QUALITY OF PRIMARY EDUCATION IN ETHIOPIA: THE CASE OF EARLY GRADE MATHEMATICS COMPETENCY IN TIGRAI

Abraha Asfaw

Dissertation Submitted to the Department of Curriculum and Teacher Professional Development Studies in Fulfillment of the Requirements for the Degree of Doctor of Philosophy (PhD) in Curriculum Design and Development

College of Education and Behavioral Studies
Addis Ababa University
Addis Ababa, Ethiopia
March, 2015

Dedication:

To My Father - My Foundation

ADDIS ABABA UNIVERSITY

College of Education and Behavioral Studies

Department of Curriculum and Teachers' Professional Development Studies

This is to certify that the PhD dissertation prepared by **Abraha Asfaw** entitled **QUALITY OF PRIMARY EDUCATION IN ETHIOPIA: THE CASE OF EARLY GRADE MATHEMATICS COMPETENCY IN TIGRAI**

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 the Examining Board Committee:

Amare Asgedom	[signature]	27/03/15
Supervisor	Signature	Date
Temechegn Engida	[signature]	27/3/2015
Internal Examiner	Signature	Date
Edward Silver	[signature]	27/3/2015
External Examiner	Signature	Date
Gebregziabher Debes	[signature]	27/03/2015
Chair person	Signature	Date

DEPARTMENT OF TEACHER EDUCATION & CURRICULUM STUDIES
ADDIS ABABA UNIVERSITY COLLEGE OF EDUCATION

Quality of Primary Education in Ethiopia: The Case of Early Grade Mathematics Competency in Tigrai

By Abraha Asfaw

Dissertation Submitted to the Department of Curriculum and Teacher Professional Development Studies in Fulfillment of the Requirements for the Degree of Doctor of Philosophy (PhD) in Curriculum Design and Development
Addis Ababa University

Abstract

This study explored the status of quality of primary education in Ethiopia as measured by early grade mathematics competency in Tigrai. For this purpose, the study adopted quantitative research design and the Early Grade Mathematics Assessment (EGMA) approach with a focus on Counting Concept (CC) and Number Sense (NS) constructs and their respective indicators. Operationally, while CC included One-to-One correspondence, Cardinality and Missing Number sub-tests; NS construct was defined by measures of Oral Counting, Number identification, Quantity Discrimination, and Addition and Subtraction. Data was collected from 834 grades 1 and 2 students, 55 teachers and 21 head teachers from 21 randomly selected primary schools and seven districts of the Regional State. The study used a data collection instrument that comprised two sets of items: (a) seven sub-tests on the measures of the constructs, and (b) background questionnaire on predictive variables. From the results of the analysis of data using both descriptive and inferential statistical techniques, it was concluded that: (1) quality of primary education in Ethiopia as measured by Early Grade Mathematics Competency is basically low, as the mean score of the children fell at about 39 per cent, far less than the policy benchmark set (minimum 50 %); (2) urban children outperformed their rural counterparts with medium effect size (d=.78), i.e. 50% urban children *surpassed about 78% of children from rural setting; (3) gender inequality in favor of boys is a reflection of rural setting, indicating that rural girls are at double disadvantage; and (4) of the variables included, age, being male in rural setting, availability of functional library and textbook-student ratio predicted relative success in learning. Given that early grade is the foundation for human and knowledge development, the findings are not only status indicators but also future predictors. Students who start with learning problems are likely to have limited capacity to succeed in upper grades. The findings, therefore, imply the need for deepening our knowledge of quality dimensions in the Ethiopian policy context, reforming curriculum, conducting further and comprehensive research on critical achievement and inequality variables, and designing timely and appropriate intervention schemes to redress the problem.*

Key Words: Quality, Early Grade, Mathematics, Competency

ACKNOWLEDGEMENTS

The process of developing this research and the nature of the study itself helped me to realize that this final outcome is a result of accumulated experiences, and not necessarily an impact of the PhD program only. Without the support of many people in the process of my education from early age to this level, the present achievement could have been difficult to imagine. I am thankful to all.

I enjoyed the support, guidance and professional critique of my advisor, Dr Amare Asgedom, truly speaking a colleague and a friend. Since the inception of the study to its current status, he pushed me to the depth of the conceptualization and technicalities, and extended his unreserved support during difficult transitions. Thank you for what you have done to me.

Many colleagues encouraged and extended their support throughout the study. Dr Ambisa Kenea was always on my side, I am indebted to thank him for his encouragement, constructive comments and sharing my academic load to give me time for the research work. The comments from Dr Dessu Wirtu and Dr Belete Kebede (USA) on the draft version enriched the quality of the report and I extend my thanks to both of them. Atsbha Kasa, Tewelde Girmay, and Gebre Welde-Silasse (and his beloved wife Mebrat Kahsay), all from USA, shared my ambition and their support was helpful to bring this study to its final stage. I should also note the support from Dr Gebre-Egziabher Debeb and Haftay Gebre-Egziabher at different levels of the study. I extend my appreciations to all!

The data collection was so expensive and money intensive. I really appreciate the generous vehicle support of Tigrai Development Association (TDA), especially H.E. Ambassador Tewlde Gebru, Tigrai Regional State Education Bureau, especially Ato Gobezay W/Aregay, Ato Teklay G/Medhin, the then Deputy Head of Woreda Administration and Head of Finance and Economic Development of Kilte-Awlaelo woreda. Tadesse Mamo and Rezene Fiseha helped in the coordination of the training of assessors and data collection process, and I extend my appreciation to the support I enjoyed during my study. My brother Bekuretsion Asafw was always on my side, especially the process of data entry and cleaning would have been very difficult without his direct involvement. Thank you Bekru!

This study was time taking. I have to extend my gratitude to my beloved wife W/ro Solome Mamo for her care, support, and courage to shoulder the family responsibilities throughout my study time. My Kids (Mearg, Hermela, and Tsadena) were so patient and loving despite my focus on my study for so long. Please know that you are my vision and inspiration.

I recognize that my parents invested a lot on my education. My father and mother worked hard to push me up the education ladder since early ages. My mother, W/ro Tekien Sibhatu, spent sleepless nights during my whole school years to make sure I have everything in time; my father, Ato Asfaw Ambaye, laid my foundation. He was a self-literate, and used to surprise me in his fond of knowledge and critical arguments to continuously shape my thinking and make sure I am growing. Unfortunately, even today (at this level) I run short of adequate words to express my indebtedness to his lifelong efforts to ensure my success in the academic arena. Anyway, I say thank you to both of you and I pray to rest the soul of my father in peace! There were difficult times where I have to think of dropping out of school had it not been for the unparallel sacrifice of my parents, my brothers (Werkilul and Haile-Mariam), and my sister (Mulu) and her husband (Kishi Fetiyeyo Redae). Please know that the memory of the past is still alive and I thank you all for what you have done to me!

TABLE OF CONTENTS

Page

Abstract………………………………………………………………………….. *iii*

Acknowledgements……………………………………………………………...… *v*

List of Tables…………………………………………………………………… *xi*

List of Figures…………………………………………………………………. *xiii*

Abbreviations/ Acronym...….. *xiv*

CHAPTER 1: SETTING THE SCENE: THE ISSUE AND ITS CONTEXT……………………………………………….. 1

1.1. Introduction…………………………………………………………….. 1

1.2. The Issue in Context…………………………………………………. 4

1.2.1. Research on learning: The conceptual shift…………………..... 4

1.2.2. Early grade mathematics learning in Tigrai: The inadequacy of the evidence……………………………………………….…..... 7

1.2.3. Research on early grade mathematics constructs…………….. 10

1.2.4. Determination of early grade mathematics competency in Tirgai.. 11

1.3.The Research Problem……………………………………………….. 12

1.4.Objectives of the Study……………………………………………….. 15

1.5. The Contributions of the Study……………………………………. 15

1.6. The Theoretical Framework for Assessing Competency…………..... 20

1.6.1. Established theoretical models of research in student learning. 20

1.6.2. Personal assumptions …………………….............................. 25

1.6.3. The conceptual framework of the study.................................... 27

1.7. The Scope of the Study………………………………………………. 28

1.8. Limitations of the Study…………………………………………….... 29

1.9. Organization of the Thesis…………………………………………… 31

1.10. Operational Definitions of Key Terms……………………………… 33

Page

CHAPTER 2: RESEARCH METHODOLOGY ……………………......... **35**

2.1. The Research Design…………………………………………… 35

2.2. Sampling Frame…………………………………………………. 38

2.3. Sampling Procedures and Sample Size…………………………. 42

2.4. Instruments of Data Collection………………………………….. 46

2.5. Training of Assessors, Piloting and Data Collection Process………………………………………………………... 55

2.6. Data Entry, Quality Checking, and Analysis Techniques…………. 60

CHAPTER 3: QUALITY OF PRIMARY EDUCATION: DEFINITIONAL PERSPECTIVES………………... **65**

3.1.Introduction…………………………………………………….. 65

3.2.Philosophical Perspectives on Defining Quality of Education…….. 66

3.3. Systems Model on Defining Quality of Education……………….. 77

3.4. EFA Perspectives on Defining Quality of Education…………….. 81

3.5.Limitations of the EFA Declarations……………………………. 89

3.6. Conclusion: Operationalizing Educational Quality in this study..... 94

CHAPTER 4: ASSESSING QUALITY IN MATHEMATICS: LESSONS FROM GLOBAL EXPERIENCES ……….................. **99**

4.1. Introduction ……………………………………………………... 99

4.2. Why Assessment of Learning?…... 100

4.3. Assessing Mathematics Learning: Lessons from TIMSS, PISA and SACMEQ………………………………………………… 103

4.3.1. TIMSS ……………………………………….................... 104

4.3.2. PISA …………………………………………………… 108

4.3.3. SACMEQ ……………………………………………… 111

4.3.4. TIMSS, PISA and SACMEQ: similarities and differences.. 114

4.4. Early Grade Mathematics Assessment (EGMA) ………………... 116

4.4.1. Background ……………………………………………. 116

Page

4.4.2. Counting Concept (CC) and Number Sense (NS) in early grade mathematics ……………………………………….. 119

4.4.3. EGMA and its main features …………………………….. 122

4.5. Summary ……………………………………………………… 125

CHAPTER 5: THE LANDSCAPE OF PRIMARY EDUCATION IN ETHIOPIA …………………………………….................. 126

5.1. Introduction …………………………………………………….. 126

5.2. Primary Education in Ethiopia: Overview of the Genealogy, Access and Equity ………………………………………………. 126

5.3. Primary Education in Ethiopia: Issues of Relevance and Quality.. 132

5.3.1. Relevance and quality of primary education in historical perspective.. 132

5.3.2. Empirical evidence on quality of primary education in Ethiopia.. 139

5.4. Primary Education in the State of Tigrai ……………………….. 143

5.5. Status of Early Grade Learning in Ethiopia and the State of Tigrai......... 149

5.6. Summary ……………………………………………………… 153

CHAPTER 6: THE STATUS OF BACKGROUND VARIABLES AND EARLY GRADE MATHEMATICS COMPETENCY (EGMC) IN TIGRAI ……………………………………... 155

6.1. Introduction …………………………………………………….. 155

6.2. The Status of Individual, Home and School Variables …………. 156

6.3. Achievement Scores of Children by Sub-test and Construct …... 170

6.4. Summary ……………………………………………………… 185

Page

CHAPTER 7: PREDICTIVE VARIABLES OF EARLY GRADE MATHEMATICS COMPETENCY …………………… 187

7.1. Introduction …………………………………………………….. 187

7.2. Relationship among the Early Grade Mathematics Sub-tests….... 188

7.3. The Contributions of background variables in early grade mathematics competency ………………………………………. 191

7.4. Summary ……………………………………………............... 204

CHAPTER 8: CONCLUSION: INSINUATION ABOUT QUALITY....... 206

8.1. Introduction.. 206

8.2. Revisiting the Problem and its Approach...................................... 206

8.3. Conclusions.. 210

8.4. Implications.. 216

BIBLIOGRAPHY.. 220

ANNEXES... 243

Annex 1: National Minimum Learning Competencies /MLC/ in Mathematics for Grades 1 & 2... 244

Annex 2A: Student Data Collection Format (Tigrigna)........................ 246

Annex 2B. Student Data Collection Format (English).......................... 256

Annex 3A. Teacher Questionnaire (Tigrigna)...................................... 265

Annex 3B. Teacher Questionnaire (English)....................................... 268

Annex 4A. Head Teacher Questionnaire (Tigrigna).............................. 271

Annex 4B. Head Teacher Questionnaire (English)............................... 274

Annex 5. Early Grade Math Assessment (EGMA) Administration Guideline- Abridged.. 277

Annex 6. Student Sampling Sheet... 279

Annex 7. School Field Visit Summary Sheet.. 280

Annex 8. Student Responses by Task and Item.................................... 281

LIST OF TABLES

		Page
1.	Scores in Mathematics as measured by the national learning assessments, by grade	8
2.	List of sample schools of the study, by woreda	45
3.	Sample size of the study	46
4.	Alpha coefficients and their interpretations	58
5.	SACMEQ: the eight levels of mathematics competencies with corresponding skill indicators	113
6.	Number of missing schools as a result of the land tax, 1949–1954	145
7.	Number of respondents by school and sex	157
8.	Individual characteristics of respondent children	158
9.	Individual characteristics of respondent teachers and head teachers	161
10.	Sampled school distribution, location, total student population and grade levels enrolled in 2011/12 academic year	164
11.	Home and school language congruence, availability of functional library, and textbook-student ratio	165
12.	Class size and availability of math teacher's guides and teacher support	167
13.	Views of head teachers on the availability of functional pedagogical center, water tap, latrine and electricity in schools	168
14	The status of selected home related variables as viewed by respondent students	169
15	Competency mean scores of students in Tigrai by construct and sub-test	173
16	Mean scores by sub-test and grade	175
17	Frequency distribution of competency scores in OC, OTO and NI	177
18	Frequency distribution of competency scores in C, MN, QD, Add, & Sub sub-tests	180
19	Zero-order correlations between the sub-tests (N=833)	189
20	Results of t-test on mean differences as a function of sex and location	192
21	The contribution of sex difference on achievement, by location	195
22	One-Way ANOVA on achievement difference as a function of age	196

		Page
23	KG experience and absenteeism as predictors of mathematics achievement.	198
24	The contributions of reference materials, literacy of mother and father, and support in studying on academic achievements ……………………………….	200
25	Mean scores of children as a function of availability of reference materials, literacy of mother and father, and support in studying ……………………..	201
26	The contributions of functional library and textbooks on early grade mathematics achievements ………………………………………….......	203

LIST OF FIGURES

Page

1. Conceptual framework of the study …………………………………….......... 27
2. Map of Tigrai and woredas of the sample schools....................................... 43
3. Definitions of the quality concept by Harvey and Stensaker (2008) ………. 71
4. Scheerens’ basic systems model on the functioning of education................ 78
5. Learning Competency as a center piece of quality definition ……………... 96
6. Cut-off points of the levels of performances in PISA Mathematics 2003 and 2012 ………………………………………………………………… 110
7. Primary Education NER, by Region and Sex - 2005 E.C (2012-13) ………. 131
8. National Mean Scores of Students in Mathematics, by Grade and Assessment …………………………………………………….................. 142
9. Mathematics performances of grades 4 and 8 students from Tigrai as compared to national averages ……………………………………………... 148
10. Percentage of children unable to read a single word correctly, by language and grade ………………………………………….............................. 152
11. Percentage of Children Scoring Zero on Reading Comprehension………… 153
12. Views of children regarding who supports in studying at home (N=833) … 169
13. Proportion of zero and over 60 per minute scorers in OC, OTO and NI by grade level ………………………………………….............................. 179
14. Proportion of zero and below half scorers in C, MN, QD, Add & Sub by grade ……………………………………………………………………... 183
15. Normality test of the distribution of the raw scores ……………………....... 184
16. The relationship between Quality of Education and Early Grade Mathematics Competency.. 207

ABBREVIATIONS/ ACRONYMS

Add	Addition
ANOVA	Analysis of Variance
C	Cardinality
CC	Counting Concept
COPWE	Commission for Organizing the Party of the Working People of Ethiopia
CTA	Curriculum, Textbook and Assessment
ECCE	Early Childhood Care and education
EFA	Education For All
EGMA	Early Grade Mathematics Assessment
EGMC	Early Grade Mathematics Competency
EGRA	Early Grade Reading Assessment
ELQIP	English Language Quality Improvement Program
EMIS	Education Management Information Systems
ERGESE	Evaluative Research on the General Education System of Ethiopia
ESDP	Education Sector Development Program
FDRE	Federal Democratic Republic of Ethiopia
FiNLA	First National Learning Assessment
FNLA	Fourth National Learning Assessment
GEQIP	General Education Quality Improvement Package
GER	Gross Enrolment Rate
GRM	Global Monitoring Report
ICT	Information and Communication Technology
IEA	International Association for the Evaluation of Educational Achievement
IIEP	International Institute for Educational Planning
JICA	Japan International Cooperation Agency
KG	Kindergarten
MAP	Management and Administration Program
MDG	Millennium Development Goal

MN	Missing Number
MoE	Ministry of Education
MoFED	Ministry of Finance and Economic Development
MoH	Ministry of Health
MWA	Ministry of Women's Affairs
NER	Net Enrolment Rate
NI	Number Identification
NMAP	National Mathematics Advisory Panel
NS	Number Sense
OC	Oral Counting
OECD	Organization for Economic Cooperation and Development
OTO	One-To-One Correspondence
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PISA	Programme for International Student Assessment
QD	Quantity Discrimination
RTI	Research Triangle Institution
SACMEQ	Southern and Eastern Africa Consortium for Monitoring Educational Quality
SIP	School Improvement Program
SMASEE	Strengthening Mathematics and Science Education in Ethiopia
SNLA	Second National Learning Assessment
SNNPR	Southern Nations, Nationalities and Peoples Region
SPSS	Statistical Package for the Social Sciences
Sub	Subtraction
TIMSS	Trends in Mathematics and Science Studies
TNLA	Third National Learning Assessment
TPLF	Tigrai People's Liberation Front
TTI	Teacher Training Institute
UN-ECA	United Nations Economic Commission for Africa
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNICEF	United Nations Children's Fund

USA	United States of America
USSR	Union of Soviet Socialist Republics
WCEFA	World Conference on Education for All

CHAPTER 1
SETTING THE SCENE: THE ISSUE AND ITS CONTEXT

1.1. Introduction

This study tried to investigate the status of early grade mathematics competency in Tigrai, one of the nine ethnic regional states in Ethiopia (Federal Democratic Republic of Ethiopia (FDRE), 1995). It is located in the northernmost part of the country, and as per the 2007 population census, it's over four million population constitutes 6.1 per cent of the total 74 million population of the country estimated by the same census. The proportion of primary school age children (7 – 14 years age) is about 22.97 percent of the total regional population. Though the sex composition is almost equal (49.2 per cent males to 50.8 percent females), only one-fifth of the total population lives in urban areas. At national level too, the nearly 74 million population was characterized by comparable sex mix, of which only 16 per cent were from urban, and primary school age children constituting about 24 per cent (FDRE, Population Census Commission, 2008).

Despite this huge population size, educational opportunity was limited in scope till mid 1990's. We Ethiopians regrettably remember the nearly two decades (1974 - 1991) of intense internal strife which, among other things, caused misallocation of national resources to war expenses, and destroyed the education system in Tigrai and left many children out of school. As the armed struggle led by Tigrai People's Liberation Front (TPLF) got stronger and stronger, the central government control continued to shrink, until its complete expulsion from the region in 1989 and its ultimate downfall in May1991. Consequently, there was no national government led schooling in Tigrai in the years 1989 to the academic year ending in 1991(Young, 1997).

In other words, during the Jomtien Education For All (EFA) declaration (1990), the country was in a state of war and unable to respond to the international call for action to expand educational access for all children. It was only after government change took place in 1991[1] that the country established the first ever sector specific education and training policy document to redress the educational needs in the country, focusing on four pillars – access, equity, relevance and quality (Ministry of Education (MoE)- Ethiopia, 1994a: 2). The national constitution also endorsed the international agreements, including the EFA declaration, as integral parts of the federal constitution (FDRE, 1995, Article 9 (4)). Educational efforts in Ethiopia in the last decades had, therefore, both national and international goals – expanding primary education access for all children in a way that ensures learning.

Consequently, during the first decade of this century, schooling opportunity is expanded more than ever in Tigrai, as it is true in the whole country. Millions of children are enrolled at primary, with increased student population at all levels (primary, secondary and tertiary). In the academic year ending in 2012, the national and Tigrai Regional State Net Enrollment Rates (NER) for primary education (grades 1-8) reached 85.4 and 92.1 percent respectively. In total, the number of primary school children in the nation reached

[1]Though the whole country was constrained because of the internal conflict, Tigrai became the war front between Derg and Tigrai People's Liberation Front (TPLF). The conflict came to an end in 1991 as the Derg regime was overthrown by the Ethiopian People’s Revolutionary Democratic Front (EPRDF).

over 17.8 million (over one million of them from Tigari) in the same year (MoE, 2012). Though the number of schools opened and children enrolled in Tigrai after the down fall of the military junta in 1991 were 518 and 198074 respectively (Taddele, 2008), current data indicates that there were 1,006,973 children in 1995 primary schools (grades 1 – 8) in the academic year ending in 2012 (MoE, 2012). But does this access tally with quality of education or development of the desired competency?

Global assessments towards universal primary education are showing inconsistencies between access and quality gains. While achievements in access are commonly encouraging, learning outcomes from poor countries are generally low, compared to that of the developed world (UNESCO, 2011; United Nations, 2012). “The median child in a low-income country performs at about the third percentile of a high-income country distribution (i.e. worse than 97 percent of students who were tested in the high-income country)” (RTI, 2009: 1).

The global community recognized Ethiopia’s exemplary success in bringing children to school and heading towards universal primary education (UNESCO, 2007 & 2008). But, to repeat, are children actually learning? Studies such as the National Learning Assessments at grades 4 and 8 (MoE, 2000, 2004, 2008b, & 2013a) showed learning crisis in schools. However, such studies take the development of learning skills (reading, writing and arithmetic) for granted and test what the students know or otherwise after four or so years of schooling (RTI, 2009). In other words, assessment of learning (knowing the accumulated effect) is focused at the expense of *assessment for learning* (gathering evidence on how students are learning for possible intervention). It is only recently that Ethiopian Early Grade Reading Assessment (EGRA) was conducted at grades 2 and 3 to understand the competency of students to learn through reading (Benjamin, 2010). This study focused on the status of quality of early grade learning in Ethiopian schools by taking the case of mathematics competencies in Tigrai regional state.

1.2. The Issue in Context

This part focuses on situating the study in the context of the prevailing conditions in research around learning and the conceptual shift we are experiencing, the inadequacy of evidence in early grade mathematics learning in Ethiopia/Tigrai, the nature and interrelationship of mathematics learning constructs, and the determinants of early grade mathematics learning in the study area. The points are both justifications and contextual definitions to understand the relevance of early grade research in Tigrai with focus on school mathematics.

1.2.1. Research on learning: The conceptual shift

The conception of learning and how it transpires are points of disarray, yet unresolved. It is clear that schools are for students' learning. But, if research is to measure learning, there should be a frame of reference as to what learning is all about. For example, Cheung (1994) reviewed Doyle's (1977) three areas of research in measuring learning. These are the process-product, the mediating process and the classroom ecology paradigms. The process-product paradigm of classroom learning asserts a direct relationship between teacher variables and quality of learning. This depends on the readiness of the teacher to bring about the desired learning on the part of the students. Input variables like the training of the teachers, pedagogical content knowledge, motivation, and others, with almost no direct indicator on the level of implementation, are assumed to predict the resulting learning outcomes in schools. The mediating process, on the other hand, focuses on the stimulus-response relationship as determinant of learning. This is a view of the behaviorists with the conception that the realization of learning depends on the strength of the stimuli that initiate responses on the part of students. In other words, the quality of learning is directly proportional to the strength of the stimuli from the teacher and classroom resources. As the strength of the stimuli to elicit responses differs, the relative importance of variables to bring about learning varies.

The third, the classroom ecology paradigm, perceives learning as a result of minimum environmental setting for appropriate learning to happen. Here, the focus is not on the search for the important variables that bring differences in achievement or differences in stimulus – response strength but about the integral elements of a classroom setup for instructional purposes. This position promotes the proposition that the whole is different from the sum of the parts and learning is a result of the integration of classroom elements such as time available, quality of textbooks, teacher training, availability of teaching materials, etc. rather than the relative contributions of these variables on individual basis.

Measuring learning in terms of competency is, however, a relatively new phenomenon. Halasz and Michel (2011) connected the growing use of the term ‘competency’ in primary and general education to the OECD report published in 1994 and to the proposal of the four pillars of education (learning to know, to do, to live together and to be) by the

Delors Commission (1996), later included in the Dakar EFA declaration (UNESCO, 2000). Today, the term competency seems to have both philosophical and practical backgrounds.

According to Tiana, Moya and Luengo (2011) the term *competency* is a kind of learning that indicates the use of knowledge, attitude and skill to accomplish certain task in a specified context. In this regard, learning constitutes three elements: (1) acquisition of knowledge (scientific knowledge, attitude and skill), (2) engagement in activities, and (3) context specific use rather than universal application of knowledge. For some, this minimizes wastage and is economical approach to learning; for others, the social benefit is more important in which differences among students are recognized but are not defined as deficiencies (ibid). By implication, then, all students are able to learn as a result of schooling; schools can improve learning capabilities; and the differences in achievement are not inherent shortfalls but reflections of current situation in learning. Competency based learning, therefore, emphasizes on meaningful learning and on the integration of theory and practice. Anything devoid of these may indicate learning but not in the sense of competency.

Similarly, the Dakar EFA framework (UNESCO, 2000) defined learning as the incorporation of useful knowledge, reasoning ability, skills and values. Education for children is, therefore, an opportunity designed to meet learning needs consisting of:

> learning tools (such as literacy, oral expression, numeracy and problem solving) and the basic learning content (such as knowledge, skills, values, and attitudes)

required by human being to be able to survive, to develop their full capacities, to live and work in dignity, to participate fully in development, to improve the quality of their lives, to make informed decision, and to continue learning. (p. 75).

Though there is no indication to the operational definition of the term competency, practice in Ethiopia also shows a trend of specification of learning competencies for different grade levels and subjects. For example, for mathematics grades 1 through 4, the Ministry of education listed competencies under seven themes. The list includes learning competencies for numbers, operations (addition, subtraction, multiplication and division), measurement, geometric shapes and solid objects, money, time, and patterns and graphs, specified by grade as appropriate (MoE, 2008a). Despite the specification of the learning competencies by grade levels, the reality at the early grades is not documented in detail so far. Thus, this research was intended to measure the status of early grade (grades 1 and 2) mathematics learning competencies in view of the national parameters and the corresponding conception of early grade learning.

