above table that the average attrition rate of math student teachers is 24.75%. This indicates the existence of problems. It may be the recruitment and selection problem, the curriculum, problem of facilities or problem of teacher educators etc. Hence it needs in depth research study.

Moreover related to curriculum Nardos (1999, p. 189) states that in the Ethiopian Education system curriculum reform was held through: "(a) Education Sector Review (ESR) carried out in 1974, (b) Evaluation Research on the General Education System of Ethiopia (ERGESE), carried out in 1986, the Long Term Planning Committee was established in 1953 and the General Polytechnic Education held in 1987."

According to Nardos the above mentioned reforms were a few of the most significant curriculum under takings in the last two regimes. In the current situation also curriculum needs a reform accordingly with new innovations.

For instance ESDP IV document (MOE, 2010, p.18) states that: “the development of a curriculum framework has enabled the MOE to revise basic curriculum documents in line with the competence based approach." In addition to this it has been stated in the document that Minimum Learning Competence materials (MLC) for pre-primary, primary and secondary education up to grade 12, content flow charts, syllabuses and quality text books for all subjects need to be developed.

Furthermore the Curriculum frame work of Ethiopian Primary Mathematics Education is classified under the following areas:

> (a) Numbers and Operations with numbers: It is mentioned in the booklet that in this part of the curriculum the number system is introduced step by step and the ability of the students to order and perform fundamental operations on numbers is developed; (b) Sets: As it is mentioned in the booklet the concept of sets is treated spirally right from early definitions to the development of students’ abilities in operating with sets and using variables to describe sets; (c) Equations and inequalities: It has been described in the book let that the competencies in solving linear equations and inequalities in a given domain are developed step by step up to the stage where students are able to solve simple word problems leading to linear equations and inequalities; (d) Ratios, Proportions and Percentages: Students are encouraged and assisted to define and apply the concepts of direct and inverse proportionality, ratios and percentages and apply their knowledge in solving real-life problems; (e) Graphs, Relations and Functions: In the frame work it has been explained that the students’ ability to collect present and interpret data in a pictorial way is gradually developed by applying the concepts learnt in solving relevant and real-life problems; (f) Measurements: the students’ ability in measuring is developed right from measuring the length of line segments to the stage where they are able to compute the volumes of various solid objects; and (g) Geometry: It is explained in the frame work book that students define, measure and classify angles, triangles, quadrilaterals and circles. From this they develop basic skills of geometric construction. They identify common solids and their properties (MOE, 2010, p.25).

Thus this study assesses the syllabus of mathematics education from grades 1-8 attached in appendix- N and the relationship/match of the courses attached in appendix-K of primary teacher education to the syllabus of each cycle.

2.3. Practices and Challenges of Primary Teacher Education of Ethiopia Vis-à-vis Mathematics

Concerning best practices of conceptual mathematics, Hiebert and Douglas (2012), suggest that there are numerous strategies that were proposed over the years for building students' conceptual understanding of mathematics. The researchers synthesize that current research on best practices of mathematics helps students to gain a deep and lasting understanding of mathematics and contributes for better evidence based education. The conceptual understanding and strategies which build basic math skill and speed are not as separate as previously thought; in fact these best practices help both aspects of mathematics ability. The best practices are catagorized as follows:

> (1) Work and Talk**:** Teachers and students should intentionally and explicitly talk about, and work on, important mathematical relationships. Specifically, time should be spent: (1.1) "Examining relationships between facts, procedures and ideas within a lesson and across lessons." In other words, how do problems connect, how are they different, and how might they be different versions of the same idea? (1.2) Digging into why procedures work the way they do, and why they can't work in other ways, for instance "Why do we usually add from right to left"? (1.3) Solving problems using different procedures and comparing/contrasting results**.** (2) Work and Wrestle**:** "Teachers should provide opportunities for students to wrestle with key mathematical ideas…" Specifically, time should spend: (2.1) Posing problems to students that are just past what they can easily handle, specifically problems that take skills they have mastered and add a twist. (2.2) having students present their solutions to difficult problems and letting the class discuss the validity of the solution and offer alternative methods. (3) Have classes that are 'Well organized, fast paced and focused on mathematics (as opposed to passing in/out papers, discipline, etc.)' (4) Teachers should model new information clearly and concisely. (5) Once the students have been set up for success, significant time should be allotted for error-free practice (Hiebert and Douglas, 2012, pp. 10-11).

The two researchers conclude that strategies such as class discussion are well-known, the authors' summary of current research shows that the type of questions posed to students, the type of math problems they are asked to wrestle with and the role of students in the lesson are all key aspects to students to grasp the concepts of mathematics.

Thus when the more thoughtful teachers design their mathematics lessons, the deeper the students' understanding will go. Similarly to embed effective practices the following frame works are necessary for mathematics education:

> (1) Knowing school mathematics in depth and breadth; (2) Knowing students as thinkers; (3) Crafting and managing learning environments; (4) Developing classrooms and supporting classroom discourse as part of "Teaching for understanding"; (5) Building relationships that support learning; (6) Knowing students as learners; and 7) Reflecting on one's practice (Schoenfeld and Kilpatrick ,2008, p.2).

The main message of Schoenfeld and Kilpatrick is that the practices of mathematics education need competent, knowledgeable and effective teachers. The question is how can we produce these teachers? This question leads me to assess the recruitment and selection criteria of teachers.

I read a letter sent from Addis Ababa City Government Education Bureau to KUC with reference number A9.2/1011/AG8-44/11 on 10th of October 2016 written in Amharic. The subject of the letter indicates " Recruitment and Selection Criteria for 2016/2017 academic year primary school candidates" The criteria indicates that trainees should be recruited based on their interest, ethics and academic competence and in addition to this to join the University College trainees should fulfill the following: (1) Length 1.45 meter and above, (2) Free from listening disability, (3) Free from staggering problem, (4) Free from stammering problem, (5) Free from mental disorder/psychosis, (6) EGSECE result should be 2.00 and above in 7 subjects including Mathematics and English, (7) Grades 9 and 10 Transcript result should be 50.00 and above, (8) The college entrance exam result should be Satisfactory, (9) Age of the candidate should be between 16 and 25. Based on the above criteria the recruitment and selection committee categorize the weight for entrance examination 35%, for grades 9 and 10 transcript result 40%, and for EGSECE result 25%. In addition to this regular students who completed grade 10 and students who completed grade 12 and who have pass marks in the university entrance exam (EHEE) are also invited to join primary school pre-service teacher training program. Of course some of the above mentioned recruitment and selection criteria are also written in unprinted guideline material prepared by Addis Ababa city Government Education Bureau in 2011/2012. However grade 12 students are not included in the previous recruitment and selection guideline. Thus this study assesses and answers the question "To what extent these criteria contribute for the students' college achievement?" And what are the challenges during practices of the program? Related to the above questions ESDP IV indicates that the main challenges of teacher education as follows:

> (a) It Needs to make teacher training and qualifications at the standard levels, (b) Well qualified teachers in mathematics and science are not sufficient, (c) Quality of pre-service training needs improvement; better teaching materials, more adequate practical training, more adequate teaching methods supported by technology and (d) Low level of confidence amongst a number of teachers on the benefits of ICT (MOE, 2010, p.19).

Moreover in ESDP V (MOE, 2015) document the following challenges are identified:

> The low quality outcomes and persistent high dropout and repetition rates; Lack of skilled teachers and relevant teaching and learning materials; Within College of Teacher Educations, there remain weaknesses in the practical experience of teacher educators and in the subject knowledge of teacher trainees. In addition to this teacher pedagogical skills, which now receive greater emphasis in the diploma program are still below the level. Teachers are needed to apply the active teaching and student-centered methods required by the new curriculum; however this was not observed to be practical by teachers. New curriculum revisions were well received but a common complaint among students, teachers and higher officials was a weak linkage between examinations and curriculum (pp.16-20).

To overcome the above challenges MOE (2015) suggests bridging courses for new trainee teachers and by now these courses are included to ensure that all candidates entering from grade 10 hold the necessary subject-knowledge. To improve this in practice experience sharing among teacher educators, CTEs and Universities that train teachers needs to be encouraged and should also establish partnerships with nearly by schools.

In addition to this MOE (2015) explains that to overcome the gap of linkage between examinations and the new curriculum in collaboration with the National Educational Assessment and Examinations Agency (NEAEA) they are in the process of assessing all national examinations to ensure compliance with new curriculum content and materials. Thus this study also considers the availability of the above challenges and may also seek for practical solutions for the challenges identified through scientific investigation.

When I infer the above points, in order to make significant progress of primary teacher education program of Ethiopia; policy makers, strategists, researchers, professionals, teachers, and parents all need to engage in an ongoing dialogue about what kinds of teachers are needed as we progress in the twenty-first century. If all come to consensus then the program may smoothly progress and efficient teachers will be produced.

Related to instructional practices of Mathematics Solomon (2006) explored the effect of some American instructional practices on the Tigrai middle school Mathematics teachers who teach grades (5-8) students as follows:

The participants of the study were In-service teachers who attended summer diploma program in Abbydi Addi Teacher Training College. The writer designed intervention program, selected participant teachers' classes (experimental group) and control group. The researcher and his assistant taught the course math 251 and they applied different models of teaching the content. For instance to teach whole number multiplication they use Lattice Multiplication Algorithm, to teach division of whole numbers they use regrouping models, to teach multiplication and division of integers they use the pattern model, and to add and subtract fractions they use the vertical and horizontal strip model etc. Finally the researcher concludes that participant teachers in the study reacted positively to the standards-based instructional practices and showed willingness to implement the models in their math classrooms. In this study these practices will be assessed and other effective implementation models can be identified as alternative strategies and the above mentioned practices will be identified and can be informed as better experiences for others if they are found to be essential method for teaching mathematics.

Similarly Dawit (2008) explains practices of teachers as follows: The majority of metaphors formulated by prospective (77.4%) and In-service teachers (75.4%) refer to the behaviorist notion of learning. Very small numbers of metaphors that refer to constructivist notion of learning were formulated.

In addition to this Examples of metaphors related to the behaviorist notion of learning/ behaviorist metaphors are:

> (a) Teaching is moulding or trimming; (b) Teaching is like cooking food; (c) Learning is like a digestive system; (d) A teacher is like a journalist; (e) Teaching is leveling the land; f) Teaching is feeding; (g) A teacher is a carpenter; (h) Learning is feeding the empty mind; (i) Learning is like washing clothes; (j) Learning is being filled with food; (k) A teacher is a farmer of small land; and (l) Learning is knowing how to eat (Dawit, 2008, p. 62).

Furthermore Dawit explains examples of metaphors related to the Constructivists notion of learning/ constructivist metaphors as follows:

> (a) A teacher is a coach, students are football players; (b) Teaching is sparkling a candle; (c) Teaching is a brokering; (d) A teacher is a map for a plane while students are the pilots; (e) A teacher is base of a building, students are architects; (f) Learning is a journey for new ideas and discovering new ideas; (g) Learning is exploring like Vasco De Gama, you find something new spontaneously; (h) Teaching is showing the door of knowledge; students will swim in it; (i) Learning is solving problems of the community by applying theoretical knowledge; (j) Teaching is showing students how to work in the society; students should know the society to be good citizens; and 0(k) Learning is practicing, working, trying, cooperating and solving community problems (Dawit , 2008, p. 63).

Finally the researcher concludes that all the metaphors formulated by mathematics teachers were within the behaviorist notion of learning. From this I infer that mathematics teachers' method of teaching is mainly dominated by traditional/formal lecture method. However, problem solving and different models of teaching indicated by the previous researcher Solomon T. (2006) are not practiced according to this article. Ofcourse I tried to survey the availability of these practices and/ or new trends of teaching mathematics in this study. Related to practices Danielson (1996) designs four components of professional practices as follows:

Planning and preparation: It includes comprehensive understanding of the content to be taught, knowledge of the students' backgrounds, and designing instruction and assessment. Its components are: (1.1) Demonstrating knowledge of content and pedagogy; (1.2) Demonstrating knowledge of students; (1.3) Selecting instructional goals; (1.4) Designing coherent instruction; (1.6) assessing student learning**; (2) The classroom Environment**: It addresses the teachers' skill in establishing an environment conducive to learning, including both the physical and interpersonal aspects of the environment. Its components are: (2.1) creating an environment of respect and rapport; (2.2) Establishing a culture for learning; (2.3) Managing classroom procedures; (2.4) Managing student behavior; (2.5) Organizing physical space; **(3) Instruction/ Delivery service**: It is concerned with the teacher's skill in engaging students in learning the content, and includes the wide range of instructional strategies that enable students to learn. Its components are: (3.1) communicating clearly and accurately; (3.2) using questioning and discussion techniques; (3.3) Engaging students in learning; (3.4) providing feedback to students; (3.5) Demonstrating flexibility and responsiveness. And **(4) Professional responsibilities**: It addresses a teacher's additional professional responsibilities, including self assessment, and reflection, communication with parents, participating in ongoing professional development, and contributing to the school and district environment. Its components are: (4.1) Reflecting on teaching; (4.2) Maintaining accurate records; (4.3) Communicating with families; (4.4) Contributing to the school and district; (4.5) Growing and developing professionally; and (4.6) Showing professionalism (pp. 3-4).

Moreover the writer categorized four domains with specific components each of which consists of multiple elements, organizes teacher assessment, self-assessment and reflection with rubrics that define degrees of proficiency. Hence on the basis of the above components of teachers' professional practice the result of teachers' assessment can be categorized into the following summative evaluation ratings from the highest to the least:

(1)Distinguished: Evidence of high levels of knowledge, implementation and integration of performance standards along with evidence of leadership initiative and willingness to model and serve as a mentor for colleagues (It lies in the rating scale of 4.00); (2) Proficient: Evidence of increased knowledge implementation and integration of performance standards and evidence of a clear proficiency and skill in the performance area (It lies in the rating scale of 3.00-3.99); (3) Basic: Evidence of basic knowledge and implementation of performance standards. Integration of performance standards is not evident. Teacher is making progress towards proficiency (It lies in the rating scale of 2.00-2.99); and (4) unsatisfactory: Little or no knowledge and minimal implementation of performance standards. Does not meet minimal performance standards and needs substantial improvement (It lies in the rating scale of 1.00-1.99) (Danielson, 1996, pp.11-15):

Danielson's assessment ratings are albeit modified and used in this study to identify primary school mathematics teachers' practices during classroom observation.

2.4. Challenges of Learning and Teaching Mathematics

Mathematics is the science that deals with numbers, equations, functions, geometric shapes, and patterns of counting, reasoning, and logical relationships of shape quantity and arrangement (Hom, 2013; Petti, 2016; Free Encyclopedia, 2016;). In addition to this they state that some of the major sub divisions of mathematic are Arithmetic, Algebra, Geometry, Trigonometry and Calculus. Based on the concept of mathematics they discuss mathematics education as the practice of teaching and learning mathematics which is primarily concerned with research in mathematics learning and teaching process.

Different researchers state the major challenges of learning and teaching mathematics. For instance; Pia (2015) states that the problems of learning and teaching mathematics range from pedagogical, social, economic, administrative and policy aspects to attitude of students and teachers as well as competence of teachers and the overall teaching learning process. Similarly Ball and Bass (2000) identify that teachers' big problem of teaching is to integrate subject matter knowledge and pedagogy in their work. They also state teaching as a practice embedded within both regularities and endemic uncertainties. The examples they provided for this statement is that some topics such as Arithmetic with integers, probability, and fractions are quite often difficult for primary school students.

Furthermore Reys (2010, pp.9-15) identify the following nine major challenges of mathematics education:

(1) Mathematics teacher content knowledge: Too many teachers have this problem; (2) Teacher understanding of student learning and effective teaching strategies: It's not enough to know a lot of mathematics. A good teacher must also understand how students are thinking about mathematics and how to structure instructional opportunities to support their learning; (3) Shortage of good Mathematics teachers; (4) Teacher preparation programs: Initial teacher preparation is not as effective as it could be. We need to identify what makes an effective teacher; (5) Induction into the profession of teaching mathematics: We lose potentially good teachers because of inadequate or non-existent induction or support programs; (6) Evaluation of effective teaching: To what extent should teacher "effectiveness" be evaluated based on student performance on common assessments? (7) Student interest in and motivation to learn mathematics: Are students less motivated to learn mathematics than in previous generations? Why are some students more motivated than others? How a strong student work ethic is developed? (8) Opportunity to learn: All students do not currently have access to high quality teaching and curriculum. How do we change this situation? And (9) Weak Influence of educational research on practice: How do we prioritize and support the systematic study of new interventions and other basic and applied educational research? We need to establish and promote communities of researchers.

To know the existence of the above mentioned challenges it is essential to study the practices of Ethiopian primary teacher education by focusing on mathematics education, because any one can not hesitate to emphasize these challenges since their influence for effective practices is predictable. Hence this study gives more emphasis to investigate the existence of these challenges and suggest intervening solutions.

2.5. Profile of novice primary School Teachers' after graduation

TDP document (MOE 2007) Amharic version explains the profile for primary school graduate teachers need to fulfill academic and professional skill; ethics and good citizen ship; competent in producing responsible citizens, in subjectmatter content, in class organization and management, in assessment and in areas related to education system as well as in values, attitudes, ethics and abilities essential to professionalism. In addition to the above profiles impartiality, transparency, accountability, working collaboratively, etc. are mentioned in the document and the profiles are explicitly categorized in the document. To confirm these profiles

The National Professional Standards for Teachers (NPST) designed seven standards (MoE, 2013, pp.10-22), these are:

> 'Standard 1: Professional Knowledge (Know the students and how they learn)': Based on this standard basic elements and performance criteria are explained in detail; for instance, for the element demonstrate physical, social, intellectual and emotional development and characteristics of students 5 performance criteria are listed. One of these criteria utilizes the whole school (physical and human) as an environment to enhance student learning; 'Standard 2: (Know the content and How to teach it)': In this standard the basic elements which will be performed are: know the content and teaching strategies of the teaching area, know the content selection and organization, use curriculum, assessment and reporting, know literacy and numeracy strategies, use Information and Communication Technology (ICT) and the evidence guides listed are under pinning knowledge, under pinning skill, assessment methods and context of assessment; 'Standard 3: (Professional practice)': It Plans for and implement effective teaching and learning. In this standard the basic elements which will be performed are: establish challenging learning goals, plan structure and sequence of learning programs, use teaching strategies, select, prepare and use resources, use effective classroom communication, evaluate and improve teaching and learning programs, engage parents/care givers in the educative process and the evidence guide are; underpinning knowledge, underpinning skill, assessment methods and context of assessment; 'Standard 4: (Create and maintain supportive and safe learning environments)': In this standard the basic elements which will be performed are; support student participation, manage classroom activities, manage challenging behavior, maintain student safety, use ICT safely, responsibly and ethically, and the evidence guides are similar to the other standards; 'Standard 5: Assess and provide feedback and report on student learning)': In this standard the basic elements which will be performed are; assess student learning, provide feedback to students on their learning, interpret student data, make consistent and comparable judgments, report on student achievement, and evidence guides are listed including its performance criteria; 'Standard 6: (Professional Engagement)': It engages in professional learning. In this standard the basic elements that will be performed are; identify and plan professional learning needs, engage in professional learning and improve practice, engage with colleagues and improve practice, apply professional learning and improve student learning, evidence guides and its performance criteria are also listed; 'Standard 7: (Engage professionally with colleagues, parents/care givers and the community)'. In this standard the basic elements are; meet professional ethics, comply with legislative, administration and organizational requirements, organize and support team meetings, engage with the parents/care givers, engage with professional teaching networks and broader communities and the evidence guide are listed including its performance criteria.

On the basis of the above mentioned National Professional Standards for Teachers it is essential if the curriculum and teacher education programs designed accordingly and their practices accomplish through the bench mark of the standards. Of course in this study I use these standards to assess primary mathematics teacher education courses.

Moreover the above standards need to be integrated with teacher education programs. In Ethiopian Teacher Education Program the three programs that are Pre-service, Induction and CPD are relevant and implemented accordingly. However teaching license has not yet started.

The TDP document (MOE, 2007) explains teaching license and re-license criteria as follows:

> (a) Teachers who join the profession should achieve 50% and above in the pre-assessment of teaching certification; (b) Those that joined the profession will be involved in induction program and upgrade themselves through CPD program and should achieve 60% and above in the CPD result; (c) Student teachers who completed the pre-service program and certified by the recognized institutions will be registered to join the profession; (d) Teachers who joined the profession and involved in the induction program during their first year and second year of teaching will be assessed based on their students' achievement and CPD program. When they achieve 60% and above they will be certified to teach with license; (e) To re-license their certificate teachers will be evaluated based on performance centered activities and their students result; (f) Teachers at the level of higher and associate lead teacher will be evaluated through the fulfillment of the standard designed to get the license and it will be renewed for every three years; (g) License and re-license will be manipulated through an established government body or quality assurance agency; (h) Teachers will not be allowed to teach without a license; (I) Teacher educators will be also licensed through higher diploma program; (j) Newly employed teachers should fulfill the standard designed to train teachers; and (k) Teacher educators renew their license based on the standard and their performance centered activities result (pp. 25-26).

In addition to license and re - license TDP document (MOE, 2007, p.44) reveals teachers' remuneration strategies as follows: "(1) Acceleration in carrier development; (2) Scholarship; (3) Teachers who work at a distance and hardship areas will get better salary; (4) Teachers get priority in financial loan, housing utensils, etc.; (5) Retirement with full salary; (6) rewards in form of money, medals, certificate etc.; (7) Visiting historical places free of charge; and (8) Creating opportunities to get a house, land, free transport etc".

More over related to license ESDP V explains that:

> It was planned to license all teachers by 2015. This target was set, before the work volume was clearly identified, or a regulatory body established. However in 2011/12, the licensing directorate began to function and supports the ongoing efforts to ensure suitably qualified and capable staff. Its growing system of licensing and re - licensing assesses professional competencies on the basis of predetermined standards (MOE, 2015, p.20).

It is obvious that teachers' license and re-license as well as remuneration strategies are significant for effective practices of teachers if it is implemented precisely.

Related to teachers' practice Reda (2008, p.67) explains that "teachers have different expectations for the low ability and high ability students. These differing expectations lead to different teacher behaviors that in turn, affect student behavior and academic performance."

Results of Reda's study reveal that academic performance was related significantly and positively to teacher expectation, teacher behavior and student behavior. In addition to this the writer states that teacher expectation, teacher behavior, and student behavior were also related significantly and positively to each other. The researcher used grade 11 students, Mathematics education, and Mathematics teacher as his sample studies in Bahirdar preparatory school.

From this finding I infer that Mathematics teacher educators' of KUC inspiration for all prospective mathematics teachers who joined the university college is to achieve good result however during practices teacher educators expectation and prospective mathematics teachers achievement may vary and it reduces teacher educators' motivation towards teaching the subject.

2.6. The need of Prospective Teachers' and Teachers' Attitude towards mathematics

Mensah et al (2013) explain that the conceptions, attitudes, and expectations of students regarding Mathematics and Mathematics teaching are considered to be very significant factors to their school experience and achievement. Moreover they found that there is students' positive correlation between their attitude and mathematics achievement. It means the more positive the attitude, the higher the level of achievement in the student. Finally the authors conclude that negative attitude prevents the students from learning mathematics and it may also reduce to acquire knowledge and skill that could be used to develop problem solving ability in the subject and also they state that students' success in mathematics depend on their attitude towards the subject.

Similarly Relich, Way and Martin (1994, p.56) explain attitude as "a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related" As the authors mentioned it when exploring the attitudes of pre-service teachers toward mathematics it is necessary not only to consider their attitudes towards the subject itself, but also their attitudes towards the teaching of mathematics. In addition to this Relich et al (1994) state that the attitudes of pre-service teachers towards mathematics is essential to teach the subject and to influence their students interest in the subject. In a similar issue Fennema and Sherman (1976) pointed out that a person's attitude toward mathematics is critical to choose mathematics and learn it. According to them it is true not only in high schools, but in colleges and teacher training institutions.

Furthermore, Kalder and Lesik (2011) state that many pre-service teachers have negative attitudes toward mathematics that had developed when they were students, or effects of their previous mathematics classes affect them to have a negative impact on their mathematics attitude. In addition to this the authors suggest that pre-service teachers' achievement towards mathematics have a negative correlation with anxiety toward the subject. This means that high anxiety creates low achievement and low anxiety creates high achievement.

According to Mclead (1994) and Tapia and Marsh (2004), many researchers adopt Fennema-Sherman Math attitudes scales (FSMAS) to evaluate students' mathematics attitude, because the impact of FSMAS has been left widely in all research on attitudes towards mathematics education research over the last three decades. In addition to this the writers state that; the confidence in learning Math scale is intended to measure confidence in one's ability to learn and to perform well on mathematics tasks; the math Anxiety Scale is intended to measure feelings of anxiety, dread nervousness, and different symptoms related to doing mathematics; the effective motivation scale in math is intended to measure efficacy as applied to mathematics; the mathematics usefulness scale is designed to measure students' beliefs about the usefulness of mathematics currently and in relationship to their future education, vocation, or other activities.

Thus this study also considers the above mentioned factors to measure the attitude of prospective teachers. Because the implication of the studies indicates that it is essential to know the beliefs, emotions, feelings, interest and values of the prospective teachers towards mathematics for better practices of actual teaching activities of the subject and learning mathematics.

Chapter III: Design and Methodology

This chapter comprises design, method, data source, and data collecting instruments, procedures, techniques of data analysis, and validity, reliability, and ethical considerations.

3.1. Design

A research design is the plan of a research study and a framework which will be created to seek answers to research questions (Creswell, 2012). Moreover Creswell states that before beginning the research paper, it needs to decide how you plan to design the study. Similarly De vaus (2001), and Sultan (2016) state that research design is a plan of the research which determines to know what data is required, what methods are going to be used to collect and analyze this data, and how all of this is going to answer your research questions before hand.

Thus the design I use in this inquiry is mixed research design specifically convergent/ concurrent or parallel study/triangulation design. I selected convergent design, because my study needs both quantitative and qualitative data and I need to triangulate the results obtained from questionnaire, documents, interview and observation.

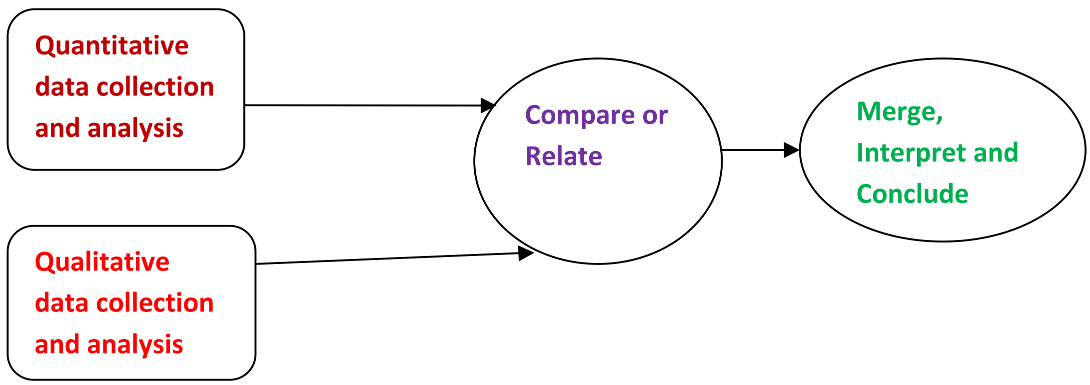
Moreover Creswell and Clark (2011) also state the importance of using convergent/concurrent design as follows:

> Greater validity of the research is confirmed through quantitative and qualitative data collection and analysis; the design is essential when the researcher seeks to elaborate, illustrate, triangulate and clarify the results from one method with the results from the other method; and when the researcher seeks to answer different questions and illustrate both qualitative and quantitative findings it is essential to use this design (pp. 62-63).

According to Creswell and Clark (2011, p.77) the purpose of convergent design is: "To obtain different but complementary data on the same topic to best understand the research problem, and to triangulate the methods by directly comparing and contrasting quantitative statistics results with qualitative findings for corroboration and validation purposes".

Similarly convergent/ concurrent design procedure is displayed in the diagram as follows:

Figure 4: Convergent/concurrent design procedure.



Adapted from Creswell and Clark (2011, p.69)

I used the above diagram as a guide during data collection and analysis. Hence, this design is compatible to collect data and analyze the data based on my research questions.

Thus I used concurrent /Convergent design in this study and I collected both quantitative and qualitative data concurrently and then I compared the two data bases to determine confirmation, cross validation or corroboration.

As Creswell and Clark (2011) asserts; in the results and discussion chapter first I presented quantitative statistical results followed by qualitative data results to support or disconfirm the quantitative results and conclude the final results based on data triangulation organized from the different data collecting instruments.

3.2. Method

According to Patricia, and Rangarjan (2013) Research Methodology is the process used to collect data by applying different research techniques for the purpose of making decisions, developing theories, Identifying and solving problems etc,. Furthermore the authors state that the methodology part of the study mainly includes participants of the study, data collecting instruments, data sources, procedures and techniques of data analysis. In this section the method used in the study will be explained as follows:

3.2.1. Participants

The study participants can be categorized in two ways. These are the pilot study participants and the main study participants.

3.2.1.1. Pilot study participants

The main purpose of the pilot study is to confirm the reliability and validity of data collecting tools. Hence the pilot study participants are depicted in the table as follows:

Table 3: Pilot Study Participants of Prospective Mathematics Teachers, and Teacher Educators in the two Teacher Education Colleges with respect to Gender

CTE	Prospective mathematics teachers									Teacher Educators		
	Second year			Third year			Total					
Dessie	M	F	T	M	F	T	M	F	T	M	F	T
	64	21	85	59	20	79	123	41	164	1	2	3
Debre Berhan	68	23	91	54	21	75	122	44	166	2	2	4
Total	132	44	176	113	41	154	245	85	330	3	4	7

As displayed in the table the pilot test participants were 330 prospective mathematics teachers which include all second and third year prospective mathematics teachers in both colleges. In addition to these 7 mathematics teacher educators were also participants of the study.

Table 4: The pilot test participants of primary school mathematics teachers around Dessie and Debre Berhan primary schools with respect to Gender

Primary Schools	Teachers		
	Male	Female	Total
Segno Gebeya primary school (Dessie)	2	4	6
Nigusmichael primary School (Dessie)	1	4	5
Model primary school (Debre Berhan)	2	3	5
Zerayacob primary school (Debre Berhan)	1	5	6
Total	6	16	22

As displayed in table 4 the pilot test participants are 22 primary school mathematics teachers in which 16 are females and 6 males.

The result of the pilot study indicates that the reliability of attitude test items in both teacher education colleges is α = .726 and the validity of the items confirmed to be valid using CFA in appendix-B table 2. In addition to this questionnaire, Interviews, and Observation check lists are also tested and improved.

3.2.1.2. Main study participants

After the pilot test some improvements made on attitude test items and all regular 2015/2016 academic year prospective mathematics teachers of KUC (N= 143) filled the attitude assessment items. From these 39 females and 56 males were second year and 18 females and 30 males were third year.

Moreover after some improvements on teachers' questionnaire and interview items 18 sample primary schools were randomly selected from 3 randomly selected sub-cities of Addis Ababa public primary schools. From these schools all (144) mathematics primary school teachers; of which 54 males and 90 females, 18 primary school directors (11males and 7 females), 162 purposively selected primary school students (83 females and 79 males), and 36 purposively selected parents (14 females and 22 males) participated in the study. From Ministry of Education (MoE); higher education officer (N= 1), and senior experts (N = 2), and from Addis Ababa city government education bureau mathematics senior expert (N=1) were participants of the study.

The target population was then divided into the following groups: (a) Kotebe University College (KUC) prospective mathematics teachers (N=143), (b) KUC mathematics teacher educators (N=12), (c) Addis Ababa public primary school mathematics teachers (N=144).

Table 5: The main study participants of KUC prospective teachers, and teacher educators, and primary school teachers of 18 sample public schools with respect to Gender.

Kotebe University College									Public primary school mathematics teachers		
Prospective Mathematics Teachers						Mathematics Teacher Educators					
Second year			Third Year								
M	F	T	M	F	T	M	F	T	M	F	T
56	39	95	30	18	48	10	2	12	54	90	144

As indicated in table 5 the study participants of Kotebe University College are 143 prospective mathematics teachers, and 12 teacher educators. In addition to this Kotebe University College department head and Dean of Natural and Computational sciences as well as 144 primary school mathematics teachers of Addis Ababa public primary schools, 18 directors, 162 students and 36 parents participated in the study.

3.2.2. Data Source

The major sources of data were: (a) KUC prospective primary school mathematics teachers; (b) KUC mathematics teacher educators; (c) KUC department head and faculty dean of natural and computational sciences; (d) Primary school mathematics teachers, directors, students, parents and mathematics syllabus/ flow chart; (e) Teacher education officers and experts; and (f) Primary school prospective mathematics teachers' college result, Ethiopian General Secondary Certificate Examination (EGSCE), entrance exam, and high school results as well as documents, course outlines and course catalog.

In this regard primary sources are: Prospective mathematics teachers, Primary school mathematics teachers, Teacher educators, Directors, Parents, Education officers, Experts, and Primary school students.

Secondary sources are: Course outlines, syllabus/flow chart, articles, archives and policy documents related to the issue.

3.2.3. Data Collecting Instruments

Data collecting instruments used in this study are:

3.2.3.1. The Attitude toward Mathematics Inventory in Amharic (ATMI -Amharic)

This study used Attitude towards mathematics inventory items to identify the attitude of prospective mathematics teachers. Kalder and Lesik, (2011) state that The Attitudes toward Mathematics Inventory (ATMI), created by Tapia and Marsh (2004) was based on the Fennema-Sherman (1976) instrument with some ideas eliminated in order to focus on only six factors: Confidence, Anxiety, Value, Enjoyment, Motivation and Teacher expectation. These researchers applied the adaptation of Tapia and Marsh questionnaire and modified for use in their study to make appropriate for college students who are elementary and secondary pre-service teachers. This study also adapted the instruments used by Kalder and Lesik (2011) to measure the attitudes and beliefs of pre-service teachers. A total of 72 items were adapted by them however item number 39 and 53 are the same; that is "Mathematics makes me feel uneasy and confused" then I discarded item number53 and used 71 items for this study (attached in appendix A).

In addition to this the authors used some common observed variables to different sub-scales, however I used one observed variable for one subscale by confirming from other research works like Tsao (2014); Mensah et al (2014); and Relich et al (1994). Forinstance the authors used item number 3 to measure Confidence and Teacher expectation, howevcer I used this item to measure Teacher expectation; they used Item number 19 to measure Confidence and Anxiety, but I used this item to measure Anxiety; they used item number 22 to measure Confidence and Anxiety, but I used this item to measure Confidence etc. (see the detail information in Appendix A).

In this study the original adapted English items of Kalder and Lesik (2011) translated into Amharic. A lecturer from English department of KUC translated the items from English to Amharic and two assistant professors; one from Amharic and the other from English departments reviewed the translated items in terms of the accuracy of translation including back translation into English and its essence of measurement in Ethiopian context. Factors (sub-scales) used to test pre-service teachers attitude towards mathematics are: (a) Confidence, (b) Anxiety, (c) Value, (d) Enjoyment, (e) Motivation and (f) Teacher expectation. The observed variables or items used to measure each sub-scale are attached in Appendix A. In the confidence category items used to assess trainees' mathematical tasks and belief in their ability to successfully complete their tasks are: 2, 7, 9, 11, 22, 26, 27, 30, 32, 35, 45 and 47 some statements on the survey that were designed to measure attitude in this category are " I struggled with many concepts in mathematics", " I usually don't worry about my ability to solve mathematics problems", " I have selected mathematics as my area of emphasis".

In the Anxiety category items used to assess trainees' level of anxiety and the effect of this anxiety on their performance in mathematics are: 1, 12, 13, 14, 15, 19, 37, 39, 41, 43, 49, and 58. Some examples of the statements that were used to measure anxiety are: “I have usually been at ease during mathematics tests", “Mathematics makes me feel uncomfortable and nervous", and “I get a sinking feeling when I think of trying hard mathematics problems"

In the Value of mathematics category items used to assess trainees' beliefs on the importance and relevance of mathematics in their present and future daily lives are: 23, 38, 62, 63, 64, 65, 66, 67, 68, 69, 70, and 72. Examples of the statements that were used to measure value are: "Mathematics has contributed greatly to Science and other fields of knowledge", “Mathematics helps develop a person's mind and teachers to think", " and Mathematics is needed in order to keep the world running".

In the enjoyment of mathematics category items used to measure the level of enjoyment that trainees experience when working on mathematics tasks are: 25, 31, 44, 51, 52, 54, 56, 59, 60, and 71. Some examples of the statements that were used to measure enjoyment are: “I have dropped mathematics courses because they became too difficult", " I look forward to teaching mathematics",” and Mathematics is enjoyable and stimulating to me".

In the motivation category items used to assess trainees’ interest in pursuing additional experiences in mathematics are: 5, 24, 28, 29, 36, 46, 48, 55, 57, and 61. Some examples of the statements that were used to measure motivation are: "I don't want to teach mathematics in the future", “It wouldn’t bother me at all to take more mathematics courses", "I have never liked mathematics and it is my most dreaded subject".

Finally in the teacher expectation category items used to measure trainees' perception of their teachers’ beliefs and expectations are: 3, 4, 6, 8, 10, 16, 17, 18, 20, 21, 33, 34, 40, 42, and 50. Some examples of the statements that were used to measure this category are: "I had many competent mathematics teachers", “My teachers focus mainly on memorization, facts and procedures",” My teachers had confidence in me as a student of mathematics".

The pilot test is conducted in two randomly selected Teacher Education Colleges that is Dessie and Debre Berhan Teacher education Colleges. The detail analysis of the attitude measure of pilot test is attached in appendix B.

In this study all the items are rated according to the degree of agreement with the statement on a 5 point Likert -type scales (values ranging from 1-5), that is 1 represents strongly disagree, 2 represents disagree, 3 represents undecided, 4 represents agree and 5 represents strongly agree. A score of 5 indicates a more positive relation to learning and teaching mathematics for positive statement items. However for negatively stated items a score of 5 indicates a gap of attitude towards mathematics and learning and teaching mathematics. Scores of each domain scale and the cumulative score of all domains indicate trainees’ attitudes toward learning and teaching mathematics.

3.2.3.2. Interview

(a) Mathematics Teacher Educators' Interview: A semi-structured interview questionnaire was administered for all (12) mathematics teacher educators of KUC. Background information items and both close-ended and open-ended items were used. The close ended items are very short and simple to understand. The items are categorized under professional development, under student teachers' status and practicum activity, under management and administration, under courses and practices, and under Technological Pedagogical Content Knowledge (TPACK). These items do not exceed 5 pages. The items are attached in appendix C and the responses of teacher educators' are recorded using audio device and presented and analyzed in pages 125- 140 of chapter IV.

(b) Interview provided for Teacher Education officers, Experts, University College department head and Dean: The interview guide lines (unstructured items) comprise background information of the respondents' and 7 open-ended items. The participants of this interview were: MOE higher education officer (n=1), MOE and Addis Ababa Education bureau senior experts (n=3). The interview items are attached in appendix- I and the result is presented in pages 226-230. Similarly KUC department head and faculty dean (n=2) were also interviewed, the items are attached in appendix P and the result is presented in pages 140-142 of chapter four.

(c) Primary school Directors' Interview: From 18 sample schools 18 directors participated in the interview that is one director from each school; of which 11 were males and 7 females. The semi-structured interview items consist of background information, use of technology, use of higher order instructional methods, use of assessment techniques and use of lesson plan and teachers' status. A total of 24 items that is 6 close-ended and 18 open-ended items were used. These items are attached in appendix -G and the responses are organized, analyzed and presented in chapter IV of pages 203-207.

(d) Primary school mathematics teachers' interview: The semi-structured interview items consist of background information, continuous professional development (CPD), use of technology, use of higher order instructional methods, use of lesson plan, and use of College courses and practices and TPACK activities. Close-ended and open- ended items were used. In addition to this background information items are included. Number of respondent teachers are 49; of which 29 females and 20 males. These teachers are selected purposively from both cycles (that is 2 or 3 teachers can be selected from grades 1-4), if the number of teachers is greater than second cycle and vice versa, for instance some schools have only two mathematics teachers for second cycle in this case only one teacher was selected for interview. But if the number of teachers in both cycles is large and almost equal; four teachers selected purposively for interview, for instance in the 6 schools 4 teachers were selected for interview depending on the numbers of teachers in each cycle (see table 64) and their response is organized, analyzed and presented in chapter IV of page 183-189. The items are attached in appendix-F

(e) Primary school students' Interview: First the items were prepared in English and translated into Amharic; the translation was reviewed and back translation was held by two lecturers (from Amharic and English departments) of KUC. In this part semi-structured interview items are used. The students were selected purposively from all grades (1-8). A total of 54 students from 18 sample schools were participated in the interview that is 3 students selected purposively from each school. Thus from grades 2-8 one student was selected from each grade where as from grade 1 one student selected purposively because the number of students in grade 1 are greater than other grades. The items are attached in appendix- E and their response is organized, analyzed and presented in chapter IV of pages 208-211.

(f) Primary school parents Interview: The items were prepared in English and translated into Amharic. The translation was reviewed and back translation was held by two lecturers of KUC (From Amharic and English departments). The semi-structured interview items are clear and precise. Two parents are purposively selected from four parents of PTA members. From 18 sample schools 36 parents participated in the interview that is two parents from each school; of which 14 were females and 22 were males. The items are attached in the appendix H and their response is organized, analyzed and presented in chapter IV of pages 211-213.

3.2.3.3. Questionnaire

These items were prepared for the Third International Mathematics and Science Study by Boston College in 1998 entitled Researching the factors Associated with Achievement: TIMSS1999 Questionnaires; from the website timss.bc.edu/timss1999i/questionnaires.html. I used this tool because it is written in the first page of the material that the purpose of the Third International Mathematics and Science Study (TIMSS) is that: " TIMSS is a major source of information for discussion of the quality of education around the world and the tools are prepared at the standard level in which other researchers can use it for related purposes.” These items were prepared in English. I adapted the items and modified a little bit and translated into Amharic. Two Lecturers from KUC (From Amharic and English departments) participated in reviewing and back translation into English. After pilot test some items are improved and administrated to be filled by all 152 public primary school mathematics teachers of Addis Ababa in 18 sample schools; of which 62 are males and 90 are females.

All the items are filled by the respondents. However from 152 participants 8 teachers did not return the questionnaire. Both English and Amharic version items are attached in appendix-D and the responses are presented and analysed from pages 167-183.

3.2.3.4. Observation

Observation checklists were prepared to observe the practices of Teacher educators and primary school mathematics teachers. The check lists are prepared based on Danielson's (1996) components of professional practices and the evaluation ratings that comprise 4 scales are:

1 represents "Un satisfactory", 2 represents "Basic", 3 represents "Proficient" and 4 represents "Distinguished". Each evaluation rating has its own Scenario. The observation check lists are attached in appendix -J. In 18 sample schools there are 152 mathematics teachers from grades 1-8 and from these 35% of them that is 54 randomly selected mathematics teachers of which 31females and 23 males were observed. In order to assert the representativeness of teachers from both cycles; from first cycle 2 teachers and from second cycle 1 teacher were randomly selected from grades (1-8). In general 36 first cycle mathematics primary school teachers and 18 second cycle mathematics primary school teachers were observed.

The observation was held by the researcher and two lecturers from KUC at MSC and MA level (one from mathematics department and the other from education whose background is mathematics) one teacher was observed twice by two persons at a time in different classes and at the end of observation we discussed in each performance ratings and we agreed in both better and worse performances and then filled in another new check list. The ratings that we agreed are recorded twice in two observations and the average result of two times observation ratings is entered in the SPSS for analysis. Moreover 4 randomly selected teacher educators were also observed in KUC of which 3 males 1 female. The observation was held by the researcher and the department head and after each observation we agreed in each rating and recorded twice and after two observations the average result is recorded and analyzed in SPSS. The observation checklists are attached in appendix-J and the result is organized and presented in chapter IV of pages 142-154 of teacher educators’ observation result and from pages 190-202 of primary school mathematics teachers’ result.

3.2.3.5. Documentary Analysis

In this study documentary/text analysis guide line is used to assess primary school curriculum flow chart of mathematics from grades 1-8 prepared in 2012/13 by MOE and purposively selected grade1 syllabus preapared in 2013. Prospective mathematics teachers course outlines revised in 2012/13. Syllabus was reviewed based on: (a) learn ability of the content; (b) sequence and continuity of the content; (c) integration and scope of the content; and (d) balance of the total learning (Tyler, 1949; Taba, 1962; Pratt, 1980; Derebssa, 1999). The course outlines are reviewed based on their relationship to the syllabus and the principles and standards designed by The National Council of Teachers of Mathematics (NCTM, 2015) and The National professional standards for Teachers (MoE, 2013) which is a standard of teachers’ competency in subject matter, pedagogy, psychology, etc. The course outlines and syllabus are attached in appendix-M and appendix-N respectively. The third document was KUC second year prospective mathematics teachers’ result that is trainees college result, EGSECE results, entrance exam result, and their high school result were analyzed by employing regression analysis. The result is presented in chapter IV of pages 116-123.

3.2.4. Procedure

(a) Procedure of the Attitude toward Mathematics Inventory (ATMI): ATMI Items adapted and translated into Amharic were administrated to 330 prospective mathematics teachers of Dessie and Debre Berhan in the pilot study by the researcher and two assistant data collectors in each teacher education college. All second and third year prospective mathematics teachers of both colleges were the participants of the study. After the pilot test some improvements was made and

ATMI in Amharic was administered to 143 prospective mathematics teachers of KUC. In all cases, first the study participants were given directions on how to record their answers before they started to respond. The sub-scales used to assess the attitude of prospective mathematics teachers were: (1) Self confidence, (2) Anxiety, (3) Value, (4) Enjoyment, (5) Motivation, and (6) Teacher expectation (the perception of trainees to their mathematics teachers).

The pilot test result was first analyzed using IBM SPSS statistics version 20 and IBM SPSS Amos version 23. Using base line data the psychometric properties of the adapted ATMI - Amharic measure was established based on Cronbach alpha (Internal consistency of the sub scales and Confirmatory Factor Analysis (CFA) techniques to confirm a particular subset of observed variables.

According to Schumacker and Lomax (2010) the primary rational for Confirmatory Factor Analysis (CFA) is to test the statistical significance of a hypothesized factor model, whether the sample data confirm that model or not and they asserted that the CFA Model-fit criteria commonly used are Chi-square (X^2), the goodness of fit index (GFI), the adjusted good of fit index (AGFI), Root Mean Square Residual Index(RMR), Standardized Root Mean Square Residual (SRMR), Root-Mean square error of approximation (RMSEA), Tucker- Lewis Index(TLI), Normed fit Index (NFI), Parsimony fit index (PNFI) and Akaike information criteria (AIC). The result of the pilot test based on the above fit indices and internal consistency using Cronbachs alpha coefficients is presented in appendix B as a base line data. Similarly the attitude measure of 143 KUC prospective mathematics teachers is also presented in chapter IV of pages 105-135.

(b) Procedure of sample schools: As the area of the study indicates, Kotebe University College and Primary school mathematics teachers of Addis Ababa are involved in the study. To begin with first I collected the total number of primary schools of Addis Ababa in each sub-city from Addis Ababa Education bureau documents and statistics office in a soft copy and then after I identified public schools from private, missions and different religious schools on 19^{th} of October 2014/2015; I got the number of public schools in each sub-city from grades 1-8 as follows: Addis Ketema = 22, Akaki-kality =17, Arada =19, Bole = 16, Gulelie = 19, Kirkos = 22, Kolfe = 26, Lideta = 16, Nefassilklafto = 19 and Yeka = 27. Hence the total number of public schools in all sub- cities is 203. From the 10 sub-cities, I selected 3 sub-cities (30%) randomly using lottery method and the selected sub-cities were Yeka, Bole and Akaki-kality. Hence the number of public schools in the three sub-cities is 60. Then I selected 30% of the schools from each sub-city and the schools were selected using lottery method and the selected schools in each sub-city were: yeka = 8, Bole = 4 and Akaki- kality = 6. In general 18 public primary schools were samples of the study. Thus I used a multi-stage cluster sampling technique. Hence generalization is done on a population of clusters (i. e. Practices of Induction and CPD programs in all public primary schools of the three sub cities related to mathematics education). The finding can be used as an indicator for all public primary schools of Addis Ababa.

(c) Procedures of Interview and Questionnaire: Interview was administered to all mathematics teacher educators of KUC (N=12), MOE teacher education directorate director (N=1), senior experts of MOE and Addis Ababa education bureau (N=3), primary school directors (N=18), purposively selected primary school mathematics teachers (N=49), purposively selected primary school students from grades 1-8 (N=162), purposively selected parents from Parent Teacher Association /PTA (N=36), and KUC department head of mathematics and faculty dean of natural and computational sciences (N=2). In general 283 persons were participants of the interview. Two assistant data collectors and I administered the interview. The assistant data collectors were oriented before they started to collect data. During interview session the response of each interviewee was recorded using an audio-device. In addition to these questionnaires were administered to all 152 mathematics primary school teachers in 18 sample schools of which 90 were females and 62 were males. From these 144 teachers returned the questionnaire where as 8 did not return the questionnaire.

(d) Procedure of Observation: In general 54 primary school mathematics teachers and 4 mathematics teacher educators were observed. In 18 sample schools observed grades and section were randomly selected and one teacher was observed twice by two data collectors and the average result was recorded. From the observed teachers 31 were females and 23 were males. From first cycle 36 teachers and from second cycle 18 teachers were observed in different grades. The observation was held by the researcher and two assistant data collectors whose background is mathematics at masters' level. Similarly 4 randomly selected mathematics teacher educators were observed; from these 3 were male and 1 was female. The department head and the researcher observed each teacher educator twice and the average result was recorded.

(e) Procedure of Document Analysis: In the study the following documents were analyzed: Mathematics syllabus from grades 1-8, all mathematics course outlines designed for primary school prospective mathematics teachers and second year mathematics prospective teachers' result; that is College, EGSECE, Entrance exam and High school results were assessed.

3.2.5. Techniques of Data Analysis

The adapted ATMI –Amharic attitude measure items were analyzed using: (1) Cronbach alpha (α) to know the internal consistency estimates, (2) Confirmatory Factor Analysis (CFA) to confirm the construct validity of the observed variables for each sub-scale and to know the fit indices. According to Schumacker and Lomax (2010, p.85) CFA provides the following model fit indices: "(a) Chi-Square (x^2); (b) The goodness of fit index (GFI); (c) The adjusted good of fit index (AGFI); (d) Root Mean Square Residual (RMR); (e) Root Mean Square error of approximation (RMSEA); (f) Tucker- Lewis index (TLI); (g) Normed fit index (NFI); (h) Parsimonious fit index (PNFI); and (i) Akaike Information Criteria (AIC)."

Thus the above model fit indices used to analyse construct validity. In addition to these Percentages, Frequency tabulations, Mean, Variance, Standard deviations, Correlation, Regression, ANOVA, t-test, and text analysis used to analyze the data. For instance Regression analysis is used to identify the contributions of recruitment and selection criteria to the trainees' college achievement. Text analysis is used to analyze the course outlines of prospective teachers and the syllabus of primary school mathematics education. To assess the course outlines The National Professional Standards for teachers prepared by MoE (2013), and The National Council of Teachers of Mathematics (NCTM, 2015) standard are employed. To assess the syllabus of primary school mathematics education content selection and assessment criteria written by Derebssa (1999, pp.178-184) are used. Some of the criteria are: "(a) Learn ability of the content; (b) Sequence and continuity of the content (c) Appropriate balance of scope and depth, (d) Integration and scope of the content; (e) Logical relationship to main ideas and basic concepts, (f) Balance of the total learning." Thus both quantitative and qualitative methods of data analysis are employed in the study. Two soft wares (IBM SPSS statistics version 20 and IBM SPSS Amos version 23) are used.

3.2.6. Validity, Reliability, and Ethical Considerations

The validity and reliability of items was tested during the pilot test and these items are confirmed to use them as valid and reliable items. For instance the validity of attitude test items are confirmed through Confirmatory Factor Analysis (CFA) and the reliability of each item is tested based on Cronbach alpha coefficient reliability is found to be above 0.7 (see Appendix B).

The reliability and validity of Interview and questionnaire items are confirmed through the review of professional persons and pilot test. To confirm the validity and reliability of observation check lists two persons observed one teacher twice in a particular class and after each observation the two raters discussed and agreed on their low and high rating results and finally the average result of two observations was recorded.

Related to Ethical considerations all cited resources are acknowledged and participants of the study were treated well and the confidentiality of them was adequately protected. In the pilot study the reliability of the attitude test items was $\alpha = .726$. After the pilot test Some items were improved and KUC prospective mathematics teachers filled the Attitude test items and the reliability coefficient of Kotebe University College prospective mathematics teachers' attitude test items is 0 .842(α =0.842), and the mean of the total items is 3.061. In addition to this the reliability coefficient of the attitude test items of KUC prospective mathematics teachers' swing between 0.712 and 0.763 for each factor. In a similar study of English version the alpha coefficients of Relich's et al (1994) swing between 0.29 and 0 .89. The study was conducted on 345 students enrolled in a pre-service undergraduate teacher education program at a university in

Sydney. The factors used were: (a) Mathematics self concept (α =0 .89), (b) Mathematics learning and teaching Anxiety (α =0.79), (c) Usefulness of mathematics (α =0 .78), (d) Motivation/Enjoyment of mathematics (α =0 .57), (e) Other's perceptions of being a mathematics teacher (α =0 .29). The result shows the similar attitude test items prepared in English and in Amharic have no large differences in their consistency of measuring attitude. Hence it indicates that it is also possible to test the attitude of trainees in their mother tongue.

Chapter IV: Data Presentation, Analysis, Results and Discussion

This Chapter Comprises data obtained through the investigation of the strategies and practices of Pre-service teacher education program, Induction, and Continuous Professional Development program (CPD) in terms of the curriculum and TPACK knowledge areas related to mathematics education. Hence the exploration of pre-service teacher education program held through: (a) the prospective mathematics teachers attitude towards mathematics; (b) teacher educators' practices and their assessment on the status of trainees, and management of KUC; (c) the views of KUC mathematics department head and Natural and computational sciences dean; (d) The contribution of the recruitment and selection criteria (Entrance exam result, High school transcript average, and EGSECE GPA) to prospective mathematics teachers University College achievement and the contribution of University College achievement to COC result; and (e) the standard of prospective mathematics teachers Curriculum. Moreover the inquiry of Induction and CPD programs held through: (a) primary school mathematics teachers' questionnaire, interview, and observation results; (b) primary school directors, parents, and students interviews results; and (c) the assessment of primary school mathematics syllabus result. And finally in the overall teacher education program data were obtained through interviewing MoE higher education officer and senior experts and Addis Ababa education Bureau mathematics senior expert. In addition to the above issues the relationship/match of primary teacher education curriculum to primary school curriculum and major factors that affect the practices of teacher educators and primary schools teachers are also discussed. Thus the data are presented, analyzed and discussed as follows:

4.1. The strategies and practices of Pre-service, Induction, and CPD programs in terms of the curriculum and TPACK knowledge areas related to mathematics education

This section discusses the strategies and practices of Initial teacher education program, Induction, and CPD programs in terms of the curriculum and TPACK knowledge areas.

4.1.1. The strategies and practices of Pre-service/Initial Teacher Education Program

This section deals with the data presentation, analysis and discussion of: (a) prospective mathematics teachers attitude test; (b) the contribution of recruitment and selection criteria (high school result, EGSCE GPA and entrance exam result) to prospective mathematics teachers University College achievement and the relationship of the trainees' University College achievement to their COC result; (c) KUC teacher educators' interview and observation result; department head, and dean of natural and computational sciences interviews result; and documentary / text analysis result of prospective mathematics teachers curriculum.

4.1.1.1. Prospective Mathematics Teachers Attitude towards Mathematics

To test the attitude of prospective mathematics teachers' a total of 71 items (attached in appendix A) were adapted and used to assess the trainees' confidence, anxiety, value, enjoyment, motivation, and teacher expectation. To assert the reliability and validity of items translated into Amharic pilot test was conducted in Dessie and Debre Berhan teacher education colleges and a total of 330 second and third year prospective mathematics teachers were filled the attitude test items; from the participants 164 trainees were from Dessie Teacher Education College and 166 were from Debre Berhan Teacher Education College. The participants' characteristics and attitude test result, and analysis of the pilot test is attached in Appendix B.

After the pilot study some improvements was made on the Amharic version items and then the items administered to the main study of KUC prospective mathematics teachers and the result is organized and analyzed as follows.

4.1.1.1.1. KUC Prospective Mathematics Teachers Attitude test result Analysis and Discussion

This section deals with the data analysis and discussion of prospective mathematics teachers' attitude test result using the following tables.

Table 6: Characteristics of Prospective Mathematics Teachers of KUC with respect to Sex, Year level, and Ages

Second year			Third Year			Total			Age in Years					
									18-20			21-24		
M	F	Total	M	F	T	M	F	T	M	F	T	M	F	T
56	39	95	30	18	48	86	57	143	24	43	67	62	14	76

As indicated in table 6 the minimum age is 18 and maximum age is 24 and number of male prospective teachers is greater than number of female prospective teachers. This indicates most of female trainees do not select mathematics as their field of study. Hence this implies that male students select to study mathematics better than females.

Table 7: The mean, standard deviation and Internal consistencies (α) of each attitude Factor in 143 cases of KUC

Mathematics Attitude factors	Number of Items	Mean	Items mean	SD	Cronbach Alpha (α)
Confidence	12	39.57	3.29	8.62	0.748
Anxiety	12	27.71	2.31	8.07	0.715
Value	12	37.17	3.10	7.23	0.763
Enjoyment	10	33.17	3.31	7.13	0.712
Motivation	10	28.75	2.86	7.28	0.719
Teacher expectation	15	50.94	3.39	9.26	0.741
Over all scale	71	217.32	3.06	27.11	0.842

As indicated in table 7 the aggregate average of KUC prospective mathematics teachers' attitude towards mathematics is 3.06 which is almost nearer to 3.00 and this involves in the rating scale “undecided/neutral”. This indicates the attitude of prospective mathematics teachers towards mathematics needs to analyse negative items separately using the following tables.

The next table displays negatively stated confidence items (2, 11, 32, 35, and 47) and positively stated items (7, 9, 22, 26, 27, 30, and 45). In both cases the rating scales are: 1= Strongly disagree, 2= Disagree, 3= Undecided, 4= Agree, 5= Strongly agree” . Thus the items listed as follows: Item 2 (I struggled with many concepts in Mathematics); Item 7 (I have often helped others with their math home work); Item 9 (I elected to take part in mathematical competitions); Item 11 (I usually comprehended math content well and seldom got lost); Item 22 (I have usually been at ease during math courses); Item 26 (I usually don\t worry about my ability to solve math problems); Item 27 (New math content has usually been easy for me to understand); Item 30 (When confronted with a difficult math concept. I generally worked until I understand the concept); Item 32 (I cannot recall many mathematical concepts that were hard for me to understand); Item 35 (My teachers did not believe I was capable of learning mathematics); Item 45 (I have selected math as my area of emphasis); and Item 47 (I generally have had difficulty relating new mathematical concepts to those I had previously learned) to identify the attitude test result (Confidence) of prospective mathematics teachers.

Table 8: The result of Attitude test (Confidence) of prospective mathematics teachers of KUC in terms of Sex and Academic year

Sex	Stat.	Confidence test Items											
		2	7	9	11	22	26	27	30	32	35	45	47
Male	Mean	3.65	3.86	2.91	3.95	3.77	2.76	3.38	3.59	3.41	3.55	2.90	3.06
	N	86	86	86	86	86	86	86	86	86	86	86	86
	Std.	1.47	1.12	1.68	1.04	1.54	1.42	1.32	1.32	1.42	1.53	1.47	1.33
	Total mean	3.40											
Female	Mean	3.75	3.86	2.46	3.61	3.67	2.30	2.77	3.42	3.21	3.42	2.56	2.72
	N	57	57	57	57	57	57	57	57	57	57	57	57
	Std.	1.56	.789	1.48	1.28	1.46	1.32	1.27	1.36	1.32	1.63	1.45	1.42
	Total mean	3.15											
Total mean	Mean	3.69	3.86	2.73	3.82	3.73	2.57	3.14	3.53	3.33	3.50	2.76	2.92
	N	143	143	143	143	143	143	143	143	143	143	143	143
	Std.	1.50	.997	1.62	1.15	1.50	1.40	1.33	1.34	1.37	1.56	1.47	1.37
	Mean	3.29											
Acad. Year	Stat.												
Second Year	Mean	3.78	3.88	2.87	3.83	3.87	2.46	3.06	3.49	3.26	3.58	2.81	2.94
	N	95	95	95	95	95	95	95	95	95	95	95	95
	Std.	1.47	.97	1.67	1.18	1.44	1.35	1.35	1.32	1.41	1.55	1.39	1.38
	Total mean	3.32											
Third Year	Mean	3.52	3.81	2.44	3.79	3.44	2.79	3.29	3.58	3.46	3.33	2.67	2.89
	N	48	48	48	48	48	48	48	48	48	48	48	48
	Std.	1.56	1.07	1.48	1.09	1.59	1.47	1.29	1.38	1.30	1.59	1.62	1.37
	Total mean	3.25											
Total mean	Mean	3.69	3.86	2.73	3.82	3.73	2.57	3.14	3.53	3.33	3.50	2.76	2.92
	N	143	143	143	143	143	143	143	143	143	143	143	143
	Std.	1.50	.997	1.62	1.15	1.50	1.40	1.33	1.34	1.37	1.56	1.47	1.37
	Mean	3.297											

As indicated in table 8 the aggregate mean of the items (2, 11, 32, 35, and 47) of confidence is 3.45, and the frequency and percent of these items for agree and strongly agree is 84 (58.7%). This implies that most of (58.7%) Kotebe University prospective mathematics teachers are not confident in their ability to learn mathematics (See tables 8 and appendix O of table 6).

The following items: Item 1 (I have usually been at ease during math tests); Item 12 (I did not feel comfortable seeking help from my math teachers outside of class); Item 13 (I did not like being introduced to new mathematical content); Item 14 (Mathematics makes me feel un comfortable and nervous); Item15 (I get really up tight during math topics); Item 19 (I almost never get uptight while taking math tests); Item 37 (I get a sinking feeling when I think of trying hard math problems); Item 39 (Math makes me feel un easy & confused); Item 41 (I was frequently lost and had trouble keeping up in my math classes); Item 43 (My mind goes blank and I am unable to think clearly when doing mathematics); Item 49 (My math teachers often became frustrated with me); and Item 58 (Math makes me uncomfortable and nervous) used to identify the attitude test result (Anxiety) of prospective mathematics teachers as follows:

Hence the negatively stated Anxiety items are: 12, 13, 14, 15, 37, 39, 41, 43, 49, and 58; positively stated items of Anxiety are: 1 and 19

Table 9: The result of Attitude test (Anxiety) of prospective mathematics teachers of KUC With respect to Sex and Academic year

Sex	Stat.	Anxiety test Items											
		1	12	13	14	15	19	37	39	41	43	49	58
Male	Mean	2.73	2.42	1.85	1.69	2.11	3.93	2.27	2.43	2.41	2.02	2.08	2.07
	N	86	86	86	86	86	86	86	86	86	86	86	86
	Std.	1.33	1.55	1.24	1.22	1.37	1.43	1.38	1.39	1.63	1.24	1.22	1.34
	Total mean	2.33											
Female	Mean	2.44	2.26	1.93	1.58	2.11	3.65	2.18	2.00	2.79	2.17	2.07	2.11
	N	57	57	57	57	57	57	57	57	57	57	57	57
	Std.	1.29	1.47	1.21	1.10	1.36	1.49	1.35	1.27	1.74	1.53	1.21	1.28
	Total mean	2.27											
Total mean	Mean	2.62	2.36	1.88	1.64	2.10	3.82	2.23	2.26	2.56	2.08	2.07	2.08
	N	143	143	143	143	143	143	143	143	143	143	143	143
	Std.	1.32	1.52	1.22	1.17	1.36	1.46	1.37	1.36	1.68	1.36	1.21	1.31
	Mean	2.30											
Academic Year	Stat.												
Second Year	Mean	2.59	2.24	1.75	1.64	2.12	3.85	2.22	2.20	2.55	2.03	2.03	2.10
	N	95	95	95	95	95	95	95	95	95	95	95	95
	Std.	1.37	1.51	1.15	1.18	1.40	1.41	1.35	1.32	1.67	1.32	1.18	1.30
	Total mean	2.28											
Third Year	Mean	2.67	2.58	2.14	1.65	2.08	3.75	2.25	2.38	2.58	2.19	2.17	2.06
	N	48	48	48	48	48	48	48	48	48	48	48	48
	Std.	1.23	1.53	1.34	1.18	1.30	1.55	1.41	1.44	1.70	1.41	1.28	1.36
	Total mean	2.37											
Total mean	Mean	2.62	2.36	1.88	1.64	2.10	3.82	2.23	2.26	2.56	2.07	2.08	2.08
	N	143	143	143	143	143	143	143	143	143	143	143	143
	Std.	1.32	1.52	1.23	1.17	1.36	1.46	1.37	1.36	1.68	1.36	1.21	1.31
	Mean	2.32											

As displayed in the above table 9 the aggregate mean of negative items (12, 13, 14, 15, 37, 39, 41, 43, 49, and 58) of anxiety is 2.13 and the frequency and percent of these items for agree and strongly agree is 34 (24%) (see tables 9 and appendix O of table 7). This implies that 24% of KUC prospective mathematics teachers are learning mathematics through stress/tension.

The following table uses item 25 (I have dropped math courses because they became too difficult); item 31 (I look forward to teaching Mathematics); item 44 (I can recall math teachers who made me feel stupid in class); item 51 (I enjoy going beyond the assigned work and trying to solve new problems in mathematics); item 52 (Math is enjoyable and stimulating to me); item 54 (I am highly interested to teach math in the school and use it outside the school); item 56 (I have always enjoyed studying math in school); item 59 (Math is dull and boring because it leaves no room for personal opinion); item 60; (Math is very interesting and I have usually enjoyed it); and item 71 (There is nothing creative about math it is just memorizing formulas & things) to display the atitude test result (Enjoyment) of prospective mathematics teachers as follows: Hence the negative enjoyment items are: 25, 44, 59, and 71; positive items of enjoyment are: 31, 51,52,54,56, and 60.

Table 10: The result of Attitude test (Enjoyment) of prospective mathematics teachers of KUC with respect to Sex and Academic year

Sex	Stat.	Enjoyment test Items									
		25	31	44	51	52	54	56	59	60	71
Male	Mean	2.69	3.73	3.15	3.87	4.09	4.31	4.15	1.97	3.22	2.21
	N	86	86	86	86	86	86	86	86	86	86
	Std.	1.61	1.31	1.39	1.31	1.33	0.96	1.14	1.43	1.34	1.32
	Total m	3.34									
Female	Mean	2.70	3.33	2.77	3.74	4.21	4.14	4.18	2.32	3.35	2.09
	N	57	57	57	57	57	57	57	57	57	57
	Std.	1.70	1.58	1.46	1.59	1.16	0.89	1.07	1.49	1.32	1.39
	Total m	3.28									
Total mean	Mean	2.69	3.57	3.00	3.82	4.14	4.25	4.16	2.10	3.27	2.16
	N	143	143	143	143	143	143	143	143	143	143
	Std.	1.64	1.43	1.43	1.42	1.26	0.94	1.11	1.46	1.33	1.35
	Mean	3.31									
Academic Year	Stat.										
Second Year	Mean	2.64	3.68	3.04	3.93	4.21	4.28	4.22	2.07	3.27	2.11
	N	95	95	95	95	95	95	95	95	95	95
	Std.	1.59	1.39	1.44	1.39	1.19	0.89	1.07	1.46	1.32	1.33
	Total mean	3.35									
Third Year	Mean	2.79	3.35	2.92	3.60	4.00	4.17	4.04	2.17	3.27	2.27
	N	48	48	48	48	48	48	48	48	48	48
	Std.	1.75	1.49	1.43	1.48	1.38	1.02	1.18	1.48	1.36	1.38
	Total mean	3.26									
Total mean	Mean	2.69	3.57	3.00	3.82	4.14	4.25	4.16	2.10	3.27	2.16
	N	143	143	143	143	143	143	143	143	143	143
	Std.	1.64	1.43	1.43	1.42	1.26	0.94	1.11	1.46	1.33	1.35
	Mean	3.31									

As displayed in table 10 the aggregate mean of negative items (25, 44, 59, and 71) of enjoyment is 2.49 and the frequency and percent of these items for agree and strongly agree is 48 (33.6%) (see tables 10 and appendix O of table 8). This implies 33.6% of prospective mathematics teachers of KUC do not like mathematics.

The following table uses item 5 (I do not want to teach mathematics in the future); item 24 (I have taken math classes even though they were not required); item 28 (I did not take a math class of my senior year in high school); item 29 (It wouldn't bother me at all to take more math courses); item 36 (When I had trouble with a concept I usually gave up and stopped trying); item 46 (I have generally considered math as a related sequence progression of ideas); item 48 (I am avoiding taking Mathematics classes in college); item 55 (I have never liked math and it is my most dreaded subject); item 57 (I would like to develop my math skill and study this subject more); and item 61 (I am interested and willing to acquire further knowledge of math) to display the attitude test result (Motivation) of prospective mathematics teachers.

Hence negatively stated motivation items are: 5, 28, 36, 46, 48, and 55 and positively stated items of motivation are: 24, 29, 57, and 61.