1.2.2. Early grade mathematics learning in Tigrai: The inadequacy of the evidence

Early grade research practice in Ethiopian education in general and in the subject mathematics in particular is not common. Hence, the local literature in the area is so thin to give basis for such studies and policy recommendations. About the situation in Tigrai, our understanding of quality of learning as measured by early grade mathematics competencies is fundamentally limited to judgments on the basis of the findings of the national learning assessments at grades 4 and above, and anecdotal evidence from the field. This is so despite many changes in the policy context (such as the introduction of Tigrigna as a medium of instruction at primary level), expansion of educational opportunities at all levels and the increased importance of evidence to make appropriate decisions.

Table 1. Scores in Mathematics as measured by the national learning assessments, by grade

Year published	Level	Mean scores (%) Grade 4	Grade 8	Grade 10	Grade 12
2000	National	39.3	38.2	-	-
	Tigrai	36.9	45.3	-	-
2004	National	39.7	40.9	-	-
	Tigrai	34.5	44.4	-	-
2008	National	40.3	34.1	-	-
	Tigrai	41.4	40.4	-	-
2010	National	-	-	34.7	54.3
	Tigrai	-	-	32.2	51.8
2013	National	37.04	25.53		
	Tigrai	36.84	25.97		

(Source: MoE, Ethiopia (2000, 2004, 2008b, 2013a).***Ethiopian 1st, 2nd, 3rd and 4th National Learning Assessment of Grade 4 Students.*** Addis Ababa, Ethiopia; MoE, Ethiopia. (2010).***Ethiopian First National Learning Assessment of Grades 10 & 12 Students.*** Addis Ababa).

From Table 1, it is clear that both national and Tigrai achievements, except at grade 12, were below average (i.e. below 50%). The findings were basically consistent in conveying the message that an average student who stayed for four or more years in schools in Ethiopia/Tigrai was able to achieve about 35 to 55 per cent only. Why?

However, the learning assessments were aimed at evaluating the match between what students were supposed to learn (competencies identified) and what they actually learned by the end of the grade levels tested. In doing so, the Ethiopian National Learning Assessment shares the limitations of research at this level identified by RTI (2009):

> Most national and international assessments are paper-and-pencil tests administered to students in grade 4 and above (that is, they assume students can read and write). It is not always possible to tell from the results of these tests whether students score poorly because they lack the knowledge tested by the assessments, or because they lack basic reading and comprehension skills (p.1).

What is known so far is, therefore, mathematics achievements in grade 4 and above in Tigrai, and even at national level, are low. The problem is we do not know so far whether the low achievements of students are because of inadequacies in the development of mathematics skills and concepts at early grades (basically counting concepts & number sense), the testing procedure (mainly the inclusion of reading and writing skills in testing) or grade level specific difficulties. Simply, the national learning assessments focus on measuring the outcomes expected to be realized by the end of grade 4 or above, but the reasons for failure could be related to the level of mastery of prerequisite competencies at early grades (specially at grades 1 and 2), including the ability to read and write. The system of assessment also indicates *assessment of learning*, the dead end, and not assessment for learning which aims at enhancing learning and thereby improving academic achievements.

1.2.3. Research on Early Grade Mathematics Constructs

The Ethiopian Education and Training Policy (1994) stated that “the preparation of curriculum will be based on the stated objectives of education, ensuring that the relevant standards and the expected profiles of students are achieved” (FDRE, 1994:12). This is in line with the conception of the 2000 Dakar Declaration which claimed the realization of “recognized and measurable learning outcomes” (UNESCO, 2000: 17) with an emphasis on literacy, numeracy and life skills. However, early grade mathematics competency is basically about number competency (Jordan & Levine, 2009; Jordan *et al*, 2009; Zevenbergen, Dole, & Wright, 2004).

Accordingly, early grade mathematics studies in the developed world revealed that the foundation elements for competency in mathematics learning are classified into two basic constructs, namely Counting Concepts (CC) and Number Sense (NS). In the literature, the indicators[2] of Counting Concept construct are listed to be one-to-one correspondence, stable order (missing number), cardinality, order irrelevance, and abstraction; and Number Sense construct includes number identification, counting skill, understanding quantity, and ability in the four operations as appropriate (Gelman & Meck, 1983; Baroody, 1993; Clarke & Shinn, 2004; Smith, 2010). However, the strength of the relationship among the specific indicators of the two constructs and the power of each construct to predict success in mathematics learning are still issues open for further investigation because of two basic reasons: (1) research evidence in early grade

[2] Indicators are the measures of Counting Concept and Number Sense Constructs for which items were developed to measure competency. In this report, sub-test and sub-construct are used interchangeably to refer to the divisions under each construct. As per the scope of this paper, those refer to: (a) under Counting Concept – One-to-One correspondence, Cardinality and Missing Number, and (b) under Number Sense – Oral Counting, Number Identification, Quantity Discrimination, and Addition plus Subtraction.

mathematics, even in the developed world, is not conclusive and the link among the mathematics concepts described is not yet well established (Smith, 2010); and (2) The knowledge structure in the context of Ethiopia lacks sufficient research evidence. These gaps of knowledge call for culture specific research endeavor for home-grown mathematics knowledge structure and process of learning synergy.

1.2.4. Determinants of Early Grade Mathematics Competency in Tigrai

Studies in Ethiopia identified some proxy variables to the mathematics learning competencies in particular and overall academic achievements in general. The three Ethiopian National Learning Assessments (MoE, 2000, 2004, 2008b) at Grade 4 showed that achievements in mathematics in Tigrai favored males over females and rural over urban. The results obtained from grade 8 were also consistent with that of grade 4 except for the switch in the rural and urban based achievements in mathematics in the first national assessment. The latest report, named as the fourth National Learning Assessment, provided some differing findings in which urban, being male, having additional reading materials, education of father, and absenteeism were identified as predictors of achievement (MoE, 2013a). However, in the reports, there are no clarifications if the gender differences in achievements start from early on or these are manifestations of later experiences. Moreover, though early childhood education in Ethiopia is generally limited in scope (GER in 2008 was only 4.2%), the opportunity is much better in urban areas than otherwise (MoE, MoH, & MWA, 2010). Findings that favor rural areas over urban ones in Ethiopia (like the cases in the national learning assessments for Tigrai), therefore, need further verifications as it seems underestimating the input variations between rural and urban settings.

In summary, the following basic questions sum-up the justifications for this research: What is the status of quality of education and early grade learning in Tigrai as measured by mathematics competency? What are the conditional variables that influence the development of early grade mathematics competency in the context of the study area?

1.3. The Research Problem

Secular education in Ethiopia was introduced at the beginning of the 20th Century from Europe (MoE, 1984: 1-2). Despite its long history, however, the development of responsive education system is not yet a reality. Current achievements in the expansion of educational opportunities and increase in enrolment at all levels are encouraging. The development becomes incomplete because worries in the status of student learning or quality of education are increasing (World Bank, 1998, 2008; MoE, 2000, 2004, 2008b, 2013a; Benjamin, 2010). Though the evidence at hand is limited, especially with regard to early grade mathematics competency, the available ones indicate two types of problems: (1) the mean achievement scores in the National Learning Assessments are low; and (2) there are inequalities in state of learning resulting from differences in location of residence (urban-rural), sex, income level, parental education, and related factors. The evidence in primary school achievement so far favors boys and children from better income as compared to girls and those from low income families respectively (MoE, 2000, 2004, 2008b, 2013a; Tilaye & Bediru, 2006; Tamirie, 2006, 2009; Tatek, 2007, 2008; Poluha, 2004; Camfield, 2011). The evidence regarding urban-rural difference, however, has some inconsistency. For example in the Third National Learning Assessment grade four rural children outperformed those from urban (MoE, 2008), while the reverse was true in 2012 (MoE, 2013a).

In fact, the latest National Learning Assessment report by the Ministry of Education indicated not only the correlates of achievements (like gender, age, home and school language differences, access to reference materials, father's education, family income level, and absenteeism) but also the decreasing trend of the achievement magnitude over the years (ibid.). From the results of studies in Ethiopia, factors of learning seem to relate to individual characteristics (such as sex, KG experiences and absenteeism), school variables (like material availability), and family background (mainly related to income and education level). However, there is no conclusive evidence on the source (s) of learning variables in the Ethiopian context though school related factors seemed more vivid in the national Early Grade Reading Assessment (EGRA) report (Benjamin, 2010).

Generally, as available studies focused on upper grades the literature has a limitation in providing relevant and adequate information about the quality of education in the early grades and the nature of predictors. Likewise, there is a knowledge gap on the status of early grade mathematics competency and its determinants in Ethiopia in general and in the state of Tigrai in particular. Therefore, the principal question of this research was: What is the status of quality of education in Ethiopia as measured by early grade mathematics competency in Tigrai? In view of this basic question, the researcher hypothesized the following:

1. The mean scores for grades 1 and 2 children in mathematics in Tigrai, as measured by Counting Concept (CC) and Number Sense (NS) constructs, exceed 50% (the minimum benchmark set by the policy).
2. There is statistically significant relationship:

   2.1. Within the indicators of:

      (a) CC Construct (one-to-one correspondence, missing number and cardinality), and

      (b) NS Construct (number identification, oral counting, understanding quantity, and addition and subtraction).

   2.2. Across the indicators of the CC and NS constructs.

   2.3.Between the CC and NS constructs.

3. Males and urban children out-perform their respective counterparts in early grade mathematics competency.
4. Individual background (KG experience, age, interest towards mathematics, absenteeism, and repetition), home variables (literacy of mothers and fathers, support during study time, availability of time for academic activities after school and availability of reference materials at home) and school variables (availability of functional library, home and school language difference, and textbook-student ratio) predict students' early grade mathematics competency.

1.4 Objectives of the Study

The primary objective of this study was to assess the status of quality of primary education by taking early grade (grades 1 and 2) mathematics competency as measured by the indicators of Counting Concept (CC) and Number Sense (NS) constructs. Specifically, this research intends to:

1. Investigate the status of early grade (grades 1 & 2) mathematics competency in view of the policy assumption for students' promotion from grade to grade and the status of quality of primary education in the study area.
2. Explore the extent of relationship between the early grade mathematics competency constructs (CC and NS), and within and cross correlations among the indicators (sub-domains) of each of the constructs to identify policy, practice and research priorities.
3. Identify the predictive powers of the individual, home and school variables included in the study towards early grade mathematics competency development.

1.5 Contributions of the Study

This study was an exploratory study on early grade mathematics competencies as demonstrated by the students' ability to provide correct answers, in some cases within the limit of the time given. That is, the study was to generate knowledge for a better understanding of the state of early grade mathematics competencies in the study area to judge about quality of primary education in the nation. In other words, the study integrated early grade mathematics learning with quality of education based on the assumption that: (a) learning is the basis to judge about quality of education; (b) early years area the foundational years for learning competency development; and (3) early years have far reaching effects on further learning. In other words, this research is important for the following reasons:

1. **Mathematics study is a quality study**- Mathematics in general is a problem solving oriented subject and a thinking process. Unlike the reading skill, it requires the coordination of mental and physical activities and hence, enhances hardworking habits. It is less subjective, hardly open to fraud or cheating, and hence plays important role in children's behavior modification. Basic theories and manipulations like division of numbers, formulating functions, etc. promote understanding of equality, postulating, reasoning and evidence based learning. Educators are of the opinion that children today are growing in a world dominated by mathematics determinant in academic, occupational and daily living activities – technology, and school subjects and most jobs require mathematics abilities and concepts (Kilpatrick, Swafford & Findell, 2001;Baglici, Codding & Georgiana, 2010; Batterman, 2009). Kilpatrick, Swafford & Findell (2001) further noted that mathematics is "an intellectual achievement of great sophistication and beauty that epitomizes the power of deductive reasoning. Innumeracy deprives not only of opportunity but also of competence in everyday tasks" (p.1). Use of computers, mobile phones, and other communication devices, for example, require the proficient applications of mathematical knowledge and skills. The developments of such skills connect academic experiences with life and

professional activities which imply improved a dimension of quality of education as measured by school outcomes.

2. **Mathematics education affects national and individual prospects** – Mathematics education has far reaching individual, social and national implications in this technology oriented competitive world. The report of the American National Mathematics Advisory Panel (2008: 1) further described the comparative advantage of mathematics in this competitive world as follows:

> The eminence, safety, and well-being of nations have been entwined for centuries with the ability of their people to deal with sophisticated quantitative ideas. Leading societies have commanded mathematical skills that have brought them advantages in medicine and health, in technology and commerce, in navigation and exploration, in defense and finance, and in the ability to understand past failures and to forecast future developments. History is full of examples.

Given the prospective development in science, communication technology, and competition-oriented global market, the decisiveness of mathematical skills in gaining comparative advantages is unquestionable. Failing to equip citizens with the necessary mathematical skills would mean failing to respond to the rapidly changing technological world. Communication technologies, computers, defense technologies and others are all becoming mathematics intensive ones and nations with less of mathematical education would mean less prepared for and lagging behind the global competition, and this would ultimately endanger their own survival. I think this promise is reflected in the current higher education entrant proportions in Ethiopia, i.e. 70 per cent to natural science and engineering and the other 30 per cent to social sciences and humanity fields of studies.

This broader perspective of mathematics education also has individual implications. The research report by the American National Mathematics Advisory Panel described the situation as follows:

> Success in mathematics education also [*sic*] is important for individual citizens, because it gives them college and career options, and it increases prospects for future income. A strong grounding in high school mathematics through Algebra II or higher correlates powerfully with access to college, graduation from college, and earning in the top quartile of income from employment. The value of such preparation promises to be even greater in the future. The National Science Board indicates that the growth of jobs in the mathematics-intensive science and engineering workforce is outpacing overall job growth by 3:1.

The argument that strong mathematical abilities predict success in education and employment has a promising prospect when individual citizens are able to develop strong foundations during the early years. The reason is simple – early stage is the critical one to develop life serving qualities for strong academic career cannot be built in the vacuum.

3. **Early stage is the critical stage in human development** - Piaget's conception of linear stages of cognitive development is no more enjoying acceptance in the academic arena. Current evidence from sociology, neuroscience, pediatrics, epidemiology, developmental psychology and others, summarized by McCain and Mustard (1999), support the existence of critical stages of development (as opposed to linear development pattern assumed by scholars like Piaget) with long-lasting effects on human development, coping abilities and overall competencies. The evidence further showed that early experience, not only affects, but also limits the direction and state of cognitive development and learning readiness of children. The early school years are, therefore, windows of opportunity for the establishment of foundational basis of development or otherwise. During the early years of schooling, children's genetic makeup interacts with the home experiences and the school contextual elements to determine the academic, social and personal competencies of the individual during adulthood period. In this regard, McCain and Mustard (1999) provided three concluding remarks: First, during the critical stages of development (or early years), human brain needs enabling and stimulating conditions to develop appropriately. Second, the quality of early stimulation influences the development of the thinking abilities as well as body regulation functions of the children. Third, early negative life experiences have enduring effects that are difficult to overcome in later stages of development. Combining the two, early stage and mathematics learning, increases the importance of the study because of the focus at the foundation and in the most applicable and determinant subject for further

learning. Thus, studies such as this one inform policy makers, practitioners and the general public regarding the criticality of the early years and mathematics in human development, care and education to avoid opportunity and investment mismatch.

4. **Research and intervention implications** - The research project introduces a new method of research (as opposed to the usual paper-and- pencil method) to the Ethiopian context in early grades. Previous researches focused on grades 4 and above, and this early grade research may influence the research community: (1) to consider this critical time in human cognitive development, and (2) to look into alternative ways of doing research in early grade schooling to shade light on the current understanding of critical (rather than linear) stage of cognitive development, child learning strategies and policy/ intervention options.

1.6. The Theoretical Framework for Assessing Competencies

Three sets of arguments, under three subtitles, are advanced here to situate and justify the relevance of the conceptual model adapted in this study. These can be classified as: (1) established theoretical foundations of research in education, (2) personal assumptions, and (3) the conceptual framework of the study adapted.

1.6.1. Established theoretical models in research in student learning

Different approaches are practiced in educational research which stem from differing perspectives on the foundations of education and learning. For example, after detailed analysis and synthesis of ideas, Bigge and Shermis (2004) recognized the *stimulus-response* theories of the neo-behavioristic family and the *cognitive interactionist* theories of the cognitive family as the "two leading twentieth-century learning theories" (p. 10). Staub and Stem (2002) also reached on similar understanding but called them as associationist and constructivist outlooks. However, contemporary discourses in the area included situative/ pragmatist-socio-historic (Greeno, Collins &Resnick, 1996) or simply socio-cultural theory (Zevebergen, Dole and Wright, 2004) as an emerging third perspective. Hence, the researcher is convinced to compare the differences among these three theoretical paradigms (behaviorist, cognitive theorist, and situationist) in conceptualizing learning and their implications to educational research approaches. Besides, despite variations among proponents under each category, the discussion in this paper focuses on the common features of each theoretical viewpoint.

Behaviorist view or the S-R theory –knowledge is what we experience as a result of our interaction with the environment (social as well as physical). That is, knowledge exists outside of the human mind and is gained through our sense organs or empirical experiences. It is a collection of responses specified as specific objectives. Mathematical knowledge is, therefore, a set of proportions or statements that can be verified using empirical evidence (or as Ernest (1998) called it *a posteriori*). Learning occurs as a result of accumulation of stimulus-response associations in which motivation plays the role of strengthening or weakening the bond. In view of the contenders of this perspective, only observable stimulus-response relationships characterize the state of learning and assessment. Consequently, the role of the teacher should focus on the selection of appropriate stimuli for anticipated responses and delivering tasks on the basis of logical sequence of learning and the corresponding specific objectives. It is criticized for its fond of environmental determinism over the human potential - free will and self-control (Greeno, Collins and Resnick, 1996; Ernest, 1998; Bigge & Shermis, 2004; Wadeley, Birch & Malim, 1997). The implication to research approach in education is clear. The focus is on measuring the strength of the association between stimulus and response (as the case in Pavlov's experiment with dogs), studying the conditions for a stimulus to be effective, and understanding the state of learning measured by observable and specific objectives.

Cognitive[3] view–Pioneered by Jean Piaget, cognitive theory commonly "stresses on the importance of studying the mental processes which affect our behavior and enable us to make sense of the world around us" (Wadeley, Birch & Malim, 1997: 35).This theory recommends for the establishment of parallelism between "subject matter domains and general cognitive abilities such as reasoning, planning, problem-solving, and comprehending language" (Greeno, Collins and Resnick, 1996: 16).Unlike the behaviorists, cognitive theorists focus on mental functions like remembering and forgetting and define learning as "a process of gaining or changing insights, outlooks, expectations, or thought patterns" (Bigge & Shermis, 2004: 11). In other words, as cognitive view overlaps with constructivism, learning is perceived as a process of construction of knowledge through personal experience and task-based activities (Moon, 2002). Information or curricular content is important only as an input to the development of the general abilities. This viewpoint is also called constructivism.

---

[3]The word 'cognitive' is derived from the Latin word *cognuscere,* meaning 'to know.' (Bigge & Shermis, 2004: 182)

As mentioned in the work of Greeno, Collins and Resnick (1996), cognitive theory based research practices incline to show three models: (1) structure of knowledge and nature of insights created or likely to be created, (2) constructivism characterized by investigation of cognitive growth (especially conceptual development, logical mathematical development, reasoning), and (3) information processing in relation to problem-solving, logical reasoning, planning, and language ability.

Notwithstanding these contributions, however, the notion of ‘stages of development and readiness’ is not enjoying consistent acceptance because of lack of universal application of the model and differing views with regard to mental ability or intelligence. For example, Gardener (2011) criticized Piaget for his conception of intelligence as inherited, single and content-free entity or human construct. Zevebergen, Dole and Wright (2004: 22) also mentioned the focus on “what children cannot do, rather than what they can do,” as another reason to its diminished influence in recent years.

Situative (pragmatist or socio-cultural) view – This viewpoint recognizes the importance of both the environment and the individual, as interacting entities in enhancing learning and not as either/or issues. The human mind is not empty, even at birth. The environment also consists of important elements to know for life purposes. Thus, knowledge is not exclusively here or there, it can be found from one’s experiences, from the physical environment, from the social setting, and from books (Greeno, Collins & Resnick, 1996).

The uni-dimensionality and extreme positions of the behaviorists and cognitive theorists created vacuum in the knowledge system about learning. The critique is that both behaviorist and cognitive (rationalists, according to Greeno, Collins & Resnick, 1996) ignored the possibility of learning to occur as a result of the interaction between the environment (especially the socio-cultural sphere) and the individual child. This is the new point of view contributed by the pragmatists and socio-cultural theorists whose major proponents are John Dewey and Lev Vygotsky respectively. The proponents recommend looking into the child as an active and interactive being whose process of learning is shaped by supportive and valuing context. As opposed to the behaviorists' *stimulus-response association* or cognitivists' *cognitive abilities* view of learning, situationists understand learning as a process of formation of new insights or modification of old ones. Besides, meaning in this perspective is implied in the action of the individual and ideas are integral parts of practice (ibid). Thus, this position is also called *cognitive-field interactionism,* rooted in the ideas of scholars like, noted by Bigge & Shermis (2004):

- Kurt Lewin (1890-1947) - understood human beings as purposive,
- John Dewey (1859-1953) - focused on the experience of human being as a result of interaction of the individual with what comprises milieu at that particular time and developed the principle of 'learning by doing,' and
- Lev Vygotsky (1896-1934) - conceives learning as cognitive experience where the individual interacts within the cultural context and learning should be defined in that context.

The general implications of each of the three perspectives to research in learning are well treated by Greeno, Collins & Resnick (1996). The focus of the behaviorist is in measuring the observable stimulus-response connections assuming learners are *passive*. The cognitive branch, on the other hand, emphasizes on assessment of the development of conceptual understanding of children who are cognitively *active* to develop meaning. The third, the situationist position, perceives children as *interactive* and studies focus on the link between *meaning* and *action* as defined in the specific context.

1.6.2. Personal assumptions

While thinking of this research title, the researcher had two basic assumptions in mind, not necessarily unique but personalized ones. These personal assumptions are also vivid in the title itself. The phrase "early grade mathematics competency" conveys, at least, the message that schools are learning institutions and learning can be measured in some way. The issue left for investigation is the extent of students' learning mathematics in the early grades.

Children go to school with life experiences as a result of their activities such as playing with peers, exchanging ideas through their languages, engagement in some parent-assigned activities (like cattle herding, fetching water, shopping, taking care of their younger siblings) and even pre-schooling. Thus, though the theories available so far may not be consistent in valuing children's experiences and in how to bridge the gap between home and school contexts, defining schools as learning institutions is not disputable. Rather, widespread disarrays are observed regarding what constitutes learning: S-R associations, mental insights, or meaning and action integrations. In this research, however, the conception of learning is limited to what students can do in a certain situation, i.e. the development of understanding is embedded within the students' actions. In this sense, learning is measurable in terms of: (1) the accuracy of the meaning making process, (2) the accuracy of subject and grade specific performances, and (3) the scope of the activity or performance covered in a given time. These three characteristics are integral elements of the idea of learning competency–merging knowledge, skill and interest to produce useful action in a specific context (Tiana, Moya and Luengo, 2011) – and the situationist theory of learning.

Thus, the conception of learning, and the design and analysis of this study are influenced by the situationist theory in general and that of Vygotsky in particular. Though both pragmatists and socio-cultural theorists share similar conceptions of education, the idea of scaffolding makes that of Vygotsky preferable over the other versions of the situationist view point in education or classroom learning. Specifically, the following points justify the application of the theory in this research:

- ***The idea of context*** - though the Early Grade Mathematics Assessment (EGMA) format is relatively universal, the contents of the test could be contextualized as per the standards of the local curriculum and expected national competencies. The analysis of results should also follow the prevailing context indicators than universals truths.
- ***Scaffolding*** - the research included items on the contributions of home and school related variables that may affect students' learning. Besides, during the data collection assessors should help the children to understand what has to be done by

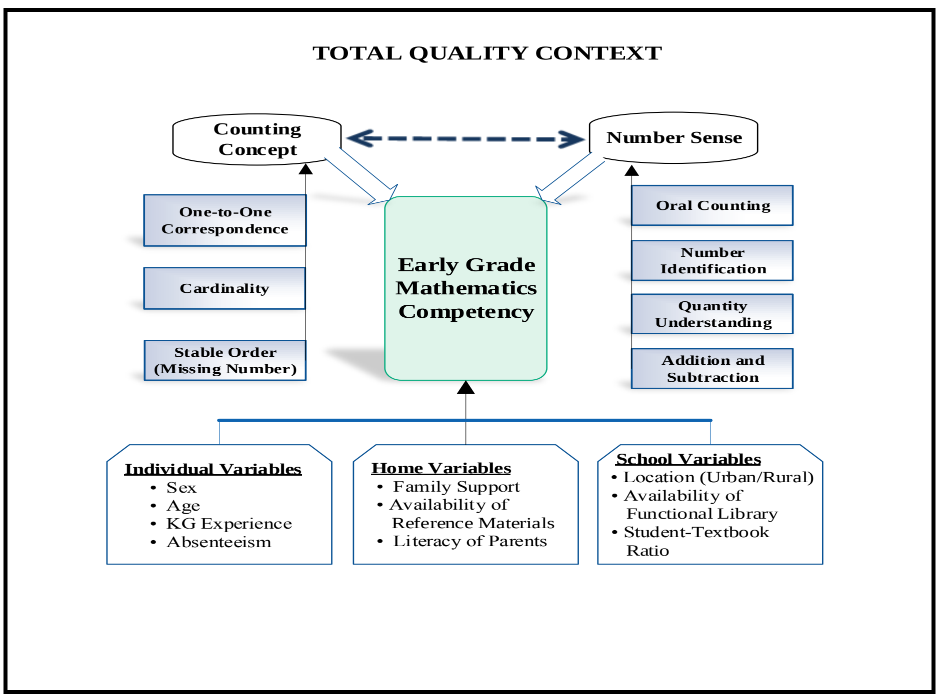
reading the instructions of each task and working on the examples to make sure each child has understood what is expected under each task.

- ***Focus on activity*** - during the assessment children should be helped to give their consent to take the assessment, to ask questions if any, to use any local material for counting or to deal with operations, to discontinue at any level of the assessment, etc. The assessor is only there to help the children and record their responses. Chapter two provides the detailed procedures of the assessment process and the expectations.

1.6.3. The conceptual framework of the study

In view of the situationist theory mentioned above, the following conceptual framework was designed to show the defining elements of early grade mathematics learning and the factors that enhance or hinder early grade mathematics competency in the study area.

Figure 1: Conceptual framework of the study



The conceptual framework (Figure 1) is designed in view of the “principles before skill” conception of Gelman and Meck (1983) in their study of preschoolers’ counting and the number sense characterization of mathematics research. It integrates learning factors, structure of knowledge in early grade mathematics and the specific indictors of competencies. The idea conveyed in this conceptual framework is that the predictive factors affect the development of students’ overall early grade mathematics competency described in terms of counting concept and number sense constructs, and their indicators. There is no conclusive evidence or understanding so far which construct (counting concept or number sense) comes first, and hence the relationship is indicated by a broken double arrow line. Nor is the evidence on predictive powers of the counting concept and the number sense constructs a finished agenda, each of these are connected separately to the overall competency for further investigation. Basically, the framework shows a causal relationship between the predictors (constructs and background variables) and the overall competency (as a composite result) in the given context or domain defined by the rectangular figure embedding the whole context of learning in view of the framework.

1.7. The Scope of the Study

The study was limited to one of the nine administrative regions in Ethiopia – Tigrai, Northern Ethiopia. The region has a total of 46 woredas, 34 rural and 12 urban woredas, with a total area of 53,386.18 square km. As of 2010, the number of primary (grades 1-8) schools and students in the region reached 1,956 and 982,772 (493,525 boys and 489,247 girls) respectively. Thus, GER at the time was 102.87%, of which 154,493 were in grade 1 and 139,458 in grade 2 government schools (Tigrai Regional State Education Bureau, 2010). This time there will be an increase in school population because of expansion of both educational opportunities and population growth. Hence, this study is limited to the study of mathematics learning competency at grades 1 and 2 in government schools, in Tigrigna language, in both rural and urban settings.

In measurement perspectives, competencies related to fractions, geometric shapes, measurements, division and multiplication, money and time were not included in the assessment instrument because of two basic reasons: (1) in order to focus on the foundational and familiar in the two grades, and (2) to make the test length manageable.

1.8. Limitations of the Study

The following can be mentioned as limitations of this research work:

First, the ultimate goal of schools is to change the behavior of the students. Such change of behavior could be in the area of knowledge, skill or attitude. Howard Gardner (1993) also mentioned some seven typologies of human intelligence – Linguistic, Logical-Mathematical, Spatial, Musical, Kinesthetic, Interpersonal and Intrapersonal Intelligences. Later, he added the eighth area of intelligence called Naturalist. However, this research focused only on what students should learn in early grade mathematics based on the list of competencies identified by the Ministry of Education.

Second, competencies are action-based and fluency –oriented. Thus, the competency tests might be mechanical in nature when typically applied to the context of early grade learning. The research focused on what students should learn rather than what they learned and it did not deliberately focus on theoretical understandings (conceptions and misconceptions). Thus, the report may not provide complete evidence on students' knowledge, attitude and skill as separate entities rather than as integrated to guarantee practical accomplishments.

Third, the test package of Early Grade Mathematics Assessment (EGMA) is an oral test focusing on competencies to provide quick and correct answers – more of a measure of brain readiness. Some of the sub-tests are timed and others are scored by the ratio of correct answers out of attempted. In the process of administration, there is an issue of time which does not allow children to pause for more than three seconds in each item. Therefore, the EGMA testing procedure does not give attention to other important learning skills such as writing.

Fourth, the research was limited to government schools and to regular students. Lessons from private schools and special needs children were paramount importance had it not been for the limitations of the scope of this research because of resource constraints. Thus, the lessons may not be inclusive of the whole situation of early grade mathematics learning in the study area.

Fifth, the inclusion of the predictive (background) variables was limited to those that can be treated using information from student respondents. The views of teachers and head teachers were used to describe the context rather than analyzing the relationship with the learning competencies intended. Hence, the analysis might not reflect shared understandings of communities and other stakeholders.

1.9. Organization of the Thesis

The focus of this research is to explore the status of early grade mathematics competency in Tigrai as a measure of quality of education. It integrates mathematics competency indicators with quality education assumptions for three basic reasons: (1) early grade mathematics is the foundation upon which higher skills should be built; (2) early grade experience in mathematics has far reaching impact on later learning – less prepared are likely to lag behind the well prepared; and (3) quality is a matter of learning on the part of the children. Thus, each part of this document enriches the relationship and research implications of quality and early grade mathematics competency.

Chapters 1 focuses on the background of the study emphasizing on what is known and what necessitates this research work in the context of both theoretical evidence and prevailing conditions in Ethiopia. It analyzes the motives behind research works in Ethiopia so far and why early grade mathematics research is important at this particular time. It also shows the anticipated hypothetical issues to be proved or disproved by the end of the work, with basic information on theoretical framework, scope of the study, limitations and operational definitions of terms.

Chapter 2 is devoted to methodological description. The subjects, sampling techniques, sample size, instruments of data collection, techniques of analysis, handling ethical issues, and about maintaining and improving quality of data and findings.

Chapters 3 through 5 are interconnected. Chapter 3 deals with quality conceptions and its dynamism overtime. Definitional options are classified as philosophical, systems and EFA perspectives based on justifications drawn from trend analysis. In the whole review, the researcher tried to link definitions with methodological issues of research on quality of education. Finally, the conclusion provides ways of operationalizing quality.

Chapter 4 follows with research methods and assessment systems on quality of education - how learning is linked with current trends in quality definition. The chapter reviews international learning assessment systems such as Trends in Mathematics and Science Studies (TIMSS), Programme for International Assessment (PISA), and Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) and Early Grade Mathematics Assessment (EGMA) as a recent developments in intervention-oriented educational research practices.

Chapter 5 presents education in Ethiopia and the State of Tigrai (from historical perspective), links the dynamism in quality conception to the Ethiopian/ Tigrai context, and reviews research findings and official documents on quality of primary education, including the state of early grade learning assessment at national and regional levels.

In Chapter 6, descriptive data is presented and analyzed systematically to draw conclusions and implications. It has classifications on the basis of the nature of data, achievements scores and frequency distributions being the main categories of the section.

Chapter 7 is totally devoted to the analysis of predictive powers of selected individual, home and school variables and to the identification of the relationship among the measures of early grade mathematics competency listed under the CC and NS constructs.

Chapter 8 presents summary of findings, concluding remarks (with emphasis on accepting or rejecting hypotheses foamed) and implications based on basic findings and limitations of the current research work. There are also addendums included at the end of the report mainly focusing on providing complete list of bibliography, and selected appendices (instruments, raw data and analytic evidence).

1.10. Operational Definitions of Key Terms

Construct – In this study, refers to children's attribute related to the implicit knowledge of counting principles and number representation skills as defined by the indicators under each construct - Counting concept (CC) and Number Sense (NS).

Early Grade –In this research, early grade refers to grades 1 through 4 where focus, among others, is on literacy and numeracy achievements.

Indicators (of constructs) – are the sub-domains under each constructs measured directly using tests. Thus, the terms *indicators*, *measures*, and *sub-tests* were used interchangeably in this paper.

Mathematics Competency – refers to the achievements of children in mathematics or in the sub-tests as measured by the CC and NS indicators included in this study. Thus, the terms ‘achievement’ and ‘competency’ are used interchangeably in this research report.

Quality of education –refers to the status of student learning as measured by the Early Grade Mathematics Competency assessment scheme applied in this research.

Schools –throughout the paper, unless otherwise explained, the term refers to governmental primary schools in Tigrai Regional State.

CHAPTER 2
RESEARCH METHODOLOGY

This part of the paper discusses the research approach, sampling frame and sample size, sampling procedure, instruments of data collection, training of assessors and instrument validation, and data entry, quality checking and analysis techniques used in the inquiry process. The underlying conceptions are also included to give a basis to the methods and techniques.

2.1. The Research Design

The purpose of this study was to explore the state of learning competency in early grade mathematics (grades 1 and 2) Tigrai Regional State. The procedure of competency measurement focused on level of fluency, i.e. the ability to provide accurate responses within a given time, usually timed to one minute. This has three implications to the research approach: (1) there should be a test by which the state of competency shall be measured, (2) responses shall be registered to understand the proportion of correct answers out of the total, and (3) there should be a numerical value (score or achievement) that shows the level of performance (competency) of each child in the test. Hence, a quantitative research design, particularly survey design aimed at exploring the situation, was applied because of the following basic reasons:

1. The need to find corresponding numerical values representing competencies to determine the state of early grade learning in mathematics in the study area. In

essence, this was basically measuring the cognitive development of children as a function of schooling.

2. The intention for generalizations: Policy formation requires the understanding of communal constructs prevailing in the target population. On the contrary, it was difficult (as it is true in many quantitative studies) to include all target respondents of the study. Representative samples of students and teachers were, therefore, selected using random sampling techniques to set the ground for generalizations from the statistic data. That is, generalizations or parametric characteristics regarding the situation of early grade mathematics competencies and their correlates in Tigrai should be identified using inferential statistics employed on the sample characteristics.

The process of operationalization of the research process also included the identification and categorization of variables in the study as dependent and independent. The results were as indicated below:

Dependent variable – The dependent variable in this study refers to the target students' overall early grade mathematics competency levels measured by the sub-tests of the two constructs (CC & NS) and a result of the sum of achievements in each of these. In other words, the overall as well as the construct specific achievements were composite variables which depended on the performances of students in each subtests. For relevance purposes, therefore, the subtests were developed based on the list of grade specific expected minimum learning competencies outlined by the Ethiopian Ministry of Education (MoE, 2008a). Besides, the relationship of the overall early grade mathematics competency with selected individual, home and school related variables was assessed in search of critical variables that affect the level of learning in schools. The number of such contextual variables, however, was limited in view of the capacity of children to provide reliable information, the expected relevance of the variable to early grade mathematics learning and the time factor in testing the children.

Independent variables: There were two sets of independent variables. The first referred to the subtests (measures of the constructs) which determine the level of overall early grade competency as a composite variable. The relationships between paired sub-tests and the two constructs were also of interest to understand the interdependencies. The second set of independent variables included learning context variables operationalized as follows:

1. Individual characteristics –variables included under this theme were sex, age, KG experience, interest in mathematics, absenteeism and repetition experiences;
2. Home related variables –this category included variables such as literacy of mothers and fathers, family support during study time, availability of time for academic activities after school, and availability of reference materials in mathematics; and
3. School related variables – in this regard, only variables within the reach and conceptual development of the children were treated. Those included were availability of functional library, home and school language difference or similarity, and textbook-student ratio in mathematics in the respective schools. Information obtained from teachers and head teachers were mainly used for two purposes: (1) to enrich the background information on school characteristics

obtained from children; and (2) to further describe the profile of the sample schools for contextualized understandings of the findings.

2.2. Sampling Frame

The target population of this study was early grade school children in Tigrai – all students in grades 1 through 4 by focusing on two grade levels (Grades 1 & 2). Thus, the list of all government schools in the region was obtained to apply a two-stage cluster sampling technique to select schools, and then the target children from grades 1 and 2. This is so because: (1) selecting children directly for the sampling purpose was practically difficult, if not impossible; and (2) the design allows to aggregate data on the basis of individual or group characteristics, or both.

The level of sampling accuracy of the simple random sample design (measured by the sample variance) is used as a reference for complex designs like the two-stage cluster sampling, some assumptions were made to find out equivalent sampling accuracy to a simple random sample design of 400 students. This 400 sample size standard for a simple random sample design is the accepted number for even a large number of populations and is believed to yield 95 per cent confidence limits of means/percentages (Kish, 1965; Ross, 2005). Hence, the theory of the design effect and the *intraclass* correlation coefficient, called *roh*, was applied to measure the degree of homogeneity of student characteristics when selected by school than on individual basis. This enabled the researcher to obtain comparable sample size for the two-stage cluster sample design. The assumption behind the formula is that student characteristics within schools inclines to be homogenous compared to between school ones.

The sampling technique of this study, therefore, considered possible factors of the deign effect using the essence of Kish's (1963) formula:

$$n_c = n^* (1 + (b-1)\, roh)$$

Where, n_c= Actual sample size required for the two stage sampling.

n^*= The effective sample size for simple random sampling.

b = Number of students to be selected from each school.

roh = Coefficient of interclass correlations which measures the degree of homogeneity within students from the same school or cluster.

There are two issues within this formula. These are:

(1) Selection by school increases the homogeneity of students in the sample than when they were selected from different schools at random. In other words, within school characteristics are more homogeneous than between school characteristics. And, the increase in homogeneity of respondents because of the two stage cluster sampling affects the representativeness.

(2) As the number of individuals (in this case students) to be selected from each school increases, both homogeneity factor and actual sample size for the two stage cluster sample increase. This implies the need for an increased sample size in two-stage cluster sampling than would have been for simple random technique.

Hence, the student sample size of this study was determined to be 840 from 21 primary schools (with equal numbers of students by sex and grade level – grades 1 & 2). Mathematics teachers of the sample students and the school principals were also included for descriptive data purposes (or to collect data on proxy variables). Had it been purely determined by the design effect formula, even at *intraclass* correlation coefficient of 0.1 (at 95% confidence limits of the mean), the sample size would have been 1,960 children from 49 schools (at 40 students from each institution).

The intended sample size was reduced to 840 students from 21 schools on the bases of the implications of the design effect described above, effects on the validity of the findings to generalize about students' mathematical competencies in the region, personal judgment, and the resource available for the study. Specifically, the following justifications provide a framework to the sample size:

1. The design effect formula does not take the size of the base population into consideration. It just assumes a sample size of 400 subjects selected on the basis of simple random sampling technique as ideal representation of even large population and suggests how to find the comparable sample size for two-stage cluster sampling. It is because of this reason that the sample size for the region in the national learning assessment of grade 4 students (determined applying this design effect formula) was 1,000 students from 25 schools. It could have been less, had it not been decided by the researchers to limit the minimum number of schools from each region to 25. In the national Early Grade Reading Assessment (EGRA) study too, the proportional sample size for Tigrai region was more or less

the same as the third national learning assessment study (MoE, 2008b; Benjamin, 2010).

2. Scholars are of the opinion that statistical analysis on less than 30 individuals might provide spurious magnitudes of findings (Cohen, Manion and Morrison, 2007). Hence, the researcher determined the number of students from each sample school to be 40 (20 students from each grade with equal number of boys and girls) to collect data from fairly representative number of students for each school.
3. The newly established Early Grade Mathematics Assessment (EGMA) technique, applied in this study, is an assessor based one-on-one test. As opposed to paper and pencil group tests, this approach focused on accuracy and speed of students in providing answers to questions read by an assessor. From experiences of the researcher in the Ethiopian Early Grade Reading Assessment (EGRA), conducted in 2010 in a similar way to that of EGMA, one assessor is able to assess maximum of 14 children in a day. Thus, groups of assessors of three individuals were assigned to finish data collection in one school in the same day, i.e. 40 children in a day. For validity and cost reasons too assessors should not stay for more than a day in one school.

In summary, the study targeted grades 1 and 2 children who were attending school in Tigrai in 2011/12 academic year. Taking student level unit of analysis as the basis for the selection of sample respondents, two-stage cluster sampling technique was employed in selecting primary schools and students randomly. The total student sample size of the study was a function of drawing fixed number of students (i.e. 40) from each school and three schools from each woreda. Mathematics teachers of the target children and school head teachers were also included to collect data on school variables.

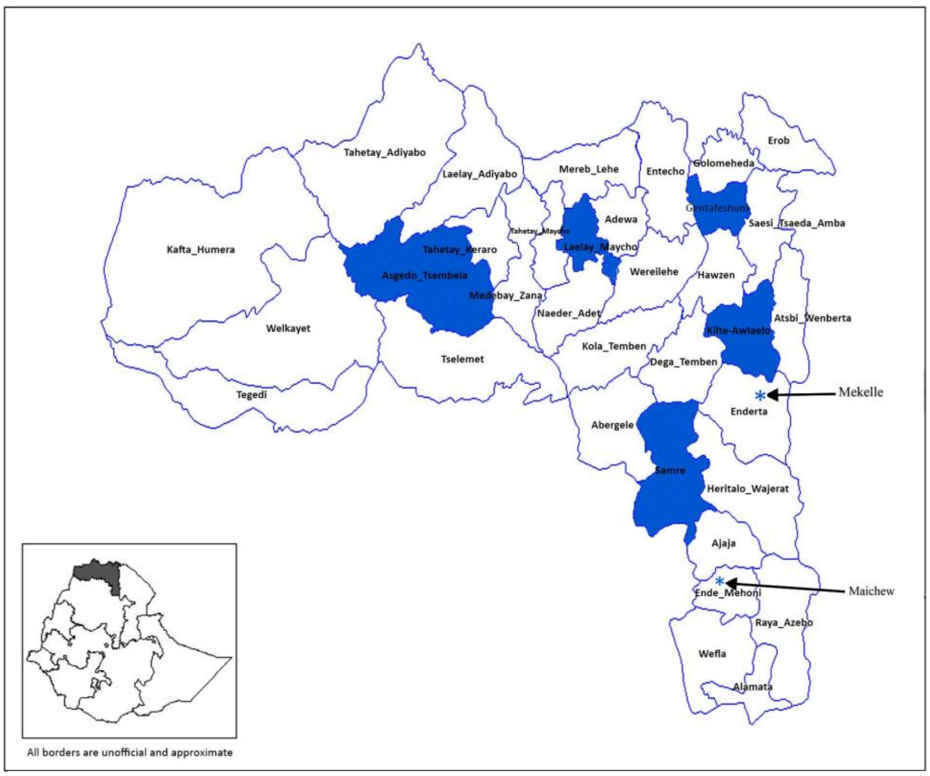
2.3. Sampling Procedures and Sample Size

It was difficult to randomly select students without identifying schools first. Thus, the selection of students was preceded by the random selection of sample primary schools for the study. For this reason, the research applied a two stage cluster sampling technique and followed the following procedures in identifying the target respondents:

1. It was mentioned that the desired sample size of the study was 840, and the number of children from one school was limited to be 40. Thus, the number of desired sample schools for the study was determined to be 21.
2. Two types of lists were used in arranging schools for random selection. That is, the list of schools by woreda, obtained from the Regional Education Bureau, was used to produce a regional master list. However, the final list prepared for the sampling purpose included only government schools that included up to grade 4 students.
3. From the woreda based regional master list, sample schools were selected using random number table without replacement. To cluster sample schools by woreda, three schools from each woreda were selected randomly. That is, the woreda based list of government primary schools was divided in to three intervals so that it would be possible to add two more schools based on systematic sampling

technique. If the first sample school from woreda 'A' appeared to be in the first interval, the other two schools would be selected from the next two intervals; if it was from the second, one from the first and the other from the third intervals would be included by adding or subtracting the length of the interval to the base point; and so on.

Figure 2.Map of Tigrai and woredas of the sample schools



Retrived from: ***http://www.africa.upenn.edu/eue_web/r1_d.gif***
on January 11, 2015 at 5:00 PM. (edited).

The distribution of the sample schools, by woreda, was as indicated in Figure 2, i.e. the sample frame included schools from seven woredas: Asgede-Tsimbla and Laelay-Maichew from North-West and Central Zones respectively; Ganta-Afeshum and Kilte – Awlaelo from Eastern Zone; Maichew town from South and

Seharti-Samre from South-Eastern zones. Mekelle, the capital city of the regional state, was also one of the sample areas of the study and hence, the distribution seems fairly representative.[4]

4. Students for the study were selected through stratified systematic sampling. Assessors, (with the help of head teachers, unit leaders and classroom teachers) lined up students of all sections by grade and sex. Random selection from each grade and sex starts by dividing the total number of boys or girls by 10 and picking up one child randomly from the first 10 in the queue to continuing selection based systematic sampling technique. That is, ten girls and ten boys from each grade (a total of 40 grades 1 and 2) were selected from each school.

Mathematics teachers of the selected students and respective school head teachers were also included in the study to get ideas on contextual issues of students' early grade mathematics competencies. The sample schools included were as shown in Table 2.

[4]Tigrai Regional State has seven zones – Western, North-Western, Central, Eastern, South-Eastern, Southern and Mekelle.

Table 2.List of sample Schools of the study, by woreda

No.	Sample Schools	Sample Woredas
1	Endabaguna	Asgede-Tsimbla
2	Abeba/keseba	
3	Mai-tekli	
4	Adi-teshafi	Laelay-Maichew
5	Gure	
6	Natka-bilae	
7	Debreselam	Ganta-Afeshum
8	Genahti	
9	Susan	
10	Gule	Kilte-Awlaelo
11	Adi-werema	
12	Kihen	
13	Zikre-Semaetat	Mekelle
14	Lekatit 11	
15	Emba-Mamo/KirosGesesse	
16	Adi-Tigrai	Seharti-Samre
17	Gawi	
18	Samre	
19	Wofri-Selam	Maichew
20	Almaz Alemu	
21	Adi-Selkhi	

The total number of students included in the study was 834 (99.29% of the planned), and the overall proportion of respondents included in the study was 96.08 per cent of the planned. This difference was a result of the incompleteness of the responses recorded and not because of the discrepancies between assessed and planned figures. With regard to teacher respondents, the number of respondent teachers was less than the expected because of the actual number of teachers available in the sample schools (see Table 3).

Table 3. Sample size of the study

No	Respondents	Planned	Achieved	Remark
1	Grades 1 & 2 students	840	834	99.29%
2	Grades 1 & 2 mathematics teachers (four from each school)	84	55	65.48%
3	School head teachers	21	21	100%
	Total	**945**	**910**	**96.30%**

2.4. Instruments of Data Collection

The EGMA Instrument:

Three instruments were used for data collection purposes. Whereas respondents teachers and head teachers were provided questionnaires on individual, school profiles, and related proxy variables; the data collection instrument provided to students comprised two kinds of formats: (1) Early Grade Mathematics Assessment (EGMA) format, adopted for this purpose, to collect data on students' mathematics competency; and (2) student background questionnaire to get information on selected individual, home and school related variables supposed to influence mathematics learning in the grades under investigation. The language of all instruments was Tigrigna, the regional official language and medium of instruction in primary schools in the regional state.

EGMA is an individual oral test, and not a paper-and-pencil test. A trained assessor explains the instructions for each part, provides examples to ensure the child understands what is to be done, and presents the questions procedurally. When the sub-test is timed, the assessor uses a stop-watch set to one minute and to down count. When the items should be read by the assessor, the child should be informed to provide oral response. Example, in oral counting, the assessor asks the child to count starting from one and to proceed until he or she is told to stop. There were also times when the child should read and the assessor should record the responses. For example, in number identification sub-test, the child reads the numbers from his/her own copy (called student stimuli) and the assessor marks) records right and wrong answers. That is, the system of EGMA assessment focuses on avoiding the influences of writing and language or reading skills on the performance of children, and is administered on one-on-one basis - one assessor assesses one child at a time. Apart from the understanding on the advantages of good start in learning, the instrument selection and development in this study was based on the research findings listed by the National Mathematics Advisory Panel (NMAP), U.S. Department of Education (2008: xiv):

(a) The relative advantages of the interaction among conceptual understanding, procedural articulation and automaticity in evoking factual information (speed in providing mathematical facts) – For example, addition ability of children depends on the level of understanding counting, what addition means, ability to apply relevant procedural steps, and the understanding of the numerical facts involved in the mathematical algorism. Unless a child is fast in identifying the numbers to be added, is able to apply procedural skills and conceptualize what addition is all about, it is going to be very difficult for the child to provide correct answers. According to the report of NMAP, these parts of learning have “mutually reinforcing” effects in developing mathematical abilities.

(b) “Effort” catalyzes the success in mathematics learning – this is not to deny the contribution of inherent human qualities in learning. The researcher, however, believes that inherent dispositions are inputs which should be activated and materialized through engagement in learning activities or otherwise.

Hence, the test item development and the test format reflected the principle of measuring conceptual efficiency and procedural articulations of children (as embedded in their action) by minimizing the influence of confounding factors (such as the writing ability) on students’ response patterns and contents. In this sense, the seven subtests, listed hereunder, were all related to number and operation competencies. Three of the tasks were timed to one minute (60 seconds) to show articulation and were fluency subtests because the measurement aims at searching for indicators of both accuracy and speed in providing answers. Thus, the data collectors or assessors were trained on using stop watches in the timed sub tests –adjusting the time to one minute for down count, switching on when the child starts responding, stopping the watch when appropriate, recording remaining seconds if any, etc. The stop watch used was selected on the basis of easiness to use, eligibility of the readings, and its ability to produce sound when the set time is finished. Apart from the timed subtests (subtasks), the remaining parts focused on limiting the nature of students’ responses (right or wrong) to the given items. The reasons and justifications for doing so are explained hereunder.

In the instrument development, this researcher used the list of foundational skills and concepts in mathematics learning. The term 'foundational' is not used to indicate that number learning starts in schools but to emphasize on the initial school-based experiences of children and the start of learning numbers (the basis of mathematics) in a formal environment. These foundational concepts and skills, as presented in Chapter 1, can be categorized into two main constructs: *Counting Concept* and *Number Sense*. That is, each of these constructs encompasses differing lists of skills or principles (Smith, 2010) from which those applicable to this research were selected.

A. **Counting Concept (CC) Construct–** This construct includes about five principles related to counting skills. These are one-to-one correspondence, cardinality, and stable order (missing number), order irrelevance and abstraction principles. However, the last two (order irrelevance and abstraction) were not included in the data collection instrument of this study. Order irrelevance refers to the recognition of the commutative property of counting using objects – whether the object is counted first, second, last or in any order, the quantity will not be affected. The abstraction principle also refers the implicit use of all the other principles while counting. Thus, both require some kind of repetition of tasks in the data collection process and were excluded to keep the test length reasonable.
B. **Number Sense (NS) Construct–**The component parts of this construct are skills, not principles as the case in counting concepts). As learned from the literature, the foundational skills under this category are oral counting, number identification, understanding magnitude/quantity, and addition and subtraction. The instrument

of data collection of this research included all four tasks to assess students' numeracy skills.

In formatting the student assessment package, the measures of the constructs or subtests were re-arranged according to the difficulty levels and structure of knowledge in the subject in general and in the Ethiopian mathematics school curriculum in particular. Accordingly, the sequence of sub-tests in the instrument proceeded from counting numbers (both orally and using objects) to number identification and finally to operations (addition and subtraction). That is, the subtests or sub-constructs of the assessment, as per their arrangement in the student instrument, were as listed below:

1. **Oral Counting (OC)** – This task focused on the counting skill and not on the concept or principle of counting. It was used to assess the students' ability of producing numbers in one-minute time to limit the counting fluency (as measured by accuracy and speed) of each child. Counting usually begins with number 1 and students are required to continue counting as fast as possible till the end of the one minute (60 seconds). The scoring, therefore, is based on the counting of the correct oral responses out of the total counted in 60 seconds or less depending on the timing when the child starts counting wrongly. A child is allowed to continue counting until the end of the one minute provided he or she is counting correctly. The maximum number counted correctly marks the child's fluency or competency of oral counting within one minute.
2. **One-To-One Correspondence (OTO) –** This is also counting and identification of number words. It differs from the oral counting for it is counting using objects,

and not oral counting. This is also timed to 60 seconds or one minute. It differs from oral counting for the objects (circles in this case) to be counted were limited to 60, arranged in six columns and 10 rows. In this sub-test too, a child was allowed to continue counting until the 60 objects and/or the 60 seconds were finished provided that the child did not make any mistake in the process of counting. Though the last number counted correct within the time marks the fluency of the child, competencies of children who finished counting correctly before the one minute time was over were obtained by conversion. The conversion involved computation assuming a child was to continue the same way as he or she did for the 60 objects, i.e. if this many in one minute, how many in the remaining seconds and in total.

3. **Number Identification (NI) –** This tries to relate number symbols (numerals) with counting concepts. The numbers were randomly selected (from grade 1 mathematics textbook) and placed in a grid. The child was, therefore, to name numbers listed in the given sequence. The numbers (all 1 through 99) were randomly arranged in a 5x12 number table and copied to the student stimuli for congruence purposes. This is a timed test to check students' fluency to name numbers within a given time (60 seconds). A child should stop if and only if he or she misses all the numbers in the first row or if the time is finished.The scoring depends on the number of correct responses from the total attempted in the given one minute time. In cases of remaining seconds, conversion was applied to find the estimated competency of a child.