Table 11: The result of Attitude test (Motivation) of prospective mathematics teachers of KUC with respect to Sex and Academic year

Sex	Stat.	Motivation test Items									
		5	24	28	29	36	46	48	55	57	61
Male	Mean	2.46	2.16	2.36	2.33	3.52	3.36	2.15	1.99	4.59	4.09
	N	86	86	86	86	86	86	86	86	86	86
	Std.	1.50	1.33	1.56	1.54	1.39	1.42	1.37	1.25	0.76	1.39
	Total mean	2.90									
Female	Mean	2.39	1.91	1.79	2.49	3.53	3.51	2.07	2.28	4.46	3.93
	N	57	57	57	57	57	57	57	57	57	57
	Std.	1.63	1.31	1.36	1.53	1.39	1.35	1.33	1.36	0.73	1.45
	Total mean	2.83									
Total mean	Mean	2.43	2.06	2.13	2.39	3.52	3.42	2.12	2.11	4.54	4.03
	N	143	143	143	143	143	143	143	143	143	143
	Std.	1.55	1.32	1.51	1.53	1.38	1.39	1.35	1.30	0.75	1.41
	Mean	2.86									
Academic Year	Stat.										
Second Year	Mean	2.53	2.05	2.15	2.42	3.68	3.56	2.21	2.13	4.49	4.03
	N	95	95	95	95	95	95	95	95	95	95
	Std.	1.54	1.34	1.56	1.53	1.36	1.41	1.38	1.31	0.84	1.41
	Total mean	2.93									
Third Year	Mean	2.25	2.08	1.10	2.33	3.21	3.15	1.94	2.06	4.63	4.02
	N	48	48	48	48	48	48	48	48	48	48
	Std.	1.58	1.30	1.40	1.55	1.38	1.32	1.28	1.29	0.53	1.44
	Total m	2.78									
Total mean	Mean	2.43	2.06	2.13	2.39	3.52	3.42	2.12	2.11	4.54	4.03
	N	143	143	143	143	143	143	143	143	143	143
	Std.	1.55	1.32	1.51	1.53	1.38	1.39	1.35	1.30	0.75	1.41
	Mean	2.86									

As displayed in the table the aggregate mean of negative items (5, 28, 36, 46, 48, and 55) of motivation is 2.62 and the frequency and percent of the items for agree and strongly agree is 51 (35.7%) (See tables 11 and appendix O of table 9). This indicates 35.7% of prospective mathematics teachers of KUC lack inspiration in learning and teaching mathematics which envisages that they have no enthusiasm to learn and teach mathematics.

The following table uses item 23 (I chose a major that did not require too many math courses); item 38 (My teachers often applied that math lessons to real world situations); item 62 (Math has contributed greatly to science and other fields of knowledge); Item 63 (Math is less important to people than art or literature); item 64 (Math is not important for the advance of civilization & society); item 65 (Math is very worthwhile and necessary subject); item 66 (Math is important for artists and writers to understand it as well as scientists) ; item 67 (Math is not important in everyday life); Item 68 (Math helps develop a person's mind and teachers to think); item 69 (Math is needed in designing practically every thing); item 70 (Math is needed in order to keep the world running); and item 72 (I don't use mathematics in my everyday life) to display the result of attitude test (value) of prospective mathematics teachers. Hence the negatively stated value items are: 23, 63, 64, 67, and 72; and positively stated items of value are: 38, 62, 65, 66, 68, 69, and 70.

Table 12: The result of Attitude test (Value) of prospective mathematics teachers of KUC With respect to Sex and Academic year

Sex	Stat.	Value test Items											
		23	38	62	63	64	65	66	67	68	69	70	72
Male	Mean	2.66	3.72	4.26	1.81	1.37	3.94	4.01	1.66	4.04	3.80	4.07	2.01
	N	86	86	86	86	86	86	86	86	86	86	86	86
	Std.	1.54	1.50	1.12	0.92	0.67	1.23	1.13	0.85	1.07	1.23	1.10	1.20
	Total mean	3.11											
Female	Mean	2.28	3.21	4.05	1.72	1.73	3.91	4.00	1.67	4.18	3.98	4.10	2.04
	N	57	57	57	57	57	57	57	57	57	57	57	57
	Std.	1.41	1.24	1.06	0.99	1.04	1.26	1.15	0.79	1.02	1.14	1.01	1.25
	Total mean	3.07											
Total mean	Mean	2.51	3.52	4.17	1.78	1.52	3.93	4.01	1.66	4.09	3.87	4.08	2.02
	N	143	143	143	143	143	143	143	143	143	143	143	143
	Std.	1.50	1.42	1.10	0.95	0.85	1.24	1.14	0.82	1.05	1.19	1.06	1.22
	Mean	3.09											
Acad. Year	Stat.												
Second Year	Mean	2.49	3.58	4.18	1.76	1.56	3.95	4.04	1.67	4.13	3.82	4.12	1.95
	N	95	95	95	95	95	95	95	95	95	95	95	95
	Std.	1.49	1.40	1.09	0.92	0.87	1.22	1.12	0.83	1.06	1.18	1.06	1.16
	Total mean	3.10											
Third Year	Mean	2.54	3.39	4.17	1.81	1.44	3.89	3.94	1.65	4.02	3.98	4.02	2.17
	N	48	48	48	48	48	48	48	48	48	48	48	48
	Std.	1.53	1.45	1.12	1.00	0.82	1.28	1.17	0.81	1.02	1.21	1.08	1.33
	Total mean	3.08											
Total mean	Mean	2.51	3.52	4.17	1.78	1.52	3.93	4.01	1.66	4.09	3.87	4.08	2.02
	N	143	143	143	143	143	143	143	143	143	143	143	143
	Std.	1.50	1.42	1.10	0.95	0.85	1.24	1.14	0.82	1.05	1.19	1.06	1.22
	Mean	3.09											

As displayed in table 12 The aggregate mean of negative items (23, 63, 64, 67, and 72) of value is 1.90 and the frequency and percent of the items for agree and strongly agree is 18 (12.9%) (see tables 12 and appendix O of table 10). This implies 12.9% of prospective mathematics teachers of KUC could not distinguish the benefit or value of mathematics.

However the aggregate mean of positive items (38, 62, 65, 66, 68, 69, and 70) of value is 3.95 and the frequency and percent of the items of agree and strongly agree is 99(69.5%) (see tables16 and 17). This implies 69.5% of KUC prospective mathematics teachers know the benefit or degree of importance of mathematics.

The following table uses item 3(My teachers relied on over head projectors or chalk boards as tools to present information); item 4(My teachers spent the necessary amount of time helping me to understand Math concepts); item 6 (I had many competent mathematics teachers); item 8 (My teachers emphasized understanding and not just memorization); item 10 (During my math classes I was expected to sit quietly and listen); item 16(My teachers focus mainly on memorization, facts & procedures); item 17(My Math teachers were supportive in my efforts to learn math); item 18 (My teachers assigned several homework problems each night); item 20 (My teachers had confidence in me as a student of mathematics); item 21 (I learned best when my teachers took the time to connect new concept to that which I had already); item 33(My math teacher were very patient with me); item 34 (Many of my math teachers were in competent); item 40 (My teachers used a combination of manipulative, visual aids and cooperative learning); item 42 (My teachers used math games to reinforce my understanding of concepts); and item 50 (My math teachers frequently used a lecture format) to display the attitude test result of Teacher expectation.

Hence negatively stated teacher expectation items are: 10, 16, 34, and 50 and positively stated items of teacher expectation are: 3, 4, 6, 8, 17, 18, 20, 21, 33, 40, and 42.

Table 13: The result of attitude test (Teacher expectation) of prospective mathematics teachers of KUC with respect to Sex and Academic year

Sex	Stat.	Teacher expectation test items														
		3	4	6	8	10	16	17	18	20	21	33	34	40	42	50
Male	Mean	4.39	3.26	4.05	3.93	3.20	3.03	3.76	3.74	3.21	4.16	3.19	2.31	3.43	2.71	2.78
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
	Std.	1.14	1.49	1.13	1.18	1.62	1.54	1.35	1.15	1.13	1.19	1.46	1.34	1.34	1.34	1.42
	T.M	3.41														
Female	Mean	3.93	3.63	4.05	4.07	3.12	3.42	3.54	3.61	3.18	3.79	3.05	1.96	3.75	2.86	2.63
	N	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
	Std.	1.36	1.17	0.93	1.27	1.59	1.68	1.49	1.19	1.28	1.25	1.63	0.98	1.17	1.26	1.28
	Total mean	3.37														
Total	Mean	4.21	3.41	4.05	3.98	3.17	3.19	3.67	3.69	3.2	4.01	3.13	2.18	3.56	2.77	2.72
	N	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143
	Std.	1.25	1.38	1.05	1.21	1.61	1.61	1.41	1.16	1.19	1.23	1.53	1.22	1.28	1.31	1.36
	Total mean	3.39														
Acad. year	Stat.															
Second Year	Mean	4.3	3.39	4.13	3.99	3.17	3.26	3.78	3.76	3.24	4.05	3.21	2.18	3.64	2.80	2.6
	N	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95
	Std.	1.16	1.39	1.07	1.23	1.61	1.61	1.38	1.2	1.21	1.23	1.55	1.22	1.25	1.28	1.37
	Total mean	3.43														
Third Year	Mean	4.02	3.44	3.89	3.98	3.17	3.04	3.46	3.56	3.1	3.94	2.98	2.17	3.39	2.71	2.96
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	Std.	1.41	1.37	0.99	1.18	1.60	1.59	1.44	1.08	1.15	1.23	1.48	1.23	1.35	1.37	1.32
	Total mean	3.32														
Total	Mean	4.21	3.41	4.05	3.98	3.17	3.19	3.67	3.69	3.2	4.01	3.13	2.18	3.56	2.77	2.72
	N	143	143	143	143	143	143	143	143	143	143	143	143	143	143	143
	Std.	1.25	1.38	1.05	1.21	1.61	1.61	1.41	1.16	1.19	1.23	1.53	1.22	1.28	1.31	1.36
	Total mean	3.39														

As indicated in table 13 the mean of negatively stated items (10,16, 34, and 50) is 2.82. The frequency and percent of these items is 18 and 22.1% respectively. This implies that 22.1% of prospective mathematics teachers attitude negatively developed due their previous teachers negative attitude towards mathematics and teaching mathematics (see appendix O of table 11).

Similarly the researchers (Kalder and Lesik, 2011; Mensah, Okyere, and Kuranchie, 2013; Andres, Victor, and Benito, 2014) have also asserted that the practices of previous teachers have a great influence on their students' performance either in its positive or negative side. Thus KUC prospective mathematics teachers also reflect their own practices similar to their previous mathematics teachers' practices during their actual teaching activity. This means the attitude of KUC prospective mathematics teachers towards mathematics and teaching mathematics develops on their students' attitude.

Thus from the above data analysis and discussion I conclude that the attitude test result of prospective mathematics teachers indicates the existence of feelings of anxiety and fear as well as feelings of discouragement and depression among prospective mathematics teachers of KUC and most of the prospective teachers (58.7%) are not confident in their ability to learn and teach mathematics.

When I compare the finding of this study to other research works negative attitude towards mathematics is also available in different Universities and Collges of the world. For instance Relich et al (1994) findings held in the University of Western Sydney indicates that high proportions of pre-service prospective mathematics teachers hold negative attitudes towards mathematics and also a similar study by Mensah, Okyeng, and Kuranchie (2013) held in Catholic University College of Ghana(Fiapre-Sunyani) indicates that many students have developed negative attitude towards the study of mathematics as a result of mass failure of students of the subject and their teachers negative attitude towards the subject.

Related to attitude it is significant to see the relationship of attitude factors in the table as follows:

Table 14: Inter correlations of the 6 factors that are used to assess prospective mathematics teachers of KUC (N=143) in ATMI - Amharic

	Confidence	Anxiety	Value	Enjoyment	Motivation	Teacher expectation
Confidence: Pearson Correlation Sig(2- tailed)	1	0.808** 0.000	0.817** 0.000	0.867** 0.000	0.800** 0.000	0.875** 0.000
Anxiety: Pearson Correlation Sig (2- tailed)	0.808** 0.000	1	0.719** 0.000	0.868 ** 0.000	0.983** 0.000	0.670** 0.000
Value: Pearson Correlation Sig (2- tailed)	0.817** 0.000	0.719** 0.000	1	0.788** 0.000	0.734** 0.000	0.810** 0.000
Enjoyment: Pearson Correlation Sig (2- tailed	0.867** 0.000	0.868** 0.000	0.788** 0.000	1	0.898** 0.000	0.692** 0.000
Motivation: Pearson Correlation Sig (2- tailed)	0.800** 0.000	0.983** 0.000	0.734** 0.000	0.898** 0.000	1	0.638** 0.000
Teacher expectation: Pearson Correlation Sig (2- tailed)	0.875** 0.000	0.670** 0.000	0.810** 0.000	0.692** 0.000	0.638** 0.000	1

** Correlation of the six factors is significant at the 0.01 level (2- tailed)

As indicated in table 14 there is strong relationship among all attitude factors at 0.01 levels (0.99, confidence interval). Similarly along with the attitude test the factorial validity of the adapted Amharic items was examined using Confirmatory Factor Analysis (CFA) in the pilot test and after the improvements of some items the test was administered to KUC prospective mathematics teachers and the result is indicated in the table below.

Table 15: Confirmatory Factor Analysis (CFA) Results of ATMI- Amharic of KUC Prospective Mathematics Teachers' Attitude

NPAR	X^2	DF	P	GFI	AGFI	RMR	RMSEA	NFI	PNFI	AIC	TLI
38	166.834	98	.000	.875	.826	.130	.070	.800	.653	242.834	.882

Notes: NPAR= Number of Parameters, X^2 = Chi-Square, DF= Degree of Freedom, P= Probability level, GFI= Goodness of Fit Index, AGFI = Adjusted Good of fit index, RMR = Root Mean Square Residual, RMSEA = Root-Mean-Square Error of Approximation, NFI = Normed

Fit Index, PNFI = Parsimonious Fit Index, AIC = Akaike Information Criterion, and TLI = Tucker- Lewis Index. As displayed in table 9, X^2 test yields a value of 166.834 (df = 98) with corresponding p value of 0.000. This implies that p value is too small to reject the null of a good fit. Schumacker and Lomax (2010, p.85) state that "X^2 is quite sensitive to sample size that is for smaller sample size it rejects the hypothesis. Hence X^2 is probably less useful as an indicator than other model fit". The pilot study for this model is tested based on 330 samples which are very large. In addition to this Schumacker and Lomax (2010) state that in contrast as sample size decreases (below100) then X^2 statistics indicates non-significant probability levels and they noted that a non significant X^2 value indicates the two matrices are almost similar, indicating that the implied theoretical model significantly reproduces the sample variance-covariance relationships in the matrix. However X^2 is not the only criterion to confirm model fit.

Concerning model fit criteria Schumacker and Lomax (2010, p.76) suggest the following acceptable fit interpretation.

> (a) GFI's acceptable level is from 0(no fit) to 1(perfect fit). However value close to 0.90/0.95 reflects a good fit and GFI value greater than 0.95 is a very great fit; (b) AGFI's acceptable level is from 0(no fit) to 1 (perfect fit). However value nearer to 1 is a good fit and greater than .95 is a very great fit; (c) RMR has no defined acceptable level; (d) RMSEA value between 0.05 and 0.08 indicate close fit; (e) TLI's acceptable level is from 0 (no fit) to 1(perfect fit). However value close to 0.90 is a good fit; (f) NFI's acceptable level is from 0 (no fit) to 1 (perfect fit). However value close to 0.90 or 0.95 reflects a good model fit; (g) PNFI's acceptable level is from 0 (no fit) to 1(perfect fit). However value nearer to 1 is perfect fit; (h) AIC value close to 0 indicates a more parsimonious model.

Hence as seen from table 21 except X^2 other model fit indices indicate acceptable level fit. For instance in the pilot study attitude test of GFI is .984, it means 98.4% of the sample covariance matrix fits the population covariance matrix, AGFI is .981 (see appendix B in page 317, table 2). However little improvement was made on the same attitude test items and administered to 143

KUC prospective mathematics teachers. The result indicates GFI = .875 (see table 21). The above model fit indices of table 21 and Appendix Q indicate the validiy of each item. These confirm that the validity of ATMI – Amharic items are good. As displayed in table 7 the total reliability of the items (71) translated into Amharic is α = 0.842. This implies the internal consistency/reliability estimates for the entire Amharic measure is high. Because it is beyond Cortina’s (1993) criteria of acceptance (α =0.70).

4.1.1.2. The contribution of the recruitment and selection criteria (Entrance exam result, High school transcript average, and EGSECE GPA) to prospective mathematics teachers University College Achievement and the relationship of trainees' University College result to their COC result

This section deals with the presentation, analysis, and discussion of data obtained through two different second year entries that is 2012/2013 entries and 2013/2014 entries high school result, entrance exam, and EGSECE result to their University College achievement and the relationship of trainees' University College result to their COC result in order to know the predictive validity of the recruitment and selection criteria employed to select the trainees and to know the relationship of trainees' University College achievement to their COC result.

4.1.1.2.1. The academic achievement result of 2012/2013 entrants of Mathematics Diploma regular student teachers of KUC

This sub- section deals with the presentation of data using tables 16, 17, 18, and 19 and its analysis and discussion accordingly as follows:

Table 16: The minimum, maximum, mean and standard deviation of the predictors and Criterion measure variables (N=53) of Mathematics Diploma student Teachers' result

Variables	Minimum	Maximum	Mean	Std. Deviation
College GPA	.00	3.58	2.0596	.83607
Entrance Exam result	5.89	22.28	13.3902	3.76529
High school transcript average	50.30	80.60	61.4972	6.34092
EGSECE GPA	2.00	3.00	2.1987	.24074
Valid N (list wise)				

Table 16 displays that the total mean of Mathematics students' college GPA is a little bit above average. However the standard deviation indicates that there is a relatively low variation compared to entrance exam result and high school transcript average. Entrance exam result indicates the candidates' low result. This implies that entrance exam is better selection criteria than EGSECE GPA and high schoo transcript average.

Table 17: Inter-correlations among predictors and criterion measure variables (N=53) of Mathematics student teachers' result

Variable	Sex	College GPA	Entrance Exam result	High school transcript average	EGSECE GPA
Sex Sig. (2-tailed)	1	.299* .030	.364** .007	.207 .136	.223 .108
University College GPA Sig. (2-tailed)	.299* .030	1	.862** .000	.701** .000	.447** .001
Entrance Exam result Sig. (2-tailed)	.364** .007	.862** .000	1	.557** .000	.385** .004
High school transcript average Sig. (2-tailed)	.207 .136	.701** .000	.557** .000	1	.559** .000
EGSECE GPA Sig. (2-tailed)	.223 .108	.447** .001	.385** .004	.559** .000	1

*Correlation is significant at the 0.05 level (2-tailed)

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

Table 17 indicates that correlation is observed between sex and college GPA (.299*, $p < 0.05$) and between sex and entrance exam (.364**, $p < 0.01$). This can be inferred that the relative positions of female trainees' college GPA and entrance exam result is associated with the relative positions of male trainees' college GPA and entrance exam result. Similarly there is strong correlation between University College GPA and entrance exam result (.862**, $p < 0.01$), between University College GPA and high school transcript average (.701**, $p < 0.01$), and between University College and EGSECE GPA (.447**, $p <0.01$).

The significant result of the above correlation indicates that student teachers who achieved above average result in entrance exam, in the high school, and EGSECE will probably obtain an above average result in the University College. In addition to these there is strong correlation between high school transcript average and EGSECE GPA as well as between entrance exam result and high school transcript average and EGSECE GPA. From these I can infer that entrance examination, high school transcript average, and EGSECE GPA were successful selection criteria for 2012/2013 entrants of mathematics prospective teachers

Table 18: Summary of regression analysis (N=53) of Mathematics student teachers' result

Variable	Un standardized Coefficients		Standardized Coefficients	T	Sig.	R	R^2
	B	Standard error	Beta				
Constant	-2.594	.570		-4.553	.000	.902[a]	.814
Students' College entrance exam result	.152	.017	.683	9.163	.000		
Students' high school transcript average	.042	.011	.317	3.817	.000		
EGSECE GPA	.025	.259	.007	.096	.924		

a. Predictors: (Constant)

The regression equation is $\hat{y} = a + b_1x_1 + b_2x_2 + b_3x_3 + - - - -$

$\therefore\ \hat{y} = -2.594 + 0\ .152\ X_1 + 0\ .042\ X_2 + 0.025\ X_{3,}$

Hence table 18 indicates the regression coefficient of college Entrance Exam result (b_1 = 0.152, t_1 = 9.163, df = 52, P < .01) is significant. This means that Student teachers who have good result in the Entrance Exam are expected to be successful in the University College. Similarly students' high school transcript average (b_2= 0.042, t_2= 3.817, df =52, p< .01) is also significant. However when we see students' EGSECE GPA (b_3= 0.025, t_3= 0.096, df = 52, p<.01 and p<.05) is not significant at both levels of significance. Because the value of t is less than the levels of significance(.924), this implies that EGSECE GPA has little/no contribution to the students' University College achievement. From the regression equation: $\hat{y} = -2.594 + 0\ .152\ x_1 + 0\ .042\ x_2 + 0\ .025\ x_{3,}$ and from table 24, we can observe that the correlation between actual college GPA and Predicted college GPA is R = .902. Hence the percent of college GPA that is due to a combination of high school average score, EGSECE GPA and Entrance Exam result is then R^2 = .814. It means that 81.4 percent of the variance of college GPA is explained by Entrance Exam result, high school transcript average, and by EGSECE GPA. Because $1-R^2$ is 0.186; it means 18.6 percent of college GPA is due to other factors such as motivation, involvement in extracurricular activities, measurement error, test construction, reading habit and so on.

Table 19: Summary of ANOVA (Analysis of variance (N=53) of Prospective Mathematics Teachers' result

ANOVA[a]

Model	Sum of Squares	df	Mean square	F	Sig.
Regression	29.596	3	9.865	71.587	.000[b]
Residual	6.753	49	.138		
Total	36.348	52			

a. Dependent Variable: Student teachers' College GPA

b. Predictors: (Constant), EGSECE GPA (Ethiopian General Secondary Education Certificate Examination Result), Students' Entrance Exam Result, and Students' High School Transcript Average Result

In the above table 19 an observed F ratio of 71.587 with (3, 49) degree of freedom is 2.79, $P < 0.05$ and 4.21, $P < 0.01$.In both cases the F-ratio is greater than the F critical values, i.e., $2.79 < 71.587$, $P < 0.05$, and $4.21 <.71.587$, $P < 0.01$.We can see that, With R = .902, Fobs = 71.587, F critical value of 2.79 less than Fobs = 71.587, $P < 0.05$ and F critical = 4.21 is also less than F observed = 71.587, p <. 0.01. This indicates the means are significantly different and it implies that the predictor variables (Entrance exam result, High School transcript average, EGSECE result.) were successful to predict students' University college achievement. SPSS output includes “sig.” it is necessary to compare this value (.000) with alpha, in this case .05. Since the sig. level is less than alpha, the results are also significant in this level.

4.1.1.2.2. The academic achievement result of 2013/2014 (second year) Entrants of Mathematics diploma regular student teachers of KUC

This part of section 4 deals with the presentation of data using tables 26, 27, 28, and 29 and its analysis accordingly as follows:

Table 20: The minimum, maximum, mean and standard deviation of the predictors and criterion measure variables (N=51) of Prospective Mathematics Teachers’ result

Variables	Minimum	Maximum	Mean	Std. Deviation
College GPA	2.24	3.88	2.8820	.44842
Entrance Exam result	7.78	20.22	13.7869	3.03086
High school transcript average	51.18	89.30	66.6469	6.74468
EGSECE GPA	2.00	3.71	2.5265	.34501
Valid N (list wise)				

As you could see from table 20 the total mean of Mathematics student teachers’ college GPA is above average. However the standard deviation indicates that there is a relatively low variation compared to entrance exam result and high school transcript average.

Table 21: Inter-correlations among predictors and criterion measure variables (N=51) of Mathematics student teachers’ result

Variable	Sex	College GPA	Entrance Exam result	High school transcript average	EGSECE GPA
Sex Sig. (2-tailed)	1	-.006 .967	.139 .332	.065 .649	.159 .264
College GPA Sig. (2-tailed)	-.006 .967	1	.355* .011	.247 .081	.537 ** .000
Entrance Exam result Sig. (2-tailed)	.139 .332	.355* .011	1	.204 .151	.275 .051
High school transcript average Sig. (2-tailed)	.065 .649	.247 .081	.204 .151	1	.165 .248
EGSECE GPA Sig. (2-tailed)	.159 .264	.537** .000	.275 .051	.165 .248	1

*Correlation is significant at the 0.05 level (2-tailed)

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

As displayed in table 21, the correlation between entrance exam result and student teachers' University College GPA is significant at 0.05 levels and the correlation between EGSECE GPA and Student teachers' University College GPA is also significant at 0.01 levels. This indicates that mathematics trainees who achieved above average in entrance exam and EGSECE will probably obtain above average result in the University College. From this I can infer that entrance exam and EGSECE result were successful selection criteria for 2013/2014 entrants of mathematics prospective teachers.

Table 22: Summary of regression analysis (N=51) of Mathematics student teachers' result

Variable	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	R	R^2
	B	Standard error	Beta				
Constant	.385	.609		.632	.530	.592[a]	.351
Students' College entrance exam result	.030	.018	.202	1.633	.109		
Students' high school transcript average	.009	.008	.130	1.072	.289		
EGSECE GPA	.598	.160	.460	3.737	.001		

The statistical interpretation of table 28 will be as follows:

Predictors: (Constant). The regression equation is $\hat{y} = a + b_1x_1 + b_2x_2 + b_3x_3 + - - - -$

$\therefore\ \hat{y} = 0.385 + 0.030\ X_1 + 0.009\ X_2 + 0.598\ X_3,$

As indicated in table 22 the regression coefficient of college Entrance Exam result ($b_1 = 0.030$, $t_1 = 1.633$, df = 50, $P < .01$ and $p<0.05$) is not significant. This means that trainees' entrance exam result has no/little contribution on their University college result. Similarly trainees' high school transcript average ($b_2= 0.009$, $t_2= 1.072$, df =50, $p< .01$ and $p<0.05$) is also not significant. However when we see students' EGSECE GPA ($b_3= .598$, $t_3= 3.737$, df = 50, $p<.0.01$) is significant at both levels of significance. Because the observed t- ratio is greater than 2.704, this implies that EGSECE GPA has an effect on student teachers' University College result for this batch.

From the regression equation: $\hat{y} = 0.385 + 0.030\ x_1 + 0.009\ x_2 + 0.598\ x_3,$ and from the above table 28 we can observe that the correlation between actual college GPA and Predicted college GPA is R = .592. the percent of college GPA that is due to a combination of high school average score, EGSECE GPA and Entrance Exam result is then $R^2 = .351$. It means that 35.1 percent of the variance of college GPA is explained by Entrance Exam result, high school transcript average and EGSECE GPA because $1-R^2$ is 0.649. It means 64.9 percent of college GPA is due to other factors such as motivation, involvement in extracurricular activities, measurement error, test construction, reading habit and so on.

Table 23: Summary of ANOVA (Analysis of variance (N=51) of Prospective Mathematics Teachers' result

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	3.526	3	1.175	8.462	.000[b]
Residual	6.528	47	.139		
Total	10.054	50			

a. Dependent Variable: Students' College GPA
b. Predictors: (Constant), EGSECE GPA (Ethiopian General Secondary Education Certificate Examination Result), Students' Entrance exam result, Students' high school Transcript Average result

In the above table 23 an observed F ratio of 8.462 with (3, 47) with degree of freedom 50 is 2.80, $P < 0.05$ and 4.23, $P < 0.01$.In both cases the F-ratio is greater than the F critical values; i.e., $2.80 < 8.462$, $P < 0.05$, and $4.23 <.8.462$, $P < 0.01$.We can see that, With $R = .592$, $F_{obs} = 8.462$, F critical value of 2.80 less than $F_{obs} = 8.462$, $P < 0.05$ and $F_{crit} = 4.23$ is also less than $F_{obs} = 8.462$, p <. 0.01. This indicates the means are significantly different and it implies that the predictor variables (Entrance exam result, High School transcript average, EGSECE result.) had contribution to their student teachers' University college achievement. SPSS output includes "sig." it is necessary to compare this value (.000) with alpha, in this case .05. Since the sig. level is less than alpha, the results are also significant in this level.

Moreover table 21 indicates 2013/2014 entrants of prospective mathematics teachers academic result and from this data correlation is observed between University College GPA and entrance exam result (.355*, $p< 0.05$); and between University College GPA and EGSECE GPA (.537**, $p< 0.01$). These imply that prospective mathematics teachers who achieved above average in entrance exam result and EGSECE GPA will probably obtain above average result in the University College. From this result I infer that entrance exam and EGSECE GPA result had contribution to 2013/2014 entrants of KUC second year prospective mathematics teachers University College results. Similarly for 2013/2014 entrants of KUC second year prospective mathematics teachers Appendix R of table 12 indicates that there is strong correlation between trainees' professional written exam (COC) and KUC GPA (.570**, $p< 0.01$).

Moreover the original data attached in appendix L of table 3 indicates that student teachers who have good result in the entrance exam result achieved good result in the University College and Competency Assessment test (COC). However from 47 prospective mathematics teachers only 10 prospective mathematics teachers achieved 50 and above in the Diploma graduates Professional and Academic written examination (COC) (see appendix L). This implies that student teachers who are recruited and selected from grade 10 and who are not qualified for preparatory level education also failed in competency assessment test. This is a very good indicator that instead of recruiting and selecting and training after the completion of grade 10 it is better to recruit and select and train after the completion of preparatory level education.

Next to this it is essential to discuss the views of teacher educators, department head, and natural and computational sciences' dean related to pre-service teacher education program as follows.

4.1.1.3. KUC mathematics Teacher Educators, Department head, and Natural and Computational Sciences dean interviews result and Teacher educators observation result

In this section the data obtained through interviewing teacher educators, department head, and Natural and Computational sciences dean result, and teacher educators' observation result is organized and analyzed as follows:

4.1.1.3.1. Teacher Educators' Interview Result

Teacher educators were interviewed to answer both close ended and open ended items and their responses are organized and analyzed as follows:

Table 24: Characteristics of KUC respondent teacher educators with respect to Sex, Qualification and Experience

University College	Sex			Qualification			Teaching experience	
	M	F	Total	MSC	PhD	Total	Minimum	Maximum
Kotebe	10	2	12	11	1	12	6	35

Table 24 indicates that the numbers of male teacher educators are five times of female teacher educators. This implies that females interest and belief towards mathematics need further study particularly in the high schools and Universities.

Table 25: Response of teacher educators on professional development (N= 12)

PD variables	S. disagree		Disagree		Agree		S. Agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
HDP duration of training was adequate					11	91.7	1	8.3	3.08	.2887
HDP training was integrated to my field of study			10	83.3	2	16.7			2.17	.3893
HDP training was logical, reasonable and compatible			9	75.0	3	25			2.25	.4523
HDP training was relevant and helped me to teach mathematics					11	91.7	1	8.3	2.96	0.4330
HDP training was highly related to math content	4	33.3	8	66.7					1.67	.4924
HDP training helped me to use active learning methods					9	75	3	25	3.08	.2887
HDP helped me to use scientific assessment techniques			2	16.7	10	83.3			2.83	.3893
HDP helped me to manage the classroom effectively			4	33.3	8	66.7			2.92	.2887
PD is necessary for teachers who are not competent in professional skills and knowledge					11	91.7	1	8.3	3.08	.2887
PD improves the knowledge, skills, and practice of teachers in the institution					10	83.3	2	16.7	3.17	.3893
PD helps teachers to be confident on their work					10	83.3	2	16.7	3.17	.3892
PD puts unnecessary work load on teachers	5	41.7	7	58.3					1.58	.5149
PD helps to improve student performance			1	8.3	10	83.3	1	8.3	3.00	.4264
PD trainings should be limited to subject matter knowledge and methods related to the subject			9	75	3	25			2.25	.4523
I took PD trainings in terms of TPACK	2	16.7	10	83.3					1.83	.3893
PD trainings should be supported by TPACK			1	8.3	7	58.3	4	33.3	3.25	.6216

As displayed in table 25, HDP training was not related to mathematics content and not supported by TPACK. However all teacher educators (100%) agreed and strongly agreed that HDP helped them to apply active learning methods; most of them (83.3%) agreed that HDP helped them to use scientific assessment techniques and most of them(66.7%) agreed that HDP helped them to manage the class room effectively. This implies that HDP training is significant for mathematics teacher educators to encode the subject matter effectively. However the training in not related to mathematics content and do not use technology.

Table 25.1: Summary of item statistics on professional development

	Mean	Min.	Max.	Range	Max./Min	Variance	No. of items
Item means	2.646	1.500	3.250	1.750	2.167	.373	16
Item variance	.175	.083	.386	.303	4.636	.008	16

Table 25.2: Scale statistics on professional development

Mean	Variance	Std. deviation	Alpha	No. of items
42.3333	5.515	2.34844	.621	16

As displayed in tables 25.1 and 25.2; Reliability Coefficient is .621 and teacher educators' response on professional development indicates the need of additional trainings related to mathematics content using technology.

Table 26: Student teachers' status and practicum activities as evaluated by Teacher Educators (N=12)

Variables	S. disagree		Disagree		Agree		S. agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
They have a high interest in math	3	25	9	75					1.75	.4523
The student teachers achieved the expected result in the institution	2	16.7	7	58.3	3	25			2.08	.6686
The student teachers have good mathematics background	2	16.7	10	83.3					1.83	.3893
The student teachers are highly motivated to learn all math courses	1	8.3	11	91.7					1.92	.2887
The student teachers have good math problem solving skill	1	8.3	10	83.3	1	8.3			2.00	.4264
During teaching practice student teachers have good preparation			10	83.3	2	16.7			2.17	.3893
During teaching practice student teachers have confidence			10	83.3	2	16.7			2.17	.3893
During teaching practice student teachers have knowledge of the subject matter			6	50.0	6	50.0			2.50	.5222
During teaching practice student teachers have good personality			1	8.3	11	91.7			2.92	.2887
During teaching practice student teachers have legible handwriting	2	16.7	9	75.0	1	8.3			1.92	.5149
During teaching practice student teachers prepare practical lesson plan and teach effectively			9	75.0	3	25.0			2.25	.4523
During teaching practice student teachers prepare and use appropriate teaching aids			11	91.7	1	8.3			2.08	.2887
During teaching practice student teachers have the skill of managing the classroom			10	83.3	2	16.7			2.17	.3893
During teaching practice the student teachers assess the students effectively			2	16.7	9	75.0	1	8.3	2.92	.5149
During teaching practice student teachers apply active learning methods			10	83.3	2	16.7			2.17	.3893

Table 26.1: Summary item statistics of student teachers' status and practicum activity

	Mean	Min	Max	Range	Max/Min	Variance	No. of items
Item means	2.167	1.750	2.917	1.167	1.667	.113	15
Item variance	.182	.083	.447	.364	5.364	.009	15

Table 26.2: Scale statistics of student teachers' status and practicum activity

Mean	Variance	Std. deviation	Alpha	No. of items
32.500	8.818	2.96954	.721	15

As indicated in tables 26. 26.1, and 26.2; the reliability Coefficient is .721, student teachers mathematics interest, background, knowledge, and confidence is found to be below average based on the evaluation of teacher educators. This reduces the student teachers mathematics achievement in the University College. In addition to this mathematics teacher educators' evaluation on the University colleges' management and administration and their evaluation on mathematics department will be as follows:

Table 27: Teacher educators' evaluation of mathematics department (N= 12)

Variables	S. disagree		Disagree		Agree		S. agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
There are adequate facilities in the department to teach the courses effectively	7	58.3	5	41.7					1.42	.5149
The department arranges peer observation program	4	33.3	8	66.7					1.67	.4924
The department facilitates colleagues collaborative work			10	83.3	2	16.7				
The department encourages teachers self assessment			3	25.0	9	75.0			2.75	.4523
The department arranges remedial class for females and slow learners			5	41.7	7	58.3			2.58	.5149
The department has in-direct controlling mechanism of teachers performance			10	83.3	2	16.7			2.17	.3893
The department has new mechanism of controlling discipline problems	1	8.3	9	75.0	2	16.7			2.08	.5149
The department has a new system of solving student teachers academic problems	1	8.3	10	83.3	1	8.3			2.00	.4264

Table 27.1: Summary item statistics of teacher educators' evaluation on their department

	Mean	Min	Max	Range	Max/Min	Variance	No. of items
Item means	2.104	1.417	2.750	1.333	1.941	.190	8
Item variance	.216	.152	.265	.114	1.750	.003	8

Table 27.2: Scale statistics of teacher educators' evaluation on their department

Mean	Variance	Std. deviation	Alpha	No. of items
16.8333	4.697	2.16725	.723	8

As indicated in tables 27, 27.1, and 27.2; Reliability Coefficient is .723, teachers evaluation indicates that: (a) there are no adequate educational facilities; (b) the department did not arrange peer observation among teachers; (c) The department does not have in-direct controlling mechanism of teachers; (d) the department has no mechanism of controlling discipline problems; and (e) the department did not design a new system of solving student academic problems. These drawbacks are challenges that hinder prospective mathematics teachers' effective achievement of mathematics.

The next table indicates teacher educators' assessment on the management and administration of the University College.

Table 28: Teacher educators' evaluation on the management and administration of the University College (N= 12)

Variables	S. Disagree		Disagree		Agree		S. Agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
Student teacher ratio is appropriate			10	83.3	2	16.7			2.17	.3893
There is an incentive for role model teacher educators	3	25.0	9	75.0					1.75	.4523
There is transparency between the academic staff and the university college management			11	91.7	1	8.3			2.08	.2887
There is integrity between the department and the management of the university college			11	91.7	1	8.3			2.08	.2887
The management system of the university College encourages accountability	3	25.0	9	75.0					1.75	.4523
The management gives priority for public interest			10	83.3	2	16.7			2.17	.3893
The management applies immediate response for bureaucratic activities	3	25.0	8	66.7	1	8.3			1.83	.5774
There is no partiality in the university college			10	83.3	2	16.7			2.17	.3893
The university college management is loyal and honest			10	83.3	2	16.7			2.17	.3893
The university college management respects the university college legislation and work accordingly	1	8.3	10	83.3	1	8.3			2.00	.4264

Table 28.1: Summary Item statistics of teacher educators' evaluation on the management and administration of the University College

	Mean	Min.	Max.	Range	Max/Min	variance	No. of items
Item means	2.017	1.750	2.167	.417	1.238	.031	10
Item variance	.170	.083	.333	.250	4.00	.005	10

Table 28.2: Scale statistics of teacher educators' evaluation on the management and administration of the University College

Mean	Variance	Std. deviation	Alpha	No. of items
20.1667	5.970	2.44330	.825	10

Tables 28, 28.1 and 28.2 indicate that the reliability coefficient of the items is .825 and As indicated in table 28 there is a wide gap of relationship between the academic staff and management of the university college. This can be considered as one of the obstacles that influence the effective implementation of the designed plan of the university college. In addition to this student teachers ratio seems inappropriate because 83.3% of respondents suggest that the average teacher- student ratio is 1:60 in one class.

Concerning the use of technology 12 teacher educators (100%) responded as follows:

All teacher educators said that they use calculators and computers to develop models and to organize data. However most of them (75%) don't use computers to solve problems on line and they don't share experiences and solve problems collaboratively with mathematicians of the world. And some teacher educators (41.7%) have suggested that they apply higher order instructional methods such as independent long term projects, challenging problems, and technical problem solving skills, linking mathematics to other disciplines, and debating on particular mathematics issues through practical reasons.

Table 29: Teacher educators' assessment techniques (N=12)

Variables	S. disagree		Disagree		Agree		S. Agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
I usually use problem solving type tests					10	83.3	2	16.7	3.17	.3893
I use performance tasks in and outside the class					11	91.7	1	8.3	3.08	.2887
I use different observation techniques to assess my students task					10	83.3	2	16.7	3.17	.3893
I use work sheets solutions of my students					10	83.3	2	16.7	3.17	.3893
I use mathematics project work reports			3	25.0	9	75.0			2.75	.4523
I use a semester math portfolios			9	75.0	3	25.0			2.25	.4523

Table 29.1: Summary item statistics on teacher educators' assessment techniques

	Mean	Min	Max	Range	Max/Min	Variance	No. of items
Item means	2.931	2.250	3.167	.917	1.407	.137	6
Item variance	.158	.083	.205	.121	2.455	.002	6

Table 29.2: Scale statistics on teacher educators' assessment techniques

Mean	Variance	Std. deviation	Alpha	No. of items
17.5833	1.902	1.37895	.602	6

As displayed in tables 29, 29.1 and 29.2 teacher educators apply all assessment techniques. However semester mathematics Porto-folios and mathematics project work reports are not used equally as other assessments mentioned in the table.

Concerning the activities of Technological Pedagogical Content Knowledge (TPACK) teacher educators responded for each category (TK, CK, PK, TCK, PCK, TPK and TPCK as follows:

Table 30: Teacher educators' practices on Technology Knowledge (TK) (N= 12)

Variables	S. disagree		Disagree		Agree		S. Agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
I understand the way that technologies are used in a specific content domain					11	91.7	1	8.3	3.08	.2887
I understand the range of technologies that mathematicians use in science and engineering					10	83.3	2	16.7	3.17	.3893
I often refer to digital technologies to teach mathematics using web tools	2	16.7	8	66.7	2	16.7			2.00	.6030
I understand that technology changes the existing situation to new knowledge					9	75.0	3	25.0	3.25	.4523

Table 30.1: Summary item statistics on teacher educators practices using Technology Knowledge (TK)

	Mean	Min.	Max.	Range	Max/Min	Variance	No. of items
Item means	2.875	2.00	3.25	1.25	1.625	.345	4
Item variance	.201	.083	.364	.280	4.304	.014	4

Table 30.2: Scale statistics on teacher practices using Technology Knowledge (TK)

Mean	Variance	Std. deviation	Alpha	No. of items
11.50	1.909	1.38170	.772	4

As displayed in tables 30, 30.1 and 30.2 the Reliability coefficient of the items is .772. Hence I infer that teacher educators have the knowledge of technology; however they don't apply their technology knowledge to teach mathematics courses using the web tools.

Table 31: Teacher educators Content Knowledge (CK) related to Technology (N= 12)

Variables	S. disagree		Disagree		Agree		S. Agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
I use different software applications, online problem solving through the internet to solve math problems	6	50.0	5	41.7	1	8.3			1.58	.6686
I prepare mathematics worksheets for my students to solve it collaboratively through the internet	7	58.3	4	33.3	1	8.3			1.50	.6742
I state theorems and prove using related theories/axioms/postulates by giving reasons for each step					9	75.0	3	25.0	3.25	.4523
I apply the theorems by using practical examples					9	75.0	3	25.0	3.25	.4523
I use different strategies to solve mathematics problems					11	91.7	1	8.3	3.08	.2887

Table 31.1: Summary item statistics of teacher educators' content knowledge (CK) related to technology

	Mean	Min.	Max.	Range	Max/Min	Variance	No. of items
Item means	2.533	1.50	3.25	1.75	2.167	.825	5
Item variance	.279	.083	.455	.371	5.455	.027	5

Table 31.2: Scale statistics of teacher educators' content knowledge related to technology

Mean	Variance	Std. deviation	Alpha	No. of items
12.6667	3.333	1.82574	.727	5

Tables 31, 31.1, and 31.2 indicate, the reliability coefficient is .727. Hence I can infer that teacher educators do not use technology to teach mathematics contents.

Table 32: Teacher educators' pedagogical knowledge (PK) (N= 12)

Variables	S. disagree		Disagree		Agree		S. agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
I have generic knowledge about how students learn intensively					11	91.7	1	8.3	3.08	.2887
I have the skill and knowledge about teaching approaches					10	83.3	2	16.7	3.17	.3893
I have the skill and knowledge about methods of assessment					10	83.3	2	16.7	3.17	.3893
I apply different learning theories in my lesson			5	41.7	6	50.0	1	8.3	2.67	.6513
I always prepare course plan and apply it in my instruction	3	25.0	7	58.3	2	16.7			1.92	.6686
I use different resources (technology and local resources) to transmit the subject matter effectively	1	8.3	3	25.0	8	66.7			2.58	.6686

Table 32.1: Summary item statistics of teacher educators' pedagogical knowledge (PK)

	Mean	Min.	Max.	Range	Max/Min	Variance	No. of items
Item means	2.764	1.917	3.167	1.250	1.652	.237	6
Item variance	.284	.083	.447	.364	5.364	.030	6

Table 32.2: Scale statistics of teacher educators' pedagogical knowledge (PK)

Mean	Variance	Std. deviation	Alpha	No. of items
16.5833	4.265	2.06522	.720	6

Tables 32, 32.1 and 32.2 indicate that the reliability coefficient is .720 and teacher educators use their pedagogical knowledge. However they don't use technologies and local resources to transmit the subject matter feasibly to their students. This implies teacher educators need trainings on "How to teach mathematics using TPACK"

Concerning Technological Content Knowledge (TCK) all teacher educators (100%) responded that they don't use smart phones, computers to teach mathematics content using the internet and they have not yet started to use digital animation. Hence I infer that In order to reduce mathematics abstractions and to inculcate tangible concepts in the students' mind it needs to use TCK. However teacher educators have not yet applied the standards of mathematical problem solving abilities through on line learning.

Table 33: Teacher educators' practices on pedagogical content knowledge (PCK) (N=12)

Variables	S. disagree		Disagree		Agree		S. agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
I know how to combine pedagogy and content and teach effectively					11	91.7	1	8.3	3.08	.2887
I know how to make a subject understandable to my students					11	91.7	1	8.3	3.08	.2887
I know what makes a subject difficult or easy to learn			1	8.3	11	91.7			2.92	.2887
I know the common misconceptions of my students in mathematics			1	8.3	10	83.3	1	8.3	3.00	.4264
I know how my students develop mathematics concept in the classroom			1	8.3	11	91.7			2.92	.2887

Table 33.1: Summary item statistics of teacher educators on pedagogical content knowledge (PCK)

	Mean	Min.	Max.	Range	Max/Min	Variance	No. of items
Item means	3.00	2.917	3.08	.167	1.057	.007	5
Item variances	.103	.083	.182	.098	2.182	.002	5

Table 33.2: Scale statistics of teacher educators on pedagogical content knowledge (PCK)

Mean	Variance	Std. deviation	Alpha	No. of items
15.00	1.273	1.12813	.757	5

As displayed in tables 33, 33.1 and 33.2 the reliability coefficient is .757 and teacher educators practice on PCK is beyond satisfactory level. This implies that teachers theoretical knowledge is good , however the main problem is to put these theories into practice.

Concerning Technological Pedagogical Knowledge (TPK) all teacher educators (100%) responded that they know how technology enables them to use different teaching approaches. However, they don't usually use on line collaborative tools to solve some challenging problems with other mathematicians of the world.

Teacher educators' response on Technological Pedagogical content Knowledge (TPCK) displayed in the following tables as follows:

Table 34: Teacher educators' practices on Technological Pedagogical Content Knowledge (TPCK) (N=12)

Variables	S. disagree		Disagree		Agree		S. Agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
I understand the interplay between content, pedagogy and technology			2	16.7	7	58.3	3	25.0	3.08	.6686
I know the relationship between my students and technology			4	33.3	8	66.7			2.67	.4924
I know the relationship between math content and technology			3	25.0	6	50.0	3	25.0	3.00	.7386
I have strong relationship with technology					10	83.3	2	16.7	3.17	.3893
In general I know the relationship between students, teachers, content, practices and technology			1	8.3	9	75.0	2	16.7	3.08	.5149

Table 34.1: Summary item statistics of teacher educators' practices on TPCK

	Mean	Min.	Max	Range	Max/Min	Variance	No. of items
Item means	3.00	2.667	3.167	.500	1.188	.038	5
Item variances	.330	.152	.545	.394	3.600	.026	5

Table 34.2: Scale statistics of teacher educators practices on TPCK

Mean	Variance	Std. deviation	Alpha	No. of items
15.00	3.818	1.95402	.733	5

As indicated in tables 34, 34.1 and 34.2 the reliability coefficient is .733 and teacher educators have performed in a better way on TPCK activities based on their own witness.

Furthermore as indicated in Appendix S of table 13 Inter-correlations of TPACK knowledge areas display that correlation is observed between CK and PK (0.683*, P< 0.05). This implies that teacher educators' practices are performed through the integration of CK and PK. Which is supported by UNESCO (2008) as mentioned in the literature part of this study in page 61.

From 12 teacher educators one of my interviewees responded as follows:

> I suggest that the present recruitment and selection of primary mathematics teacher Education needs a paradigm shift, and the recruitment and selection will be successful if trainees will be recruited and selected after the completion of preparatory level education with a good result. And the strategies of training should be related to technology and courses should be at the standard level. Concerning the revision of courses it is better to start from the feedback of mathematics teacher educators and availability of resources and after the evaluation result of teacher educators in each course then the courses that need revision would be identified on the basis of feasible reasons. Concerning facilities there should be smart classrooms, appropriate reference books, mathematics laboratory, etc. in the department. The main challenges I faced in KUC mathematics department are: (a) poor mathematic background of the trainees; (b) large class size usually 1:60; (c) some courses such as calculus and linear algebra courses are beyond the capacity level of the trainees; (d) mathematics trainees joined to study mathematics without their interest; (e) class room practices of mathematics courses need to be supported by technology; and (f) frequent revision of courses without evaluation research (Date: 03/6/2016).

The above interviewed teacher educator emphasizes on the improvement or change of the recruitment and selection of prospective mathematics teachers by recommending that prospective mathematics teachers should be recruited and selected after the completion of preparatory level education with a good result. Moreover he suggested that revision of courses should be held after evaluation research and availability of sufficient facilities including smart class rooms.

Similarly I interviewed another teacher educator and her response was as follows:

> I don’t support the recent recruitment and selection of prospective mathematics teachers. It needs change and courses should be revised after evaluation research by mathematics teacher educators, forinstance calculus courses and linear algebra are beyond the level of primary school prospective mathematics teachers. To implement the courses facilities like smart class rooms, mathematics models, and reference books should be fulfilled and the average class size is 1:60 it should be 1:40. The challenges I faced in the department is that there is a wide gap among trainees background of mathematics and some courses like calculus and linear algebra are beyond the level of diploma trainees and trainees lack interest and confidence to learn mathematics (Date: 03/12/2016).

The opinion of the above interviewees also indicates the change of the recruitment and selection of prospective mathematics teachers and the fulfillment of facilities like reference books, smart class rooms, and computers. In addition to this she suggested that class size should not exceed 40 students in a class room.

Among teacher educators my third interviewee for warded the following points:

> I need to suggest the radical change of training teachers by changing the recruitment and selection of trainees and designing new strategies of training systems through technology and courses should not be revised for the sake of revision it should be done after further research related to primary school syllabus. Forinstance some courses like calculus and linear algebra are beyond the level of primary school prospective mathematics teachers. The department should fulfill all facilities essential to implement all mathematics courses including technology. Trainees are selected to study mathematics with out good background, with out interest, and without any readiness and motivation to learn mathematics. Hence I suggest that the University college and the department need to work to reduce the above mentioned problems and to fulfill facilities and classrooms (Date: 03/17/2016).

The above interviewee opinion implies the revision of courses needs evaluation research and essential to implement the courses using technology. Infact teacher educators’ readiness to teach the courses related to technology is also necessary.

Among mathematics teacher educators my fourth interviewee forwarded the following:

> I need to train prospective mathematics teachers at degree level, who achieved good result in Higher Education Entrance Examination (EHEE). The department should fulfill facilities adequately. For instance reference books, mathematics laboratory, and smart classrooms need to be fulfilled. And to revise courses there should be feedback from teacher educators, for instance some courses like calculus and linear algebra are beyond the level of primary school prospective mathematics teachers, and after revision there should be validation workshop and teacher educators' readiness trainings. My challenges are trainees' wide gap of mathematics back ground, large class size frequently 1:60, trainees are not ready, are not motivated and have no interest to learn mathematics (Date: 03/19/2016).

My fifth interviewee responded as follows:

> I do not agree to the current recruitment and selection of primary teacher education. It will be better if primary school prospective teachers selected and recruited after the completion of preparatory level education. After selection it will be better if trainees trained related to TPACK. In addition to this the current revision of mathematics courses needs improvement and I suggest that the revision needs to be held after the feeddback of teacher educators and evaluation research. After the revision of courses teacher educators readiness trainings should be planned by MoE/ Institutions. Teaching learning facilities like mathematics laboratory, smart classrooms and adequate reference books needs to be fulfilled. The challenges I faced as a teacher educator in the University College are mainly trainees' poor mathematics background, some courses are beyond the level of the trainees, courses are not offered based on its prerequisites. In general courses offered for primary prospective mathematics teachers should match with mathematics syllabus of primary school students (Date: 09/13/2017).

The third, fourth and fifth interviewees opinion related to the recruitment and selection of prospective mathematics teachers is almost similar and all of them suggested that there should be a radical change of recruiting and selecting mathematics trainees and the revision of courses should be after the result of research and to implement these courses there should be adequate facilities including smart class rooms. The rest 7 teacher educators' and the above interviwees have suggested a similar opinion that some courses like calculus and Linear algebra are beyond the level of primary school prospective mathematics teachers. Moreover the response of the other mathematics teacher educators is almost similar to the concepts of the above interviewed teachers.

Thus teacher educators responded the following as challenges of training prospective primary school mathematics teachers: (a) Poor mathematics background of the trainees; (b) Large class size, usually 1:60; (c) Courses are beyond the capacity of the trainees; (d) negative attitude of trainees towards the subject and the profession; (e) trainees are not ready and have no motivation to learn mathematics; (f) some courses still need revisions; (g) Practices of courses are not incorporated with technology; (h) recruitment and selection did not involve candidates that would be successful in the University Colleges; and (i) there is lack of facilities like adequate reference books, smart classrooms, and computers.

Finally teacher educators recommended that: (a) the curriculum should be revised based on the result of a research and should involve mathematicians, researchers and experts; and (b) Courses need to include Basic mathematics, Teaching methodology, Statistics, Geometry, Trigonometry, Computer, and Algebra and need to be designed based on the level of trainees.

4.1.1.3.2. Kotebe University College Mathematics department head and faculty dean of Natural and Computational Sciences Interviews result

Related to the system of training the department head said that:

> Our prospective mathematics teachers are not supported by technology/TPACK and sufficient facilities. In addition to this to train teachers in mathematics, trainees should have good mathematics background and should be recruited and selected based on their interest, maturity level and readiness to pursue College/University level academic courses. In addition to this I can say that courses should be designed and revised based on research findings. Of course some courses are more abstract and may not be important for primary school mathematics prospective teachers. Hence I suggest that courses should be designed based on the capability of the trainees and their background through the practical follow up using evaluation research by involving teacher educators, researchers and experts (Date: 04/18/2016).

The view of the department head indicates that the university college still needs more reference books, mathematics laboratory with the necessary equipments, smart classrooms to support teaching - learning through technology and to balance the standard of our training at the international level. In addition to this the department head emphasizes recruitment and selection of prospective mathematics teachers needs improvement and he suggested that trainees should be recruited and selected after the completion of preparatory level education with a good result.

To this end the department head recommended that to train teachers all over Ethiopia, there should be Universities established for that purpose or there should be center of excellence to train teachers all over Ethiopia. In addition to the department head I interviewed the faculty dean of natural and computational sciences and he responded as follows:

> The University College does not have smart classroom or mathematics modeling laboratory to train teachers at the standard level. In addition to this I suggest that recruitment and selection of teachers should be from the completion of preparatory level education with a good mathematics background. Concerning the revision of courses, I underline that this trend should start from the curriculum evaluation result of teacher educators and then will be reviewed at the national level and then confirmed by investigating the need of government, community, teachers and students. To design mathematics curriculum throughout the institutions it needs to raise a leading question like “What should be the appropriate mathematics curriculum for prospective primary mathematics teachers?" In addition to this I unveil that there is no readiness trainings provided for teacher educators after the revision of courses. Similarly mathematics teacher educators need also more training in pedagogy, psychology, and TPACK. Concerning facilities I want to reveal that all the necessary facilities will be fulfilled according to the plan of the department. However if the department could not plan and submit to get more facilities from the faculty we do not know what the department needs. Concerning the recent training strategies of prospective mathematics teachers I suggest that there is science and GEQIP project working particularly for the quality of education in the University College with the help of technology, hence GEQIP project have already approved its project to work in our University College and in the near future our University College will have technology supported trainings. However in general I recommend that there should be center of excellence of teachers at the level of University in Ethiopia (Date: 04/18/2016)

The dean mainly gave more emphasis for quality of education which can be confirmed through technology and he also suggested that mathematics teacher educators also need further trainings on pedagogy, psychology, assessment techniques and methods of teaching. Finally the dean recommended the establishment of center of excellence of teachers at University level in Ethiopia.

Thus the merged analysis result and discussion of prospective mathematics teachers attitude test, the regression analysis and discussion of prospective mathematics teachers recruitment and selection criteria in terms of their University College achievement and the relationship of their University College achievement to their COC result, and teacher educators suggestion related to the trainees indicate that there is no interest, readiness, and motivation to learn mathematics among prospective mathematics teachers and these imply that there is negative attitude towards mathematics among prospective mathematics teachers.

4.1.1.3.3. KUC Mathematics Teacher Educators Observation Result

From 12 mathematics teachers 4 teachers (one female and 3 male) were observed randomly in the class and out of the class. The observation in the class was held by two persons (The department head and me). We observed one teacher two times in different periods and after each observation we discussed the different ratings and agreed for each rating result and we took the average of the two observation results from each check list and the observation result is organized and analyzed as follows:

Table 35: Teacher Educators' Ability of Practicing their Knowledge (N =4)

Designing Knowledge Work	Min.	Max.	Mean	Std. deviation
Demonstrating Knowledge of Content and Pedagogy	3.00	4.00	3.2500	.5000
Ability of making students to be in the learning situation	3.00	4.00	3.2500	.5000
Ability of informing instructional objectives	3.00	4.00	3.7500	.5000
Knowledge of resources including technology	2.00	3.00	2.5000	.57735
Ability of designing coherent instruction	3.00	4.00	3.2500	.5000
Techniques of assessing student learning	3.00	4.00	3.2500	.5000
Knowledge of students' backgrounds, skills and interests	3.00	4.00	3.2500	.5000
Objectives are designed related to curriculum frame works and standards	3.00	4.00	3.7500	.5000
Teachers' ability of relating mathematics content to TPACK and use of digital technologies to teach mathematics content	1.00	2.00	1.2500	.5000

Table 35.1: Summary Item Statistics on Teacher Educators' Ability of Practicing their Knowledge

	Mean	Minimum	Maximum	Range	Max/Min	Variance	N of items
Item means	3.056	1.250	3.750	2.500	3.00	.590	9
Item variances	.259	.250	.333	.083	1.333	.001	9

Table 35.2: Scale statistics on teacher educators' ability of practicing their knowledge

Mean	Variance	Std. deviation	Alpha	No. of items
27.5000	9.667	3.10913	.853	9

As displayed in tables 35, 35.1, and 35.2 the mean of teacher educators' ability of practicing their knowledge is 3.056 this involves in the evaluation ratings "Proficient" this implies that teacher educators performance of practicing their knowledge indicate a clear proficiency and skill in the performance area. However teacher educators' ability of relating mathematics content to technology and teaching mathematics using technology is below satisfactory.

Table 35.3: Analysis of Variance on Teacher Educators' Ability of Practicing their Knowledge

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		3.222	3	1.074		
	Between Items	18.889	8	2.361	15.000	.000
Within People	Residual	3.778	24	.157		
	Total	22.667	32	.708		
Total		25.889	35	.740		

Grand Mean = 3.0556

As displayed in table 35.3 for the degree of freedom (3,24) obtained value of F = 15.00 and critical F- ratio = 3.01 since obtained value of F is greater than critical F-ratio (15.00 > 3.01 for $p< 0.05$) then the differences of means is significant at 0.05 level of significance; this implies that teacher educators' ability of practicing their knowledge is different from one teacher to the other and which can be inferred that there is differences of ability in practicing knowledge among teacher educators.

Table 36: Teacher Educators' Ability of Organizing the Environment for Knowledge Work (N = 4)

Organizing the environment for knowledge work	Min.	Max.	Mean	Std. deviation
Class room interactions are highly respectful	2.00	4.00	3.00	.81650
There is high levels of civility among members of the class	3.00	4.00	3.7500	.5000
Students take much of the responsibility for establishing a culture for learning in the classroom	3.00	4.00	3.7500	.5000
Students are pride in their work	1.00	3.00	2..000	.81650
Students demonstrate initiating improvements to their result	1.00	3.00	2.000	.81650
Teacher demonstrates a passionate commitment to the subject	1.00	2.00	1.2500	.5000
Class room routines and procedure are coherent in their operation	3.00	4.00	3.5000	.57735
Students assume considerable responsibility for their smooth functioning	2.00	4.00	3.000	.81650
Student behavior is entirely appropriate	1.00	2.00	1.7500	.5000
Students participate in monitoring others behavior	3.00	4.00	3.7500	.5000
Teacher's monitoring of students behavior is suitable and preventive	3.00	4.00	3.7500	.5000
Teacher's response to student misbehavior is sensitive to individual student needs	3.00	4.00	3.7500	.5000
Teacher's classroom is safe	3.00	4.00	3.500	.57735
Students contribute to ensuring that the physical environment supports the learning of all students	3.00	4.00	3.7500	.5000
Students hold the work to the highest standard	3.00	4.00	3.7500	.5000

Table 36.1: Summary item statistics of Teacher Educators' ability of organizing the environment for knowledge work

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.083	1.250	3.750	2.500	3.00	.783	15
Item Variances	.372	.250	.667	.417	2.667	.035	15

Table 36.2: Scale statistics of Teacher educators' ability of organizing the environment for knowledge work

Mean	Variance	Std. deviation	Alpha	No. of items
46.2500	18.250	4.27200	.744	15

As displayed in tables 36, 36.1 and 36.2 the mean of teachers' ability of organizing the environment for knowledge work is 3.083, this involves in the evaluation rating "Proficient" this indicates teacher educators have clear proficiency and skill in organizing the environment for knowledge work. Nevertheless teacher educators demonstration with passionate commitment to the subject and the appropriateness of the students behavior to learn the subject is below satisfactory.

Table 36.3: Analysis of Variance of Teacher Educators' Ability of Organizing the Environment for Knowledge Work

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		3.650	3	1.217		
	Between Items	43.833	14	3.131	10.038	.000
Within People	Residual	13.100	42	.312		
	Total	56.933	56	1.017		
Total		60.583	59	1.027		

Grand Mean = 3.0833

As indicated in table 36.3 for the degree of freedom (3, 42) obtained value of F = 10.038 and critical F- ratio = 2.83. Since obtained value of F greater than critical F-ratio (10.038 >2.83 for p< 0.05) then the differences of means is significant at 0.05 level of significance; this implies that teacher educators' ability of organizing the environment for knowledge work is different from one teacher to the other and this can be inferred that there is differences of ability in organizing the environment for knowledge among teachers.

Table 37: Teacher educators' Instruction Practices (N = 4)

Instruction practices	Min.	Max.	Mean	Std. deviation
Teacher's oral and written communication is clear and expressive	3.00	4.00	3.7500	.5000
Teacher's anticipating possible student misconceptions	2.00	4.00	3.000	.81650
Students formulate many of the high level questions	1.00	2.00	1.2500	.5000
Students assume responsibility for the participation of all students in the discussion/cooperative learning	1.00	2.00	1.7500	.5000
Students are highly engaged throughout the lesson and make material and learn cooperatively	1.00	2.00	1.7500	.5000
Contributions of students to the representation of content, the activities and the materials	3.00	4.00	3.2500	.5000
The structure and pacing of the lesson allow for student reflection and closure	2.00	3.00	2.2500	.5000
Teacher's feedback to students is timely	2.00	4.00	3.0000	.81650
Teacher's feedback to students is of consistently high quality	3.00	4.00	3.500	.57735
Students make use of the feedback in their learning	3.00	4.00	3.2500	.5000
The teacher is highly responsible to students' interest and questions	2.00	4.00	3.2500	.95743
The teacher is making major lesson adjustments of necessary	3.00	4.00	3.5000	.57735
The teacher persists in ensuring the success of students	2.00	3.00	2.7500	.5000

Table 37.1: Summary item Statistics of Teachers Educators Instruction pactices

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	2.788	1.250	3.750	2.500	3.00	.623	13
Item Variances	.378	.250	.917	.667	3.667	.049	13

Table 37.2: Scale Statistics of Teacher Educators' Instruction Practices

Mean	Variance	Std. deviation	Alpha	No. of items
36.2500	14.250	3.77492	.710	13

As displayed in tables 37, 37.1, and 37.2 the mean of teacher educators instruction practices is 2.788 it involves in the evaluation rating of "Basic" this implies teacher educators' practices on the above 12 components need improvement and teacher educators are in a position of making progress towards "Proficient". Similarly cooperative learning among the trainees is not satisfactory (mean= 1.75)

Table 37.3: Analysis of variance of teacher educators' instruction practices (N= 4)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		3.288	3	1.096		
Within People	Between Items	29.923	12	2.494	7.832	.000
	Residual	11.462	36	.318		
	Total	41.385	48	.862		
Total		44.673	51	.876		

Grand Mean = 2.7885

As displayed in table 37.3; for the degree of freedom (3, 36) obtained value of F = 7.832 and critical F- ratio = 2.87. Since obtained value of F greater than critical F-ratio (7.832 > 2.87 for p< 0.05) then the differences of means is significant at 0.05 level of significance; this implies that teacher educators' ability of practicing the instruction is different from one teacher to the other and this can be inferred that there is differences of ability in practicing instruction among teacher educators.

Table 38: Teacher Educators' Professional Responsibilities (N =4)

Variables	Min.	Max.	Mean	Std. deviation
Teacher’s reflection on the lesson is highly accurate and perceptive	3.00	4.00	3.500	.577
The teacher is citing specific examples	3.00	4.00	3.250	.500
The teacher draws on an extensive repertoire to suggest alternative strategies	3.00	4.00	3.250	.500
Teacher’s system for maintaining accurate records is efficient and effective	3.00	4.00	3.500	.577
Students contribute to the system for maintaining accurate records	2.00	3.00	2.500	.577
The teacher successfully engages the students in the instructional program	3.00	4.00	3.25	.500
The teacher assumes leadership with colleagues	2.00	4.00	2.750	.957
The teacher makes a substantial contribution to the profession through different activities	3.00	4.00	3.250	.500
The teacher actively pursues professional development	2.00	4.00	3.250	.957
The teacher assumes a leadership position in ensuring that school practices and procedures	2.00	3.00	2.250	.500

Table 38.1: Summary Statistics of Teacher Educators’ Professional Responsibilities

	Mean	Minimum	Maximum	Range	Max./min	Variance	N of items
Item means	3.075	2.250	3.500	1.250	1.556	.181	10
Item variances	.408	.250	.917	.667	3.667	.073	10

Table 38.2: Scale Statistics of Teacher Educators’ Professional Responsibilities

Mean	Variance	Std. deviation	Alpha	N of items
30.7500	12.250	3.5000	.741	10

Tables 38, 38.1, and 38.2 display that, the mean of teacher educators practices on professional responsibilities is 3.075; it involves in the evaluation rating of "Proficient" this indicates teacher educators have a clear proficiency and skill in practicing their professional responsibilities. However teacher educators leadership position in ensuring school practices and procedures is below satisfactory.

Table 38.3: Analysis of Variance of Teacher Educators' Professional Responsibilities

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		3.675	3	1.225		
Within People	Between Items	6.525	9	.725	2.283	.047
	Residual	8.575	27	.318		
	Total	15.100	36	.419		
Total		18.775	39	.481		

Grand Mean = 3.0750

As displayed in table 38.3; for the degree of freedom (3, 27) obtained value of F = 2.283 and critical F- ratio = 2.96. Since obtained value of F is less than critical F-ratio (2.283 < 2.96 for p< 0.05) then the differences of means is not significant at 0.05 level of significance, this implies that teacher educators' ability of practicing professional responsibilities is almost similar. This means that there are no significant differences of practicing professional responsibilities among teacher educators.

4.1.1.3.3.1. The Observation result of teacher educators' Performance on Technology, Pedagogy and Content Knowledge (TPACK)

Kotebe University College mathematics teachers had been observed how they practice teaching learning activities using technology; however except pedagogical knowledge (PK) and Pedagogical Content Knowledge (PCK) teachers did not use technology to teach mathematics. For instance they were not observed to use calculators, smart phones, and computers to implement Technology knowledge (TK), Content Knowledge (CK) which needs to apply their knowledge of mathematics through online problem solving and cloud computing using website, Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPCK) by applying computer and using the internet to solve problems from the cloud and online learning. However teacher educators' practices on pedagogical knowledge (PK) and Pedagogical Content Knowledge (PCK) were observed and the result is organized and analysed as follows:

Table 39: Teacher Educators practices on Pedagogical Knowledge (PK) (N =4)

Variables	Min.	Max.	Mean	Std. deviation
The teacher has generic knowledge about how students learn intensively	3.00	4.00	3.2500	.5000
The teacher has the skill and knowledge about teaching approaches	2.00	4.00	3.2500	.95743
The teacher has the skill and knowledge about methods of assessment	2.00	4.00	3.0000	.816501
The teacher applies different learning theories in the lesson	2.00	3.00	2.2500	.50000
The teacher always prepares lesson plan and apply it in the instruction	1.00	2.00	1.50000	.577355
The teacher uses different resources (technological as well as local resources) to transmit the subject matter effectively	1.00	3.00	2.0000	.816505

Table 39.1: Summary Item Statistics of Teacher Educators' Practices on Pedagogical Knowledge (PK)

	Mean	Minimum	Maximum	Range	Max/Min	Variance	N of items
Item means	2.542	1.500	3.250	1.750	2.167	.535	6
Item variances	.514	.250	.917	.667	3.667	.076	6

Table 39.2: Scale statistics of teacher educators' practices on pedagogical knowledge

Mean	Variance	Std. deviation	Alpha	N of items
15.2500	7.583	2.75379	.712	6

As displayed in tables 39, 39.1, and 39.2 the mean of teacher educators' practices on pedagogical knowledge is 2.542 and it involves in the evaluation rating of "Basic" this implies that teacher educators pedagogical knowledge needs progress towards "Proficient"

Table 39.3: Analysis of Variance of Teacher Educators' Practices on Pedagogical Knowledge

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		3.792	3	1.264		
Within People	Between Items	10.708	5	2.142	5.885	.003
	Residual	5.458	15	.364		
	Total	16.167	20	.808		
Total		19.958	23	.868		

Grand Mean = 2.5417

As displayed in table 39.3; for the degree of freedom (3, 15) obtained value of F = 5.885 and critical F- ratio = 3.29. Since obtained value of F greater than critical F-ratio (5.885 > 3.29 for p< 0.05) then the differences of means is significant at 0.05 level of significance; this implies that teacher educators' ability of practicing pedagogy is different from one teacher to the other and this can be inferred that there is differences of ability in practicing pedagogical knowledge among teacher educators.