4. **Cardinality (C)** – This task tries to assess students' counting skill to understand the number of objects in a set. The child should count the number of objects in a set and tell how many objects are in the set. It is not timed for the student to deal with different questions. There are three possibilities here: (a) a child counts correctly and provides the correct number of objects in the set, (b) a child counts correctly but could not tell the number of objects, and (c) the child may not finish counting objects correctly. Scoring depends on the number of right and wrong responses out of the total tried.
5. **Quantity Discrimination (QD) –** This refers to measuring the ability of children to compare magnitude either using counting objects or numbers. However,quantity discrimination using object groups is similar to the oral counting skill. Thus, quantity discrimination using numbers was the preference in this study. Note that this was not a timed test; it simply focused on judging their understanding of magnitude from the responses of each child. Scoring was based on number of correct answers out of attempted.
6. **Missing Number (MN) –** This task focused on two elements: (1) order of numbers, and (2) identifying the number symbol missed in the list. The scoring depended on the identification of right and wrong answers, without time factor, to allow each child deal with all the items in the question paper.
7. **Addition (Add) and Subtraction (Sub) –**This system followed reading problems aloud to the students and allowing them to use any thing for counting while dealing with the addition or subtraction activities. It was not timed and scoring was about the count of right responses out of the total items attempted.

8. **Student Background questionnaire** – This is aimed at collecting some information about proxy factors of students' leaning competencies.

Instrument Development Process:

The Early Grade Mathematics Assessment (EGMA) instrument is standardized in terms of procedural and instructional requirements. But, the contents of the assessment were developed based on the local context or local curriculum. Though all items were framed based on the operational curriculum content, the skills and concepts included in the assessment instrument were selected on the basis of what children should know and be able to do to develop proficiency in mathematics, and not on the principle of curriculum content coverage. Foegon, Jiban and Deno (2007) called this *robust indicators'* approach to competency study. That is, the EGMA instrument was developed by the researcher based on the specified sub-constructs and school textbooks in Tigrigna language. In doing so, focus was given to the nature of items used, the subtests included, and simplicity to the cognitive development of the target children but not to the representativeness of the curriculum content.

Generally, the final data collection package included the following:

A. Student instruments –Mathematics test paper (including background questions) and student stimuli (copy of part of the test instrument) in Tigrigna. For documentation purposes, this instrument was translated into English.
B. Teacher and head teacher questionnaires – originally prepared in Tigrigna and translated into English.

C. Multiple and single use materials - data collection manual in Tigrigna (adopted from the Early Grade Reading Assessment test package), stop watch, sampling sheet, and data collection completeness check sheet.

Though the teacher and head teacher questionnaires were self-explanatory, easy to understand, prepared in the language of the respondents (Tigrigna), each part of the student test package included details of the assessment procedures - approaching the child, obtaining consent, starting and stopping procedures, response marking, time keeping, and scoring techniques.

Generally, the development of data collection instruments passed through three stages:

(1) The drafting of the instruments started from a review of the grade specific competencies established by the Ministry of Education (2008a), the operational regional curriculum for the two grades, and selected individual, home and school related variables in view of the context of the study area. It was after such preliminary activities that instruments of data collection for students, their mathematics teachers and school head teachers were drafted in Tigrigna language – the medium of instruction in primary education in the region.

(2) Comment by two professionals: The first reviewer was university instructor and researcher in mathematics education with an experience in primary school mathematics curriculum development in Tigrigna language. The second reviewer was a curriculum expert with over a decade of experience in curriculum and classroom instruction research who speaks the language.

(3) Piloting towards the end of the training of assessors to establish reliability coefficients of the student test and to obtain feedbacks on clarity of the items from school teachers. Piloting could not be separated from the assessors' training for the procedures of random selection of students, approaching children, use of stop-watches, coding responses, dealing with teachers and head teachers, and so on required know-how and appropriate skill development to do so.

(4) Finalizing the data collection instruments based on the feedbacks obtained throughout the process.

2.5. Training of Assessors, Piloting and Data Collection Process

Training of assessors:

After the reviews and resulting amendments of the data collection instruments, assessors were identified and invited for training in Tigrai, Wukro Town, in May 2012. The candidate assessors invited for the training were 14 in number, recruited based on qualification (grade 10 complete or above), proficiency in Tigrigna language, and prior experience in data collection. The training was organized for five days (May 18 – 22, 2012) and facilitated by the researcher and an assistant (mathematics teacher in Wukro Secondary School). The main points of discussion in the training were the rationale of the training, why early grade mathematics testing, overview of the EGMA subtests or sub-constructs, introducing to the teacher and head teacher questionnaires, systematic random selection of grades 1 and 2 children, and piloting procedures. There were also individual and paired practice sessions to improve proficiency in response recording, including proper use of stopwatches. The training had fixed schedules for each day, introduced to and commented by the trainees on the first day to help them understand a bigger picture about the training.

Finally, out of the 14 trainees, 10 assessors were selected based on their scores on the reliability tests administered on the second, third and fifth days of the training. All the assessors selected had above 95% average reliability indices. It is believed that such selection process of assessors has positive impact on the accuracy levels of trainees during student assessment in particular and in the overall test reliability in general.

Piloting:

In addition to the review of the items and the test format by two professionals to improve the test quality, training of assessors and pilot testing were conducted for the same purpose. The pilot test had two basic intentions: (1) to establish the reliability index of the student test (the EGMA) and to collect feedback on teacher and head teacher questionnaires, and (2) to provide assessors the opportunity to practice actual data collection and thereby improve their proficiency in administering the test and the truthfulness of the data. The pilot testing conducted at Selam Primary school in Wukro included 39 (19 girls and 20 boys), two mathematics teachers (one from each grade) and the school head teacher. In terms of grade level, 19 children were from grade 1 and the rest were from grade 2.

The teacher and head teacher questionnaires were administered through interview to learn about the clarity of items to the respondents. Thus, item improvement on the teacher and head teacher questionnaires was made based on three types of inputs: (a) the report of the assessors on the clarity of an item as perceived during the interview, (b) the analysis of the match of responses of the respondents to each item, and (c) the analysis of the relevance of variables included in the questionnaire formats to the study objectives and analytical setting.

With regard to the student data collection package, the background questions were reviewed applying the procedure used on the teacher and head teacher questionnaires. For the test items, however, *Cronbach's alpha* was used to find out the coefficient of the internal consistency of test items – inter-item correlations that inform on the correlation of each test item with the total sum of other items in the test. Accordingly, findings showed a resulting reliability statistic of 0.73 and a coefficient of Cronbach's alpha greater than 0.70 for each item when the scenario 'if item deleted' was applied on the test results.

As per the guideline provided by Cohen, Manion, and Morrison (2007:506), reliability indices of a certain test could be interpreted as shown in Table 3. Though there are varying conceptions, these authors consider an alpha value of 0.67 or above as acceptable for research purposes. It was on such basis that the researcher proceeded to the final data collection stage with minor modifications on selected items of the student test format.

Table 4.Alpha coefficients and their interpretations

No	Alpha coefficient	Interpretation
1	>0.90	very highly reliable
2	0.80–0.90	highly reliable
3	0.70–0.79	Reliable
4	0.60–0.69	marginally/minimally reliable
5	<0.60	unacceptably low reliability

In the finalization process of the student test package, test length was also one are of concern to avoid fatigue on the part of students during testing. Thus, the length of the test and each of the sub-tests were adjusted based on experiences in piloting and the review of relevant literature (RTI, 2009, 2014).

Data collection in schools:

After finalization of the data collection instruments, the selected 10 assessors were grouped into three teams based on reliability scores and gender. While two of the teams had three individuals, the third team included four assessors and was assigned to remote areas (to Endabaguna route) to reduce the length of stay in schools in the remote areas. In all cases, one of the assessors in each group was assigned as a team leader, and the researcher and two assistants supervised the teams in the field.

Before the assessors depart for data collection, they were introduced and handed over two types of checklists:

1. Checklist of materials required for the data collection - each team and assessor should check the availability of enough data collection formats and functional

materials required (stop watch, clip board, pencils, erasers, and bags) before the left for the data collection site.

2. Data completeness checklist - Before leaving each school too assessors used formats developed for the purpose of checking completeness of the work done each time.

Throughout the data collection process, the following points were focused:

A. Ensuring clarity of communication – measures taken in this regard included developing instruments in the language of the respondents (Tigrigna), and nominating native speakers of Tigrigna as data collectors.

B. Confidence building on the part of the participants in providing data -each respondent was informed about the objectives of the study, the limited use of the information, the confidentiality of the information provided or collected. Besides, participants were requested to provide their consent or otherwise to participate, were provided clarification on the possibility to withdraw (if necessary), and the whole process avoided writing names for anonymity purposes.

C. Minimizing the effects of technical issues as confounding variables – In view of this issue, the two main areas of concern were response recording and number of items to be included in the test. In case of the first, recording responses of students was the responsibility of the trained assessors to avoid the effect of writing skill on the response patterns of the children. Efforts were made to shorten the test length without compromising the inclusion of sufficient number of items to measure each sub-construct.

2.6. Data Entry, Quality Checking and Analysis Techniques

Data entry:

The basic unit of analysis in this research is the student mathematics competence as measured by the EGMA format. The student background information, the teacher and head teacher views are either to provide basis for categorization or hints on explanatory issues to the student achievement. Thus, data entry template created using the statistical software called SPSS (Statistical Packages for Social Sciences) included four main categories of the data sheets.

1. Background information of the respondents – sex, age, grade level or qualification, domicile (rural/urban), etc.
2. The responses directly related to competencies of students,
3. Listing of responses on proxy variables – home and school variables, and individual characteristics of respondents in view of the criterion to be measured.
4. General coding on missing values, coding schools names, etc.

The researcher created data template and coding system (in SPSS software) while the data collection was on process. After data collection, and checking up for completeness and usability of the hard copies from each group, two data entry clerks (a male and a female) were selected based on computer skill and relevant experiences. In terms of educational background, both data entry clerks were first degree graduates (one in accounting and the other in computer science).

The researcher organized one day training for the data entry clerks to familiarize them with the nature of the data, coding system and expected level of accuracy. The morning session was completely devoted to discussions on the nature of the data, objectives of the research, coding systems and practicing. The guided practice was made using the pilot data (already in SPSS format) to compare with and judge the accuracy levels of the data entry clerks. In the afternoon, the data entrants started independent activity under a close support and monitoring by the researcher. It was after such a process of training that the data entry was started under the supervision of the researcher.

Quality control:

The strategy set to control the quality of the data entered including three tasks:

a. Training of the data entry clerks – as mentioned above the training focused on providing a sense of the objective of the research and the nature of data, studying the coding system and practicing using the pilot data. This process helped the researcher to get feedback on the strengths and gaps to be fixed.
b. Re - coding one school data (40 student response sheets and three or more teacher and head teacher questionnaires, which is about 4.7% of the total) from each of the data entry clerks by the researcher for accuracy checking purpose. The intention was if the rate of error exceeds 2%, then the whole data should be re-coded systematically. Fortunately, except minor errors in typing, the data entry had no problems.
c. In addition to on the spot checking through continuous monitoring and technical support, data cleaning took place using the hard copy when necessary. After such

quality checking, data was edited, complied and analysis framework was established using relevant themes to make the data ready for statistical analysis.

Data analysis techniques:

Though the application of SPSS software, the following procedures were used to identify major findings of the study:

1. Frequency counts, percentages and mean calculations - to identify proportions of achieving or less achieving students.
2. t-test / ANOVA - to compare results between male and female, rural and urban children, children with KG experience and those without, and the contribution of age on achievement. For statistically significant differences, effect sizes were computed manually to understand the level of contribution of variables to achievement differences. Effect size (denoted by d) refers to mean differences measured in standard deviation units and, as suggested by Cohen, Manion, and Morrison (2007), the relative powers of t- and F- statistics can be computed using the following formula: squares

   Effect size of t-ratio: d=$\frac{Mean\ difference}{Pooled\ \ standard\ \ deviation}$

   Effect size of F ratio: Eta-Square = $\frac{Sum\ of\ Squares\ \ between\ \ groups}{Total\ \ Sum\ \ of\ \ Squares} = \frac{SS_{between}}{SS_{Total}}$

   The interpretations of resulting effect sizes were also evaluated based on the scholarly guideline forwarded by Cohen (1988), cited by Meyers, Gamst and Guarino (2006: 41):

   A. For t statistic, effect sizes of .20, .50, and .80 are considered as small, medium, and large respectively.

B. For F statistics, effect sizes of .01, .06, and .15 are considered to be small, medium, and large respectively

3. Pearson Correlations – to find out strengths of relationship between predictors and criterion variables. The researcher adopted the interpretation of prediction aimed correlation values by Cohen, Manion, and Morrison (2000: 202). The authors forwarded the following basic suggestions in this regard:
   a. Correlation coefficients from 0.20 to 0.35 are very slight relationship; magnitudes in this range portray limited value especially in exploratory research like this one, be it for individual or group predictions.
   b. Correlation values within the range from .35 to .65 usually show very limited accuracy in prediction. Pearson r values nearly .40 may be helpful for group, not for individual, predictions. However, correlation values within this range can produce useful meaning if they are combined with other linear models in multiple regression analysis.
   c. Correlation coefficients between .65 to .85 are accurate enough for group predictions applicable for different purposes. Near the top and above correlation values also contribute a lot to individual predictions.
4. Multiple regression techniques - to determine the predictive values of selected independent variables on the dependent variables (mathematical competency).

In summary, as the study is focused on measuring competencies, the researcher applied quantitative design to make appropriate generalizations. For this purpose, representative sample respondents (grades 1 and 2 children, their mathematics teachers and the head teacher from 21 schools) were selected randomly using two stage sampling techniques – random selection of schools followed by systematic sampling of students by grade and sex. The data collected by trained individuals using piloted data collection instruments was analyzed using both descriptive and inferential statistical techniques in SPSS software. The findings were, therefore, products of the chains of activities aimed at generating quality data and appropriate analytical techniques.

CHAPTER 3
QUALITY OF PRIMARY EDUCATION: DEFINITIONAL PERSPECTIVES

3.1. Introduction

The conception of educational quality is full of disarrays, yet a point of interest for many. If someone tries to define what quality of education is all about, others appear with different, sometimes opposing, views of the same terminology. From an observation of such prevalence, Admas (1993: 3) said that "…the concept of educational quality has remained somewhat *elusive*, and many persistent questions surround any attempt at definition." In fact, the word *'elusive'* may not be appropriate adjective at this point for the implicit problem of definition is not inherent in the terminology itself but in the changing human expectations from education, i.e. dynamism within education. McNeil (1996) stated that some scholars advocate for knowledge transfer or training of the mind, others for self-actualization, and still others for social transformation as subjects and targets of education. The legitimate line of thought, therefore, would be asking and trying to understand why different scholars offer differing meanings to the same term (i.e. quality of education). However, blaming the word *quality* itself may not take to a destination.

It is intrinsically clear that education makes people better than they were before because of learning. However, there is no consensus on what education should aspire for, what element of education or schooling makes us better, and what justifies a preference of one end result over another (Burbules, 2004). The debate over these issues is overwhelming, classified as philosophical, sociological and systems model perspectives (Scheerens, 2011). Despite such continued debates and disarrays over the conception of quality in the literature, EFA declarations, without clear definition, claimed for the realization of quality primary Education For All (EFA) by the year 2015 (UNESCO, 2000) which necessitates an appropriate analysis to learn from experience.

In this review, therefore, three perspectives and their varieties are the areas focused because of relevance to the intentions of the thesis. From Scheerens (2011) categorization, the *philosophical* and *systems model* perspectives are analyzed assuming the sociological dimension (with main concern on equality) is taken care of in the two perspectives. The first is intended to provide theoretical basis underlying the discourse while the latter is to support the process of examining quality in view of the operational aspects of schools as originations – connecting theory to practice. Moreover, the quality conception implicated in the EFA declarations, as 'collective' visions and commitments, are analyzed under the theme called *EFA perspective* because of the far reaching influences of the declarations in development partnership and local education policy developments. Issues of measuring quality and remarks on its customized definition in this research, with a focus on learning, are also parts of the discussion in this chapter.

3.2. Philosophical Perspectives on Defining Quality of Education

The theoretical discourse in defining quality (of education) reveals a process of value making or value searching. It is a decision making process on whether quality exists, what represents quality, what is good or bad, what is acceptable, and what the parameters are. Thus, while asking about what quality of education is all about, it should be clear that, like Pirsig (1984), we are assuming *quality* exists. If we say School A or Country A students are better than others, then we are speaking about quality differences. Nor is it possible to think of improving educational provisions without quality assumptions. However, still there are other issues to understand what the constituent elements of quality of education are.

Pirsig (1984:233-238) discussed in length whether quality is the characteristic of the object or the image of the viewer and ended up saying that quality is a result of the interaction between the objective characteristics and the subjective elements, and not a property of exclusively either of the opposite ends. For pragmatic purposes, however, this research is guided by the view that quality exists in the object itself, i.e. it refers to the characteristics of education and not to the perceptions of stakeholders. It is objective means, Pirsig argues, quality is scientifically measurable, its definition is compatible with the existing scientific knowledge, and the conception has some kind of universality or applicability in a relatively wider scope. Contra-positive argument also enriches the justification why objective view is preferred in this research. That is, if quality is subjective (a perception of the viewer), then views of the beholders may be less verifiable and the knowledge generated becomes doubtful.

Harvey and Stensaker (2008) also believe that heavy reliance on personal beliefs than evidence-based arguments widens the possible disagreements in conceptualizing quality of education. Professionals and educational stakeholders from the same community in the same time may view an education system differently, and hence quality in view of whom is still an issue (Adams, 1993). What is good or acceptable for the poor may be economic empowerment while expectations of the rich might be influenced by the desire to promote social status quo. That is, allowing students, teachers, parents, politicians and others to set different ends for and expectations from education has the consequence of ending up with no definition at all.

A corollary issue in the definition is whether quality is relative (context based) or has specific universal standard (Ellis, 1993; Leu, 2005). Burbules (2004: 5-6) explains this debate as a difference between transcendent and socio-cultural bound conceptions of the idea of quality. Strong teleological aims (such as truth, rationality and moral character) and weaker teleological ones (those focusing on capabilities, skills and dispositions – called competencies) support for transcendent or universal conception of quality. On the contrary, anti-teleological views assert that educational objectives are meaningful when they are related to a certain context. An attempt to universalize the definition of quality of education is an attempt of oppression, destroying human identities (usually that of the poor) and differences. Thus, situated definition of quality is legitimate and humanistic.

In fact, Burbules' strong teleological and anti-teleological views seem extremes of the continuum. It is hard to imagine an education system devoid of a context and free of cultural reflections, unless it means relying on dominant (in reality western) cultures. Brock-Utne (2000), Hyslop-Margison and Sears (2006), and Burbules (2004) ask a series of questions such as the following: Who should make the selection of the goals? Whose knowledge should be included as curriculum content? Whose cultural norms should be promoted? Whose language should be used as a medium of instruction? When selection is mandatory in all these cases, for sure the card should go to the developed society and ultimately the process leads to social domination and hegemony.

However, the competency based approach to quality conception appears to have mediating and adaptability characteristics because of the following reasons:

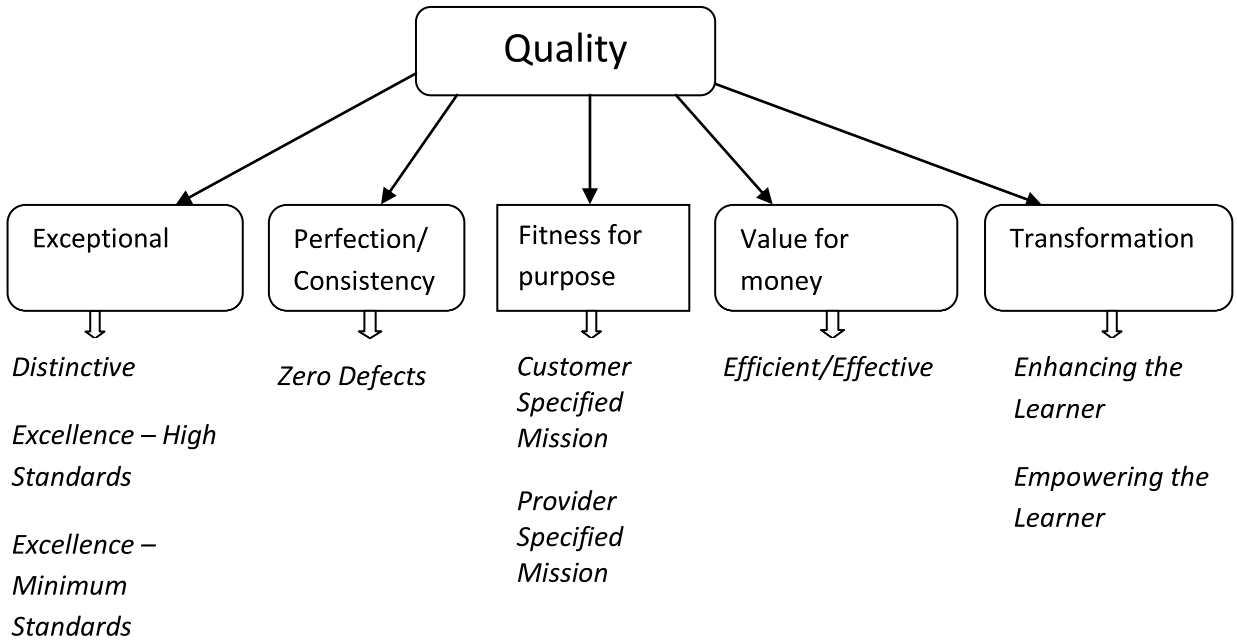
- Comparable capabilities or competencies can be branded as desired outcomes of different countries or educational contexts (especially primary education) without fit or unfit fixations. For example, counting numbers could be used as a common goal of mathematics learning for schools in different countries or cultural locales without any prejudice to the system of counting or numeration system.
- Though capabilities could function as standards, the approach provides suppleness and freedom to situate educational contents, to reflect identity ingredients or cultural norms, but still envision comparable educational outcomes. Whether the child learns and be able to count in Tigrigna, Amharic, English or any other language, whether the counting is using sticks/stones or computers, the criteria by which the competency should be judged is going to be similar.

However, even this weaker teleological approach (Burbules, 2004) has limitations and requires careful and participatory approach to set common parameters. Some competencies designed for American schools, for example, may not be applicable to Ethiopian situation because of differences in the developmental status of the two countries. Take the counting competency or capability. As competency includes accuracy and speed (in counting), setting the same standard for those incomparable settings would be unfair and even unrealistic.

The above debates, differences and disarrays demonstrate the absence of agreed upon theory or framework useful to search for or coin widely accepted or less controversial definition of quality of education. The definitions are numerous to list them all, some are lucid accounts and others are nebulous in nature. The intention here is, however, to review the different conceptions and usages of the term for a better communication and better way of understanding the place of state of learning in the conceptualization process of quality. It is an inquiry into broader frames of thinking about quality of education and their implication to student learning, and not to claim a complete list of all existing in the literature. Hence, the classifications by Harvey and Stensaker (2008) and that of Adams (1993) found to be appropriate for this purpose.

Harvey and Stensaker (2008: 433) suggested five ways of defining quality while reviewing the ways of thinking about quality in higher education. These are *exceptional, perfection or consistency, fitness for purpose, value for money, and transformation* stand points. Watty's (2010: 215) pictorial representation of the approaches to define quality, Figure 3, is used to summarize the differing conceptions.

Figure 3.Definitions of the quality concept by Harvey and Stensaker (2008)



(Source: Watty, 2010: 215)

Quality as *exceptional* – This view gives priority to excellence defined by performing above the stipulated standards for the purpose. It presumed three layers of assumptions: (1) high standard criteria are set, (2) the criteria identified are hard to be achieved by ordinary or majority of schools but some or the target, and (3) quality is achieved if the school performance surpasses the exceptional standards. In view of learning standards in primary schools, this is meant that students from School X have demonstrated high level of mastery of curriculum objectives as compared to others, depending on the nature of comparison - normative or criterion.

Quality as *perfection or consistency* – the authors noted the difficulty to achieve perfection or consistency in education. The conception can be interpreted in terms of providing services to students with steadiness overtime and across institutional activities.

It refers to the process of doing things right, including care for stakeholders, commitment and concern in the implementation of activities characterizing the process. In the absence of such values, perfection and consistency is unthinkable. It is this predictability of institutional setup to promote learning and learning outcomes that accounts to the principle of consistency as a line of argument for educational quality.

Quality as *fitness for purpose*–This conception implies some steps of judgment about educational or learning outcomes. First, standards are set that fit the vision and mission of the educational institution, and not necessarily context detached standards as the case in the quality as exceptional scenario. Second, educational outcomes are measured or compared with the stated ones. The degree of relationship between the two justifies the standard of the educational quality. It also implies a system of accountability in view of the extent of compatibility between envisioned and achieved learning outcomes.

Quality as *value for money* - This way of thinking focuses on weighing the return of education in terms of its expenses (including investment). It tries to introduce accountability on the part of educational professionals such as teachers and head teachers and tries to make cost-benefit analysis. The expenses in building classrooms, teacher salaries, running costs and other expenses should have some kind of relationship with the realization of educational objectives expected by the society or the government. The quantification process could, however, be difficult at best and confusing at worst. Arithmetic on the money or expense could be easier but educational outcomes, or state of learning, as returns of the money used may not be easily quantifiable, and some learning outcomes, like attitude, are not enumerable. Besides, sometimes educational outcomes may be directly the opposite of the intended. For example, during Emperor Haileslase of Ethiopia, the curriculum never preached about ethnic rights. One of the requirements of the then student movement was, however, ethnic freedom and ethnic rights. Was the money worth of the results then? The answer is both: the government would say ‘no’ and education was at lost but the community would respond ‘yes’ and the outcome could be viewed as a gain to the advantage of the mass.

Quality as *transformation* - education is conceived as a means for individual and social changes. The interpretation views education as an agent of social renovation in the spheres of knowledge accumulation, cultural modification (such as avoiding harmful traditional practices), technical and economic advancements, and quality of living. Thus, schools are miniature societies and “laboratory study of social living” (Taba, 1962:396); the curriculum includes real social problems for students to practice problem solving activities and thereby enhance the application of curricular knowledge or experiences in real life situations (McNeil, 1990).

Adams (1993: 7-11), on the other hand, classified the definitions in the existing literature into six themes: quality as *reputation*; quality as *resources and inputs*; quality as *process*; quality as *content*; quality as *outputs and outcomes*; and quality as “*value added*.” Each of these approaches to the conceptualization of quality has definite implications as to what should be expected from schools and the instructional process.