Table 40: Teacher Educators' Practices on Pedagogical Content Knowledge (PCK)

Variables	N	Minimum	Maximum	Mean	Std. deviation
The teacher knows how to combine pedagogy and content and teach effectively	4	2.00	4.00	3.00	.81650
The teacher knows how to make a subject understandable to the students	4	2.00	4.00	3.25	.95743
The teacher knows what makes a subject difficult or easy to learn	4	2.00	4.00	3.25	.95743
The teacher knows the common misconceptions of the students in mathematics	4	2.00	4.00	3.00	.81650
The teacher knows how the students develop math concept in the classroom	4	2.00	4.00	2.75	.95743

Table 40.1: Summary Item Statistics of Teachers' Practices on Pedagogical Content Knowledge (PCK)

	Mean	Minimum	Maximum	Range	Max/Min	variance	N of numbers
Item means	3.050	2.750	3.250	.500	1.182	.044	5
Item variance	.817	.667	.917	.250	1.375	.019	5

Table 40.2: Scale Statistics of Teachers' Practices on Pedagogical Content Knowledge (PCK)

Mean	Variance	Std. deviation	Alpha	N of items
15.2500	10.917	3.30404	.782	5

As displayed in tables 40, 40.1, and 40.2 the mean of teacher educator' pedagogical content knowledge is 3.050; this involves in the evaluation ratings of "Proficient" then it can be inferred that teacher educators have a clear proficiency and knowledge in practicing pedagogical content knowledge. However teacher educators knowledge of how the students develop mathematics concept in the classroom in not high.

Table 40.3: Analysis of Variance of Teacher Educators' Practices on Pedagogical Content Knowledge (N=4)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		6.550	3	2.183		
	Between Items	.700	4	.175	.368	.827
Within People	Residual	5.700	12	.475		
	Total	6.400	16	.400		
Total		12.950	19	.682		

Grand Mean = 3.0500

As displayed in table 40.3; for the degree of freedom (3, 12) obtained value of F = .368 and critical F- ratio = 3.49. Since obtained value of F is less than critical F-ratio (.368 < 3.49 for p< 0.05) then the difference between means is not significant at 0.05 level of significance; this implies that teacher educators’ ability of practicing pedagogical content knowledge is almost similar among teachers and one is not performing better than the other.

From the teacher educators' observation result tables 35, 36, 38, and 40 indicate that the mean of teacher educators' ability of practicing their knowledge is 3.056, the mean of teacher educators' ability of organizing the environment for knowledge is 3.083, the mean of teacher educators professional responsibilities is 3.075, and the mean of teacher educators practices of PCK is 3.050. All these teacher educators activities involve in the rating of “proficient". These imply that teacher educators performance of practicing their knowledge, organizing the environment for knowledge work, teacher educators professional responsibilities, and teacher educators practices of PCK is found to be competent. Moreover there are significance differences among teachers in practicing the above mentioned activities except PCK (see tables 35.3, 36.3, 38.3, and 40.3). However the mean of teacher educators’ instruction practices is 2.788, and the mean of teacher educators' ability of practicing PK is 2.542. These lay in the rating scale of " Basic" which implies that teacher educators instruction practices and the ability of practicing PK need more improvement and progress towards proficient (see tables 37 and 39). Similarly the mean of cooperative learning among prospective mathematics teachers is 1.75(see table 37). This is one of the components of teacher educators' instruction practices and this implies that cooperative learning among prospective mathematics teachers is below average. Hence teacher educators need progress towards proficiency for their instruction practices, need improvement on PK, and need improvement on facilitating cooperative learning among the trainees.

4.1.1.4. Document Analysis/Text Analysis result of Primary Mathematics Teachers Education Curriculum in terms of its standard

To analyze the course outlines of mathematics primary teacher education, I used the following assessment criteria retrieved from the web site and The National Professional Standards for Teachers designed by MoE of Ethiopia.

These are: (1) Components of a model course outline designed by Academic Senate of California Community Colleges (2008,pp.24-43). Retrieved from http://alamedaperalta.edu/curriculum-committee/files/20 (2) McGill University of Canada (2016, pp. 1-21) designed standard components of course outlines. Retrieved from http://www.mcgill.ca/tis/teaching/coursedesign/outline and (3) The National Professional Standards for Teachers of Ethiopia (MoE, 2013, pp.11-26), blue print material. The first two mentioned institutions designed almost similar components of standard course out lines as follows: In the Introduction part they described that course outlines are intended to provide students with an overall plan for a course to enable them to function efficiently and effectively in the course.

According to the above mentioned institutions a standard course outline can be divided into nine sections, these are:

"(I) Introduction and General information: this part of the course outline needs to describe (a) Number and title of the course, (b) number of credits and contact hours, (c) name and title of the instructor, (d) days, dates, places and time of regular classes, (e) Prerequisites: that is particular courses, specific knowledge or skills a student should know before beginning the course. For example; use of the computer, ability to read, architectural plans, etc."

"(II) Course descriptions and Learning outcomes: Course goals or objectives, clear statements of the knowledge, competencies or skills you expect students to have acquired by the end of the course. For example by the end of the course students should be able to synthesize information…." or made predictions or "Solve problems" etc.

" (III) Course content: it consists of (a) A description of the topics to be addressed in the course, (b) A concept map or graphic representation of the content of the course, (c) The rational for the sequence of the course, especially if there is not an assigned text in chapter sequence. For example, a historical approach with topics arranged chronologically, a progression from simple to more complex procedures or concepts or a series of theoretical principles followed by applications. If appropriate, explain what the course is not about or what topics will not be covered".

"(IV) Instructional methods: provide a brief description of instructional approaches that will be used during the course. For instance, Lectures, Seminars, Laboratory or Clinical activities, group projects, problem solving in group or individual using work sheet or internet etc."

“(V) Assignments and Evaluation: Providing explicit information about assignments and grading procedures will allay student anxiety or prevent phone cells, e-mails and visits from students questioning their mark after the worse is finished. Once the course is finished, it is difficult to setup consistent standards and the result can be comparison and perceived injustice. In the evaluation part the following issues should be addressed: (a) A description of the means of evaluation to be used in the course, (b) A clear student of what percentage of the final grade each assignments and examination will represent, (c) The criteria and procedures for arriving at each emotionality score, (d) The consequences of a delayed presentation or later program are extensions possible. What are acceptable circumstances for a delay? Are these penalties? (e) The topic or name of each assignment, explicit information about assignments.(for example, length, breadth) can also be provided as part of the course outline, but this may be more easily provided later in the course, as assignments are presented.”

“(VI) Course Materials: Specific information should be provided about required texts including title, authors, edition number and where they can be purchased or borrowed. Additional material should be noted if they are part of the required reading; it should be clear what is required, reading as opposed to suggested reading. Recommended readings should also be listed”.

“ (VII) Legislation/policy statements of the institution related to the learners (i.e.., rules and regulations, due date of activities, absentees, etc.) would be included”

“(VIII) Access to the instruction: Office hours for students, office location, and telephone number for office appointments, other contact information may be provided such as email and similar information and applicable calendar course description”

"(IX) Feedback: All instructors are strongly encouraged to conduct mid course evaluation. Advising students of mid course evaluation ahead of time will likely lead to more constructive feedback."

Based on the above stated criteria the revised courses of 2012/2013 offer for prospective primary school mathematics teachers assessed as follows:

4.1.1.4.1. **The Assessment result of Courses designed for Primary Mathematics Teacher Education Trainees**

The courses are: (1) Basic Mathematics I (Math 101), 3 credit hours and 4 contact hours, (2) Basic mathematics II (Math 102), 4 credit hours, and 5contact hours, (3) Plane Geometry (Math 111), 3 credit hours and 4 contact hours, (4) Introduction to calculus (Math 162), 3 credit hours and 4 contact hours, (5) Solid Geometry (Math 112), 3 credit hours and 4 contact hours, (6) Fundamental Concept of Algebra (Math 221), 3 credit hours and 4 contact hours, (7) Elementary Linear Algebra (Math222), 3 credit hours and 4 contact hours,(8) Calculus I (Math 261), 4 credit hours and 5 contact hours, (9) Calculus II (Math 262), 4 credit hours and 5contact hours,(10) Introduction to probability and statistics (Math 272), 3 credit hours and 4 contact hours, (11) Methods of Teaching Mathematics (TeMa 242), 2 credit hours, and 2 contact hours,(12) Applied mathematics I (Math 231), 4 credit hours and 5 contact hours, and (13)Introduction to Information and Communication Technology (ICTE 101), 2 credit hours and 3 contact hours. (See the detail in appendix – K.)

Hence the above mentioned courses course out line components compared based on the criteria mentioned above as follows:

(I) Introduction and General Information: All the above mentioned courses fulfill these criteria except the introduction part which is not written in each course outline; (II) Course descriptions and learning outcomes: All the above mentioned courses fulfill these criteria; (III) Course Contents: In all courses contents are written in outline form. There is no description about the contents as mentioned in the criteria; (IV) Methods of Instruction: In All course outlines appropriate methods are suggested for each course; (V) Assignments and Evaluation: All courses assignments and grading procedures are mentioned as a component under Methods of Assessment; (VI) Course Materials: Some references are listed for each course. However the places where to get the references are not mentioned and compulsory and recommended readings are not written separately in all course outlines; (VII) Legislation, policy statements of the instruction related to the learners; rules and regulations and due date: These are not mentioned in all courses; (VIII) Access to the Instruction that is; Instructors name, address, academic status, advising hours, days and dates: these all are not mentioned in all Mathematics course out lines, and (IX) Feedback: This criterion indicates mid-course evaluation time and procedures. All the above mentioned Mathematics courses did not include this in the components.

From the above mentioned courses assessment analysis I conclude that almost all criteria are fulfilled except VII, VIII, and IX. Furthermore Richards, Simco, and Twiselton (2005) state that the subject matter of primary teacher education Mathematics involves several areas among these are the areas of subject knowledge, mental mathematics (the recall of simpler mathematical facts), diagnosis of errors (trainees must be taught to recognize children's errors i.e. avoiding methods which contribute to or exacerbate pupil's errors), classroom management, the search for a reliable standard (the concerns expressed by this area is that even with the basic qualification there seems to be a lack of knowledge or competence in mathematics on the part of intending teachers), assessment and record keeping.

Concerning teacher education Mathematics courses Richards et al (2005) suggest the following courses to be at the standard level:

> (1) Standards by content: The authors stated that prospective primary school mathematics teachers syllabus should include : (a) Geometry of lines circles and simple solid bodies, but excluding conic sections; (b) Coordinate Geometry of lines and circles; (c) Algebra, progressions; (d) The binomial theorem for positive integers; (e) Logarithms and their use, Probabilities; (e) Plane trigonometry, The solutions of triangles, Mechanics, Friction, virtual work, Centre of gravity, Simple machines, Motions of pendulums and projectiles, Motion in a circle, Impulsive forces acting on elastic and inelastic particles; (2) Procedural concerns: It is a system of allowing trainees to follow their own procedures of solving Mathematical problems. For instance to add 45+65, a trainee can start to add from the right instead of starting to solve from the left; (3) Student Teachers background: This procedure needs to consider students teachers capacity of solving different problems and since the ability of one differs from the other teacher educators/trainers need to consider how one learns from the other; (4) Algorithm: In this procedure what is expected from the student teacher is the correct answer, no need of worrying about how the student solved the problem (pp. 80-90)

Moreover Richards et al (2005) suggest that the National Curriculum for primary mathematics teacher education of Initial Teacher Training (ITT) should fulfill the following:

> (a) It needs a rational to accompany the raw statements of required content and it should provide a clearly defined purpose of a set of goals appropriate to the future of mathematics education;(b) The expected breadth and depth of coverage of contents, the amount of mathematical materials, and workable model has to be involved; (c) It is important to stress that ‘good’ courses in primary mathematics for student teachers include all the elements that develops; competence in mathematics, effective teaching and assessment methods, high standard knowledge, skill and attitude (pp. 52-57).

4.1.1.4.2. Analysis of Primary Mathematics Teacher Education Curriculum based on Richards et al (2005) Standards of Primary Teacher Education Curriculum

Standards by content: The authors quotation on page 179 considers that teachers training syllabus should include the following : (a) Geometry of lines circles and simple solid bodies, but excluding conic sections; (b) Coordinate Geometry of lines and circles; (c) Algebra, progressions, The binomial theorem for positive integers; (d) Logarithms and their use, Probabilities; (e) Plane trigonometry, The solutions of triangles, Mechanics, Friction, virtual work, Centre of gravity, Simple machines, Motions of pendulums and projectiles, Motion in a circle, Impulsive forces acting on elastic and inelastic particles.

The above mentioned standard courses are included in the courses of mathematics primary teacher education of KUC except Logarithms and their use, Mechanics, Friction, virtual work, center of gravity, simple machines, Motions of pendulums and projectiles, Motion in a circle, Impulsive forces acting on elastic and inelastic particles.

Procedural concerns like system of solving problems, student teachers capacity of solving different problems, cooperative learning of the students, and whether they depend on algorithm or not assessed in teacher educators' Interview, and teacher educators observation as well as in the attitude test.

Student teachers/prospective mathematics teachers: Prospective mathematics teachers' capacity of problem solving and how one student learns from the other student were provided for teacher educators to respond it during interview. However all of them responded that prospective mathematics teachers have no high school mathematics background and lack interest as well as they don't want to work hard. Of course one student learns from the other but clever students are few in number. These analogies can also be confirmed from the attitude test of the trainees that there is apprehension among prospective mathematics teachers when they solve mathematics problems.

4.1.1.4.3. Analysis of Primary mathematics Teacher Education Curriculum based on the National Professional Standards of Teachers (NPST) of Ethiopia designed by MoE in 2013

Furthermore The National Professional Standards for Teachers (NPST), (MoE, 2013) designed a standard for teacher education profile after graduated from Teacher Education Institutions. Hence based on the standards I tried to assess the contents of courses designed for prospective mathematics teachers of primary school as follows:

Selective standards appropriate to mathematics and possible contents to be learned by prospective teachers are the following (MoE, 2013, pp.11-26): To assess the contents of primary school mathematics teacher education based on the standard I used the curriculum attached at appendix-K.

“(1) understand students with diverse linguistic, cultural, religious and socio economic backgrounds.” According to this standard the curriculum of mathematics teacher education considers multicultural education. Hence all the contents of mathematics are appropriate to teach based on the environment and the culture of the community. For instance to teach set theory teacher educators can use any available materials around the environment suitable to the trainees culture such as stick, bamboo trees stick, pebbles etc.

“(2) Underpinning knowledge”. Based on this standard the curriculum of teacher education needs to develop the physical, social, and intellectual aspects of prospective teachers. This standard encourages teacher educators to train by giving the trainees different project works in which they use their creative and prepare any mathematics figures/ materials appropriate to the content and present for their colleagues. For instance they can prepare slide rules to multiply and divide numbers from locally available resources and present and share their experiences to their classmates.

"(3) Link key concepts, principles, and theories across the curriculum and to life applications." Based on this standard the curriculum of prospective mathematics teachers should balance the total learning. Of course teacher education curriculum have all knowledge/recalling type contents, understanding type contents, application type contents (It means deriving formulas and applying the formula to solve different problems), Analysis type for instance proving theorems, Synthesis type creating ones own formula and conclusion based on mathematical data and in the evaluation type it considers to evaluate the measurement of a building or a tree using trigonometric functions.

"(4) Engages students in formulating and testing hypothesis according to the methods of inquiry and standards of evidence within the discipline". The possible contents of this standard should comprise data presentation and analysis, deriving formulas and applying the formulas. For this standard appropriate courses are listed in appendix-k except identifying and testing hypothesis.

"(5) Use Information and Communication Technology (ICT)". For this standard prospective mathematics teachers should learn ICT courses and their applications to teach mathematics. For instance how to apply TPACK in learning and teaching mathematics. This content is not available in the curriculum of primary mathematics teacher education. Of course there is a course ICTE-103, but this course is not helping prospective teachers how they teach mathematics using ICT.

"(6) Plan, structure, and sequence learning programs." According to this standard the contents should be organized using logical and psychological sequence. In primary school mathematics teacher education curriculum the courses need to be re arranged and pre-requisite and subsequent courses are not identified in the course outlines or in the course catalog.

“(7) Engage with colleagues and improve practice.” Based on this standard prospective mathematics teachers need to learn how to identify mathematics problems and solve problems collaboratively. This is available in the curriculum and teacher educators were also observed when they practiced cooperative learning

“(8) Provide frequent opportunities for students to engage in learning experiences that promote problem solving, critical thinking, inquiry, and creativity.” Based on this standard there should be contents that develop trainees’ problem solving skill, critical thinking, inquiry, and creativity. Mainly these types of contents should involve proving theorems by providing logical reasoning and creating once own formula to solve different problems. These courses are available and it needs only effective teachers to apply it practically and efficiently.

“(9) Design learning experiences that take account of the key concepts, principles, and theories, including those outlines in the curriculum frame work.” Based on this standard there should be contents that involve all cognitive domain categories; these are Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation. Of course most parts of Affective and Psychomotor categories may not be involved in mathematics teacher education curriculum. Hence all cognitive domain category contents are available except affective and psychomotor domains.

“(10) Collect, analyze, and present information to support the improvement of curricular materials.” Based on this standard there should be contents that makes the trainees to collect data, present data, and analyze data collaboratively and individually. These contents are available to some extent. However teacher educators' project work for their trainees is not specifically explained in the course outlines how the trainees do their project work.

"(11) Help trainees represent physical events, work with data and reasons to communicate mathematically and make comments within their respective content areas in order to solve problems." This standard needs the trainees to learn how to prove theorems and give reason for each step. This is available in the contents of some course outlines. Hence it needs effective teachers to practice it efficiently.

"(12) Use ICT to support the attainment of planned learning outcomes." For this standard trainees need to learn contents how to use ICT and how to apply ICT to learn and teach mathematics. This is not available in the curriculum.

Thus the above mentioned standards are components of the seven general standards. These standars are also considerd to serve as strategies to practice pre-service teacher education program. Hence based on these standards the overall standard assessment of primary mathematics teacher education curriculum is good. However it needs some improvements mentioned in the assessment based on each criterion. Therefore it is possible to conclude that the strategies of pre-service primary teacher education need to follow the seven standards as strategies that lead to effective practices of primary teacher education program

In general the result of the study on practices of pre-service primary mathematics teacher education program indicates that there is a gap between prospective mathematics teachers attitude and mathematics education. This implies that prospective mathematics teachers lack interest and are not confident in their ability to learn and teach mathematics. In addition to these there is a gap between teacher educators' practices and TPACK activities. This violates the trend of UNESCO’s plan which states that "21st century training of teachers needs to be supported by technology so as to make the practices of pre-service teacher education program at the standard level". Moreover there is a wide gap of cooperative work between the academic staff and the University College management (see table 34). This reduces the effective practices of pre-service primary mathematics teacher education program.

Furthermore during classroom observation cooperative learning among prospective mathematics teachers was not observed. Concerning facilities based on teacher educators, department head, and faculty dean interviews result; there is no smart classroom, no modeling class rooms to practice mathematics courses through cooperative learning, no computer access for prospective mathematics teachers and no adequate reference books.

Thus I conclude that the practices of pre-service primary mathematics education need more progress towards proficiency.

4.1.2. The strategies and practices of Induction and CPD programs interms of the curriculum and TPACK knowledge areas related to Mathematics Education

This section comprises the presentation, analysis, and discussion of data obtained through: (a) Practices of Primary school mathematics teachers' and their attitude towards mathematics and teaching mathematics; and (b) Primary school directors, Parents, and Students interview; and (c) The assessment of primary school mathematics curriculum.

4.1.2.1. Practices of Primary School Mathematics Teachers’ and their Attitude towards Mathematics and Teaching Mathematics

This section comprises the presentation, analysis, and discussion of data obtained through: (a) primary school mathematics teachers' questionnaire, interview, and observation result; (b) primary school directors, parents, and students interviews result.

4.1.2.1.1. Primary school mathematics teachers’ questionnaire, interview, and observation result

This sub-section comprises data presentation, analysis, and discussion of primary school teachers' questionnaire, interview, and observation result

4.1.2.1.1.1. Primary school mathematics teachers’ questionnaire result

The responses of primary school mathematics teachers’ is organized, presented, analysed, and discussed using the following tables as follows:

Table 41: Characteristics of Respondent Teachers in randomly selected sub-cities and schools of Addis Ababa

Serial No.	Sub-cities	Schools	Teachers' Sex and Qualification				
			M	F	Diploma	1st degree	Total
1	Yeka	Birhangozo	3	5	6	2	8
		Dej. Wondirad	4	6	7	3	10
		Kokebetsibah	5	5	6	4	10
		Misrakchora	2	4	4	2	6
		MissFord	3	3	5	1	6
		Salayesh	4	5	7	2	9
		Yekaterara	3	5	8		8
		Yewatatochgenet	2	3	5		5
2	Bole	Goro	5	6	9	2	11
		Hidasie	4	7	8	3	11
		Misrakber No.2	3	6	9		9
		Misrakdil	3	4	7		7
3	Akaki-Kality	Akakimengist	3	4	5	2	7
		Fitw.Abayneh	5	6	9	2	11
		Furi	3	5	8		8
		Gelan N0.1	3	6	9		9
		Gelan No. 2	3	4	6	1	7
		Kality	4	6	7	3	10
		Total	62	90	125	27	152

As displayed in table 41; from 152 teacher respondents 125 (82.5 %) are females. This indicates that particularly in the first cycle (1-4) the number of females is larger than males. This implies that females have given more responsibility than males that they look after children better than males.   In addition to this out of 18 sample schools 7 directors are females, this indicates that females have also started to involve in school administration which encourages other female teachers to join school administration.

In 18 sample schools out of 152 teachers 27 teachers (17.76%) are first degree holders. In 18 sample schools there are 152 mathematics teachers and the questionnaire was administered to all teachers, however 8 teachers did not return the questionnaire. Out of 152 teachers 144 teachers (95%) filled and returned the questionnaire.

Table 42: Characteristics of Primary School Teachers who filled and returned the Questionnaire in each sample school (N = 144)

School	Sex			Grade taught		Education level		Age			Teaching experience	
	M	F	T	1^{st} cycle	2^{nd} cycle	Dip.	Degree	18-29	30-39	40&above	1-4 years	Above 4years
Akakimengist	1	6	7	5	2	5	2	3	2	2	2	5
Birhanguzo	3	5	8	6	2	6	2	2	4	2	1	7
Dej. Wondirad	4	4	8	5	3	5	3	2	2	4	2	6
Fitawu. Abayaneh	3	6	9	7	2	7	2	2	3	4	3	6
Furi	3	5	8	5	3	8		2	2	4	2	6
Gelan No.1	3	6	9	6	3	9		3	3	3	3	6
Gelan No. 2	3	4	7	5	2	6	1	2	2	3		7
Goro	4	6	10	7	3	8	2	1	6	3	2	8
Hidasie	4	7	11	7	4	8	3	2	4	5	3	8
Kality	4	6	10	7	3	7	3	2	4	4	1	9
Kokebetsibah	3	5	8	4	4	4	4	2	3	3	2	6
Misrakber No. 2	3	6	9	6	3	9		1	3	5	1	8
Misrakchora	2	4	6	4	2	4	2	1	2	3		6
Misrakdil	3	4	7	5	2	7		2	3	2	2	5
Missford	3	3	6	4	2	6		1	2	3	3	3
Salayesh	4	5	9	6	3	7	2	3	4	2	2	7
Yekaterara	2	5	7	4	3	7		2	3	2	1	6
Yewatatochgenet	2	3	5	3	2	5		2	2	1		5
Total	54	90	144	96	48	118	26	35	54	55	30	114

As displayed in table 42 most of the teachers (61.8%) are between the ages of 18-29 and 30-39 and the number of female mathematics teachers is greater than males. Most of the teachers (79.2%) teaching experience is above 4 years. It implies most of them have completed induction program trainings. Increasing the number of female mathematics teachers is relevant for first cycle children (1-4) due to their mother hood approach and their significant teaching methods.

Increasing number of female teachers in the lower grade is also significant due to that female teachers will be role models for the society to send their female children to school.

Table 43: Professional Status of Teachers

Variables	Yes		No		Respondents
	Frequency	Percent	Frequency	Percent	Total
Was teaching profession your choice?	111	77.1	33	22.9	144
Was mathematics your choice of study?	119	82.6	25	17.4	144
Would you change to another career if you had the opportunity?	133	92.4	11	7.6	144
Do you think that society appreciates your work?	10	6.9	134	93.1	144
Do you think your students appreciate your work?			144	100	144

As indicated in table 43, most of the teachers (92.4%) responded that they change the profession when they get the opportunity. In addition to this 93.1% and 100% of the respondents said that the society and the students do not appreciate their work respectively. From this statement I infer that teachers attitude towards the profession is minimal.

All respondents said that they have very few books (2-10) at their home and all of them teach mathematics from 17-25 periods per week that is from 10-17 hours. Teachers who teach mathematics at first cycle (1-4), also teach subjects like environmental science for about 5 hours, Aesthetics for about 3 hours, English for about 10 hours, and Amharic for about 5 hours. In addition to this teachers spend 1-3 hours for supervision and they do not spend any time for student counseling. More over some teachers 18(12.5%) spend 1-3 hours for administrative duties and 132(91.7%) teachers spend for individual curriculum planning, but they do not spend for cooperative curriculum planning. This implies that teachers lack time to diagnose academic problems of their students.

Table 44: The time teachers spend for different activities except teaching

Items	None		Less than 1 hour		1-2 hours		3-4 hours		More than 4 hours		Total	
	F	P	F	P	F	P	F	P	F	P	F	P
Preparing or grading student tests or exams					4	2.8	140	97.2			144	100
Reading and grading other student work			2	1.4	114	79.2	28	19.4			144	100
Planning lessons					113	78.5	31	21.5				
Meeting with students out of classroom time(for tutoring, guidance, etc.	142	98.6	2	1.4							144	100
Meeting with parents	142	98.6	2	1.4								
Professional reading and development activity (i.e., seminars, conferences, etc.)					9	6.3	5	3.5	130	90.3	144	100
Keeping students' records up to date					5	3.5	139	96.5			144	100
Administrative tasks including staff meetings (i.e., photocopying, displaying students, work)					4	2.8	140	97.2			144	100

As displayed in table 44; teachers mostly spend their time on professional reading and development activities; like meetings, seminars, workshops, etc. This reduces teachers' time of effective preparation and rehearsal of the subjectmatter for their students.

Teachers were asked the general hours they spend on teaching activities in and out of school per week; most of the teachers 84(58.3%) spend on 21-25 hours per week for teaching activities in and out of the school; where as some teachers 60(41.7%) spend on 26-30 hours per week for teaching activities in and out of the school. In addition to this teachers were asked how often they have meetings with other teachers in mathematics to discuss and plan teaching approaches and curriculum; Most of the teachers 109(75.7%) responded once in a week and the rest 25(17.4%) and 10(6.9%) responded every other month and once in a month respectively. This indicates cooperative problem solving among mathematics teachers is minimal.

Table 45: Teachers influence on school activities

Activities	None		Little		Some		A lot		Total	
	F	P	F	P	F	P	F	P	F	P
Subject matter to be taught							144	100	144	100
Specific text books to be used					4	2.8	140	97.2	144	100
The amount of money to be spent on supplies	144	100							144	100
Identifying the supplies to be purchased	140	97.2	4	2.8						

As seen from table 45, all teachers (100%) have much influence on the subject matter to be taught and most of the teachers (97.2%) use specific text books it indicates that mathematics teachers have no opportunities to refer and use different books to strengthen their students' mathematics knowledge.

Table 46: Teachers' response on the importance of different activities that help the students to be good at mathematics

Activities	Not important		Somewhat important		Very important		Total	
	F	P	F	P	F	P	F	P
Remember formulas and procedures					144	100	144	100
Think in a sequential and procedural manners					144	100	144	100
Understand mathematical concepts, principles, and strategies					144	100	144	100
Be able to think creatively					144	100	144	100
Understand how mathematics is used in the real world					144	100	144	100
Be able to provide reasons to support their solutions					144	100	144	100

As displayed in table 46 all the activities are significant to make the students to be good at mathematics. However to put these into practice it needs teachers competence in subject matter knowledge, method of teaching and enthusiastic activity.

Table 47: Teachers' Attitude towards Mathematics, and Teaching Mathematics (N=144)

	S. Disagree		Disagree		Agree		S. agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
Mathematics is primarily an abstract subject			32	22.2	92	63.9	20	13.9	2.92	.5972
Mathematics is primarily a formal way of representing the real world			35	24.3	82	56.9	27	18.8	2.94	.6561
Mathematics is primarily a practical and structured guide for addressing real situations			7	4.9	32	22.2	105	72.9	3.68	.5629
If students are having difficulty, an effective approach is to give them more practice by themselves during the class			24	16.7	86	59.7	34	23.6	3.07	.6330
Some students have a natural talent for mathematics and others do not					78	54.2	66	45.8	3.46	.5000
More than one representation (picture, concrete material, symbol set, etc.) should be used in teaching mathematics topic					111	77.1	33	22.9	3.23	.4218
Mathematics should be learned as sets of algorithms or rules that cover all possibilities			3	2.1	27	18.8	114	79.2	3.77	.4689
Basic computational skills on the part of the teacher are sufficient for teaching Primary School Mathematics			2	1.4	17	11.8	125	86.8	3.85	.3917
A liking for and understanding of students are essential for teaching mathematics					111	77.1	33	22.9	3.23	.4218

Table 47.1: Summary item statistics of teachers' attitudes towards Mathematics and teaching mathematics

	Mean	Min.	Max.	Range	Max/Min	Variance	No. of items
Item means	3.350	2.917	3.854	.938	1.321	.127	9
Item variance	.276	.153	.430	.277	2.806	.011	9

Table 47.2: Scale statistics of teachers' attitudes towards mathematics and Teaching mathematics

Mean	Variance	Std. deviation	Alpha	No. of items
30.1528	6.830	2.61336	.716	9

Tables 47, 47.1, and 47.2 indicate that teachers' attitude on a specific items (mathematics is primarily an abstract subject, mathematics should be learned as sets of algorithms or rules that cover all possibilities, and basic computational skills on part of the teacher are sufficient for teaching primary school mathematics) is negative. However the other components of teachers' attitude towards mathematics and teaching mathematics are beyond satisfactory.

Table 48: Teachers' response to their familiarity with mathematics documents (N= 144)

Documents	No such document		Not familiar		Fairly familiar		Very familiar		Total	
	F	P	F	P	F	P	F	P	F	P
The national curriculum guide for mathematics			1	0.7			143	99.3	144	100
The regional curriculum guide for mathematics			1	0.7			143	99.3	144	100
The school curriculum guide	143	99.3	1	0.7						
The national examination specifications	143	99.3	1	0.7						
The regional examination specifications	143	99.3	1	0.7						
The national pedagogy guide for mathematics	143	99.3	1	0.7						
The regional pedagogy guide for mathematics	143	99.3	1	0.7						

As seen from table 48; primary school mathematics teachers are very familiar with the national curriculum guide for mathematics and the regional curriculum guides for mathematics only. Hence teachers are not familiar with the rest guides. This indicates the existence of wide gap between teachers and mathematics documents which reduces teachers' effective preparation and presentation.

Table 49: Teachers' response to their preparation on primary school mathematics contents (N= 144)

Contents	I do not teach these topics		Not well prepared		Somewhat prepared		Very well prepared		Total	
	F	P	F	P	F	P	F	P	F	P
Fractions, decimals and percentages	15	10.4					129	89.6	144	100
Ratios and proportions	28	19.4					116	80.6	144	100
Measurement (units, instruments, and accuracy	14	9.7					130	90.3	144	100
Perimeter, area and volume	7	4.9					137	95.1	144	100
Geometric figures (definitions and properties)							144	100	144	100
Geometric figures(symmetry, motions, and transformations, congruence and similarity	9	6.2					135	93.8	144	100
Coordinate geometry	135	93.8					9	6.2	144	100
Algebraic representation	47	32.6					97	67.4	144	100
Evaluate and perform operations on algebraic expressions	128	88.9					16	11.1	144	100
Solving linear equations and inequalities	112	77.8					32	22.2	144	100
Representation and interpretation of data in graphs, charts, and tables	93	64.6					51	35.4	144	100
Simple probabilities (understanding and calculations)	142	98.6					2	1.4		

As displayed in table 49; all teachers (100%) are very well prepared to teach geometric figures that are definitions and properties and also (95%) are very well prepared to teach perimeter, area and volume. However some (11.1%) are very well prepared to evaluate and perform operations on algebraic expressions. It means that most of the teachers (88.9%) are not well prepared to evaluate and perform operations on algebraic expressions.

Teachers were also asked to respond the number of students they teach in mathematics classroom. Most of the teachers (86.4%) suggested that they teach an average number of 62 students in one class in which 29 are boys and 33 are girls. The rest (13.6%) suggested they teach an average number of 58 students (32 boys and 26 girls). This indicates that the class size is not suitable to teach mathematics.

Teachers were also asked to respond the subject which they emphasized most; then most of the teachers (92%) responded that they emphasize most for combined algebra and geometry. Most of the teachers (78%) responded that they teach mathematics for about 900 minutes per week the rest (22%) teach for about 1125 minutes per week. All of the respondents use a text book to teach mathematics in the class.

The respondents (100%) said that their mathematics teaching time (76%-100%) is based on their mathematics text books.

To know whether students use technology during mathematics lessons or not the following items were asked for mathematics teachers: (a) Do the students in your mathematics class have calculators available to use during mathematics lessons? (b) To what extent are the students in your mathematics class permitted to use calculators during mathematics lessons? (c) How often do students in your mathematics class use calculators for the activities checking answers, tests and exams, routine computation, solving complex problems, and exploring number concepts? (d) Do the students in your mathematics class have computers available to use during mathematics lessons? For these items all teachers responded that students are not allowed to use calculators or smart phones during the lesson and exams; because they said that this is the rule and regulation of the schools.

In planning mathematics lessons the main sources of written information which are suggested by all teachers are; (a) syllabus, (b) student text books, and (c) Teacher's guide.

Table 50: Teachers' response on what they usually ask their students during Mathematics lessons (N= 144)

Variables	Never or almost never		Some lessons		Most lessons		Every lesson		Total	
	F	P	F	P	F	P	F	P	F	P
Explain the reasons behind an idea			138	95.8	6	4.2			144	100.00
Represent and analyze relationships using tables, charts, or graphs			110	76.4	34	23.6			144	100.00
Work on problems for which there is no immediately obvious method of solution	144	100							144	100.00
Use computers to solve exercises or problems	144	100							144	100.00
Write equations to represent relationships	97	67.4	47	32.6					144	100.00
Practice computational skills							144	100.00	144	100.00
Use graphing calculators to solve exercises or problems	144	100							144	100.00

As displayed in table 50 activities which are never implemented by teachers are: (a) They do not work on problems for which there is no immediately obvious method of solution, (b) They do not use computers to solve exercises or problems, and (c) they do not use graphing calculators to solve exercises or problems. This implies teachers never use technology to teach math.

Table 51: Teachers' response on how often their students practice the following activities in mathematics lesson (N= 144)

Activities	Never or almost never		Some lessons		Most lessons		Every lesson		Total	
	F	P	F	P	F	P	F	P	F	P
Work individually without assistance from the teacher			129	89.6	15	10.4			144	100
Work individually with assistance from the teacher					134	93.1	10	6.9	144	100
Work together as a class with the teacher teaching the whole class					112	77.8	32	22.2	144	100
Work together as a class with students responding to one another			141	97.9	3	2.1			144	100
Work in pairs or small groups without assistance from the teacher			138	95.8	6	4.2			144	100
Work in pairs or small groups with assistance from the teacher					123	85.4	21	14.6	144	100

As indicated in table 51; students perform active learning methods mainly in some lessons. This implies that teachers lack to practice partcipatory method of teaching.

Table 52: The time teachers spend on the following activities in a typical month of lessons in percentage (N= 144)

Activities	5-15%		16-30%		31-45%		46-70%		71-100%		Total	
	F	P	F	P	F	P	F	P	F	P	F	P
Administrative tasks (not related to lesson's content/purpose)	144	100									144	100
Homework review			9	6.2	115	79.9	20	13.9			144	100
Lecture style presentation by teacher			16	11.1	122	84.7	6	4.2			144	100
Teacher guided student practice					7	4.9	137	95.1			144	100
Re-teaching and clarification of content/procedures	98	68.1	46	31.9							144	100
Student independent practice					106	72.6	38	26.4			144	100
Tests and quizzes			137	95.1	7	4.9					144	100

As displayed in table 52; teachers spend most of the time for lecture style presentation, homework review and teacher guided student practice. This implies teachers do not give emphasis for the students to be engaged in different activities.

Teachers were asked to respond how much the following contents had been taught;

(1) Fractions and number sense: the sub topics under this topic are written in the appendix- M; however teachers suggested as follows:

(a) the sub-contents such as whole numbers including place values are grade 2 contents and the period allotted for these in the syllabus is 5; (b) understanding and representing common fractions are grade 3 and 4 contents the period allotted for this is 3 for each grade; (c) Computations with common fractions is a grade 5 content and the period allotted for this is 5; (d) Understanding and representing decimal fractions is grade 5 content and the period allotted for this is 7; (e) Computations with decimal fractions is a grade 5 content and the period allotted for this is 5; (f) Relationships between common and decimal fractions, ordering of fractions is a grade 5 content and the period allotted for this is 5; (g) Rounding whole numbers and decimal fractions is a grade 4 content and the period allotted for this content is 7; (h) Estimating the results of computations is not the content of primary school mathematics; (i) Number lines is a grade 6 content and the period allotted including integers, and ordering integers is 7; (j) Computations with percentages and problems involving percentages is a grade 5 content and the period allotted for decimals and percentages is 5; (k) Simple computations with negative numbers is a grade 6 content, it is a sub content of integers and the period allotted for this is 3**;** (l) Square roots, small integer exponents is a grade 8 content and the period allotted for square, square roots, cubes and cube roots is 10.

(2) Measurement: Measurement is grades 5, 6, and 7 content and this content is written in the syllabus of grades 5, 6 and 7 with geometric figures and measurement and the period allotted for each grade is 10 In addition to this the contents: (a) Perimeter and area of simple shapes (triangle, rectangles, and circles) is a grade 4 content and the period allotted for perimeter and areas of rectangle and square is included in the content of plane and solid figures; (b) Volume of rectangular solids is a grade 8 content and the period allotted for this is included with solid figures.

(3) Geometry: the sub contents under geometry to be taught in primary grades are: (a) Cartesian coordinates of points in a plane and coordinates of points on a given straight line are grade 8 contents and for these the allotted period is 3; (b) Congruence and similarity are grade 8 contents and for this the allotted period is 5; (c) Simple two dimensional geometry (angles on a straight line, parallel lines, triangles and quadrilaterals) are grade 6 contents and for these the allotted period is 7.

Moreover teachers respond that Symmetry and transformation (reflection and rotation), visualization of three dimensional shapes, and Proportionality (scales applied to maps and models) are not included in primary mathematics syllabus. In addition to this concepts of ratio and proportion; ratio and proportion problems are grade 7 content; period allotted for these is 7 periods.

Under Algebra: number patterns and simple relations, simple algebraic expressions, and representing situations algebraically and formulas are grade 8 contents and taught for 8 periods. Whereas solving simple equations and inequalities are grade 7 contents and the periods allotted for these are 7. Under Data Representation, Analysis, and Probability; that is representation and interpretation of data in graphs, charts and tables, Arithmetic mean are grade 5 contents and taught for 5 periods. The content simple probabilities (understanding and calculations) is a grade 8 content taught for 6 periods.

Thus teachers taught the above mentioned contents in each grade level based on the period allotment. However 5 periods allotted to teach the following contents are not appropriate. These contents are: Data Representation, Analysis, and Probability; that is representation and interpretation of data in graphs, charts and tables, and Arithmetic mean.

Thus from the above teachers response it is possible to conclude that all teachers teach only contents written in the text book.

Table 53: Teachers' response to factors that challenge mathematics class (N= 144)

Factors	Not at all		A little		Quite a lot		A great deal		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
Students with different academic abilities					6	4.2	138	95.8	3.96	.2005
Students who came from a wide range of backgrounds (e.g., language, economic, residence, etc.)					6	4.2	138	95.8	3.96	.2005
Students with special needs, (e.g., hearing, vision, speech impairment, physical disabilities, mental or emotional/psychological impairment	4	2.8	140	97.2					1.97	.1649
Uninterested students					3	2.1	141	97.9	3.98	.1433
Disruptive students					141	97.9	3	2.1	3.02	.1433
Parents interested in their children's learning and progress	3	2.1	141	97.9					1.98	.1433
Parent's uninterested in their children's learning and progress					3	2.1	141	97.9	3.98	.1433
Shortage of computer hardware					3	2.1	141	97.9	3.98	.1433
Shortage of computer software					5	3.5	139	96.5	3.97	.1837
Shortage of other instructional equipment for students' use					6	4.2	138	95.8	3.96	.2005
Shortage of equipment for your use in demonstrations and other exercises					2	1.4	142	98.6	3.01	.1174
Inadequate physical facilities					142	98.6	2	1.4	3.035	.1174
High student/teacher ratio					139	96.5	5	3.5	2.99	.1837
Low morale among fellow teachers/administrators			3	2.1	140	97.2	1	0.7	3.98	.1667
Low morale among students					3	2.1	141	97.9	1.98	.1433
Threat(s) to personal safety or the safety of students	3	2.1	141	97.9					1.98	.1433

Table 53.1: Summary Item Statistics on Factors that Challenge Mathematics class

	Mean	Minimum	Maximum	Range	Max/Min	Variance	No. of items
Item means	3.358	1.972	3.986	2.014	2.021	.639	16
Item variances	.026	.014	.040	.026	2.915	.000	16

Table 53.2: Scale Statistics of Factors that Challenge Mathematics class

Mean	Variance	Std. deviation	Alpha	No. of items
53.7292	1.304	1.14182	.728	16

As displayed in tables 53, 53.1, and 53.2 The main challenges of teachers in mathematics classroom are: (a) Students with different academic abilities; (b) Students who came from a wide range of backgrounds; (c) Uninterested students; (d) Disruptive students; (e) Parents are not interested in their children's learning and progress; (f) Shortage of computers; (g) Shortage of instructional equipments; (h) inadequate facilities; (i) High student/teacher ratio; and (j) low morale among students. Teachers' response for the question how often they usually assign mathematics homework is: (a) All of them assign mathematics homework every day; (b) They usually assign mathematics homework for their students for 90 minutes and above. In addition to this they often assign mathematics homework for their students with respect to the tasks displayed in the following table.

Table 54: Teachers' response on how often they practice the following tasks to assign Mathematics home work (N =144)

Tasks	Never		Rarely		Sometimes		Always		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
Worksheets/work book	138	95.8	6	4.2					1.04	.2005
Problem/ questions sets in text book					1	0.7	143	99.3	3.99	.0833
Reading/problem solving in a text book or supplementary materials			7	4.9	137	95.1			2.95	.2158
Writing definitions or solving mathematics exercises			139	96.5	5	3.5			2.04	.1837
Small investigation (s) or gathering data	138	95.8	6	4.2					1.04	.2005
Working individually on long term projects or word problems			138	95.8	6	4.2			2.04	.2005
Working as a small group on long term projects or challenging problems			139	96.5	5	3.5			2.04	.1837
Finding one or more uses of the content covered	139	96.5	5	3.5					1.03	.1649
Preparing oral reports either individually or as a small group	140	97.2	4	2.8					1.035	.1837
Reviewing a mathematics journal	143	99.3	1	0.7					1.007	.0833

Table 54.1: Summary item statistics on how often teachers practice the above Mentioned tasks to assign mathematics home work

	Mean	Minimum	Maximum	Range	Max/ Min	variance	No of items
Item means	1.821	1.007	3.993	2.986	3.966	1.029	10
Item variance	.031	.007	.047	.040	6.706	.000	10

Table 54.2: Scale statistics on how often teachers practice the above mentioned tasks to assign mathematics home work

Mean	Variance	Std. deviation	Alpha	No. of items
18.2083	1,033	1.01647	.778	10

From tables 54, 54.1, and 54.2 I can infer that teachers' main tasks to assign students for mathematics home work are mainly problems/ question sets in text book, and reading/ problem solving in a text book or reference materials. However students' practices on gathering data, oral reports, reviewing a mathematical journal are almost nil. These need to be considered as main tasks of teachers

Table 55: Teachers' responses on how often they do the tasks listed after they gave Home work (N = 144)

Tasks	Never		Rarely		Sometimes		Always		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
Record whether or not the home work was completed			11	7.6	128	88.9	5	3.5	2.96	.3319
Collect, correct and keep assignments			7	4.9	131	91.0	6	4.2	2.99	.3014
Collect, correct assignments and then return to the students			8	5.6	129	89.6	7	4.9	2.99	.3238
Give feedback on homework to whole class			5	3.5	128	88.9	11	7.6	3.04	.3319
Have students correct their own assignments in class	131	91.0	11	7.6	2	1.4			1.10	.3492
Have students exchange assignments and correct them in class	140	97.2	4	2.8					1.03	.1649
Use it as a basis for class discussion	139	96.5	4	2.8	1	0.7			1.04	.2328
Use it to contribute towards students' grades or marks	4	2.8	134	93.1	6	4.2			2.01	.2641

Table 55.1: Summary of item statistics on how often teachers do the above mentioned tasks after they gave home work

	Mean	Minimum	Maximum	Range	Max/min	variance	No. of items
Item means	2.147	1.028	3.042	2.014	2.959	.924	8
Item variance	.086	.027	.122	.095	4.484	.001	8

Table 55.2: Scale statistics on how often teachers do the above mentioned tasks after they gave home work

Mean	Variance	Std. deviation	Alpha	No. of items
17.1736	1.865	1.36556	.721	8

As displayed in tables 55, 55.1, and 55.2 after the teachers gave home work they sometimes record whether or not the homework was completed. Hence they sometimes collect, and correct assignments and return to students, and give feedback on home work to whole class.

Table 56: Teachers' assessment weight of their students work respected to the following assessment techniques (N = 144)

Assessment techniques	None		Little		Quite a lot		A great deal		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
Standardized tests produced outside the school	136	94.4	8	5.6					1.06	.2299
Teacher-made short answer or problem solving tests that require students to explain their reasoning	16	11.1	126	87.5	2	1.4			1.90	.3411
Teacher made multiple choice, true-false and matching tests					17	11.8	127	88.2	3.88	.3238
How well students do on homework and assignments	134	93.1	10	6.9					1.07	.2551
How well students do on projects or practical problems	141	97.9	3	2.1					1.02	.1433
Observations of students	14	9.7	127	88.2	3	2.1			1.92	.3362
Responses of students in class	13	9.0	131	91.0					1.91	.2876

Table 56.1: Summary item statistics on teachers' assessment weight of their students work respected to the above assessment techniques

	Mean	Minimum	Maximum	Range	Max/min	variance	No. of items
Item means	1.823	1.021	3.882	2.861	3.803	1.011	7
Item variances	.079	.021	.116	.096	5.664	.011	7

Table 56.2: Scale statistics on teachers' assessment weight of their students' work using the above assessment techniques

Mean	variance	Std. deviation	Alpha	No. of items
12.7639	1.454	1.20596	.721	7

As displayed in tables 56, 56.1, and 56.2 teachers assess their students' mainly using teacher made multiple choice, true-false and matching items. However problem solving tests are minimal. Hence to assess mathematics using mainly the above mentioned items do not develop the problem solving ability of the students.

Table 57: Teachers' practices of the assessment information after they gathered data from their students' result (N= 144)

Practices	None		Little		Quite a lot		A great deal		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
Provide students' grades or marks					5	3.5	139	96.5	3.97	.1837
Provide feedback to students			2	1.4	135	93.8	7	4.9	3.05	.2484
Diagnose students' learning problems	3	2.1	138	95.8	3	2.1			2.00	.2048
Report to parents	2	1.4	138	95.8	4	2.8			2.01	.2044
Assign students to different programs or tracks	137	95.1	7	4.9					1.05	.2158
Plan for future lessons			2	1.4	140	97.2	2	1.4	3.00	.1673

Table 57.1: Summary item statistics of Teachers practices on the assessment information after they gathered data from their students' result

	Mean	Minimum	Maximum	Range	Max/min	Variance	No. of items
Item means	2.510	1.049	3.965	2.917	3.781	1.055	6
Item variances	.042	.028	.062	.034	2.207	.000	6

Table 57.2: Scale statistics of Teachers practices on the assessment information after they gathered data from their students' result

Mean	Variance	Std. deviation	Alpha	No. of items
15.0625	.590	.76842	.684	6

As indicated in tables 57, 57.1, and 57.2 teachers use the assessment result mainly to provide students' grades or marks and to give feedback for the students. However teachers do not use it to assess themselves and the curriculum.

4.1.2.1.1.2. Primary School Mathematics Teachers' Interview result

In the 18 sample schools primary school teachers were interviewed to respond for close ended and open ended items and their responses are organized and analyzed as follows:

Table 58: Characteristics of interviewed teachers in 18 sample schools (N = 49)

	Sex		Level/Cycle		Qualification	Teaching Experience	
	M	F	1st	2nd	Diploma	Min	Max
Birhangozo	1	2	2	1	3	2	8
Dej. Wondirad	2	2	2	2	4	4	16
Kokebetsibah	1	3	3	1	4	5	12
Misrakchora		2	1	1	2	7	13
MissFord		2	1	1	2	3	10
Salayesh	1	1	1	1	2	6	17
Yekaterara	1	1	1	1	2	4	9
Yewatatochgenet	2		1	1	2	3	11
Goro	1	3	3	1	4	8	15
Hidasie	2	2	3	1	4	6	14
Misrakber No.2		2	1	1	2	3	7
Misrakdil	1	1	1	1	2	5	7
Akakimengist	2		1	1	2	3	17
Fitw.Abayneh	2	2	3	1	4	4	7
Furi	1	1	1	1	2	3	9
Gelan N0.1		2	1	1	2	5	19
Gelan No. 2	1	1	1	1	2	6	11
Kality	2	2	2	2	4	4	7
Total	20	29	29	20	49		

As indicated in table 58, more teachers interviewed from first cycle because, the number of teachers teaching from grade (1-4) is greater than from those who teach at second cycle (5-8). From the interviewed teachers the minimum teaching experience is 2 and the maximum is 19. This implies that all interviewed teachers have completed induction program. The following tables (Table 59, Table 59.1, and Table 59.2.) display primary school teachers' responses on CPD activities in 18 sample schools.

Table 59: Practices of Continuous Professional Development Related to math(N =49)

CPD activities	S. Disagree		Disagree		Agree		S. Agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
CPD duration of training is adequate	8	16.3	14	28.6	27	55.1			2.39	.7587
CPD training is integrated to my field of study			11	22.4	38	77.6			2.84	.373
CPD training is logical, reasonable and compatible			20	40.8	29	59.2			2.59	.497
CPD training is relevant & helped me to teach mathematics effectively			5	10.2	36	73.5	8	16.3	3.00	.577
CPD training is highly related to math content	48	97.9	1	2.1					1.02	.395
CPD training helped me to use scientific assessment techniques	1	2.0	17	34.7	31	63.3			2.61	.533
CPD training helped me to practice active learning methods			7	14.3	30	61.2	12	24.5	3.10	.621
CPD helped me to manage the classroom effectively			5	10.2	35	71.4	9	18.4	3.08	.534
CPD is necessary for teachers who are not competent in professional skills and knowledge			16	32.7	27	55.1	6	12.2	2.796	.645
CPD improves the knowledge, skills and practice of teachers in the school			4	8.2	38	77.6	7	14.3	3.06	.475
CPD helps teachers to be confident in their work & improves student result			5	10.2	37	75.5	7	14.3	3.04	.498
CPD puts unnecessary load on teachers	6	12.2	22	44.9	21	42.9			2.31	.466
CPD is not significant for teachers(consumes time and wastage of resources	15	30.6	32	65.3	2	4.1			1.74	.531
CPD should be limited to subject matter development knowledge and methods			27	55.1	22	44.9			2.45	.503
CPD training was supported by TPACK	47	95.9	2	4.1					1.04	.369

Table 59 indicates, CPD training provided in the schools is not related to mathematics content and is not also supported by technology (TPACK).

Table 59.1: Summary item statistics of CPD school practices

	Mean	Minimum	Maximum	Range	Max/Min	Variance	No. of items
Item Means	2.492	1.306	3.102	1.796	2.375	.319	17
Item Variances	.300	.139	.576	.436	4.128	.011	17

Table 59.2: Scale statistics of CPD activities

Mean	Variance	Std. deviation	Alpha	No. of items
42.3673	10.112	3.17998	.527	17

As indicated in tables 59.1 and 59.2 the Items Cronbach’s alpha coefficient is .527. According to teachers' assessment the average point for the practices of CPD is 2.52 except the mean (1.74) of the component (CPD is not significant for teachers). This implies that CPD practices in the schools are not at the level of proficiency. Moreover teachers who are taking induction training suggest that the modules prepared for induction program need to update and contents are not related to mathematics. Thus both induction and CPD programs need improvement. Related to technology all interviewees (100%) responded as follows: (a) Teachers as well as their students do not use calculators or computers to develop models; (b) Teachers and their students do not use calculators and computers to organize and solve some statistical data; (c) Teachers do not use computers to solve different exercises; and (d) teachers have no internet access in all sample schools. These imply that in all sample schools teachers and students have no opportunities to teach and learn using technology. The following table displays teachers' use of higher order instructional methods, use of lesson plan and college courses and practices (for detail information see appendix- F)

Table 60: Teachers' system of practices on higher order instructional methods, lesson plan and college courses (N= 49)

Items	S. disagree		Disagree		Agree		S. Agree		Mean	Std. deviation
	F	P	F	P	F	P	F	P		
I encourage my students to work on independent math worksheets	7	14.3	37	75.5	5	10.2	-	-	1.96	.498
I encourage my students to work on problems for which there is no obvious solution/challenging problems	6	12.2	43	87.8	-	-	-	-	1.88	.047
I create opportunities for my students to debate on different problems by explaining their reasoning	3	6.1	21	42.9	25	51.0	-	-	2.45	.615
I use all components of lesson plan	-	-	-	-	15	30.6	34	69.4	3.69	.466
I apply the time, activities and materials planned in my lesson	-	-	-	-	26	53.1	23	46.9	3.47	.504
I prepare my self before the class					34	69.4	15	30.6	3.31	.466
I always use appropriate and attractive teaching aids	11	22.4	38	77.6	-	-	-	-	1.78	.422
I learned appropriate mathematics courses and helped me to teach math at primary level	-	-	6	12.2	43	87.8	-	-	2.88	.331
The courses I learned in the college brought me some ethical changes in my profession	-	-	6	12.2	43	87.8	-	-	2.88	.331
The courses I learned in the college helped me to develop my knowledge, skill and attitude	-	-	-	-	27	55.1	22	44.9	3.45	.503
The courses I learned in the college helped me to be motivated more and become efficient in all classroom activities.	-	-	27	55.1	22	44.9	-	-	2.45	.503

As displayed in table 60 teachers don’t prepare worksheets for their students to be done independently, students have no opportunities to practice challenging problems, and to work problems through reasoning. The aggregate mean of Teachers’ system of practices on higher order instructional methods, lesson plan, and college courses is 2.75. This indicates teachers' practices on these activities are below the level of proficiency.

Table 60.1: Summary item statistics of teachers systems of practices on higher order Instructional methods, use of lesson plan and college courses

	Mean	Min.	Max.	Range	Max/Min	Variance	No. of items
Item means	2.744	1.776	3.694	1.918	2.080	.476	11
Item variances	.211	.110	.378	.268	3.442	.007	11

Table 60.2: Scale statistics of teachers’ responses on higher order instructional methods, use of lesson plan and application of college courses

Mean	Variance	Std. deviation	Alpha	No. of items
30.1837	8.986	2.99773	.815	11

As indicated in tables 60.1, and 60.2 Cronbach’s Alpha coefficient is .815 (high) however, primary school teachers use of higher order instructional methods, use of lesson plan and application of college course are below the level of proficiency based on teachers evaluation.

Concerning TPACK activities primary school teachers have not yet started to teach using technology and students have no opportunities to share experiences from other students of the world. However related to pedagogical knowledge (PK) all respondent teachers said that: (a) they have generic knowledge about how students learn intensively; (b) they have skill and knowledge about teaching approaches; (c) they have skill and knowledge about methods and assessment; (d) they apply different learning theories in the class; and (e) they always prepare lesson plan and apply it in their instruction.

Furthermore most of the teachers (87.8%) responded that they have studied different disciplines like accounting, economics, hotel management etc. different from the teaching profession; the reasons suggested by 34 teachers (69.4%) are mainly economic problem and students' discipline problems. Most of the teachers (77.8%) have tried to evaluate the curricular materials of mathematics respected to each grade some of the comments forwarded by teachers are: (a) Excess content are designed for grades 1and 2, (b) some illustrations are not clear and not related to the content, (c) In some grades (1,2,3), the size of the text books are very large and are not suitable for children to carry or put it in the bag, and (d) some answers written in the teacher's guide are incorrect. Moreover primary school mathematics teachers suggest the following grade 1 contents as difficult and beyond the level of the learners: Unit 5 (Measuring using traditional measures); Unit 6 (Basic concepts of fractions); Unit 7 (Multiplying and dividing whole numbers up to 20); Unit 10 (Ethiopian money); Unit 11 (Time); Unit 12 (Data handling and simple mathematics sequence).

Among 49 primary schools mathematics teachers one of my interviewees forwarded the following points:

> I did not get the chance of the reward however some of my colleagues got the reward in terms of money, material, and certificate according to their rank. In the schools trainings like induction and CPD programs are on progress, however Induction program modules prepared in 1998 need revision and contents are not related to mathematics. I suggest that the school has no adequate facilities to teach mathematics; I am using my own mathematical instruments. Some of the challenges I faced in teaching mathematics are: (a) students' disciplinary problems; (b) students poor mathematics background; (c) most of the parents do not follow up their children academic achievement; (d)Some children are always sleeping in the class room, because they usually come without eating food due to poverty and many children in one family. But some NGO's provide food for few children, however the problem is still available (Date: 03/30/2016).

The opinion of the above interviewee indicates that there are no adequate facilities to teach mathematics in the school and students' mathematics background is below satisfactory. And some children lack food due to that their family could not support them in providing sufficient food because of poverty and many children in one family. However to alleviate this problem in some schools feeding program has already started by the government and NGO's.

Similarly my second interviewee forwarded the following points:

> I know more about teachers' license and I have already taken the written examination, however I am still waiting for the result. Of course there is reward for teachers who have best performances in terms of money, material and certificate. Related to trainings Induction and CPD programs are progressing in the schools, however the modules prepared in 1998 E.C for induction training need to update and contents are not related to mathematics. The school facilities are not adequate particularly there are no mathematical instruments set to teach Geometry. The main problems I faced during teaching mathematics are: (a) Students Disciplinary problems, (b) Students' Mathematics background is poor, (c) some students have no interest to learn mathematics,(d) Most of the parents do not follow up their children performance and activities (e) There is a wide gap among students performance (Date: 04/08/2016).

The above two interviewees of primary school mathematics teachers and other interviewees have almost similar opinions and I summarized their opinion as follows:

Some teachers (42.9%) know more about teachers license and they said that they have already taken the written examination however the result have not yet informed to them. In addition to this the respondents suggested that there is a reward or an incentive for role model teachers in terms of money, material and certificate. Moreover all interviewed teachers responded that there are no adequate facilities in the schools to teach mathematics effectively and they suggested that Induction and CPD trainings are available in the schools; however the content of Induction modules prepared in 1998 need revision and contents are not related to mathematics.

All interviewed teachers suggest the following major challenges they faced in the classroom and outside the classroom: (a) Students Disciplinary problems; (b) Students mathematics background is poor; (c) some students have no interest to learn mathematics; (d) most of the parents do not follow up their children performance and activity; (e) there is a wide gap among students performance; and (f) some students are coming without eating food and always sleeping in the classroom, to reduce the problem the government has started feeding program. However the program involves only few children and still some vulnerable children need help in all schools.

4.1.2.1.1.3. Primary School Mathematics Teachers Class room Observation result

The observation result of primary school mathematics teachers is organized and presented using the following tables including the interpretation of each table as follows:

Table 61: Characteristics of Observed Mathematics Primary School Teachers

Name of the school	Teachers Sex and Qualification							Teaching experience in years	
	Sex		Level/Cycle		Qualification		Total	1-4 years	Above 4years
	M	F	1st	2nd	Diploma	Degree			
Birhangozo	1	2	2	1	3		3	2	1
Dej. Wondirad	1	2	2	1	3		3		3
Kokebetsibah	1	2	2	1	2	1	3		3
Misrakchora	2	1	2	1	2	1	3	1	2
MissFord	1	2	2	1	3		3	1	2
Salayesh	1	2	2	1	3		3		3
Yekaterara	1	2	2	1	3		3	1	2
Yewatatochgenet	2	1	2	1	3		3	2	1
Goro	1	2	2	1	3		3		3
Hidasie	2	1	2	1	3		3		3
Misrakber No.2	1	2	2	1	3		3	1	2
Misrakdil	2	1	2	1	3		3		3
Akakimengist	2	1	2	1	3		3		3
Fitw.Abayneh	1	2	2	1	3		3	2	1
Furi	1	2	2	1	3		3	1	2
Gelan N0.1	1	2	2	1	3		3		3
Gelan No. 2	1	2	2	1	3		3	2	1
Kality	1	2	2	1	2	1	3		3
Total	23	31	36	18	51	3	54	13	41

Table 61 indicates that more teachers were observed in the first cycle, because the numbers of teachers teaching from grades 1-4 are greater than teachers who teach at the second cycle (5-8).

As displayed in table 61, from each sample school two teachers from first cycle and one teacher from second cycle were randomly selected and observed twice in different periods. The observed grades were selected using lottery method in each sample school. Fortunately all grades (1-8) were involved in the observation. Two teachers were selected from first cycle, because the number of teachers in first cycle is greater than second cycle.

Teachers were observed by two data collectors whose education background is at Masters level in mathematics. At the end of observation the two raters discussed and agreed with high and low rating performances and the result recorded. One teacher was observed two times and the average result was recorded. Most of the teachers (75.9%) have above 4 years of teaching experience; it means most of them have completed Induction trainings.

Teachers were observed while teaching the topics in the following grades: (a) In grade 1; Lines and simple figures, straight and curved lines, whole numbers up to 100, Multiples of 10 up-to 100, Ethiopian money and Time, (b) In grade 2 ; points, lines and shapes, Drawing lines, Addition and subtraction of money, (c) In grade 3; word problems on Ethiopian money, Time and minutes, Reading time, Days, Weeks, Months and Years (d) In grade 4; Solid figures, Time, Minutes and Second, and Comparing using time, (e) In grade 5; Data handling, Drawing and interpreting bar graphs, Average of numbers and lines, (f) In grade 6; Equalities and inequalities of Linear equations, Indicating points on the number line and equations and Angles, (g) In grade 7; Solving Linear equations and inequalities, Ratio and proportion, Quadrilaterals, Polygons and circles, (h) in grade 8; Further on linear inequalities, Cartesian coordinate system, Similar plane figures, Similar triangles and Circles.

Table 62: Teachers' ability of practicing their knowledge (N = 54)

Designing Knowledge Work	Min.	Max.	Mean	Std. deviation
Demonstrating Knowledge of Content and Pedagogy	2.00	4.00	3.1296	.64563
Ability of making students to be in the learning situation	2.00	4.00	3.2407	.54721
Ability of informing instructional objectives	2.00	4.00	2.9444	.65637
Knowledge of resources including technology	1.00	3.00	2.1852	.67500
Ability of designing coherent instruction	2.00	4.00	2.9074	.70760
Techniques of assessing student learning	2.00	4.00	3.3889	.65637
Knowledge of students' backgrounds, skills and interests	2.00	4.00	3.0926	.70760
Objectives are designed related to curriculum frame works and standards	2.00	4.00	3.3519	.51970

Table 62.1: Summary item statistics of Teachers' ability of practicing their knowledge

	Mean	Minimum	Maximum	Range	Max/Min	Variance	No. of items
Item means	3.030	2.185	3.389	1.204	1.551	.147	8
Item variance	.413	.270	.501	.231	1.854	.007	8

Table 62.2: Scale statistics of Teachers' ability of practicing their knowledge

Mean	Variance	Std. deviation	Alpha	No. of items
24.2407	6.337	2.51737	.550	8

Tables 62, 62.1, and 62.2 indicate, the grand mean of teachers ability of practicing their knowledge work is 3.030 this lays in the ratings "Proficient" this implies teachers have a clear proficiency and skill in practicing their knowledge work. However ability of informing instructional objectives, Knowledge of resources including technology, and ability of designing coherent instruction lay under the rating "Basic" this implies teachers need more progress towards proficiency.

Table 62.3: Analysis of variance of teachers' ability of practicing their knowledge (N= 54)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		41.984	53	.792		
	Between Items	55.442	7	7.920	22.063	.000
Within People	Residual	133.183	371	.359		
	Total	188.625	378	.499		
Total		230.609	431	.535		

Grand Mean = 3.0301

As indicated in table 62.3, for the degree of freedom (53, 371) obtained value of F = 22.06, critical F- ratio = 2.02, since obtained value of F greater than critical F-ratio (22.063 > 2.02 for $p < 0.05$) ; then the difference between the means of teachers' ability of practicing their knowledge is significant at 0.05 level of significance; this implies that teachers ability of practicing their knowledge is different from one teacher to the other and this can be inferred that there is differences of ability in practicing knowledge among teachers.

Table 63: Teachers' ability of organizing the environment for knowledge work (N= 54)

Organizing the environment for knowledge work	Min.	Max.	Mean	Std. deviation
Class room interactions are highly respectful	2.00	4.00	2.93	.57796
There is high levels of civility among members of the class	2.00	4.00	2.9259	.54433
Students take much of the responsibility for establishing a culture for learning in the classroom	2.00	4.00	3.2222	.53787
Students are pride in their work	3.00	4.00	3.2222	.41964
Students demonstrate initiating improvements to their result	3.00	4.00	3.2593	.44234
Teacher demonstrates a passionate commitment to the subject	3.00	4.00	3.0370	.51259
Class room routines and procedure are coherent in their operation	2.00	4.00	3.1296	.39076
Students assume considerable responsibility for their smooth functioning	2.00	3.00	2.2407	.43155
Student behavior is entirely appropriate	2.00	3.00	2.6111	.49208
Students participate in monitoring others behavior	1.00	3.00	1.3519	.51970
Teacher's monitoring of students behavior is suitable and preventive	2.00	4.00	2.7778	.57188
Teacher's response to student misbehavior is sensitive to individual student needs	2.00	4.00	2.9259	.54433
Teacher's classroom is safe	2.00	4.00	3.1111	.53787
Students contribute to ensuring that the physical environment supports the learning of all students	2.00	4.00	3.0370	.61316

Table 63.1: Summary item statistics of Teachers' ability of organizing the environment for knowledge work

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	2.841	1.352	3.259	1.907	2.411	.258	14
Item Variances	.264	.153	.376	.223	2.462	.004	14

Table 63.2: Scale statistics of Teachers' ability of organizing the environment for knowledge work

Mean	Variance	Std. deviation	Alpha	No. of items
39.7778	7.195	2.68234	.524	14

As displayed in tables 63, 63.1, and 63.2 the grand mean of teachers ability of organizing the environment for knowledge work is 2.84 this will be involved in the ratings “Basic" this means teachers need to improve/ progress towards proficiency.

Table 63.3: Analysis of variance on teachers' ability of organizing the environment for knowledge work (N= 54)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		27.238	53	.514		
Within People	Between Items	181.175	13	13.937	56.973	.000
	Residual	168.540	689	.245		
	Total	349.714	702	.498		
Total		376.952	755	.499		

Grand Mean = 2.8413

As indicated in table 63.3, for the degree of freedom (53, 689), obtained value of F= 56.973 and critical F-ratio= 1.93 then since obtained value of F is greater than critical F-ratio (56.973>1.93, $p< 0.05$) then the differences between means is significant at 0.05 level of significance; this implies that there is a difference of teachers' ability of organizing the environment for knowledge.

Table 64: Teachers' Instruction practices (N= 54)

Instruction practices	Min.	Max.	Mean	Std. deviation
Teacher's oral and written communication is clear and expressive	2.00	4.00	2.8519	.5287
Teacher's anticipating possible student misconceptions	2.00	4.00	2.9444	.49208
Students formulate many of the high level questions	1.00	3.00	2.2407	.47325
Students assume responsibility for the participation of all students in the discussion	1.00	3.00	2.1852	.511667
Students are highly engaged throughout the lesson and make material	2.00	3.00	2.7222	.45211
Contributions of students to the representation of content, the activities and the materials	2.00	4.00	3.0556	.56357
The structure and pacing of the lesson allow for student reflection and closure	2.00	4.00	2.9815	.56604
Teacher's feedback to students is timely	2.00	4.00	3.2407	.51157
Teacher's feedback to students is of consistently high quality	2.00	4.00	3.0185	.56604
Students make use of the feedback in their learning	2.00	4.00	3.1481	.52870
The teacher is highly responsible to students' interest and questions	2.00	4.00	3.2037	.52771
The teacher is making major lesson adjustments of necessary	2.00	4.00	3.1481	.49172
The teacher persists in ensuring the success of students	2.00	4.00	2.8519	.52870

Table 64.1: Summary item statistics of Teachers' Instruction practices

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	2.892	2.185	3.241	1.056	1.483	.113	13
Item Variances	.270	.204	.320	.116	1.568	.001	13

Table 64.2: Scale statistics of teachers' instruction practices

Mean	Variance	Std. deviation	Alpha	No. of items
37.5926	6.850	2.61720	.527	13

As displayed in tables 64, 64.1, and 64.2, the aggregate mean of teachers instruction practices is 2.89 which is at the level of " Basic" this implies that teachers need more progress or improvements in their instruction practices.

Table 64.3: Analysis of variance on teachers instruction practices (N= 54)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		27.926	53	.527		
	Between Items	73.402	12	6.117	24.553	.000
Within People	Residual	158.444	636	.249		
	Total	231.846	648	.358		
Total		259.772	701	.371		

Grand Mean = 2.8917

As displayed in table 64.3; for the degree of freedom (53, 636), obtained value of F= 24.553 and critical F-ratio=1.93 (24.553 > 1.93, p< 0.05) this implies the difference between means is significant at 0.05 level of significance. Hence it can be inferred that teachers differ in their instruction practices or there is differences in implementing the instruction among teachers.

Table 65: Teachers' Professional Responsibilities (N= 54)

Variables	Min.	Max.	Sum	Mean	Std. deviation
Teacher's reflection on the lesson is highly accurate and perceptive	2.00	4.00	165	3.056	.68451
The teacher is citing specific examples	2.00	4.00	161	2.98	.68655
The teacher draws on an extensive repertoire to suggest alternative strategies	2.00	3.00	144	2.67	.47583
Teacher's system for maintaining accurate records is efficient and effective	2.00	4.00	157	2.91	.7076
Students contribute to the system for maintaining accurate records	2.00	3.00	129	2.39	.49208
The teacher communicates frequently and sensitively with families	1.00	2.00	71	1.31	.46880
The teacher successfully engages the students in the instructional program	2.00	3.00	144	2.67	.47583
Students participate in communicating with families	1.00	3.00	69	1.28	.49208
The teacher makes a substantial contribution to school and disjoint events and projects	2.00	4.00	151	2.80	.59494
The teacher assumes leadership with colleagues	2.00	3.00	122	2.26	.44234
The teacher makes a substantial contribution to the profession through different activities	1.00	3.00	124	2.30	.50017
The teacher conducts an action research and mentoring new teachers	3.00	4.00	180	3.33	.4758
The teacher actively pursues professional development	3.00	4.00	199	3.69	.46880
The teacher assumes a leadership position in ensuring that school practices and procedures	1.00	3.00	110	2.04	.64319

Table 65.1: Summary statistics of teachers' professional responsibilities

	Mean	Minimum	Maximum	Range	Max./min	Variance	N of items
Item means	2.548	1.278	3.685	2.407	2.884	.472	14
Item variances	.304	.196	.501	.305	2.559	.013	14

Table 65.2: Scale statistics of teachers' professional responsibilities

Mean	Variance	Std. deviation	Alpha	N of items
35.667	8.981	2.99685	.566	14

As displayed in tables 65, 65.1, and 65.2, practices of teachers professional responsibilty items mean is 2.548 and total mean is 35.667 which is categorized in the evaluation rating of "Basic" this indicates that teachers need more progress in their professional responsibilities.

Table 65.3: Analysis of variance of teachers' professional responsibilities (N= 54)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		34.000	53	.642		
	Between Items	331.656	13	25.512	91.728	.000
Within People	Residual	191.630	689	.278		
	Total	523.286	702	.745		
Total		557.286	755	.738		

Grand Mean = 2.5476

Table 65.3 indicates, for the degree of freedom (53, 689), obtained value of F= 91.728 and critical F-ratio=1.93 then obtained value of F is greater than critical value of F-ratio (91.728 > 1.93, p< 0.05) this implies the difference between means is significant at 0.05 level of significance. Hence it can be inferred that teachers differ in their practices of professional responsibilities or there is differences in implementing the professional duties among teachers.

The observation result of teachers on Technology, pedagogy and content knowledge (TPACK) is as follows:

Primary school mathematics teachers were observed how they practice teaching learning activities using technology; however except pedagogical knowledge (PK) and Pedagogical Content Knowledge (PCK) teachers did not use technology to teach mathematics. For instance they did not use calculators, smart phones, and computers to implement Technology knowledge (TK), Content Knowledge (CK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and Technological Pedagogical Content Knowledge (TPCK) to teach mathematics by applying computer and using the internet to solve problems from the cloud. However teachers pedagogical knowledge (PK) and Pedagogical Content Knowledge (PCK) were observed and data presented and analyzed as follows:

Table 66: Teachers application of their pedagogical knowledge (N = 54)

Variables	Min.	Max.	Sum	Mean	Std. deviation
The teacher has generic knowledge about how students learn intensively	2.00	4.00	159	2.9444	.49208
The teacher has the skill and knowledge about teaching approaches	2.00	4.00	161	2.9815	.53167
The teacher has the skill and knowledge about methods of assessment	2.00	4.00	160	2.9630	.38671
The teacher applies different learning theories in the lesson	2.00	3.00	120	2.2222	.41964
The teacher always prepares lesson plan and apply it in the instruction	3.00	4.00	209	3.8704	.33905
The teacher uses different resources (technological as well as local resources) to transmit the subject matter effectively	2.00	3.00	155	2.8704	.33905

Table 66.1: Summary item statistics of teachers practices on their pedagogical knowledge

	Mean	Minimum	Maximum	Range	Max/Min	Variance	No. of items
Item means	2.975	2.222	3.870	1.648	1.742	.276	6
Item variance	.180	.115	.283	.165	2.459	.005	6

Table 66.2: Scale statistics of teachers practices on their Pedagogical Knowledge

Mean	Variance	Standard deviation	Alpha	No. of items
17.8519	2.732	1.65298	.744	6

As displayed in tables 66, 66.1, and 66.2, the mean of practices of teachers on pedagogical knowledge is 2.975 which is categorized in “Basic" this indicates that teachers need some progress in their practices of pedagogical knowledge

Table 66.3: Analysis of variance of teachers' application on their pedagogical knowledge (PK) (N = 54)

	Sum of squares	Df	Mean square	F	Sig.
Between people	24.136	53	.455	119.275	.000
Between Items	74.543	5	14.909		
Within people Residual	33.123	265	.125		
Total	107.667	270	.399		
Total	131.802	323	.408		

Grand mean =2.9753

As displayed in table 66.3, for the degree of freedom (53, 265) obtained value of F = 119.275, critical F- ratio = 1.93, since obtained value of F greater than critical F-ratio (119.275 > 1.93 for p< 0.05) then the differences of means is significant at 0.05 level of significance; this implies that teachers ability of practicing their knowledge is different from one teacher to the other and which can be inferred that there is differences of ability in practicing knowledge among teachers.

Table 67: Teachers' Practices on Pedagogical Content Knowledge (PCK) (N= 54)

Variables	Minimum	Maximum	Sum	Mean	Std. dev.
The teacher knows how to combine pedagogy and content and teach effectively	2.00	4.00	154	2.85	.627
The teacher knows how to make a subject understandable to the students	2.00	4.00	158	2.93	.544
The knows what makes a subject difficult or easy to learn	2.00	3.00	128	2.37	.592
The teacher knows the common misconceptions of the students in mathematics	1.00	3.00	123	2.28	.627
The teacher knows how the students develop math concept in the classroom	2.00	4.00	151	2.80	.562

Table 67.1: Summary item statistics of Teachers' practices on Pedagogical Content Knowledge (PCK)

	Mean	Minimum	Maximum	Range	Max/Min	variance	N of numbers
Item means	2.644	2.278	2.926	.648	1.285	.089	5
Item variance	.350	.296	.393	.097	1.327	.002	5

Table 67.2: Scale statistics of teachers' practices on pedagogical content knowledge (PCK)

Mean	Variance	Std. deviation	Alpha	N of items
13.2222	4.025	2.00628	.707	5

As indicated in tables 67, 67.1, and 67.2 the mean of teachers performance on pedagogical content knowledge (PCK) is 2.644 which is categorized in the evaluation rating of “Basic" this implies that teachers need more improvement on the practices of Pedagogical Content Knowledge (PCK).

Table 67.3: Analysis of variance on teachers' practices of pedagogical content knowledge (PCK) (N = 54)

ANOVA

		Sum of Squares	df	Mean Square	F	Sig
Between People		42.667	53	.805		
Within People	Between Items	19.163	4	4.791	20.298	.000
	Residual	50.037	212	.236		
	Total	69.200	216	.320		
Total		111.867	269	.416		

Grand Mean = 2.6444

Table 67.3 indicates, for the degree of freedom (53,212) obtained value of F = 20.298 and critical F- ratio = 1.93 since obtained value of F greater than critical F-ratio (20.298 > 1.93 for p< 0.05) then the differences of means is significant at 0.05 level of significance; this implies that teachers ability of practicing their PCK different from one teacher to the other and which can be inferred that there is differences of ability in practicing PCK among teachers.

4.1.2.1.2. Directors, Students, and Parents Interview Result

In this section the responses of directors, students, and parents presented, interpreted, and discussed as follows:

4.1.2.1.2.1. Primary School Directors Interview result

In the sample schools 18 primary school directors were interviewed and their demographic data, responses, and analysis displayed as follows:

Table 68: Characteristics of primary schools directors with respect to sub-cities, schools, Sex and qualification

Serial No.	Sub-cities	Schools	Sex		Qualification			
			M	F	1st degree	Masters	Experience in teaching & administration in years	Total
1	Yeka	Birhangozo	1		1		5	1
		Dej. Wondirad	1		1		17	1
		Kokebetsibah		1	1		13	1
		Misrakchora	1		1		7	1
		MissFord		1	1		5	1
		Salayesh	1		1		9	1
		Yekaterara		1	1		8	1
		Yewatatochgenet	1		1		7	1
2	Bole	Goro		1	1		5	1
		Hidasie		1	1		11	1
		Misrakber No.2	1		1		7	1
		Misrakdil		1	1		6	1
3	Akaki-Kality	Akakimengist	1		1		15	1
		Fitw.Abayneh		1	1		6	1
		Furi	1		1		9	1
		Gelan N0.1	1		1		10	1
		Gelan No. 2	1			1	7	1
		Kality	1		1		13	1
		Total	11	7	17	1		18

As indicated in table 68, there are 7 female directors which is significant to stimulate other female teachers to join school administration. All directors have 5 years and above experience in teaching and school administration. The responses of directors presented as follows:

From 18 directors one of my interviewees responded as follows:

> In our school students are not allowed to use calculators and mathematics teachers have also no access to use computers and LCD projectors to teach mathematics, because to fulfill facilities like computers and smart class rooms the school has no sufficient budget. Of course some mathematics teachers prepare and give problems for their students,but to distribute the problems using work sheets for all students need budget, hence due to financial problem the students will be obliged to copy the problems from the blackboard (Date:03/23/2016).

Similarly my second interviewee forwarded as follows:

> I suggest that there is peer observation among mathematics teachers, but there is no self assessment among math teachers. Teachers will be assessed using teachers' performance check lists which will be filled by students, the administration of the school, and PTA. The assessment weight consists of: (a) Student's assessment =25%, (b) Parent teachers' association assessment = 25%, (c) The school administration assessment= 50%. In addition to these I suggest that teachers assess their students using continuous assessment techniques. Concerning school facilities teachers use resource centers to prepare and use locally available resources, but we do not have factory made mathematical instruments to be provided for each student. Moreover teachers participate in text book evaluation in each academic year and model teachers will be rewarded at the end of the year and teachers' license have also started by giving written examination in our school (Date:03/30/2016).

I infer that the above mentioned interviewees and the rest interviewees' opinion are almost similar. I summarize the opinion of the interviewed directors as follows:

From the directors view I deduce that teachers assess their students through continuous assessment. However continuous assessment is considered by most teachers giving continuous tests. This indicates that teachers need trainings on how to apply continuous assessment. Mathematics teachers and students don't use calculators and computers to develop models, organize and solve statistical data, etc. the reason given by the directors is that first of all students are not allowed to use calculators to solve mathematical problems, due to that it reduces their thinking ability. And teachers have no access to use computers for organizing models and solving statistical data due to financial problem of the schools. According to their response in all sample schools there is no internet access; however I observed Goro and Kality primary schools have started to organize internet server rooms.

Related to higher order instructional methods, assessment techniques, and usage of lesson plan and teaching aids, among the directors my third interviewee forwarded the following:

Mathematics teachers do not prepare independent work sheets for their students instead they write on the blackboard and students copy and work the problems independently out of the class. However they prepare additional challenging problems for their students and create opportunities to solve the problems in group by explaining logical reasons in the class and out of the class. In addition to this I suggest that there is peer observation among mathematics teachers, collaborative problem solving and colleagues sharing experiences. There is also peer assessment among mathematics teachers and the schools assess their teachers through classroom observation, student achievement, and Induction and CPD activities. Hence teachers' assessment weight consists of (a) Student's assessment (25%), (b) Parent- teachers association assessment (25%), (c) The school administration assessment (50%). Similarly teachers assess their students through continuous assessment. Concerning use of lesson plan and teaching aids I suggest that almost all teachers prepare and use lesson plan, however most of the teachers do not prepare and use teaching aids (Date: 03/23/2016).

Similarly the fourth interviewee forwarded as follows:

Mathematics teachers and students do not use calculators and computers. Particularly calculators are not allowed for the students to solve mathematics problems, because most of the teachers believe that it reduces students thinking ability. Inaddition to this mathematics teachers do not prepare independent execises and challenging problems for their students, instead they give the exercises written in the text book to do independently. Students solve mathematics problems in group, however they don't debate in the steps use to solve the problems. Teachers assess their students mainly using paper-pencil tests and they plan their lessons by incorporting all components of lesson plan and they also sometimes use appropriate and attractive teaching aids (Date: 03/18/2016).

Related to teachers' subject matter knowledge evaluation, Indution and CPD trainings the sixth interviewee forwarded as follows:

Teachers' subjectmatter knowledge is assessed by the students, department head, PTA, and the school management. Some mathematics teachers apply group discussion and encourage their students to solve exercises infront of their classmates using the blackboard. There are locally available materials in the school to teach mathematics effectively and teachers evaluate curricular materials at the end of the school year and role model teachers get incentives in terms of material, money and certificates. In addition to this Induction is practiced by performing four different modules within two years. Some of the challenges of Induction and CPD programs are teachers turnover, scarcity of qualified mentors, CPD structure is not availble in our school, there is no coordination between education bureau, trainers, schools and institutions to practice CPD (Date: 03/21/2016).

Related to teachers' practices I summarize the responses of directors as follows:

Mathematics teachers do not prepare independent work sheets for their students instead they write on the blackboard and students copy and work the problems independently out of the class.

However they prepare additional challenging problems for their students and create opportunities to solve the problems in group by explaining logical reasons in the class and out of the class. In addition to this the directors responded that there is peer observation among mathematics teachers, collaborative problem solving and colleagues sharing experiences. There is peer assessment among mathematics teachers and the schools assess their teachers through classroom observation, student achievement, and Induction and CPD activities. According to them the assessment weight consists of: (a) Student's assessment (25%); (b) Parent- teachers' association assessment (25%); and (c) The school administration assessment (50%). In addition to these the directors said that teachers assess their students through continuous assessment. However in my observation continuous assessment is considered by most teachers giving continuous tests. This indicates that teachers need trainings on how to apply continuous assessment.

Related to lesson plan and teaching aids all directors (100%) responded as follows:

Teachers plan their lessons by incorporating all components of lesson plan and teachers apply the time, activities and materials when they plan their lessons; however mathematics teachers use new approaches of preparing and applying lesson plan named "SMASE", that is Strengthening Mathematics and Science Education; the plan consists of additional components such as prerequisite knowledge, competence level, starter activities, main activities, concluding activities and extra activities that needs to support special needs students. Related to preparation the directors said that most of the teachers do not have the habit of 3 types of preparations before entering into the classroom, that is preparing for the subject matter, preparing appropriate teaching aids and preparing lesson plan. Furthermore the directors suggested that most of the teachers do not use teaching aids, however first cycle (1-4) teachers usually use charts, abacus, and flash cards. They also said that teachers' subject matter knowledge is confirmed by classroom observation and students' evaluation.

Similarly the directors' views related to method of teaching, classroom management of teachers and teaching learning facilities is as follows:

All directors responded that almost all mathematics teachers apply questioning and answering method, discussion and problem methods, but still lecture method is the most dominative and all teachers manage the classroom effectively. The directors' response for teaching-learning facilities like mathematical instrument set, and additional reference books is that these materials are not sufficiently available in the schools where as charts, abacus, prisms, pyramids which are made of using locally available resources are available in the schools' resource center. In addition to this the directors suggest that teachers evaluate curricular materials and there is an incentive for role model teachers in terms of materials certificate and money.

Related to teacher's license, induction and CPD program among the interviewed directors one of them suggested as follows:

> Teachers' license have already started by administering professional written examination to higher and associate level teachers and for some teachers the result had been informed but still the license has not yet given for those teachers. In our school Induction and CPD programs are on progress; Induction program is designed for beginner teachers and they work on this for about two years by attending four modules prepared in 1998. Novice teachers perform the modules through the guide of mentors. The contents of the modules of induction program are peer observations, life skill, gender, HIV AIDS, Female education, Need of CPD, Students behavior, students' reflection, teaching learning materials, etc. After the completion of Induction program the beginner teachers will be promoted to CPD program (Date: 03/21/2016).

To sum up the opinion of directors related to teachers' induction and CPD programs in all sample schools 31 primary mathematics teachers are involved in the induction program and all other teachers are involved in the CPD program. Moreover the directors said that previously

CPD was modular system and teachers were complaining that it was boring, it was wastage of time, and creating unnecessary workload on teachers; however the new approach of CPD practices is based on the need of teachers, schools and education bureau.

4.1.2.1.2.2. Primary School Students Interview result

From 18 sample schools 3 students were selected purposively from each school and interviewed in Amharic and their characteristics and responses are organized as follows:

Table 69: Demographic data of interviewed students in 18 sample schools

S.No.	Name of the school	Number of students in each cycle and average Age				Sex		
		1st cycle (1-4)	Average Age	2nd cycle (5-8)	Average Age	M	F	Total
1	Akakimengist	2	9	1	13	2	2	4
2	Birhanguzo	2	10	1	12	1	1	2
3	Dej. Wondirad	2	9	1	13	2	1	3
4	Fit awurari Abayneh	2	10	1	11	1	2	3
5	Furi	2	10	1	13	2	1	3
6	Gelan Number 1	2	9	1	13	2	2	4
7	Gelan Number 2	2	10	1	12	1	1	2
8	Goro	2	9	1	13	2	1	3
9	Hidasie	2	9	1	13	1	2	3
10	Kality	2	9	1	12	1	1	2
11	Kokebetsibah	2	10	1	13	2	2	4
12	Misrakchora	2	10	1	13	1	3	4
13	Misrkber Number 2	2	9	1	12	1	2	3
14	Misrakdil	2	10	1	13	2	1	3
15	Missford	2	9	1	12	1	2	3
16	Salayesh	2	10	1	12	1	2	3
17	Yekaterara	2	9	1	14	2	1	3
18	Yewotatochgenet	2	9	1	13	1	1	2
	Total	36		18		26	28	54

As displayed in table 69; 162 students were interviewed from these 28 were females and 26 were males. The participants' responses are organized as follows:

For the first item most of (76.5%) first cycle students responded that: Their favorite subject is Environmental science and some of them (19.8%) responded that their favorite subject is mathematics. In addition to this (31.9%) second cycle students responded that mathematics is their first favorite subject and others (68.1%) responded that they do not understand mathematics. All of the participants said that they have mathematics text books and most of them (74.7%) said that they study mathematics at home with the help of their parents whereas some students (25.3%) study mathematics without any help. Most of the respondents (94.4%) did not have mathematical instruments (set squares, compass, protractor, ruler, etc.). They said that they learn Geometry borrowing from others. From the respondents some students (30.3%) are doing their home work and class work alone, the others are doing with the help of other students and their family.

Among the students one of my interviewees forwarded the following:

> Iam grade 5 and 15 years old. My favorite subject is environmental science. I have mathematics text book. I do mathematics exercises at home alone, but most of the time I do not have time to do math homework. I don't have mathematics instruments, because my parents do not want to buy for me. I learn Geometry by borrowing compass, protractor, and ruler from my classmates. My teacher usually teaches using lecture method. The problems I faced in mathematics lesson are: (a) I have no mathematics instrument sets to learn Geometry; (b) Most of the teachers do not teach using teaching aids; (c) I do not have time to do home work and project works because during my spare time I polish shoes to earn money and help my parents and small brothers and sisters (Date: 03/30/2016)

Similarly among the students the second interviewee responded as follows:

> I am grade 4 and 12 years old. My favorite subject is environmental science. I have mathematics text book and I do mathematics execises at home alone. My teacher usually teaches using lecture method. My mathematics teacher gives homework without giving hints and without doing similar examples, I do not understand Geometry, because I don't have mathematics instrument sets and some teachers do not demonstrate the shape of geometric figures using real objects (Date: 03/30/2016).

The above two interviewees have similar problems like problem of understanding Geometry, due to lack of mathematics instrument set, and mathematics teachers do not demonstrate Geometric figures using real objects.

Among the interviewed students the third interviewee forwarded the following:

> I am grade 7 and 14 years old. I do not understand mathematics, because it is very difficult subject. I have mathematical instruments that help me to learn Geometry. However some teachers also do not show us Geometric figures using real objects and they do not display how to construct angles using ruler, protractor, and compass. When teachers solve problems they do not write clear steps and the steps they use to get the answers is usually confusing me (Date: 03/30/2016).

Among the interviewed students the fourth student responded as follows:

> I am grade 8 and 15 years old. I am not good at mathematics, in addition to this no one is helping me to do the home work and I do not understand the exercises and examples written in the book. When the teacher does some exercises in the class, I do not understand what she says, because she usually teaches in English as well she does not use different teaching aids and do not write clear steps when she solves mathematics problems. When I ask my friends to show me the steps of solving problems, they usually say No, because they say that the questions are not clear for them (Date: 03/18/2016).

Among the interviewed students the fifth student responded as follows:

> I am grade 1 and 9 years old. My favorite subject is Environmental science. I have mathematics text book. I uaually do mathematics exercises at home. No one is helping me to do the problems, but I do the classwork with my classmates. I do not have mathematics Instruments (protractor, compass, ruler, setsquares, etc.), because the school and my parents did not give these materials. My teacher sometimes uses teaching aids like pictures and abacus. There is no computer in my school. My mathematics teacher usually applies lecture and demonstration method and she checks my exercise book. I do not understand when the teacher does the exercises without giving examples and without drawing/displaying pictures (09/29/2017).

Among the interviewed students the sixth interviewee responded as follows:

> I am grade 2 and 10 years old. My favorite subject is Mathematics. I have mathematics text book. I do the home work alone, but I do the class work with my classmates. I learn Geometry by borrowing mathematics instruments (compass, protractor, ruler, etc.,) from my class mates. My mathematics teacher sometimes uses teaching aids like charts and ruler. I did not see any computer in the school and my mathematics teacher usually applies lecture method and she sometimes checks my exercise books (09/29/2017).

Thus I summarize the view of all interviewed students as follows:

Their mathematics teachers sometimes use teaching aids and the method of teaching teachers apply is mainly lecture method and most of them (95.1%) responded that their mathematics teachers sometimes check their exercise books and they said that there is no smart classrooms in the schools. However I observed smart classrooms at Goro and Kality primary schools. Finally all the participants suggested that; (a) Teaching-Learning facilities such as mathematical instruments, computers and additional reference books are not sufficiently available in the schools, (b) Most of the teachers do not use teaching aids and some teachers use hodgepodge steps when they solve the problems. These confuse the students and they do not learn mathematics with interest and these will be some of the main causes to hinder their understanding during solving mathematics equations and problems. Thus mathematics teachers practices based on their students assessment is minimal

4.1.2.1.2.3. Parents Interview result

All the sample schools have parent teacher associations (PTA); among them I interviewed 36 parents who are members of PTA and 2 parents are selected purposively and interviewed from each school. Among the parents 22 (61.1%) are educated at diploma level and 5(13.9%) are educated at first degree level and the rest are at the level of grades (8-12). The responses of the parents are organized and analysed as follows:

Among the participants 14 were female and 22 were male. The occupation of 21 participants is private work and 8 participants are government workers and 7 of them are retired and doing other activities different from their previous occupation. From 36 parents one of the interviewees forwarded as follows:

> I check the education performance of my children and I fulfill all educational materials needed for my children. However the school should teach more about discipline, because my children are not obeying for their mothers and elders (Date: 03/14/2016).

Among the interviewed parents the second parent responded as follows:

> My child is doing mathematics and other subjects alone and she has never asked me for help. I fulfilled all the materials needed for her education (Date: 03/17/2016)

From the interviewed parents the third parent forwarded as follows:

> I usually follow up my child's mathematics achievement. He is grade 6 student and he usually achieves an average of 60 and above. My child told me that when students shout in the class he could not listen what the teachers says and he rarely asks me when he faced this problem. This indicates the existence of disciplinary problems in the class (Date: 03/23/2016)

I summerize the view of the above interviewees and other interviewed parents opinion as follows*:*

For the first question 24 parents (66.7%) responded that: They check the education performance of their children where as 12 parents (33. 3%) said that they do not check the performance of their childre.

Most of the parents 27 (75%) said that their children need their help when they do mathematics problems at home where as 9 parents (25%) responded that their children do not need any help from them and they do all problems of mathematics by themselves. All Parents responded that they communicate with the school about their children during parents day when they called by teachers and most of them (75%) buy the necessary educational materials for their children whereas 9/(25%) parents buy only exercise books , pencils, rubber and bags due to financial problem.

Finally all of the parents suggested that the schools should teach more about discipline and ethics, because their children are developing delinquent behaviors and are not obedient and loyal to their parents in addition to this parents suggested that in Addis Ababa public primary schools there are children who came without eating any food and those children should be helped by the school/ NGO's and/or the government, however the government has already started feeding program in the school involving few students, still a lot of students need help. Thus based on the view of parents their follow up to their children is not satisfactory.

Thus to sumup Primary School Mathematics Teachers Practices, and Attitude towards mathematics and teaching mathematics; the result of teachers' questionnaire, interview, and observation as well as directors, parents, and students interviews result condensed as follows:

Related to primary school mathematics teachers practices the result of their response indicates that teachers mostly spend their time on professional reading and development activities, like meetings, seminars, work shops, etc. This implies that the time for teachers' effective preparation and rehearsal of the subject they teach is minimal. Moreover teachers mainly rely on mathematics text books. This indicates that teachers' reference is limited to only one book.

In planning mathematics lessons teachers source of information are syllabus, student text books, and teacher's guide. In addition to these teachers never use technology to teach mathematics; their application of participatory method of teaching is minimal; and all teachers teach only contents written in the text book. Similarly teachers mainly assign the students to do mathematics homework mainly problems or questions set in text book, and they do not mainly consider these assignments as basis for class discussion. However students' practices on gathering data, oral reports, reviewing a mathematical journal are almost nil.

Related to teachers' assessment technique they respond that they mainly use multiple choice, true-false, and matching items to assess their students. This implies that the development of students' problem skill is minimal. In addition to this their assessment techniques serve only for marks and to give feedback to their students. However teachers do not use their assessment to assess themselves and to assess the curriculum.

Teachers response on interview items indicate that the aggregate mean of teachers' system of practices on higher order instructional methods, lesson plan, and application of College courses are below the level of proficency. In addition to this most of the teachers (77.8%) have evaluated the curricular materials of mathematics and they suggested that; there are excess contents of grades 1, and 2; some illustrations are not clear and not related to the content; in some grades (1, 2, 3) the size of the text books are very large and are not appropriate to children to carry the books and are not appropriate to put them in their bag. Moreover some answers written in the teacher's guide are incorrect, furthermore teachers suggest that the following grade 1 contents are difficult and beyond the level of the students; these are unit 5 (Measuring using traditional measures), unt 6 (Basic concepts of fractions), unit 7 (Multiplying and dividing whole numbers up to 20); Unit 10 (Ethiopian money), unit11 (Time) and unit 12 (Data handling and simple mathematics sequence). Nevertheless most of the teachers (87.8%) do not encourage their students to work on problems for which has no obvious solutions or challenging problems and 75.5% of them do not encourage their students to work on independent mathematics worksheets, and most of them (77.6%) do not use appropriate and attractive teaching aids.

Furthermore the quantitative data of observation result indicated in tables 62, 63, 64, 65, 66, and 67 display that:

(a) The grand mean of 8 components of teachers’ ability of practicing their knowledge is 3.030. This involves under the rating "Proficient" which implies that teachers have a clear proficiency and skill in practicing their knowledge. In addtion to this Anova table 62.3 indicates that there are differences of ability in practicing their knowledge among mathematics teachers. However teachers ability of informing instructional objectives, knowledge of resources including technology, and ability of designing coherent instruction lay under the rating "Basic" this implies teachers need more progress on the above mentioned tasks towards proficiency; (b) the grand mean of 14 components of teachers ability of organizing the environment for knowledge work is 2.84, which involves under the ratings " Basic" this implies that teachers need to improve their ability of organizing the environment for knowledge work towards proficiency. However there is significance differences among teachers ability of organizing the environment for knowledge work (see Anova table 63.3); (c) the aggregate mean of 13 components of teachers instruction practices is 2.89 which is at the level of "Basic". This implies teachers need more progress or improvements in their instruction practices; in addition to this Anova table 64.3 indicates that there is differences in implementing the instruction among primary school mathematics teachers; (d) the mean of 14 components of practices of teachers professional duties is 2.55 which is categorized under the assessment rating "Basic" this indicates that teachers need more progress in their professional responsibilities; moreover Anova table 65.3 indicates that there is differences in implementing the professional duties among primary school mathematics teachers; (e) the mean of 6 components of practices of teachers on pedagogical knowledge is 2.98 which is categorized in the evaluation rating "Basic" this indicates that teachers need some progress in their practices of pedagogical knowledge. However Anova table 66.3 indicates the significance differences among teachers in practicing PK. and (f) table 67.1 indicates the mean of 5 components of practices of teachers on Pedagogical Content Knowledge (PCK) is 2.64, this is categorized under the assessment ratings of "Basic" this implies that teachers need more progress on Pedagogical Content Knowledge towards proficiency. However Anova table 67.3 indicates that there are differences of ability in practicing PCK among primary mathematics teachers.

Furthermore the qualitative data result of primary school teachers' practices and performance discussed based on directors, students, and parents interview response as follows:

All directors responded that mathematics teachers and students do not use calculators and computers to develop models, organize and solve statistical data, etc. the reason given by the directors is that students are not allowed to use calculators beccause the directors believe that it reduces the students' thinking ability. And teachers have also no access to use computers for organizing models and solving statistical data due to financial problem of the schools. Of course in most of the sample schools there is no internet access except Goro and Kality primary schools. In addition to this the directors suggest that mathematics teachers do not prepare independent worksheets for their students instead they write on the blackboard and students copy and work the problems independently out of the class. However teachers plan on their lessons and they provide group activities for their students.

Related to lesson plan and methods the directors stated that mathematics teachers use new approaches of preparing and applying lesson plan named "SMASE" that is strengthening mathematics and science education. Moreover the directors assessed that almost all mathematics teachers sometimes apply questioning and answering method, discussion, and problem solving method and teachers also assess curriculum materials at the end of each semester. Finally the directors said that lecture method is still dominant method in which teachers usually apply in the classroom.

Similarly primary school students responded that their mathematics teachers sometimes use teaching aids and the method of teaching they apply is mainly lecture method and the students responded that their mathematics teachers sometimes check their exercise books. Moreover the students suggest that most of the teachers do not write clear steps when they solve problems using the blackboard. In addition to students parents said that teachers need to teach more about positive discipline for their students. Because parents suggest that the discipline of their children is not positive at home.

Teachers' practices on TPACK activities were assessed using teachers questionnaire, interview, observation, directors and students interview. The merged result indicates that teachers never use computers to solve problems cooperatively with other mathematicians of the world and students were not allowed to use calculators, smart phones to solve problems during teaching learning and examination session.

Furthermore the observation result indicates primary school mathematics teachers' instruction practices, their ability of informing instructional objectives, knowledge of resources including technology and ability of designing coherent instruction, ability of organizing the environment for knowledge work, ability of implementing the curriculum, ability of performing their professional duties, and their practices on PK and PCK lay under the rating scale "Basic". This implies that teachers need more progress on the above practices towards proficiency.

Moreover the interview response of directors and students indicate that primary school mathematics teachers do not use computers to develop models, to organize and solve statistical data, they do not prepare independent worksheets, they do not write clear steps when they solve problems on the blackboard and lecture method is the most dominant method of primary school mathematics teachers.

From the above quantitative and qualitative data primary school mathematics teachers' practices based on their own self-assessment using the questionnaires, and interview result, and from directors, their students, and parents suggestion; I infer that primary school mathematics teachers need to work hard, improve, and need to progress towards proficiency. From the above findings I infer that primary school mathematics teachers' practices need more progress by integrating the subject matter with the trainings acquired from Induction and CPD programs. However in table 65 the interview result of teachers indicates that the aggregate result of 14 components of practices of CPD related to mathematics education is 2.52 except the component "CPD is not significant for teachers, because it consumes time and it is wastage of resources" the mean of this component is 1.74. Hence this implies that CPD practices in the schools are not at the level of proficiency. In addition to this teachers who are taking induction training suggest that the modules prepared in 1998 for induction program need to update and contents are not related to mathematics education. Therefore according to this evidence Induction and CPD programs were not found to be effective. Thus I conclude that induction and CPD need further assessment and revision inorder to prepare teachers for effective practices.

Related to primary school mathematics teachers Attitude towards mathematics and teaching mathematics data is organized in table 49 and discussed as follows:

(a) Some mathematics teachers (22.9%) respond that teaching profession was not their choice; (b) Some (17.4%) explained that mathematics was not their choice of study; (c) Most of mathematics teachers (92.4%) responded that they want to change their profession, when they get the opportunity; (d) most of mathematics teachers (93.1%) suggested that the society do not appreciate their work and all of mathematics teachers also respond that their students do not appreciate their work. These imply that primary school mathematics teachers' attitude towards teaching profession in general and towards teaching mathematics in particular is negative.

Furthermore the response of teachers' on their attitude towards mathematics and teaching mathematics is organized in table 53 and the result indicates that:

(1) The mean of "mathematics is primarily a formal way of appreciating the real world" is 2.94. For this statement 24.3% of mathematics teachers disagreed which implies some mathematics teachers (24.3%) have negative attitude towards mathematics; (2) The mean for the statement "Mathematics is primarily practical and structured guide for addressing real situations" is 3.68 and for this statement few (4.9%) teachers disagreed which implies few teachers have negative attitude towards mathematics; (3) The mean of " Basic computational skills on the part of the teacher are sufficient for teaching primary school mathematics" is 3.85 for this statement 11.8% of teachers agreed and 86.8% of teachers strongly agreed. This implies primary mathematics teachers neither give significant attention for primary school mathematics syllabus nor for their students; (4) The mean of the statement "More than one representation (picture, concrete material, symbol set, etc.) should be used in mathematics" is 3.23 and for this statement 77.1% of mathematics teachers agreed and 22.9% strongly agreed. This indicates teachers' positive attitude towards mathematics; (5) For the statement the mean of "If students are having difficulty in mathematics an effective approach is to give them more practice by themselves during the class" is 3.07. In this case Some (16.7%) teachers disagreed where as 59.7% agreed and 23.6% strongly agreed which implies that 83.3% of teachers attitude of teaching mathematics is negative; (6) For the statement the mean of "Some students have a natural talent for

mathematics and others do not" is 3.46. For this statement most of the teachers (54.2%) agreed and some (45.8%) strongly agreed, which implies that all of the teachers know the mathematics background of their students; (7) the mean of "A liking for and understanding of students are essential for teaching mathematics" is 3.23. For this statement 77.1% of teachers agreed and 22.9% strongly agreed. This indicates mathematics teachers' knowledge of methodology; (8) the mean of "mathematics is an abstract subject" is 2.92. For this statement 63.9% of teachers agreed and 13.9% of teachers strongly agreed; (9) the mean of the statement "mathematics should be learned as sets of algorithms or rules that cover all possibilities" is 3.77. For this statement 18.8% of teachers agreed and 79.2% of teachers strongly agreed. This indicates negative attitude of mathematics teachers towards mathematics.

Hence the above statements indicate the existence of negative attitude towards mathematics and teaching mathematics among primary school mathematics teachers. Furthermore the interview result of primary school mathematics teachers indicate that 87.8% of primary school mathematics teachers study other disciplines different from the teaching profession this implies that most of primary school mathematics teachers attitude towards the profession is negative. Thus from the quantitative and qualitative data result I deduce that there is negative attitude among public primary mathematics teachers of Addis Ababa towards mathematics and teaching mathematics in particular and the teaching profession in general.

4.1.2.2. The Standard of Primary School Mathematics Curriculum

The National Council of Teachers of Mathematics (NCTM, 2016, pp. 1-10) designed the following principles and standards of primary school mathematics curriculum. Retrieved from http://en.wikipedia.org/wiki/principles_and_standards_for_school_Mathematics

The principles and the standards are:

(1) Equity: it encourages equal access to mathematics for all students especially students who are poor, disabled, females, members of minority groups, etc. (2) Curriculum: Curriculum that is most important to the students lives and careers should be considered. The standards of primary school mathematics content are: (a) Number and Operations; b) Algebra; c) Geometry; d) Measurement; e) Data analysis; f) Probability and processes; g) Problem solving; h) Reasoning and proof; i) Communication; j) Connections/sequence and continuity, and k) Representations. The strategies use to implement are: (1) Effective teaching techniques (methods); (2) Learning according to the principles and standards of school mathematics; (3) Scientific assessment techniques should be applied, such as; continuous assessment, self assessment, peer assessment, with reference to students cognitive ability, attitudes and skills;and (4) Technology: it is related to Technological, Pedagogical and content knowledge (TPACK). It emphasizes a teacher's understanding of how technologies particularly Information and Communication Technology (ICT) can be used effectively as a pedagogical tool. Technology refers to an understanding of the way that technologies are used in a specific content domain. For instance, for mathematics teachers it is an understanding of the range of technologies that mathematics uses in science and engineering. Using computer (I pads, smart phones, tablets, etc) students can solve mathematics problems from the website by sharing different experience with other students of the world (pp. 1-10). Based on the above criteria the standard of primary school mathematics of Ethiopia can be displayed in the table as follows:

Table 70: Availability of standard contents of primary school mathematics Curriculum from grades 1-8; based on the standard content designed by NCTM (2016). For detail information see Appendix- N

Note that Nominal scale: 1= Not available, 2= Available both are indicated using the sign "x"

Content	Grades															
	1		2		3		4		5		6		7		8	
	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Number and operations		x		x		x		x		x		x		x		x
Algebra		x		x		x		x		x		x		x		x
Geometry		x		x		x		x		x		x		x		x
Measurement		x		x		x		x		x		x		x		x
Data handling & Analysis		x		x		x		x		x	x			x	x	
Probability and processes	x		x		x		x		x		x		x			x
Problem solving		x		x		x		x		x		x		x		x
Reasoning and proof												x		x		x
Communication		x		x		x		x		x		x		x		x
Connections/sequence and continuity		x		x		x		x		x		x		x		x
Representations	x		x		x			x		x		x		x		x
Specific expectations/puzzles	x		x		x			x		x		x		x		x
Equity		x		x		x		x		x		x		x		x
Learning outcomes		x		x		x		x		x		x		x		x
Effective and appropriate teaching techniques		x		x		x		x		x		x		x		x
Scientific assessment mechanisms		x		x		x		x		x		x		x		x
Technology/TPACK	x		x		x		x		x		x		x		x	

Table 70 indicates the content standards of NCTM. Thus almost all the contents suggested by NCTM as a standard are included in mathematics syllabus of primary schools, except technology (TPACK), Data analysis and probability and processes in some grades.

In addition to the above standards Derebssa (1999, pp.178-184) suggest the following to be considered during content selection and assessment:

(1) Sequence and continuity of the contents; (2) Appropriate balance of scope and depth: it needs careful consideration of facts, ideas, concepts, principles, and thought systems; (3) Scope and integration of the content; (4) Balance of the total learning (Cognitive domain categories); (5) Logical relationship to main ideas and basic concepts; (6) Learn ability of the subject matter: it refers to the grade and maturity level of the students. To include contents beyond the students' level is a futile activity; (7) Authenticity and durability of the content; (8) Utility: it considers subject matter contents that contribute to the development of society and useful for daily life activity of the students.

I selected grade 1 syllabus purposively due to that grade 1 mathematics is the base for all grades and mathematics teachers also suggest that some contents of grade 1 are beyond the level of the students. and I assessed the content of the syllabus of grade one based on the criteria mentioned above as follows:

***4.1.2.2.*1. The Analysis result of Grade 1 Mathematics Syllabus (MOE, 2012/2013) Amharic version (Translated into English and attached in Appendix-N)**

The document states that, process of learning mathematics is similar to the process of house construction. Any house needs a base before construction and similarly the base for learning Mathematics is grade 1.

The document emphasizes that Mathematics syllabus for grade one has four parts these are: (1) Numbers and basic Calculations; (2) Measurements; (3) Geometric figures; and (4) Systems of data handling.

Objectives: The purpose of grade 1 Mathematics is to develop the students' skill of calculation and knowledge of basic mathematics. And the objectives are to: (a) develop the students' problem solving ability; (b) motivate students learn mathematics through enjoyment, eagerness and consistency; (c) practice the theories into their daily life activities; and (d) equip students with ethical behavior that are accepted by the society.

Students who completed grade 1 are expected to: (a) count, read and write whole numbers up to 100; (b) order and analyze place value of whole numbers up to 100; (c) identify and use

Ethiopian money; (d) identify the fractions of one whole using different figures; (e) measure length, weight and content using traditional measurements that are used in their daily life; (f) identify and write geometric figures like perpendicular, four and three sided figure and circle; (g) calculate and solve whole numbers up to 100 by adding and subtracting different questions; (h) multiply whole numbers by 2 and divide by 2 without remainder; (i) list the basic differences and relationships between the four operations; (j) solve word problems using four basic operations and whole numbers up to 100; (k) tell and use the measurement of time; (l) handle and read simple data by using figures and graphs; and (m) explain the beginning and design of numbers, shapes and color.

Furthermore the syllabus consists of 12 units these are: (a) Unit1: Counting numbers up to 9 (20 periods); (b) Unit 2: Adding and subtracting counting numbers up to 9 (22 periods); (c) Unit 3: Whole numbers from 0 up to 20 (12 periods); (d) Unit 4: Adding and Subtracting whole numbers up-to 20 (17 periods); (e) Unit 5: Measuring using traditional measures (7 periods); (f) Unit 6: Basic concepts of fractions (6 periods); (g) Unit 7: Multiplying and dividing whole numbers up to 20 (20 periods); (h) Unit 8: Lines and simple figures (8periods); (i) Unit 9: Whole numbers up to 100 (18 periods); (j) unit 10: Ethiopian money (5periods); (k) Unit 11: Time (5periods); and (L) Unit 12: Data handling and simple mathematics sequence (6 periods). As indicated in the above statements students learn about 146 periods in two semesters. It means 6,570 minutes. Based on the above mentioned criteria, objectives, and units of grade 1 syllabus analysis can be explained as follows:

Criterion number 1: Sequence and Continuity: The sequence will be better if unit 7 precedes unit 5, and should be followed by unit 9. There is continuity of all units in the syllabus of the next grades. Criterion number 2: Appropriate balance of scope and depth: The content coverage (scope) of mathematics grade 1 is far beyond the maturity level of the students, because 12 units for 7years ages children is difficult to complete the units with a feasible and understandable teaching learning process. When I assess the depth it is reasonable except multiplying and dividing whole numbers up-to 20. It is better be multiplying and dividing one digit whole number up to 10. Criterion number 3: Scope and Integration of the contents: The scope and integration indicates horizontal relationship of the content to other subjects. For instance measuring, time counting, and data handling indicate horizontal relationship to science subjects.

Criterion number 4: Balance of the total learning: In all units the contents involve knowledge that is recall type mathematics terminologies, concepts and principles; understanding of digits and place values, applying numbers to count time and money, analyzing data, concluding or finding answers to problems and practicing judgment through traditional system of measurement. In the psychomotor domain counting, reading, and writing are involved in the content. Criterion number 5: Logical relationship to main ideas and concepts: Of course this needs to arrange the contents in sequence and will be obvious to identify the logical relationship of one content to the other. Thus the syllabus needs to revise the sequence in order to fulfill this criterion. Forinstance if criteria one is practical this will be fulfilled.

Criterion number 6: Learn ability of the subject matter: From the 12 units' unit5, unit6, unit7, unit10, unit11, and unit 12 are beyond the maturity level and experience of the students. primary school mathematics teachers interview result also indicates that these units are difficult for grade 1 students. Therefore these units need revision and change by other simple and appropriate contents at the level of the students. For instance, "Compare whole numbers up to 100 using the symbols "<", ">", "=" ; "Place value of numbers up to 100"; " Telling the time by reading a clock"; " Data handling and mathematical sequence"; "Use Ethiopian money to buy and sell";

“Add and subtract multiples of 10 up to 100”; “ Dividing positive whole numbers up to 20 by 2”; “ Concepts of fractions”, “Measurement of length and weight”; etc. are difficult for grade one students to learn due to their age and experience.

Criterion number 7: Authenticity and durability of the content: This criterion needs to know the truthfulness and long lasting of the contents. This needs to assess how far the students apply these contents in their daily life activities and need to assess the standard of the content when it is compared to the international level. In general the above assessment primary school mathematics curriculum is confirmed to be at the international standard when it is assessed using standards of NCTM. Except TPACK frame work which is not included in the primary school mathematics curriculum. TPACK helps the students to learn mathematics using technology. However all observed contents of grade 1 are authentic and durable.

Criterion number 8: Contributions of the contents to the society: All the contents of the syllabus of grade 1 have a great contribution to the society. For instance assume that a student stopped learning from grade 3 one day her mother sent her to the shop to buy a kilo of sugar and gave her a note of 50.00 birrr if the price of one kilo of sugar is 12.00 birr how much she gets a balance from the shop keeper. If she returned 38.00birr for her mother this implies that she applied what she learned practically. Thus students are helping their parents and this indicates the contribution of students to the society which implies the contribution of mathematics to the society.

4.1.3. The Interview result of MoE Teachers and Education leaders Development Directorate Director and senior experts and Mathematics education expert from Addis Ababa City Government Education Bureau

This section deals with the responses and interpretation of teachers and education leaders development directorate director and experts as follows:

4.1.3.1. The Interview result of Teachers and Education leaders Development Directorate Director

One education officer (Directorate Director of teacher Education) and two senior experts were interviewed to respond for 7 open ended items and their responses are organized and analyzed as follows: The first interviewee was Teachers and Education Leaders Development Directorate Director. Related to the training strategies using technology the director forwarded as follows:

> The recent strategies of training teachers in relation to technology are on the process of Implementation. MOE has already designed a huge project with the cooperation of General Education Quality Improvement Program (GEQIP), the project will begin to connect schools with an ICT server to create online learning through the internet using computer, tablets, smart phones, I pads, etc. Hence students learn and solve mathematics problems from the cloud by using digitally supported teaching - Learning techniques (Date: 12/04/2016).

Concerning the future training of teachers the director responded as follows:

> We established a task force consists of university educators, MOE officers, experts and stake holders to improve and suggest the training strategies of primary and secondary school teachers. Moreover I underline that the previous training program of primary schools and secondary schools may not continue as usual. Concerning TESO (2003) document and TDP (2007) document, I can say that the implementation of TESO (2003) and TDP (2007) documents will be changed all in all by the new document TDP which will be established by the task force. Concerning the recent education structure (4-4-2-2) and teachers training based on the structure; I suggest that In the MOE document primary schools from grades 1-8 will be taught by diploma level teachers; however the curriculum designed for first cycle (1-4) Teachers and second cycle (5-8) teachers is different. Nevertheless some regions have already employed first degree level teachers to teach at second cycle (5-8) by their own budget. This is not the plan of MOE (Date: 12/04/2016).

Related to primary teacher education visa-avis the world context as well as Induction and CPD programs and challenges of the programs the director responded as follows:

> Primary teacher education training will progress based on the policy of the government through integrating the nexus between research, academic knowledge, professional knowledge, practicum and general knowledge at the standard level. In addition to this I underline that courses will be revised at least once in five years. However, when technology changes courses also need a paradigm shift to go with the recent situations of the world. After the revision validation of the courses and teachers readiness for the implementation of the courses will be held through the work shop. Related to Induction and CPD; MOE prepared four modules to practice Induction program for novice teachers in 1998 E.C (2005/2006). In addition to this we confirmed that a newly employed teachers work on the four modules by the guide of mentor teachers for about two years. After the completion of two years the beginner teachers will continue their training through CPD. Of course CPD training practices had been revised and by now teachers will implement CPD program based on their need and the need of schools and education bureau. Related to challenges I suggest that recently teachers' turnover is very high this will have a negative impact for candidates who need to join the teaching profession. However it will be solved through research by identifying major problems of teachers and this will get an immediate solution in the future (Date: 12/04/2016)

Thus the view of teachers and education leaders' development directorate director can be summarized in brief as follows:

According to the director's response training of teachers using ICT will start in a very short period of time and task force is established to replace the previous trends of teachers training. And she underlined that revision of courses will be based on new technologies and recent innovations. She also suggested that high turnover of teachers is the main challenges of schools and education bureau. However this crucial challenge gets immediate solution in the future.

4.1.3.2. The Interview result of MoE and Addis Ababa Education Bureau experts

The two senior experts of MoE are coordinators of pre-service and in-service programs and the third expert is from Addia Ababa Education Bureau who is a mathematics expert. Thus the responses of the three experts is organized and analysed as follows:

First MoE experts were asked about the current trainings of teachers using technology and both of them responded that MoE has planned a huge project with GEQIP with an amount of US $100 million dollar. However among the interviewees the pre-service expert responded as follows:

> The recent training of teachers for first cycle (1-4) is generalist training system, however second cycle (5-8) teachers will be trained through the program of specialist. The previous documents will be replaced by a new document in the future. In addition to this I can say that the standard of teacher education training will be confirmed through the new program which will be designed related to the international level. The basic reason for the revision of courses is to integrate the training system to new technologies and science. Similarly I can say that teachers' readiness for the revised curriculum and newly designed program will be asserted through the workshop (Date: 11/04/2016).

The response of In-service expert was as follows:

> The previous documents will be replaced by a new document in the future and the standard of teacher education training will be confirmed through the new program which will be designed related to the international level. I confirm that the basic reason for the revision of courses is to integrate the training system to new technologies and science. Related to Induction and CPD programs implementation is on progress without any problem after the revision of the programs. We found that the previous program was not supported by teachers, but after it had been revised teachers have involved in the training without any complain (Date: 11/04/2016).

Similarly Addis Ababa City government Education Bureau Mathematics education expert forwarded as follows:

> Induction and CPD programs practices are on progress without any problem after the revision of the programs. I assert that the previous program was not supported by teachers, but after the revision of the program teachers have involved in the training without any complain. I know first degree level teachers will be assigned to teach at grades 7and8. However I do not know how teachers will be trained for second cycle primary education. (Date: 12/04/2016).

The view of the above interviewed experts can be summarized as follows:

Concerning the previous teacher education document TESO (2003) and TDP (2007); both the pre-service and In-service experts of MoE forwarded almost similar opinion that:

The previous documents will be replaced by a new document in the future. Furthermore they said that the standard of teacher education training will be confirmed through the new program which will be designed related to the international level. In addition to this the experts responded that the basic reason for the revision of courses is to integrate the training system to new technologies and science. They also suggested that teachers readiness for the revised curriculum and newly designed program will be asserted through the workshop.

The same question was raised for a mathematics expert in the education bureau of Addis Ababa his response was different from the pre-service program expert of MoE and he said that first degree level teachers will be assigned to teach at grades 7and 8. However he could not respond how teachers will be trained for second cycle primary education. Concerning Induction and CPD programs; the main message of the three experts(two from MoE and one from Addis Ababa education bureau is that Induction and CPD programs practices are on progress without any problem after the revision of the programs. They said that the previous program was not supported by teachers, but after the revision teachers have involved in the training without any complain.

The challenges of Teacher Education Program have been forwarded by the experts as follows:

(a) Teachers are not dedicated to the profession; (b) There is high turnover of teachers; (c) Teachers has low interest to work in co-curricular activities; and (c) Some teachers are not still willing to promote themselves through Induction and CPD training programs.

From the views of directorate director and senior experts I conclude that there is a negative attitude and belief among primary school mathematics teachers towards the profession.

4.1.4. The relationship/match of primary mathematics teacher education curriculum to primary school mathematics curriculum

To assess the relationship of mathematics teacher education curriculum to primary school mathematics curriculum it needs to refer to appendix-M (All mathematics course outlines prepared for prospective mathematics teachers of primary school), and appendix-N (mathematics flow chart/ syllabus prepared for primary school students from grades 1-8).

4.1.4.1. The relationship/match of primary mathematics teacher education curriculum to first cycle (1-4) mathematics curriculum

To compare or to identify the similarities and differences of the curriculum of primary teacher education and first cycle primary school curriculum it needs to refer to first cycle mathematics syllabus (1-4) and primary mathematics teacher education courses. Note that the sign “x” indicates relationship to a particular grade. Hence the following table displays their relationship in terms of the scope and depth of contents by reviewing the course outlines designed for each course and syllabus of school curriculum designed for grades (1-8) as follows.

Table 71: The relationship/match of first cycle (1-4) primary school mathematics syllabus to Primary teacher education courses

First cycle (1-4) primary school content	Grade				Related courses and content		
	1	2	3	4	Courses	Code	Content
Data handling that is drawing graphs, interpreting graphs, and recording data	x	x	x	x	Introduction to probability and Statistics	Math 272	Classification of data, Histograms, Ogive etc.
Fractions(Concepts, fractions of one whole, Comparing & Ordering, proper fractions, unit fractions, etc.)	x	x	x	x	Basic Mathematics I	Math 101	The set of rational numbers, order property
Comparing and ordering up to 2digits decimal numbers				x	Basic Mathematics I	Math 101	Order property, Decimals etc
Addition and subtraction of decimal numbers				x	Basic mathematics I	Math 101	Set of rational numbers, decimals, ratio, etc.
Measurement (measuring length, weight and content)	x	x	x	x	Plane Geometry	Math 111	Measurement of length, angles, plane figures
Money (word problems, changing Ethiopian notes of money)	x	x	x				
Rounding off numbers and finding values to the nearest				x	Fundamental concepts of Algebra	Math 221	Elementary theory of numbers, division, etc.
Time (Times in a day and in a week, days, months and years, calculating on time	x	x	x	x			
Addition and subtraction using word problems			x				
Calculating using four main operations				x	Basic mathematics I	Math 101	Operation of Natural numbers and Integers
Points, Lines and Simple figures	x	x	x		Solid Geometry	Math 112	Point, line and plane, skew lines
Straight and Curved lines	x				Solid Geometry	Math 112	Point, Line, Plane, Skew lines
Four sides, Square, Triangle, and Circle		x			Plane Geometry	Math 111	Quadrilaterals, Rectangle, Triangles, Parallelograms, Circles
Parallel, Perpendicular and Intersected lines			x		Solid Geometry	Math 112	Parallel lines, perpendicular lines and planes in space
Plane and Solid figures (Right angle, points, lines, and plane figures, perimeter and areas of Rectangle and Square				x	Solid Geometry and Plane Geometry	Math 112 and Math 111	Point, line, plane, solid angles, Areas of polygon, Rectangle, Triangle, trapezium
Rectangle, Square, Parallelogram and Trapezium			x		Plane Geometry	Math 111	Rectangles, Triangles, Parallelograms, Trapezium and regular polygons

As indicated in table 71 the following contents of first cycle (1-4): (1) Money (Changing notes of money, word problems using money); (2) Time (Time in days, months, years and calculating on time); and (3) Addition and Subtraction using word problems have no relationship to primary mathematics teacher education curriculum. In addition to these the following primary mathematics teacher education curriculum which offer for primary prospective mathematics teachers are not related to primary school first cycle (1-4) curriculum. These courses are: (1) Introduction to Calculus (Math 162); (2) Elementary Linear Algebra (Math 222); (3) Calculus I (Math 261); and Calculus II (Math 262). Hence most of the other courses (6 courses) of primary mathematics teacher education are related to first cycle primary school mathematics curriculum. However the above mentioned four courses have no relationship/match to first cycle primary school mathematics curriculum. In addition to this teacher educators suggest that these courses are beyond the level of primary school prospective mathematics teachers and these similar courses are also offer for degree level University students. Thus inspite of the four courses of primary mathematics teacher education and few contents of primary school mathematics; the overall assessment indicates that first cycle primary school mathematics curriculum has relationship/match to primary mathematics teacher education curriculum.

4.1.4.2. The relationship of primary mathematics teacher education curriculum to second cycle (5-8) primary school mathematics curriculum

The relationship of primary mathematics teacher education curriculum to second cycle primary school curriculum is displayed in the table as follows:

Table 72: The relationship/match of primary mathematics teacher education curriculum to primary school second cycle (5-8) curriculum

Second cycle primary school mathematics content	Grade				Related courses and content of Teacher Education		
	5	6	7	8	Courses	Code	Content
Equality and Inequality Equations, Linear equations and Inequalities	x	x	x	x	Basic mathematics I	Math 101	Algebraic expression, equations and inequalities
Expressing decimals in terms of fractions	x				Basic Mathematics I	Math 101	The set of rational numbers (Decimals, percent, ratio, etc.)
Comparing and Ordering fractions	x				Basic Mathematics I	Math 101	The set of rational numbers, order property
Calculating Decimals	x				Basic Mathematic I	Math 101	The set of rational numbers, decimals, etc
Data handling and interpretation, Collecting data using tally mark	x		x		Introduction to probability and statistics	Math 272	Data collection and data presentation, tabular, histogram, pie chart
Lines, Angles and their measurement	x		x		Plane Geometry	Math 111	Measurement and units of measurement (length, angles and plane figure
Categorizing triangles based on their sides and angles	x				Plane Geometry	Math 111	Measurement and units of measurement
Measurement (Angles, triangles, Quadrilaterals, Polygons, Circles)	x	x	x		Plane Geometry	Math 111	Measurement and units of measurement
Polygons, circles, Theorems of triangles, and right angles	x	x	x	x	Plane geometry	Math 111	Triangles, polygons, circles
Construction and interpretation of line graph and pie chart, mean, mode, median and range of data			x		Introduction to probability and statistics	Math 272	Basic construction, graphs, charts, mean, mode, median, range
Basic concepts of sets (definition, relationship, and calculations on sets		x			Basic Mathematics I & Fundamental concepts of Algebra	Math 101 and Math 221	Set theory, set operations and their properties, applications of set theory
Fractions and 10th numbers (Explaining fractions in simple mathematics work and changing fractions into decimals, ordering fractions)		x			Basic Mathematics I	Math 101	The set of rational numbers (order property, decimals, percent,)
Addition, subtraction, multiplication and division of fractions		x			Basic Mathematics I	Math 101	Operation on rational numbers and their properties
Integers (comparing and ordering, adding and subtracting)		x			Basic Mathematics I	Math 101	Real number system (The set of integers, operation and order property)
Indicating points on the number line		x			Solid Geometry	Math 112	Point, Line, plane
Rational numbers (concept, comparing and ordering and operation on Q			x		Basic Mathematics I	Math 101	Real number system (the set of rational numbers)
Ratio, proportion, and percentages			x		Basic Mathematics I	Math 101	The set of rational numbers (decimals, percent, ratio and proportion)
Square, Square roots, cubes, and cube roots				x	Basic Mathematics II	Math 102	Roots of polynomial functions
Further on working with variables (Algebraic theorems, multiplication of binomials, highest common factors)				x	Fundamental concepts of Algebra	Math 221	Elementary theory of numbers (G.C.D, L.C.M)
Cartesian coordinate system				x	Basic Mathematics I	Math 101	Relations and functions (Cartesian product)
Similar figures (plane figures and triangles)				x	Plane Geometry	Math 111	Point, Line, plane figures and triangles
Circles (angles in the circle)				x	Plane Geometry	Math 111	Circles (chords, arcs, secant, arc measures and angles)
Probability (concept, simple events)				x	Introduction to	Math	Basic concepts, universe,

Second cycle primary school mathematics content	Grade				Related courses and content of Teacher Education		
	5	6	7	8	Courses	Code	Content
					probability and statistics	272	sample, census
Introduction to trigonometry				x	Basic mathematics II	Math 102	Trigonometric functions
Solid Figures				x	Solid Geometry	Math 112	Point, line, Plane, Skew lines

As displayed in table 72 second cycle (5-8) primary school contents have a strong association or relationship to primary teacher education courses. This implies second cycle (5-8) primary school mathematics contents are related to primary mathematics teacher education courses. However the four courses (Introduction to Calculus (Math 162); (2) Elementary Linear Algebra (Math 222); (3) Calculus I (Math 261); and Calculus II (Math 262)) have no relationship to second cycle primary school mathematics. Hence I conclude that primary mathematics teacher education curriculum has a great contribution for prospective mathematics teachers to perform primary school mathematics curriculum effectively.

In general as indicated in tables 71, and 72 as well as appendix- k, appendix-M, and appendix-N; primary mathematics teacher education curriculum is related to primary school mathematics curriculum for grades 1-8 except the courses: (1) Introduction to calculus (Math 162); (2) Elementary Linear Algebra (Math 222); (3) Calculus I (Math 261); and (4) Calculus II (Math 262). Moreover When I compare the results of documentary analysis to the regression analysis discussed from pages 116-126 the result of the two indicates a match/ relationship between the curriculum of the college and primary school mathematics curriculum. The course outlines/designed courses for prospective mathematics teachers have depth and scope than primary schools syllabus. However most of the contents to be taught in primary schools are involved in the University College Course outlines by increasing its depth and scope to train mathematics teachers.

4.1.5. Major factors that affect mathematics teacher educators and primary school Mathematics teachers during the practices of mathematics education

Teacher educators responded the following major factors that challenge practices of primary mathematics teacher education as follows:

(a) Poor mathematics background of the trainees; (b) Large class size, frequently 1: 60; (c) Courses are designed beyond the capacity of the trainees; (d) Negative attitude of trainees towards mathematics and teaching mathematics; (e) student teachers are not ready and have no motivation to learn mathematics; (f) Some courses still need revision; (g) Courses are not practiced using technology; (h) prospective mathematics teachers recruitment and selection could not involve candidates who can achieve good results in college and University level education; (i) There is lack of facilities, such as adequate reference books, smart classrooms and computers; and (j) Frequent revision of courses without evaluation research.

Similarly primary mathematics teachers filled the questionnaire and responded the following factors as challenges of mathematics education during practices as follows:

(a) Students with different academic abilities; (b) students who came from a wide range of backgrounds (for example; language differences, economic problems, residence, gender, attitude differences, etc.); (c) students with special needs (for example; hearing, vision, and speech impairments, physical disabilities, mental, emotional and psychological impairments; (d) uninterested students ; (e) Disruptive students; (f) Parents are not willing to follow up their children's progress of learning; (g) Shortage of computer hard ware and soft ware; (h) Shortage of other instructional equipment for students' use like mathematical instruments kit; (i) Shortage of equipments to visualize mathematical devices; (j) Inadequate physical facilities (school compound, library, water, toilet, classroom, smart classrooms, lunch rooms, etc.); (k) Teacher students ratio is large, for instance an average of 1:72 in some sample schools like Goro, Yewatatochgenet, Yekaterara, and Misrakdil; (l) Low morale among students, fellow teachers, and administrators; (m) Threats to personal safety or the safety of students; and (n) Some contents are beyond the maturity level of the students (for instance grade1, grade2, and grade3)

Similarly the observation result in both KUC and primary schools asserted that: (a) There is large class size; (b) prospective mathematics teachers and second cycle primary school students' classroom participation is low; (c) There is scarcity of mathematics reference materials; (d)There is Primary school students disciplinary problem; (e) Primary school mathematics teachers turnover is high; (f) Prospective mathematics teachers practicum activity is low; (f) Some Prospective mathematics teachers and most of primary school mathematics teachers beliefs and attitudes towards mathematics and teaching mathematics is negative.

Furthermore the challenges of Teacher Education Program have been forwarded by teacher education and education leaders directorate director and the experts as follows: (a) Teachers are not dedicated to the profession; (b) There is high turnover of teachers; (c) Teachers has low interest to work in co-curricular activities; and (c) Some teachers are not still willing to promote themselves through Induction and CPD training programs.

From the views of directorate director, senior experts, teachers' interview and questionnaire response, and observation result I conclude that there is a negative attitude and belief among public primary school mathematics teachers of Addis Ababa towards the profession in general and towards mathematics and teaching mathematics in particular.

Ingeneral the factors that need immediate solutions are: (a) students disciplinary problems in primary schools; (b) Safety of girls ; (c)vulnerable students need help; (d) Shortage of facilities to teach and learn geometry; (e) some schools have no lunch room; (f) prospective mathematics teachers should join to study mathematics with their interest. Hence I conclude that the factors mentioned above alleviate the effective practices of primary mathematics teacher education.

Chapter V: Summary, Conclusions and Recommendations

5.1. Summary and Conclusions

In this section findings related to the following research questions are summarized and concluded as follows:

(a) How are the strategies and practices of pre-service, Induction, and CPD programs in terms of the curriculum and TPACK knowledge areas (i.e., TK, CK, PK, PCK, TCK, TPK, and TPCK) related to mathematics education? (b) How is prospective mathematics teachers' attitude towards mathematics? (c) To what extent the recruitment and selection criteria contribute to the trainees' mathematics achievement in the University College? (d) How are the practices of primary school mathematics teachers? And how is their attitude towards mathematics and teaching mathematics? (e) How is the relationship/match of primary mathematics teacher education curriculum to primary school mathematics curriculum? And how is their standard? And (f) what are the major factors that affect primary school teachers and teacher educators during mathematics curriculum practices? And what possible interventions can be employed?

5.1.1. The strategies and practices of pre-service, Induction, and CPD programs in terms of the curriculum and TPACK knowledge areas (i.e., TK, CK, PK, PCK, TCK, TPK, and TPCK) related to mathematics education

Related to the above mentioned issue pre-service teacher education program was explored in KUC, and Induction and CPD programs were explored in 18 public primary schools of Addis Ababa and the result indicates the following findings and conclusion.

5.1.1.1. The strategies and practices of pre-service teacher education program in terms of the curriculum and TPACK knowledge areas

The data used to summarize and conclude pre-service primary teacher education program related to mathematics is obtained through the investigation of: (I) prospective mathematics teachers attitude towards mathematics; (II) the contribution of the recruitment and selection criteria (Entrance exam, High school result, and EGSECE GPA) to the prospective mathematics teachers'University College achievement and the relationship of their University College result to professional written exam (COC) result; (III) KUC mathematics teacher educators**,** department head, and natural and computational sciences dean interviews result**;** (IV) teacher educators' observation result; and (V) the standard of primary mathematics teacher education curriculum**.**

(*I) Prospective Mathematics Teachers' Attitude towards Mathematics*

Prospective mathematics teachers' attitude test is administered to 143 KUC prospective teachers using 71 items to assess the trainees' confidence, anxiety, value, enjoyment, motivation, and teacher expectation. As explained in the literature part of this study Mensah, Okyere, and Kuranchie (2013) state that student teachers success in learning and teaching mathematics depend on their attitude towards the subject. Hence the study assessed the attitude of prospective mathematics teachers towards mathematics and the attitude test result indicates that there are feelings of anxiety, feelings of discouragement, and depression among prospective mathematics teachers and most of (58.6%) the prospective mathematics teachers are not confident in their ability to learn and teach mathematics. These findings are supported by teacher educators interview response that prospective mathematics teachers are not interested in mathematics, they are not motivated to learn mathematics courses, and they are not confident in learning and teaching mathematics (see table 32 and pp.147-159 for detail information).

Moreover the assessment of prospective mathematics teachers on their previous mathematics teachers indicates that some of their mathematics teachers have inefficient performance. Similarly researchers have also asserted that the practices and experiences of previous teachers have a great influence on their students' performance either in its positive or negative side. In addition to this mathematics teacher educators assessment indicates that prospective mathematics teachers are not motivated to learn all mathematics courses, they lack confident in ability of solving problems and they are not motivated in their teaching practices. Simultaneously test items translated into Amharic are tested and confirmed to be reliable ($\alpha = 0.842$) and valid (confirmed by CFA). Hence other researchers can use it for similar purpose.

Hence I infer that on the basis of attitude test items and teacher educators' assessment; prospective mathematics teachers lack interest and enthusiasm to learn and teach mathematics. This reduces the effective practices of pre-service teacher education program.

(II) The contribution of the recruitment and selection criteria (Entrance exam, High school result, and EGSECE GPA) to the prospective mathematics teachers'University College achievement and the relationship of University College result to professional written exam (COC) result

Related to practices of pre-service primary mathematics teacher education program, the contribution of the recruitment and selection criteria to the student teachers University College achievement were also assessed using regression analysis. The result of the assessment indicates that there is strong correlation between University College GPA and entrance exam result (.862**, $p < 0.01$); between University College GPA and high school transcript average (.701**, $p < 0.01$); and between University College GPA and EGSECE GPA (.447**, $p < 0.01$). These imply that prospective mathematics teachers of 2012/2013 entrants of recruitment and selection criteria were effective.

Moreover prospective mathematics teachers of 2013/2014 second year entrants of University College GPA has correlation with entrance exam result (.355*, $p < 0.05$), and EGSECE GPA result (.537**, $p < 0.01$). This implies that entrance examination result and EGSECE GPA were effective criteria to select prospective mathematics teachers of 2013/2014 second year entrants of KUC. Similarly as indicated in appendix R of table 11 there is strong correlation between students' professional written exam (COC) and KUC GPA (.570**, $p < 0.01$). Inaddition to this the original data attached in appendix L of table 3 indicates that student teachers who have good result in the entrance exam result achieved good result in the University College and Competency Assessment test (COC). However from 47 prospective mathematics teachers only 10 prospective mathematics teachers achieved 50 and above in the Diploma graduates Professional and Academic written examination (COC) (see appendix L). This implies that student teachers who are recruited and selected from grade 10 and who are not qualified for preparatory level education also failed in competency assessment test. This is a very good indicator that instead of recruiting and selecting and training after the completion of grade 10 it is better to recruit and select and train after the completion of preparatory level education.

Furthermore teacher educators assessment also indicates that prospective mathematics teachers who are recruited and selected from grade 10 do not achieve the expected result, they have no interest to learn and teach mathematics, they have no mathematics problem solving skill, they have no confidence, and they do not have good mathematics background.

(III) KUC mathematics teacher educators, department head, and natural and computational sciences dean interviews result

Related to mathematics teacher education curriculum teacher educators suggest that the strategies of training need to be integrated with technology and courses should be at the standard level. Moreover revision of courses need to start from the feedback of teacher educators and it need to be conducted through evaluation research. However there is frequent revision of courses held through the coordination of MoE. In addition to this calculus courses and linear algebra are beyond the level of diploma trainees and recruitment and selection need not be from grade 10. Related to TPACK teacher educators suggest that they have the knowledge of technology, however they do not apply their knowledge to teach mathematics courses using the web tools. Teacher educators assess their practices for each category as follows: (a) the mean of 4 components of CK is 2.53; (b) the mean of 6 components of PK is 2.77; (c) the mean of 5 components of PCK is 3.00; (d) the mean of 5 components of TPCK is 3.00. Based on the above teacher educators assessment teachers perform better in PCK and TPCK. Moreover correlation is observed between Ck and PK (0.683*, $p< 0.05$) (see appendix S of table 13). This implies teacher educators perform better in practicing PCK.

Related to primary mathematics teacher education curriculum and TPACK knowledge areas the department head and the dean views on pp.153-154 indicate that appropriate curriculum need to be designed based on the level and background of the trainees and curriculum revision should progress based on evaluation research. In addtion to this facilities need to be fulfilled and curriculum practices should be supported by TPACK.

(IV) Teacher Educators' observation result

The mean of 9 components of teacher educators' ability of practicing their knowledge is 3.056 which is at the level of proficient. This implies teacher educators have a clear proficiency and skill in practicing their knowledge. However the mean of teacher educators' ability of relating mathematics content to TPACK is 1.25 which is below satisfactory (see table 41 p.163). In addition to this the mean of 15 components of teacher educators' ability of organizing the environment for knowledge is 3.083. This implies teacher educators have a clear proficiency and skill in organizing the environment for knowledge. The mean of 13 components of teacher educators' instruction practices is 2.788 which involve in the evaluation ratings of "Basic". This implies that teacher educators' instruction practices need more improvement and progress towards proficient. Similarly the observation result indicates cooperative learning among prospective mathematics teachers is below average (mean = 1.75) (see table 43, p.167). In addition to this anova table 43.3 indicates the existence of ability of differences among teacher educators in practicing the instruction.