Quality as *reputation* – Similar to Harvey and Stensaker’s (2008) conception of quality as perfection or consistency, the basis for the quality as reputation conception appears to be a belief on the match between inputs and outputs – better inputs would help to realize better outputs and develop institutional value to attract stakeholders. However, there is no guarantee for the assumption without adequate information on the process of implementation of activities in schools and classrooms. The author also tried to provide additional information on the applicability of *reputation* conception to higher institutions than to primary schools for assessment is considered to be the best instrument to reveal the required information. In fact, this appears to be incompatible with current developments in applying assessments to determine the state of learning and there by quality of education in primary schools. Tests like PISA, TIMISS, EGRA and EGMA are typical examples of the recent practice.[5]

Quality as *resources* and *inputs* - the author classified quality as having normative and descriptive profiles. The normative sense deals with comparison of schools using characteristics of interest. However, the descriptive profile refers to availability of necessary inputs for the purpose of schooling activities. These include availability of trained teachers, resources for instructional purposes, and characteristics or readiness of students, but not the ends results of education (such as learning achievements or graduation).

Quality as *process* - focuses on the interaction among teachers, students and the school community as a whole. Scheerens (2011) also has to say this in terms of such qualitative characteristics of process in schools that justify quality:

[5]The details on the genealogy of international and national assessment practices are discussed in Chapter 4.

> When asked about the key characteristics of ‘‘good’’ schooling, a very senior colleague recently referred to a school he had visited in India. It was not a proper school, in the sense that there was a real school building. Children sat on stamped earth underneath a shelter of corrugated iron sheets. There was just one textbook for the whole class of students. But even in these primitive circumstances the colleague noticed qualities in the attention of the students and the dedication of the teachers that brought him to this qualification. I had somewhat similar feelings when I visited a remote school in Jamaica last year. Here again the poverty and lack of resources was painfully obvious, yet the task related atmosphere, the meticulous way in which the building and the grounds were kept and the reverence with which the threadbare textbooks were handled, struck me as impressive (pp. 4-5).

The suggestion here is that quality is not only the characteristics of the two ends (input and/or end results) but also how the inputs are used and the human interaction such as teacher commitment, student engagement and perseverance which are keys to produce required outcomes.

Quality as *content* - a focus on curriculum contents prevail dominance over other aspects of schooling. The main contents of curriculum for advocates of mind training is the scientific knowledge as opposed to the student experiences (interaction between the student and the environment) proposed by psychologists. The third dimension of the debate is the interest to give priority to social problems and cultural issues. In practice, the dominance of one over the others depends on the prevailing philosophical assumptions and policy priorities of the time in a given country.

Quality as *outputs or outcomes* - The four basic indicators of outcomes of education stated by the author are achievement in cognitive skills, enrollment proportion in the next level of education, income level of graduates and professional competence as professionals. These are all effects of schooling and not necessarily characteristics of school settings.

Quality as *value added* - The operational definition of quality as value added shows comparison of end results with entry behaviors of students to understand the contribution of schooling in the life of the students and community development endeavors. It seems similar to the outcomes *or outputs* conception of quality because of the interest on end results. However, the end result as it appears does not make sense in the interpretation of value added approach; there should be a parameter by which the impact of quality should be judged.

In summary, the philosophical perspective in defining quality presented arguments that center on what is good, on what ground and with what characteristics. In this sense, the perspectives of quality definitions provided by Harvey and Stensaker (2008) seem to focus on the contributions of education as a system or a school as an academic institution. The attention given to how schools should function or what schools need for effective accomplishment of educational goals is not clear. The options simply provide judgmental instruments to view education by its consequences, without clear view on state of learning. It would have been then nice if hints were included regarding the place and the how of learning to ensure these end results.

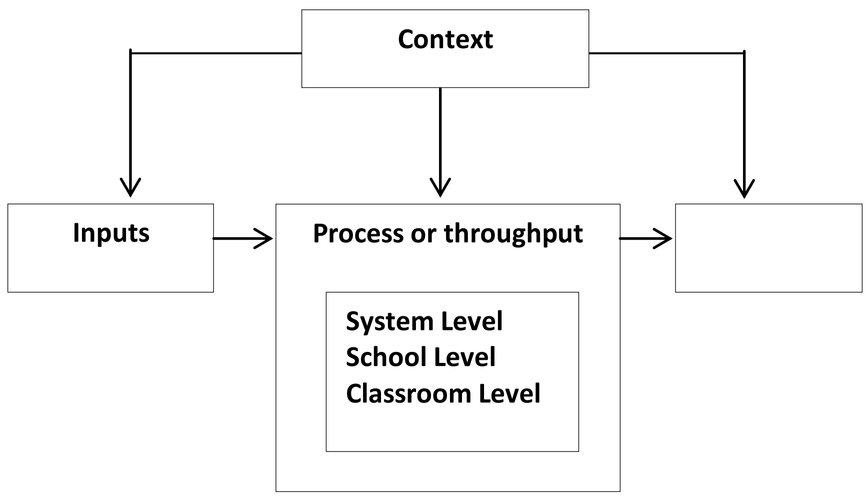
On the other hand, Adams (1993) thematic categories of quality conceptions are mixed. Some are input driven, others are process focused and still others are outcome obsessed. What seems lacking here is a definition based on combined effects of inputs, process and outputs. Hence, searching for alternative definitions of quality, situated in the school setting as an institution, would have been nice to understand the implications for intervention to improve learning and the subsequent consequences of educational systems.

3.3. Systems Model on Defining Quality of Education

Schools as purposeful organizations are perceived in two ways: as rational bureaucracies and as miniature communities (Bidwell (1965) as cited by Bryk and Hermanson (1993)). The first position reflects formal division of roles and responsibilities to run the school and recommends school management by specialists. The miniature community conception, however, is pro context based instruction and community involvement in school affairs. It tries to facilitate informal communication and all ideas are valued and respected. Whichever conception prevails, school operation in a given context involves three main elements: input, process and output. The inputs are the resources necessary to start operation or teaching-learning process in schools; the process refers to the curriculum-based interaction of the students with the environment (social and physical);

and the output or outcome denotes the attainment of the desired learning objectives judged from mastery level of contents, number of graduates of a level or grade, and employability of graduates in the business sector. As education is a purposeful activity, however, its operation should recognize the context which has the power of shaping outcomes and limiting factors of the process of implementation (Scheerens, 2011).

Figure 4. Scheerens' basic systems model on the functioning of education



(*Source*: Schreerens, J., Hans Luytn and Jan van Ravens, 2011: 5)

According to Schreerens (2011: 5-7), this systems model implies at least six ways of defining educational quality named as *productive view, instrumental effectiveness view, equity view, efficiency perspective, adaptation perspective, and disjointed view*.

(1) *The productive view*–The view point focuses on the evaluation of end results, which are believed to reflect quality standards of the school system. The parameters that serve as desired educational results might range from immediate consequences (like mastery of classroom objectives and passing to the next grade or level) to the

observation of impacts like social transformation. Yet, there is no consensus on what types of objectives or end results should be recognized as best indicators of educational quality. For example, some countries may give priority to global issues and others to specific cultural assets but both can claim evaluating quality by its outcomes or end results. Therefore, the definitional description provides a framework on the prevalence of thinking education in terms its products but not about the fixed elements of it. Moreover, this productive view of quality pays due attention to context, inputs and process variables and how each function to the realization of end results though final judgment about quality should be made by what has been achieved and not otherwise.

(2) *The instrumental effectiveness view* –this thinking has basis on the possibility of predicting outcomes from the context, inputs and process. If context specific educational outcomes are identified, necessary inputs are provided and evidence on the process of implementation is available, then we can certainly speak about the nature of outcomes to be realized. Thus, outcome indicators are no more part of an endeavor to understand quality of education for quality can be predicted from context, inputs and process indicators as instruments to the final end.

(3) *The Adaptation perspective* - This position views the system elements as interlinked and strives to identify the right things to be done and the right way of accomplishing activities. That is, this adaptation perspective is a combination of the efficiency (doing things right) and effectiveness (doing the right things). For this purpose, continuous review of contexts variables, curriculum contents, educational goals, and

social consequences of education are focused for relevance and standard enhancement purposes.

(4) *The equity perspective* –this is a right-based approach to quality definition. It has both equality and fairness implications. First, the position promotes the idea of equal entitlement for educational services (including distribution of inputs, process and outcomes). Second, it recognizes the principle of equal outcomes, i.e. fairness – responding to educational needs on the basis of compensatory principles (if need be) and similar outcome standards.

(5) *The efficiency view* - this perspective goes for the highest potential outcomes with possible minimum costs. In this sense, this position combines the productivity and instrumental views of quality with due attention on the possibility of maximizing outcomes and wise use of resources.

(6) The disjointed view – unlike the preceding ways of defining quality based on systems model, this view tries to understand each element of the model as stand-alone or relatively independent of the others. It is a way of checking the status of each for the system to work at its acceptable level.

To conclude this part, though the author remarked that the disjointed view point is relatively widely accepted than the others, evidence on which one of the conceptual understandings contributes to quality enhancement in schools is lacking. Nor is the best option clear to make preference in policy development and research activities. This seems partly because the definitions are more of philosophical as opposed to what we expect from the naming –systems model – which is supposed to focus on operational aspects than personal beliefs. In any case, it is clear that the area still calls for further context based research endeavors in view of how these operational elements of school work effectively (independently or as parts of a whole) in the context of human behavior modification.

3.4. EFA Perspectives on Defining Quality of Education

It has been long ago since the global community has started launching basic **E**ducation **F**or **A**ll (EFA) initiatives. The *Lima Meeting (1956)* and *Santiago Conference of Education Ministers* (1963) promised for free and compulsory education in Latin America and the Caribbean; the Karachi (1960) and Tokyo (1962) conferences declared for the Asian continent and set 70% and 90% primary school gross enrolment rates by 1964 and 1980 respectively; and the Addis Ababa conference of African Education Ministers, organized by UNIESCO and UN-ECA in 1961, foreseen the realization of universal, compulsory and free primary education (grades 1-6) in all African countries by the year 1980 (UNESCO & UN-ECA, 1961; The Inter - Agency Commission, 1990). However, none of those regional declarations functioned up to the expectations set and the world community declared a global quality primary Education For All in Jomtien (Thailand) in 1990 with a follow up update in 2000 in Dakar (Senegal). Why these regional and global commitments? What approaches were adopted? What does 'quality' mean in the perspective of the regional and global EFA documents? The approaches for the development of primary education development from 1948 – 1990 (from the time of the Universal Human Rights declaration to the global EFA declaration) is treated as phase I and the time since Jomtien declaration as phase II.

Global primary education quality perspectives from 1948 - 1990:

Following World War II, the world community established the Universal Human Rights declaration in 1948 as a consequence of the war and the liberation movements against colonialism and other forms of repression in all corners of the globe (Yonemura, 2007; Brock-Utne, 2000; Hyslop-Margison& Sears, 2006). The time seemed to mark a shift from colonization and oppression to rights based approaches and relationships between countries and societies at the global level. Regional EFA declarations, later upgraded into global commitments, came into existence to expand educational access for all citizens of the respective regions. The *Lima (1956)* and *Santiago* (1963) conferences targeted Latin America and the Caribbean; Karachi (1960) and Tokyo (1962) declared for the Asian countries; and Addis Ababa conference (1961) asserted to improve educational access in African countries. One thing of interest was common among the regional conferences – the hard fact is that they all were initiated following the Universal Human Rights Declaration (1948) and the physical expulsion of the colonial countries from their administrative territories. Why then at those times? What do we learn from experience?

History tells us that most European countries universalized primary education in the years 1870 to 1914 and the period is called the age of nation building for the continent (Eric Hobsbawn cited by Alexander, 2000). Unfortunately, in their time of national progress, they cynically planned to oppress others for the sake of grabbing resources and declared the scramble of the African Continent officially. As the orientation of colonialism is towards the exploitation of human and natural resources from the subjugated countries, educational expansion in its true sense (scientific and aimed at changing the lives of the poor indigenous) was unthinkable. Rather the colonial powers had designed two strategies to 'educate' the children's of the respective colonies: (1) sending missionaries to diffuse religion to their own advantage, and (2)if at all they had to work in education in their colonies, it should be limited to the lower grades and guided by principles of assimilation and differentiation (indirect rule). The French principle (assimilation) means baptizing the children in the colonies to develop adults with French personalities – changing identify to identify themselves as French Citizens. The differentiation philosophy is the guiding framework of the indirect rule strategy which helped Britain to administer colonies using the local personalities and institutions (Brock-Utne, 2000; Adams and Bjork, 1975; Manuwuike, 1978; Busia, 1964; Scanlon, 1964; Fafunwa, 1971).

In this sense, the power to define quality of education seemed in the hands of the developed world and two types of quality conceptions seemed vivid. The first refers to quality for nation building in the European countries, which we are not even sure that it did not include continuity of their supremacy over and presence in other countries as an implicit end result. The second quality conception is disempowering the poor – preparing them for manipulation and subordination (*ibid.*). This was the background context of primary education in many developing countries in Asia, Latin America and Africa during colonialism.

The end of colonialism in each of the three continents marked a new era in the development of primary education in the developing countries, especially those freed from colonialism. The UNESCO led regional conferences mentioned above were meant to support existing system-based efforts in expanding primary education. Only few countries, Mali and Tanzania among them, reformed the education system anew (Brock-Utne, 2000). In the early times, just after independence, the move in primary education was towards political freedom and nation building. However, the political orientation of the expansion could not continue beyond the 1960s as a consequence of the priority shift to economic development (Yonemura, 2007). Thus, financing primary education in developing countries got less attention from the financial institutions like the World Bank because secondary and tertiary levels were assumed to give higher return to the public (Brock-Utne, 2000; Yonemura, 2007). The World Bank remained with this position until the second half of the 1980s despite it got reports that support otherwise (Colclough, 1980; Yonemura, 2007).

Gradually the Bank[6] started to provide attention to primary education because of the change of assumptions regarding the contribution of primary education to economic development in a comparative sense. Colclough (1980) informed the Bank on how primary education contributes to economic development by improving productivity and on its non-economic returns such as health improvement, nutrition, family size, and cultural awareness. After about fifteen years the Bank also published a book entitled as 'P*riorities and Strategies for Education: A World Bank Review'* with the same conception and on why primary education should attract public funding (World Bank,

[6] Unless otherwise explained, the Bank refers to the World Bank as an institution.

1995). The changes on the contributions of primary education to economic development since the 1980s influenced the Bank to view quality of education in terms of learning outcomes as value-added measures of “learning gains and increase in income-earning activity” (ibid. p. 46). This conception may not be true for the cases of UNICEF and UNESCO - two major international education support institutions. However, World Bank appears to be more influential in shaping education policies of developing countries to its interest than the other two for policy compromise is a precondition for loans in developing countries (Brock-Utne, 2000).

In terms of global influences, the colonial view gave way to the rationalist principle in the 1970s, and then to the cultural approach in the 1980s (Hervey & Stensaker, 2008; Hyslop-Margison & Sears, 2006). In the neo-liberal ideology dominated way of life in the 1980s, the structural adjustment motive came into being which hardly hit the embryonic education system in developing countries like Africa.

> The economic structural adjustment programs (ESAPs) of the World Bank starting in the mid-1980s were meant to be the medicine that would help African and other 'developing' countries repay their debts by having their exports grow. The medicine consociated of measures like trade liberalization, privatization, forced devaluation of the local currency to 'get the prices right,' and reducing public expenditures by laying off people in public administration, as well as cutting sectors like health and education (Brock-Utne, 2000: 21).

Unfortunately, Brock-Utne concluded that many studies consistently showed the decline in achievements in primary education net enrolments in countries which introduced structural adjustment. "It was this steady deterioration of the education sector in the developing countries in the 1980s that led some of the multilateral organizations to organize the 1990 World Conference on Education For All (WCEFA) (ibid., p. 4). It is unfortunate that colonialism, neo-liberal ideology (with emphasis on competition, market led development approaches and testing in a landscape of anomalies) and the structural adjustment policy were all deliberate happenings with significant impacts on developing countries. Thus, the measures to follow cannot be considered as genuine responses to the problems but muddling acts to the affected.

Global primary education quality perspectives since 1990:

Education policies and practices after 1990 are influenced by the Jomtien (1990) and Dakar (2000) Education For All (EFA) declarations. The EFA and MDG goals are classified as common goals with 2015 as the due date. The 1990 Jomtien, Thailand, declaration document started from an analysis of global challenges (economic stagnation and decline, economic disparities, marginalized populations, environmental degradation and rapid population growth) and education as an instrument of human development, including the inter-relationship between the two. Though the global challenges are likely to constrain the realization of equitable access to education, the declarations seem to recognize that it is education of the citizens that foster the fight against the evolving crisis in the world. Besides, despite the efforts of many countries across the globe to improve educational access, and the right to education declaration passed in 1948, during the

Jomtien declaration more than 100 million children (about 60 million of them girls) were out of school and about 960 million adults (about two-third of whom were women) were illiterate (UNDO, UNESCO, UNICEF and World Bank, 1990). Accordingly, the Jomtien declaration advocated about the need to “an ‘expanded vision’ that surpasses present resource levels, institutional structures, curricula, and conventional delivery system while building on the best in current practices” (p. 158). Beyond access, the declaration focused on ensuring leaning in schools (see Article 4 of the Jomtien declaration).

Though the 1990’s was considered as a *literacy* decade and enrolment relatively increased in quantity, preliminary assessments towards the close of the decade showed the contrary. That is, EFA Assessment 2000 confirmed that about 113 million children, especially girls and children from marginalized community, were out of the reach of basic education in many countries; less than one-third of the children below six years age had access to ECCE; and about 880 million adults were illiterate. As a result, the Dakar Framework for Action (2000) came into existence as “a re-affirmation of the vision set out in the World Declaration on Education For All in Jomtien a decade ago (i.e. in 2000)” (UNESCO, 2000, p. 12). By re-affirmation, it was meant to keep the promise alive and deliver as declared before:

> We re-affirm the vision of the declaration on education for all, supported by the Universal Declaration of Human Rights and the Convention on the rights of the Child, that all children, young people and adults have the human right to benefit from an education that will meet their basic learning needs in the best and

fullest sense of the term, an education that includes learning to know, to do, to live together and to be (p.8).

The Dakar Declaration not only revitalized the goal of access but also shaped the views on the intentions of education from assumptions to support the fight against global challenges and improve social welfare to more of student behaviors, i.e. to know, to do, to live together and to be. The quality goal of the declaration was also stated as: "Improving all aspects of the quality of education and ensuring excellence of all so that recognized and measurable learning outcomes are achieved by all, especially in literacy, numeracy and essential life skills" (UNESCO, 2000: 17). That is, the EFA goals are inclusive of access, equity and quality. Hence, the growing concern on the quality of learning in schools was featured in the UNESCO led Global Monitoring Report (GMR) as early as 2005 (UNESCO, 2004). This time, the same series of report glumly informed the world community that 57 million children were out of school by 2011, a total of 250 million children, 130 million of them staying in primary school and the rest with less than grade 4 experience, are not able to "read, write or do basic mathematics" (UNESCO, 2014: 5). The post - 2015 Education First initiative, by the UN- Secretary General, also made equitable quality of learning as one of the center pieces of the EFA unfinished agendas[7] (United Nations - Secretary General, 2012).

Since the start of a focus on learning in the Jomtien declaration, re-affirmed in Dakar 2000, "student achievement has become a major point of reference in judging the quality of education." (Kellaghan & Greaney, 2004: 1). This view of learning outcomes in turn

[7]The three priority areas of the post -2015 Education For All (EFA) initiative are stated as: (1) Put every child in school, (2) Improve the quality of learning, and (3) foster global citizenship.

shaped the practice in many countries to look for new ways of thinking patterns – benchmarking curriculum-based learning using measurable indicators and introducing feedback system called learning assessments in many countries.

3.5. Limitations of the EFA Declarations

Despite the renewed global commitments to ensure the right to education of every child and some encouraging results, the global monitoring reports on the situation of EFA delivery and related studies show gaps in achievements, including the unbearable possible failure of the world community to keep the promise - universal primary education by 2015. UNESCO and UNICEF (2005) publication on measuring exclusion from primary education estimated the number of out-of-school children at 115 million in the year 2001/02; UNESCO (2008) EFA Global Monitoring Report predicted that about fifty-Eight countries will not meet UPE by the year 2015. Though there are encouraging results, it is becoming inescapable reality that there will be significant number of children left behind even by the year 2015. Earlier assertions indicated that about 58 counties around the world (UNESCO, 2008) will not realize UPE, and around 29 million children will be out-of- school worldwide by the target year (UNESCO, 2009), which is supposed to be the fate of about 56 million children by current estimations (UNESCO, 2010).

Therefore, notwithstanding the positive implications of the EFA commitments, there are considerable limitations that deserve the attentions of national policy makers and researchers. These can be classified as: (a) State of Fuzziness, and (b) State of Influence.

A **State of fuzziness:**

Terms like quality, learning, primary education, and the four pillars of education (to know, to do, to live together, and to be) are used without operational definitions. Consequently, because of lack of common definition of what primary education is meant, there appears to cause differences in measuring indicators, including estimating enrolment rates and out of school children in different countries. Besides, if the four pillars (to know, to do, to live together, and to be) have to be used as quality indicators, still many things require in depth clarifications. Rao (2003: 599) interpreted the four pillars in the UNESCO report (1996) as, "…going beyond an instrumental view of education as a process one submits to in order to achieve specific aims (in terms of skills, capacities or economic potential) to one that emphasizes the development of the complete person, in short, learning to be." Amare (2008: 12) too seemed convinced by the arguments of Rao and considered this notion as an indication of a shift of viewpoint from a heavily reliance on factual/subject area knowledge to the recognition of the social and emotional aspects of learning. However, the pillars are not self-standing and needs further elaboration for clarity - which knowledge to know? What to do? What is the norm of living together? To be whom? Given that the EFA declaration was framed in a global perspective, there is no proof to show that those seemingly sound principles are not likely to carry the interest and the elements of the dominant culture to the local contexts. In fact, Yamada (2007) said that "following suit with earlier styles of multi-site adaptation, the current discourse on EFA can be considered as a form of educational transfer in the era of globalization" (p.2). Hence, it could rather be viewed as a source of conflict than a source of harmony; and a source of identity crises than a source of being. And, who knows these all could be contributing to the low quality of education in the poor countries.

A State of influence:

Because of the conception of the right to education, the global community was initiated to specify the goals for all countries in the world, irrespective of the distance to be travelled by each one. The countries were at different levels of educational development at the times of declarations but the deadlines were (are) the same for all. Was it fair or justifiable decision? It is right that, as claimed in the Dakar declaration, the EFA goals were collective decisions but are they individually initiated goals? Was there a freedom for the developing countries to have their say? Do not we need a review of past experiences (from the pre-Dakar decorations) regarding what went wrong because of the collective decision or commitment that expect for all countries to reach the same destination, from different starting points, by the same time? Theoretically, everyone can hope to create a quality educational opportunity for all citizens even in a time shorter than the years specified by each of the declarations but feasibility.

Reports like UNESCO (2000:8) attributed the shortfalls to the commitment-delivery dichotomy which cannot be an excuse for, during policy design, the commitment should foresee the delivery in context. Besides, the Dakar declaration seemed to ignore the lessons from the previous global (the Jomtien) and regional declarations. The document acknowledged the detailed analysis made on the state of basic education around the globe, but not in view of the lessons from the past EFA declarations. Hence, the Dakar

Declaration is viewed more as a result of right-based reflections, political decisions, and interest to diffuse educational ideas from one corner to the other, usually from the rich to the poor countries, (Yamada, 2007:2) than as practical commitments to make real differences in the developing world as promised.

Moreover, the EFA declaration and implementation does not seem fundamentally different from what the developing countries experienced during the colonial time. The educational priorities, norms and conceptions were drawn from that of the developed world (which included the ex-colonialists). The challenge starts from here and it would have been nice, as we were reminded by Odora (1998:18), if the declaration first addressed education for 'freedom' and 'self-reliance' than Education For All (EFA).

In summary, the EFA declaration seems a process of *socialization* than an instrument of *excellence.* The developed countries seem trying to cultivate the citizens of the developing countries to be able to make a contribution to the economic monopoly of the developed world and be able to consume their products than cultivating excellence to be competent in the global market oriented economy. It will not be wrong if someone perceives it as a process of hegemony than helping the developing countries to improve their lives through education.

Whatever the justification behind, practice shows that African initiatives (like the education for self-reliance in Tanzania) were not encouraged because they are to function against cultural hegemony, deemphasize the principle of return in education and will not breed dependency over capacity building, superficiality over sustainability in developing countries. In this regard, Brock-Utne (2000: 71) cited Tuomas Takala (1998) who analyzed the national education policies of Ethiopia (1994), Mozambique (1995), Zambia (1996), and Namibia (1993) and found out similarities with the World Bank publications and Jomtien EFA documents, though Namibia was not officially under structural adjustment program.

It should be clear, however, that this is neither to oppose the EFA declaration and commitments, nor to underestimate its contributions to widen educational opportunities in developing countries. The main idea is to show that:

- The attribution of the challenges of access and quality of primary education to the delivery side only, and thereby assuming cause – effect relationship between being low income country and children achieving low entails irrationality.
- If low scores are associated with low income, there is also a possibility of the factors to be scarcity of resources to finance both access and quality at the same time or the influence of factors related to planning and policy development.
- International assessments are usually designed in the perspectives of the west and the low achievement may not necessarily mean insufficient learning but relevance – mismatch between what the children in the poor countries have learned and what is measured; or the curriculum was not relevant and they did not make any effort to master it.

- ➲ It is justifiable to conclude in relation to the factors studied but explaining the problem without adequate data is a mere speculation.

3.6. Conclusion: Operationalizing the conception of educational quality in this study

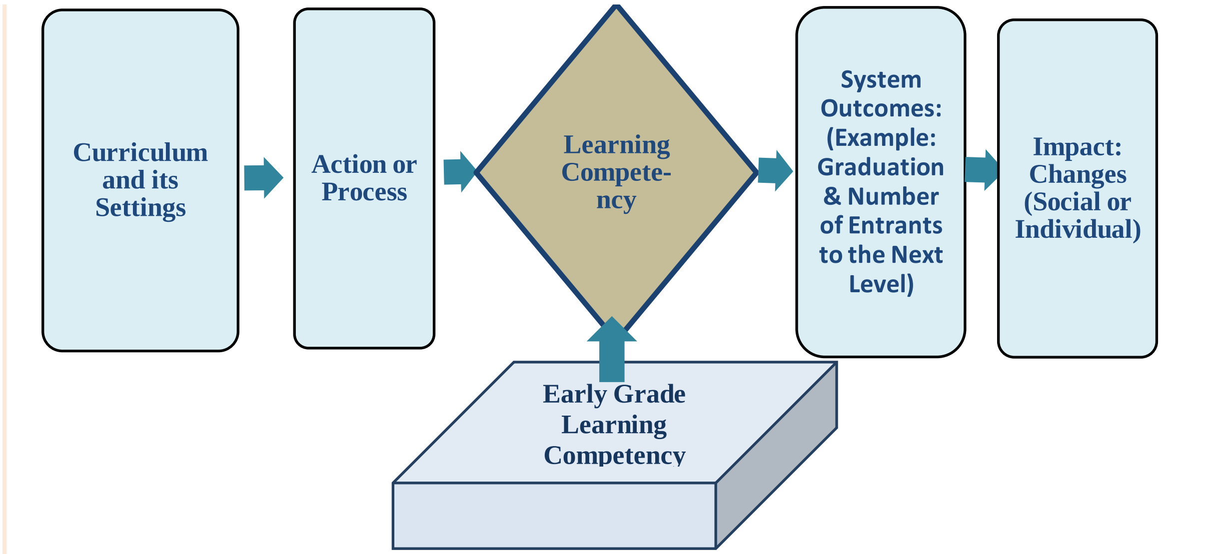
Despite the variations in defining quality in the academic literature, a global move from input-based quality conception to learning outcomes is becoming universal and is likely to continue for some time in the future (Kellaghan & Greaney, 2001). This study is in line with the current developments in the definition of quality in that it is aimed at exploring the status of early grade mathematics learning competencies and the vision of the Ethiopian government which is working towards explicit indicators by which progress should be measured (MoE, 2008a).

On the other hand, the intrinsic assumption behind globalization is market competition and fond of testing to make schools accountable for the contribution towards economic developments. This global market competition is defined by human development index competition in which education is entrusted to play a different role (Kellaghan & Greaney, 2001; Adams, 1993). This new world order requires excelling in learning outcomes defined as competencies - effective action that combines knowledge, attitude and skills, and not each of these as stand-alone entities (Tiana, Moya & Luengo, 2011; Halász& Michel, 2011; Pepper, 2011; Dabrowski & Wis´niewski, 2011). Besides, according to Burbules (2004), competencies are capabilities named as weaker teleological learning outcomes because of the flexibility they provide in mediating international and local views of quality with an emphasis on ability development rather than on mastery of knowledge. Examples of competencies could include number sense, communication skills, reading, mathematical operations, etc.

There are also supportive arguments from Sen (1989) who defined life as a set of 'doings and beings,' called *capabilities*, and education as a means to improve the quality of human life through the development of appropriate capabilities. This conception too reflects that quality of education is quality of learning measured by the ability to do and to be as the case in competency-based approach. The central point in the two approaches is that learning is about doing, and not the sum of the separate pieces from knowledge, attitude and skills.

In the past, the identification of such competencies was left for individual countries and respective curriculum planners. The post-2015 Education First initiative, however, is accompanied by proposed global competencies for the different levels (Early childhood, Primary and Post-primary education) (Learning Matrices Task Force, UN-Secretary General Education First Initiative, 2012). The focus on learning as a quality measure, therefore, reflects both international and national trends in educational policy and practice.

Figure 5: Learning Competency as a center piece of quality definition



The conception of quality as learning competency in this paper has ideological, logical and pragmatic reasons. It is ideological, because learning competecnies enhance competitiveness in the global context without necessarily loosing identity or locality. That is, there is a possbility of developing similar competencies (like problem solving) without necessarily using same curricular contents or being in the same conetxt. Furthermore, competencies should be conceived as learning process capabilities that refresh readiness to further learning, and thus keep the spiral of learning dynamic. In this sense, competencies catayze the dynamics of learning as children move from one stage to the next or from one content area to another. Mere association of competencies with end results is a dead end conception of learning outcomes.

There are also logical and pargmatic reasons to competency for inputs, process and impacts get their idetity from the state of learning. If there is no learning, inputs and process loose their visibility and practical significance despite how convincing the theoretical arguments are.Promotion rates, number of entrants to the next level, etc are not really proper measures or indicators of quality. Those may inform how many have gone through the system or level but not the nature and criterion-based extent of learning. Social or individual changes too presuppose theproper management of school gradautes. There is no or little social change as a conesequnce of schooling does not necessarily mean schools did not do their jobs properly. Both failure in the managment of the school grdautes and limitations in learning could lessen the impact of education. Thus, without appropriate evidence on what happened to learning, jumping to measure the impact of eduaction or schooling in social transformation would be futile exercise.

To sum up, there are specific arguments as to why this study defined early grade mathematics competency as a measure of quality of education. The following are the basic assumptions behind this research:

1. Competencies are the required learning outcomes not only because of the policy background in Ethiopia but also they provide a holistic approach to view life-based educational outcomes. Viewing outcomes in terms of knowledge, attitude, skill as separate entities, like the behaviorists, has two limitations: (a) integrating the three is left for the child without any feedback from the classroom, (b) life does not resemble such dissociation and it simply means limiting the applicability of the school knowledge in life activities.
2. Early grade learning is both an initial stage for the child and for the subject knowledge upon which further learning should take place. Thus, learning at this

stage is crucial and has far reaching effect on the quality of education at a system level.

3. Mathematics is one of the determinants of not only academic and personal competency but also participation in society. In this regard, Kilpatrick, Swafford and Findell (2001) have to assert the following:

> Children today are growing up in a world permeated by mathematics. The technologies used in homes, schools, and the workplace are all built on mathematical knowledge. Many educational opportunities and good jobs require high levels of mathematical expertise. Mathematical topics arise in newspaper and magazine articles, popular entertainment, and everyday conversation. Mathematics is a universal, utilitarian subject—so much a part of modern life that anyone who wishes to be a fully participating member of society must know basic mathematics. Mathematics also has a more specialized, esoteric, and esthetic side. It epitomizes the beauty and power of deductive reasoning (p.15).

It is because of such realities and implications that the status of early grade learning competency in mathematics is adopted as a basic education quality indicator. A system of education that does not provide strong foundation is not likely to create miracles at the upper grades. Nor is any other school subject to substitute the contributions of mathematics on human capability development. Thus, the issue of early grade mathematics competency is as much a subject of learning theory and pragmatism as it is political, implied in the '*Tyranny of the International Horse Race'* by Brown (1998).

CHAPTER 4
ASSESSING LEARNING IN MATHEMATICS: LESSONS FROM GLOBAL EXPERIENCES

4.1. Introduction

The shift in conceptualizing quality from input and process elements to learning competencies or outcomes seems accompanied by shifts in research ideologies and technicalities. Since the 1990s, quality of education has become quality of learning; measuring quality means measuring learning using tests of different forms which is evident in the existing international and national assessment practices these days (Kellaghan, 2004; Cheung, 1994). However, the objective of such assessments is not always overt and critical analysis is required to understand details and universals.

In terms of measurement formats, the international landscape shows two types of assessments co-existing these days. On one hand, the paper-and-pencil model seems commonly used in many learning assessment practices. TIMSS (Trends in Mathematics and Science Study), PISA (Programme for International Student Assessment) and SACMEQ (Southern and Eastern Africa Consortium for Monitoring Educational Quality) are among the well-established and internationally recognized systems of assessment in our time (RTI, 2009).

Currently, however, early grade learning assessment formats (mainly in reading and mathematics) are emerging and are getting wider acceptance in many countries. In this case, Early Grade Reading Assessment (EGRA) and Early Grade Mathematics

Assessment (EGMA) are the two relevant examples with standardized procedures and easily modifiable contents to fit a specific curriculum setting under consideration (*Ibid*). Thus, this part of the study provides evidence with regard to the why of assessment, overview of lessons from international and regional assessments, and developments in early grade assessment with particular emphasis to mathematics. The effort is to learn about applicability requirements of existing assessment approaches, findings and implications.

4.2. Why Assessment of Learning?

To begin with, the researcher is of the opinion that there are two categories of possible explanations underlying the present learning assessment practices at different levels- international, regional, and national. Some are necessitating conditions and others are expected outcomes of the practice itself. The necessitating conditions include the following: First, as indicated in the OECD (2010) report more than any time in the past the world is highly interconnected; ICT innovations are making communication simple, efficient and instant; physical proximity has dimensioned its role because of communication technologies; globalization is integrating the world market and competition for employment. Thus, checking progress of learning in view of securing comparative advantages is an avoidable. Second, change is a reality of life these days and is “so pervasive, so fundamental and so rapid those education communities [*sic*] do not know how to cope with it” (Mazurek, Winzer & Majorrek, 2000: 7-8). Third, there is also a motivation to know others because of safety and security concerns – developments of one might be threats to the neighbor (Alexander, 2000).

On the other hand, literature shows that learning assessment practices have intended outcomes:

1. Like the case of this research, tests are perceived as status checking mechanisms. They are entrusted to provide evidence on what students' know and are able to do as a result of schooling.

2. Test results are also informative about best policies and practices helpful to improve the state of learning (Kellaghan & Greaney, 2004; UNESCO, 2008; Ginsburg et al, 2000; Scheerens, 2004; Haahr et al, 2005; OECD, 2013). Nations cannot ignore learning from others to win failure. There is no reason for any country or society to practice trial and error method while there is a bulk of verified information from which everybody can learn about success and failure stories.

3. Notwithstanding the above objectives, there is a subtle intention of learning assessment practices around the globe. That is, international assessment schemes are also intended to inform the positioning of a country as compared to others (Kellaghan, 2004; Kellaghan and Greaney, 2004). Especially, "international tests in mathematics are famous for their horse race appeal: to find out the highest-scoring countries, the lowest-scoring countries, and for the citizens of any particular country, how its students rank against the rest of the world" (Loveless, 2007: 1). Why such competition centers mathematics? Two basic motives are clear:
    a. *It is both success and survival issue:* The American National Mathematics Advisory Panel (2008) describes the assumptions behind mathematics education in terms of the need to ensure safety and security in this technical era.

This time is a time of technology and the proficiency to produce and manipulate those technological resources matters in ensuring social protection. In fact, the report stressed that leading societies are those with high expertise in mathematics because of the ability to make complex analysis of experiences, history and the future. Mathematics ability is also praised for its contribution towards success in other subjects and in employment. "…The growth of jobs in the mathematics-intensive science and engineering workforce is outpacing overall jobs by 3:1" (p. xii). Thus, mathematics skills are at issue because of the belief that quantitative skills, founded in mathematics, dominate contemporary life style, and are the basis for employment and understanding national threats and coping mechanisms.

b. *The politics of competition* – Brown (1998) in his article entitled, *'The Tyranny of the International Horse Race'* implied that governments are so careful to reveal performances in mathematics because of far-reaching consequences in national politics. Public announcement of the results of the *Third International Mathematics and Science Study (1996)*, for example, was delayed because of fear of negative public reactions or back fires in relatively low achieving countries. Governments suggested the announcement of mathematics achievements of the 45 countries to include policy suggestions to heal resulting public angers. It happened so for failure in mathematics is perceived as dimensioning scope of influence in the global political arena (*ibid.*) and because "the competition among countries now revolves around human capital and the comparative advantage in knowledge" (OECD, 2010: 14). Such national rank-

> oriented approach to research on learning, however, resulted in unforeseen serious limitation: as observed in international assessments like TIMSS, findings are not analyzed to show how the best performing countries educate their citizens (Talbott in Loveless, 2007).

In this sense, though the concept of educational quality as quality of learning is not altered, the perspective by which quality of learning is viewed contradicts with the EFA right-based approach (UNESCO, 2000). In view of assessment practices in mathematics, quality does not seem to refer to the relative capacity gains on the part of students but to the achievement rank of the country in the global setting – competition induced conception. That is, although the objectives and contents of international tests may not tally with national priorities, results in mathematics are considered as parameters of global comparison. The danger is that children are likely to be considered as objects to fulfill national interests and not as human beings with their own destination –self-actualization. Hence, there should be reconciliation between competency- based national standards (capability to perform to the level specified in national documents) and normative views of international achievements (rank-driven performance requirements) to avoid mixing techniques in judging quality of learning.

4.3. Assessing Mathematics Learning: Lessons from TIMSS, PISA and SACMEQ

TIMSS, PISA and SACMEQ are analyzed hereunder because of relevance to the intentions of this study: (1) all three include assessment of mathematics learning; (2) they have long time experiences (ranging from 15 – 50 years) worth learning for appropriate understanding of trends in assessment and mathematics; while the first two are well recognized international assessment schemes (Dronkers, 2010; Loveless, 2007; OECD, 2010; Olson, Martin & Mullis, 2008; OECD, 2009), the third one has hands-on experiences in the African context (SACMEQ, 2010); and (3) they represent the trend in paper-and-pencil format of assessment around the globe; and (4) the language of research of all three is English which makes it within the reach of the researcher.

4.3.1. TIMSS

Historically, the current TIMSS (Trends in Mathematics and Science Study) is an outgrowth of the first IEA (International Association for the Evaluation of Educational Achievement) study named as 'Pilot Twelve-Country Study.' It was carried out in the early 1960s to reveal cross-national data on student learning in mathematics, reading, comprehension, geography, science, and non-verbal ability followed by the second study in 1980 -1982. In 1995, the third study was conducted under the acronym called TIMSS to mean Third International Mathematics and Science Study (Dronkers, 2010; Loveless, 2007; Olson, Martin & Mullis, 2008).Afterwards, the study is conducted in a continuing series of four years - 1995, 1999, 2003, 2007 and 2011. In 2003, without change to its acronym TIMSS used in 1995, the description became Trends in Mathematics and Science Study with a focus at grades four and eight student testing (Loveless, 2007; Mullis et al., 2000).

Since the start of the four year-periodic assessment in 1995, the system helped IEA to assess grade four students for a second time at grade eight. That is, grade four students in one assessment are assessed at grade eight in the next. For example, TIMSS 1995 focused on assessing grade four students from the sample countries and TIMSS 1999 (also called TIMSS-Repeat or TIMSS-R) replicated the previous TIMSS at grade eight. Such periodic study and overlap with student progress from grade four to eight provided an opportunity to analyze changes on student performance over the four years (Mullis et al., 2000).

Since its inception, the scope of TIMSS grew in many ways. The Pilot Twelve-Country Study with a total of 9,918 students aged 13 - 14 years in 1959 (Foshay et al., 1962) involved more than 500,000 children from over 45 countries in 1995 (Mullis et al., 1997) and over 600,000 children from about 63 countries in 2011 (Mullis, Martin, Foy & Arora, 2012). It also introduced the idea of benchmarking participants by which performances of students from the sample countries should be viewed. Accordingly, 52 countries and seven benchmarking partakers in grade four assessments, and 45 countries and 14 benchmarking entities in grade eight assessments took part in the mathematics category of TIMSS 2011 (ibid.).

In the case of methodological issues, the items in mathematics test were drawn from content and cognitive domains presented in multiple choices and free-response (writing response) item formats. Content domains were delimited in consultation with participating countries, and content categories and items were different for grade 4 and 8 students. However, the cognitive domain items (which include knowing, applying and reasoning) were the same for both grades. Besides, TIMSS assessment format included background questionnaires focusing on home and school profiles information on factors influencing performance of students in the different settings.

Note that interpretations of TIMSS mathematics achievements were based on the customized scale established in 1995. The scale assumes that achievements generally range from 0 - 1,000 and hence 500 and 100 are set as mean and standard deviation of the scale respectively (Mullis et al., 1997; 2012). Besides, TIMSS mathematics reports use four point international benchmarks with the following cut-of-points: “Advanced International Benchmark (625), High International Benchmark (550), Intermediate International Benchmark (475), and Low International Benchmark (400)” (Mullis et al., 2012, p.86). As indicated in TIMSS 2011, reports not only included timely findings in mathematics or science but also analyzed trends since the base year of the periodic assessment, i.e. 1995. Thus, TIMSS mathematics report 2011 provided the following major and consistent findings over the years:

1. Asian countries continued to be the top scorers in the TIMSS mathematics assessments conducted so far. The list includes Singapore, Korea, Hong Kong SAR, Japan and Chinese Taipei.
2. Trends between 1995 and 2011showed that mathematics achievements at grade four are characterized by increase over the years but not consistent at grade eight.
3. Country specific data showed better achievement in mathematics knowledge as opposed to application and reasoning skill development. It became clear that at both grade four and eight, it is relatively easier for children to recall and recognize mathematical concepts than providing justifications and applying the knowledge in real life.

4. Gender differences in mathematics achievements vary from country to country and from assessment to assessment. Between 1995 and 2007, TIMSS assessments showed negligible gender differences with an increase in the magnitude of difference in favor of girls at grade eight. As per TIMSS 2011 report, however, trends by gender showed no consistent reality that can be concluded at a global level.
5. TIMSS reports since 1995 also provide evidence on the contribution of early start and support in developing mathematical performance. Children who start school early, children with preschool or kindergarten experiences, and children whose parents engage them in early numeracy activities perform higher as compared to their counter parts. In other words, children who never had such experiences are reported to have the lowest achievement in the TIMSS mathematics reports of grades 4 and 8.
6. Availability of resources and support at home affect learning in mathematics in both grades 4 and 8. Parents' or caregivers' level of education, availability of key home resources (such as books and computers), and study support positively correlate with students' achievements in mathematics.
7. School resources and safety are necessary conditions– availability of relevant books, instructional materials, and computers tend to predict students' academic success in mathematics. Safety issues, including bullying practices, influence achievements in mathematics negatively. Also, children who speak the language of the school showed better achievement in mathematics at both grades. Children from schools reporting inadequacy of general instructional materials (buildings,

space, materials, etc.) and mathematics specific (library materials, audio-visual materials, computers, calculators, etc.) had relatively lower achievements in TIMSS mathematics.

8. Attitude towards mathematics and achievement in the subject affect each other. Though attitude towards mathematics in its general sense seemed less positive as one increases in grade level, evidence so far shows the existence of mutual influence between the two.
9. Finally, while engaging instruction (interaction of the child with the environment) contributes towards the development of mathematical concepts and skills, as we can guess, malnutrition negatively affects student achievement and success in schools.

4.3.2. PISA

The inception of PISA - Programme for International Student Assessment - goes back to 1997 when OECD[8] countries agreed to "monitor the outcomes of education in terms of student performance on a regular basis and within an internationally agreed common framework" (OECD, 2004:36). For that purpose, PISA assessment tries to measure the extent to which 15- year old children, finishing compulsory education and transitioning to adulthood, are prepared for life with all its challenges. In fact, it is both predictive study of success in life (as opposed to mastery of curriculum objectives) as well as evaluative study of education systems using policy and practice indicators. From its inception, PISA study covers reading, mathematical and scientific literacy, and in every round of three years the focus shifts from one area to the other. That is, reading was a focus of the first

[8] OECD is an acronym for Organization for Economic Co-operation and Development

PISA conducted in 2000, mathematics in 2003, and science in 2006. Afterwards, as the task of assessment started to repeat its cycle in the predetermined order, reading and mathematics were the subjects of attention in 2009 and 2012 respectively (Council of Ministers of Canada, 2013; OECD, 2014; OECD, 2013; OECD, 1999; Max Planck Institute for Human Development, 2002).The review of findings in mathematics, therefore, takes into consideration the reports in 2003 and 2012 because of their focus in mathematics literacy.

Though PISA 2000 sampled a total of 180,000 students by drawing 4,500 to 10,000from 28 OECD and four non-OECD countries, the coverage in 2003 increased to over 250,000 randomly selected students from 30 OECD and 11 partner countries, and to over half a million children from a total of 65countries (34 OECD and 30 non-OECD)in 2012. At all times, the main instruments of data collection were paper-based tests with items drawn from four content areas– space and shape, change and relationships, quantity, and uncertainty. The instrument also includes background questionnaires to assess family, school and personal correlates (OECD, 2004).

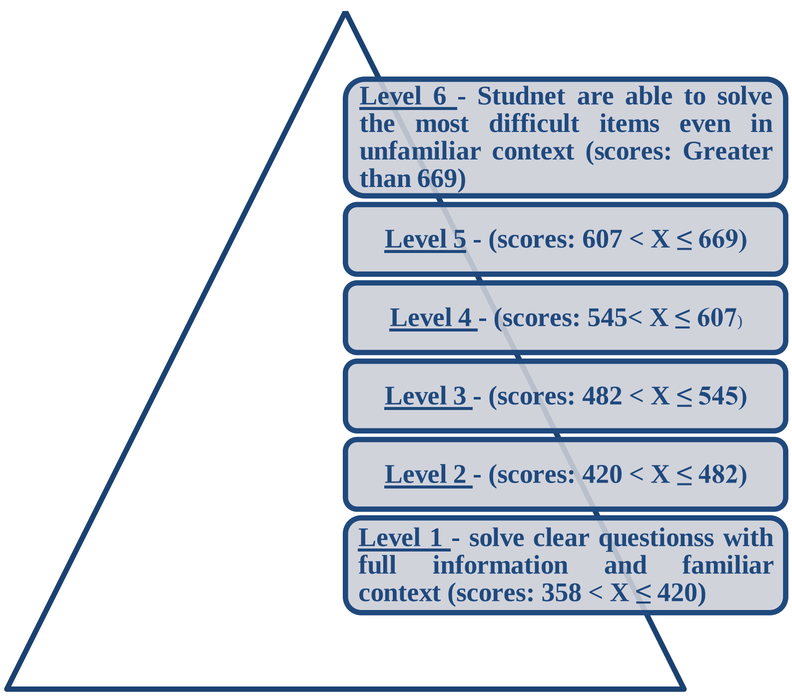
The interpretation of PISA mathematics findings depends on the operational definition of mathematics literacy and the levels of proficiency established for this purpose. The conception of mathematics literacy is defined as:

> An individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded mathematical judgements [sic] and to engage in mathematics, in ways that meet the needs

of that individual's current and future life as a constructive, concerned and reflective citizen (OECD, 1999: 41).

In this sense, literacy in mathematics implies the readiness of students to apply acquired knowledge and skills in real life and not the measurement mastery of school objectives. In both 2003 and 2012, like TIMSS, a scale of mean 500 points and a standard deviation of 100 points, and six levels of performances (ranging from level 1, the least, to the highest level 6) were used in interpreting findings. Test items were developed based on the six levels of performances in the scale and interpretation of findings combined these performance levels with their cut-off points as shown in Figure 6 (OECD, 2014; OECD, 2004).

Figure 6.Cut-off points of the levels of performances in PISA Mathematics 2003 and 2012.



(Source: OECD. (2014).***PISA 2012 Results: What Students Know and Can Do – Student Performance in Mathematics, Reading and Science (Volume I, Revised edition, February 2014).***PISA, OECD Publishing).

Therefore, the following summarizes PISA 2012 mathematics performances of 15-year old students and the trend since PISA 2003:

- Like TIMSS, Asian countries (Shanghai-China, Singapore, Hong Kong-China, Chinese Taipei, Korea, Macao-China and Japan in descending order) were the top scorers in mathematics.
- 25 out of the total participating countries in PISA 2012 showed an increase in mathematics performance as compared to that of 2003 findings.
- In a number of countries performances favor boys than girls. Out of the 65 PISA participating countries in 2012, boys outperformed girls in 38 of these countries and girls did perform better than boys in five of the countries.
- Data on opportunity to learn variables (exposure to mathematical terms, applied and formal mathematics, established in terms of indices) proved their contribution towards student mathematics achievement and differences in such opportunities showed consequences on the proficiency of students in mathematics learning (OECD, 2014).

4.3.3. SACMEQ

The genealogy of SACMEQ (The South African Consortium for Monitoring Educational Quality) is an international non-profit organization aimed at enhancing cooperative cross-national research in southern and eastern African countries. Basically, it is an outgrowth a single research work in the early 1990s by UNESCO's International Institute for Educational Planning (IIEP) in Zimbabwe. In 1995, SACMEQ was established as a consortium of seven[9] African Ministries of Education and became registered independent non-profit development organization consisting of 15 member countries[10] in 1997. The objectives underlying this organization include capacity building in the technicalities of quality improvement through training and research practices, and encouraging evidence-based policy and practice changes (Greaney & Kellaghan, 2008; SACMEQ, 2010; 2012).

SACMEQ research projects focus on the reading and mathematics achievement levels of grade 6 children, though SACMEQ III included additional dimension related to HIV and AIDS. It also assesses child and school level factors such as attitude towards learning, family and school background variables. Since 1997, three studies have been accomplished with an increased number of sample sizes. SACMEQ I (1995-1999) included around 20,000 students, 3,000 teachers, and 1,000 head teachers; the subjects were increased to about 40,000 students, 4,000 teachers and 2,000 head teachers in SACMEQ II (2000 -2004). SACMEQ III (2006-2011) further increased the subjects to above 60,000 students, 8,000 teachers, and 2,800 head teachers. Reports on SACMEQ IV (2012 -2014) are not yet accessible (SACMEQ, 2012: 2-3).

In SACMEQ study, mathematics literacy is defined as "the capacity to understand and apply mathematical procedures and make related judgments as an individual and as a member of the wider society" (Shabalala, 2005 as cited by Greaney & Kellaghan, 2008:129-130).In view of this conception and skills identified, eight levels of

---

9 The first seven Ministries of Education registered during the establishment of SACEMQ in 1995 are: Kenya, Malawi, Mauritius, Namibia, Tanzania (mainland), Zambia, Zimbabwe

10 Botswana, Lesotho, Mozambique, Seychelles, South Africa, Swaziland, Tanzania (Zanzibar), and Uganda joined the consortium in 1997.

mathematical competencies were identified for measurement and analytical purposes. Table 5 presents the competencies and their corresponding indicators.

Table 5. SACMEQ: the eight levels of mathematics competencies with corresponding skill indicators

Level:	Skill indicators include:
8. Abstract Problem-solving	o Identifies the nature of an unstated mathematical problem embedded in verbal or graphic information, and translates it into algebraic or equation form to solve the problem.
7. Problem-solving	o Extracts information from tables, charts, and visual and symbolic representations to identify and solve multistep problems.
6. Mathematically skilled	o Solves multiple-operation problems involving fractions, ratios, and decimals; o Translates verbal and graphic representation information into symbolic, algebraic, and equation form.
5. Competent Numeracy	o Translates verbal, graphic or tabular information into an arithmetic form in order to solve a given problem; o Solves multiple-operation problems involving everyday units of measurement, whole and mixed numbers, or all of these; and o Converts basic measurement units from one level to another.
4. Beginning Numeracy	o Translates verbal or graphic information into simple arithmetic problems; o Uses multiple mathematical operations on whole numbers, fractions, decimals, or all of these.
3. Basic Numeracy	o Translates graphical information into fractions; o Interprets place value of whole numbers up to a thousand; and o Interprets simple common everyday units of measurement.
2. Emergent Numeracy	o Applies a two-step addition or subtraction operation involving carrying and checking (through basic estimation); o Estimates the length of familiar figures; and o Recognizes common two-dimensional shapes.
1. Pre-Numeracy	o Applies single-step operations (addition & subtraction); o recognizes simple shapes; o Matches numbers and pictures; and o Counts in whole number.

(***Source:*** Greaney & Kellaghan (2008:131-132); SACMEQ (2010: 8-9)).

Similar to TIMSS and PISA, SACMEQ II and III scores were transformed into a scale of mean 500 and standard deviation 100 for standardization purposes (Hungi, 2011:3). Thus, unlike SACMEQ I, reports of SACMEQ II and III were able to include cross-national and trend analyses results. Major findings in this regard include the following:

- Botswana, Kenya, Mauritius, Seychelles, Swaziland, and Tanzania (main land) were the top and above average scoring countries in mathematics in both SACMEQ II and III. On the contrary, Lesotho, Malawi, and Zambia were on the bottom end of the list of scores in the respective studies.
- Over the years, Lesotho, Mauritius, Namibia, and Tanzania showed an increase of 30 average points or above in their mathematics achievements. The only country with considerable decrease (over 46 points) was Mozambique, attributed to its educational reform in between.
- Predictive factors: Social-economic status, student sex, age, grade repetition, absenteeism, homework, speaking the medium of instruction, and school resources were found to be shared and consistent variables responsible to the variance in mathematics achievements across the participating countries (SACMEQ, 2012; SACMEQ, 2010; Greaney & Kellaghan, 2008; Hungi, 2011).