Moreover the mean of 10 components of teacher educators' professional responsibilities is 3.075. This implies teacher educators have a clear proficiency and skill in their professional responsibilities. In addition to this related to TPACK the mean of 6 components of PK is 2.542, which is at the level of "Basic". This implies teacher educators need more progress towards the proficiency of practicing PK. Nevertheless the mean of 4 components of PCK is 3.050. This implies teacher educators have a clear proficiency and skill in practicing PCK. However teacher educators were not observed to perform TK, CK, TCK, TPK, and TPCK. Hence it is possible to conclude that teacher educators' use of technology to perform mathematics courses is minimal. Thus the merged results of teacher educators, department head, and dean of natural and computational science interviews and observation result indicate that teacher educators' practices on mathematics education need more improvement and progress towards proficient.

(V) The Standard of Primary Mathematics Teacher Education Curriculum

The standard of primary mathematics teacher education curriculum was assessed based on the following criteria:

(1) Components of a model course outline designed by academic senate of California Community Colleges (2008); (2) Mc-Gill University of Canada (2016) designed standard components of course out lines; (3) Richards et al (2005) standards of primary teacher education curriculum; and (4) The National Professional Standards for Teachers of Ethiopia (NPTS) (MoE, 2013).

Thus based on the first two criteria the revised courses of 2012/2013 offer for prospective primary school mathematics teachers assessed as follows:

The courses fulfill most of the standards except: (a) Legislation, policy statements of the instruction related to the learners, rules and regulations and due date; (b) Instructor's name, address, academic status, advising hours, day, and dates; (c) Mid course evaluation time and procedures. In addition to these according to Richards et al (2005), the mentioned standards are included in the courses of Mathematics primary teacher education except logarithms and their use, Mechanics, friction, virtual work, center of gravity, simple machines, motions of pendulum and projectiles, motion in a circle, impulsive forces acting on elastic and in elastic particles.

Furthermore The National Professional Standards for Teachers (NPST) (MoE, 2013) designed a standard for teacher education profile after graduated from Teacher Education Institutions. These standards are written on pages 78-79 (7general standards) and page 183-185 specific categories of the 7 standards. Hence based on the standards I tried to assess the contents of courses designed for prospective mathematics teachers of primary school as follows:

Most of the courses are fulfilled compared to the courses designed and attached at appendix-K except the standards: (a) Engages students in formulating and testing hypothesis according to the methods of inquiry and standards of evidence within the discipline; (b) use information and communication technology courses to acquire knowledge and develop skill that enable prospective mathematics teachers to teach mathematics courses; and (c) collect, analyse, and present information to support the improvement of curricular materials.

In general the result of the study on practices of pre-service primary mathematics teacher education program indicates that there is a gap between prospective mathematics teachers attitude and mathematics education. This implies that prospective mathematics teachers lack interest and are not confident in their ability to learn and teach mathematics. In addition to these there is a gap between teacher educators' practices and TPACK activities. This violates the trend of UNESCO's plan which states that "21st century training of teachers needs to be supported by technology so as to make the practices of pre-service teacher education program at the standard level". Moreover there is a wide gap of cooperative work between the academic staff and the University College management. This reduces the effective practices of pre-service primary mathematics teacher education program.

5.1.1.2. The strategies and practices of Induction and CPD programs

Related to practices of CPD table 65 (p.207) indicates that the mean of 14 components of teachers' assessment for the practices of CPD is 2.52 except the mean (1.74) of the component

CPD which states that CPD is not significant for teachers. This implies that CPD practices in the schools need progress towards proficiency. Moreover teachers who are taking induction training suggest that the four modules prepared in 1998 for induction program need to update and contents are not related to mathematics and TPACK. Thus both induction and CPD programs need to progress towards proficiency.

According to the directors' response in all sample schools Induction and CPD programs are on progress and they said that Induction program is designed for beginner teachers in which they attend the program for two years using four modules prepared in 1998 by the guidance of mentors. The contents of the modules of Induction program are; peer observations, life skill, gender, HIV Aids, female education, need of CPD, students' behavior, students reflection, and teaching learning materials. This indicates that subjectmatter trainings are not involved in Induction program. Moreover the directors said that after the completion of Induction program beginner teachers will be promoted to CPD program.

Furthermore in all sample schools the directors' said that 31 primary mathematics teachers are attending the program and all other beginner teachers who are teaching other subjects are also involved in the program. However teachers suggest that induction modules contents need revision and update. In addition to these primary school mathematics teachers views indicate that previously CPD was modular system and teachers were complaining that; CPD is boring, it is wastage of time, and creating unnecessary work load on teachers; however according to the directors' view the new approach of CPD practices is based on the need of teachers, schools, and education bureau. In addition to this related to technology all the directors (100%) responded as follows: (a) Teachers as well as their students do not use calculators or computers to develop models; (b) Teachers and their students do not use calculators and computers to organize and solve some statistical data; (c) Teachers do not use computers to solve different exercises; and (d) teachers have no internet access in all sample schools. These imply that in all sample schools teachers and students have no opportunities to use technology that support them for the teaching learning process.

5.1.1.2.1. The practices of primary school mathematics teachers

Related to Induction, CPD and TPACK practices the observation result of primary mathematics teachers indicates that tables 68, 68.1, and 68.2 (p. 215) display the aggregate mean of 8 components of teachers ability of practicing their knowledge is 3.030 which involves in the ratings of “Proficient” this implies teachers have a clear proficiency and skill in practicing their knowledge. However tables 69, 70, 71, 72, and 73 (pp. 217-225) indicate that the grand mean of 14 components of teachers’ ability of organizing the environment for knowledge work is 2.84 which is involved under the ratings “Basic”; the aggregate mean of 13 components of mathematics teachers instruction practices is 2.89, which is at the rating category of “Basic”; the aggregate mean of 14 components of teachers Professional responsibilities is 2.55 which is categorized in the evaluation rating of “Basic”; the aggregate mean of 6 components of teachers’ practices on pedagogical knowledge is 2.98 which is categorized in “Basic”; and the aggregate mean of 5 components of teachers performance on Pedagogical Content Knowledge (PCK) is 2.64 which is categorized in the evaluation rating of “Basic”. These imply that teachers need more progress towards the proficiency of practicing the above tasks. However anova tables 69.3, 70.3, 71.3, 72.3, and 73.3, (pp.218-225) indicate that there are significant differences among primary school mathematics teachers in implementing the above mentioned tasks. This implies that there are teachers who work better than the others.

Furthermore primary school teachers were observed on the practices of TPACK. However except pedagogical knowledge (PK) and Pedagogical Content Knowledge (PCK); teachers did not use technology to teach mathematics. For instance they did not use calculators, smart phones, and computers to teach mathematics. In addition to these they are not aware of Technology Knowledge (TK), Content Knowledge (CK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and Technological Pedagogical Content Knowledge (TPCK) to teach mathematics by applying computers through the internet.

Thus the above mentioned practices need updating trainings through induction and CPD programs. However findings indicate that the practices of Induction and CPD programs need progress towards proficiency and it also need to involve subject matter knowledge using TPACK. Hence it is possible to conclude that the practices of Induction and CPD programs need a road map that promotes it to effective practices.

5.1.1.2.2. The attitude of primary school mathematics teachers towards mathematics and teaching mathematics

Table 53 on page 193 indicates that the aggregate mean of negative items of teachers' attitude towards mathematics and teaching mathematics is 3.40. For example the items and their mean indicate that: (a) Mathematics is primarily an abstract subject is 2.92; (b) If students face difficulty in mathematics, an effective approach is to give them more practice by themselves during the class is 3.07; (c) Mathematics should be learned as sets of algorithms or rules that cover all possibilities is 3.77; (d) Basic computational skills on the part of the teacher are sufficient for teaching primary school mathematics is 3.85. Moreover the interview result of primary school mathematics teachers point outs that 87.8% of them study different disciplines other than the teaching profession. On the basis of these statements teachers attitude towards mathematics and teaching mathematics in particular and towards the teaching profession in genral is negative. These attitudes are also supported by the professional status of teachers displayed in table 55; that some teachers (22.9%) responded that teaching profession is not their choice; some teachers (17.4%) responded mathematics is not their choice of study; and most of them (92.4%) responded that they change the profession when they get the opportunity; most of them (93.1%) and all (100%) responded that the society and the students do not appreciate their work respectively. Hence the attitude of teachers towards mathematics and teaching mathematics in particular and the teaching profession in general is negative. This implies that primary school mathematics teachers have no enthusiasm to work in the profession.

5.1.1.2.3. The standard of primary school mathematics curriculum

The standard of primary school Mathematics curriculum is assessed in terms of: (a) Equity; (b) Included mathematics contents; and (c) Recommended strategies of teaching and learning as suggested by The National Council of Teachers of Mathematics (NCTM, 2016, pp. 1-10). And curriculum assessment criteria, these are: (1) Sequence and continuity of the contents; (2) Appropriate balance of scope and depth; (3) Scope and Integration of the contents; (4) Balance of the total learning; (5) Logical relationship to main ideas and basic concepts; (6) Learnability of the subject matter; (7) Authenticity and Durability of the content; and (8) Utility.

Based on the above criteria the result of the assessment indicates as follows:

As displayed in table 76 the contents suggested by The National Council of Teachers of Mathematics (NCTM) as a standard are included in Mathematics syllabus of Ethiopian Primary School except technology/ICT, Data analysis, Probability and processes in some grades.

Inaddition to this grade 1 mathematics syllabus was assessed using the above curriculum assessment criteria and the result indicates as follows:

The syllabus fulfills the above mentioned assessment criteria except the following contents:

For instance related to Sequence and continuity, unit 7 (Multiplying and Dividing whole numbers upto 20) better to precede unit 5 (Measuring using traditional measures) and need to be followed by unit 9 (Whole numbers up to 100). In addition to this the assessment of Learnability of the subject matter indicates that unit 5(Measuring using traditional measures)**;** unit 6(Basic concepts of Fractions); unit 7(Multiplying and Dividing whole numbers up to 20); unit 10(Ethiopian Money); unit 11 (Time); and unit 12(Data handling and Simple mathematics Sequence) need a little bit simpler than this. Forinstance unit 7 needs to be replaced by the content multiplying and dividing one digit counting numbers.

In general primary school mathematics curriculum is found to be at the standard level regardless of some improvements.

5.1.2. The relationship/match of primary mathematics teacher education curriculum to primary school mathematics curriculum

In this section the similariries and differences between primary mathematics teacher education curriculum and primary school mathematics curriculum was assessed as follows:

As portrayed in tables 77 and 78 contents of first cycle (1-4) syllabus such as money (changing notes of money, word problems using money); time (time in days, months, years, and calculating on time); and addition and subtraction using word problems have no relationship to primary mathematics teacher education curriculum. In addition to this some primary mathematics teacher education courses offered for primary mathematics prospective teachers have no relationship to primary school mathematics syllabus. These courses are: (a) Introduction to Calculus (Math, 162); (b) Elementary Linear Algebra (Math, 222); (c) Calculus I (Math 261); and (d) Calculus II (Math 262). Moreover related to these courses teacher educators suggested that the courses are beyond the level of primary school prospective mathematics teachers. However second cycle (5-8) and most of the first cycle (1-4) mathematics contents have relationship to other courses of primary mathematics teacher education except the above mentioned Calculus and Linear Algebra (Math, 222) courses.

5.1.3. Factors that affect primary school teachers and teacher educators during mathematics curriculum practices

The major challenges identified in the study during the practices of primary mathematics teacher education in KUC are: (a) Poor mathematics background of the trainees; (b) Large class size, usually an average of 1: 60; (c) Courses are designed beyond the capacity of the trainees; (d) Negative attitude of trainees towards mathematics and teaching mathematics; (e) student teachers are not ready and have no motivation to learn mathematics; (f) Courses are not practiced using technology; (h) prospective mathematics teachers recruitment and selection criteria does not involve best candidates that would be successful in learning and teaching mathematics; (g) There is lack of facilities, such as adequate reference books, smart classrooms and computers; and (h) There is frequent revision of courses without evaluation research and some courses still need revision, because these courses are beyond the level of prospective primary school mathematics teachers'.

Moreover challenges of practices of mathematics education in public primary schools are: (a) Students with different academic abilities; (b) students who came from a wide range of backgrounds (for example; language differences, economic problems, residence, gender, attitude differences, etc.); (c) students with special needs (for example; hearing, vision, and speech impairments, physical disabilities, mental, emotional, and /psychological impairments; (d) uninterested students, that is there are students who do not want to learn mathematics; (e) Disruptive students; (f) Parents are not willing to follow up their children's progress of learning; (g) Shortage of computer hard ware and soft ware; (h) Shortage of other instructional equipment for students' use like mathematical instruments kit; (i) Shortage of equipments to use for visualizing and constructing geometric figures; (j) Inadequate physical facilities (school compound, library, water, toilet, classroom, smart classrooms, etc.); (k) Teacher students ratio is large, for instance 1:72 in some sample schools like Goro, Yewatatochgenet, and Misrakdil; (l) Low morale among students, fellow teachers, and administrators; (m) Threats to personal safety or the safety of students; and (n) Some contents are beyond the maturity level of the students (for instance grade1, grade2, and grade3)

Similarly the observation result in both KUC and primary schools asserted that: (a) There is large class size; (b) prospective mathematics teachers and second cycle primary school students' classroom participation is low; (c) There is scarcity of mathematics reference materials; (d) Primary school students disciplinary problems are observed; (e) Primary school mathematics teachers turnover is high; (f) Prospective mathematics teachers practicum activity is low; (f) Some Prospective mathematics teachers and most of primary school mathematics teachers beliefs and attitudes towards mathematics and teaching mathematics is negative. Thus the above mentioned factors alleviate the effective practices of mathematics education.

5.2. Recommendations

On the basis of the findings I suggest the following solutions of the problem that need interventions:

1. *Recruitment and selection of prospective primary school mathematics teachers*

Related to recruitment and selection criteria Mathematics department of KUC need to design criteria to select prospective mathematics teachers and create awareness and provide readiness trainings in which the trainees can study mathematics and complete with good result and teach mathematics effectively in primary schools. In addition to this recruitment and selection of students who study and teach mathematics need to be selected after the completion of preparatory level education with best results in mathematics and better if they trained at degree level. Moreover to make the attitude of prospective mathematics teachers positive towards mathematics and teaching mathematics, it is essential to recruit and select students who have good background in mathematics and who are interested to study and teach mathematics.

2. *Rethinking about teacher education policy at national level*

The Ministry of Education of Ethiopia needs to establish at least two excellence centers to train teachers at University level and produce well equipped teachers who can teach in all schools of Ethiopia effectively. In addition to this the training strategies of constructivists' particularly their methodologies that enable teacher educators to reflect on their knowledge, skill, beliefs, attitudes and classroom experiences to their students effectively need to be practiced. Hence this trend helps teacher educators to discuss together and plan different innovations they want to bring into their own classrooms. Moreover a guideline that includes road maps that lead to the right track for successful practices of teacher education program needs to be included in the policy. Thus it will be vital if the above mentioned points involved in the teacher education policy.

3. *Rethinking about effective strategies and practices of primary teacher education program*

The Strategies that help to generate resources inorder to strengthen the effective practices of teacher education programs and methodologies need to be designed and implemented. In addition to this action plans that help to meet the achievement of teachers' goals at the standard level need to be prepared by teacher education institutions based on the direction indicated from teacher education policy. Moreover to narrow the gap of different academic abilities of primary school students and prospective mathematics teachers; mathematics teachers and teacher educators need to alter their instructional methods from lecture and demonstration to discovery learning, problem solving, discussion, reviewing mathematics materials, etc. and it also needs to arrange remedial class to balance the ability of the trainees and need to use smart classrooms. Furthermore practices of Induction and CPD programs need follow up and monitoring and the training need to be supported by technology. In addition to this four Modules are prepared to train beginner teachers through induction program in 2005. However some contents of the modules need revision and contents are not related to mathematics and there should be also a guide line how mentors follow up beginner teachers.

4. *Revision of primary teacher education curriculum and primary school curriculum*

The revision of courses should be done based on the need of teacher educators, trainees, schools, and education bureau. In addition to this courses should be revised based on evaluation research and it will be essential to design courses according to the level of trainees. In addition to this courses need to be appropriate to the level of trainees. For instance the contents of Calculus courses of diploma trainees are similar to degree level students. Furthermore the curriculum of first cycle (1-4) students particularly some contents of grades 1, 2, and 3 are beyond the maturity level of the students. Hence contents like data handling and analysis; word problems of time and money etc. need revision.

5. *Application of technology and other school resources*

Effective practices and achievement need to integrate appropriate resources and technologies. Hence Universities/Colleges who train teachers should fulfill adequate facilities particularly smart classrooms, computers, reference books, mathematics laboratory, and mathematics instruments. Similarly to balance language, gender, attitude, and speed of learning differences of the prospective mathematics teachers' modern method of teaching and use of current technologies are the most preferable. Moreover the physical facilities of schools like water, toilet, lunch room; attractive compound, sport fields, etc. need to be fulfilled.

6. *Class size and appropriate use of technology*

In KUC an average class size is 1:60. It is obvious that large class size mitigates the application of active learning and difficult to teach mathematics using TPACK activities. Hence number of students in a class is preferable not exceed 40. Moreover a guide to practice TPACK activities needs to be included in Teacher Education Policy. The study also identified that teacher student ratio in four public schools is an average of 1: 72. To alleviate this problem these schools need to construct additional buildings or use the buildings of cluster schools.

7. Feeding program

Some public primary schools have feeding programs of breakfast and lunch. However still some schools need feeding program , because I observed many children are going to school without eating breakfast and stay till the end of the school program and teachers have also suggested that these children are sleeping in the classroom throughout the lesson. For instance the schools with similar cases are Yewotatochgenet, Yekaterara, Hidasie, Salayesh, etc. Thus the school and stakeholders need to seek for additional help from NGOs' or government organizations.

8. School community relationship and students disciplinary problems

Parents academic follow up of their children is minimal in public primary schools. To alleviate this problem the schools need to communicate with parents and should create awareness how parents follow up their children in and outside the school. Moreover public primary school students discipline problems are getting beyond the control of teachers and schools. Hence the schools need to design their own strict rule and regulations, teach the importance of positive discipline for their students, and particularly teachers are expected to inculcate positive discipline to their students to alleviate this problem. In addition to this Public schools should create suitable learning opportunities for all students particularly for special needs students.

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Appendices

Appendix A: Adapted Attitudes Measure Items of Prospective Mathematics Teachers

The pilot test held on from November, 2015 to January, 2016

በአንደኛ ደረጃ ት/ቤቶች ለማስተማር በሚሰለጥኑ እጩ መምህራን የሚሞላ መጠይቅ

የመጠይቁ ዓላማ "The practices and Challenges of Primary Teacher Education in Addis Ababa City Government: Focus on Mathematics Education" **ለሚለው ርዕስ ጥናት የሚሆን መረጃ ለመሰብሰብ ነው፡፡**

መመሪያ፡-

በሚከተለው ስኬል መሰረት ትክክለኛ የሆነውን የሒሣብ ትምህርት ተሞክሯችሁን በሠንጠረዥ ትይዩ የ "✓" ምልክት በማስቀመጥ መልሱ፡፡

"Strongly disagree" = 1	"**በጣም አልስማማም** " = 1
"Disagree" = 2	"***አልስማማም***" = 2
"Undecided" = 3	"***ሐሳብ የለኝም***" = 3
"Agree " = 4	"***እስማማለሁ***" = 4
"Strongly agree" = 5	"**በጣም እስማማለሁ**" = 5

በቅድሚያ ይህን መጠይቅ ለመሙላት ስላደረጋችሁልኝ ትብብር አመሰግናለሁ፡፡

አጥኚው

Name of the university /college ________________________

Academic Year of the student: ______________________

Sex: M _____ F ___ age _______

Field of specialization: ____________________________

Major: ____________ Minor __________________

No.	ATMI –Original	ATMI-Amharic	1	2	3	4	5
1	I have usually been at ease during math tests	በሒሣብ ፈተና ወቅት በአብዛኛው የመጨነቅ ስሜት የለኝም					
2	I struggled with many concepts in Mathematics	ብዙ የሒሣብ ፅንሰ ሐሳቦች ለማወቅ ጥረት አድርጌያለሁ					
3	My teachers relied on over head projectors or chalk boards as tools to present information	እኔን ያስተማሩኝ መምህራን ትምህርቱን የሚያቀርቡት በሰሌዳ እና በፕሮጀክተር ነበር					
4	My teachers spent the necessary amount of time helping me to understand Math concepts	የሒሣብ ፅንጸ ሐሳቦችን እንዳውቅ መምህራኖቹ እኔን ለመርዳት የሚያስፈልገውን ጊዜ ሁሉ ተጠቅመዋል					
5	I do not want to teach mathematics in the future	ወደፊት ሒሣብ ማስተማር አልፈልግም					
6	I had many competent mathematics teachers	ብዙ ብቃት ያላቸው የ|ሒሣብ መምህራን አስተምረውኛል					
7	I have often helped others with their math home work	ብዙ ጊዜ የቤት ስራ ሒሣብ እንዲሰሩ የተሰጣቸውን ተማሪዎች አግዛለሁ					
8	My teachers emphasized understanding and not just memorization	መምህራኖቹ ትኩረት የሚሰጡት ፅንሰ ሐሳቡ					

		እንዲገባን እንጂ እንድንሸመድደው አይደለም					
9	I elected to take part in mathematical competitions	በሒሣብ ውድድር እንድሳተፍ ተመርጬ አውቃለሁ					
10	During my math classes I was expected to sit quietly and listen	በሒሣብ ክፍል ጊዜ ቁጭ ብዬ እና ፀጥ ብዬ እንዳዳምጥ ይጠበቃል					
11	I usually comprehended math content well and seldom got lost.	ብዙውን ጊዜ የሒሣብ ትምህርትን ይዘት ሳነብ እረዳለሁ፤ ሆኖም አንዳንድ ጊዜ አይገባኝም					
12	I did not feel comfortable seeking help from my math teachers outside of class	ከክፍል ውጭ የሒሣብ መምህራኖችን እርዳታ መፈለግ አይመቸኝም					
13	I did not like being introduced to new mathematical content	አዲስ የሒሣብ ይዘቶችን ማወቅ አልወድም ነበር					
14	Mathematics makes me feel un comfortable and nervous	ሒሣብን መማር ምቾት አይሰማኝም እረበሻለሁ					
15	I get really up tight during math topics	እያንዳንዱ የሒሣብ ርዕስ ላይ እጨነቃለሁ					
16	My teachers focus mainly on memorization, facts & procedures.	አብዛኛውን ጊዜ የሒሣብ መምህራኖች ትኩረት የሚሰጡት በቅደም ተከተል ለሚሰሩ ፤ በማስታወስ እና በሚሸመደዱ ይዘቶች ላይ ነው					
17	My Math teachers were supportive in my efforts to learn math.	የሒሣብ መምህራኖች ጥረት እንዳደረግ ድጋፍ ያረጉልኝ ነበር					

18	My teachers assigned several homework problems each night	መምህራኖች ብዙ የቤት ሥራ በየጊዜው ይሰጡኝ ነበር					
19	I almost never get uptight while taking math tests	የሒሣብ ፈተናዎችን ስፈተን አልጨነቅም					
20	My teachers had confidence in me as a student of mathematics	የሒሣብ መምህራኖቹ በእኔ ላይ እምነት ነበራቸው					
21	I learned best when my teachers took the time to connect new concept to that which I had already.	የሒሣብ መምህራኖች አዲሱን ፅንሰ ሐሳብ ፊት ከተማርኩት ጋር በማያያዝ ሲያስተምሩኝ በጣም ይገባኝ ነበር					
22	I have usually been at ease during math courses	በአብዛኛው የሒሣብ ኮርሶችን የምማረው ዘና ብዬ ነው					
23	I chose a major that did not require too many math courses	ብዙ የሒሣብ ኮርስ የማይሰጥበትን ዋና የጥናት መስክ ለማጥናት መርጬ ነበር					
24	I have taken math classes even though they were not required	ለእኔ ባያስፈልገኝም የሒሣብ ኮርሶችን እማራለሁ					
25	I have dropped math courses because they became too difficult	የሒሣብ ኮርሶችን ለመማር ከተመዘገብኩ በኋላ ትቻቸዋለሁ፤ ምክንያቱም በጣም ከባድ ነበሩ					
26	I usually don\t worry about my ability to solve math problems	ስለ ሒሣብ ችሎታዬ ብዙ አልጨነቅም					
27	New math content has usually been easy for me to understand	በአብዛኛው አዲስ የሒሣብ ርዕስን በቀላሉ እረዳለሁ					
28	I did not take a math class of my senior year in high school	በከፍተኛ ሁለተኛ ደረጃ የመጨረሻው ዓመት ትምህርት ሂሣብ አልተማርኩም ነበር፡፡					
29	It wouldn't bother me at all to take more math courses	ብዙ የሒሣብ ኮርሶችን መማር አያስጨንቀኝም					
30	When confronted with a difficult math concept. I generally worked until I	ከባድ የሒሣብ ፅንሰ ሐሳብ ሲያጋጥመኝ እስኪገባኝ ድረስ					

	understand the concept	እሰራለሁ					
31	I look forward to teaching Mathematics	ሒሣብ ለማስተማር በጉጉት እየጠበቅሁ ነው					
32	I cannot recall many mathematical concepts that were hard for me to understand.	ያልገቡኝን የሒሣብ ፅንሰ ሐሳብ ማስታወስ አልችልም					
33	My math teacher were very patient with me	መምህራኖቼ በጣም ይታገሱኝ ነበር					
34	Many of my math teachers were in competent	አብዛኞቹ የሒሣብ መምህራኖቼ ብቃት አልነበራቸውም					
35	My teachers did not believe I was capable of learning mathematics	እኔ ሒሣብ መማር እንደምችል መምህራኖቼ እምነት አልነበራቸውም					
36	When I had trouble with a concept I usually gave up and stopped trying.	ሒሣብ አልገባ ሲለኝ አብዛኛውን ጊዜ ለመስራት አልሞክርም እተወዋለሁ					
37	I get a sinking feeling when I think of trying hard math problems	ከባድ የሒሣብ ፕሮብሌሞችን ለመስራት ሳስብ ባህር ውስጥ ገብቶ የመስመጥ ያህል ይሰማኛል					
38	My teachers often applied that math lessons to real world situations	መምህራኖች ሒሣብን ከነባራዊ ሁኔታ ጋር በማዛመድ ያስተምራሉ					
39	Math makes me feel un easy & confused	የሒሣብ ትምህርት የማይመችና የመደናገር ስሜት ይፈጥርብኛል					
40	My teachers used a combination of manipulative, visual aids and cooperative learning	መምህራኖቼ ሒሣብን ሲያስተምሩ በቡድን መማር ዘዴንና የተለያዩ የትምህርት መርጃ መሣሪያዎች ይጠቀሙ ነበር					
41	I was frequently lost and had trouble keeping up in my math classes	በሒሣብ ክፍለ ጊዜ አዘውትሮ የመገኘት ችግር ነበረብኝ					
42	My teachers used math games to reinforce my understanding of concepts	የሒሣብ መምህራኖቼ የሒሣብን ፅንሰ ሐሳብን ለማስረዳት ሒሣባዊ ጨዋታዎችን ይተገብሩ ነበር					
43	My mind goes blank and I am unable to	ሒሣብ በምሰራበት ወቅት በደንብ					

	think clearly when doing mathematics	ማሰብ አልችልም ጭንቅላቴም ባዶ የሆነ ይመስለኛል					
44	I can recall math teachers who made me feel stupid in class	በሒሣብ የደካማነት ስሜት እንዲሰማኝ ያደረጉኝን መምህራ አስታውሳለሁ					
45	I have selected math as my area of emphasis	ሒሣብ የጥናት መስኬ እንዲሆን መርጨዋለሁ					
46	I have generally considered math as a related sequence progression of ideas	ሒሣብን በአጠቃላይ ሳስበው የተያያዙና ተከታታይነት ያላቸው የሐሳቦች ክምችት ነው					
47	I generally have had difficulty relating new mathematical concepts to those I had previously learned	እኔ በአጠቃላይ አዲሶቹን የሒሣብ ፅንሰ ሐሳቦች ከተማርኩት ጋር የማዛመድ ችግር አለብኝ					
48	I am avoiding taking Mathematics classes in college	በኮሌጅ ውስጥ ሒሣብን መማር አልፈልግም					
49	My math teachers often became frustrated with me	የሒሣብ መምህራኖች ብዙ ጊዜ በእኔ ሥጋት ነበራቸው					
50	My math teachers frequently used a lecture format	የሒሣብ መምህራኖች ዘወትር የሚጠቀሙት የማስተማር ስልት ገለጻ ነው					
51	I enjoy going beyond the assigned work and trying to solve new problems in mathematics	ከተሰጠው የክፍል ስራ በተጨማሪ አዳዲስ የሒሣብ ፕሮብሌሞችን መስራት ያስደስተኛል					
52	Math is enjoyable and stimulating to me	ሒሣብ የሚያስደስተኝና የሚያነቃቃኝ ትምህርት ነው					
54	I am highly interested to teach math in the school and use it outside the school	ሒሣብን በት/ቤት የማስተማር እና በውጭ ለተለያዩ ስሌቶች የመጠቀም ከፍተኛ ፍላጎት አለኝ					
55	I have never liked math and it is my most dreaded subject	ሒሣብ በጣም ከሚያስፈራኝ የትምህርት አይነቶች አንዱ እና የምጠላው ትምህርት ነው					

56	I have always enjoyed studying math in school	ሒሣብ ሁልጊዜ መማር ያስደስተ|ኛል					
57	I would like to develop my math skill and study this subject more	የሒሣብ ክህሎቴን ማበልፀግና ትምህርቱን የበለጠ ማጥናት እፈልጋለሁ					
58	Math makes me uncomfortable and nervous	ሒሣብ የሚረብሸኝና ምቾት የማይሰጠኝ ትምህርት ነው					
59	Math is dull and boring because it leaves no room for personal opinion	ሒሣብ ደነዝና አሰልቺ ትምህርት ነው ምክንያቱም በግል ሐሳብን የመግለጽ ቦታ የለውም					
60	Math is very interesting and I have usually enjoyed it	ሒሣብ አብዛኛውን ጊዜ ፍላጐትን የሚያነሳሳና የሚያስደስተኝ ትምህርት ነው					
61	I am interested and willing to acquire further knowledge of math	በሒሣብ ደስተኛ ስለሆንኩ የበለጠ የሒሣብ ዕውቀት ለመቅሰም ፍላጎት አለኝ					
62	Math has contributed greatly to science and other fields of knowledge	ሒሣብ ለሳይንስና ለሌሎች የዕውቀት መስኮች ከፍተኛ አስተዋጽኦ አበርክቷል					
63	Math is less important to people than art or literature	ሒሣብ ለሰዎች የሚሰጠው ጥቅም ከኪነጥበብና ስነ ጽሑፍ ያነሰ ነው					
64	Math is not important for the advance of civilization & society	ሒሣብ ለሥልጣኔና ለሕብረተሰብ ዕቅድገት ጠቀሜታ የለውም					
65	Math is very worthwhile and necessary subject	ሒሣብ በጣም አስፈላጊና ዋጋ የለው የትምህርት አይነት ነው					
66	Math is important for artists and writers to understand it as well as scientists	ሒሣብ ለደራሲዎች፣ ለአርቲስቶች እንዲሁም ለሳይንቲስቶች ጠቀሜታ አለው					
67	Math is not important in everyday life	ሒሣብ ለዕለታዊ ሕይወት ጠቀሜታ የለውም					
68	Math helps develop a person's mind and teachers to think	ሒሣብ የሰውን አዕምሮ ለማጎልበትና የመምህራንን የማሰብ ክህሎት ለማዳበር ይረዳል					

69	Math is needed in designing practically every thing	ሒሣብ ማንኛውንም ነገር በተግባር ለመንደፍ ያስፈልጋል					
70	Math is needed in order to keep the world running	ሒሣብ የአለምን የቴክኖሎጂ ሩጫ ለማስቀጠል አስፈላጊ ነው					
71	There is nothing creative about math it is just memorizing formulas & things	ሒሣብ ቀመሮችንና የሒሣብ ንድፈ ሐሳቦችን ከመሸምደድ ውጭ የሚፈጥረው ነገር የለም					
72	I don't use mathematics in my everyday life.	ሒሣብን የዕለት ከዕለት እንቅስቃሴ ውስጥ አልጠቀምም					

Confidence	Anxiety	Value	Enjoyment	Motivation	Teacher
2,7,9,11,22,26, 27,30,32,35, 45, and 47,	1,12,13,14,15,19,3 7,39,41,43,49, and 58.	23,38,62,63,64,65 ,66,67,68,69,70, and 72.	25,31, 44,51,52,54,56 ,59,60, and 71.	5,24,28,29,36,4 6,48,55,57, and 61,	3,4,6,8,10,16, 17,18,20,21,3 3,34,40,42, and 50.

Note that each item measures the respective factors. Adapted from the Journal.vol 5 (Teacher Attributes) December 2011. (www.k-12prep.math.ttu.edu) pp.14-18. By Robin S. Kalder and Sally A. Lesik.

Kalder and Lesik (2011) used the items (3, 19, 22, 24, 28, 35, 36, 38, 41, 43, 44, 45, 46, 47, 48, 49, 51, 52, 54, 55, 56, 61, and 71) to measures the subscales commonly. For instance item 3 is used to measure Confidence and Teacher education, but I used item number 3 to measure Teacher expectation by confirming from different readings. They used item 19 to measure both Confidence and Anxiety, but I used it to measure Anxiety only. It is possible to observe from the above table the items I used respected to each sub-scales or factors other than the two writers. The authors commonly used the above items as follows: (1) Confidence: 3, 19,22, 35, 36, 41, 45, 47, 51, 52,and 56; (2) Anxiety: 19, 22, 41, 43, 44, 47, 49, and 55; (3) Value: 24, 28, 38, 45, 46, 48, 54, and 61; (4) Enjoyment: 24, 36, 43, 44, 46, 48, 51, 52, 54, 55, 56, and 71; (5) Motivation: 24, 28, 46, 48, 55, 61, and 71; and (6) Teacher expectation: 3, 35, 49, and 38.

Appendix B: Pilot test result of Attitudes Measure Items of Dessie and Debre Berhan Teacher Education Colleges of prospective Mathematics Teachers

In the two teacher education colleges 330 prospective mathematics teachers filled the attitude test; from these 164 prospective mathematics teachers are from Dessie; ofwhich 85 are second year (F=21 and M= 64) and 79 are third year (F=20 and M=59) and 166 prospective mathematics teachers are from Debre Birhan; of which 91 are second year (F= 22 and M= 69) and 75 are third year (F= 21 and M = 54).

Table 1: Reliability, mean, standard deviation, and squared multiple correlation of the pilot test items (N=330)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.726	.728	71

Item Statistics

	Mean	Std. Deviation	N
I have usually been at ease during math tests (Anxiety / F2)	2.44545	1.343133	330
I struggled with many concepts in mathematics (Confidence /F1)	3.80303	1.182698	330
My teachers relied on over head projectors or chalk boards as tools to pr esent information. (Teacher expectation /F6)	4.26061	1.126616	330
My teachers spent the necessary amount of time helping me to understand mathematics concepts. (Teacher expectation / F6)	3.52727	1.388462	330
I do not want to teach mathematics in the future. (Motivation / F4)	2.54545	1.616610	330
I had many competent mathematics teachers. (Teacher expectation / F6)	4.03030	1.028022	330

I have often helped others with their math home work (Confidence / F1)	3.60000	1.139509	330
My teachers emphasized understanding and not just memorization. (Teacher expectation / F6)	3.97273	1.228777	330
I elected to take part in mathematical competitions (Confidence/ F1)	2.53333	1.368483	330
During my mathematics classes I was expected to sit quietly and listen (Teacher expectation/ F6)	3.28182	1.619403	330
I usually comprehended math content well and seldom got lost (Confidence / F1)	3.76061	1.077665	330
I did not feel comfortable seeking help from my math teachers outside of class (Anxiety /F2)	2.36061	1.444082	330
I did not like being introduced to new mathematical content (Anxiety/F2)	1.75152	1.082640	330
Mathematics makes me feel uncomfortable and nervous (Anxiety/F2)	1.79394	1.302310	330
I get really uptight during mathematics topics (Anxiety /F2)	2.25455	1.459294	330
My teachers focus mainly on memorization, facta and procedures (Teacher expectation /F6)	2.96364	1.631345	330
My math teachers were supportive in my efforts to learn math (Teacher expectation /F6)	3.56970	1.444933	330
My teachers assigned several home work problems each night (Teacher expectation /F6)	3.77879	1.038545	330

I almost never get uptight while taking math tests (F2)	3.56061	1.581896	330
My teachers had confidence in me as a student of mathematics (Teacher expectation /F6)	3.43636	1.204303	330
I learned best when my teachers took the time to connect new concept to that which I had already (Teacher expectation /F6)	4.29697	.996799	330
I have usually been at ease during math courses (Confidence /F1)	3.51212	1.423267	330
I chose a major that did not require too many math courses (Value /F3)	2.68182	1.422348	330
I have taken math classes even though they were not required (Motivation /F5)	1.83939	1.038013	330
I have dropped math courses because they became too difficult (Enjoyment /F4)	2.76061	1.633695	330
I usually do not worry about my ability to solve math problems (Confidence /F1)	2.84242	1.405381	330
New math content has usually been easy for me to understand (Confidence /F1)	3.14848	1.435253	330
I did not take a math class of my senior year in high school (Motivation/F5)	1.90000	1.320518	330
It wouldn't bother me at all to take more math courses (Motivation/F5)	2.66970	1.610185	330
When confronted with a difficult math concept, I generally worked until I understand the concept (Confidence/F1)	3.99697	1.279957	330
I look forward to teaching mathematics (Enjoyment/F4)	3.65152	1.528776	330

I can not recall many mathematical concepts that were hard for me to understand (Confidence/F1)	3.81515	1.280820	330
My math teachers were very patient with me (Teacher expectation/F6)	3.32424	1.502082	330
Many of my math teachers were incompetent (Teacher expectation/F6)	2.23636	1.246958	330
My teachers did not believe I was capable of learning mathematics (Confidence/F1)	3.30606	1.539834	330
When I had trouble with math concept I usually gave up and stopped trying (Motivation/F5)	3.62121	1.503442	330
I get a sinking feeling when I think of trying hard math problems (Anxiety/F2)	1.93636	1.256791	330
My teachers often applied that math lessons to real world situations (Value/F3)	3.47879	1.368725	330
Mathematics makes me feel uneasy and confused (Anxiety/F2)	2.23333	1.258447	330
My teachers used a combination of manipulative, visual aids, and cooperative learning (Teacher expectation/F6)	3.53939	1.299974	330
I was frequently lost and had trouble keeping up in my math classes (Anxiety/F2)	2.60606	1.780328	330
My teachers used math games to reinforce my understanding of concepts (Teacher expectation/F6)	2.75455	1.310605	330

My mind goes blank and Iam unable to think clearly when doing mathematics (Anxiety/F2)	2.31515	1.436841	330
I can recall math teachers who made me feel stupid in class (Enjoyment/F4)	2.25758	1.398116	330
I have selected math as my area of emphasis (Confidence/F1)	2.91515	1.673705	330
I have generally considered math as a related sequence pregression of ideas (Motivation/F5)	3.68485	1.482650	330
I generally have had difficulty relating new mathematical concepts to those I had previously learned (Confidence/F1)	2.70909	1.489653	330
Iam avoiding taking mathematics classes in college (Motivation/F5)	1.99697	1.410983	330
My mathematics teachers often became frustrated with me (Anxiety/F2)	1.91818	1.023717	330
My math teachers frequently used a lecture format (Teacher expectation/F6)	2.74545	1.333025	330
I enjoy going beyond the assigned work and trying to solve new problems in mathematics (Enjoyment /F4)	3.31515	1.525093	330
Mathematics is enjoyable and stimulating to me (Enjoyment/F4)	3.86970	1.273290	330
Iam highly interested to teach mathematics in the school and use it outside the school (Enjoyment/F4)	4.28182	.883470	330

I have never liked mathematics and it is my most dreaded subject (Motivation/F5)	1.59697	1.071029	330
I have always enjoyed studying mathematics in school (Enjoyment/F4)	4.26364	1.019660	330
I would like to develop my mathematics skill and study this subject more (MotivationF5)	4.46667	.768161	330
Mathematics makes me uncomfortable and nervous (Anxiety/F2)	1.50303	.933173	330
Mathematics is dull and boring because it leaves no room for personal opinion (Enjoyment/F4)	1.98182	1.460619	330
Mathematics is very interesting and I have usually enjoyed it (Enjoymen/F4)	4.30000	.994361	330
I am interested and willing to acquire further knowledge of mathematics (Motivation/F5)	3.93333	1.421217	330
Mathematics has contributed greatly to science and other fields of knowledge (Value/F3)	3.94242	1.334492	330
Mathematics is less important to people than art or literature (Value/F3)	1.64848	.937604	330
Mathematics is not important for the advance of civilization and society (Value/F3)	1.53939	.954891	330
Mathematics is very worthwhile and necessary subject (Value/F3)	4.11515	1.363466	330
Mathematics is important for artists and writers to understand it as well as scientists (Value/F3)	4.06364	1.187144	330
Mathematics is not important in every life (Value/F3)	1.67576	1.001983	330

Mathematics helps develop a person's mind and teachers to think (Value/F3)	4.32424	.851078	330
Mathematics is needed in designing practically everything (Value/F3)	4.23030	1.023281	330
Mathematics is needed inorder to keep the world running (Value/F3)	4.28182	.927117	330
There is nothing creative about math it is just memorizing formulas and things (Enjoyment /F4)	1.96667	1.429853	330
I don' use mathematics in my everyday life (Value/F3)	1.86970	1.322470	330

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.058	1.503	4.467	2.964	2.972	.801	71

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
I have usually been at ease during math tests (Anxiety / F2)	214.64848	424.958	.041	.500	.727
I struggled with many concepts in mathematics (Confidence /F1)	213.29091	423.119	.093	.494	.725
My teachers relied on over head projectors or chalk boards as tools to pr esent information. (Teacher expectation /F6)	212.83333	415.252	.273	.633	.719
My teachers spent the necessary amount of time helping me to understand mathematics concepts. (Teacher expectation / F6)	213.56667	421.413	.100	.590	.725

I do not want to teach mathematics in the future. (Motivation / F4)	214.54848	408.540	.274	.671	.718
I had many competent mathematics teachers. (Teacher expectation / F6)	213.06364	424.741	.077	.546	.725
I have often helped others with their math home work (Confidence / F1)	213.49394	409.588	.394	.536	.715
My teachers emphasized understanding and not just memorization. (Teacher expectation / F6)	213.12121	436.624	-.177	.589	.734
I elected to take part in mathematical competitions (Confidence/ F1)	214.56061	420.758	.114	.533	.725
During my mathematics classes I was expected to sit quietly and listen (Teacher expectation/ F6)	213.81212	419.861	.099	.720	.726
I usually comprehended math content well and seldom got lost (Confidence / F1)	213.33333	419.591	.188	.520	.722
I did not feel comfortable seeking help from my math teachers outside of class (Anxiety /F2)	214.73333	429.041	-.035	.665	.731
I did not like being introduced to new mathematical content (Anxiety/F2)	215.34242	419.205	.196	.570	.722
Mathematics makes me feel uncomfortable and nervous (Anxiety/F2)	215.30000	420.563	.127	.593	.724
I get really uptight during mathematics topics (Anxiety /F2)	214.83939	424.397	.042	.629	.728
My teachers focus mainly on memorization, facta and procedures (Teacher expectation /F6)	214.13030	432.685	-.093	.693	.735

My math teachers were supportive in my efforts to learn math (Teacher expectation /F6)	213.52424	425.606	.023	.648	.728
My teachers assigned several home work problems each night (Teacher expectation /F6)	213.31515	422.496	.128	.563	.724
I almost never get uptight while taking math tests (F2)	213.53333	429.927	-.051	.657	.732
My teachers had confidence in me as a student of mathematics (Teacher expectation /F6)	213.65758	419.861	.157	.625	.723
I learned best when my teachers took the time to connect new concept to that which I had already (Teacher expectation /F6)	212.79697	428.837	-.019	.587	.728
I have usually been at ease during math courses (Confidence /F1)	213.58182	409.326	.307	.603	.717
I chose a major that did not require too many math courses (Value /F3)	214.41212	419.033	.137	.484	.724
I have taken math classes even though they were not required (Motivation /F5)	215.25455	418.014	.235	.647	.721
I have dropped math courses because they became too difficult (Enjoyment /F4)	214.33333	402.831	.359	.666	.714
I usually do not worry about my ability to solve math problems (Confidence /F1)	214.25152	420.554	.113	.555	.725
New math content has usually been easy for me to understand (Confidence /F1)	213.94545	426.495	.008	.604	.729
I did not take a math class of my senior year in high school (Motivation/F5)	215.19394	414.692	.235	.610	.720
It wouldn't bother me at all to take more math courses (Motivation/F5)	214.42424	411.905	.223	.770	.720

When confronted with a difficult math concept, I generally worked until I understand the concept (Confidence/F1)	213.09697	426.939	.009	.521	.728
I look forward to teaching mathematics (Enjoyment/F4)	213.44242	398.649	.460	.610	.710
I can not recall many mathematical concepts that were hard for me to understand (Confidence/F1)	213.27879	424.329	.059	.614	.727
My math teachers were very patient with me (Teacher expectation/F6)	213.76970	423.339	.056	.697	.727
Many of my math teachers were incompetent (Teacher expectation/F6)	214.85758	420.943	.128	.618	.724
My teachers did not believe I was capable of learning mathematics (Confidence/F1)	213.78788	404.994	.350	.643	.715
When I had trouble with math concept I usually gave up and stopped trying (Motivation/F5)	213.47273	411.989	.243	.742	.719
I get a sinking feeling when I think of trying hard math problems (Anxiety/F2)	215.15758	416.826	.208	.614	.721
My teachers often applied that math lessons to real world situations (Value/F3)	213.61515	416.736	.187	.512	.722
Mathematics makes me feel uneasy and confused (Anxiety/F2)	214.86061	425.512	.038	.624	.727
My teachers used a combination of manipulative, visual aids, and cooperative learning (Teacher expectation/F6)	213.55455	420.521	.128	.626	.724
I was frequently lost and had trouble keeping up in my math classes (Anxiety/F2)	214.48788	409.795	.223	.609	.720

My teachers used math games to reinforce my understanding of concepts (Teacher expectation/F6)	214.33939	421.556	.107	.667	.725
My mind goes blank and Iam unable to think clearly when doing mathematics (Anxiety/F2)	214.77879	408.124	.325	.714	.716
I can recall math teachers who made me feel stupid in class (Enjoyment/F4)	214.83636	402.320	.442	.621	.712
I have selected math as my area of emphasis (Confidence/F1)	214.17879	408.779	.258	.657	.718
I have generally considered math as a related sequence pregression of ideas (Motivation/F5)	213.40909	409.215	.294	.660	.717
I generally have had difficulty relating new mathematical concepts to those I had previously learned (Confidence/F1)	214.38485	416.560	.169	.617	.723
Iam avoiding taking mathematics classes in college (Motivation/F5)	215.09697	404.222	.403	.707	.713
My mathematics teachers often became frustrated with me (Anxiety/F2)	215.17576	417.665	.247	.619	.721
My math teachers frequently used a lecture format (Teacher expectation/F6)	214.34848	419.978	.134	.559	.724
I enjoy going beyond the assigned work and trying to solve new problems in mathematics (Enjoyment /F4)	213.77879	413.455	.214	.627	.721
Mathematics is enjoyable and stimulating to me (Enjoyment/F4)	213.22424	414.314	.253	.627	.720

Iam highly interested to teach mathematics in the school and use it outside the school (Enjoyment/F4)	212.81212	418.165	.280	.627	.720
I have never liked mathematics and it is my most dreaded subject (Motivation/F5)	215.49697	418.233	.221	.574	.721
I have always enjoyed studying mathematics in school (Enjoyment/F4)	212.83030	427.655	.009	.714	.727
I would like to develop my mathematics skill and study this subject more (MotivationF5)	212.62727	424.265	.133	.517	.724
Mathematics makes me uncomfortable and nervous (Anxiety/F2)	215.59091	418.960	.242	.534	.721
Mathematics is dull and boring because it leaves no room for personal opinion (Enjoyment/F4)	215.11212	420.896	.101	.764	.725
Mathematics is very interesting and I have usually enjoyed it (Enjoymen/F4)	212.79394	425.653	.059	.631	.726
I am interested and willing to acquire further knowledge of mathematics (Motivation/F5)	213.16061	418.932	.139	.583	.724
Mathematics has contributed greatly to science and other fields of knowledge (Value/F3)	213.15152	419.564	.141	.576	.724
Mathematics is less important to people than art or literature (Value/F3)	215.44545	422.613	.144	.576	.724
Mathematics is not important for the advance of civilization and society (Value/F3)	215.55455	417.768	.266	.571	.720
Mathematics is very worthwhile and necessary subject (Value/F3)	212.97879	413.535	.246	.627	.720

Mathematics is important for artists and writers to understand it as well as scientists (Value/F3)	213.03030	416.947	.221	.562	.721
Mathematics is not important in every life (Value/F3)	215.41818	417.265	.264	.572	.720
Mathematics helps develop a person's mind and teachers to think (Value/F3)	212.76970	425.649	.076	.592	.725
Mathematics is needed in designing practically everything (Value/F3)	212.86364	424.039	.094	.617	.725
Mathematics is needed inorder to keep the world running (Value/F3)	212.81212	424.652	.093	.661	.725
There is nothing creative about math it is just memorizing formulas and things (Enjoyment /F4)	215.12727	412.421	.251	.652	.719
I don' use mathematics in my everyday life (Value/F3)	215.22424	423.190	.076	.584	.726

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
217.09394	429.058	20.713716	71

As indicated in the above table the total items mean is 3.058, which belongs to the rating scale “undecided" this means prospective mathematics teachers of Dessie and Debre Birhan could not decide on their attitudes towards mathematics. However the total mean for negative items (2, 11, 32, 35, and 47) of confidence is 3.48 and the frequency and percent of the above mentioned negative items for agree and strongly agree is 213 (64.6%) this implies that 64.6% of prospective mathematics teachers of the two colleges are not confident in their ability to learn mathematics.

Sim ilarly the total mean for negative items (12, 13, 14, 15, 37, 39, 41, 43, 49, and 58) of anxiety is 2.07 and the frequency and percent of the above mentioned items of agree and strongly agree is 75 (22.82%) this implies that 22.82%% of prospective mathematics teachers of the two colleges are learning mathematics under stress.

The total mean for negative items (25, 44, 59, and 71) of enjoyment is 2.24 and the frequency and percent of the above mentioned items of agree and strongly agree is 96 (29.1%) this implies that 29.1% of propsective mathematics teachers of the two colleges do not like to study mathematics.

The total mean of negative items (5, 28, 36, 46, 48, and 55) of motivation is 2.56, and the frequency and percent of the above mentioned items of agree and strongly agree is 126 (38.07%) this implies that 38.07% of prospective teachers of the two colleges have no enthusiasm to Study and teach mathematics. This conclusion can be confirmed by analyzing item number 5 separately that " I don't want to teach mathematics in the future" the aggregate mean for this item is 2.55 and the frequency and percent of the item of agree and strongly agree is 140 (42,4%). This implies that 42.4% of Dessie and Debre Berhan prospective mathematics teachers do not want to teach mathematics in the future, but they are studing mathematics.

The total mean of negative items (23, 63, 64, 67, and 72) of value is 1.88 and the frequency and percent of the above mentioned items of agree and strongly agree is 55 (16.56%) this implies that 16.56% of prospective mathematics teachers of the two colleges do not know the use or value of mathematics. However the aggregate mean of positive items (38, 62, 65, 66, 68, 69, and 70) is 4.06 and the frequency and percent of the above mentioned items of agree and strongly agree is 250 (75.77%) this implies that 75.77% of Dessie and Debre Berhan prospective mathematics teachers know the value or use of mathematics.

The mean of negative item 16 "my teachers focus mainly on memorization, facts, and procedures' is 2.96 and the frequency and percent of the item for agree and strongly agree is 171 (51.8%), The mean of item number 34 "Many of my mathematics teachers were incompetent" is 2.24 and the frequency and percent of the item for agree and strongly agree is 79 (23.9%), and the mean of item number 50 " My mathematics teachers frequently used a lecture format" is 2.75 and the frequency and percent of the item for agree and strongly agree is 137 (41.5%). This implies that 39.07% of Dessie and Debre Berhan prospective mathematics teachers are susceptible to reflect similar to their previous teachers when the start teaching mathematics.

Factorial Validity Evidence: The factorial validity of the adapted Amharic items was examined using Confirmatory Factor Analysis (CFA) in the pilot test. The following table indicates the confirmatory factor analysis results of observed variables translated into Amharic.

Table 2: Confirmatory Factor Analysis Results of ATMI- Amharic in the pilot study

NPAR	X^2	DF	P	GFI	AGFI	RMR	RMSEA	NFI	PNFI	AIC	TLI
54	1846.968	246	.000	.984	.981	.193	.141	.875	.780	1954.968	.876

Notes: NPAR= Number of Parameters, X^2 = Chi-Square, DF= Degree of Freedom, P= Probability level, GFI= Goodness of Fit Index, AGFI = Adjusted Good of fit index, RMR = Root Mean Square Residual, RMSEA = Root-Mean-Square Error of Approximation, NFI = Normed Fit Index, PNFI = Parsimonious Fit Index, AIC = Akaike Information Criterion, and TLI = Tucker- Lewis Index.

As indicated in table-2 the overall model fit appears quite good except X^2, RMR, and RMSEA. However the Chi-square(X^2) test yields a value of 1846.968(df=246) with a corresponding P value of .000. This P value is too small to reject the null of a good fit. Schumacker and Lomax (2010) state that X^2 is quite sensitive to sample size that is for smaller sample size it rejects the hypothesis. Hence X^2 is probably less useful as an indicator than other model fit. The pilot study for this model is tested based on 330 samples which are very large. Because the above mentioned authors state that above 200 sample size makes X^2 statistic to have a tendency to indicate a significant probability level. In addition to this Schumacker and Lomax (2010) state that in contrast as sample size decreases (below100) then X^2 statistics indicates non-significant probability levels and they noted that a non significant X^2 value indicates the two matrices are almost similar, indicating that the implied theoretical model significantly reproduces the sample variance-covariance relationships in the matrix.

Concerning model fit criteria Schumacker and Lomax (2010, p.76) suggest the following acceptable fit interpretation. "(a) GFI value close to 0.90/0.95 reflects a good fit. GFI value greater than 0.95 is a very great fit, (b) AGFI value nearer to 1 is a good fit greater than .95 is a very great fit. (c) RMR value less than 0.05 is a good fit, (d) RMSEA value between 0.05 and 0.08 is a good fit, (e) TLI value close to 0.90 is a good fit, (f) NFI value close to 0.90 or 0.95 reflects a good model fit, (g) PNFI value nearer to 1 is perfect fit, (h) AIC value greater or equal to 0 is a good fit."

As displayed in table 2 except X^2 , RMR and RMSEA the other model fits appear quite good. Hence the result of the pilot test indicates the construct validity of observed variables translated into Amharic confirmed as valid and reliable. Because the Cronbach alpha for all (71) attitude measure items is 0.726 and this indicates high internal consistency of the items.

Appendix C: Semi structured Interview Questionnaire prepared for KUC Mathematics teacher educators

Addis Ababa University College of Education and Behavioral Studies.

Department of Curriculum and Instruction.

Dear Instructors: I am currently conducting a research on:

"Practices and Challenges of Primary Teacher Education in Addis Ababa City Government: Focus on Mathematics Education" Hence, the main purpose of this interview is to collect data which helps me to examine the present practices of mathematics primary teacher education curriculum in terms of Technological Pedagogical Content Knowledge (TPACK) and identify factors that contribute and challenge teacher education program during the training activities. Your response to each item in the interview is so relevant and contributes for the success of the study. Thus you are kindly requested to listen the directions and respond accordingly. Please be sure that your responses will be used only for academic purposes.

Thank you in advance for your valuable time and thoughtful response in completing this interview

General Directions

1) No need of telling names
2) For close ended items you have alternatives to agree or disagree
3) For open-ended items you are kindly requested to respond your opinion briefly.

Thank you for your cooperation.

Part I: Background Information.

1.1) Sex _______
1.2) Field of study: Major__________ Minor________
1.3) Academic qualification: Bachelor____ Masters___ PhD____
1.4) Teaching experience: In Universities/colleges. _____ Years. In primary/ secondary schools ____years. Other experience------ years.
1.5) Total teaching experience_____ years.

Part II: Professional Development Information

Teacher Professional Development (TPD): is considered as an essential mechanism for deepening teachers' content knowledge and developing their teaching practice. As a result it could be a corner stone of systematic reform efforts designed to increase teachers 'capacity to teach to high standards. It is on job training by arranging school/university/college program to CPD training. Hence duration of the training, Coherence, Relevance, Content focus, Methods and techniques of assessment and classroom management trainings will be involved in the program and trainings will be supported by Technological Pedagogical Content Knowledge (TPACK). TPACK is a frame work or a system of training prospective teachers to practice on line learning, hybrid learning and applying collaborative models by using cloud computing to solve mathematics problems and construct knowledge through cooperative learning from the environment, related materials, students, teachers, by using smart phones, I pads, tablets, etc. Technology impacts not only on the teaching and learning process but also on the ways and opportunities educators learn. Technology influences two important aspects of education. One is the way schools train prospective teachers (Pre-service) and the other is how schools design continuing education for their teachers to learn on the job either at the physical workplace or at virtual learning (TPD). TPD includes trainings through the workshop, Observing to each other, Teaching colleagues, Participating in Curriculum revisions, coaching and being coached by others, assisting less experienced teachers and being assisted by more experienced ones, making inquiry, solving problems collaboratively, making personal readings to wide ones' professional subject matter knowledge and practice, etc. In the interview PD refers to professional development, HDP refers to higher diploma program. PDP refers to professional development program. Having the above points in mind and by integrating your previous trainings answer the following questions:

Direction: For close ended items you have alternatives to agree and disagree and for open ended items you are asked to respond as concisely as possible. Note that the rating items will be assessed through your agreement/disagreement as follows:

1:- Strongly disagree, 2:- Disagree, 3:- Agree, 4:- Strongly agree.

Serial no.	PD variables	1	2	3	4
2.1	HDP duration of training was adequate				
2.2	HDP training was integrated to my field of study				
2.3	HDP training was logical, reasonable and compatible				
2.4	HDP training was relevant				
2.5	HDP training helped me to teach mathematics effectively				
2.6	HDP training was highly related to mathematics content				
2.7	HDP training helped me to use active learning methods				
2.8	HDP helped me to use scientific assessment techniques				
2.9	HDP helped me to manage the classroom effectively				
2.10	In general PD is necessary for teachers who are not competent in professional skills, and knowledge.				
2.11	PD improves the knowledge, skills and practice of teachers in the institution.				
2.12	PD helps teachers to be confident on their work.				
2.13	PD puts unnecessary work load on teachers.				
2.14	PD helps to improve student performance.				
2.15	PDPs should be limited to subject matter development knowledge and methods related to each subject.				
2.16	You took PD trainings in terms of TPACK				
2.17	PDPs should be supported by TPACK				

Part III: Student teachers' status and practicum activity:

Serial no.	Variables	1	2	3	4
3.1	They have a high interest in mathematics				
3.2	The student teachers achieve the expected result in the institution				
3.3	The student teachers have good mathematics background				
3.4	The student teachers are highly motivated to learn all math courses				
3.5	The student teachers have good math problem solving skill				
3.6	During teaching practice student teachers have good preparation.				
3.7	During teaching practice student teachers have confidence to teach the subject matter				
3.8	During teaching practice student teachers have knowledge of basic mathematics				
3.9	During teaching practice student teachers have good personality/professional ethics.				
3.10	During teaching practice student teachers have legible hand writing.				
3.11	During teaching practice student teachers prepare workable/practical lesson plan and teach effectively				
3.12	During teaching practice student teachers prepare and use different teaching aids/resources				

3.13	During teaching practice student teachers have the skill of managing the classroom and curious to each student personal problems.				
3.14	During teaching practice student teachers assess the students effectively				
3.15	During teaching practice student teachers apply active learning methods.				

Part IV: Concerning Management and Administration of the University College

Serial No.	Variables	1	2	3	4
4.1	There are adequate educational facilities to teach the courses				
4.2	Students teacher ratio is appropriate				
4.3	There is an incentive for role model teacher educators				
4.4	The department arranges peer observation program				
4.5	The department facilitates colleagues collaborative work				
4.6	The department encourages teachers self assessment				
4.7	The department arranges remedial class for female and slow learners				
4.8	The department has in-direct controlling mechanism of teachers performance				
4.9	The department creates new mechanism of controlling discipline problems				
4.10	The department has a new system of solving student teachers academic problems				
4.11	The management of the university college is transparent				
4.12	There is integrity among the management and administration of the University college and the department				
4.13	The management system encourages accountability				
4.14	The management gives priority for public interest				
4.15	The management applies immediate response for bureaucratic activities				
4.16	There is no partiality in the University college				
4.17	The University college management is loyal and honest				
4.18	The University management respects the university college legislation and works accordingly				

Part V: Courses and practices: How do you practice the courses?

5.1 Use of technology:

Serial No.	Variables	1	2	3	4
5.1.1	You use calculators/computers to develop models				
5.1.2	You use calculators/computers for data organization				
5.1.3	You use computers to solve problems online				
5.1.4	You share experiences and solve problems collaboratively using the web tools.				

5.2 Use of higher order instructional methods:

Serial No.	Variables	1	2	3	4
5.2.1	You usually prepare long term projects to be done independently				
5.2.2	You work on problems for which there is no obvious solution				
5.2.3	You encourage the students to develop technical problem solving and writing skills				
5.2.4	You work on interdisciplinary lessons				
5.2.5	You encourage the students to debate on particular math issues and explain their reasoning.				

5.3 Use of student assessments:

Serial No.	Variables	1	2	3	4
5.3.1	You usually use problem solving type tests				
5.3.2	You use performance tasks in and outside the class				
5.3.3	You use different observation techniques to assess your students task				
5.3.4	You use mathematics worksheet solutions of your students				
5.3.5	You use mathematics project work reports				
5.3.6	You use a semester math portfolios				

Part VI: Concerning Technological Pedagogical Content Knowledge (TPACK) activities:

Serial No.	Technology Knowledge (TK) variables	1	2	3	4
6.1	You understand the way that technologies are used in a specific content domain				
6.2	You understand the range of technologies that mathematicians use in science and engineering				
6.3	You often refer to digital technologies (Internet, smart phones, I pads, laptops, etc. to teach mathematics using web tools				
6.4	You understand that technology changes the existing situation to new knowledge				
Serial No.	Content Knowledge (CK)	1	2	3	4
6.5	You use different software applications, online problem solving through the internet to solve math problems				
6.6	You prepare mathematics work sheets for your students to solve it collaboratively through the internet				
6.7	You state theorems and prove using related theories/ axioms/postulates by giving reasons for each step				
6.8	You apply the theorems by using practical examples				
6.9	You use different strategies to solve mathematics problems				
Serial No.	Pedagogical Knowledge (PK)				
6.10	You have generic knowledge about how students learn intensively				
6.11	You have the skill and knowledge about teaching approaches				
6.12	You have the skill and knowledge about methods of assessment				
6.13	You apply different learning theories in your lesson				
6.14	You always prepare course plan and apply it in your instruction				
6.15	You use different resources (technological as well as local resources) to transmit the subject matter effectively				
Serial No.	Technological Content Knowledge (TCK)				
6.16	You use smart phones, computers for internet access to provide new ways of teaching math content				
6.17	You use digital animation through laptops/computers/smart phones to avoid abstractions and confusion of your students				
6.18	You use digital animation to create tangible concept on the standards of mathematics problem solving abilities				
Serial No.	Pedagogical Content Knowledge (PCK)	1	2	3	4
6.19	You know how to combine pedagogy and content and teach effectively				
6.20	You know how to make a subject understandable to your students				

6.21	You know what makes a subject difficult or easy to learn				
6.22	You know the common misconceptions of your students in mathematics				
6.23	You know how your students develop math concept in the classroom				
Serial No.	Technological Pedagogical Knowledge (TPK)	1	2	3	4
6.24	Technology enables you to use different teaching approaches				
6.25	You usually use online collaborative tools to solve some challenging problems with other mathematicians of the world.				
Serial No	Technological Pedagogical Content Knowledge (TPCK)				
6.26	You understand the interplay between content, pedagogy and technology				
6.27	You know the relationship between your students and technology				
6.28	You know the relationship between math content and technology				
6.29	You have strong relationship with technology				
6.30	In general you know the relationship between students, teachers. content, practices and technology				

Part VII: Open ended items.

Direction: For the following items respond by telling as concisely as possible what you know.

7.1) What do you suggest about the recruitment and selection of mathematics primary teacher education?

____

____

7.2) What type of training strategies should be applied for mathematics primary teacher education in the future?

____

____

7.3) What do you suggest about the frequent revision of mathematics primary teacher education courses? Do you know the reason? a) Yes__ b) No__ If your answer is "Yes" please respond briefly:

____

____

7.4) After the revision of courses was there any readiness trainings offered for you?

a) Yes __b) No__

7.5) In question No. 7.4 if your answer is "Yes" Was it supported by TPACK? a) Yes __ b) No _

7.6) What facilities are fulfilled in the University College to train mathematics student teachers effectively?

____

____

7.7) What are the challenges you faced In your University college instruction?

____

____

7.8) Tell your general opinion about mathematics primary teacher education Curriculum and practices?____

____

____

Appendix D: Public Primary School Mathematics Teachers Questionnaire (Translated into Amharic).

These items are addressed to primary school teachers of Mathematics, who are asked to respond about their academic and professional backgrounds, instructional practices, and attitudes towards teaching mathematics. The purpose of these items is to collect data for the topic "Practices and Challenges of Primary Teacher Education in Addis Ababa City Government: Focus on Mathematics Education."

The items are adapted from http://www. BM2_TeacherM.pdf-AdobeReader.

The items are prepared for the Third International Mathematics and Science Study by Boston College (1998), chestnut Hill, MA 02467 USA.

Since the content of the items mainly emphasizes to measure Mathematics teachers attitudes towards teaching Mathematics and their instructional practices I found them very essential to collect data by applying these items to be filled by Math primary school teachers of Addis Ababa. Because my topic is "Practices and Challenges of Primary Teacher Education: Focus on Mathematics Education." To check the reliability and concept difficulty of the items pilot test had been conducted and the items translated into Amharic are tested and some iems are improved. Based on the result of the pilot test, items had been improved in Ethiopian context and used.

General Directions:

1. There is no "right" or "wrong" answers to any of these items. You are kindly requested to respond your school experiences of teaching Mathematics.
2. For the items you selected please put " X" mark in the box corresponding to it. No need of writing your name.
   "Thank you for your cooperation in advance"

1. How old are you?

*Check **one** box only.*

under 25 .... ☐
25-29 . ... ☐
30-39... ☐
40-49... ☐
50-59... ☐
60 or more . ... ☐

2. Sex: Female: ☐
Male: ☐

3. **Field of Study: Major ………………… Minor ………………….**
4. **Teaching Experience in mathematics ……………… years.**

Section A

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

4. In one typical calendar, for how many periods do you teach per week? ---------------- periods.

5. In one typical calendar week from Monday to Sunday, for how many single <hours/periods> are you formally <scheduled/time-tabled> to teach each of the following subjects?

Note: List only the generic science courses appropriate for your school.

Count a double <hour/period> as two single <hours/periods>.

Write zero if none.

Number of
single <hours/periods>

a) Mathematics.. ______
b) <GENERAL/INTEGRATED SCIENCE> .... ______
c) <PHYSICAL SCIENCE>... ______
d) <EARTH SCIENCE>.. ______
e) <LIFE SCIENCE> .... ______
f) <BIOLOGY> .... ______
g) <CHEMISTRY>... ______
h) <PHYSICS> .... ______
i) Other subjects .... ______

6. In one typical calendar week from Monday to Sunday, for how many single <hours/periods> are you formally <scheduled/time-tabled> to perform each of the following tasks?

Count a double <hour/period> as two single <hours/periods>.
Write zero if none.

Number of
single <hours/periods>

a) Student supervision (other than teaching) .... ______
b) Student counseling/appraisal .... ______
c) Administrative duties... ______
d) Individual curriculum planning .... ______
e) Cooperative curriculum planning .... ______
f) Other non-student contact time (i.e., use not specified) .... ______
g) Other .... ______

7. APPROXIMATELY how many hours per week do you normally spend on each of the following activities outside the formal school day? Do not include time already accounted for in Question # 6.

*Check **one** box in each row .i. e, 1= None, 2= less than one hour, 3=1-2 hours, 4=3-4 hours, 5= more than 4hours. Thus write 1,2, 3, 4, or 5 corresponding to the items appropriate to your choice.*

a) Preparing or grading student tests or exams.........
b) Reading and grading other student work..............
c) Planning lessons by you................................
d) Meeting with students outside of classroom time (e.g., tutoring, guidance)...........................
e) Meeting with parents..
f) Professional reading and development activity (e.g., seminars, conferences, etc.)..................
g) Keeping students' records up to date....................
h) Administrative tasks including staff meetings (e.g. photocopying, displaying students' work).........
i) Other..

8. APPROXIMATELY how many hours per week do you normally spend on your teaching activities altogether (include time spent in and out of school)?

*Please **round** to the nearest whole hour.* .... ______

9. About how often do you have meetings with other teachers in your subject area to discuss and plan curriculum or teaching approaches?

Select one and write "X" mark in the space

Never...
Once or twice a year..
Every other month...
Once a month...
Once a week..

Two or three times a week..
Almost every day..

10. How much influence do you have on each of the following...
Note that: 1= none, 2= little, 3= some, 4= a lot. Select 1, 2.3.or 4 for each of the following.
a) Subject matter to be taught.................................. 1 2 3 4
b) Specific textbooks to be used 1 2 3 4
c) The amount of money to be spent on supplies 1 2 3 4
d) What supplies are purchased................................ 1 2 3 4

11. To be good at mathematics at school, how important do you think it is for Students to.....
Note that: 1= Not important, 2= Somewhat important, 3= Very important based on these select 1, 2, or 3 for each of the following.
a) Remember formulas and procedures............................... 1 2 3
b) Think in a sequential and procedural manner................. 1 2 3
c) Understand mathematical concepts, principles, and strategies......... 1 2 3
d) Be able to think creatively... 1 2 3
e) Understand how mathematics is used in the real world ……… 1 2 3
f) Be able to provide reasons to support their solutions 1 2 3

12. To what extent do you agree or disagree with each of the following statements?
Note that: 1= Strongly disagree, 2= Disagree, 3= Agree, 4= Strongly agree. Circle the numbers that represent the actual statements of your experience.

a) Mathematics is primarily an abstract subject. 1 2 3 4
b) Mathematics is primarily a formal way of
representing the real world. 1 2 3 4
c) Mathematics is primarily a practical and structured
guide for addressing real situations. 1 2 3 4
d) If students are having difficulty, an effective
approach is to give them more practice by
themselves during the class. 1 2 3 4
e) Some students have a natural talent for
mathematics and others do not. 1 2 3 4
f) More than one representation (picture, concrete
material, symbol set, etc.) should be used in
teaching a mathematics topic. 1 2 3 4
g) Mathematics should be learned as sets of
algorithms or rules that cover all possibilities. 1 2 3 4
h) Basic computational skills on the part of the
teacher are sufficient for teaching
<PRIMARY SCHOOL> mathematics. 1 2 3 4
i) A liking for and understanding of students are
essential for teaching mathematics. 1 2 3 4

13. Indicate your familiarity with each of the following documents:
Note that: 1= No such document, 2= Not well prepared, 3= somewhat prepared, 4= Very well prepared. By considering the representation of each number circle the following numbers corresponding to your familiarity.

a) <THE NATIONAL CURRICULUM GUIDE
FOR MATHEMATICS> 1 2 3 4
b) <THE REGIONAL CURRICULUM GUIDE(S)
FOR MATHEMATICS> 1 2 3 4
c) <THE SCHOOL CURRICULUM GUIDE> 1 2 3 4
d) <THE NATIONAL EXAMINATION

SPECIFICATIONS> 1 2 3 4
e) <THE REGIONAL EXAMINATION
SPECIFICATIONS> 1 2 3 4
f) <THE NATIONAL PEDAGOGY GUIDE
FOR MATHEMATICS> 1 2 3 4
g) <THE REGIONAL PEDAGOGY GUIDE
FOR MATHEMATICS> 1 2 3 4

14. How well prepared do you feel you are to teach…

1= I don't teach these topics, 2= Not well prepared, 3= somewhat prepared, 4= very well prepared.
Circle the number corresponding to each statement.

a) Fractions, decimals and percentages? 1 2 3 4
b) Ratios and proportions? 1 2 3 4
c) Measurement – units, instruments, and accuracy?....................... 1 2 3 4
d) Perimeter, area, and volume? 1 2 3 4
e) Geometric figures – definitions and properties? -------------- 1 2 3 4
f) Geometric figures – symmetry, motions and transformations,
congruence and similarity? …………………………………… 1 2 3 4
g) Coordinate geometry? 1 2 3 4
h) Algebraic representation? 1 2 3 4
i) Evaluate and perform operations on algebraic expressions? 1 2 3 4
j) Solving linear equations and inequalities? 1 2 3 4
k) representation and interpretation of data in graphs, charts, and tables? 1 2 3 4
l) simple probabilities – understanding and calculations? .... 1 2 3 4.

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

Write "X" mark in the space if it is your education level.

<DID NOT COMPLETE SECONDARY SCHOOL>................................
<SECONDARY ONLY>..
<BA OR EQUIVALENT>...
<MA/PHD>..

16a. Do you have a <teacher training certificate>?

*Check **one** box only.* .... ***Yes*** ☐ ***No*** ☐

16b. How many years of <pre-service teacher training> have you had?

Please round to the nearest whole number. .... ______
(Write in 0 (zero), if you have not had any teacher training.)

16c. If you have had <pre-service teacher training>, did you begin this training in primary school?

*Check **one** box only.* .... ***Yes*** ☐ ***No*** ☐

17. While studying to obtain your <BA or equivalent or teacher training certificate>, what was your major or main area of study?

I do not have a <BA or equivalent or teacher training certificate.>..............
(Check the box and skip to the next question.)
*Check **one** box in each row. And write Yes or No.*

a) Mathematics...
b) Biology...
c) Physics..
d) Chemistry..
e) Education...
f) Mathematics Education...
g) Science Education..
h) Other...

18. If you have a master's degree, what was your major or main area of study?

I do not have a master's degree. .... Yes ☐ No ☐

(Check the box and skip to the next question.)
Check ***one*** *box in each row. And write Yes or No for each of the following subjects:*

a) Mathematics...
b) Biology..
c) Physics..
d) Chemistry..
e) Education...
f) Mathematics Education...
g) Science Education..
h) Other..

19. Was teaching your first choice as a career when beginning university or teacher education college?
Check only ***one*** *box.* .... ***Yes*** ☐ ***No*** ☐
20. Would you change to another career if you had the opportunity?
Check only ***one*** *box.* .... ***Yes*** ☐ ***No*** ☐
21. Do you think that society appreciates your work?
Check only ***one*** *box*.. ***Yes*** ☐ ***No*** ☐
22. Do you think your students appreciate your work?
Check only ***one*** *box.* .... ***Yes*** ☐ ***No*** ☐
23. Approximately how many books are in your home?
(Do not count magazines or newspapers.)
Write "X" mark if it is available corresponding to the statement:
None or very few (0-10)...
Enough to fill a shelf (11-25)..
Enough to fill a bookcase (26-100)..
Enough to fill two bookcases (101-200)...
Enough to fill three or more bookcases (more than 200).............................

Section B

In this section, many of the questions refer to **your Mathematics class**. Please remember that this is the class which is identified on the cover of this questionnaire, and which will be tested as part of your responsibility in your school.

1. How many students are in your mathematics class?
Write in a number for each. Write 0 (zero) if there are none.
boys ______ girls ______

2. What subject matter do you emphasize most in your mathematics class?
Write "X" mark in the blank space for your most emphasis:
Mainly number (e.g., whole numbers,
Fractions, decimals, percentages, etc.) ....
Geometry...
Algebra...
Combined algebra and geometry..
Combined algebra, geometry, number, etc. ....
Other, please specify _________________________..............................
3. How many minutes per week do you teach mathematics to your Mathematics class?
Minutes: ______
4a. Do you use a textbook in teaching mathematics to your class?
Check ***one*** *box.* ***Yes*** ☐ ***No*** ☐
4b. If yes, approximately what percentage of your weekly mathematics teaching time is based on your mathematics textbook?
Write "X" mark for the corresponding percentages if it is based on text book.

0-25% . ...
26-50%...
51-75%...
76-100%...

5. Do the students in your mathematics class have calculators available to use during mathematics lessons?

*Check **one** box only.* ***Yes*** ☐ ***No*** ☐

6. To what extent are the students in your mathematics class permitted to use calculators during mathematics lessons?

*Check **one** box only.*

Unrestricted use.. ☐
Restricted use.. ☐
Calculators are not permitted... ☐

7. How often do students in your mathematics class use calculators for the following activities?

*Note that: 1= **Almost every class, 2= Once or twice a week, 3= Once or twice a month, 4= Never, or hardly ever.***

Circle 1, 2, 3, or 4 for the following usage of calculators based on the above scales.

a) Checking answers 1 2 3 4
b) Tests and exams 1 2 3 4
c) Routine computation.......................... 1 2 3 4
d) Solving complex problems................. 1 2 3 4
e) Exploring number concepts 1 2 3 4

8. Do the students in your mathematics class have computers available to use during mathematics lessons?

Note that: 1=Never or almost Never, 2= some lessons, 3= Most lessons, 4= every lesson then circle the number corresponding to the statement:

a) In the classroom 1 2 3 4
b) In other instructional rooms (computer labs,
science lab, reading lab, library, etc.) 1 2 3 4

If computers are available,

Yes No

c) Do any of the computers have access to the Internet? Yes ☐ No ☐

d) Do you use the Internet for instructional/educational purposes? Yes ☐ No ☐

9. In planning mathematics lessons, what is your main source of written information when...

a) Deciding which topics to teach(goals) ------------
b) Deciding how to present a topic ________
c) Selecting problems and exercises for work in class and home work _____
d) Selecting problems and applications for assessment and evaluation-------

Note that: 1= National or Regional Examination Specifications, 2= National or Regional Curriculum Guide, 3= School Curriculum Guide, 4= Teacher Edition of Textbook, 5= Student Edition of Textbook, 6= Other Resource books. For each of the above statements Write 1,2,3,4,5, or 6 depending on your main source, corresponding to the above mentioned statements.

10. In your mathematics lessons, how often do you usually ask students to do the following?

1= Never or almost never, 2= Some lessons, 3= Most lessons, 4= Every lesson, then circle the number corresponding to each statement:

a) explain the reasoning behind an idea 1 2 3 4
b) represent and analyze relationships using tables, charts, or graphs 1 2 3 4
c) work on problems for which there is no immediately obvious method of solution 1 2 3 4
d) use computers to solve exercises or problems 1 2 3 4
e) write equations to represent relationships 1 2 3 4
f) practice computational skills............................... 1 2 3 4
g) use graphing calculators to solve exercises or problems 1 2 3 4

11. In mathematics lessons, how often do students...

1= Never or almost never, 2= Some lessons, 3=Most lessons, 4= Every lesson, then circle the number corresponding to each statement:

a) Work individually without assistance from the teacher 1 2 3 4
b) Work individually with assistance from the teacher 1 2 3 4
c) Work together as a class with the teacher teaching the whole class 1 2 3 4
d) Work together as a class with students responding to one another 1 2 3 4
e) Work in pairs or small groups without assistance from the teacher 1 2 3 4
f) Work in pairs or small groups with assistance from the teacher 1 2 3 4

12. In a typical month of lessons for your mathematics class, what percentage of time is spent on each of the following activities?

Write in a percentage
for each activity
The total should
add to 100%

a) Administrative tasks (not related to lesson’s content/purpose) .... ______%
b) Homework review... ______%
c) Lecture-style presentation by teacher.. ______%
d) teacher-guided student practice.. ______%
e) Re-teaching and clarification of content/procedures............................ ______%
f) Student independent practice .... ______%
g) Tests and quizzes .... ______%
h) Other.. ______%

13. The following list includes the main topics addressed by the school Mathematics test. Check the response that describes when students in your mathematics class have been taught each topic.

If a topic has been taught before this
year and also in the current year,
check the two boxes that apply.
Otherwise, check ***one*** *box in each row.*
1= Taught before this year, 2=Taught 1-5 periods this year, 3= Taught more than 5periods this year, 4= Not yet taught, 5= I don’t know. Then circle the number corresponding to each topic:

a) Fractions and Number Sense

1) Whole numbers – including place values, factorization and operations (+,–, ×,÷) 1 2 3 4 5
2) Understanding and representing common fractions.. 1 2 3 4 5

3) Computations with common fractions 1 2 3 4 5
4) Understanding and representing decimal fractions 1 2 3 4 5
5) Computations with decimal fractions............. 1 2 3 4 5
6) Relationships between common and decimal fractions, ordering of fractions 1 2 3 4 5
7) Rounding whole numbers and decimal fractions 1 2 3 4 5
8) Estimating the results of computations 1 2 3 4 5
9) Number lines 1 2 3 4 5
10) Computations with percentages and problems involving percentages 1 2 3 4 5
11) Simple computations with negative numbers… 1 2 3 4 5
12) Square roots (of perfect squares less than 144), small integer exponents 1 2 3 4 5

b) Measurement

13) Units of measurement; standard metric units... 1 2 3 4 5
14) Reading measurement instruments 1 2 3 4 5
15) Estimates of measurement; accuracy of measurement 1 2 3 4 5
16) Perimeter and area of simple shapes – triangle, rectangles, and circles 1 2 3 4 5
17) Perimeter and area of combined shapes 1 2 3 4 5
18) Volume of rectangular solids – i.e., Volume = length × width × height 1 2 3 4 5

c) Geometry

19) Cartesian coordinates of points in a plane 1 2 3 4 5
20) Coordinates of points on a given straight line ….. 1 2 3 4 5
21) Simple two dimensional geometry – angles on a straight line, parallel lines, triangles and quadrilaterals 1 2 3 4 5
22) Congruence and similarity 1 2 3 4 5
23) Symmetry and transformations (reflection and rotation) 1 2 3 4 5
24) Visualization of three-dimensional shapes 1 2 3 4 5

d) Proportionality

25) Scales applied to maps and models 1 2 3 4 5
26) Concepts of ratio and proportion; ratio and proportion problems 1 2 3 4 5

e) Algebra

27) Number patterns and simple relations............. 1 2 3 4 5
28) Simple algebraic expressions 1 2 3 4 5
29) Representing situations algebraically; formulas 1 2 3 4 5
30) Solving simple equations 1 2 3 4 5
31) Solving simple inequalities 1 2 3 4 5

f) Data Representation, Analysis, and Probability

32) Representation and interpretation of data in graphs, charts, and tables 1 2 3 4 5
33) Arithmetic mean... 1 2 3 4 5
34) Simple probabilities – understanding and calculations 1 2 3 4 5

14. In your view to what extent do the following limit how you teach your mathematics class?

1= Not at all, 2=A little, 3= Quite a lot, 4= A great deal, then select the number corresponding to each statement:

a) Students with different academic abilities 1 2 3 4
b) Students who come from a wide range of backgrounds, (e.g., economic, language) 1 2 3 4
c) Students with special needs, (e.g., hearing, vision, speech impairment, physical disabilities, mental or emotional/psychological impairment) 1 2 3 4
d) Uninterested students 1 2 3 4
e) Disruptive students 1 2 3 4
f) Parents interested in their children's learning and progress 1 2 3 4
g) Parents uninterested in their children's learning and progress 1 2 3 4
h) Shortage of computer hardware 1 2 3 4
i) Shortage of computer software 1 2 3 4
j) Shortage of other instructional equipment for students' use 1 2 3 4
k) Shortage of equipment for your use in demonstrations and other exercises 1 2 3 4
l) Inadequate physical facilities 1 2 3 4
m) High student/teacher ratio 1 2 3 4
n) Low morale among fellow teachers/administrators 1 2 3 4
o) Low morale among students 1 2 3 4
p) Threat to personal safety or the safety of students 1 2 3 4

15. How often do you usually assign mathematics homework?
Write "X" in the blank space corresponding to your selection. Select only one option.
Never..
Less than once a week...
Once or twice a week..
3 or 4 times a week...
Every day...
If "never," please skip ahead to Question 19.
16. If you assign mathematics homework, how many minutes of mathematics homework do you usually assign your students?
(Consider the time it would take an average student in your class.)
Write "x" mark corresponding to the statement. Select only one.
Less than 15 minutes...
15-30 minutes..
31-60 minutes..
61-90 minutes..
more than 90 minutes ....

17. If you assign mathematics homework, how often do you assign each of the following kinds of tasks?
1= Never, 2= Rarely, 3= Sometimes, 4= Always, then select the number for each statement:
a) Worksheets or workbook..................................... 1 2 3 4
b) problem/question sets in textbook....................... 1 2 3 4
c) reading in a textbook or supplementary materials 1 2 3 4
d) Writing definitions or other short writing assignment.. 1 2 3 4
e) Small investigation(s) or gathering data 1 2 3 4

f) Working individually on long term
projects or experiments 1 2 3 4
g) Working as a small group on long term
projects or experiments 1 2 3 4
h) Finding one or more uses of the content
covered.. 1 2 3 4
i) Preparing oral reports either individually
or as a small group 1 2 3 4
j) Keeping a journal.. 1 2 3 4

18. If students are assigned written mathematics homework, how often do you do the following?

I do not assign written homework. .... Yes ☐ No ☐

1= Never, 2= Rarely, 3= Sometimes, 4= Always, then select the number corresponding to each statement;

a) Record whether or not the homework was
completed.. 1 2 3 4
b) Collect, correct and keep assignments 1 2 3 4
c) Collect, correct assignments and then
return to students 1 2 3 4
d) Give feedback on homework to whole class 1 2 3 4
e) Have students correct their own
assignments in class 1 2 3 4
f) Have students exchange assignments
and correct them in class..................................... 1 2 3 4
g) Use it as a basis for class discussion 1 2 3 4
h) Use it to contribute towards students'
grades or marks 1 2 3 4

19. In assessing the work of the students in your mathematics class, how much weight do you give each of the following types of assessment?

Note that 1= None, 2= Little, 3= Quite a lot, 4= A great deal, then select the number for each statement:

a) Standardized tests produced outside the school ... 1 2 3 4
b) Teacher-made short answer or essay tests that
require students to describe or explain their
reasoning 1 2 3 4
c) Teacher made multiple choice, true-false and
matching tests 1 2 3 4
d) How well students do on homework
assignments 1 2 3 4
e) How well students do on projects or
practical/laboratory exercises 1 2 3 4
f) Observations of students 1 2 3 4
g) Responses of students in class 1 2 3 4

20. How often do you use the assessment information you gather from students to...

Note that: 1= None, 2= Little, 3= Quite a lot, 4= A great deal, then select the number to each statement:

a) Provide students' grades or marks? 1 2 3 4
b) Provide feedback to students? 1 2 3 4
c) Diagnose students' learning problems? 1 2 3 4
d) Report to parents? 1 2 3 4
e) Assign students to different programs
or tracks? 1 2 3 4
f) Plan for future lessons? 1 2 3 4

THANK YOU for the thought, time, and effort you have Put into completing this questionnaire.

The Amharic version/translation of the above items will be as follows:

በመጀመሪያ ደረጃ (ከ1ኛ - 8ኛ) ክፍል በሚያስተምሩ የሒሣብ መምህራን የሚሞላ መጠይቅ

የመጠይቁ ዓላማ "The practices and challenges of Primary Teacher Education in Addis Ababa City Government: Focus on Mathematics Education" ለሚለው ርዕስ ጥናት የሚሆን መረጃ ለመሰብሰብ ነው፡፡

ለዚህ ጥናት መሳካት እናንተ የምትሰጡት መረጃ ከፍተኛ አስተዋጽኦ አለው፡፡

ጊዜአችሁን መስዋት አድራጋችሁ ይህንን መጠይቅ በመሙላታችሁ በቅድሚያ አመሰግናችኋላሁ፡፡

አጥኚው

አጠቃላይ መመሪያ

1. ሒሣብ ስታስተምሩ በትምህርት ቤት ያላችሁን ልምድ (ተሞክሮ) አመለካከትና፣ ያጋጠማችሁን ተግዳሮት በመጻፍ ያላችሁን አስተዋጽኦ አበርክቱ፡፡
2. በእናንተ አመለካከት መሠረት ትክክል ነው ለምትሉት ጥያቄ በሳጥኑ ውስጥ "✓" ምልክት አስቀምጡ፡፡
3. በጽሑፉ ለሚመለሱ ጥያቄዎች ጠቅላል ባለ እና አጠር ባለ ዓረፍተ ነገሮች በመግለጽ ጻፉ፡፡

ክፍል አንድ

1. የትምህርት ቤቱ ስም ______________________
2. የምታስተምረው/ሪው የክፍል ደረጃ ________ ክፍል ነው፡፡
3. ዕድሜ

   ሀ. ከ25 ዓመት በታች .... ☐

   ለ. ከ25 — 29................................... ☐

   ሐ. ከ30 — 39 .... ☐

   መ. ከ40 — 49 .... ☐

   ሠ. ከ50 — 59 .... ☐

4. ፆታ .... ወንድ ☐ ሴት ☐
5. የትምህርት ደረጃ፡-

   ሀ. ሁለተኛ ደረጃ...................................... ☐

   ለ. ሰርተፊኬት(10+1) .... ☐

   ሐ. ዲፕሎማ (10+3) .... ☐

   መ. የመጀመሪያ ዲግሪ................................. ☐

   ሠ. ከላይ የተለየ ከሆነ ይጻፍ..

6. የጥናት መስክ : አብይ ....

7. በመምህርነት ሙያ ስንት ዓመት ሰልጥነህል/ሻል?

_______ዓመት

8. በመደበኛ የመምህርነት ሙያ ስትሰለጥን /ስትሰለጥኝ ሥልጠናውን የጀመርሽው/ከው ___ ክፍል ለማስተማር ነው?

9. የመምህርነት ሙያ ምርጫህ/ጫሽ ነበር?

ሀ. ነው ☐ ለ. አይደለም ☐

8. ስሰለጥን የመጀመሪያ ምርጫዬ ሒሣብ ነበር?

ሀ. አዎ ☐ ለ. አይደለም ☐

9. ሁኔታዎች ከተመቻቹልህ/ሽ ሙያውን የመቀየር ፍላጐት አለሽ/ለህ

ሀ. አዎ ☐ ለ. የለኝም ☐

10. ህብረተሰቡ የመምህርነት ሙያን

ሀ. ያደንቃሉ ☐ ለ. ይንቃሉ ☐

11. ተማሪዎች የመምህርነትን ሙያ

ሀ. ያደንቃሉ ☐ ለ. ይንቃሉ ☐

12. በቤትህ/ በቤትሽ ምን ያህል የሒሣብና ሌሎች የሚነበቡ መጽሐፍት አሉ?

የሚከተሉትን በማንበብ የ"✓" ምልክት በባዶ ቦታ ያስቀምጡ፡፡

ሀ. ምንም መጽሐፍት የለኝም _________

ለ. በጣም ጥቂት (2 — 10) _________________

ሐ. በመደርደሪያው ልክ (11-25________

መ. አንድ የመፍሐፍ ሳጥን የሚመላ (26-100)__________

ሠ. ሁለት የመጽሐፍት ሳጥን የሚሞላ (101-200)________

ረ. ሦስትና ከዚያ በላይ የሚሆኑ የመፍሐጽት ሳጥን የሚሞላ (201 እና በላይ)______

13. የአሁኑን ዓመት ጨምሮ የሒሣብ ትምህርትን ለ____________ ዓመታት ያህል አስተምሬአለሁ፡፡

14. በሳምንት __________ ክፍለ ጊዜየት አስተምራለሁ፡፡

15. በአንድ ሳምንት የትምህርት ቀናት ውስጥ የሚከተሉትን የትምህርት ዓይነቶች ለስንት ሠዓት ያህል ታስተምሪያለሽ/ለህ?

ሀ. ሒሣብ ____________

ለ. አካባቢ ሣይንስ ____________

ሐ. ስነውበት __________

መ. እንግሊዝኛ _

ሠ. አማርኛ____________

ረ. ከተጠቀሱት ሌላ የምታስተምሩት ትምህርት ካለ ይጻፍ________

16. ከሰኞ እስከ አርብ ባለው ጊዜ ውስጥ ከማስተማር በተጨማሪ ሥራዎች ለምን ያህል ሠዓት ትሠራለህ/ትሰሪያለሽ ምንም አልሠራም ለሚለው ምላሽ ከፊትለፊት ሠዓት ይጻፍ፡፡

ሀ. ስለተማዎች ሁኔታ /ጥናት ስለሚያደርጉት እንቅስቃሴ መከታተል ____________________ሠዓት

ለ. ተማሪዎችን መምከርና መከታተል ___________ ሠዓት

ሐ. የተማሪዎችን ደብተር የፕሮጀክት ሥራ ማረም (መገምገም) ___________ሠዓት

መ. የአስተዳደር ሥራዎች ____________ ሠዓት

ሠ. በግል የተማሪዎችን መጽሐፍ መገምገም ____________ሠዓት

ረ. በቡድን የተማሪዎችን መጽሐፍ መገምገም ___________ሠዓት

ሸ. በክበባት መሳተፍ ___________ሠዓት

17. ከትምህርት ቤት ውስጥ የሚከተሉትን ሥራዎች ለምን ያህል ሠዓት ትሠራለህ/ለሽ? በተሰጠው ቦታ ላይ ቁጥሮቹን በመጻፍ አመልክቱ፡፡

1= ምንም አልሠራም 2= ከአንድ ሠዓት በታች

3 = ከአንድ እስከ ሁለት ሠዓት ድረስ 4 = ከሦስት እስከ አራት ሠዓት ድረስ

5 = ከአራት ሠዓት በላይ

ሀ. የተማሪዎችን ቴስቶችና ፈተናዎች በማዘጋጀትና በማረም _____

ለ. የተማሪዎችን ሥራ እያነበብኩ ማርክ እሰጣለሁ _____________

ሐ. የዕለተዊና ሳምንታዊ የትምህርት ዕቅድ ማዘጋጀት_____

መ. ከመደበኛ ሠዓት ውጭ ደከም ያሉ ተማሪዎችን መርዳት _____

ሠ. ከተማሪዎች ወላጆች ጋር መወያየት _

ረ. ሙያዊ መጽሐፍቶችን ማንበብ፣ ስልጠና መሳተፍ____________

ሸ. የተማሪዎችን ሪከርድ ማሻሻል________

ቀ. የአስተዳደር ሥራዎችን መስራት ፈተና ማባዛት፣ (ቅጽ ማባዛት)_______________

በ. ለሌላ /የተለየ የግል ሥራ __________

18. በአጠቃላይ ለማስተማር ሥራ በትምህርት ቤት እና ከትምህርት ቤት ውጭ በሳምንት _________ ሠዓት እሠራለሁ፡፡

19. የመማር ማስተማርን ችግሮች በተመለከተና ለሒሣብ ትምህርት መጽሐፍት፣ ሲላበስ እና ለመሳሰሉት ግምገማ ከሥራ ባልደረባችሁ ጋር ለምን ያህል ጊዜ ስብሰባ ታካሂዳላችሁ፡፡ ለትክክለኛው መልስ በሳጥኑ ውስጥ የ"✓" ምልክት ያድርጉ፡፡

ሀ. ፍጹም .... ☐

ለ. በዓመት አንድ ጊዜ .... ☐

ሐ. በዓመት ሁለት ጊዜ .... ☐

መ. በወር አንድ ጊዜ .... ☐

ሠ. ወር በገባ ሁል ጊዜ .... ☐

ረ. በሳምንት አንድ ጊዜ ………………… ☐

ሰ. በሳምንት ሁለት ጊዜ ………………… ☐

ሸ. በሳምንት ሶስት ጊዜ ………………… ☐

ለ. በየቀኑ ሶስት ጊዜ …………………… ☐

20. ለሚከተሉት የትምህርት ሥራ እንቅስቃሴዎች ምን ያህል ተጽዕኖ ፈጣሪ ነሽ/ነህ? በሚከተለው መሠረት ቁጥሮቹን አክብቡ

1= በፍጹም 2= በትንሹ 3= በአብዛኛው 4= በብዙ

ሀ. የሒሣብ ትምህርት ይዘቶችን በማስተማር	1	2	3	4
ለ. የተወሰኑ የሒሣብ መጽሐፍቶችን በመጠቀም	1	2	3	4
ሐ. ለትምህርት አስፈላጊ የሆኑ ማቴሪያሎችን በመግዛት	1	2	3	4

21. በሒሣብ ትምህርት ጥሩ ተማሪ ለመሆን ከሚከተሉት ውስጥ ለተማሪዎች የበለጠ አስተዋጽኦ ያላቸው የትኞቹ ናቸው፡፡

በሚከተለው ማብራሪያ መሠረት ቁጥሮችን አክቡ

1= አይጠቅሙም 2= የተወሰነ ጠቀሜታ አለው 3= በጣም ጠቀሜታ አለው

ሀ. የሒሣብ ፎርሙላዎችና የአሠራር ደንቦችን ማስታወስ	1	2	3
ለ. በቅደም ተከተልና በደንቡ መሠረት ማሰብ	1	2	3
ሐ. የሒሣብ ፅንሰሃሳቦችን መርሆችን የአሠራር ዘዴዎችን መረዳት	1	2	3
መ. በራስ ፈጠራ አስቦ መስራት	1	2	3
ሠ. ሒሣብ ለዚህ ዓለም ያበረከተውን አስተዋጽኦ መረዳት	1	2	3
መ. የሒሣብ መፍትሔዎችን (solutions) ለመደገፍ አሳማኝ ምክንያቶችን መስጠት	1	2	3

22. በሚከተሉት ሐሳቦች ምን ያህል ትስማማለህ/ትስማሚያለሽ?

1= በጣም አልስማማም 2= አልስማማም

3 = እስማማለሁ 4 = በጣም እስማማለሁ

ሀ. ሒሣብ የማይታይና የማይጨበጥ (ረቂቅ) ትምህርት ነው	1	2	3	4
ለ. ሒሣብ የእውነተኛውን ዓለም መንገድ ለማወቅ ቅድሚያ የሚሰጠው ነው	1	2	3	4
ሐ. ሒሣብ የተግባርና መመሪያ መንገዶችን በመከተል እውነተኛ ክስተቶች ለማወቅ ቅድሚያ የሚሰጠው ነው	1	2	3	4
መ. ተማሪዎች ሒሣብ አልገባ ሲላቸው ቀናው መንገድ ብዙ የሒሣብ መልመጃዎችን በተደጋጋሚ እንዲሰሩ ማድረግ ነው፡፡	1	2	3	4
ሠ. ጥቂት ተማሪዎች የተፈጥሮ የሒሣብ ተሰጥኦ ሲኖራቸው አብዛኞቹ የላቸውም	1	2	3	4
ረ. አንድን የሒሣብ ርዕስ ለማስተማር ከአንድ በላይ ሥዕሎችን፣ የሚታዩና የሚዳሰሱ ማቴሪያሎች፣ ስብስቦችን ወ.ዘ.ተ መጠቀም አስፈላጊ ነው፡፡	1	2	3	4
ሸ. ሒሣብን ለመማር የሒሣብ መሠረታዊ መርህዎችንና ሕጎችን ማወቅ ግዴታ ነው፡፡	1	2	3	4
ቀ. ለአንድ የሒሣብ መምህር መሠረታዊ የሆነ የሒሣብ ስሌቶች ክህሎትን ማወቅ ለመጀመሪያ ደረጃ ትምህርት ቤት በቂ ነው	1	2	3	4
በ. የተማሪዎችን ሁኔታ መረዳትና ተማሪዎችን መውደድ ሒሣብን ለማስተማር አስፈላጊ ነው	1	2	3	4

23. ከሚከተሉት ትምህርታዊ ዶኩሜንቶች ጋር ያለዎትን የግንኙነት ወይም የትውውቅ ደረጃ ያመልክቱ፡፡

1. ይህ ዶክሜንት አይታወቅም
2. በደንብ አልተዘጋጀም
3. በመጠኑ ተዘጋጅቷል
4. በጣም በተሻለ ሁኔታ ተዘጋጅቷል

ሀ. በአገር አቀፍ ደረጃ የሚያገለግል ብሔራዊ የሒሣብ ሥርዓተ ትምህርት	1	2	3	4
ለ. በክልል ደረጃ የተዘጋጀ የሒሣብ ስርዓተ ትምህርት መመሪያ	1	2	3	4
ሐ. በት/ቤት ደረጃ የተዘጋጀ የሒሣብ ስርዓተ ትምህርት መመሪያ	1	2	3	4
መ. ብሔራዊ የሒሣብ ፈተና አዘገጃጀት መመሪያ	1	2	3	4
ሠ. የክልል የሒሣብ ፈተና አዘገጃጀት መመሪያ	1	2	3	4
ረ. የብሔራዊ የሒሣብ ፔዳጐጂ መመሪያ	1	2	3	4
ሰ. የክልል የሒሣብ ፔዳጐጂ መመሪያ	1	2	3	4

24. የሚከተሉትን ለማስተማር ምን ያህል ዝግጅት ያስፈልግሃል/ሻል

1= እነዚህን ርዕሶች አላስተምርም

2= በደንብ አልዘጋጅም

3= በመጠኑ እዘጋጃለሁ

4= እጅግ በጣም እዘጋጃለሁ

ሀ. ክፍልፋዮችን፣ ዴሲማሎችንና ፐርሰንቴጆችን	1	2	3	4
ለ. ሬሽዮና ፕሮፖርሽን	1	2	3	4
ሐ. ሜዠርመንት፣ ዩኒትስ፣ የሒሣብ መሣሪያዎች እና ፍጹምነት	1	2	3	4
መ. ዙሪያ፣ ስፋት፣ ይዘት	1	2	3	4
ሠ. የጂኦሜትሪ ምስሎች፣ ትርጉሞችና ፕሮፐርቲዎች	1	2	3	4

ረ. የጂኦሜትሪ ምስሎች፣ ሲሜትሪ፣ ሞሽንስ፣ እና ትራንስፎርሜሽን፣ ኮንግረንስና ሲሚላሪቲ	1	2	3	4
ሸ. ኮኦርድኔት ጂኦሜትሪ	1	2	3	4
ቀ. አልጀብራዊ ሪፐረዘንቴሽን	1	2	3	4
በ. የኦፐሬሽን ስሌትና አሠራር በአልጀብራዊ ሀተታ	1	2	3	4
ተ. የሊነርኤኬሽንና ኢንኢኳሊቲስ ስሌት	1	2	3	4
ቸ. የግራፍ፣ የቻርት፣ እና ሰንጠረዥ መረጃዎችን መተንተን	1	2	3	4
ኘ. መሠረታዊ ፕሮባብሊቲስ ፅንሰ ሐሳብና ካልኩሌሽን	1	2	3	4

ክፍል ሁለት

የሚከተሉት ጥያቄዎች በክፍል ውስጥ ሒሣብን ለማስተማር የምታደርጊውን/ገውን እንቅስቃሴ ለማወቅ የሚሹ ስለሆነ በክፍል ውስጥ ያለህን/ያለሽን ልምድ (ተሞክሮ) በትክክል አስቀምጥ/ጭ፡፡

1. በምታስተምሪው/ረው ክፍል ውስጥ ሒሣብ የሚማሩ ተማሪዎች ብዞት ወንድ _________

   ሴት _______

2. ትኩረት የምትሰጭው/የምትሰጠው የሒሣብ ይዘት ለየትኛው ነው? በደረጃ አስቀምጡ

   (ለበለጠው 1, 2, 3)

   ሀ. በቁጥሮች ለሚሰሉ (ሙሉ ቁጥሮች፣ ክፍልፋዮች፣ ዴሲማሎች ፣ ፐርሰንት፣ መቁጠሪያ ቁጥሮች …ወዘተ) _________

   ለ. ለጂኦሜትሪ___________________

   ሐ. ለአልጀብራ __________________

   መ. ለጂኦሜትሪና ለአልጀብራ______________

   ሠ. በጂኦሜትሪና በአልጀብራ ለሚሰሉ ቁጥሮች ___________________

   ሌሎች ይዘቶች ካሉ ይጻፉና በደረጃ ይሰጣቸው ___________________

3. በአንድ ክፍል በሳምንት ምን ያህል ደቂቃዎች /ሠዓት ታስተምሪያለሽ/ለህ? ____ ደቂቃዎች፡፡

4. በክፍል ውስጥ ሒሣብ ስታስተምር/ሪ የተማሪዎችን መጽሐፍ ትጠቀሚያለሽ/ለህ?

ሀ. አዎ ☐ ለ. አልጠቀምም ☐

5. ያተማሪዎችን መጽሐፍት የምትጠቀሚ/የምትጠቀም ከሆነ በምን ያህል ፐርሰንት በሳምንት የተማሪዎችን መጽሐፍ ትጠቀሚያለሽ/ማለህ? የ"✓" ምልክት በማድረግ ምረጡ

ሀ. ከ 0-25% ___ ለ. ከ 26-50%_ ሐ. ከ 51-75%__ መ. ከ76-100%_____

6. ሒሣብ ስታስተምሪ/ር ተማሪዎችሽ/ህ ካልኩሌተር እንዲጠቀሙ ታደርጊያለሽ/ህ

ሀ. አዎ ☐ ለ. አልጠቀምም ☐

7. ተማሪዎች በክፍል ውስጥ ሒሣብን ለመስራት ካልኩሌተር ሲጠቀሙ ብታይ ትፈቅጃለሽ/ለህ?

ሀ. አዎ ☐ ለ. አልፈቅድም ☐

8. በተራ ቁጥር 7 መልስሽ/ህ አልፈቅድም ከሆነ ምክንያቱ ባጭሩ ቢገለጽ ____________________

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9. ተማዎች ካልኩሌተር የሚጠቀሙ ከሆነ ብዙውን ጊዜ የሚጠቀሙት ለየትኛው ሥራ ነው? ለየትኛው ሥራ እንደሚጠቀሙና ለምን ያህል ጊዜ እንደሚጠቀሙ ቁጥሮችን በመክበብ አመልክቱ፡፡

1= በሁሉም የክፍል ሥራ 3= በወር አንድ /ሁለት ጊዜ

2= በሳምንት አንድ /ሁለት ጊዜ 4= በፍጹም አይጠቀሙም / አልፎ አልፎ

ሀ. የሰሩትን ለማረጋገጥ	1	2	3	4
ለ. በቴስቶችና በፈተናዎች ወቅት	1	2	3	4
ሐ. ብዛት ያላቸው ቁጥሮችን ለማስላት	1	2	3	4
መ. ከበድ ያሉ ፕሮብሌሞችን	1	2	3	4
ሠ. የቁጥሮችን ጽንሰሐሳብ ለመረዳት	1	2	3	4

10. በሒሣብ ትምህርት ወቅት በክፍል ውስጥ ተማሪዎችሽ/ህ ኮምፒዩተር ይጠቀማሉ?

ሀ. አዎ ☐ ለ. አይጠቀሙም ☐

11. በትምህርት ቤታችሁ ተማሪዎች ኮምፒዩተር የሚጠቀሙት እንዴት ነው?

1= በፍጹም 2= ለጥቂት ይዘቶች 3= ለብዙ ይዘቶች 4= ለእያንዳንዱ ይዘት

ሀ. በክፍል ውስጥ	1	2	3	4
ለ. በኮምፒውተር ክፍል	1	2	3	4
ሐ. በሳይንስ ላቦራቶሪ (ቤተመጻሕፍት)	1	2	3	4

12. በትምህርት ቤታችሁ ሁሉም ተማሪዎች ኮምፒዩተር ይጠቀማሉ?

ሀ. አዎ ☐ ለ. አይጠቀሙም ☐

13. በተራ ቁጥር 12 የሰጠሽው/ኸው መልስ ይጠቀማሉ ከሆነ

ሀ. ኮምፒውተሮቹ ኢንተርኔት /ዌብሳይት/ አላቸው

ሀ. አዎ ☐ ለ. የላቸውም ☐

14. ሒሣብን ለማስተማር ስታቅጂ/ስታቅድ ከሚከተሉት ውስጥ የመረጃ ምንጭ ለሆኑሽ/ለሆኑህ የሚችሉትን ለተገቢው ርዕስ ቁጥሮችን አስቀምጡ፡፡

1. ብሔራዊ /ክልላዊ የፈተና አወጣጥ መመሪያ
2. ብሔራዊ /ክልላዊ የሥርዓተ ትምህርት መመሪያ
3. የትምህርት ቤት ሥርዓት ትምህርት መመሪያ
4. የመምህሩ መመሪያ
5. የተማሪዎች መጽሐፍት
6. ሌሎች ምንጮችን

ሀ. በተማሪዎች ግብ መሠረት ማስተማር የሚገባኝን ርዕስ ለማወቅ___________

ለ. ትምህርቱን እንዴት ማቅረብ እንዳለብኝ ለማወቅ_________

ሐ. ተማሪዎች በክፈል ውስጥ እና ከክፍል ውጭ ሊሠሯቸው የሚቡ ፕሮብሌሞችንና

መልመጃዎችን ለመምረጥ _______

መ. ለግምገማ የምጠቀምባቸውን ችሮብሌሞችንና ተግባሮችን ለመምረጥ __________

15. ሒሣብን ስታስተምሪ/ስታስተምር ተማሪዎቹ የሚከተሉትን እንዲሰሩ ታደርጊያለሽ/ታደርጋለህ?

1= በፍጹም 2= በጥቂቱ 3= በአብዛኛው 4= ሁልጊዜ

	1	2	3	4
ሀ. ለተሰጠው ሃሳብ ምክንያት መስጠት	1	2	3	4
ለ. ለተሰጡት መጃዎች በቻርት፣ በሠንጠረዥ፣ እና በግራፍ በማስቀመጥ መተንተን	1	2	3	4
ሐ. ለፕሮብሌሞች የራስን ስልት በመጠቀም አስልቶ ትክክለኛ መልስ እንዲሰጡ ማድረግ	1	2	3	4
መ. ፕሮብለሞችንና መልመጃዎችን ለመሥራት ኮምትውተር እንዲጠቀሙ ማድረግ	1	2	3	4
ሠ. የስሌት ክህሎትን እንዲያዳብሩ ማድረግ	1	2	3	4
ረ. የሒሣብ ኢኩዬሽኖችን ከዐ.ነገር አውጥተው እንዲሠሩ ማድረግ	1	2	3	4
ሸ. መልመጃዎችን ለመሥራት ካልኩሌተርና ግርፍ እንዲጠቀሙ ማድረግ	1	2	3	4

16. በሒሣብ ትምህርት ወቅት ተማሪዎች የሚከተሉትን ምን ያህል ተግባራዊ ያደርጋሉ?

1= በፍጹም 2= በጥቂቱ 3= በአብዛኛው 4= ሁልጊዜ

	1	2	3	4
ሀ. የመምህሩን እርዳታ ሳይፈልጉ በግል መስራት	1	2	3	4
ለ. በመምህሩ እርዳታ በግል መስራት	1	2	3	4

ሐ. መምህሩ ሲያስተምር ሁሉም አብረው መስራት 1 2 3 4

መ. በጋራ ተማሪዎች ምላሽ እየሰጡ ማስተማር 1 2 3 4

ሠ. ሁለት ወይም ከዚያ በላይ በቡድን በመሆን ያለመምህሩ

እርዳታ በጋራ መስራት 1 2 3 4

ረ. ሁለት ወይም ከዚያ በላይ በቡድን በመሆን በመምህሩ

እርዳታ በጋራ መስራት 1 2 3 4

17. በተወሰነ ወር ወይም በሒሣብ ክፍለ ጊዜ ወቅት ለሚከተሉት ሥራዎች በፐርሰንት ምን ያህል ጊዜ ታጠፋለህ? ለሁሉም ሥራዎች የምታጠፋው /ፊው ጊዜ ሲደመር መቶ ፐርሰንት መምጣት አለበት፡፡

ሀ. ለአስተዳደር ሥራ / ከትምህርቱ ጋር የማይገናኝ________________%

ለ. የተማሪዎችን የቤት ሥራ ማረም ________________ %

ሐ. ተማሪዎችን በገለጻ ማስተማር ________________ %

መ. ተማሪዎቹ በመምህሩ እርዳታ እንዲሠሩ ማድረግ ________________ %

ሠ. ይዘቶችንና መርሆዎችን ግልጽ ለማድረግ ደግሞ ማስተማር__________ %

ረ. ተማሪዎች በራሳቸው እንዲለማመዱ ማድረግ ________________ %

ሸ. ቴስቶችንና አጫጭር ሙከራዎችን መስጠትና ማረም ________________%

ቀ. ለሌሎች ሥራዎች ________________________________%

18. የሚከተሉትን የሒሣብ ርዕሶች ተማሪዎች መማር አለመማራቸውንና ለምን ያህል ጊዜ/ክፍለ ጊዜ እንደተማሩ ቁጥሮቹን በመክበብ አመልክቱ፡

1= ከአንድ ዓመት በፊት ተምረዋል 2= በዚህ ዓመት ከ1-5 ክፍለ ጊዜያት ተምረዋል

3= በዚህ ዓመት ከ5 ክ/ጊዜያት በላይ ተምረዋል 4= ገና አልተማሩም 5= አላውቅም

ሀ. ክፍልፋዩችና መሠረተዊ የቁጥር ስሌት

18.1) ሙሉ ቁጥሮች ፣ አስርዮሽ ፣ የቁጥር ርቢዎች እና መሠረታዊ ስሌቶ (+, −,×,÷)	1	2	3	4
18.2) መሠረታዊ ክፍልፋዮችን ፅንሰ ሀሳብ መረዳትና መጻፍ	1	2	3	4
18.3) መሠረታዊ ክፍልፋዮችን በመጠቀም ማስላት	1	2	3	4
18.4) የዴሲማል ክፍልፋዮችን መዳትና መጻፍ	1	2	3	4
18.5) የዴሲማል ክፍልፋዮችን በመጠቀም ማስላት	1	2	3	4
18.6) በጋራ ፣ በዴሲማል እና በቅደም ተከተል ክፍልፋዮችን መጻፍና ያላቸውን ግንኙነት መዳት	1	2	3	4
18.7) የሙሉ ቁጠሮችና፣ የዴሲማል ክፍልፋዮች አቅራብ	1	2	3	4
18.8) የስሌትን ውጤት መተንበይ	1	2	3	4
18.9) የመስመር ላይ ቁጠሮች (Number lines)	1	2	3	4
18.10) ፐርሰንቴጅና ፕሮብሌሞችን በፐርሰንት ማስላት	1	2	3	4
18.11) በኢ-ተጋማሽ ቁጥሮች ማስላት	1	2	3	4
18.12) ስኴር ሩት (Radical), Perfect squares, ከ144 ያነሱ እና የቁጥሮች ርቢዎች	1	2	3	4
ለ.ልኬት (measurement)				
18.13) Units of measurement, standard metric units	1	2	3	4
18.14) የመለኪያ መሣሪያዎችን ማወቅ	1	2	3	4
18.15) የልኬት ውጤትን መተንበይ, የልኬት ትክክለኛነት	1	2	3	4
18.16) የጎን ሶስት ፣ የካሬ እና ክብን ዙሪያ እና ስፋት ማስላት	1	2	3	4
18.17) የሌሎች የጂኦሜትሪ ቅርጾችን ዙሪያና ስፋት ማስላት	1	2	3	4

18.18) Volume of rectangular solids	1	2	3	4
ሐ. ጂኦሜትሪ				
18.19) Cartesian coordinates of points in a pane	1	2	3	4
18.20) Coordinates of points on a given straight line	1	2	3	4
18.21) Simple two dimensional geometry, angles on a Straight line, parallel lines, triangles and quadrilaterals	1	2	3	4
18.22) Congruence and similarity	1	2	3	4
18.23) Symmetry and transformations (Reflects on and rotation)	1	2	3	4
18.24) visualization of three-dimensional shapes	1	2	3	4
መ) ፕሮፖርሽናሊቲ				
18.25) የካርታና የሞዴሎች ስኬል አጠቃቀም	1	2	3	4
18.26) የሬሽዮና ፕሮፖርሽን ፅንሰ ሐሳብ እና የሬሽዮ ፕሮፖርሽን ፕሮብለሞች	1	2	3	4
ሠ) አልጀብራ				
18.27) የቁጥሮች ቅደም ተከተልና ዝምድና	1	2	3	4
18.28) አልጀብራዊ መግለጫዎች	1	2	3	4
18.29) አልጀብራዊ ፎርሙላዎች	1	2	3	4
18.30) የአልጀብራዊ ኢኩዬሽን ስሌት	1	2	3	4
18.31) እኩለ ያልሆኑ አልጀብራዊ ኢኩዬሽን ስሌት	1	2	3	4
ረ) መረጃን ማጠናቀር መተንተንና ፕሮባብሊቲ				

18.32) መረጃን ከግራፍ ከቻርትና ከሰንጠረዥ መተንተን

እና ማጠናቀር	1	2	3	4
18.33) ሒሣባዊ አማካይ	1	2	3	4
18.34) የፕሮባብሊቲ ፅንሰ ሐሳብና ስሌት	1	2	3	4

19. የሒሣብ ትምህርትን ስታስተምር/ ስታስተምሪ ከሚከተሉት ውስጥ ለአንተ /ለአንቺ ተግዳሮቶች ናቸው የምትይውን /ለውን በሚከተለው ስኬል መሰረት ቁጥሮችን አክብብ/አክብቢ፡፡

1= በፍጹም አይደለም 2= በጥቂቱ ነው 3= በጣም ነው 4= እጅግ በጣም ነው

ሀ. የተማሪዎች የተራራቀ የሒሣብ ችሎታ	1	2	3	4
ለ. የተለያየ የተማሪዎች የትምህርት ፍላጎት	1	2	3	4
ሐ. የልዩ ፍላጎት ተማሪዎች የመስማት፣ የማየት፣ የመናገር አካላዊ ጉዳት፣ አዕምሮአዊ ጉዳት ያላቸው ተማሪዎ መኖር	1	2	3	4
መ. ሒሣብን የሚጠሉ ተማሪዎች መኖር	1	2	3	4
ሠ. ሥርዓት የሌላቸው ተማሪዎች መኖር	1	2	3	4
ረ. የወላጆች ስለልጆቻቸው ያላቸው የትምህርት ክትትልና መሻሻል ፍላጐት አነስተኛነት	1	2	3	4
ሸ. ስለ ልጆቻቸው ትምህርትና መሻሻል ምንም አይነት ክትትል የማያደርጉ ወላጆች መኖር	1	2	3	4
ቀ. የኮምፒውተር ዕጥረት መኖር	1	2	3	4

በ. አስፈላጊ የትምህርት መሣሪያዎችና ተማሪዎች ሊጠቀሙባቸው የሚያስችሉ እና በማሳየት ለማስተማር አስፈላጊ ማቴሪያሎች አለመኖር	1	2	3	4
ተ. ተማሪዎች በተግባር እየተለማመዱ ሊጠቀሙባቸው የሚችሉ እና በማሳየት ለማስተማር አስፈላጊ ማቴሪያሎች አለመኖር	1	2	3	4
ቸ. የትምህርት ቤት ቁሳቁሶች እና ለጥናት አመቺ የሆኑ የግቢ ውበት እና ቤተመጽሐአት ችግር	1	2	3	4
ኘ. የተማሪዎችና መምህራን ጥምርታ ከፍተኛ መሆኑ	1	2	3	4
አ. የመምህራንና የት/ቤቱ አስተዳደር የሥራ ሞራል ዝቅተኛ መሆን	1	2	3	4
ዘ. የተማሪዎች የትምህርት ሞራል ዝቅተኛነት	1	2	3	4
ፐ. የመምህራንና የተማሪዎች ደህንነት አደጋ ውስጥ መሆን	1	2	3	4

20. ለተማሪዎች የቤት ሥራ እንዲሠሩ የምትሰጪቸው/ የምትሰጣቸው መቼ ነው?

ሀ. በፍጹም አልሰጥም........................

ለ. በሳምንት አንድ ጊዜ.....................

ሐ. በሳምንት ሁለት ጊዜ...................

መ. በሳምንት ከ3 እስከ 4 ጊዜ............

ሠ. ሁልጊዜ ....

21. በተራ ቁጥር 20 የሰጠኸው /ሽው መልስ በፍጹም አልሰጥም ከሆነ ምክንያቱን ባጭሩ ጻፍ ___

22. የሒሣብ ትምህርት የቤት ሥራ የምትሰጭ/የምትሰጥ ከሆነ ተማሪዎች የሚከተሉትን ይዘቶች እንዲሰሩ ትሰጫለሽ/ለህ

ሀ. በወርክሽት	1	2	3	4
ለ. መጽሐፍ ላይ ያሉ ጥያቄዎጽንና ፕሮብለሞችን	1	2	3	4
ሐ. መጽሐፍ ማንበብና ተጨማ የሚነበቡ ማቴሪያሎችን	1	2	3	4
መ. የሒሣብ ቃላቶች ፅንሰሃሳቦችንና በጽሑፍ የሚሠሩ መልመጃዎችን	1	2	3	4
ሠ. መረጃዎችን መሰብሰብና ማጠናቀር	1	2	3	4
ረ. በነፍስ ወከፍ የሚሠሩ ፕሮጀክቶችና ሙከራዎች	1	2	3	4
ሸ. በቡድን የሚሠሩ ፕሮጀክቶችንና ሙከራዎችን	1	2	3	4
ቀ. የተማሩትን ይዘቶች ጠቀሜታ	1	2	3	4
በ. በሪፖርት መልክ በግል (በቡድን) መረጃዎችን	1	2	3	4
ተ. በሪፖርት መልክ በግል (በቡድን ተሰርተው የሚቀርቡ ሒሣባዊ ግኝቶችን)	1	2	3	4

23. ለተማሪዎች የቤት ሥራ የምትሰጭ/የምትሰጥ ከሆነ የሚከተሉትን ተግባራዊ ታደርጊያለሽ/ታደርጋለህ?

1= በፍጹም 2= አልፎ አልፎ 3= አንዳንድ ጊዜ 4= ሁልጊዜ

ሀ. የቤት ስራ በሙሉ መሰራቱን ሪከርድ ማድረግ	1	2	3	4
ለ. መሰብሰብ ማረምና ማስቀመጥ	1	2	3	4
ሐ. መሰብሰብ ማረምና ለተማሪዎች መመለስ	1	2	3	4
መ. ለሁሉም ተማሪዎች በክፍል ውስጥ ግብረ መልስ መስጠት	1	2	3	4

ሠ. በክፍል ውስጥ ተማሪዎቹ እራሳቸው አርመው

እንዲያስተካክሉ መስጠት 1 2 3 4

ረ. ተማሪዎች የሠሩትን በመለዋወጥ እንዲያርሙ ማድረግ 1 2 3 4

ሸ. በክፍሉ ውስጥ እንዲወያዩበት ማድረግ 1 2 3 4

ቀ. የቤት ሠራቸውን እያረሙ ወደ ማርክ መቀየር 1 2 3 4

24. የተማሪዎች የክፍል ሥራ ስትገመግሚ /ስትገመግም ለሚከተሉት ሥራዎች ምን ያህል ክብደት ትሰጫቸዋለሽ/ትሰጣቸዋለህ?

1= ምንም 2= ጥቂት 3= በጣም ብዙ 4= እጅግ በጣም ብዙ

ሀ. ደረጃቸውን የጠበቁ ቴስቶች ሆነው ከት/ቤት ውጭ የሚሰሩ 1 2 3 4

ለ. በመምህሩ የተዘጋጁ ቴስቶች ሆነው ተማሪዎቹ ለእያንዳንዱ

ደረጃ ምክንያት ሊያቀርቡ የሚችሉበት ችሮብሌም 1 2 3 4

ሐ. በመምህሩ/ሯ የተዘጋጀ የምርጫ፣ የእውነት /ሐሰት እና

አዛምድ ጥያቄዎች 1 2 3 4

መ. ተማሪዎች የቤት ሥራ ሲሰጣቸው ምን ያህል ይሠራሉ 1 2 3 4

ሠ. ተማሪዎች የፕሮጀክት ፣ የላቦራቶሪ/የሙከራ ሥራዎችን

ከክፍል ውስጥም ሆነ ውጭ ምን ያህል ይሠራሉ? 1 2 3 4

ቀ. የተማሪዎችን የክፍል ውስጥ ተሳትፎ 1 2 3 4

25. ከተማሪዎች የሰበሰብሽውን /ከውን የግምገማ መረጃ ምን ያህል ትጠቀሚበታለሽ/ለህ

1= ምንም 2= በጥቂቱ 3= በጣም ብዙ 4= እጅግ በጣም ብዙ

ሀ. ለተማሪዎቹ ማርክ ለመስጠት 1 2 3 4

ለ. ለተማሪዎቹ ግብረ መልስ ለመስጠት 1 2 3 4

ሐ. የተማሪዎችን የመማር ተግር ለመፍታት 1 2 3 4

መ. ለወላጆች ለማሳወቅ	1	2	3	4
ሠ. ተማሪዎችን በተለያየ ችሮግራም ለመመደብ	1	2	3	4
ሸ. ለሚቀጥለው ትምህርት እቅድ ለማዘጋጀት	1	2	3	4

ጊዜያችሁን ሰውታችሁ ይህንን መጠይቅ በመሙላታችሁ በጣም አመሰግናለሁ፡፡

አጥኚው

Appendix E: Semi-Structured Interview Questionnaire prepared for primary school students (Translated into Amharic).

Addis Ababa University College of Education and Behavioral Studies.
Department of Curriculum and Teacher professional Development Studies.

Dear Student : I am currently conducting a research on: "Practices and Challenges of Primary Teacher Education in Addis Ababa City Government: Focus on Mathematics Education" Hence, the main purpose of this interview is to collect data which helps me to examine the present practices of mathematics primary teacher education curriculum and CPD in terms of Technological Pedagogical Content Knowledge (TPACK) and identify factors that contribute and challenge teacher education program and CPD during the training activities. Your response to each item in the interview is so relevant and contributes for the success of the study. Thus you are kindly requested to respond what you know. Please be sure that your responses will be used only for academic purposes.

Thank you in advance for your valuable time and thoughtful response.

Part I:- Background Information :

1.1) Sex ____ 1.2) Grade ____ 1.3) Age _____

Part II:- Main Information:

2.1) what is your favorite subject?

2.2) Do you have math text book? a) Yes --- b) No ---. If your answer is no what is the reason? And how can you do your class and home work?

2.3) How do you study mathematics?

2.4) Do you have mathematics Instruments? (Set squares, compass, protractor, ruler etc.)

a) Yes --- b) No ---. If your answer is no what is the reason? And how do you learn Geometry?

2.5) Do you do your class work and homework alone? A) Yes – b) No---. If you answer is no who is helping you to do your class work and home work?

2.6) Does the teacher use different teaching aids? A) Yes --- b) No ---. If your answer is yes what types of teaching aids your teacher uses most of the time?

2.7) Is there computer access in your school? a) Yes --- b) No -- if your answer is yes do you learn using computer? a) Yes—b) No---.

2.8) What methods of teaching your mathematics teachers usually apply? a) Lecture b) discussion c) problem solving d) debating, e) all, if any different for these please tell ?

2.9) Do you understand when the teacher teaches mathematics in the classroom? a) Yes—b) No--- If your answer is no what is the reason?

2.10) To what extent your teacher checks you exercise books? a) Sometimes b) always c) Not at all.

2.11) Is there smart board in your classroom? a) Yes – b) No--

2.12) What is your general opinion about mathematics teaching learning process? That is about facilities (text books, other resources, teacher's competency, etc.) and teachers practices?

The Amharic version of the above items will be as follows:

በመጀመሪያ ደረጃ (ከ1ኛ - 8ኛ) ክፍል በሚማሩ ተማሪዎች የሚሞላ ቃለ መጠይቅ

አዲስ አበባ ዩኒቨርሲቲ የትምህርትና ባህሪ ጥናት ኮሌጅ

የሥርዓተ ትምህርትና ማስተማር የትምህርት ክፍል

ውድ ተማሪዎች ፡ የዚህ ጥናት ዋና ዓላማ"Practices and Challenges of Primary Teacher Education in Addis Ababa City Government: Focus on Mathematics Education" ለሚለው ርዕስ መረጃ ለመሰብሰብ ነው፡፡ ለዚህ ጥናት መሳካት እናንተ የምትሰጡት መረጃ ከፍተኛ አስተዋጽኦ አለው፡፡

ጊዜያችሁን መስዋዕት አድርጋችሁ ለዚህ መጠይቅ መረጃ ለመስጠት ፈቃደኛ በመሆናችሁ በጣም አመሰግናለሁ፡፡

አጥኚው

ክፍል I፡ ቅድመ መረጃ

1.1 የትምህርት ቤቱ ስም ________________________________

1.2 ፆታ ______ 1.3 ክፍል _____________ 1.4 ዕድሜ _______

ክፍል II፡ ባዶ ቦታው ላይ በአጭሩ በመጻፍ ወይም "✓" በማድረግ የሚሞላ

a. የምትወደው/ጂው የትምህርት ዓይነት ___________
b. የሒሣብ መማሪያ መጽሓፍ አለህ/ሽ?

   ሀ. አዎ ______ ለ. የለኝም_________
c. የሒሣብ ትምህርትን እንዴት ነው የምታጠኚው/የምታጠናው?
d. የሒሣብ መማሪያ መሣሪያዎች ወ.ዘ.ተ አሉ አሉሽ/ሉህ?

   ሀ. አዎ _______ ለ/ የለኝም

2.5 በተራ ቁጥር የሰጠሽው/ኸው መልስ የለኝም ከሆነ የጂኦሜትሪን ትምህርት እንዴት ትማሪያለሽ /ለህ? ____

2.6 የክፍልና የቤት ሥራ የምትሰሪው /የምትሠራው ብቻሽን/ህን ነው?

ሀ. አዎ __________ ለ. አይደለም ____________

2.7 በተራ ቁጠር 2.6 የሰጠሽው/ኸው መልስ አይደለም ከሆነ የምትሰሪው/ሰራው ከማን ጋር ነው?

2.8 የሒሣብ መምህሩ/ሯ ሲያስተምር/ስታስተምር የትምህርት መርጃ መሣሪያ ይጠቀማል/ትጠቀማለች?

ሀ. አዎ _________ ለ. አይጠቀምም _______________

2.9 በተራ ቁጥር 2.8 የሰጠሽው/ኸው መልስ አዎ ከሆነ የሚጠቀሙትን የትምህርት መርጃ መሣሪያ ዘርዝሪ/ዘርዝር____

____

2.10 በትምህርት ቤታችሁ የኮምፒውተር ትምህርት ትማራላችሁ

ሀ. አዎ__________________ ለ. አንማርም _________________

2.11 መምህሯ/ሩ ሒሣብን ስታስተምር/ሲያስተምር ብዙውነጊዜ የሚጠቀመው /የምትጠቀመው የማስተማር ዘዴ የትኛው ነው?

ሀ. በገለጻ ለ. በውይይት ሐ. ችግርን በመፍታት ዘዴ

መ. በክርክር

ከላይ ከተጠቀሱት የተለየ ካለ ይጻፍ __________________________________

____

____

2.12 የሒሣብ መምህሯ/ሩ ደብተራችሁን የሚያርሙት

ሀ. አንዳንድ ጊዜ ለ. ሁልጊዜ ሐ. አያርሙም

2.13 ሒሣብ በምትማሩበት ወቅት መምህሯ/ሩ የሚጠቀሙት ጥቁር ሠሌዳ ብቻ ነው? ሀ. አዎ____________ ለ. አይደለም____________

2.14 በተራ ቁጠር 2.13 የሰጠሽው/ኸው መልስ አይደለም ከሆነ ከጥቁር ሠሌዳ በተጨማ የሚጠቀሙበትን ጥቀስ /ጥቀሽ________________________________

____

2.15 እስከ አሁን ድረስ የሒሣብ ትምህርትን ስትማር/ስትማሪ ያጋጠመህ/ያጋጠመሽ ችግር ምንድን ነው? የሒሣብ ትምህርት ይገበሀል/ሽል?

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Appendix F: Semi-Structured Interview Questionnaire prepared for primary school mathematics teachers.

Addis Ababa University College of Education and Behavioral studies

Department of Curriculum and Instruction.

Dear Teachers: I am currently conducting a research on: "Practices and Challenges of Primary Teacher Education in addis Ababa City Government: Focus on mathematics Education " Hence, the main purpose of this Interview is to collect data which helps me to examine the present practices of mathematics primary teacher education curriculum and CPD and Induction in terms of Technological Pedagogical Content Knowledge (TPACK) and identify factors that contribute and challenge teacher education program and CPD and induction during the training activities. Your response to each item is so relevant and contributes for the success of the study. Thus you are kindly requested to listen the directions and tell your response accordingly. Please be sure that your responses will be used only for academic purposes. Thank you in advance for your valuable time and thoughtful response.

General Directions

1) No need of telling your name
2) for close-ended items you have alternatives to agree or disagree
3) For open-ended items you are kindly requested to respond briefly.

Part I: Background Information:

Direction: Please tell about your personal background.

1.1. School: ____________________________

1.2. Sex ____ 1.3. Field of study: - Major _____ Minor ______

1.4. Academic qualification: - Certificate ___ Diploma ____ BA/B.Ed./ B.Sc. degree ----- Masters ___ PhD _____.

1.5. Teaching experience in year ______.

Part II: Continuous Professional Development (CPD) Information.

CPD is defined as a program designed for teachers to be successful in their life career. It helps to improve the reflection of teachers' knowledge, skill and attitude in their daily teaching activities (MOE, 2007 p.18) Amharic version. Hence CPD is on job training by arranging school program to CPD training. CPD program emphasizes on the duration of the training, coherence, relevance, content focus, methods and techniques of assessment and classroom management trainings will be involved in the program and trainings assumed to be supported by Technological Pedagogical Content Knowledge (TPACK). TPACK is a frame work or a system of training prospective teachers to practice on line learning, hybrid learning and applying collaborative models by using cloud computing to solve mathematics problems and construct knowledge through cooperative learning from the environment, related materials, students, teachers, by using smart phones, I pads, tablets, etc. Technology impacts not only on the teaching and learn8ing process but also on the ways and opportunities educators learn. Technology influences two important aspects of education. One is the way schools train prospective teachers (Pre-service) and the other is how schools design continuing education for their teachers to learn on the job either at the physical workplace or at virtual learning (CPD). CPD training includes trainings through the workshop, Observing to each other, Teaching colleagues, Participating in Curriculum revisions, coaching and being coached by others, assisting less experienced teachers and being assisted by more experienced ones, making inquiry, solving problems collaboratively, making personal readings to wide ones' professional subject matter knowledge and practice, etc. In this items CPD refers to Continuous Professional Development. Thus having the above points in mind and by integrating previous trainings answer the following questions. Note that the rating items will be assessed through your agreement/ disagreement as follows:

1:- Strongly disagree, 2:- Disagree, 3:- Agree, 4:- Strongly agree.

Serial No.	CPD variables	1	2	3	4
2.1	CPD duration of training is adequate				
2.2	CPD training is integrated to my field of study				
2.3	CPD training is logical, reasonable, and compatible				
2.4	CPD training is relevant & helped me to teach mathematics effectively				
2.6	CPD training is highly related to mathematics content				
2.7	CPD training helped me to use scientific assessment techniques				
2.8	CPD training helped me to practice active learning methods				
2.9	CPD helped me to manage the classroom effectively				
2.10	In general CPD is necessary for teachers who are not competent in professional skills and knowledge				
2.11	CPD improves the knowledge, skills and practice of teachers in the school				
2.12	CPD helps teachers to be confident in their work and improves students' result				
2.13	CPD puts unnecessary workload on teachers				
2.14	CPD is not significant for teachers; instead it is time consuming and resource wastage.				
2.15	CPD should be limited to subject matter development knowledge and methods related to each subject				
2.17	CPD training is supported by TPACK				

Part III: Concerning your classroom activities:

3.1 Use of Technology:

Serial No.	Technology variables	1	2	3	4
3.1.1	You and your students use calculators or computers to develop models.				
3.1.2	You and your students use calculators and computers to organize and solve some statistical data.				
3.1.3	You use computers to solve different exercises				
3.1.4	You use computers to access the internet and share knowledge, solve math problems, etc. by using web tools				

3.2 Use of higher order instructional methods:

Serial No.	Variables	1	2	3	4
3.2.1	You encourage your Students to work on independent math worksheets				
3.2.2	You encourage your Students to work on problems for which there is no obvious solution/challenging problems				
3.2.3	You create opportunities for your students to debate on different problems by explaining their reasoning.				

3.3 Use of lesson plan:

Serial No.	Variables	1	2	3	4
3.3.1	You use all components of lesson plan				
3.3.2	You apply the time, activities and materials planned in your lesson				

3.3.3	During planning you also prepare your self by practicing and solving different exercises and select appropriate and various exercise to be done in the class and outside the class				
3.3.4	You always use appropriate and attractive teaching aids.				

3.4 Use of college courses and practices:

Serial No.	Variables	1	2	3	4
3.4.1	You learned appropriate courses that helped you to teach mathematics at primary level				
3.4.2	The courses you learned in the college brought you some ethical changes in your profession				
3.4.3	The courses you learned in the college helped you to develop your knowledge, skill and attitude.				
3.4.5	The courses you learned in the college helped you to be motivated more to love the profession, and to become efficient in all aspects of the teaching activities.				

3.5 TPACK activities:

Serial No.	Technology Knowledge (TK) variables	1	2	3	4
3.5.1	You understand the way that technologies are used in a specific content domain				
3.5.2	You understand the range of technologies that mathematicians use in science and engineering				
3.5.3	You often refer to digital technologies (Internet, smart phones, I pads, laptops, etc. to teach mathematics using web tools				
3.5.4	You understand that technology changes the existing situation to new knowledge				
Serial No.	Content Knowledge (CK)	1	2	3	4
3.5.5	You use different software applications, online problem solving through the internet to solve math problems				
3.5.6	You prepare mathematics work sheets for your students to solve it collaboratively through the internet				
3.5.7	You state theorems and prove using related theories/ axioms/postulates by giving reasons for each step				
3.5.8	You apply the theorems by using practical examples				
3.5.9	You use different strategies to solve mathematics problems				
Serial No./	Pedagogical Knowledge (PK)	1	2	3	4
3.5.10	You have generic knowledge about how students learn intensively				
3.5.11	You have the skill and knowledge about teaching approaches				
3.5.12	You have the skill and knowledge about methods of assessment				
3.5.13	You apply different learning theories in your lesson				
3.5.14	You always prepare lesson plan and apply it in your instruction				
3.5.15	You use different resources (technological as well as local resources) to transmit the subject matter effectively				
Serial No.	Technological content knowledge (TCK)	1	2	3	4
3.5.16	You use smart phones, computers for internet access to provide new ways of teaching math content				
3.5.17	You use digital animation through laptops/computers/smart phones to avoid abstractions and confusion of your students				
3.5.18	You use digital animation to create tangible concept on the standards of mathematics problem solving abilities				
Serial No.	Pedagogical Content Knowledge (PCK)	1	2	3	4

3.5.19	You know how to combine pedagogy and content and teach effectively				
3.5.20	You know how to make a subject understandable to your students				
3.5.21	You know what makes a subject difficult or easy to learn				
3.5.22	You know the common misconceptions of your students in mathematics				
3.5.23	You know how your students develop math concept in the classroom				
Serial No.	Technological Pedagogical Knowledge (TPK)	1	2	3	4
3.5.24	Technology enables you to use different teaching approaches				
3.5.25	You usually use online collaborative tools to solve some challenging problems with other mathematicians of the world.				
Serial No.	Technological Pedagogical Content Knowledge (TPCK)	1	2	3	4
3.5.26	You understand the interplay between content, pedagogy and technology				
3.5.27	You know the relationship between your students and technology				
3.5.28	You know the relationship between math content and technology				
3.5.29	You have strong relationship with technology				
3.5.30	In general You know the relationship between students, teachers. content, practices and technology				

Part IV: Open ended items:

1) Are you studying additional discipline other than the teaching profession in your spare time?

a) Yes ---- b) No ----. If your answer is "Yes" the field you are studying/completed studying other than the teaching profession is -----------------. Why you study this field?