4.3.4. TIMSS, PISA and SACMEQ: similarities and differences

As presented above, the three assessment systems are similar in certain aspects but different in other issues of measurement. To start with similarities, all the tests seem to focus on the understanding of quality of education and its predictive variables in which mathematics is their common denominator. Loveless (2007) further mentioned the parallelism between PISA and TIMSS in terms of sampling designs, the use of item-response theory in transforming scores into a scale of fixed mean and standard deviation, the inclusion of information on home background and school profiles. SACMEQ also shares these features. The review on SACMEQ above shows that the study designs (randomization), instruments (tests of achievement and background questionnaires), and standardizing scores all tally with that of TIMSS and PISA characteristics. Most importantly, all three focus on grades 4 and above and on the use of paper-and-pencil tests which integrate reading and writing abilities into the assessment domain. That is, such assessment systems do not show whether the child is failing to provide correct answer because of limitations in mathematical competence, or because of low level of reading or writing abilities (RTI, 2009).

However, the systems of assessment have also noticeable differences regarding what to measure in quality, data sources, and purposes of testing. Though TIMSS and SECMEQ tend to focus on measuring what students know as a result of schooling (see objectives of each in the respective sections), PISA seems to question how students are able to apply knowledge in a real life situation. Thus, according to Loveless (2007), the difference is between measuring school gains and measuring competencies to integrate knowledge and skills. In terms of main data sources, whereas TIMSS targets grades 4 and 8 and SACMEQgrade6 students, PISA gives due attention to 15-year old children who are on the verge of completing general education.

In summary, TIMSS and SACMEQ seem to share more common features than each of them does with PISA. The two focus on primary grades with the intention of measuring school outcomes and their variables. SACMEQ also includes items from TIMSS studies.

For example, Greaney & Kellaghan (2008) observed that test items of SACMEQ II were derived from "the Zimbabwe Indicators of the Quality of Education Study, SACMEQI, TIMSS, and the International Association for the Evaluation of Educational Achievement (IEA) Study of Reading Literacy" (p. 129).Thus, SACMEQ can be viewed as regional-international study in the context of Africa.

4.4. Early Grade Mathematics Assessment (EGMA)

4.4.1. Background

Early Grade Mathematics Assessment (EGMA) integrates the subject *mathematics* with the time phrase *early start* and the feedback system *assessment*. The interest is on what each of them implies to this research objective and what is different from the international assessment systems like TIMSS and PISA. The narration mentions three main points: the first point deals with why mathematics is a subject of interest for many; the second focuses on the predictive values of early start; and the third specifies the components of early grade mathematics learning that provide basis for later achievements.

Essentially evidence shows that the more development is geared towards scientific and technological advancement, the more the application of mathematics becomes so critical in the professions and daily life. Mobile phones operate with numbers, every day activities like managing private expense and shopping require basic skills in numbers. New developments in the area of quantitative skills (like online money transfer and managing personal accounts) are also evolving as we enter the era of technology and computer society. Scientists and engineers are products of mathematics-intensive quantitative models that affect social and individual prosperity and competitiveness in this globalized world. That is, the development of mathematical concepts and skills is viewed as the foundation for further learning in mathematics, knowledge acquisition in mathematics-intensive subjects, in professional practices, and in life in general (U.S. Department of Education, 2008; Smith, 2010; RTI, 2014).

The crucial nature of early grade mathematics, therefore, has to do with the new evidence in human development and knowledge acquisition. Adulthood success in mathematics and reasoning abilities necessary in life are founded in early grade mathematics experiences - those with better start are likely to outsmart their counter parts. Besides, early interventions are effective in fixing learning problems than otherwise (RTI, 2009, 2014; U.S. Department of Education, 2008; McCain & Mustard, 1999; Smith, 2010; Magnusun, Ruhm & Waldfogel, 2004; Jordan et al., 2009). Recent research works also showed that "early mathematics skills predict later reading skills just as much as early grade reading skills" (RTI, 2014: 1).

In terms of beginning schooling, however, there are two realties with regard to early grade mathematics abilities: (a) children come to school with some kind of mathematical understandings or number senses such as counting and comparing number of objects within a set; and (b) despite this common characteristic, the level of numeracy development and its timing varies with socio-economic backgrounds, children from developed world being at an advantage (The Expert Panel on Early Math in Ontario, 2003; McCain & Mustard, 1999; RTI, 2009, 2014). Why? Meta-analysis of long time research findings by RTI (2009) identified two kinds of variables in relation to the variation in readiness between poor and rich community children. The first is related to the limited opportunity of children to informal mathematical or numeracy experiences like shopping and number games and so on. The other one is related to the amount and relevance of early stimulation or neglect - what the child feels through the sense organs while engaged in informal activities involving numbers and counting (Guberman, 1999; RTI, 2009, 2014; McCain & Mustard, 1999).

In general, the above arguments substantiate that: (a) mathematics has a wider application in life and technology and deserves attention in curriculum and instructional practices; (b)there is a critical period in human learning or cognition - early age or grade - that provides basis for later achievements; and (c) the effectiveness of such an early start depends on the development of both accuracy (providing answers with minimum errors) and automaticity in providing correct responses to problems. With these in mind, there is a continuous effort to specify what kind of mathematical skills or concepts predict later success in the area. Though there is no conclusive research so far, the U.S. National Mathematics Advisory Panel recommended Kindergarten and primary school mathematics curriculum to focus on two major components of mathematics learning: (a) the understanding of concepts; and (b) development of fluency in solving problems (U.S. Department of Education, 2008). Those are believed to facilitate the construction of new knowledge over existing understandings, catalyzed by proficiency (accuracy and automaticity in providing responses to problems). Furthermore, literature review by

Smith (2010) grouped the basic and predictive skill sets of early grade mathematics into Counting Concept (CC) and Number Sense (NS) constructs. That is, the three elements combined together (early start, the principle of accuracy and proficiency, and focus on Counting Concept and Number Sense as foundational skills) provide ground to the Early Grade Mathematics Assessment (EGMA) conceptions, procedures and practices.

4.4.2. Counting Concept (CC) and Number Sense (NS) in Early Grade Mathematics

Counting Concept (CC) refers to the understanding of principles of correspondence between number words (like one, two, and three) and quantities (Smith, 2010; Fbye et al., 1989; RTI 2009, 2014). As described in the methodology section of this paper, Gelman and Meck (1983) listed out five principles by which we can measure the level of understanding of counting. These are:

a) One-to-One correspondence principle - refers to the creation of unique connection between counting objects and number words as in the example below: first cross, second cross, third cross, fourth cross, fifth cross and so on. That is, there is one number word for each cross.

Crosses	✝	✝	✝	✝	✝	...
Counting	1	2	3	4	5	...

b) The stable order principle - the order of number words remains the same at all times when the child counts. Example –all the time the number *three* precedes the number *two* - no condition alters the order of these numbers.

c) The cardinal principle - the last number in a counting sequence indicates the total number of objects counted or in a set.

d) The order irrelevance principle - the counting arrangement does not affect the number of objects or the cardinal value provided that all elements of the set are counted. In the stable order principle the issue is about the number words which are always fixed irrespective of the numeration system. In the case of order irrelevance principle, the idea is about the order of elements to be counted. As described above, though six comes after five and that is fixed, the objects used to count could be arranged in any order. Thus, it refers to the understanding that there is no inherent relationship between a number and an object in the counting though the object should not be missed out.

e) The abstraction principle - the objects used for counting purposes do not affect the counting or the quantity. That is, counting using candles or pictures of lions or actual flowers is all the same and does not change the quantity.

In the work of Smith (2010), the Number Sense category of skills refers to the development of number ability as opposed to the level of comprehension or understanding of number concepts or principles. Though the reality is not well established, available evidence shows that this category of early grade mathematics learning includes four subtasks:

a. Number Identification - the correspondence between number sound (word) and number symbol, like the case in the relationship between letter symbol and letter sound - graphophonemic awareness.
b. Counting Skill - the ability to use number words in counting (objects) orderly and specifying numbers or quantities. This counting skill is more of courting

procedure driven and can be accomplished with some kind of counting principle in mind (Baroody, 1993).

c. Understanding Magnitude - this is the ability to identify numbers and limit the magnitude in a comparative manner - which set has more elements.

d. Operation on numbers - adding, subtracting, multiplying and dividing numbers of age or grade appropriate.

The two constructs (CC and NS) seem both self-standing and interdependent. The Counting Concept component promotes the understanding of counting abilities, system of counting and quantity identification. The Number Sense deals with the skills involved in counting, connecting symbols and number names, comparing quantities, and the technicalities of operations. Understanding how to count does not necessarily equip the individual with the ability of counting as the later requires task-based practice. On the other hand, proficiency in computational skills should be supported by adequate and relevant conceptual understanding of the background knowledge. It is the appropriate integration between knowledge acquisition and computational skills that produce number, operational and problem solving competencies (National Council of Teachers of Mathematics, 2000). Therefore, though which one of the two constructs precedes the other or to what extent one influences the other is not yet clear (Smith, 2010), both should be recognized as fundamental bases for proper start in learning mathematics.

4.4.3. EGMA and its main features

EGMA is a recent phenomenon in educational research. There seems three necessitating conditions to its recent developments: (1) the growing recognition on the crucial nature of early start; (2) the need for scientific information on the status of learning in the early grades, especially in developing countries, to influence policy and curriculum making endeavors (RTI, 2009, 2014); and (3) as described above, the focus of international assessment systems such as TIMSS and PISA on upper grades, and paper and pencil tests limited the understanding of the global community regarding status of learning at early grades. Therefore, EGMA[11] is an alternative system of early grade mathematics learning assessment characterized by the following main features:

- EGMA is designed to leverage the importance of early start and the interdependence of conceptual understanding and fluency (accuracy and speed) in mathematics learning. In this regard, the U.S. National Mathematics Advisory Panel also stated the following:

> Use should be made of what is clearly known from rigorous research about how children learn, especially by recognizing a) the advantages for children in having a strong start; b) the mutually reinforcing benefits of conceptual understanding, procedural fluency, and automatic (i.e., quick and effortless) recall of facts; and c) that effort, not just inherent talent, counts in mathematical achievement (U.S Department of Education, 2008: 11).

[11] EGMA is designed by RTI (Research Triangle Institute), a non-governmental and non-for-profit organization based in USA, in response to the request from USAID in 2008 (RTI, 2009, 2014).

That is, EGMA measures competencies that integrate knowledge and skills in mathematics with an emphasis not only on correct answers but also on the time used in the process. As a result, some of the EGMA tasks are timed to one minute for the purpose of limiting the proficiency of the respondent or child. Proficiency in this case is defined as competence integrating knowledge, skills and reasoning abilities to solve mathematical problems (ibid.).

- Though the subcategories of Counting Concept and Number Sense Constructs constitute the EGMA subtests, the actual content and final test instrument are open for amendments as per the objectives of the assessment and curriculum coverage. A research by Smith (2010) included one-to-one correspondence, stable order, cardinality and order irrelevance subtests from counting concept construct; and number identification, counting skill, quantity, and addition and subtraction subtests from number sense category. The modality of test administration used was computer simulation where the children were asked about wrong and correct answers. However, the original EGMA designed by RTI and used in Kenya, Mali, Malawi, and others in the years between 2008 - 2011 included (1) oral counting (timed to one minute), (2) one-to-one correspondence (timed to one minute), (3) number identification (timed to one minute), (4) quantity discrimination, (5) number line estimation, (6) missing number, (7) word problems, (8) addition and subtraction, (9) geometry (shape recognition), (10) shape attributes, and (11) patterns extension. The EGMA booklet revised in 2011, however, consisted Number Identification, Quantity Discrimination, Number Pattern Identification, Addition and Subtraction, and Word Problem competency measures only (RTI, 2009, 2014).

- EGMA is diagnostic in nature and intervention-oriented research approach - EGMA is a one-on-one test entrusted to show the status of learning, program effectiveness, areas of learning problems and strengths, and where problem of learning mathematics starts. Unlike other international assessment systems like PISA or SACMEQ, it is more appropriate for specific curriculum or country-based evaluation than for cross-national comparisons because of its link to local learning environments than to the universally accepted learning outcomes such as problem solving. Literature depicts two basic facts regarding early grade mathematics learning and curriculum: (a) children from different cultures come to school with similar kind of mathematical skills and concepts, and (b) similarities are observed in early grade mathematics curricula of different countries. However, developments of the early grade mathematics competencies vary due to variations in learning environments (ibid.).
- EGMA administration does not confound reading (for comprehension) and writing abilities. The test requires a trained assessor with question papers, stopwatch, pencil, and other relevant materials to seat down with the child to be assessed. The assessor reads the questions to the child and records the child's responses as per EGMA tests procedures (see Annexes 2A & 2B). During the one-on-one test administration, the child (as a test taker) is free to use counting objects as appropriate. Such assessor based administration helps to: (a) minimize the influence of reading, writing and other factors on the test results of each child;

and (b) identify the level of mathematics specific competencies of each child (accuracy and speed in providing answers).

4.5. Summary

Research findings of EGMA applications are emerging, especially from developing countries. In high-income countries, mastery of Counting Concepts (CC) and Number Sense (NS) constructs are issues of preschool curricula (Smith, 2010; Gelman & Meck, 1983). Whereas EGMA research findings from developing countries like Kenya, Zambia, Ghana, and Jordan showed that children in grades 2 and 3 have difficulties in understanding and manipulating numbers (RTI, 2012a, 2012b, 2012c; Ghana, National Education Assessment Unit, 2014; RTI, 2013).

It is recognized that children start counting and develop some kind of number sense before they join formal school. It is also a reality that the level of readiness varies from society to society, those from developing countries being at a disadvantage. Such state of difference implies that some children, than others, need extra support to compensate their deficiencies (RTI, 2009). Thus, EGMA findings are helpful not only to evaluate students' mathematics achievements but also to measure the fidelity of curricular outcomes and program effectiveness.

CHAPTER 5
THE LANDSCAPE OF PRIMARY EDUCATION IN ETHIOPIA

5.1. Introduction

This section reviews developments and challenges in the Ethiopian education system. It doesn't as such intend to provide a complete historical review of the education as a whole. It is rather guided by relevance to substantiate the research problem in the context of Ethiopian education, and in the perspective of the situation in the state of Tigrai with emphasis on school mathematics. In doing so, the four pillars of the Ethiopian Education and Training Policy (FDRE, 1994) - access, equity, relevance and quality -are used as guiding themes in the analysis of policy documents, reports and pertinent empirical literature to clarify the context of the study.

5.2. Primary Education in Ethiopia: Overview of the Genealogy, Access and Equity

Though it is asserted that indigenous education in Ethiopia started in the 16^{th}C B.C. in Sabaan alphabets, the Orthodox Church introduced religious education in the 4^{th} century and served the Ethiopian community in preparing literate citizens for spiritual purposes and for government systems (MoE, 1984: 1-2). Since the late 17^{th} century Quaranic education also started its operation and expanded the scope of educational opportunity in the country (MoE, 1972:1). After the end of the 19^{th} century, however, the need for the establishment of dependable centralized government system and diplomatic relations necessitated the establishment of a new system of education called secular education, which was different from the religious and indigenous systems of education in many ways including organizational structure, objectives and contents of education. “The need for this [secular education] had been amply demonstrated as far back as 1889, when the dispute over the interpretation of the Treaty of Wuchale set the scene for the battle of Adwa in 1896” (MoE, 1984: 5).

Notwithstanding the efforts by different missionaries, the introduction of secular system of education was officially recognized in 1908, with the opening of Minilik II School in Addis Ababa. Basically, the system was imported from France and was French oriented in nature. The headmasters and teachers were French speaking, medium of instruction was French, and students set for competence examinations at the French legation. Few Ethiopian teachers were included to teach Amharic and elementary French. The curriculum was language dominated and included mainly French, English, Arabic, Amharic, Chemistry, Physics, History, Gymnastics, and Sports subjects (Work, 1934; Tekeste, 1990; Richard Pankhurst, 1976).The expansion of educational opportunity was also limited and “by 1935 there were only 4,200 students in 21 so-called government schools of which nine were in Addis Ababa (MoE, 1984:6).

The influence of France ended up in 1935 because of the Italian invasion, which destroyed the emergent education system – some were closed, others emptied and still others misused. Educated Ethiopians were executed; only few escaped (Pankhurst, 1955).

Therefore, it is futile to discuss schooling for Ethiopian children during the Italian occupation in the absence of learning institutions and education system in the country.

After the expulsion of the Italians, education was the priority for all purposes but difficult to reconstruct because of resource implications. Thus, measures were taken to make schools functional starting 1942. In August 1944, the government published a memorandum on educational policy which emphasized on mass education, use of Amharic language as a school subject and official language in the country, substitution of foreign teachers by Ethiopians, and development of complete structure of the education system (MoE, 1944). Practically, however, teaching materials written in English for the European children and teachers prepared for the same purpose were obtained from abroad. Medium of instruction, at all levels, became English (Teshome, 1979). Consequently, there was no uniform curriculum until the end of 1940's (MoE, 1948).

Quantitative increases were encouraging during this establishment period, 1941 - 1950. For example, enrolment of students grew from 19,000 in 80 government schools in 1943/44 to over 52,000 in 540 schools in 1949/50. It was unfortunate, however, that this development was halted by the introduction of the 2% land tax on all arable lands in the country (Proclamation No. 94 of 1947). The Orthodox Church, that was using the church land income for its educational expenses, was not able to comply with this rule on the ground (Teshome, 1979; Maaza, 1966).Hence, the education system faced another crisis -

about 158 government schools [12] (without formal handover) were assumed to be operational by the church and ultimately closed in between. As a result, expansion decreased from 540 schools in 1950 to 422 in 1952 (MoE, 1949, 1952, 1954)(See Table 6).Those lost schools were found none functional by the *'Ten-Year Plan for the Controlled Expansion of Ethiopian Education'* study reported in 1955 (MoE, 1955).For a variety of reasons, including the closing of so many schools, Ethiopia ranked second from the last (exceeding only to Niger) in educational expansion in the Addis Ababa Conference of African Ministries of Education in 1961. At the time, the country had only 3.3 per cent enrolment at primary and 0.5 per cent at secondary (Bjerkan, 1970).

The dissatisfaction with the imperial administration, coupled with limited expansion of education and increasing state of an unemployment of school leavers resulted continuous student demonstration demanding for a regime change and reform in the education system. From 1970 to 1972, a study called Education Sector Review was initiated and completed with, among others, five major findings: problems of responsiveness to the local situation, elitist in nature, high wastage, widely inequitable, and with highly centralized system of administration. However, its recommendations (including the four years of education for majority of the children and reduction of teacher salary) could not be implemented. Instead the recommendations added fuel to the student initiated public anger at the time and the imperial government was overthrown, ones for all, in 1974 (MoE, 1972, 1984; Tekeste, 2010).

[12]The intention of closing schools in the name of handing over to the church also reflected an element of injustice. Though as high as 35 out of 39 schools (89.7%) were closed in Tigrai, new schools were opened in other provinces.

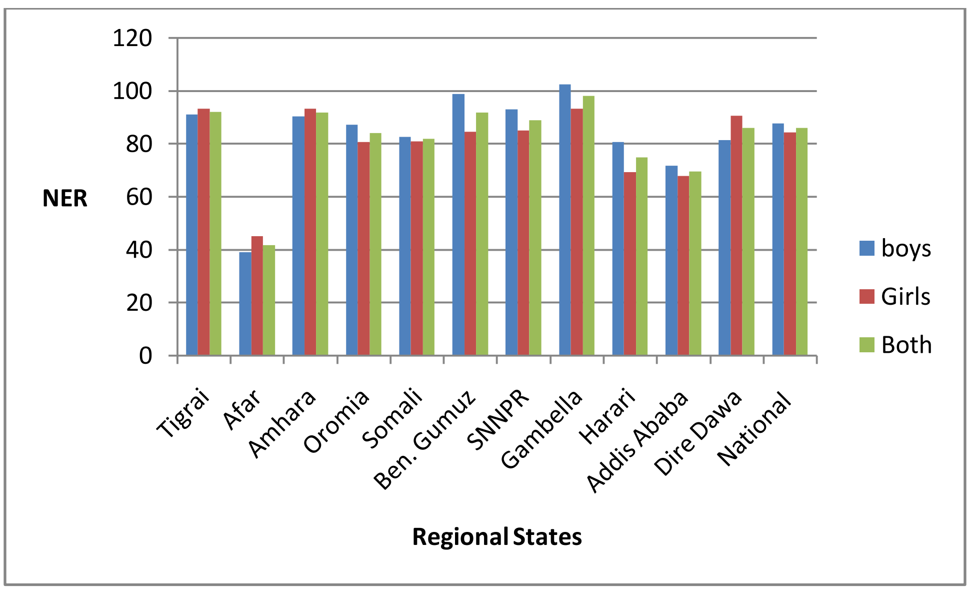
During the government change in 1974, the number of primary school children in the whole nation did not exceed 860,000, about a quarter of them from private, mission and church schools (MoE, 1984).The motto of education became mainly re-orientation of the young in socialist ideology, quest for scientific knowledge and integrating research with production in which the favored strategy was mass education (Tekeste, 2010; Destefano & Wilder, 1992, cited by Taddele, 2008). In terms of enrolment during the Derg time, Tekeste (2010) stated an increase rate of 12 per cent from 1975 to 1989 and put the total coverage at about 35 per cent of the total school age population.

It could be because of the wide spread internal conflict (especially in the North), the country was able to create educational access (grades 1-6) in 1994 to only 1.9 million or 20% of the then school age children, with considerable gap in enrolment from region to region, between the sexes, and urban-rural dwellers (MoE, 2002). The following statements describe the situation at the time adequately:

> To date, it is known that our country's education is entangled with complex problems of relevance, quality, accessibility and equity. The objectives of education do not take cognizance of the society's needs and do not adequately indicate future direction (FDRE, 1994, p. 2).

The new education and training policy changed the age long landscape of centralized system of education, fixed language (Amharic) medium of instruction and cultural hegemony to democratic decentralization, with due attention, among others, to mother tongue medium of instruction and community participation (FDRE, 1994). Developments in access and equity, therefore, appear to be encouraging. By the turn of the century (i.e. 2000 academic year), the national primary education (grades 1-8) Net Enrolment Rate (NER)[13] was about 49 per cent (about 56% for boys and 42% for girls). However, two regional states, i.e. Afar and Somali, were the lagging regions with only a little more than 10 per cent of gross enrolment (MoE, 2001). As of 2012/13 academic year, however, this NER reached 85.9% (87.7% for boys and 84.1% for girls). In this current access landscape, Gambella (98.0%), Tigrai (92.0%), Amhara (91.7%), Benshangul-Gumuz (91.6%) and SNNPR (88.9%) achieved above the national average. Although Afar seemed the lowest compared to the others, its NER was quadrupled from 2000 to 2012 (see Figure 7).

Figure 7.Primary Education NER, by Region and Sex - 2005 E.C (2012-13)



(Source: MoE, 2013b: 28)

[13]NER refers to the proportion of age specific enrolment at a given educational ladder.

5.3. Primary Education in Ethiopia: Issues of Relevance and Quality

5.3.1. Relevance and quality of primary education in historical perspective

To briefly recap the history of education in Ethiopia, the Italian invasion wiped out the French influence (1908 - 1935); Ethiopia adopted the policies and practices of Britain and USA in the 1940'sand 1950's respectively until it shifted to the USSR side during the Derg time (1974 – 1991). The downfall of the Derg regime in 1991, gave way to the rights-based approach to educational access as per the norms of the global commitment in the Education For All (EFA) documents. Notwithstanding the advantages of working towards the global commitments, some scholars consider the EFA goals to mark a shift in style of influence on the part of the developed world from one-on-one basis to a collective dominance in order to diffuse globalization norms to developing countries (Yamada, 2007:2). Therefore, there is nothing wrong if someone concludes that secular education in Ethiopia is both imported and a subject of external influence in its history. It is on the basis of such background that the relevance and quality issues are reviewed hereunder.

The issues of relevance and quality have consistent prevalence in the education system of Ethiopia. Before the invasion of the Italians, Ernest Work (1931), an American educational advisor, in his report to the Emperor, wrote about the futile exercise made to copy an education system from other countries where the conditions are so different in actual practice. In another publication (Work, 1934), he stated the following:

> …European countries are extremely active and zealous in efforts to fix upon the Ethiopians the trade and culture of their respective countries. In my work there I found this influence the greatest hindrance to my efforts in getting any real progress under way."
>
> From all sides I was asked what sort of an educational system I proposed to suggest – they hoped it would be French or Italian or English, depending upon the one asking. They often suggested it would be American since I came from America. My answer was always that so far as I was concerned it should be neither French, Italian, English, nor American. That I hoped it could be Ethiopian (p. 66).

During those days, languages of instructions were French and English, the contents were about foreign countries and personalities, and no part of the textbooks reflected about Ethiopian people and culture. That was so not because Ethiopians wanted to copy the norms and contents of education but because of the interest of the developed countries. An education system dominated by foreign staff, and using textbooks prepared for other societies with no alteration is, therefore, highly likely to create Ethiopians who can see their own country and community in the eyes of others.

After the expulsion of the Italians, the education system was reconstructed and evidence showed that concerns of relevance and quality continued to be major challenges of the system of education. Up until 1947, there was no unified curriculum in the country. Some of the problems recognized at this time were related to high class size, wide disparity in age range among children, low enrolment of girls, low quality of education, failure to implement Amharic as medium of instruction at grades 1 and 2 as per earlier recommendations, alien nature of the imported textbooks, less preparation of teachers to handle classroom instruction, less focus on life skills, and scarcity of educational materials (Meaza, 1961, 1966; Ayalew, 1964).

The experiences in the 1950's were not different from the past. A report by Maaza (1961) on the foundations of the pilot curriculum (1956 -1961), also called third curriculum,[14]showed that, among others, the standard of educational quality was very low and not adapted to the national needs. Grade 1 and 2 students learned little more than reading and writing in Amharic and a few computation skills. The new curriculum, piloted in five schools (Ameha-Desta, Medhane-Alem, and Asfa-Wossen schools from Addis Ababa; Model school attached to the TTI in Harara; AtseZera-Yacob from Debre-Berhan) from 1956 – 1961, however, in its totality "…showed greater relationship to the needs of the Ethiopian pupil…" (Ayalew, 1964:23). The report by Meaza (1961) also showed that teachers and students were much more enthusiastic and active in the classrooms; students involved in asking questions, giving suggestions and answers, bringing ideas for discussion; and some teachers tried to prepare educational materials from local resources, and focused on active learning methods.

[14]The first curriculum was designed in 1947 based on the 6-6 system of education (six years of primary and another six years of secondary). This first curriculum was replaced by an 8-4 system which functioned until the 6-2-4 system came into being in 1964 (Ayalew, 1964). Unlike those, the pilot curriculum was designed based on 6-2-3 system (Maaza, 1961).