2) Have you ever participated in text book evaluation? a) Yes ---- b) No ----

3) In question No.1 if your answer is "Yes" Are there contents beyond the maturity level of the students? a) Yes....... b) No ...... If your answer is yes tell the grade and contents which you found to be difficult for the stufents and tell some of the weak points you come across in the text book:

____

4) Do you have any idea about teachers' license? a) Yes----- b) No----

5) In question No.3 if your answer is 'Yes' what do you suggest about teachers' license? Is it necessary a) Yes----- b) No ----? If your answer is no; write the reasons briefly:

____

6) What are the rewards or incentives given for role model teachers in your school?

7) What facilities are fulfilled in your school to teach mathematics effectively?

____

____

8) What are some of the challenges you faced in teaching Mathematics?

____

9) What are your general opinions about the syllabus, text book, and teachers guide of mathematics in the grade you teach recently and what do you suggest about Induction and CPD trainings?

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Appendix G: Semi-Structured Interview Questionnaire Prepared for Primary School Directors

Addis Ababa University College of Education and Behavioral Studies.
Department of Curriculum and Teacher Professional Development Studies.
Dear Director/Principals : I am currently conducting a research on: "Practice and Challenges of Primary Teacher Education in Addis Ababa City Government: Focus on mathematics Education" Hence, the main purpose of this interview is to collect data which helps me to examine the present practices of mathematics primary teacher education curriculum and CPD in terms of Technological Pedagogical Content Knowledge (TPACK) and identify factors that contribute and challenge teacher education program and CPD during the training activities. Your response to each item in the interview is so relevant and contributes for the success of the study. Thus you are kindly requested to respond what you know. Please be sure that your responses will be used only for academic purposes.

Thank you in advance for your valuable time and thoughtful response.

Part I : Background Information :

Direction: Please respond about your personal background.

1.1 Sex ____ 1.2 Field of study: - Major _____ Minor ______

1.3 Academic qualification: - Certificate ___ Diploma ____ Degree____ Masters ___ PhD _____.

1.4 Teaching experience in year ______. 1.5. School administration experience in year _____

Part II: Continuous Professional Development (CPD) Information.

CPD is defined as a program designed for teachers to be successful in their life career. It helps to improve the reflection of teachers' knowledge, skill and attitude in their daily teaching activities (MOE, 2007 p.18) Amharic version. Hence CPD is on job training by arranging school program to CPD training. CPD program emphasizes on the duration of the training, coherence, relevance, content focus, methods and techniques of assessment and classroom management trainings will be involved in the program and trainings assumed to be supported by Technological Pedagogical Content Knowledge (TPACK). TPACK is a frame work or a system of training prospective teachers to practice on line learning, hybrid learning and applying collaborative models by using cloud computing to solve mathematics problems and construct knowledge through cooperative learning from the environment, related materials, students, teachers, by using smart phones, I pads, tablets, etc. Technology impacts not only on the teaching and learning process but also on the ways and opportunities educators learn. Technology influences two important aspects of education. One is the way schools train prospective teachers (Pre-service) and the other is how schools design continuing education for their teachers to learn on the job either at the physical workplace or at virtual learning (CPD). CPD training includes trainings through the workshop, Observing to each other, Teaching colleagues, Participating in Curriculum revisions, coaching and being coached by others, assisting less experienced teachers and being assisted by more experienced ones, making inquiry, solving problems collaboratively, making personal readings to wide ones' professional subject matter knowledge and practice, etc.

Part III:- Classroom activities of teachers:

3.1) Use of technology:

3.1.1) To what extent your mathematics teachers and students use calculators and computers? If your answer is not at all; please identify the reasons?

3.1.2) For what purpose your mathematics teachers and students use computers and calculators? Forinstance it can be to organize and solve statistical data; to solve different excercises; to access the internet and share knowledge; to solve problems from the website; etc.,? If not at all what is the reason?

3.2) Use of higher order instructional methods:

3.2.1) To what extent your math teachers prepare independent math worksheets? If not at all what is the reason?

3.2.2) Do math teachers prepare challenging problems for their students? A)Yes__B) No__ If No what is the reason?

3.2.3) Towhat extent your math teachers create opportunities for their students to debate on different problems by explaining logical reasons? If your answer is not all what is the reason?

3.2.4) Is there peer observation among math teachers? A) Yes__ B) No_ If No tell the reason?

3.2.5) Is there collaborative problem solving and colleagues teaching among math teachers? A) Yes__ B) No__If No what is the reason?

3.3) Use of assessment techniques:

3.3.1) Is there peer and self assessment among math teachers? A) Yes__ B) No__ If No what is the reason?

3.3.2) How do you assess your teachers? Are the students involved in teachers' assessment? what is the reason?

3.3.3) How do teachers assess their students? Which one is dominant? a) paper-pencil assessment b) The assessment comprises students' cognitive ability, attitude, skill, ethics; social interaction, etc. c) if any different from these please respond?

3.4) Use of lesson plan and teachers status:

3.4.1) To what extent teachers incorporate all components of lesson plan in their lesson?

3.4.2) How much teachers apply the time, activities and materials planned in their lesson effectively?

3, 4.3) How is teachers preparation before entering into the classroom? (That is solving problems, preparing resources, preparing plan, reading related math theories etc.)

3.4.4) To what extent teachers use appropriate and attractive teaching aids?

3.4.5) How do you evaluate teachers subject matter knowledge?

3.4.6) How much mathematics teachers apply active learning method and transfer clearly to their students?

3.4.7) To what extent math teachers manage the classroom effectively?

Part IV: Respond honestly and briefly for the following

4.1) what facilities are fulfilled in the school to teach mathematics effectively?

4.2) To what extent mathematics teachers participate in text book evaluation? if not at all what is the reason?

4.3) What are the rewards/incentives provided for role model teachers in the school?

4.4) Do you have any idea about teachers license? A) Yes—B) No----. Give reasons for your yes/no answers?

4.5) How is the practices of Induction in your school?

4.6) How do you Practice CPD?   4.7) What are the challenges of Induction and CPD practices in your school?

Appendix H: Semi-Structred Interview Questionnaire Prepared for Parents (Changed into Amharic)

Dear parent: The main purpose of this interview is to collect data for the research topic "Practices and Challenges of Primary Teacher Education in Addis Ababa City Governemnt: Focus on Mathematics Education". Hence your precise response has a great contribution for the success of this paper.

Thank you for your cooperation.

Part I : Background Information:

1.1) Sex --- 1.2) occupation ------------- 1.3) Academic qualification ---------

Part II: Main data:

2.1) Do you check the education performance of your child? A) Yes__B) No—

If your answer is 'yes' what are the techniques you use to control your child? If your answer is No tell the reasons?

2.2) Do your child ask your assistance to help him/her do some mathematics problems? A) Yes__ B) No __. If your answer is No what is the reason?

2.3) How do you communicate with the school about your child/children?

2.4) Do you buy some reference materials for your child/ children in addition to the school materials? A) Yes__ B) __ If your answer is No. what is the reason?

2.5) What is your general opinion about mathematics teachers practices and the school activities?
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The Amharic version of the above items will be as follows:

በወላጆች የሚሞላ የቃል መጠይቅ

አዲስ አበባ ዩኒቨርሲቲ የትምህርትና ባህሪ ጥናት ኮሌጅ

የሥርዓተ ትምህርትና ማስተማር የትምህርት ክፍል

ውድ ወላጆች፡- የዚህ ጥናት ዋና ዓላማ "Practices and Challenges of Primary Teacher Education in Addis Ababa City Government: Focus on Mathematics Education" ለሚለው ርዕስ መጃ ለመሰብሰብ ነው፡፡ ለዚህ ጥናት መሳካት እናንተ የምትሰጡት መረጃ ከፍተኛ አስተዋጽኦ አለው፡፡ ጊዜየችሁን መስዋዕት አድርጋችሁ ለዚህ መጠይቅ መረጃ ለመስጠት ፈቃደኛ በመሆናችሁ በጣም አመሰግናለሁ፡፡

አጥኝው

ክፍል I፡ ቅድመ መረጃ

1.1 የትምህርት ቤቱ ስም ______________________________

1.2 ፆታ ______ 1.3 ሥራ ______________ 1.4 የትምህርት ደረጃ ________

ክፍል II፡ ባዶ ቦታው ላይ በአጭሩ በመጻፍ ወይም "✓" በማድረግ የሚሞላ

2.1 የልጅዎትን የትምህርት ውጤት ይከታተላሉ?

ሀ. አዎ________ ለ. አልከታተልም____________________

2.2 በተራ ቁጥር 2.1 መልስዎ አዎ ከሆነ የሚከታተሉት እንዴት ነው?

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2.3 በተራ ቁጠር 2.1 የሰጡት መልስ አልከታተልም ከሆነ ዋና ምክንያትዎ ምንድን ነው?

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2.4 ልጅዎ የሒሣብ ትምህርት የቤት ሥራ ሲሰጠው የእርስዎን እርዳታ ጠይቆ /ጠይቃ ታውቃለች/ያውቃል?

ሀ. አዎ________ ለ. የለም______________

2.5 ስለልጅዎ ለማወቅ ሲፈልጉ ከትምህርት ቤቱ ጋር የሚነጋገሩት እንዴት ነው?

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2.6 ለልጅዎ የሚያስፈልገው የትምህርት መሣሪያዎችና መጽሐፍት ያሟላሉ?

ሀ. አዎ________ ለ. የላሟላም___________

2.7 በተራ ቁጥር 2.6 መልስዎ አላሟላም ከሆነ ምክንያቱን ይጥቀሱ______________________________

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2.8 የሒሣብ ትምህርትን በሚመለከት ስለልጅዎና ትምህርት ቤቱ ያለውን ችግር በአጭሩ ይጥቀሱ፡፡

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Appendix I: Interview guide line for Education officers, and Experts

Addis Ababa University College of Education and Behavioral Studies.
Department of Curriculum and Instruction.
Dear Director/Supervisor : I am currently conducting a research on: "Practices and Challenges of Primary Teacher Education in Addis Ababa City Government: Focus on Mathematics Education" Hence, the main purpose of this interview is to collect data which helps me to examine the present practices of mathematics primary teacher education curriculum and CPD in terms of Technological Pedagogical Content Knowledge (TPACK) and identify factors that contribute and challenge teacher education program and CPD during the training activities. Your response to each item in the interview is so relevant and contributes for the success of the study. Thus you are kindly requested to respond what you know. Please be sure that your responses will be used only for academic purposes.

Thank you in advance for your valuable time and thoughtful response.

Part I : Background Information :

Direction: Please respond about your personal background.

1.1 Sex ____ 1.2 Field of study: - Major _____ Minor ______

1.3 Academic qualification: - Certificate ___ Diploma ____ Degree __ Masters ___ PhD _____. Work experience ___________________

Part II: Main data:

A teacher training school for the preparation of teachers at primary level was opened in 1944/45 and Harer teacher training school started in 1952 admitting students for a 4 year program with entry at grade8. A year earlier Haileselassie I day school at Addis Ababa had also started a new 8+4 teacher training program. Long term planning committee was established in 1953 to evaluate the education sector of the country and recommended the following training strategies of teachers:

- For grade 1-4 teachers were to be trained at 8+1 level. For middle schools (5-6) teachers were to be trained at 8+4 level. In addition to this 12+1 year teacher training program was to operate at Haileselassie I day school for training middle school teachers and a program for 10th and 11th grades after one year of teacher training would be assigned to teach in grades 5and6 and a 4 year college program was recommended for the training of secondary teachers. Recommendation of the long term planning committee changed the educational system into a 3 year tier system (4-4-4) then 10+2 year training, 11+1, 12+1, were introduced from 1968/69-1973/74.
- Based on the recommendation in the period 1974-1990 the teacher education and training program was changed as follows:-a 12+1 year pre-service program was initiated in 11 institutions. In the period 1991 the present government came into power and published a new education and training policy in 1994. Then a curriculum for a 12+1 year professional courses based pre-service teacher training programs for 1st cycle (1-4) teachers was produced in 1996/97. Mother tongues began to be used as the media of instruction in the teacher training program and improved program was designed by MOE in the TESO program (2003) and TDP (2007), for primary teacher education. In these program teachers will be trained through 10+3 program. According to Bridges and Marew (2000), teacher education policy clearly states (a) recruitment and selection criteria (b) management (c) career structure (d) the nature of the training (e) curriculum (f) Finance (g) Location (h) national distribution and certificate criteria. Hence the main purpose of this study is to investigate the above mentioned policy practices related to TPACK, Curriculum standard, license, and

certification criteria. Johnson et al (2013) state that 21st century teachers training should supported by TPACK frame work. To strengthen the quality of education in Ethiopian schools MOE also designed six major components (Packages). One of them is ICT. Then:

1) What are the recent strategies of training teachers in relation to technology? Does it consider TPACK as one of the frame works to be involved in the training system?
2) As I mentioned in the above teacher education policy involves selection and recruitment, management career structure etc. Nowadays primary school teachers are training as Generalist who teach from grade (1-4) and Linear who teach for grades 5and6. Teachers who teach for grades 7and 8 are not involved in the training with the assumption that PGDT trainees may be assigned to teach in those grades. Do you have any information about this? Is there any change in the selection and recruitment system?
3) Previous teacher education document TESO (2003) was a very comprehensive document but now had been replaced by TDP (2007). However some parts of TESO like practicum, selection and recruitment criteria are still active. What are the basic reasons/causes to replace TESO by TDP?
4) The recent education structure is 4-4-2-2. Whereas the training strategy needs to include grades 7and8 to be taught by PGDT trainees. Doesn't it violate the education structure? Because trainings are progressing based on the education structure?
5) What do you suggest about the overall primary teacher education training program vis-à-vis the world context?
6) Courses had been revised twice after TESO. What are the basic reasons for the revision of primary school teacher education courses?
7) Was there any readiness trainings provided for teacher educators after the revision of courses? Are there adequate facilities to implement the courses effectively?

Appendix J: Observation Check lists prepared to observe the practices of Teacher educators and primary school mathematics teachers

Addis Ababa University

College of Education and Behavioral Studies.

Department of Curriculum and Instruction

Research Topic: “The Practices and Challenges of Primary Teacher Education in Addis Ababa City Goverment: Focus on mathematics Education"

Note that these check lists are prepared based on Danielson’s (1996) components of professional practice. These are: (1) Planning and preparation, (2) The classroom environment (3) Instruction/ Delivery of service and (4) professional responsibilities. However I modified some contents of the above mentioned components and I included TPACK frame works in the observation checklists.

Instructor’s code ________________ Name of University/College ____________________

Year of the students ’ ______ Topic _________________ Date _______________.

Name of the school ______________________ Grade ______ Period ____ Date _______

Teacher’s code ________ Sex ________ Teaching experience ______

Note that items with the symbol * will be for primary school teachers and the symbol ** will be for teacher educators. Other items will be used commonly for both teacher educators and primary school teachers.

Evaluation Ratings:

1:- Unsatisfactory: Little or no knowledge and minimal implementation of performance standards. Does not meet minimal performance standards and needs substantial improvement. (1.00 - 1.99)

2:- Basic: - Evidence of basic knowledge and implementation of performance standards. Integration of performance standards is not evident. Teacher is making progress towards proficiency. (2.00 - 2.99)

3:- Proficient: - (3.00-3.99) Evidence of increased knowledge implementers and integration of performance standards. Evidence of a clear proficiency and skill in the performance area.

4:- Distinguished: - Evidence of high level of knowledge implementation and integration of performance standards along with evidence of leadership initiative and willingness to model and serve as a mentor for colleagues.(4.00)

Serial No	Domain 1: Designing Knowledge Work	1	2	3	4
1.1	Demonstrating knowledge of content and pedagogy				
1.2	Ability of making students to be in the learning situation				

1.3	Ability of informing instructional objectives.				
1.4	Knowledge of resources including technology				
1.5	Ability of designing coherent instruction				
1.6	Techniques of assessing student learning				
1.7	Knowledge of students' backgrounds, skills, and interests				
1.8	Objectives are designed related to curriculum frame works and standards				
1.9	**Teachers' ability of relating math content to TPACK and use of digital technologies (laptops, software applications, smart phones, computers to access online learning through the internet) to teach math content				
Serial No.	Domain 2: Organizing the environment for knowledge work	1	2	3	4
2.1	Classroom interactions are highly respectful				
2.2	There is high levels of civility among members of the class				
2.3	Students take much of the responsibility for establishing a culture for learning in the classroom				
2.4	Students are pride in their work				
2.5	Students demonstrate initiating improvements to their result				
2.6	**Students hold the work to the highest standard				
2.6	Teacher demonstrates a passionate commitment to the subject				
2.7	Classroom routines and procedure are coherent in their operation				
2.8	Students assume considerable responsibility for their smooth functioning				
2.9	Student behavior is entirely appropriate				
2.10	Students participate in monitoring others behavior				
2.11	Teacher's monitoring of students behavior is suitable and preventive				
2.12	Teacher's response to student misbehavior is sensitive to individual student needs				
2.13	Teacher's classroom is safe				
2.14	Students contribute to ensuring that the physical environment supports the learning of all students				
Serial No	Domain 3 : Instruction				
3.1	Teacher's oral and written communication is clear and expressive				
3.2	Teacher's anticipating possible student misconceptions				
3.3	Students formulate many of the high level questions				
3.4	Students assume responsibility for the participation of all students in the discussion				
3.5	Students are highly engaged throughout the lesson and make material				
3.6	Contributions of students to the representation of content, the activities and the materials				
3.7	The structure and pacing of the lesson allow for student reflection and closure				
3.8	Teacher's feedback to students is timely				
3.9	Teacher's feedback to students is of consistently high quality				
3.10	Students make use of the feedback in their learning				
3.11	The teacher is highly responsible to students' interest and questions				
3.12	The teacher is making major lesson adjustments of necessary				
3.13	The teacher persists in ensuring the success of students				
Serial No.	Domain 4: Professional Responsibilities	1	2	3	4
4.1	Teacher's reflection on the lesson is highly accurate and perceptive				
4.2	The teacher is citing specific examples				
4.3	The teacher draws on an extensive repertoire to suggest alternative strategies				
4.4	Teacher's system for maintaining accurate records is efficient and effective				
4.5	Students contribute to the system for maintaining accurate records				
4.6	*The teacher communicates frequently and sensitively with families				

4.7	The teacher successfully engages the students in the instructional program				
4.8	*Students participate in communicating with families				
4.9	*The teacher makes a substantial contribution to school and disjoint events and projects				
4.10	The teacher assumes leadership with colleagues				
4.11	The teacher makes a substantial contribution to the profession through different activities				
4.12	The teacher conducts an action research and mentoring new teachers				
4.13	The teacher actively pursues professional development				
4.14	The teacher assumes a leadership position in ensuring that school practices and procedures				

5. Concerning TPACK activities:

Serial No.	Technology Knowledge (TK) variables	1	2	3	4
5.1	The teacher understands the way that technologies are used in a specific content domain				
5.2	The teacher understand the range of technologies that mathematicians use in science and engineering				
5.3	The teacher often refers to digital technologies (Internet, smart phones, I pads, laptops, etc. to teach mathematics using web tools				
5.4	The teacher understands that technology changes the existing situation to new knowledge				

Serial No.	Content Knowledge (CK)	1	2	3	4
5.5	The teacher uses different software applications, online problem solving through the internet to solve math problems				
5.6	The teacher prepares mathematics work sheets for the students to solve it collaboratively through the internet				
5.7	The teacher states theorems and prove using related theories/ axioms/postulates by giving reasons for each step				
5.8	The teacher applies the theorems by using practical examples				
5.9	The teacher uses different strategies to solve mathematics problems				
Serial No./	Pedagogical Knowledge (PK)	1	2	3	4
5.10	The teacher has generic knowledge about how students learn intensively				
5.11	The teacher has the skill and knowledge about teaching approaches				
5.12	The teacher has the skill and knowledge about methods of assessment				
5.13	The teacher applies different learning theories in the lesson				
5.14	The teacher always prepares lesson plan and apply it in the instruction				
5.15	The teacher uses different resources (technological as well as local resources) to transmit the subject matter effectively				
Serial No.	Technological content knowledge (TCK)	1	2	3	4
5.16	The teacher uses smart phones, computers for internet access to provide new ways of teaching math content				
5.17	The teacher uses digital animation through laptops/computers/smart phones to avoid abstractions and confusion of the students				

5.18	The teacher uses digital animation to create tangible concept on the standards of mathematics problem solving abilities				

Serial No.	Pedagogical Content Knowledge (PCK)	1	2	3	4
5.19	The teacher knows how to combine pedagogy and content and teach effectively				
5.20	The teacher knows how to make a subject understandable to the students				
5.21	The teacher knows what makes a subject difficult or easy to learn				
5.22	The teacher knows the common misconceptions of the students in mathematics				
5.23	The teacher knows how the students develop math concept in the classroom				

Serial No.	Technological Pedagogical Knowledge (TPK)	1	2	3	4
5.24	Technology enables the teacher to use different teaching approaches				
5.25	The teacher usually uses online collaborative tools to solve some challenging problems with other mathematicians of the world.				
Serial No.	Technological Pedagogical Content Knowledge (TPCK)	1	2	3	4
5.26	The teacher understands the interplay between content, pedagogy and technology				
5.27	The teacher knows the relationship between the students and technology				
5.28	The teacher knows the relationship between math content and technology				
5.29	The teacher has strong relationship with technology				
5.30	In general the teacher knows the relationship between students, teachers. content, practices and technology				

Appendix K: Revised Course Catalogue for Diploma Teacher Training Linear program June 2012, Addis Ababa, Ethiopia. Revised Curriculum.

Linear Diploma Program

(Mathematics Major, Physics Minor)

The Diploma program has two different components based on the division of the primary education into two levels namely: first cycle (Grades 1-4) and second cycle (Grades 5-8). As per the direction given by the Ministry of Education, teachers for the second cycle primary schools are going to be trained in linear form (major and minor).

List of Courses

I. Major Courses

No	Course Title	Course Code	Cr. Hr./Cn. hr.
1.	Basic Mathematics I	Math 101	3/4
2.	Basic Mathematics II	Math 102	4/5
3.	Plane Geometry	Math 111	3/4
4.	Introduction to Calculus	Math 162	3/4
5.	Solid Geometry	Math 112	3/4
6.	Fundamental Concepts of Algebra	Math 221	3/4
7.	Elementary Linear Algebra	Math 222	3/4
8.	Calculus I	Math 261	4/5
9.	Calculus II	Math 262	4/5
10.	Introduction to Statistics and Probability	Math 272	3/4
		Total	**33/43**

II. Courses offered to those who minor in Math

No	Course Title	Course Code	Cr. Hr./Cn.hr.
1.	Basic Mathematics I	Math 101	3/4
2.	Basic Mathematics II	Math 102	4/5
3.	Plane Geometry	Math 111	3/4
4.	Applied Mathematics I	Math 231	4/5
5	Introduction to Calculus (***)	Math 162	3/4
		Total	**17/22**

*** intended to be offered(if convinced)

III. Courses given to Linear Math Diploma as Minor

No.	Course Title	Course Code	Cr.Hr./Cn.Hr
1.	Mechanics I	Phys 101	¾
2.	Mechanics II	Phys 102	¾
3.	Heat & Thermodynamics	Phys 222	2/3
4.	Experimental Physics I	Phys 112	1/3
5.	Experimental Physics II	Phys 211	1/3
6.	Waves and Optics	Phys 261	¾
7.	Electricity and Magnetism I	Phys 201	4/6
		Total	**17/27**

IV. Supportive Courses to Linear Math Diploma

No.	Course Title	Course Code	Cr.Hr./Tu.Hr.
1.	General Chemistry	Chem 105	4/4
2.	General Biology	Biol 101	4/7
		Total	**8/11**

V. Common Courses

No.	Course Title	Course Code	Cr. Hr./Cn.Hr.
1.	Communicative English Skills I	EnLa 101	3/3
2.	Local Language		2/2
3.	Communicative English Skills II	Enla 102	3/3
4.	Info. and Comm. Tech. for Education	ICTE 103	2/3
5.	Civic and ethical Education I	CEEd 101	2/2
6.	Civic and ethical Education II	CEEd 102	2/2
7.	General Fitness & Fund. Sport Skills	PEds 101	P/F/2

8.	General Fitness & Fund. Sport Skills	PEds 102	P/F/2
		Total	**14/19**

VI Professional Courses

No.	**Course Title**	**Course Code**	**Cr. Hr.**
1.	Fundamentals of Education & TPD	TECS 111	2
2.	Life Skills & Gender Issues	EPSY 111	2
3.	General Methods of Teaching	TECS 122	3
4.	Introduction to Educational Psychology	EPSY 122	2
5.	Special Needs Education	SNEd 211	3
6.	Child Development and Support	EPSY 231	2
7.	Instructional Media	TECS 232	2
8	Introduction to Measurement and Evaluation	EPSY 242	2
9.	Methods of Teaching Mathematics	TeMa 242	2
10	School Management & Improvement	Edpm 311	2
11	Action Research (I)	ACR 311	2
12	Methods of Teaching Physics	TePh 242	2
13	Action Research (II)	ACR 322	1
		Total	**27**

VII. Practicum Courses

No.	Course Title	Course Code	Cr. Hr./Cn.Hr.
1.	Practicum I : School Observation	Prac.201	4/6
2.	Practicum II : Working under the Mentor	Prac.202	3/5
3.	Practicum III: Assisting the Mentor	Prac.301	3/5
4.	Practicum IV: Independent Teaching	Prac.302	4/6
		Total	**14/22**

VIII. Summary

No.	Course Category	Cr.Hr./Cn.Hr.
1.	**Academics (Major + Minor + Supportive)**	**56/76**
2.	**Professional**	**27/27**
3.	**Common Courses**	**14/19**
4.	**Practicum**	**14/22**
	Total	111/144

IX. Course Breakdown

<u>Year I</u>   <u>Semester I</u>

No.	Course Title	Course Code	Cr. Hr./Cn.Hr.	Prerequisite
1.	Basic Mathematics I	Math 101	¾	
2.	Mechanics I	Phys 101	¾	
3.	Experimental Physics	Phys 112	1/3	
4.	Plane Geometry	Math 111	¾	
5.	Communicative English Skills I	Enla 101	3/3	
6.	Information & Communication Technology	ICTE103	2/3	
7.	Fundamentals of Education & TPD	TECS 111	2/2	
8.	Life Skills & Gender Issues	EPSY 111	2/2	
9.	General Fitness & Fundamental Sport Skills	PEds 101	P/F/2	
		Total	**19//27**	

Year I Semester II

No.	Course Title	Course Code	Cr. Hr./Cn.Hr.	Prerequisite
1.	Basic Mathematics II	Math 102	4/5	
2.	Solid Geometry	Math 112	¾	Math 111
3.	Mechanics II	Phy 102	¾	Phys 101
4.	General Biology	Biol 101	4/4	
5.	General Methods of Teaching	TECS 122	3/3	TECS 111
6.	Introduction to Educational Psychology	EPSY 122	2/2	EPSY 111
7.	Communicative English Skills II	Enla 102	3/3	
8.	General Fitness & Fundamental Sport Skills	PEdS102	P/F/2	
		Total	**22//27**	

Year II Semester I

No.	Course Title	Course Code	Cr. Hr./Cn.Hr.	Prerequisite
1.	Introduction to Calculus	Math 162	¾	Math 102
2	Fundamental Concepts of Algebra	Math 221	¾	Math 101
3.	General Chemistry	Chem 105	4/4	
4.	Practicum I : School Observation	Prac.201	4/6	
5	Local Language		2/2	
6.	Special Needs Education	SNEd 211	3/3	
7	Child Development and Support	EPSY 231	2/2	EPSY 122
		Total	**21//25**	

Year II Semester II

No.	Course Title	Course Code	Cr. Hr./Cn.Hr.	Prerequisite
1.	Calculus I	Math 261	4/5	Math 162
2	Civic and Ethical Education I	CEEd101	2/2	
3.	Practicum II : Working Under Mentor	Prac.202	3/5	
4.	Heat and Thermodynamics	Phys 222	2/3	

5.	Waves and Optics	Phys 261	¾	Phys 102
6	Instructional Media	TECS 232	2/2	TECS 122
7.	Introduction to Measurement and Evaluation	EPSY 242	2/2	EPSY 111& 112
8	Methods of Teaching Mathematics	TeMa 242	2/2	
		Total	**20//25**	

Year III Semester I

No.	Course Title	Course Code	Cr. Hr./Cn.Hr.	Prerequisite
1.	Calculus II	Math 262	4/5	Math 261
2.	Elementary Linear Algebra	Math 222	¾	Math 221
3.	Electricity and Magnetism I	Phys 201	4/6	
4.	Practicum III: Assisting the Mentor	Prac.301	3/5	
5	School Management & Improvement	Edpm 311	2/2	
6.	Action Research I	ACR 311	2/2	
7	Methods of Teaching Physics	TePh 242	2/2	
		Total	**20//26**	

Year III Semester II

No.	Course Title	Course Code	Cr. Hr./Cn.Hr.	Prerequisite
1.	Introduction to Statistics and Probability	Math 272	¾	Math 272
2.	Civic and ethical Education II	CEEd 102	2/2	
3.	Action Research II	ACR 322	1/1	ACR 311
4.	Experimental Physics II	Phys 211	1/3	Phys 112 & Phys 201
5.	Practicum IV: Independent Teaching*	Prac.302	4/6	
		Total	**11//16**	

*Six weeks block teaching

Generalist Curriculum June 2012/13

	Year I		Year II		Year III	
	Semester I	Semester II	Semester I	Semester II	Semester I	Semester II
1	Basic Mathematics I\(3)	Basic Natural Sciences II(3)	Teaching Environmental Science(Science and scientific Inquiry (PCK I) (3)	Plane and Solid Geometry (3)	Cross cutting Issues in Education (3)	Seminar (3)
2	Basic Natural Science I(3)	Basic Mathematics II(3)	Application of Theories of Learning in Primary school (2)	Teaching Environmental Science in lower Primary School II) (PCK (3)	Instructional Media And Information Technology in Primary School(2)	Basic Physics I (4)
3	Basic English I(3)	Primary Curriculum & Instruction (3)	Basic Biology I (4)	Basic Geography (3)	Action research (1)	Teaching Environmental Science In Lower Primary School (PCK III) (2)
4	Basic Mother Tongue (2)	Practicum I (1)	Practicum II (2)	Inclusive Education in Primary Schools (3)	Teaching Reading in content areas (3)	Teaching mathematic in Lower Primary School (PCK III) (3)
5	Basic Social Studies (2)	Child Development and Learning (3)	Basic Chemistry I(4)	Practicum III (3)		Science Laboratory Technique (3)
6	Hand Writing Skills (2)	Art, Music, and Child Learning (2)	Mathematics PCK I(Teaching Mathematics in Primary School(2)	Introduction to Stat. for Generalist (2)	Practicum IV (6)	
7	Professional Ethical and Civic Education (2)	Basic English II(3)	Assessment in Primary School(3)	Teaching Mathematics in lower Primary School (PCK II) (3)	Sociological Perspective on teaching and Learning (3)	Schoolo Management and School Improvement (2)
	17	18	20	20	18	17
	Total 110					

Revised Mathematics Curriculum for Diploma Teachers (5-6 grades), 2012/2013.

Year I		Year II		Year III	
Semester I	Semester II	Semester I	Semester II	Semester I	Semester II
Basic Mathematics I Math101(3)	Basic Natural Sciences II (3)	Plane Geometry Math111(3)		Cross-cutting issues in Education (3)	
Basic Natural Sciences I (3)	Basic Mathematics II Math102(3)	) Introduction to statistics(Math172) (3)	Solid Geometry(Math211) (2)	Action research theory(1)	
Basic English (3)	Curriculum, Instruction, and Assessment in Primary School (3)	Application of Theories of Learning in Primary School (2)	Inclusive Education in Primary Schools (3)	Application media and information technology in primary schools (grades(2)	Introduction to Linear Algebra (Math 322) (4)
Basic Mother Tongue (2)	Art, Music, and Child Learning (2)	Assessment in primary school(3)	Introduction to Calculus (Math262) 4)		Seminar on issues in Primary Teaching (3)
Basic Social Studies(2)	Child Development and Learning (3)	Teaching mathematics in Primary school(TeMa241)(3)	Teaching mathematics in Upper Primary school I (TeMa(up)242) (3)	PRACTICUM IV (6)	Teaching Mathematics In Upper Primary School II (3) TeMap 341
Hand Writing Skills (2)	PRACTICUM I (1)	PRACTICUM II (2)	PRACTICUM III (3)	Teaching Reading in Content Areas (3)	Calculus I (Math 322) (4)
Professional ethics and civic education(2)	Basic English II (3)		Fundamental Concepts of Algebra Math 321(4)	Sociological Perspectives on Teaching and Learning (3)	School Management And School Improvement (2)
17	18	16	19	18	16

Appendix L: Diploma graduates professional and academic written exam result similar to COC examination for mathematics graduates of 2005 E.C Academic Year. And original data of 2005 E.C and 2006 entries of prospective mathematics teachers used for regression analysis. That is 2012/2013 and 2013/2014 entries.

Table 3: Test result of professional written examination (COC) and College GPA.

SN		Sex	Id No	Dept	TPLWER (Y)	CGPA(X)	TPLWER(Y)
1		M	RMA/001/05	**Math**	37.44	2.27	37.44
2		M	RMA/002/05	Math	54.31	2.97	54.31
3		M	RMA/003/05	Math	43.06	2.8	43.06
4		F	RMA/004/05	Math	33.75	2.42	33.75
5		M	RMA/005/05	Math	39.5	2.67	39.5
6		F	RMA/006/05	Math	35.31	2.68	35.31
7		F	RMA/051/05	Math	31.44	2.9	31.44
8		M	RMA/007/05	Math	25.5	2.37	25.5
9		M	RMA/008/05	Math	42.4	3.07	42.4
10		F	RMA/009/05	Math	21.63	2.21	21.63
11		M	RMA/010/05	Math	45.3	2.76	45.3
12		M	RMA/011/05	Math	50.4	2.7	50.4
13		M	RMA/012/05	Math	31.5	2.3	31.5
14		M	RMA/015/05	Math	77.25	3.54	77.25
15		M	RMA/016/05	Math	24.7	2.28	24.7
16		M	RMA/017/05	Math	53.25	3.25	53.25
17		M	RMA/018/05	Math	37.5	2.35	37.5
18		M	RMA/020/05	Math	35.6	2.52	35.6
19		M	RMA/022/05	Math	28.7	2.93	28.7
20		M	RMA/023/05	Math	48.44	2.27	48.44
21		M	RMA/024/05	Math	35.4	2.74	35.4
22		M	RMA/025/05	Math	33.13	2.32	33.13
23		F	RMA/026/05	Math	34.31	2.07	34.31
24		M	RMA/027/05	Math	40.19	2.5	40.19
25		F	RMA/028/05	Math	36.5	2.27	36.5
26		M	RMA/029/05	Math	50.38	2.08	50.38
27		M	RMA/030/05	Math	30.44	2.35	30.44
28		M	RMA/032/05	Math	28	2.1	28
29		M	RMA/033/05	Math	48.56	2.3	48.56
30		M	RMA/034/05	Math	51.5	2.42	51.5
31		M	RMA/035/05	Math	40.69	2.47	40.69
32		M	RMA/036/05	Math	54.19	2.35	54.19
33		F	RMA/038/05	Math	22.69	2.3	22.69
34		M	RMA/039/05	Math	48.44	2.84	48.44
35		M	RMA/040/05	Math	27.5	2.38	27.5
36		M	RMA/041/05	Math	42.19	2.04	42.19
37		F	RMA/043/05	Math	47.44	3	47.44
38		F	RMA/044/05	Math	42.44	2.86	42.44
39		F	RMA/045/05	Math	61.34	2.5	61.34
40		M	RMA/046/05	Math	65.44	3.89	65.44
41		M	RMA/048/05	Math	29.5	2.16	29.5
42		M	RMA/050/05	Math	45.56	2.71	45.56
43		F	MAR/15/04	Math	11.75	2.12	11.75
44		F	MAR/34/04	Math	21.75	2.09	21.75
45		M	MAR/22/04	Math	23.8	2.13	23.8

46		M	MAR/01/04	Math	57.4	2.18	57.4
47		M	MAR/26/04	Math	41.63	2.35	41.63

Table 4: The result of second year prospective mathematics teachers of 2005 and 2006 entrants that is 2012/2013 and 2013/2014 entrants with respect to each recruitment and selection criteria

S.No.		Sex	ID	College GPA	Entrance Exam.	Trans. Average	EGSECE	
1		M	RMA/001/05	2.21	14.22	61.4	2.28	
2		M	RMA/002/05	2.79	17.5	63.7	3	
3		M	RMA/003/05	2.89	17.89	64.59	2.57	
4		F	RMA/004/05	2.37	15	57.97	2.14	
5		M	RMA/005/05	2.42	16	61.8	2.43	
6		F	RMA/006/05	2.32	14.78	61.2	2.14	
7		F	RMA/051/05	2.16	12.28	60.9	2	
8		M	RMA/007/05	2.26	15.17	56.1	2	
9		M	RMA/008/05	2.74	17	59.3	2.14	
10		F	RMA/009/05	1.89	10.28	60.38	2.29	
11		M	RMA/010/05	2.42	16	60.51	2.29	
12		M	RMA/011/05	2.42	13	57.52	2.29	
13		M	RMA/012/05	2.00	11.28	57.65	2	
14		M	RMA/013/05	3.16	20.22	59.08	2.29	
15		M	RMA/014/05	0.00	9	51.5	2	
16		M	RMA/015/05	3.11	19.44	71.8	2	
17		M	RMA/016/05	1.95	10	67.7	2.29	
18		M	RMA/017/05	3.32	21.17	65.05	2.14	
19		M	RMA/018/05	2.11	11.28	69.7	2.29	
20		M	RMA/019/05	0.53	8.44	52.14	2	
21		M	RMA/020/05	2.16	13	64	2.8	
22		F	RMA/021/05	0.00	7.87	51.8	2	
23		M	RMA/022/05	2.21	12.28	61.4	2.28	
24		M	RMA/023/05	2.00	13	63.6	2.14	
25		M	RMA/024/05	2.32	15	65.05	2.14	
26		M	RMA/025/05	2.37	17	63.5	2.29	
27		F	RMA/026/05	2.00	11	56.8	2	
28		M	RMA/027/05	2.68	16.22	70.5	2.29	
29		F	RMA/028/05	2.42	13	66.4	2.14	
30		M	RMA/029/05	2.00	10	62.5	2.29	
31		M	RMA/030/05	2.37	12	68.4	2.43	
32		M	RMA/031/05	0.00	7.28	56.8	2	
33		M	RMA/032/05	2.00	11.44	67.2	2.14	
34		M	RMA/033/05	2.11	14.65	61.4	2.29	
35		M	RMA/034/05	2.26	13.33	60.5	2	
36		M	RMA/035/05	2.53	16	62.5	2	
37		M	RMA/036/05	2.05	11.22	58.8	2	
38		F	RMA/037/05	0.00	6.44	50.3	2	
39		F	RMA/038/05	2.00	11.78	61.8	2	
40		M	RMA/039/05	2.32	17	63.75	2.29	
41		M	RMA/040/05	2.74	19.17	69.7	2.29	
42		M	RMA/041/05	1.89	13	56.2	2	
43		M	RMA/042/05	1.89	9.44	58.36	2.14	
44		F	RMA/043/05	2.63	13	80.6	3	
45		F	RMA/044/05	2.11	12	62.5	2	
46		F	RMA/045/05	2.32	15	68.4	2	
47		F	RMA/052/05	0.00	5.89	51.2	2	
48		M	RMA/046/05	3.58	22.28	70.5	2.57	
49		F	RMA/047/05	1.26	11	50.8	2	
50		M	RMA/048/05	2.37	17	62.8	2.29	
51		M	RMA/049/05	1.26	8.44	52.2	2	
52		M	RMA/050/05	2.74	14.89	68.8	2.14	

53		F	MAR/40/04	1.50	9.11	50.3	2	

			ID No	College GPA	Entrance Exam	Transcript Average	EGSECE Result
1		M	Rdip/026/06	3.82	17.5	73	2.17
2		M	Rdip/022/06	3.47	14	67.66	2.71
3		M	Rdip/027/06	2.41	10.5	60.89	2.29
4		M	Rdip/031/06	2.35	12.44	69.52	2.29
5		M	Rdip/044/06	3.53	12.44	78.87	3
6		F	Rdip/048/06	2.59	14.78	77	2.43
7		M	Rdip/061/06	2.59	14.78	80.4	2.57
8		M	Rdip/066/06	2.47	12.83	73.2	2.14
9		F	Rdip/086/06	3.00	17.89	75.15	2.28
10		M	Rdip/121/06	3.29	12.06	72	2.75
11		M	Rdip/127/06	3.06	14.78	71.3	3.14
12		M	Rdip/155/06	2.71	15.17	58.75	2.57
13		M	Rdip/157/06	3.71	12.06	62.64	2.57
14		F	Rdip/162/06	3.18	11.28	83.42	2.14
15		F	Rdip/181/06	2.88	11.67	62.56	2.43
16		M	Rdip/191/06	2.65	13.61	65.53	2.42
17		F	Rdip/197/06	2.76	13.22	69.95	2
18		F	Rdip /204/06	3.35	15.17	61.2	2.58
19		M	Rdip /225/06	2.29	8.56	69.35	2.28
20		M	Rdip /236/06	3.88	19.44	89.3	3.71
21		M	Rdip /291/06	2.76	16.72	68.9	2.14
22		M	Rdip /309/06	2.47	11.67	64.5	3
23		F	Rdip /311/06	2.29	12.06	65.18	2.14
24		F	Rdip /312/06	2.24	10.5	65.18	2.14
25		F	Rdip /313/06	3.53	17.11	70.32	3.03
26		M	Rdip /321/06	2.88	8.94	65.42	2.29
27		M	Rdip /344/06	2.53	15.17	62.59	2.57
28		F	Rdip/373/06	2.47	13.61	67.1	2.14
29		M	Rdip/383/06	2.41	12.83	65.25	2.57
30		M	Rdip/384/06	2.88	13.22	66.23	2.57
31		F	Rdip/425/06	2.29	7.78	66.46	2.71
32		F	Rdip/426/06	3.06	13.22	60.71	2.43
33		M	Rdip/444/06	2.94	15.94	65.25	2.43
34		M	Rdip/483/06	2.65	9.33	65	2.57
35		M	Rdip/498/06	2.94	14.39	63.45	2.43
36		F	Rdip/499/06	3.06	17.89	68.91	2.43
37		M	Rdip/505/06	2.76	19.06	65.2	2.43
38		M	Rdip/508/06	2.88	15.56	64	2.29
39		M	Rdip/511/06	2.88	12.83	62.56	2.57
40		M	Rdip/550/06	2.71	20.22	63.53	2.57
41		M	Rdip/522/06	2.88	18.67	60.57	2.82
42		F	Rdip/533/06	3.71	10.89	63.54	3.25
43		M	Rdip/547/06	2.59	11.28	59.57	2.28
44		F	Rdip/567/06	3.41	15.17	62.87	2.7
45		M	Rdip/572/06	3.06	12.44	61.75	2.29
46		M	Rdip/579/06	2.41	9.72	64	2.29
47		M	Rdip/592/06	2.47	19.06	65	2.86
48		M	Rdip/604/06	3.71	17.89	64.78	3.12
49		F	Rdip/606/06	2.47	11.67	60.45	2.14
50		F	Rdip/607/06	2.53	12.44	57.85	2.29
51		F	Rdip/610/06	3.12	11.67	51.18	2.89

Appendix M: Course outlines used for documentary/text analysis.

X. Course Descriptions

Course Title - **Basic Mathematics I**

Course Code - **Math 101**

Prerequisite - **None**

Credit hours - **3**

Contact hours - **4**

Requirements - **Required for all Maths, Chemistry and Physics major diploma students**.

Course description:

In this course: Logic and set theory, Binary operation and numeration systems, Reline system, Algebraic expression; Equation and inequalities, Absolute value, exponents and radicals, relation and functions are thoroughly treated.

Course objectives

At the end of this course students should be able to:

- Use the concepts of logic and set theory in solving problems
- Describe the properties of binary operations
- Compare different n$^{\underline{o}}$ systems
- Solve equations and inequalities
- Understand the concept of relations and functions

Course content

Unit I. Logic and set theory

1.1 Introduction to logic

1.1.1 Propositions and prepositional connectives, 1.1.2 Truth tables and their applications, 1.1.3 Open Prepositions and quantifiers, 1.1.Mathematical proof

1.2 Set Theory

1.2.1 Basic nations of set, 1.2.2Set operation and their properties , 1.2.3 Application of set theory

Unit II. Binary operation and numeration system

2.1 Binary operations, 2.1.1 Definition of binary operation, 2.1.2 Properties of a binary operation, 2.2 Numeration 2.2.1 Numbers and numerals, 2.2.2 Different bases, 2.2.3 Computation with different bases

Unit III. Real number system

3.1 The set of natural numbers (N)

3.1.1 Operation and their properties, 3.1.2 Primes, composites and divisibility test

3.1.3 Factorization

3.2 The set of integers

3.2.1 Operation on Z and their properties, 3.2.2 Order property

3.3 The set of rational numbers

3.3.1 Operation on Q and their properties, 3.3.2 Order property

3.3.3 Decimals, percent, ratio and proportion

3.4 The real number system

3.4.1 Operation on the real numbers and their properties, 3.4.2 Intervals

3.4.3 Completeness property

Unit IV. Algebraic expression, equations and inequalities, the Absolute value

4.1 Simplification of Algebraic expressions

4.2 First and second degree equations

4.2.1 Linear (1^{st} degree) equations, 4.2.2 Quadratic (second degree) equations

4.3 Inequalities of first and second degree

4.3.1 Linear inequalities, 4.3.2 Quadratic inequalities

4.4 The absolute value

4.4.1 Definitions and properties of absolute value

4.4.2 Equations and inequalities involving absolute value

Unit V. Relations and functions

5.1 Relations

5.1.1 Cartesian product, 5.1.2 Domain and range of relations, 5.1.3 Graphs of relations

5.1.4 Inverse of a relation

5.2 Functions

5.2.1 Definitions of functions, 5.2.2 types of functions, 5.2.3 combinations & compositions of functions, 5.2.4 inverse of functions

Methods of instruction

- Lecture, Problem solving approach, Inductive and Deductive approach, Heuristic approach

Methods of Assessment

1. Project work and assignment 20%
2. quiz and tests 20%
3. Midterm Examination 20%
4. Final Examination 40%

References

1. Mathematics Textbook grades 9-10
2. Alemayehu Haile and Yismaw Alemu: Introductory Mathematics

Basic Mathematics II

Course Code - **Math 102**

Prerequisite - **Math 101**

Credit hrs - **4**

Contact hrs - **5**

Requirements - **Required for all Maths, Chemistry and Physics major diploma students**.

Course description

In this course, polynomial functions, Rational expression and rational functions, Exponential and logarithmic functions, trigonometric functions, coordinate geometry and complex numbers are thoroughly treated.

Course objectives

At the end of this course students should be able to:

- Define polynomial functions
- Determine roots of polynomial functions
- State properties of the rational functions and draw their graphs
- Compute with logarithms
- State properties of exponential and logarithmic functions
- State basic trigonometric identities
- Solve problems involving trigonometry
- Draw graphs of trigonometric functions

Course content

Unit I. Polynomial functions

1.1 Polynomial functions and their graphs

1.2 Theorems on polynomials; Remainder, Factor, Location, roots of polynomials.

Unit II. Rational Expression and Rational Functions

2.1 Rational expressions and working with rational expression

2.2 Rational equations and inequalities

2.3 Graphs of rational functions

Unit III. Exponential and Logarithmic functions

3.1 Exponents and radicals

3.1.1 Rules of exponents

3.1.2 Exponential functions and their graphs

3.2 Logarithms

3.2.1 Rules of logarithms, 3.2.2 Logarithmic functions

3.2.3 Application of exponential and logarithmic functions

Unit IV. Trigonometric functions

4.1 The six trigonometric functions and their properties

4.2 Graphs of trigonometric functions

4.3 Trigonometric identities

4.4 Double Angle, halt angle formulas

4.5 Solving problems involving trigonometric equations, 4.6 Solving triangles

Unit V. Complex numbers

5.1 The concept of complex numbers

5.2 Fundamental operations with complex numbers

5.3 Conjugates and modules of complex numbers

5.4 Simplifications with complex numbers

5.5 Geometrical representation of complex number sin the coordinate plane

Method of Instruction

- Active learning approach, Problem solving approach, Inductive and Deductive approach
- Heuristic approach

Methods of Assessment

1. Project work and assignment 20%
2. quiz and tests 20%
3. Midterm Examination 20%
4. Final Examination 40%

References

1. Mathematics text book grades 11-12
2. Alemayehu Haile and Yismaw Alemu : Introductory Mathematics

Course Title - Plane Geometry

Course Code - Math 111

Prerequisite - None

Credit Hours - 3

Contact hours. - 4

Requirements - **Required for all Maths, Chemistry and Physics major diploma students**.

Course Description: In his course basic concepts such as, points; lines; Planes; triangles; congruency and similarity of polygons; area and perimeter of polygons; Pythagoras' theorem; basic constructions, Circles; arcs, chords, tangent lines, secant lines, segments and sector of a circle; central angles and their measures; area of segment and of a sector; radian measure of an angle will be treated.

Course Objectives

At the end of the course each student should be able to:-

- Define basic concepts such as points; lines and planes
- Use axioms, postulates and theorems to prove congruencies and similarity of triangles
- Use formulas to find area and perimeters of polygons
- Apply Pythagorean theorem
- Know basic constructions
- Identify the relation between circles, lines and angles
- Find the area of circles, sectors, and segments of a circle

Course Contents

Unit I Undefined Terms, Definitions And Axioms

1.1 The undefined terms: - Point, Line, Plane

1.2 Definition: Line segment, half-lines, half-plane, angle, Exterior and interior of an angle, adjacent and vertical angles.

1.3 Axioms

- 1.3.1 Axioms on connection
- 1.3.2 Axioms of order
- 1.3.3 Axioms on congruency
- 1.3.4 Axioms on parallel lines
- 1.3.5 Axioms on continuity of a line
- **1.3.6** Axiom of completeness

Unit II Measurement and Units of Measurement

- 2.1 Definition
- 2.2 Units of measurement of length
- 2.3 Units of measurement of angles
- 2.4 Some postulates about angles
- 2.5 Units of measurement for area of plane figure

Unit III Triangles

a. Definition of triangles

b. Types of triangles

i. Equilateral, Isosceles, Scalene and a right angled triangles

3.2.2 Definition of altitudes and medians of a triangle

c. Congruence of triangles:

i. Definition of congruent triangles

ii. Congruence theorems for triangles, namely: ASA, SSS, AAS, and RHS

iii. Examples of application of the congruence theorems

3.4 Theorems on concurrence of:

- 3.4.1 Perpendicular side bisectors of a triangles
- 3.4.2 Bisectors of angles of triangles
- 3.4.3 Altitudes and medians of a triangle

3.5 Similarity of triangles:

- 3.5.1 Some properties of parallelogram
- 3.5.2 Theorems on proportional divisions of sides of a triangle and a parallel projection
- 3.5.3 Definition of similar triangles
- 3.5.4 Examples and applications of similar triangles
- 3.5.5 Pythagoras theorem

Unit IV Polygons

4.1 Definition of a polygon, interior and exterior angles of a polygon, perimeter of a polygon, convex and concave polygons, diagonals of a polygon, equiangular, equilateral, regular, congruent and similar polygons.

4.2 Congruence theorem on perpendicular side bisectors of a regular polygon

4.3 Quadrilaterals: trapezium, parallelogram, rectangle, rhombus.

4.4 Area of polygons:

- 4.4.1 Area postulates
- 4.4.2 Area formulae for:
  - 4.4.2.1 Rectangles, triangles, Parallelograms
  - 4.4.2.2 Trapeziums and regular polygons
  - 4.4.2.3 Area of similar polygons

4.5 Regular polygons and circles

Unit V Basic Constructions

- 5.1 Copying an angle and a line segment
- 5.2 Bisection a given angle and a line segment
- 5.3 Dropping a perpendicular line to a given line through a given point. Not on the line
- 5.4 Construction of the common polygons and regular polygons
- 5.5 Construction of special angles 30^0,60^0, 45^0, 90^0
- 5.6 Construction of a triangle that has an area which is equal to the area of a given quadrilateral.

Unit VI Circles

a. Definition of chords, arcs, secant and tangent lines, sectors and segments of a circle, central and inscribed angles and arc length.

6.2 Circumference and area of circle sector and segment.

6.3 Relationships between arc measures and angles formed by lines

Intersecting inside or outside circles.

6.4 Radian measure of angles
6.5 Definition and dependence of the radian measure on the radius of the circle

6.6 Transformation of degree measure to radian measure and vice versa.

Methods of Instruction

Active learning strategy

- Modified lecture, Inductive and deductive approach, Heuristic approach, Assignment method

Methods of Assessment

1. Project work and assignment 20%
2. quiz and tests 20%
3. Midterm Examination 20%
4. Final Examination 40%

References

1. Smart Introductory Geometry
2. Moise Elementary Geometry from advanced stand point
3. Ministry of Educ. Geometry C3
4. Ministry of Educ. Geometry C2
5. Euclidean plane Geometry, An Introductory course by Proff. Alemayehu Haile.

Course title - Introduction to Calculus

Course Code - Math 162

Prerequisite - Math 102

Credit hrs - 3

Contact hrs - 4

Requirements - Required for Maths majors diploma programme.

Course description

In this course review on functions, trigonometric functions, limits and continuity; derivatives and its applications; integration and its applications will be treated.

Course Objectives

At the end of the course each student should be able to:-

- Write the definition of every important term that appears in the course
- State and give examples of important theorems such as the mean value theorem, the fundamental theorem of calculus etc.
- Apply the different techniques of differential and integral calculus to investigate the quality and geometrical properties of the elementary functions.
- Formulate and solve properties of the elementary functions
- Formulate and solve practical problems in related rates and extreme values.

Course Content

UNIT I coordinate geometry

a. distance formulae
   i. distance between two points
   ii. distance between a point and a line
   iii. distance between two lines
   iv. dividing a line segment in a given ratio
b. equation of a line

i. two point equation of a line
ii. point – slope equation of a line
iii. point – intercept equation of a line
iv. general form of equation of a line

c. circle

Unit II Limit and Continuity

2.1 Definition of limits, 2.2 Limit theorems, 2.3 Limit at infinity, 2.4 Infinite limits, 2.5 Asymptotes

2.6 Continuity

2.6.1 Continuity of functions, **2**.6.2 One - sided continuity

2.7 Two important limits: $\lim_{x \to 0} \frac{\sin x}{x}$ and $\lim_{x \to \infty} \left(1 + \frac{1}{x}\right)^x$

Unit III Differentiation

3.1 Definition of the derivative, 3.2 Geometric significance of the derivative

3.3 Continuity and differentiability, 3.4 differentiation formulas, 3.5 The chain rule

3.6 Derivative of logarithmic and exponential functions

Unit IV. Applications of the derivative

4.1 Extreme/absolute and local/of a continuous functions

4.2 Rolle's theorem and the mean value theorem

4.3 Monotonic functions

4.4 First and second derivative tests

4.5 Maximum and minimum value of a function, 4.6 Rate of change, 4.7 curve sketching

Unit V. Integration

5.1 Anti derivative and indefinite integrals

5.2 Integration of simple trigonometric and exponential functions

5.3 Some techniques of integration,

5.3.1 Integration by substitution, 5.3.2 Integration by parts, 5.3.3 Integration by partial fraction

5.4 The definite integral, 5.5 The fundamental theorem of calculus, 5.6Change of variables

Unit VI. Application of integration

6.1 Area, volume and work done

Methods of instruction

- Active learning strategies, Inductive and deductive approach, Heuristic approach
- Assignment Method, Project Methods

Methods of Assessment

1.	Project work and assignment	20%
2.	quiz and tests	20%
3.	Midterm Examination	20%
4.	Final Examination	40%

References

- Mathematics an introductory course by Alemayehu Haile and Yismaw Alemu
- A first course in Calculus, by Abiy Kifle and Bisrat Dilnesahu
- A Primer for Calculus, 4th edition by Leonard I – Holder
- Analytic geometry, by Abera Abay

Course Title - **Solid Geometry**

Course Code - **Math 112**

Prerequisite - **Math 111**

Credit hrs - **3**

Contact hrs - **4**

Requirements - **Required for Maths majors diploma programme**.

Course Description

In this course preliminaries and definition of terms in solid geometry; lines and planes in space; locating the position of a point in space; the common solids and their classifications; their surface area and volumes, the regular polyhedral; solid of revolution and their surface area and volumes will be treated.

Course objectives

At the end of the students is expected to:-

- Define terms in solid geometry
- Know how to relate plane geometry with solid geometry
- Classify the common solids
- Identify the regular polyhedron
- Calculate the volume and surface area of solids
- Understand about
- Solids of revolutions

Course Contents

UnitI. Preliminaries and definitions of terms in solid geometry

1.1 Point, line, plane, skew lines, 1.2 solid geometry, space and surface

1.3 Solid angles and dihedral angles

Unit II. Line and planes in space

2.1 Parallel lines and planes in space, 2.2 Perpendicular lines and planes in space

2.3 Some basic theorems online and planes in space

2.4 Locating position of a point in space with the help of axes of reference

Unit III. The Common Solids

3.1 Definition and classification of the common solids such as polyhedron, cuboids, prisms, pyramids, parallelepiped, etc.

3.2 Surface areas and volumes of the common solids

3.3 Frustum of pyramids and cones

3.4 Solid revolutions

3.4.1 Cylinders

3.4.2 Cones

3.4.3 Spheres

3.4.4 Volumes and surface areas of solids revolution

Unit IV. The regular polyhedron

4.1 The regular tetrahedron

4.2 The regular hexahedron

4.3 The regular octahedron

4.4 The regular dodecahedron

4.5 The regular icosahedrons

Methods of Assessment

1.	Project work and assignment	20%
2.	quiz and tests	20%
3.	Midterm Examination	20%
4.	Final Examination	40%

Methods of instruction

- Active learning strategy

- Modified lecture, Assignment method, Project method, Inductive and deductive approach
- Heuristic approach

References

– A school Geometry part VI: by H.S.Hall and F.H.Steven
– Mathematics Secondary C Four (Old Edition) Ministry of education
– Elementary geometry from an advanced stand point by E. Moise

Course Title - Fundamental Concept of Algebra

Course Code - Math 221

Prerequisite - Math 101

Credit hrs - 3

Contact hrs - 4

Requirements - Required for Maths majors diploma programme.

Course Description

In this course we treat elementary mathematical logic, basic set theory, algebraic structures, integers, elementary number theory, rational numbers and the real number system.

Course Objective

At the end of the course students will be able to:-

- Use rule of logic, argument, and inference in proving and disproving propositions
- Define and give examples of the basic algebraic structures, like group and rings.
- state the common properties and inter relationships of the usual number system

Course Contents

Unit I. Mathematical logic

1.1 Prepositional logic

1.2 Predicate logic, 1.3 Quantifiers, 1.4 Arguments, validity and rules of inference

1.5 Mathematical proofs, 1.6 A brief historical survey of classical and non classical logic

Unit II. Set theory

2.1 Set and set operations, 2.2 ordered pairs, relations, 2.3 Partial order relations

2.4 Function/ mappings/, inverse mapping, 2.5 Composition mappings

2.6 Classification of sets and cardinality

Unit III. Algebraic Structures

3.1 Binary operations, 3.2 Algebraic structures, 3.3 Morphisms and isomorphisms

3.4 Groups and Rings, 3.5 Definition and examples of field.

3.6 Equivalent relations and quotient structures

Unit IV. The system of integers

4.1 Algebraic properties, 4.2 Well-ordering axiom, 4.3 Mathematical induction

4.4 Ordered integral domain and characterization of the system of integers

Unit V. Elementary theory of numbers

5.1 Division and division algorithm, 5.2 Different bases, 5.3 The G.C.D. 5.4 Euclidean algorithm and application of G.C.D, 5.5 The L.C.M, 5.6 The unique factorization domain

Unit VI. The rational number

6.1 Construction Q, 6.2 Algebraic properties of Q, 6.3 Decimal expansion of the rationales

6.4 Existence of irrational numbers, 6.5 The real numbers

Methods of instruction

- Active learning approach
  Modified lecture, Problem solving approach, Analytic and synthetic approach, Assignment method, Project method, Inductive and deductive method, Heuristic approach

Methods of Assessment

1. Project work and assignment 20%
2. quiz and tests 20%
3. Midterm Examination 20%
4. Final Examination 40%

References

1. Fundamental concept of algebra (Text)
2. Set theory and related topic: Schaums
3. Set theory and logic: R.R. Stoll
4. Abstract algebra, a first Course: Larry Joel Goldstein
5. Discrete Mathematics: B.S. Vatssa

Course Title - Elementary Linear Algebra

Course Code - Math 222

Prerequisite - Math 221

Credit hrs - 3

Contact hrs - **4**

Requirements - **Required for Maths majors diploma programme**.

Course Description In this course we treat geometric vectors; abstract spaces, matrices and determinants, linear transformations, Eigen Values and Eigen Vectors.

Course Objectives

At the end of the course each student should know:-

- About geometric vectors
- About matrix and determinants
- How to prove dependence and independence of vectors
- About linear transformation
- About Eigen Vectors and Linear Dependence

Course contents

Unit 1. Geometric vectors

1.1 Definition and properties of points in space

1.2 Located vectors, 1.3 Scalar product, 1.4 The norm of vector, 1.5 Lines and planes, 1.6 The cross-product,
1.7 Complex numbers and properties of complex N$^{\underline{o}}$s

Unit II Vector spaces

2.1 The axioms of vector spaces, 2.2 Sequence changed subspaces, 2.3 Combinations

Dependence and independence of vectors; Bases of a vector space and dimension of a vector space, 2.4 Sums, direct sums and direct products

Unit III. Matrices and determinants

3.1 Matrices

3.1.1 Definitions and examples of matrices, 3.1.2 The algebra of matrices, 3.1.3 Types of matrices, 3.1.4 Elementary raw operations, 3.1.5 Echelon-Matrices, 3.1.6 Matrix form of system of linear equations

3.2 **Determinants**

3.2.1 Def. Of determinants, 3.2.2 Properties of determinants, 3.2.3 Adjoint of a matrix

3.2.4 Cramer’s rule

Unit IV Linear Transformations

4.1 Definition. Of linear transformation
4.2 Properties of linear transformations
4.3 The kerned & image of a linear transformation
4.4 Algebra of linear transformation
4.5 Matrix representation of a linear map

Methods of instruction

- Active learning approach

Assignment method, Project method, Problem solving method, Modified lecture, Inductive and deductive approach

Methods of Assessment

1. Project work and assignment 20%
2. quiz and tests 20%
3. Midterm Examination 20%
4. Final Examination 40%

References

Text - Lang. Linear Algebra, 3rd ed.

References - Linear Algebra, Schaums out line series

Course Title - **Calculus I**

Course Code - **Math 261**

Prerequisite - **Math 162**

Credit hrs - **4**

Contact hrs - **5**

Requirements - **Required for Maths majors diploma programme**.

Course Description

Initiative approach of limits and continuity, differentiation and applications, calculus of exponential, logarithmic, trigonometric, inverse trigonometric, and hyperbolic functions.

Course Objectives

At the end of this course students are expected to:-

- Develop basic Concepts, Principles and techniques of differential and integral calculus.
- Investigate and analyze the analytic and geometrical properties of the elementary functions.
- Formulate and solve practical problems in related terms for ratio and extreme values.

Course Contents

Unit I. Limit and continuity

1.1 Definition of limit, 1.2 Some examples, 1.3 Basic limit theorems, 1.4 One sided limits, 1.5 Definition of continuity, 1.6 Continuous functions and their properties, 1.7 The intermediate value theorem, 1.8 Limit at infinity

Unit II. Derivatives

2.1 Definition of derivatives, 2.2 Differentiable functions and differentiation on intervals

2.3 Derivatives of combination of functions, 2.4 The chain Rule, 2.5 Higher derivatives

2.6 Implicit differentiation, 2.7 related rates

Unit III. Mean value Theorem and its applications

3.1 Max-Min theorem (Extreme value theorem)

3.2 Graphical discussion of the hypothesis of the max-min theorem

3.3 Rolle's and the Mean value theorem

3.4 Applications

3.5 Monotonic functions

3.6 The first and second derivative tests

3.7 Extreme value problems

Unit IV. The integral

4.1 Partition, upper sums and lower sums

4.2 The definite integral

4.3 Properties of definite integral

4.4 The fundamental theorem of calculus

4.5 Indefinite integrals and integration rules

4.6 The natural logarithmic function

Unit V. Techniques of integration

5.1 Integration by parts, 5.2 Integration by substitution, 5.3 Integration by partial fraction, 5.4 Trigonometric integrals, 5.5 Integration by trigonometric substitution

5.6 Numerical approximation

5.6.1 The trapezoid rule

5.6.2 The Simpson's rule

Methods of Instruction

Active learning approach, Problem solving approach, Inductive and deductive approach, Heuristic approach, Assignment method, Project method

Methods of Assessment

1. Project work and assignment 20%
2. quiz and tests 20%
3. Midterm Examination 20%
4. Final Examination 40%

Text Book

- Ellis, calculus 3rd edition

References

- Johnson, calculus with analytic geometry 6th edition
- Edwards & Penny, calculus and analytic geometry: prentice -Hall inc; 1990

Course Title - Calculus II

Course Code - Math 262

Prerequisite - Math 261

Credit hrs - 4

Contact hrs - 5

Requirements - **Required for Maths majors diploma programme**.

Course Description:-

In this course techniques of integration; integration by parts, trigonometric integrals, partial fractions, Reimann sums and Reimann integrals, the trapezoid rule and Simpson's rule, improper integral and application of integration, Taylor's formula, partial differentiation, sequences and series; alternating series and absolute convergence will be treated.

Course Objectives

At the end of the course the students will able to:-

- Identify the different techniques of integration
- Investigate and master some application of the integration such as area, volumes, are length etc, and learn how to derive some formulas.
- define sequence and series and determine whether a sequence is convergent or divergent.

Course content

Unit I. Application of the integral

1.1 Area 1. 2. Volume 1.3Ave length 1.4 surface area 1.5 work

Unit II. Inverse functions and their derivatives

2.1 Inverse trigonometric function

2.2 Derivative inverse trigonometric functions

2.3 The general exponent ion and logarithmic functions and their derivative

2.4 Hyperbolic functions and their derivatives

Unit III. Indeterminate forms, indeterminate forms and Taylor's formula

3.1 Cauchy's formula, 3.2 Indeterminate forms, 3.3 Improper integral

3.4 Taylor's formula, 3.5 Approximation by Taylor's polynomials

Unit IV. Sequence and series

4.1 Sequence, 4.2 Convergence properties of the sequence, 4.3 Properties of infinite series, 4.4 Tests for convergence, 4.4.1 The integral test, 4.4.2 The comparison test, 4.4.3 The limit comparison test, 4.4.4 The ratio test, 4.4.5 The root test,

4.5 Alternating series of absolute convergence, 4.6 Power series, 4. 7, Taylor's series

4.8 Binomial series

Suggested methods of instruction

- Active learning approach
  - Modified lecture
  - Problem solving approach
  - Inductive and deductive approach
  - Assignment method
  - Project method
  - Heuristic approach

Methods of Assessment

1. Project work and assignment 20%

2. quiz and tests 20%
3. Midterm Examination 20%
4. Final Examination 40%

Text

Calculus with Analytic Geometry By Ellis and Gullic

References

- The Calculus with Analytic Geometry By Johnson and Kikomester
- Calculus with Analytic Geometry By Leithold
- Calculus with Analytic Geometry By Edwards and Penny

Course Title - **Introduction to Probability and Statistics**

Course Code - **Math 272**

Prerequisite - **Math 101**

Credit hrs - **3**

Contact hrs - **4**

Requirements - **Required for Maths majors in the linear diploma programme**.

Course Description

In this course introduction to statistics, sampling theory, data collection, data presentation, measure of central tendency, measures of variation, simple linear regression and correlation and elementary probability will be treated.

Course Objective

At the end of the course students are expected to:-

- Use the concepts developed in this course in their particular disciplines
- Handle, analyze and express information by using the concepts of statistics and probability in their schoolwork.

Course contents

Unit I. Introduction

1.1 Definition of statistics, 1.2 Classification of statistics, 1.3 Application of statistics

Unit II. Sampling theory

2.1 Basic concepts; universe, sample, census, parameter, statistic, etc....

2.2 Principal steps in sample surveys, 2.3 Reasons for sampling

2.4 Techniques of sampling

Unit III. Data collection

3.1 Classification of data, 3.2 Methods of data collection

3.3 Design of schedules and questionnaires

Unit IV. Data presentation

4.1 Tabular methods of data presentation

4.1.1 Frequency distributions; absolute, relative and cumulative distributions

4.2 Graphic methods of data presentation

4.2.1 Histograms, 4.2.2 Polygons, 4.2.3 Ogive curves

4.2.4 Pie charts, bar charts and pictograms

Unit V. Measure of central tendency

5.1 Mean

5.1.1 Use of summation notation

5.1.2 Arithmetic mean and its properties

5.1.3 Weighted arithmetic mean

5.1.4 Geometric mean

5.1.5 Harmonic mean

5.1.6 Empirical relation between arithmetic, geometric and harmonic means

5.2 Median

5.2.1 Quartiles

5.2.2 Deciles

5.2.3 Percentile

5.3 Mode

Unit VI. Measures of variation and other descriptive measures

6.1 Range, interqurtile range, semi interqurtile range, mean deviation

6.2 Variance and standard deviation

6.3 Properties of variance and standard deviation

6.4 Measures of relative variation

6.4.1 Coefficient of variation

6.4.2 Standards scores

6.5 Measures of skewness and peakedness

6.5.1 Moments, 6.5.2 Coefficients if skewness, 6.5.3 Kurtosis

Unit VII. Simple linear regression and correlation

7.1 Linear regression

7.1.1 Curve fitting, 7.1.2 The method of least squares

7.2 Linear correlation

7.2.1 The coefficient of correlation, 7.2.2 Rank correlation,

7.2.3 Interpretation

Unit VIII. Elementary probability

8.1 Basic concepts; experiment, sample space, event etc...

8.2 Probability of an event, 8.2.1 counting principles

8.3 The addition rule, 8.4 Independent events, 8.5 Conditional Probability

8.6 Probability distributions (General)

8.6.1 Binomial distribution, 8.6.2 Normal distribution

Suggested methods of instruction

- Active learning approach

Problem solving approach, Assignment method, Project method, Modified lecture

Methods of Assessment

1.	Project work and assignment	20%
2.	quiz and tests	20%
3.	Midterm Examination	20%
4.	Final Examination	40%

References

1) Asthana, B.N. Elements of Statistics. Chaitanaya Pub. House, 1981.
2) Ball, Alan & Buckwell, Geoff. Workout Statistics, Macmillan, 1991.
3) Gupta, C.B. An Introduction to Statistical Method, New. Delhi. Vikas Pub. House,1982.
4) Hannagan, T.J. Mastering Statistics. and ed. London. Macmillian, 1986.
5) Harper, W.M. Statistics. 3rd ed. London. Mcdonald & Evans, 1977.
6) Kapur, J.H, Saxena, H.C. Mathematical Statistics. 12th ed. New Delhi. S. Chand & Company Ltd., 1984.
7) Kazimer, L.J. Theory & Problems of Probability & Statistics. New York. McGraw-Hill Book Company, 1976.
8) Spiegel, M.R. Theory & Problems of Probability & Statistics. Singapore. Mcgraw-Hill Book Company, 1982.

Course Title - Methods of Teaching Mathematics

Course Number - TeMa 242

Prerequisite - None

Credit Hours - 2

Contact Hours - 2

Classification: - Required for Maths, physics and chemistry majors in the linear diploma programme.

Course Description:

This is a mathematics methodology course designed to help prospective teachers handle effective teaching and learning process in mathematics. It mainly deals with strategies of treating mathematics topics in upper primary level (5-8 grades).

In this course, topics like the meaning of mathematics, objectives of teaching math in the our schools, theoretical and practical suggestions on the treatment of grades 5-8 mathematics will be discussed. Relationships among the Syllabus, Teacher's guide and Student's text book, techniques of planning a mathematics lesson and assessment of student's performance are also topics to be treated in the course.

Course Objectives:

At the end of the course trainees would be able to:-

- Explain the meanings given to mathematics at different times in the history of its development.
- State core objectives of teaching mathematics in the Ethiopian schools.
- Describe the relationships and differences among the Syllabus, Teacher's guide and Student's text book.
- Compare and contrast traditional teaching with other active learning strategies.
- Explain the importance of applying varieties of active learning strategies to ensure understanding.
- Apply specific active learning strategies in treating specific topics of school mathematics.
- Develop a workable annual, weekly and daily lesson plans.
- Acquaint themselves with topics of grades 5-8 mathematics.
- Develop and use various Formative and Summative Continuous Assessment (FCA & SCA) techniques to improve students' learning and grade them.

Course Contents:

Chapter I Introduction

1.1. The meaning of Mathematics and its brief historical development.
1.2. Why do students learn mathematics in schools (Objectives?)
1.3. The mathematics Syllabus, Teacher's guide and Student's text book.

Chapter II Methods of teaching school mathematics

2.1. How do students learn? (Behaviourists Vs Constructivists view)

2.2. Traditional Vs Active learning methods.

(**Examples from grades 5-8 mathematics will be considered while discussing the methods given bellow:**)

2.2.1. Teacher's talk, explanation, demonstration

2.2.2. Interactive (Gap) lecture

2.2.3. Guided discovery /Inductive or inquiry approach/

2.2.4. The technique of small group learning.

Lecture summary, Summarizing reading assignments, Problem solving, Brainstorming

2.2.5. Field experience and Field work.
2.2.6. Presentation learning (In class presentation & peer teaching)

Chapter III Planning mathematics lessons

3.1. What is a lesson plan and why do we plan lessons

3.2. The annual, weekly and daily lesson plans

3.3. Sample lesson plans

Chapter IV Assessing students' learning

4.1. Assessment, Evaluation and Action

4.2. What is Continuous assessment (CA)?

4.2.1. Formative Continuous Assessment (FCA)

4.2.2. Summative Continuous Assessment (SCA)

Suggested Summative Methods of assessment

- Three individual written assignments on applying specific active learning strategies for specific topics in math 30%
- One individual assignment on lesson preparation 10%
- Class room participation (activity) 5%
- 3 formal tests 30%
- Final examination 25%

References:-

1. Aggarwal S.M. A Course in Teaching of Modern Mathematics
2. Burger M. Mathematics for Elementary Teachers
3. Grades 5-8 Mathematics syllabus
4. Grades 5-8 Teacher's guide
5. Grades 5-8 Students' Textbook
6. Lovell K. The Growth of Basic Mathematics & Scientific Concepts in Children
7. Polya G. How to Solve it
8. Polya G. Mathematical Discovery
9. Scopes P.G. Mathematics in Secondary Schools (A teaching approach)
10. William H. Exploring Mathematics on Your own

Course Title - **Applied Mathematics I**

Course Code - **Math 231**

Prerequisite - **Math 162**

Credit hrs - **4**

Contact hrs - **5**

Requirements - **Required for Physics and Chemistry majors in Linear diploma programme**.

Course Description

In this course formal definition of limits and continuity, the derivative, application of the derivative, inverse functions and their derivatives, the integral, techniques of integration and application of the integral will be discussed.

Course Objectives

By the end of this course the student should be able to

- Write the definitions of every important term that appears in the course
- State and give examples of important theorems such as The Mean Value Theorem and The Fundamental Theorem of Calculus
- Apply the different techniques of differential calculus to investigate the analytic and geometric properties of elementary functions
- Formulate and solve practical problems in related rates and extreme values
- Integrate elementary functions
- Apply techniques of integration in solving practical problems

Course Content

Unit I. **Analytic Geometry**

1.1 Circle, 1.2 Parabola , 1.3 Translation of Axes, 1.4 Ellipses, 1.5 Hyperbola

Unit II. **Limit & Continuity**

2.1 Limit and continuity of a function at a point, 2.2 Limit of a function at infinity

2.3 Limit Theorems and Limit Calculations, 2.4 Two remarkable limits, 2.5 Asymptotes

2.6 Continuity on an interval, 2.7 Intermediate value theorem and its application

Unit III. **Derivatives**

3.1 Derivative

3.2 Drawing a tangent line to the graph of a function & Instantaneous velocity of rectilinear motion

3.3 Approximate computation of values of functions

3.4 Rules of differentiation

3.5 Higher Order Derivatives

3.6 Related Rates

Unit IV. **Applications of the derivatives**

4.1 Extreme of a function, 4.2 Mean Value Theorem , 4.3 Monotonic Functions

4.4 First and Second Derivative Tests, 4.5 Concavity and Inflection Points,

4.6 Curve Sketching, 4.7 Application of Extreme

Unit V: Inverse Functions

5.1 Definition of Inverse Functions, 5.2 Continuity and Differentiability of Inverse Functions, 5.3 The Natural Exponential Function, 5.4 General Exponential and Logarithmic Functions , 5.5 Exponential Growth , 5.6 Inverse Trigonometric Function

5.7 Hyperbolic Functions & their Inverses , 5.8 Indeterminate forms (L'Hospital's Rule)

Unit VI: The Integral

6.1 Lower and Upper Sum with their Properties

6.2 The Reimann Sum

6.3 The Definite Integral

6.4 Properties of the Definite Integral

6.5 The Fundamental Theorem of Calculus

6.6 Indefinite Integrals and Integration Rules

6.7 The Logarithm as an Integral

Unit VII: Techniques of Integration

7.1 Integration by Substitution

7.2 Trigonometric Integrals

7.3 Integration by Parts

7.4 Integration by Trigonometric Substitution

7.5 Integration by Partial Fraction

7.6 Numerical Techniques of Integration

Unit VIII: Applications of the Integral

8.1 Area, 8.2 Volume, 8.3 Arc Length, 8.4 Surface Area 8.5 Work

Text Book: Calculus with Analytic Geometry. By Robert Ellis and Denny Gulick.

References Books:

1. Calculus with Analytic Geometry, By Johnson and Kiokemeister.
2. Calculus & Analytic Geometry, By Edwards and Penny.
3. Calculus with Analytic Geometry; By Stein.
4. A First Course in Calculus, By Abiy Kifle & Bisrat Dilnesaw.
5. A Primer to Calculus, By Holder.

Course Title: Intro. To Information and Communication Technology

Course Code	**-**	**ICTE 101**
Prerequisite	**-**	**None**
Credit hrs	**-**	**2**
Contact hrs	**-**	**3**
Requirements	**-**	**Required for all Linear diploma programme students**.

Course Description:

The course includes The concept of ICT, a brief introduction of the computer system, introduction to Windows, Introduction to Microsoft Word, Introduction to Microsoft Excel and the basics of Internet usage.

Course Objectives:

By the end of the course the student will be able to:

- Identify the various tools for acquiring, analyzing and applying information
- Use computers as tools for information processing and communications
- Use Microsoft Windows efficiently
- Use Microsoft work to create good quality publications
- Use Microsoft Excel to handle spreadsheet problems
- Use Microsoft Internet Explorer to locate, search and download information from the internet to communicate by email.
- Use Microsoft Outlook to communicate, by email, with others. e attached

Appendix N: Primary School Mathematics Flow-chart (1-8) and Grade 1 Syllabus of 2012/2013

Grades 1-4 (1st Cycle)

	Grade 1	Grade 2	Grade 3	Grade 4
ALGEBRA	**1. The counting Numbers up to 9** **1.1. The counting numbers from 1to 5 & their order.** **1.2. The counting numbers from 6 to 9 & their order.** **2. Addition & Subtraction of counting numbers up to 9** **2.1. Addition up to 9** **2.2. Subtraction up to 9** **2.3. Addition of three 3 counting numbers whose sum is not greater than 9** **3. The Whole Numbers from 0 to 20** **3.1. The number 0** **3.2. Whole numbers up-to 20 and their order** **3.3. System of place value** **4. Addition and Subtraction of whole numbers up to 20** **4.1. Adding whole numbers whose sum is not more than 20.** **4.2. Subtracting whole numbers up-to 20** **4.3. Problems on Addition and Subtraction** **5. Measuring**	**1. Addition & Subtraction of whole numbers up to 100** **1.1. Revision on addition & subtraction of whole umbers up to 20** **1.2. Revision on addition and subtraction of whole numbers up to 100** **1.3. Addition and Subtraction of a one digit number to/from two digit numbers that do not involve carrying or borrowing.** **1.4. Addition/Subtraction of a one digit number to/from two digit numbers that involve carrying or borrowing.** **1.5. Addition and Subtraction of two digit whole numbers that do not involve carrying or borrowing.** **1.6. Addition and Subtraction of two digit numbers that involve carrying or borrowing.** **1.7. Addition and subtraction of whole numbers up to 100 using word problems** **Miscellaneous exercise** **2. Multiplication and Division up to 100.** **2.1. Revision of multiplication and division by 2 and 10** **2.2. Multiplication by 0 and 1 and division by 1** **2.3. Multiplication &**	**1. Ordering of whole numbers up to 10, 000** **1.1. Revision of whole numbers up to 1000** **1.2. Revision of calculating with whole numbers up to 10,000** **1.3. The multiples of 100 and of 1000 up to the whole numbers of 10,000** **1.4. The whole numbers up to 10,000** **1.5. Comparing and ordering of whole numbers up to 10,000** **Summary** **Miscellaneous Exercise** **2. Measurement** **2.1. Measuring length with millimeter, centimeter, meter and kilometer.** **2.2. Measuring content with milliliter, and liter** **2.3. Measuring weight with gram, kilogram and quintal.** **3. Fractions** **3.1. Revision of one whole into three fractions** **3.2. Unit fractions from ½ up to 1/10** **3.3. ½ and ¼ of whole numbers** **3.4. Comparing simple fractions** **Summary** **Miscellaneous Exercise** **4. Addition and subtraction of whole numbers up to 10,000** **4.1. Addition of whole numbers up to 10,000** **4.2. Subtraction of whole numbers up-**	**1. Whole numbers up to 1,000,000** **1.1 Revision of the whole numbers up to 10,000** **1.2 Multiples of 1,000, 10,000 and 100,000** **1.3 Whole numbers up to 1,000,000** **1.4 Place values of six digit whole numbers** **1.5 Comparing and ordering whole numbers up to 1,000,000** **1.6. Rounding off numbers and finding values to the nearest** **Summary of the chapter** **Miscellaneous Exercises** **2. Calculating using the Four Main Operations on Whole Numbers up to 1,000,000** **2.1 Addition and subtraction of whole numbers up to 1,000,000** **2.2. Multiplying whole numbers whose products are less than 1,000,000** **2.3. Dividing whole numbers by one digit whole number and 10 up to 1,000,000** **Summary of the chapter.** **Miscellaneous Exercises.** **3.Fractions and one digit decimal numbers** **3.1 Fractions, parts of one whole** **3.2. Comparing and ordering fractions with the same denominator.** **3.3. Addition and subtraction of fractions with the same denominator.** **3.4. Proper fractions** **3.5. 10th, 100th and 1/10th numbers.** **3.6. Comparing and ordering up-to two digits decimal numbers.** **3.7. Addition and subtraction up to two digits decimal numbers** **Summary of the Chapter** **Miscellaneous Exercises**

	using traditional devices 5.1. Measurement of Length 5.2. Measurement of content 5.3. Measurement of weight 6. Introduction to the concept of fractions 6.1. ½ 6.2. ¼ 7. Multiplying and Dividing whole numbers up to 20 by 2 7.1. Multiplying whole numbers by 2 up to 20 of their products 7.2. Dividing positive integers up-to 20 by 2	division by 3,4,5,6, 7, 8 and 9 Miscellaneous exercise 3. Measurement 3.1. Measuring length using centimeter and meter 3.2. Addition and subtraction of length using centimeter and meter 3.3. Measuring content using liter 3.4. Addition and subtraction of content using liter 3.5. Measuring weight using kilogram 3.6. Addition and subtraction of weight using kilogram 4. Introduction to the concept of fraction 4.1. Revision on ½ and 1/4 fraction 4.2. one third (1/3) 4.3. Fractions of one whole Miscellaneous Exercise 5. Whole numbers up to 1000. 5.1. Multiples of 100 5.2. Whole numbers from 101-1000 5.3. Place value of whole numbers up-to 1000. 5.4. Order of whole numbers up to 1000 Miscellaneous Exercise	to 10,000 4.3. Addition and subtraction using word problems Summary Miscellaneous exercise 5. Multiplication and Division of whole numbers up-to 10,000 5.1. Multiplying the multiples of 100 by one digit whole number 5.2. Multiplying the products of 1000 by one digit whole number. 5.3. Products of whole numbers not more than 10,000 and the products of one digit whole numbers 5.4. Dividing the products of 10 and 100 up to 10,000 by one digit numbers and 10 5.5. Dividing whole numbers up to 10,000 by one digit whole numbers and 10 with remainder and without remainder. Summary Miscellaneous Exercise	

	Grade 1	Grade 2	Grade 3	Grade 4
GEOMETRY & Algebra	8. Lines and simple figures 8.1. Straight and curved Lines 8.2. Simple figures 9. Whole numbers up-to 100 9.1. Multiples of 10 up-to 100 9.2. Whole numbers from 20 up to 100 9.3. Ordering whole numbers up-to 100 9.4. Place value of whole numbers up-to 100 10. Ethiopian	6. Points, Lines and Shapes/Figures 6.1. Drawing lines using a ruler 6.2. Four sides, Square, Triangle and Circle 6.3. Shapes of materials found in our area Miscellaneous Exercise 12. Money 12.1. Addition and subtraction of money 12.2. Marketing Miscellaneous Exercise 13. Time 13.1. Counting time in 1/2 and ¼. 13.2. Time and Minutes Miscellaneous Exercise 14. Recording Data and sequence of	6. Lines and simple figures 6.1. Intersected, Parallel, and Perpendicular Intersected lines 6.2. Drawing Intersected, Parallel and perpendicular Intersected lines 6.3. Rectangle, Square, parallelogram and Trapezium. 6.4. Circle Summary Miscellaneous Exercise 7. Money 7.1. Changing notes of money 7.2. Word problems on changing Ethiopian note of money Summary	4. Measurement 4.1.Measuring Length 4.2. Measuring weight 4.3. Measuring content Summary Miscellaneous Exercise 5.Plane and solid figures 5.1. Right angle 5.2. Points, Lines and plane figures 5.3. Perimeter and areas of Rectangle and Square 5.4. Solid Figures Summary Miscellaneous Exercise 6. Time 6.1. Time, minutes and second 6.2. Calculating on time measurement 6.3. Comparing using time counters

	Money 10.1. Ethiopian cents and birr notes 10.2. Relationship of cents and Birr notes 11. Time 11.1. Times in a day 11.2. Days in a week 12. Data Handling and Simple mathematics sequence 12.1. Simple Pictorial Graphs 12.2. Sequence of Mathematics figures	pictures /shapes 14.1. Collecting simple data 14.2. Table of simple data 14.3. Simple sequence of numbers and shapes Miscellaneous Exercise	Miscellaneous Exercise 8. Time 8.1. Reading Time 8.2. Time and Minutes 8.3. Days, Weeks, Months, and Years 8.4. Simple Calendar Summary Miscellaneous Exercise 9. Data Recording 9.1. Simple pictorial Graphs 9.2. Interpreting Graphs Summary Miscellaneous Exercises	Summary Miscellaneous exercise 7. Data Handling 7.1. Drawing bar graph for the given data 7.2. Interpreting bar graph 7.3. Average of whole numbers up to Summary Miscellaneous Exercise

GRADES 5-8

	Grade 5	Grade 6	Grade 7	Grade 8
ALGEBRA	1. Whole Numbers and the Four basic operations 1.1. The whole numbers greater than 1,000,000 1.2. Basic operations on whole numbers Summary Miscellaneous exercises 2. Working on variables 2.1. Algebraic expressions with variables 2.2. Equality and Inequality equations Summary Miscellaneous Exercises 3. Fractions, Decimals and four basic operations 3.1. Types of fraction 3.2. Expressing	1. Basic concepts of Sets 1.1. Definition and Explanation of Sets 1.2. Relationships of Sets 1.3. Calculations on Sets Summary Miscellaneous Exercises 2. Divisibility of Whole numbers 2.1. Basic concepts and Principles of Divisibility 2.2. Multiples and Divisors Summary Miscellaneous 3. Fractions and 10^{th} numbers 3.1. Explaining fractions in simple mathematics word 3.2. Changing fractions into one digit and two digits decimals 3.3. Changing and ordering fractions 3.4. Addition and Subtraction of fractions and one digit decimal numbers	1. Rational Numbers 1.1. The concept of rational number 1.2. Comparing and ordering rational numbers 1.3. Operation on rational numbers Summary Miscellaneous Exercise 2. Linear Equations and inequalities 2.1. Solving Linear Equations 2.2. Solving Linear Inequalities Summary Miscellaneous Exercise 3. Ratio, proportion and Percentage 3.1. Ratio and Proportion 3.2. Further on percentage 3.3. Application of percentage in calculation Summary Miscellaneous Exercise 4. Data Handling 4.1. Collecting Data using tally mark 4.2. Construction and Interpretation of live Graphs and Pie Charts 4.3. The Mean, Mode, Median and Range of data Summary	1. Square and Square Roots, cubes and cube roots. 1.1. The Square of a number 1.2. The square root of a rational number 1.3. Cubes and Cube roots Summary Miscellaneous Exercises. 2. Further on working with variables 2.1. Further on algebraic Theorems and Expressions 2.2. Multiplication of binomials 2.3. Highest Common factors Summary Miscellaneous Exercise 3. Linear Equations and Inequalities 3.1. Further on solutions of Linear Equations 3.2. Further on Linear Inequalities 3.3. Cartesian Coordinate System

	decimals in terms of fractions 3.3. Comparing and ordering fractions 3.4. Basic operations and fractions 3.5. Calculating decimals Summary Miscellaneous Exercise 4. Data Handling 4.1. Drawing and Interpreting bar graphs 4.2. Average of number Summary Miscellaneous exercise	3.5. Multiplication and Division of Fractions and one digit decimal numbers. Summary Miscellaneous exercise 4. Integers 4.1. Introducing Integers 4.2. Comparing and Ordering integers 4.3. Addition and Subtraction of Integers Summary Miscellaneous Exercise 5. Equalities and Inequalities of Linear equations 5.1. Equalities and Inequalities of Linear equations 5.2. Indicating points on the number line 5.3. Equations	Miscellaneous Exercise	Summary Miscellaneous exercise

	Grade 5	Grade 6	Grade 7	Grade 8
GEOMETRY	5. Geometrical Figures and Measurement 5.1. Lines 5.2. Angles and their measurement 5.3. Categorizing Triangles based on their sides and angles 5.4. Congruent lines 5.5.Measurement Summary Miscellaneous Exercises	6. Geometry and Measurement 6.1. Angles 6.2. Sketching Triangles 6.3. congruence of triangles 6.4. Measurement Summary Miscellaneous exercise	5. Geometric Figures and Measurement 5.1. Quadrilaterals, Polygons, and circles. 5.2. Theorems of Triangles 5.3. measurement Summary Miscellaneous Exercise	4. Similar Figures 4.1. Similar Plane Figures 4.2. Similar Triangles Summary Miscellaneous Exercise 5. Circles 5.1. Further on Circle 5.2. Angles in the circle Summary Miscellaneous Exercise 6. Introduction to Probability 6.1. The concept of Probability 6.2. Probability of simple Events Summary Miscellaneous Exercise 7. Geometry and Measurement 7.1. Theorems on the Right angled Triangle 7.2. Introduction to Trigonometry 7.3. Solids Figures Summary Miscellaneous Exercise

In addition to the flow chart I selected grade 1 Syllabus to assess the contents and learning experiences of grade 1 curriculum. I selected grade 1, because some teachers during the interview responded that grade1 mathematics contents are beyond the maturity level of the students. Based on the teachers opinion I decided to assess the contents and learning experiences of grade 1mathematics syllabus.

Mathematics syllabus for grade 1 (MOE, 2013), Amharic version translated into English

The document states that, process of learning mathematics is similar to the process of house construction. Any house needs a base before construction and similarly the base for learning Mathematics is grade 1.

The document emphasizes that Mathematics syllabus for grade one has four parts these are:

a. Numbers and basic Calculations
b. Measurements
c. Geometric figures and
d. Systems of data handling

Objectives: The main objectives of grade 1 Mathematics is to develop the students skill of calculation in addition to this grade 1 mathematics helps the students to:

a) Develop the students problem solving ability
b) Motivate students learn mathematics through enjoyment, eagerness and consistency
c) Practice the theories into their daily life activities
d) Equip students with ethical behavior that are accepted by the society

Students who completed grade 1 are expected to:

- Count, read and write whole numbers up to 100
- Order and analyze place value of whole numbers up to 100
- identify and use Ethiopian money
- Identify the fractions of one whole using different figures
- Measure length, weight and content using traditional measurements that are used in their daily life
- Identify and write geometric figures like perpendicular, four and three sided figure and circle
- Calculate and solve whole numbers up to 100 by adding and subtracting different questions
- Multiply whole numbers by 2 and divide by 2 without remainder
- List the basic differences and relationships between the four operations
- Solve word problems using four basic operations and whole numbers up to 100
- Tell and use the measurement of time
- Handle and read simple data by using figures and graphs
- explain the beginning and design of numbers, shapes and color

Unit 1: Counting numbers up to 9 (20 periods)

Learning out comes: After the end of the unit the students will be able to:

- Read and write counting numbers up to 9
- Order counting numbers up to 9
- Compare counting numbers using “<”, “>”, and “=” signs.

Learning Competencies	Contents	Teaching- Learning activities	Measurement and Evaluation
Identify, Compare and relate real objects Read counting numbers from 1-5.	1 Counting Numbers up to 9 1.1 counting numbers from 1-5 And their order(10 periods)	Students will identify, compare and relate counting numbers using corks, bearings, pebbles, sticks, etc.	Ask the students to relate counting numbers using corks, pebbles, etc.
Competencies	Contents	Teaching-Learning activities and Teaching aids	Measurement and evaluation
Write counting numbers		• Group the students and discuss	Asking the students to

from 1-5 **Identify and use “<”, “>”, “=” signs**		**member of sets using “less than”, ‘greater than’ and “equal to” signs.** • **Introducing counting numbers1, 2, 3, 4, and 5 using real objects or pictures.** • **Making the students to relate set of objects to number figures.** • **Making the students to count numbers starting from 1-5 and starting from 5-1 (forward & backward)** • **Making the students to practice 1, 2, 3, 4, and5 using their fingers and bolding hidden points** • **Making the students to compare numbers using real objects** • **Making the students to write numbers 1-5 in their order**	**read counting numbers from 1-5 orally.** **Checking the students when they write counting numbers from 1-5.** **Telling the students to identify and use “<”, “>”, “=” signs.** **Asking them to tell counting numbers starting from 1-5 and 5-1**
Read counting numbers from 6-9 **Write counting numbers from 6-9**	**Order of counting numbers from 6-9 (10 periods)**	• **Introducing numbers from 1-5 by drawing a number line on the chalk/white board using “<”, “>”, “=” signs** • **Making the students to practice inequality and equality signs using number line and real objects** • **Introducing counting numbers 6, 7, 8 and 9 using real objects and pictures**	**Ask the students to read numbers from 6-9**
Identify and tell the first and next numbers. **Write and order numbers from 1-9.** **Use the number “0”.** **Draw a number line containing numbers from 0-9.**		• **Telling the students to read, write and practice numbers 6, 7, 8 and 9.** • **Making the students to match set of similar pictures and real objects with the numbers.** • **Making the students in group and ask them to tell the first and next numbers in group.** • **Tell the students to write and compare the numbers from 1-9 in order.** • **Tell the students to read the numbers from 1-9 and 9-1 orally.** • **Tell the students to compare set of real objects/pictures using “<”, “>”, “=” signs**	**Giving class work to write numbers from 6-9.** **Giving home work to write numbers from 6-9** **Asking them to put numbers from 6-9 in order** **Asking them to tell the sequence of numbers from 6-9**

Unit 2: Adding and Subtracting Counting numbers up to 9 (22 periods)

Learning outcomes: At the end of the unit the students will be able to:

1) Add Counting numbers up to 9
2) Subtract counting numbers up to 9
3) Add 3 numbers whose sum is not greater than 9.

Competencies	Contents	Teaching- Learning activities and Teaching aids	Measurement and Evaluation
Add Counting numbers up to 5	2. Adding and Subtracting counting numbers up to 9 2.1. Adding counting numbers whose sum is not greater than 9 (9 periods)	• Make the students to use real objects, pictures, abacus and add two counting numbers whose sum is not greater than 5 • Make the students to practice adding two counting numbers in rows using the symbol "+" and " =" • Introducing the concept "addition" and "sum" to use them in the addition process • Make the students to use real objects and add and practice commutative property of addition • Make the students to develop addition of two numbers not greater than 9 using real objects and practical examples. • Make the students to practice addition horizontally and vertically • Make the students to solve word problems, for e.g I have a number, if I add 5 to this number I will get 9, what is the number?	Asking the students to add counting numbers up to 5 orally. Giving class work and home work to add two counting numbers whose sum is not greater than 5 Asking the students to add two counting numbers whose sum is up to 9. For e.g 2 + -- = 5 What number do you add on 3 to get 5?
Subtract counting numbers up to 5 Subtract counting numbers up to 9 Apply the relationship of addition and subtraction	2.2. Subtracting counting number up to 9 (9 periods)	• Helping the students to develop the basic concepts of subtraction by using abacus, flash card, figures, etc. • Giving chance for the students to use "–" and to practice subtraction horizontally • Help the students to practice the word subtraction and to find the difference of two numbers orally. • Make the students to practice subtraction horizontally and vertically by doing different exercises. • Helping the students to identify the relationship between addition and subtraction which is subtraction is similar to the opposite number of calculating with addition, this can be explained using real objects.	Asking the students to subtract numbers up to 5 by writing and telling orally. For e.g, 5-2= ---? Giving class work and home work to subtract counting numbers up to 9 by writing and telling orally.
		Giving questions like 8-2=6	

		2+6= 8 Make the students to set subtraction questions and solve the questions by their own.	
Add three counting numbers, whose sum is not greater than 9	Adding three counting numbers whose sum is not greater than 9 (4periods)	Help the students to work on and discuss by adding 3 counting numbers whose sum is not greater than 9 using real objects. For e.g, 1+3+5 and 2+3+4. Give word problems that involve 3 counting numbers whose sum is not greater than 9. Make the students to set simple word problems.	Asking the students to add numbers like 2+4+1= _? In the class and at home.

Unit 3: Whole numbers from 0-20 (12 periods)

Learning outcomes: At the end of the unit the students will be able to:

1) Write “0” by demonstrating ‘0’ practically
2) Read , write and Order whole numbers up to 20
3) Do the place value of whole numbers up to 20 practically.

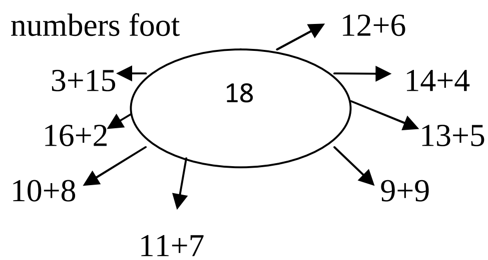
Competencies	Contents	Teaching –Learning activities using teaching aids	Measurement and Evaluation
Discuss the concept of “0” Read and write the symbol “0’ Compare and order numbers using “0” Add and Subtract using “0”	3. Whole numbers from 0-20 3.1. The Number zero (3Periods)	• Introducing the concept “0” using number line and empty sets • Help the students to practice by writing the symbol “0” • Make the students to compare and order numbers using ‘0’ • Make the students to compare and order numbers using ‘0’ • Make the students to do exercises by adding and subtracting using ‘0’	Asking the students to add ‘0’ with other numbers and subtract ‘0’ from other numbers.
Write and count whole numbers up to 20 forward and back ward Explain one digit whole numbers from10-20 by adding with 10 Identify and tell the first and next number up to 20 Compare whole numbers up to 20 using the signs “<”,	3.2. Whole numbers up to 20 and their orders (6 Periods)	Revising the previous lesson of whole numbers from 0-9 using oral questions. Introducing whole numbers from 10-20 by adding using real objects. For e.g; 10+1= 11, 10+3= 13, 10+2=12, 10+4=14. Making the students to practice writing numbers from 0-20. Making the students to practice two digit whole numbers by expanding as the sum of 10 and one digit number, For example 17= 10+7 (use abacus) Making the students to compare whole numbers up to 20 using the symbols “=”, “<” and “>” on the number line orally.	Asking the students to count and read numbers up to 20. Asking the students to write numbers from 10-20 which are the sum of 10 and one digit numbers. Asking the students to write the symbols “<”, “>”, and “=” between two digit numbers up to 20.

“>”, and “=”			
Do place values of whole numbers up to 20	3.3. System of place value of numbers (3Periods)	Making the students to practice whole numbers up to 20 using place values of 10 and 1 (use abacus and sticks)	Asking the students to tell the place values of numbers up to 20.

Unit 4: Adding and Subtracting whole numbers up to 20 (17 periods)

Learning out comes: At the end of the unit the students will be able to :

1) Add whole numbers up to 20
2) Subtract whole numbers up to 20
3) Solve word problems related to whole numbers up to 20

Competencies	Contents	Teaching-Learning activities and Teaching aids	Measurement and Evaluation
Add whole numbers up to 20 Do whole numbers up to 20 as the sum of two whole numbers.	4. Adding and Subtracting whole numbers up to 20. 4.1. Adding whole numbers whose sum is not greater than 20. (7 Periods)	Making the students to develop their addition skill by helping them to add whole numbers up to 20 using real objects. O O O O O O OOOO O OOOOOOOOO 6+4= 10	Giving class work and home work for the students to add whole numbers up to 20. Ask the students to add two numbers up to 10 and write the expanded form of the numbers and check their work.
Give reason for the sum of two numbers is greater than the addends of each number.		Students will practice expanding numbers like 5= 3+2, 7= 4+3 Make students to fill the spider numbers foot  Help the students to practice, how numbers are less than the others with reasons by using number rays.	Observe students ability of giving reasons.
Subtract using whole	4.2.Subtracting whole	Help students to develop their subtraction skill using	Ask the students to subtract

numbers up to 20	numbers up to 20 (7Periods)	real objects	numbers up to 20 by giving class work and home work Make students be in pair and draw spider number and give to their classmate sitting nearer to them. Make the students to subtract and fill spider number feet. Help students to explain any number is a difference of two numbers. For example: We have 15 bananas, in addition to these somebody gave us two. How many bananas we have altogether? Help students to fill the blank space for exercise like 5+ --- = 12 18- ? = 4
Solve problems of addition and subtraction of whole numbers up to 20 Students set word problems by themselves	4.3.Problems on Addition and Subtraction (3 Periods)	Students do mathematical equations in pairs and set problems and ask their classmate sitting nearer to them. Students solve simple word problems by setting mathematical statements. Students ask to each other by setting simple word problems.	Asking the students to fill the blank space of equality problems. Asking the students to set simple problems. Asking the students how to solve word problems

Unit 5: Measuring using traditional measures (7 periods)

Learning out comes: At the end of the unit the students will be able to:

1) Explain the significance of measurement in their daily life
2) Use appropriate words that explain length, weight and content
3) Compare and measure length, weight and content using traditional measures.

Competencies	Contents	Teaching-Learning activities and Teaching aids	Measurement and Evaluation
Explain the need of measurement	5. Measuring using traditional measures 5.1. Measurement of Length	Help the students to discuss the need of measurement in their daily life by giving examples. Help the students to compare the length of different	Ask the students to measure the desk using their hand.

	(3 Periods)	real objects, like pencil, pen, sticks, etc.	Ask the students to measure the length of their playing field using their pace.
Use explanatory words of measurement Compare length using non-formal measures		Make students to use words like tall, short, fat, thin, etc. Students compare the length of their playing field by using rope, hand, pace, etc. as a measuring device.	Let the students to measure width of the classroom or any using their pace.
Measure content using cup, bottle etc. Discuss and explain about content containers. Compare different content containers	5.2. Measurement of content (3 Periods)	Asking the students to answer who is the tallest in this class? Telling the students to bring liquid containers with water and compare empty vessels to the filled one. Comparing containers by filling water into the container using cup, and asking the students to tell the number of cups used to fill the container	Asking the students to compare different liquid containers.
Compare the weight of different real objects	5.3.Measurement of weight (3Periods)	Let the students pick two objects and compare their weight.	Asking the students to report the weight of two different objects.

Unit 6: Basic concepts of Fractions. **(6periods)**

Learning outcomes: At the end of the lesson the students will be able to:

1) Divide real objects into two equal parts and understand the concept "Half"
2) Dive real objects into four equal parts and understand the concept "Quarter"

Competencies	Contents	Teaching –Learning activities and teaching aids	Measurement and Evaluation
Explain the concept of "Half' Perform and demonstrate "Half" of real objects Recognize the statement that two parts of one whole is not always "Half" It should be two equal parts	6. Introduction to concepts of Fractions 6.1. Half (3 Periods)	Introducing fraction by cutting an orange into two equal parts. And the students call the two equal parts " half " . Cut the paper into un equal part and ask the students why the parts are not equal?	Ask the students to draw two equal parts of a square.
Demonstrate whether they understand about "1/4" Perform and demonstrate "1/4" and "3/4" Perform and demonstrate how many halves and quarters are there in one whole.	6.3. Quarter (1/4) (3 Periods)	By drawing on the paper or by cutting real objects let the students demonstrate ¼ and ¾. Let the students be in pair and discuss how many quarters are there in one whole and in one half.	Let the students draw a circle and shade ¼ and ¾ parts of a circle

Unit 7: Multiplying and Dividing whole numbers up to 20 (20periods)

Learning outcomes: At the end of the unit the students will be able to:

1) Multiply numbers up to 10 by 2 and identify the symbol “×”
2) Divide numbers up to 10 by 2 and identify the symbol “÷ “

Competencies	Contents	Teaching- Learning activities and Teaching aids	Measurement and Evaluation
Identify multiplication as repeated addition Use the symbol “×” for multiplication Times Multiplication and product	7. Multiplying and Dividing numbers up to 20 7.1. Multiplying numbers up to 10 by 2 (10periods)	Collect real objects and use addition to introduce multiplication by 2. For example: 3 ×3 = © © /©©/©© = 2+ 2 + 2 = 6 3×2 = 6	Ask the students to identify “×” from other symbols. Ask the students to read 3×2 = 6
Multiply whole numbers up to 10 by 2 Count whole numbers up to 20 by grouping them into 2. Identify and use commutative property of multiplication. Solve problems of multiplication by 2		Let the students be in pair and practice multiplication by 2 up to 20 using flash card and repeated addition. Introducing “×”, times multiplier and product. Let the students prepare multiplication table of 2 and tell orally. Let the students use real objects to understand commutative property of multiplication. For example; 2x3 = 3x2 Help students to solve word problems using multiplication by 2. For example; if I give three candies each for my two brothers. How many candies are needed to give for my brothers?	Ask the students to tell multiples of 2 up to 9.
Divide one whole into two equal parts is the same as dividing the whole by 2. Use the symbol ÷ and the word divided by. Identify the	7.2. Dividing positive whole numbers up to 20 by 2 (12 periods)	Introducing the concept of division by 2 using real objects. For example; putting 6 pebbles into two places equally. Make the students in pairs and let them do similar activities. Help students to do division exercises by 2. Let the students explain the relationship between divisions as multiplication by using real objects.	Ask the students to divide 20 set of members into two equal parts and tell the parts contained in each set. Give home work for the students to do division exercises. Ask the students to identify ‘÷’

relationship between multiplying and dividing by 2, Solve word problems using the divisor 2.		Help students to solve problems by using the relationship between multiplying and dividing by2. For example; 6÷ 2= 3 Let students solve division problems by2 and set word problems. For example; I have a number if I multiply the number by 2 the result is 16. What is the number?	from other symbols.

Unit 8: Lines and Simple figures (8 periods)

Learning outcomes: At the end of the unit the students will be able to:

1) Identify straight and curved lines
2) Identify simple geometric figures like four sides, circle and triangles

Competencies	Contents	Teaching – Learning activities and Teaching aids	Measurement and Evaluation
Identify straight and curved lines in their environment Draw straight and curved lines	8.Lines and simple figures 8.1. Straight and curved lines (4periods)	Students observe in pairs and repeat straight and curved lines existing in their environment. Telling the students to draw straight and curved lines using ruler and cents.	Ask the students to identify straight and curved lines available in their environment. Ask the students to draw straight and curved lines.
Recognizing real objects like triangle, four sides and circles in their environment	8.2. Simple Figures	Let the students explain the shapes of rectangles, circle and triangles relating to their environment. Let the students Demonstrate the above mentioned figures using their fingers and arm. Let the students draw simple figures using book stick, cents, etc. Let the students be in group and shaping simple figures like rectangle, and triangle and draw shapes like a house. Let the students sketch simple figures using pencils.	Ask the students to group simple figures based on their shape, size, and names. Ask the students to draw simple figures in group. Ask the students to draw the figures based on their shapes.

Unit 9: Whole numbers up to 100 (18 Periods)

Learning outcomes: At the end of the unit the students will be able to:

1) Count numbers from 10 up to 100.
2) Add and subtract multiples of 10 up to 100
3) Read and write whole numbers up to 100
4) Compare whole numbers up to 100 using the symbols “<”, “>” and “=”
5) Identify the place values of one and ten.

Competencies	Contents	Teaching- Learning activities and Teaching aids	Measurement and Evaluation
Find multiples of 10 up to 100 Count, read, and write multiples of 10 up to 100. Expand multiples of 10	9. Whole numbers up to 100 9.1. Multiples of 10 up to 100 (6 Periods)	Let the students demonstrate multiples of 10 using ten tied sticks. Introduce numbers from 1-10 multiplying by 10 and using multiplication as repeated addition.	Ask the students to list multiples of 10 less than 100
Compare multiples of 10 using "<", ">", and "=" signs. Add and subtrac multiples of 10 up to 100. Solve problems using multiples of 10		Introduce multiples of 10 as repeated addition. Make the students to count, read, write and expand multiples of 10. For example; 40= 4x10 Make the students to compare multiples of 10 by giving reasons. For example; 7>40, because 7<4, 20< 30, because, 20 + 10 = 30 Help the students to practice addition and subtraction of multiples of 10. Let the students solve word problems using addition and subtraction. For example; In one hospital there were 60 HIV patients last month, in this month there are 30 HIV patients. How many HIV patients are there in the hospital in the two months?	Ask the students to count multiples of 10 up to 100 orally Ask the students to give two multiples of 10 and find their sum and differences. Ask the students to compare multiples of 10 Ask the students to read whole numbers up to 100.
Read whole numbers from 21-100. Write whole numbers up to 100. Expand two digit whole numbers by multiples of 10 in one place value	9.2.Whole numbers from 21-100 (6 periods)	Help the students to add 10, 20 … 90. With one digit whole numbers and multiples of 10 using pictures, pebbles, abacus etc. For example; 20 + 3 = 23 Help students to read and write two digit numbers. Make students to practice and expand two digit two digit numbers and multiples of 10. For example; 45 = 40 + 5 = 4×10+5	Ask the students to write numbers up to 100 and check their hand writings.
Compare whole numbers up to 100. Order whole numbers up to	9.3. Order of whole numbers up to 100 (3 periods)	Help the students to compare and write numbers up to 100 in their order Make the students to write whole numbers up to 100 in their order.	Ask the students to do and practice the order of whole numbers up to 100 by giving class work and home work.

100 Identify rank order and non rank order numbers up to 100		Make the students to list and demonstrate numbers between two numbers Make the students to use rank order numbers in their daily life.	Ask the students to tell the place values of numbers up to 99
Identify two digits place value of numbers	9.4. Place value of numbers up to 100 (3 periods)	Help the students to develop their knowledge by writing the place values of numbers in 1 and 10 up to 99.	Ask the students to tell the place values of numbers up to 99.
At the end of the lesson the students identify the place values of two digit numbers	9.5. The place values of numbers up to 100	Help the students to develop their knowledge by writing the place value of numbers in one and ten places up to 99	Ask the students to tell the place values of numbers up to 99

Unit 10: Ethiopian Money (5 periods)

Learning outcomes: At the end of the unit the students will be able to :

1) Recognize Ethiopian cents and Birr notes.
2) Explain the relationship of one Birr and 10 cents.
3) Use Ethiopian money to buy and sell

Competencies	Contents	Teaching-Learning activities and Teaching aids	Measurement and Evaluation
Identify different Ethiopian cents Identify different Ethiopian Birr notes.	10.Ethiopian Money 10.1. Ethiopian cents and Birr notes . (3 periods)	Introducing Ethiopian cents and Birr notes (1 cents, 5 cents, 10 cents, 25 cents, 50 cents, and Birr notes) Discuss the relationship between 1 Birr and 10 Birr.	Ask the students to identify birr notes and cents by demonstrating the real cents and Birr notes. 1birr 5c
Use cents by changing Birr notes and know the main relationship Buy and sell Ethiopian money and use in the market of different games.	10.2. The relationships of cents and Birr notes (2 periods)	Let the students practice and identify cents and Birr notes. Let the students demonstrate equal values of cents and Birr notes. Make the students practice buying and selling goods in a game. For example, buying and selling pencils and exercise books.	Ask the students "How many cents are there in one birr" 10c

Unit 11: Time (5 periods)

Learning outcomes: At the end of the unit the students will be able to:

1) Explain morning , after noon, and night in their life experience
2) List days of the week
3) Tell the time by reading a Clock.

Competencies	Contents	Teaching-Learning activities and teaching aids	Measurement and Evaluation
Explain different times in a	11.Time	Let the students explain times of a day.	Ask the students to

day. Explain different activities in different times of a day. Read different times of a day using time indicators.	11.2. Times in a day (3 periods)	Let the students tell their activities in different times of a day. They can use pictures to show their activities in different times of a day. Make the students in group and sing a song related to times. Let them explain the times of a day by using the picture of a watch. Help the students to draw and demonstrate times of a day.	demonstrate different times using faces of a watch. Ask the students to read the times available on the face of a watch.
Name and count days of the week. Explain their activities in each day of the week.	11.3. Days of the week. (2periods)	Let them sing a song on days of a week using a table. Make them to explain their activities in each day of a week in front of their classmates.	Ask the students to name days of a week in a rhythm.

Unit 12: Data handling and Simple mathematics Sequence. (6 periods)

Learning outcomes: At the end of the unit the students will be able to:

1) Record weather conditions of the day by using simple pictures.
2) Read data from pictorial graphs.
3) Make and prepare patterns of shapes, numbers and colors.

Competencies	Contents	Teaching- Learning activities and Teaching aids	Measurement and Evaluation
Record different activities of the day by using pictures. Read data from pictorial graphs	12. Data Handling and Mathematical Sequence. 12.2. Simple pictorial graphs. (3 periods)	Make the students to draw daily weather conditions and put it in a wall. Let the student draw simple pictorial graphs of a particular thing.	Ask the students to demonstrate daily activities by using pictures.
Do patterns of shapes, colors and numbers Prepare sequence of shapes.	12.3. Mathematical sequence (2 periods)	Ask the students to complete pattern of numbers like : 0+0+o …. And 1; 0; 0;1; 0;0;1;0;0 …. Make the students in group and do patterns by asking to each other.	Ask the students to complete already prepared patterns.

APPendix O: Test Result of Attitude Items of Prospective Mathematics Teachers after Pilot Test and Improvements (Analysis from raw data)

Table 5: Reliability, mean, standard deviation, and squared mutiple correlation of KUC Prospective mathematics teachers test items (N= 143)

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.842	.846	71

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.061	1.517	4.538	3.021	2.991	.671	71

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Item1 I have usually been at ease during math tests = Anxiety = F2	214.6993	716.874	.230	.736	.840
Item2 I struggled with many concepts in mathematics = Confidence =F1	213.6224	718.701	.173	.641	.841
Item3 My teachers relied on over head projectors or chalk boards as tools to pr esent information. = Teacher expectation =F6	213.1049	712.264	.316	.738	.839
Item4 My teachers spent the necessary amount of time helping me to understand mathematics concepts. = Teacher expectation = F6	213.9091	726.647	.085	.692	.843

Item5 I do not want to teach mathematics in the future. = Motivation = F4	214.8811	705.134	.332	.769	.838
Item6 I had many competent mathematics teachers. = Teacher expectation = F6	213.2657	726.718	.125	.742	.842
Item7 I have often helped others with their math home work = Confidence = F1	213.4545	722.010	.222	.685	.840
Item8 My teachers emphasized understanding and not just memorization. =Teacher expectation	213.3287	735.898	-.038	.690	.844
Item9 I elected to take part in mathematical competitions = Confidence	214.5874	702.469	.348	.802	.838
Item10 During my mathematics classes I was expected to sit quietly and listen = Teacher expectation	214.1469	720.154	.141	.776	.842
Item11 I usually comprehended math content well and seldom got lost = Confidence	213.4965	719.097	.235	.694	.840
Item12 I did not feel comfortable seeking help from my math teachers outside of class = Anxiety	214.9580	719.364	.162	.759	.842
Item13 I did not like being introduced to new mathematical content = Anxiety	215.4336	718.163	.232	.745	.840
Item14 Mathematics makes me feel uncomfortable and nervous = Anxiety	215.6713	722.279	.178	.764	.841
Item15 I get really uptight during mathematics topics = Anxiety	215.2098	723.237	.134	.691	.842
Item16 My teachers focus mainly on memorization, facta and procedures = Teacher expectation	214.1259	731.463	.010	.731	.845

Item17 My math teachers were supportive in my efforts to learn math = Teacher expectation	213.6434	725.555	.097	.783	.843
Item18My teachers assigned several home work problems each night = Teacher expectation	213.6224	715.645	.287	.716	.839
Item19 I almost never get uptight while taking math tests = Anxiety	213.4965	717.519	.195	.666	.841
Item20My teachers had confidence in me as a student of mathematics = Teacher expectation	214.1189	717.232	.255	.645	.840
Item21 I learned best when my teachers took the time to connect new concept to that which I had already = Teacher expectation	213.3007	733.409	-.001	.675	.844
Item22I have usually been at ease during math courses =Confidence	213.5874	701.667	.389	.651	.837
Item23 I chose a major that did not require too many math courses = Value	214.8042	722.497	.126	.642	.842
Item24 I have taken math classes even though they were not required = Motivation	215.2517	713.908	.272	.751	.840
Item25 I have dropped math courses because they became too difficult = Enjoyment	214.6224	701.039	.358	.769	.838
Item26 I usually do not worry about my ability to solve math problems = Confidence	214.7413	711.024	.294	.703	.839
Item27 New math content has usually been easy for me to understand = Confidence	214.1748	724.371	.122	.751	.842
Item28 I did not take a math class of my senior year in high school = Motivation	215.1818	715.629	.211	.724	.841

Item29 It wouldn't bother me at all to take more math courses = Motivation	214.9231	714.325	.222	.723	.841
Item30 When confronted with a difficult math concept, I generally worked until I understand the concept = Confidence	213.7902	708.660	.343	.824	.838
Item31 I look forward to teaching mathematics = Enjoyment	213.7413	698.221	.457	.698	.836
Item32 I can not recall many mathematical concepts that were hard for me to understand = Confidence	213.9860	717.310	.213	.789	.841
Item33 My math teachers were very patient with me = Teacher expectation	214.1818	720.108	.152	.725	.842
Item34 Many of my math teachers were incompetent = Teacher expectation	215.1399	714.346	.293	.738	.839
Item35 My teachers did not believe I was capable of learning mathematics = Confidence	213.8182	707.939	.294	.677	.839
Item36 When I had trouble with math concept I usually gave up and stopped trying = Motivation	213.7902	706.125	.365	.700	.838
Item37 I get a sinking feeling when I think of trying hard math problems = Anxiety	215.0839	725.359	.104	.731	.842
Item38 My teachers often applied that math lessons to real world situations = Teacher expectation	213.7972	705.459	.364	.734	.838
Item39 Mathematics makes me feel uneasy and confused = Anxiety	215.0559	721.800	.154	.702	.842

Item40 My teachers used a combination of manipulative, visual aids, and cooperative learning = Teacher expectation	213.7552	726.834	.093	.773	.843
Item41 I was frequently lost and had trouble keeping up in my math classes = Anxiety	214.7552	712.468	.219	.732	.841
Item42 My teachers used math games to reinforce my understanding of concepts = Teacher expectation	214.5455	725.179	.113	.759	.842
Item43 My mind goes blank and Iam unable to think clearly when doing mathematics = Anxiety	215.2308	718.897	.195	.779	.841
Item44 I can recall math teachers who made me feel stupid in class = Enjoyment	214.3147	702.175	.405	.714	.837
Item45 I have selected math as my area of emphasis =Confidence	214.5524	705.981	.343	.719	.838
Item46 I have generally considered math as a related sequence pregregression of ideas = motivation	213.8951	710.700	.300	.693	.839
Item47 I generally have had difficulty relating new mathematical concepts to those I had previously learned = Confidence	214.3916	713.127	.271	.621	.840
Item48 Iam avoiding taking mathematics classes in college = Motivation	215.1958	699.539	.469	.721	.836
Item49 My mathematics teachers often became frustrated with me = Anxiety	215.2378	716.760	.257	.685	.840
Item50 My math teachers frequently used a lecture format = Teacher expectation	214.5944	710.623	.309	.713	.839

Item51 I enjoy going beyond the assigned work and trying to solve new problems in mathematics = Enjoyment	213.4965	710.660	.293	.730	.839
Item52 Mathematics is enjoyable and stimulating to me = Enjoyment	213.1748	719.751	.200	.795	.841
Item54 Iam highly interested to teach mathematics in the school and use it outside the school = Enjoyment	213.0699	713.080	.419	.835	.838
Item55 I have never liked mathematics and it is my most dreaded subject = Motivation	215.2098	714.223	.273	.742	.840
Item56 I have always enjoyed studying mathematics in school = Enjoyment	213.1538	723.244	.174	.814	.841
Item57 I would like to develop my mathematics skill and study this subject more = Motivation	212.7762	728.950	.133	.657	.842
Item58 Mathematics makes me uncomfortable and nervous = Anxiety	215.2308	714.207	.270	.739	.840
Item59 Mathematics is dull and boring because it leaves no room for personal opinion = Enjoyment	215.2098	719.167	.173	.751	.841
Item60 Mathematics is very interesting and I have usually enjoyed it = Enjoyment	214.0420	708.900	.341	.695	.838
Item61 I am interested and willing to acquire further knowledge of mathematics = Motivation	213.2867	714.967	.237	.709	.840
Item62 Mathematics has contributed greatly to science and other fields of knowledge = Value	213.1399	727.093	.111	.641	.842

Item63 Mathematics is less important to people than art or literature =Value	215.5385	720.912	.258	.724	.840
Item64 Mathematics is not important for the advance of civilization and society = Value	215.7972	719.557	.318	.664	.839
Item65 Mathematics is very worthwhile and necessary subject = Value	213.3846	704.027	.447	.760	.837
Item66 Mathematics is important for artists and writers to understand it as well as scientists = Value	213.3077	712.989	.340	.727	.839
Item67 Mathematics is not important in every life = Value	215.6503	715.905	.416	.751	.839
Item68 Mathematics helps develop a person's mind and teachers to think = Value	213.2238	719.583	.253	.736	.840
Item69 Mathematics is needed in designing practically everything = Value	213.4406	716.375	.268	.709	.840
Item70 Mathematics is needed inorder to keep the world running = Value	213.2308	714.249	.343	.723	.839
Item71 There is nothing creative about math it is just memorizing formulas and things = Enjoyment	215.1538	701.610	.441	.758	.837
Item72 I don' use mathematics in my everyday life = Value	215.2937	710.167	.358	.693	.838

Table 6: Negative and Positive Items of Confidemce with respect to each rating scale, academic year, frequency and percentage (Note that 2y= second year & 3y= third year)

Items	Rating Scales																			
	1				2				3				4				5			
	Fr		P		Fr		P		Fr		P		Fr		P		Fr		P	
	2y	3y	2y	3y	2y	3y	2y	3y	2y	3y	2y	3y	2y	3y	2y	3y	2y	3y	2y	3y
2	13	7	13.7	14.5	10	10	10.5	20.8	7	2	7.4	4.2	20	9	21.1	18.7	45	20	47.4	41.7

7	5	2	5.3	4.2	4	6	4.2	12.5	8	2	8.4	4.2	58	27	61.1	45.8	20	11	21.1	22.9
9	33	19	34.7	39.6	15	9	15.8	18.8	2	6	2.1	12.5	21	8	22.1	16.7	24	6	25.3	12.5
11	3	1	3.2	2.1	17	8	17.9	16.7	6	4	6.3	8.3	36	22	37.9	45.8	33	13	24.7	27.1
22	12	10	12.6	20.8	9	5	9.5	10.4	5	6	5.3	12.5	22	8	23.2	16.7	47	19	49.5	39.6
26	25	13	26.3	27.1	38	11	40	22.9	7	4	7.4	8.3	13	13	13.7	27.1	12	7	12.6	14.6
27	14	4	14.7	8.3	25	12	26.3	25	13	8	13.7	16.7	27	14	28.4	29.2	16	10	16.8	20.8
30	8	4	31.6	8.3	18	9	18.9	18.8	16	8	16.8	16.7	25	9	26.3	18.8	28	18	29.5	37.5
32	12	4	33.7	8.3	23	10	24.2	20.8	13	6	13.7	12.5	22	16	23.2	33.3	25	12	26.3	25.0
35	14	10	36.8	20.8	17	7	17.9	14.5	7	5	7.4	10.4	14	9	14.7	18.8	43	17	45.3	35.4
45	24	18	47.4	37.5	18	8	18.9	16.7	17	4	17.9	8.3	24	8	25.3	16.7	12	10	12.6	20.8
47	18	9	49.5	18.8	25	14	26.3	29.2	11	4	11.6	8.3	27	15	28.4	31.3	14	6	14.7	12.5

Table 7: Negative and Positive Items of Anxiiety with respect to each rating scale, frequency, percentage, and sex

Items	Rating Scales																			
	1				2				3				4				5			
	Fr		P		Fr		P		Fr		P		Fr		P		Fr		P	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1	15	13	17.4	22.8	34	26	39.5	45.6	7	5	8.1	8.8	19	6	22.1	10.5	11	7	12.8	12.3
12	38	26	44.2	45.6	16	12	18.9	21.1	2	4	2.3	7.0	18	8	20.9	14.0	12	7	13.9	12.3
13	53	28	61.6	49.1	12	18	13.9	31.6	3	-	3.5	-	17	9	19.8	15.8	1	2	1.2	3.5
14	58	40	67.4	70.2	15	10	17.4	17.5	-	-	-	-	8	5	9.3	8.8	5	2	5.8	3.5
15	43	29	50.0	50.9	17	9	19.8	15.8	7	7	8.1	12.3	12	8	13.9	14.0	7	4	8.1	7.0
19	10	7	11.6	12.3	9	11	10.5	19.3	3	1	3.5	1.8	19	14	22.1	24.6	45	24	52.3	42.1
37	42	26	48.8	45.6	8	13	9.3	22.8	9	3	10.5	5.3	25	12	29.1	21.1	2	3	2.3	5.3
39	29	26	33.7	45.6	25	19	29.1	33.3	7	3	8.1	5.3	16	4	18.6	7.0	9	5	10.5	8.8
41	42	23	48.8	40.4	10	7	11.6	12.3	8	2	9.3	3.5	9	9	10.5	15.8	17	16	19.8	28.1
43	45	31	52.3	54.4	13	8	15.1	14.0	9	2	10.5	3.5	19	9	22.1	15.8	-	7	-	12.3
49	39	27	45.3	47.4	19	10	22.1	17.5	13	10	15.1	17.5	12	9	13.9	15.8	3	1	3.5	1.8
58	46	26	53.5	45.6	12	13	13.9	22.8	8	7	9.3	12.3	16	8	18.6	14.0	4	3	4.7	5.3

Table 8: Negative and Positive Items of Enjoyment with respect to each rating scale, Frequency, Percentage, and Sex

Items	Rating Scales																			
	1				2				3				4				5			
	Fr		P		Fr		P		Fr		P		Fr		P		Fr		P	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
25	32	24	32.2	42.1	14	5	16.3	8.8	7	7	8.1	12.3	15	6	17.4	10.5	18	15	20.9	26.3
31	4	9	4.7	15.8	17	15	19.8	26.3	12	3	13.9	5.3	18	8	20.9	14.0	35	22	40.7	38.6
44	18	17	20.9	29.8	9	8	10.5	14.0	15	12	17.4	21.1	30	11	34.9	19.3	14	9	16.3	15.8
51	6	11	6.9	19.3	13	4	15.1	7.0	4	2	4.7	3.5	26	12	30.2	21.1	37	28	43.0	49.1
52	4	2	4.7	3.5	15	7	17.4	12.3	2	-	2.3	-	13	16	15.1	28.1	52	32	60.5	56.1
54	2	4	2.3	7.0	4	5	4.7	8.8	6	4	6.9	7.0	27	26	31.4	45.6	47	22	54.7	38.6
56	3	-	3.5	-	8	8	9.3	14.0	8	4	9.3	7.0	21	15	24.4	26.3	46	30	53.5	52.6
59	55	30	63.9	52.6	7	3	8.1	5.3	2	2	2.3	3.5	16	20	18.6	35.1	6	2	6.9	3.5
60	6	3	69	5.3	27	16	31.4	2.8	20	13	23.3	22.8	8	8	9.3	14.0	25	17	29.1	29.8
71	40	30	46.5	52.6	11	9	12.8	15.8	16	6	18.6	10.5	15	7	17.4	12.3	4	5	4.7	8.8

Table 9: Negative and Positive Items of motivation with respect to each rating scale, Frequency, Percentage, and Sex

Items	Rating Scales																			
	1				2				3				4				5			
	Fr		P		Fr		P		Fr		P		Fr		P		Fr		P	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
5	35	28	40.7	49.1	12	8	13.9	14.0	17	3	19.8	5.3	8	7	9.3	12.3	14	11	16.3	19.3
24	32	33	37.2	57.9	34	10	39.5	17.5	5	4	5.8	7.0	4	6	4.7	10.5	11	4	12.8	7.0
28	41	39	47.7	68.4	13	5	15.1	8.8	5	5	5.8	8.8	14	2	16.3	3.5	13	6	15.1	10.5
29	37	21	43.0	36.8	22	13	25.6	22.8	6	8	6.9	10.5	4	4	4.7	7.0	17	11	19.8	19.3
36	12	8	13.9	14.0	11	6	12.8	10.5	7	8	8.1	12.3	32	18	37.2	31.6	24	17	27.9	29.8
46	10	4	11.6	7.0	18	13	20.0	22.8	17	9	19.8	29.8	13	12	15.1	21.1	28	19	32.6	33.3
48	46	33	53.5	57.9	6	1	6.9	1.8	12	10	13.9	21.1	9	12	22.1	21.1	3	1	3.5	1.8
55	44	23	51.2	40.4	19	14	22.1	24.6	6	5	6.9	10.5	14	11	16.3	19.3	3	4	3.5	7.0
57	1	-	1.2	-	2	2	2.3	3.5	2	2	2.3	3.5	21	21	24.4	36.8	60	32	69.8	56.1
61	3	1	3.5	1.8	20	18	23.3	31.6	1	1	1.2	1.8	4	1	4.7	1.8	58	36	67.4	63.2

Table 10: Negative and Positive Items of Value with respect to each rating scale, Frequency, Percentage, and Sex

Items	Rating Scales																			
	1				2				3				4				5			
	Fr		P		Fr		P		Fr		P		Fr		P		Fr		P	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
23	31	25	36.1	43.9	13	11	15.1	19.3	10	6	11.6	10.5	18	10	20.9	17.5	14	5	16.3	8.8
38	11	3	12.8	5.3	14	20	16.3	35.1	3	5	3.5	8.8	18	20	20.9	35.1	40	9	46.5	15.8
62	2	1	2.3	1.8	6	3	6.9	5.3	15	15	17.4	26.3	8	11	9.3	19.3	55	27	63.9	47.4
63	41	34	47.7	59.6	24	9	27.9	15.8	17	10	19.8	17.5	4	4	4.7	7.0	-	-	-	-
64	62	35	72.1	61.4	17	7	19.8	12.3	6	10	6.9	17.5	1	5	1.2	8.8	-	-	-	-
65	2	4	2.3	7.0	14	6	16.3	10.5	13	5	15.1	8.8	15	18	17.4	31.6	42	24	48.8	42.1
66	2	1	2.3	1.8	8	7	9.3	12.3	18	10	20.9	17.5	17	12	19.8	21.1	41	27	47.7	47.4
67	47	30	54.7	52.6	24	16	27.9	28.1	12	11	13.9	19.3	3	-	3.5	-	-	-	-	-
68	-	-	-	-	12	6	13.9	10.5	11	7	12.8	12.3	25	15	29.1	26.3	38	29	44.2	50.9
69	2	1	2.3	1.8	18	7	20.9	12.3	8	10	9.3	17.5	25	13	29.1	22.8	33	26	38.4	45.6
70	-	-	-	-	14	6	16.3	10.5	7	8	8.1	14.0	24	17	27.9	29.8	41	26	47.7	45.6
72	44	30	51.2	52.6	13	8	15.1	14.0	14	6	16.3	10.5	14	13	16.3	22.8	1	-	1.2	-

Table 11: Negative and Positive Items of Teacher expectation with respect to each rating Scale, Frequency, Percentage, and Sex

Items	Rating Scales																			
	1				2				3				4				5			
	Fr		P		Fr		P		Fr		P		Fr		P		Fr		P	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
3	6	4	6.9	7.0	3	9	3.5	15.8	-	3	-	5.3	19	12	22.1	21.1	58	29	67.4	50.9
4	15	2	17.4	3.5	18	9	20.9	15.8	6	14	6.9	24.6	24	15	27.9	26.3	23	17	26.7	29.8
6	3	1	3.5	1.8	9	5	10.5	8.8	7	2	8.1	3.5	29	31	33.7	54.4	38	18	44.2	31.6
8	1	2	1.2	3.5	17	9	19.8	15.8	5	4	5.8	7.0	27	10	31.4	17.5	36	32	41.9	56.1
10	23	9	26.7	15.8	9	20	10.5	35.1	9	4	10.5	7.0	18	3	20.9	5.3	27	21	31.4	36.8
16	25	15	29.1	26.3	8	5	9.3	8.8	9	-	10.5	-	27	15	31.4	26.3	17	22	19.8	38.6
17	5	9	5.8	15.8	18	9	20.9	15.8	7	-	8.1	-	19	20	22.1	35.1	37	19	43.0	33.3
18	2	1	2.3	1.8	18	15	20.9	26.3	4	4	4.7	7.0	38	22	44.2	38.6	24	15	27.9	26.3
20	6	5	6.9	8.8	19	17	22.1	29.8	22	8	25.6	14.0	29	17	33.7	29.8	10	10	11.6	17.5
21	-	-	-	-	17	15	19.8	26.3	4	6	4.7	10.5	13	12	15.1	21.1	52	24	60.5	42.1
33	14	13	16.3	22.8	21	15	24.4	26.3	7	4	8.1	7.0	23	6	26.7	10.5	21	19	24.4	33.3
34	34	19	39.5	33.3	20	28	23.3	49.1	7	5	8.1	8.8	21	3	24.4	5.3	4	2	4.7	3.5
40	5	-	5.8	-	26	13	30.2	22.8	7	8	8.1	14.0	23	16	26.7	28.1	25	20	29.1	35.1
42	22	9	25.6	15.8	19	18	22.1	31.6	15	6	17.4	10.5	22	20	25.6	35.1	8	4	9.3	7.0
50	21	14	24.4	24.6	24	16	27.9	28.1	4	6	4.7	10.5	27	19	31.4	33.3	10	2	11.6	3.5

Appendix P: Interview guidelines prepared for KUC Department Head and Dean of Natural and Computational Sciences

The main purpose of this interview is to collect data which helps me to examine the present practices of mathematics primary teacher education curriculum and CPD in terms of Technological Pedagogical Content Knowledge (TPACK) and identify factors that contribute and challenge teacher education program and CPD during the training activities. Your response to each item in the interview is so relevant and contributes for the success of the study. Thus you are kindly requested to respond what you know. Please be sure that your responses will be used only for academic purposes.

Thank you in advance for your valuable time and thoughtful response.

Part I: Background Information:

Direction: Please respond about your personal background.

1.1 Sex ____ 1.2 Field of study: - Major _____ Minor ______

1.3 Academic qualification: - Certificate ___ Diploma ____ Degree __ Masters ___ PhD __

1.4. Responsibility --

Part II: Main data:

A teacher training school for the preparation of teachers at primary level was opened in 1944/45 and Harer teacher training school started in 1952 admitting students for a 4 year program with entry at grade8. A year earlier Haileselassie I day school at Addis Ababa had also started a new 8+4 teacher training program. The history of teacher education program till now passed through a lot of revised programs and also recently the program reached to some radical changes and started new programs like Induction and CPD, PGDT, etc. Hence the main purpose of this study is to investigate the above mentioned policy practices related to TPACK, Curriculum standard, license, and certification criteria. Johnson et al (2013) state that 21st century teachers training should be supported by TPACK frame work. To strengthen the quality of education in Ethiopian schools MOE also designed six major components (Packages). One of them is ICT. Then:

1) What are the recent strategies of training mathematics teachers in KUC related to technology? Does it consider TPACK as one of the frame works to be involved in the training system? If yes are there sufficient facilities like smart class room? If No Why?
2) Do you agree to the recent recruitment and selection criteria? If no what should be the future recruitment and selection criteria of prospective matrhemat6ics teachers?

3) Primary mathematics prospective teachers' courses revised once in three years since 1997 E.C academic year? Do you know the reason for the revision of courses?

4) Have ever participated in the revision program?

5) Was there any readiness trainings provided for teacher educators after the revision of courses? Are there adequate facilities to implement the courses effectively?

6) What do you suggest about the overall primary teacher education training program vis-à-vis the world context?

Appendix Q: The Scalar Estimates and Regression weights of Sample Items

Table 11: Prospective Mathematics Teachers of KUC Attitude test sample items validity

Items	Factors	Estimate	S.E.	C.R	P
26	Confidence	1.00			
27	Confidence	.883	.128	6.912	***
30	Confidence	.903	.129	7.009	***
32	Confidence	.976	.134	7.266	***
65	Value	1.00			
66	Value	.937	.133	7.024	***
70	Value	.869	.125	6.964	***
72	Value	1.005	.143	7.032	***
25	Enjoyment	1.00			
31	Enjoyment	.905	.133	6.811	***
60	Enjoyment	.761	.121	6.288	***
71	Enjoyment	.974	.133	7.296	***
5	Motivation	1.00			
24	Motivation	.847	.130	6.492	***
28	Motivation	1.010	.152	6.644	***
29	Motivation	.851	.146	5.851	***

As displayed in table 11; Critical Ratio (C.R) = the regression weight estimate divided by the Estimate of its Standard Error. The above table indicates the regression weight estimate of all sample items is significant at $p<0.001$ with *** level of significance of each item Estimate and C.R value.

Appendix R : Intercorrelations of primary school prospective mathematics teachers' high school result, EGSECE result, Entrance exam result, University College GPA and professional written exam (COC) resullt

Table 12: Pearson correlation result of 2005 entrants or 2012/13 of KUC Prospective primary school mathematics teachers (N=47) significant (2-tailed)

Variables	COC result	Entrance exam result	High School transcript	EGSECE result	KUC GPA
Students' Professional written Exam result (COC)	1	.280 .056	-.061 .681	.016 .914	.570** .000
Students' Entrance Exam result	.280 .056	1	.485** .001	.305* .037	.340* .019
Students high school transcript result	-.061 .681	.485** .001	1	.525** .000	-.036 .810
EGSECE result	.016 .914	.305* .037	.525** .000	1	.133 .374
KUC GPA	.570** .000	.340* .019	-.036 .810	.133 .374	1

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

*Correlation is significant at the 0.05 level (2-tailed)

Appendix S: Intercorrelations of TPACK knowledge areas based on teacher educators interview result

Table 13: Pearson correlation of TK, CK, PK, PCK, and TPCK (N= 12).

	TK	CK	PK	PCK	TPCK
TK					
Pearson correlation	1	.357	.174	.000	-.369
Sig. (2-tailed)		.255	.588	1.000	.237
CK					
Pearson correlation	.357	1	.683*	.000	.000
Sig. (2-tailed)	.255		.014	1.000	1.000
PK					
Pearson correlation	.174	.683*	1	.000	-.471
Sig. (2-tailed)	.588	.014		1.000	.122
PCK					
Pearson correlation	.000	.000	.000	1	.500
Sig. (2-tailed)	1.000	1.000	1.000		.098
TPCK					
Pearson correlation	-.369	.000	-.471	.500	1
Sig. (2-tailed)	.237	1.000	.122	.098	

* Correlation is significant at the 0.05 level (2-tailed)

Addendum: Dec laration Sheet

Here under I verify that the dissertation is my original work and has not been presented for a degree in any other University. I also make sure that all the source materials used in this dissertation have been duly acknowledged.

Name ____

Signature ______________

Date ______________________________

Submitted to: Department of Curriculum and Instructiuon

The Dissertation has been submitted with my approval as University advisor.

Name ____

Signature __________________

Date ____________________