The report by Meaza (1961) further indicated that the General Curriculum Committee suggested: (1) assignment of supervisory personnel in each school and to each subjectfor the proper implementation and evaluation of the effectiveness of the new curriculum or program; and (2) nationwide implementation to start in 1961-62 in the first three or four grades and adding one grade per year in order to complete the system (up to the end of secondary education) by 1968-69. Unfortunately, however, the government tended to adopt the 1961 Addis Ababa conference commitments of the African Education Ministers and the piloted curriculum, with all its strong indications, remained in vain. The system recommended by the conference was a 6 - 2 - 4, six years of elementary followed by two years of junior and additional four years of secondary education (Tekeste, 1990), which was functional through the whole of the Derg time.

As stated before, towards the end of the feudal system, a new education policy was framed as a result of the study called *Sector Review* (MoE, 1972). This document showed that starting early 1950's concerns over the education system "focused on its inability to satisfy the aspirations of the majority of the people, and on the adequacy of the preparation of those passing through its pipelines" (p. 2). The alien nature of the objectives of education to the Ethiopian culture and language use in schools were two of the problems that demonstrated the mismatches. Thus, issues of relevance can be considered as issues of quality defined as a *fit for purpose*.

When the Derg came to power, the system of education was said to have inherited basic inadequacies: limited and urbanized access, adherence to theoretical knowledge than to practical activities, and problem of relevance to the life of Ethiopians (MoE, 1984: 8-11). Thus, education was designed to fit the new environment and intended to "promote the all-round development of people with attention to organizational capacity, a new social consciousness, new attitudes towards labor, and an increased capacity in science and technology" (p. 13). As a result, new functions for education were outlined and integrated into the school curricula. These were *Education for Production, Education for Scientific Consciousness, and Education for Socialist Consciousness.* Unfortunately, however, educational quality proved to indicate that the results of the rhetoric are otherwise. Consequently, in January 1983, the Second Congress of COPWE[15] confessed that there was a quality problem and passed the following resolution:

> In view of the decline in quality of formal education despite its rapid expansion since the very start of the Revolution, attention be paid to make education of such content and quality as to prepare the youth from the point of view of the objective needs and ideological orientation of the country (MoE, 1984: 14).

After three years, a study entitled, *Evaluative Research on the General Education System of Ethiopia (ERGESE)* was publicized and results confirmed that educational opportunity was expanded but low quality. The report disclosed that from grades 3, 5 and 7 only 30% scored a passing overall achievement, achievements in secondary school subjects like Math and English were poor as measured by the Curriculum Department Tests developed for the research purpose. Besides, Amharic and English as media of instruction in primary and secondary schools respectively were found to be sources of learning

[15] COPWE = Commission for Organizing the Party of the Working People of Ethiopia.

problems (MoE, 1986). However, with the exception of ERGESE, previous documents did not provide research evidence to prove the assertion on low quality of education or level of learning.

The current Ethiopian Education and Training policy (1994) addressed the issues of relevance such as use of local languages as media of instruction in primary schools, decentralized primary school curriculum development, decentralized educational planning and management, etc. However, the capacity of the education system to prepare citizens as per national expectations and in view of the competitive world is still a subject of public criticism. As a result, the Ethiopia government, apart from recognition (FDRE, 1994), is introducing sector action plans and intervention schemes, operationalizing policies to guide practical activities, and prioritizing education in national development plans. Both the Plan for Accelerated and Sustained Development to End Poverty (PASDEP) (2005/06-2009/10) and Growth and Transformation Plan (GTP) (2010/11 - 2014/15), for example, identified education as a priority area of development and as a catalyst of social transformation towards prosperity (MoFED, Ethiopia, 2006, 2010).

Since the establishment of the education and training policy in 1994, the government has also introduced sector specific action plans and intervention schemes. Among those are the four consecutive Education Sector Development Program (ESDP) plans to redress the problems of access, equity, relevance and quality. The first (ESDP I) covered the period from 1997/98 to 2001/02; the second from 2002/03 to 2004/05, the third from 2005/06 - 2010/11, and the fourth from 2010/11 to 2014/15. Comparatively speaking, whereas the attention of ESDP I through III seemed on access and equity issues, ESDP IV provided more weight to the improvement of quality of general education in the country (MoE, 1998, 2002, 2005, 2010).

The emphasis on quality of general education (grades 1-10) during ESDP IV tallies with the objectives of the General Education Quality Improvement Package (GEQIP) under implementation in two phases. The first phase covered from 2008 to 2013 and the next is on a process of operationalization until 2018. The package as a whole targets five basic components: (1) Curriculum, Textbook and Assessment (CTA); (2) Teacher Development Program, including English Language Quality Improvement Program (ELQIP); (3) School Improvement Program (SIP), including school grants; (4) Management and Administration Program (MAP), including EMIS; and (5) Program Coordination, including monitoring and evaluation activities (MoE, 2008c, 2013c).

However, no national intervention program so far focuses specifically in the area of mathematics teaching and/or learning. The Ministry of Education identified Minimum Learning Competencies for grades 1-4 by subject, including mathematics (MoE, 2008a) but with no clear guideline as how such inputs should be used in classroom instruction. The Ministry also introduced an intake strategy of 70:30 undergraduate professional mixes in public higher institutions in 2008, i.e. enrolling 70 per cent of the qualifying students to Science and Technology stream and the rest 30 per cent to Social Science and

Humanities[16] (MoE, 2008d). However, it is only recently that a three-year pilot project called *Strengthening Mathematics and Science Education in Ethiopia* (SMASEE) has been designed to enhance professional capabilities of grades 7 and 8 mathematics and science teachers in Addis Ababa, Amhara and Oromia regions**.** This scheme is an in-service training model to enhance the use of student-centered methods in schools (MoE, Ethiopia & JICA, 2011, 2014). It is true that this initiative is limited in scope, focused on one aspect of teacher professional capability and too early to make conclusive judgment on its outcomes; it is, however, a good start for a country committed to transform its society into a middle income level in about 10 years to come.

Though the ultimate objective of all initiations could be improvement of learning achievements in schools, there is no clear evidence that this is the case in realty. Specifically, available literature on the situation of mathematics learning (be it at national or in the state of Tigrai)remains so worrying.

5.3.2. Empirical evidence on quality of primary education in Ethiopia

It appears that though quality concern has been there for a long time, systematic and systemic data generation is a recent experience in Ethiopia. As a result, the local literature on the state of learning in general and on school mathematics in particular is so thin. The focus of research so far appears to be on the determinants of access or inequality issues of schooling. Examples in this regard include studies by Rose and Al-

[16]Science and Technology Stream includes Engineering & Technology, Natural & Computational Sciences, Medicine & Health Sciences, and Agriculture and Natural Resources; Whereas Social Science and Humanities field encompasses Business and Economics, and Social Sciences & Humanities.

Samarrai (2001), Poluha (2004) and Camfield (2011) on factors affecting girls' education in Ethiopia with particular emphasis on household income, parental education and role model availability. Tatek (2007, 2008) also investigated the interactive effects of livelihood, socialization and school context on children's education. Studies by Muluemebeat (2007) and Tamirie (2009) further reported on the differential treatment of boys and girls or stereotypical reflections in textbooks. In fact, Tamirie (2006, 2009) included in his report a comparison of academic achievements by gender in selected schools of Addis Ababa and Enjibara, and concluded that boys outperform girls in school mathematics and the gap widens as we go up in the education ladder. Tilaye and Bedru (2006) too conducted a study on a sample of 2611 (309 boys and 302 girls) upper primary students selected from ten government and non-government schools of Addis Ababa. Results showed prevalent lower girls' performance in mathematics in both types of schools. Teshome's (2001) study too reached on the same conclusion after a detailed analysis of mathematics achievements of grades 3, 5, and 7 students from Addis Ababa primary schools.

In all cases listed above, the prime focus appears to be towards the identification of responsible factors to the variations in achievements rather than on the status of learning as a whole. In other words, the normative assessments mentioned emphasized on the investigation of group differences, and not on criterion measurement. In view of measuring both status of learning in mathematics and the contribution of different variables in the study area of this research, the Ethiopian National Learning Assessment studies at grades 4 and 8 were found worth analyzing (MoE, 2000, 2004, 2008b, 20012).

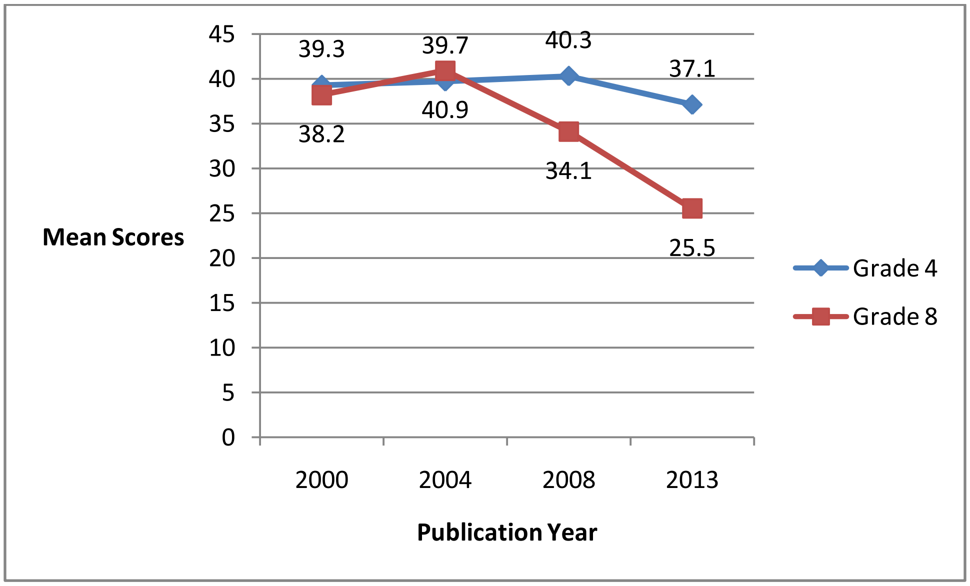
All four studies completed so far included data on achievement scores in selected subjects, and on family, individual child and school related variables.

The First National Learning Assessment (FiNLA) conducted in 2000 had a national sample size of about 10,500 grade 4 and about 5,099 grade 8 students from 256 and 134 schools respectively. Findings showed that, out of the ten regional states participated, neither of them scored above 50% mean in any of the subjects[17] included in the study. Specifically, achievements in mathematics for each of the grades remained below 40 percent (MoE, 2000).

The report of the Second National Learning Assessment (SNLA) was published in 2004. The national sample size at this time included over 13,000 grade 4 and about 8,059 grade 8 students from 376 and 213 schools respectively. Unfortunately, the results in mathematics were the same as that of the FNLA for both grade 4 and 8 students (MoE, 2004). Similar procedures and comparable sample sizes were used in the subsequent Third and Fourth National Learning Assessments (TNLA & FNLA) studies reported in 2008 and 2013 respectively. Findings, however, proved the prevalence of low performances of students in mathematics in grades 4 and 8 and decreasing trend of performances over the years (MoE, 2008b, 2013a) (see Figure 8).

[17] In the Ethiopian National Learning Assessment Scheme, whereas Grade 4 covers English, Basic Reading (in Mother Tongue language), Mathematics, and Environmental Science subjects, Grade 8 package includes English, Mathematics, Chemistry, Biology and Physics subjects. Note that Physics at Grade 8 was part of the assessment in the baseline assessment.

Figure 8.National Mean Scores of Students in Mathematics, by Grade and Assessment



(*Source:* MoE, Ethiopia (2000, 2004, 2008b, 2013a). ***Ethiopian 1st, 2nd, 3rd, & 4th National Learning Assessment of Grade 4 Students.*** Addis Ababa, Ethiopia)

The learning assessment reports used 50 per cent average as a minimum standard each student should surpass. However, Figure 7 above depicted that the reality was otherwise - performances of students at grade 4 and 8 in mathematics were far below the policy expectation. In fact, the indication of the results is found to be consistent over the years in conveying the message that by the end of four or eight years of education an average student is able to answer about or less than 40% of the items correctly. In the latest fourth national learning assessment study, the variables found to have significant contribution on the overall achievements scores were:

- Individual variables mainly gender, language used at home, and availability of additional reference materials;
- Home variables such as family size, education of fathers, number of meals per day, and home tutorial; and

- School variables represented by absenteeism within a semester and school distance found to be better predictors of overall academic performances (MoE, 2013a).

The review above shows that the literature on the status of learning in general and in mathematics in particular is limited. The indication of the available is, however, discouraging in the sense that not only the mean scores are low but also inequalities prevail as a result of sex, location, income levels of parents and related variables.

5.4. Primary Education in the State of Tigrai

Until 1991, the down fall of the Derg regime, Ethiopia had a highly centralized education system and hence variations in educational policy and practice were unthinkable. Accordingly, the history of education in the State of Tigrai and its landscape today may not be radically different from the national profile. This part of the review is, therefore, devoted to analyze very specific issues peculiar to the region and current developments of education with the intention of helping readers understand the context of the research. The emphasis is not on educational opportunity figures but policy dimensions and implications of the past, with an overview of quality indicators of the present in comparative perspective.

Experiences of the past specific to Tigrai include the following:

1. Despite the fact that Ethiopia is a multi-ethnic and multilingual society, centralized administration, including in education, prevailed up until 1991. The rule of the day

became assimilating into the Amhara culture; using Amharic as an official language, as a school subject up to grade 12 and as a medium of instruction in primary schools. This language policy is also what this researcher had experienced during his school time. Provincial territory was ignorant of ethnicity and language. At this level, the then province of Tigrai was the only ethnic territory in Ethiopia, with all maltreatment, injustice and ever shrinking size of its map as it appears appropriate to the ruling individuals, the prevailing interest and the system in function. Like all other societies in the country, Tegaru could not enjoy, to be specific to the objectives of this research, schooling in their own language and studying their own culture. For sure, this was not the fault of any other community in the country. Nor is the intention here to oppose the sharing of culture and language of communication among the citizens. The objection lies on the policy of doing things at the expense of ethnic identity, recognition, and integration of cultures as development and for development.

2. The incidence of closing schools happened in Ethiopia for about two times - during the Italian occupation and in the time of Emperor Haile-Selasie (as a consequence of the 2% land tax introduced in the 1940's). However, experiences in Tigrai differ in depth and frequency compared to the other parts of the country. What happened during the Italians could be a common denominator for all societies in the empire. The number of schools closed in the name of the land tax, however, was severe in Tigrai for nearly 90% of the then schools (35 out of 39) became dysfunctional. The issue is puzzling for many reasons including: (1) the schools were closed with no formal handover between the two parties and it was known that the church education was, by and large, religious education (MoE, 1955); (2) the incidence clearly shows

government's irresponsibleness for its actions, including marginalization. In fact, analysis of the uncovered justifications behind the decision is beyond the scope of this paper. However, it is possible to conclude that the impact was much severe in Tigrai than in any of the provinces. Table 6 depicts the agony of the past reality which amounts to social humiliation.

Table 6. Number of missing schools as a result of the land tax, 1949–1954

No	Province	Schools existing before 1943 E.C	Additional or closed down schools in 1943 E.C	in 1944 E.C	in 1945 E.C	Number of schools closed*	Total number of schools by the end of 1945 E.C**
1	Shoa	96	-1	-47	-	48 (50.0)	48 (-50.0)
2	Harar	32	-	-5	+1	5 (15.6)	28 (-12.5)
3	Arusi	34	-	-13	+4	13 (38.2)	25 (-26.5)
4	Begemedir	55	-	-1	+1	1 (1.8)	55 (0.0)
5	Gojjam	53	-8	+9	-	8 (15.1)	54 (1.9)
6	Wollo	17	+1	-	+6	-	24 (41.2)
7	Wollega	36	+11	+2	+3	-	52 (44.4)
8	Kaffa	34	-1	-19	-2	22 (64.7)	12 (-64.7)
9	Illubabor	37	-	-	-	-	37 (0.0)
10	Tigrai	39	-35	-	-	35 (89.7)	4 (-89.7)
11	Sidamo	62	-	- 25	-	25 (40.3)	37 (-40.3)
12	GamuGofa	15	-	+1	_	-	16 (6.7)
13	Addis Ababa	30	+1	-	-1	1 (3.3)	30 (0.0)
	Total	**540**	**-32**	**-98**	**+12**	**158 (29.3)**	**422 (-21.9)**

(Source: MoE, Ethiopia (1952, 1954)).

Note: a. There is no clear evidence if the newly opened schools in the range of the time (1943-45) were from those closed or not.
b. * = figures in parentheses are respective percentages of closed schools in reference to those existing before 1943 E.C.
c. ** = figures in parentheses are respective rates of increase or decrease in the number of schools in reference to those existing before 1943 E.C.

This second time incidence had far reaching influence on the development of education in Tigrai. Taking the number of schools as an example, it was only possible to see about 42 primary schools in Tigrai (almost equal to that of 1949) after solid 20 years, i.e. in 1969/70 (Taddele, 2008).

Schools in Tigrai were closed for a third time during the public armed struggle. As the downfall of Emperor Haile-Selassie gave way to the military junta to come to power, TPLF (Tigrai People's Liberation Front) was one of the many rebellion groups evolved in the country. After fifteen years of fighting and sacrifice, TPLF liberated Tigrai in 1989 which led to a total defeat of the government in 1991. Thus, government schools were totally closed for two academic years, from 1989 to1991, because of the total expulsion of the military regime from Tigrai (Young, 1997) – third setback to the education system in Tigrai.

3. Though mother tongue medium of instruction for non-Amharic speaking communities was almost impossible, education in the territory of TPLF in Tigrai was in Tigrigna language. Accordingly, after the government change in 1991, the House of Representatives passed the following decision regarding textbooks: "**የትምህርት በብሄረሰብ ቋንቋ መሰጠት በተጀመረባቸው ለምሳሌ ትግራይና ወሎጋ የተዘጋጁት ስርዓተ-ትምህርትና መፃሕፍት በትምህርት ሚኒስቴር ታይተው ሰለደረጃቸው አስፈላጊው ግምገማና ማሻሻል እንዲደረግ**" (MoE, 1993:1). This statement literally mean curriculum and textbook development in local languages such as Tigrigna and Afaan Oromo should start from the evaluation of existing materials by the Ministry of Education.

Consequently, grades 1-8 textbooks in Tigrigna were evaluated, by group of experts led by the Ministry of Education, to identify strengths and limitations for further improvement (*ibid.*). Thus, the researcher believes that the current status of mother tongue language curriculum and instruction in the State of Tigrai is an outgrowth of the experiences of TPLF before the downfall of Derg and not something initiated by the national education and training policy designed in 1994. This makes education in Tigrai unique as compared to the situation in many other ethnic communities with the exception of Afaan Oromo, with limited experience around Wollega (*ibid.*) and Amharic, the de facto language.

During the time of re-establishment in 1991, after two years of closing, the education system in Tigrai started operation with 191,411 students in 497 government primary schools (Taddele, 2008:46). In fact, some of them were temporary shelter schools intended to respond to the urgent needs of the society. As of the academic year ending in 2013, the total number of students reached over one million in 2,017 primary schools (grades 1-8). Therefore, NER for primary education in the same year was 92 per cent (91 for boys and 93.1 for girls) which is far beyond the national average (85.9 per cent) (MoE, 2012). Besides, Tigrigna is a school subject at grades 1 through 12, a medium of instruction in all primary schools (grades 1-8) and teacher education colleges. However, research evidence on the state of learning in the regional state is limited, except the four-year cyclic national learning assessment reports on grades 4 and 8 students. Hence, the possibility of putting the status of learning in mathematics in Tigrai is limited to the findings of the national learning assessment reports by the Ministry of Education.

Figure 9. Mathematics performances of grades 4 and 8 students from Tigrai as compared to national averages

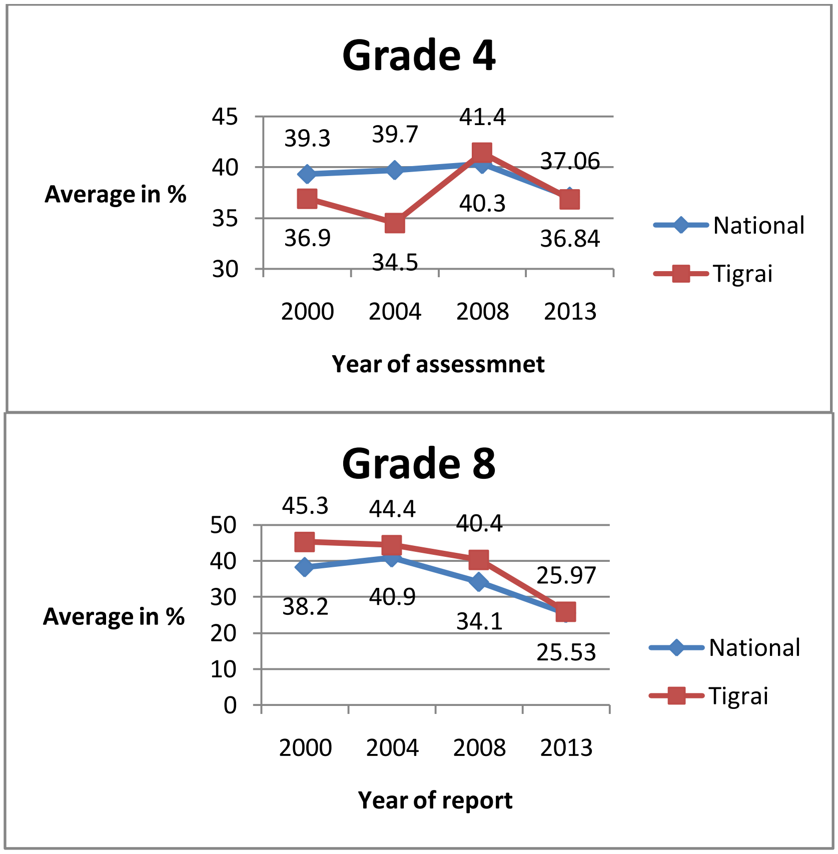


Figure 9 shows that mathematics performances of grade 4 children from Tigrai were below the national average in the first two consecutive assessments. Though the situation was reversed in the third assessment, the regional and national averages converged to the same point in the fourth report. The situation at grade 8 seemed different in the sense that children from the State of Tigrai had better achievements in the first three consecutive assessment reports while things fall to the same point in the fourth one. Furthermore, despite differences in the baseline assessment, the latest national learning assessment study showed that both national and Tigrai average performances were on the decline and converging to similar averages.

5.5. Status of Early Grade Learning in Ethiopia and the state of Tigrai

Research in the area of early grade learning in Ethiopia and in the regional state of Tigrai is so far limited or none existent in subjects like mathematics. Especially, the application of different forms of tests (in research) that minimize the interference of other skills such as reading and writing abilities of children while measuring learning in a specific area of interest is not yet developed. However, there are two basic recent developments in the area that might contribute towards the development of appropriate research approaches: (a) the identification of basic competencies for grades 1 -4 by grade and subject at a national level (MoE, 2008a); and (b) the early grade reading assessment studies conducted by DeStefano and Elaheebocus (2009), and Research Triangle Institute (RTI) in Ethiopian mother tongue languages (Benjamin, 2010). These could be very good inputs for in depth and wider research practices in early grade learning in Ethiopia.

A look at the mathematics competencies proposed by the Ministry of Education for grades 1 through 4 shows that the areas of competencies included: (1) Numbers (whole numbers, fractions, & decimals), (2) operations (addition, subtraction, multiplication and division), (3) measurements (length, weight, & capacity), (4) geometric shapes and solid objects, (5) Money, (6) Time, and (7) Patterns & Graphs. This list might be complete and acceptable from the point of view of content area coverage in mathematics curriculum. However, given that learning competencies are more of about being able to do with flexibility, accuracy and automaticity in carrying out problems (U.S. Department of Education, 2008), the list of competencies has major limitations including the following:

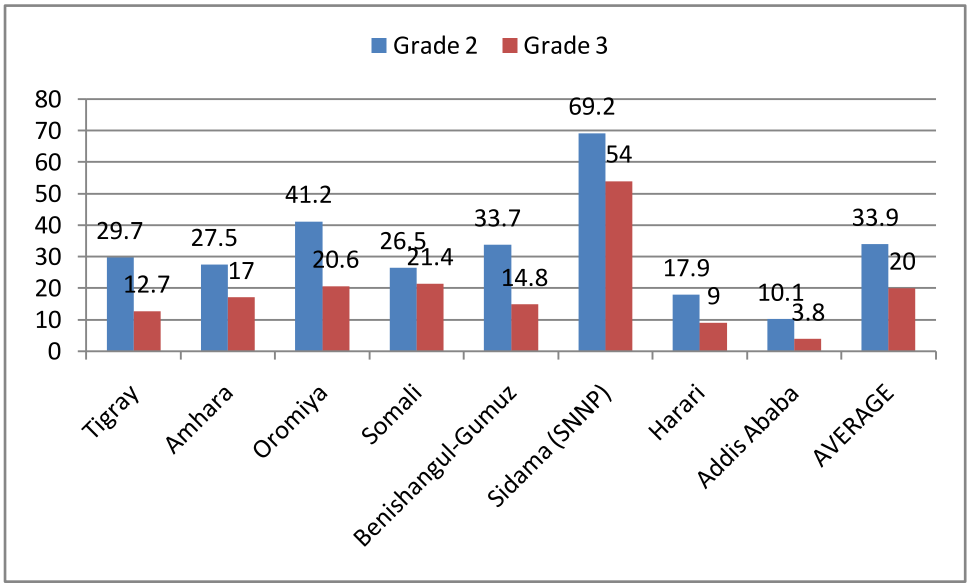
- First, the areas of competencies identified seem more of content outline than basic skills to be targeted at each grade level. This approach might lead to content coverage in textbook development, classroom instruction and assessment endeavors.
- Second, the specific competencies under each area of competency do not tally with the new approach that emphasize on counting concept and numbers sense constructs. Thus, the list simply includes place value, reading, writing, applying <, > and +, etc. and not on competencies like stable order (missing numbers), number identification, quantity discrimination, cardinality, one-to-one correspondence, etc. for the purpose of strengthening the development of foundational skills on numbers and operations.
- Last, the progression in terms of competencies is not clear. The content approach overshadowed the possibility of arranging skills from simple to complex with appropriate implications to assessment procedures.

In terms of early grade learning competency assessment, the study by DeStefano and Elaheebocus (2009) was the pioneering one in the context of Ethiopia. It was conducted in 24 schools in Woliso area, South-West Shoa Zone, Ormoia Regional State, under the principle of school effectiveness measured by reading fluency and comprehension abilities of grade 3 students. In addition to the EGRA assessment instrument, an oral test with timed subtasks and administered on one-on-one basis by trained assessors, observation, interview with teachers, and student background questionnaire were used to collect appropriate data on the ability of students to read and factors that account for variations. The total sample size included 456 grade 3 students, of which 49 per cent were girls. Results showed that: (a) thirty six percent of the children could not read a single word of grade 2 or 3 level text; (b) about 15 per cent were able to read on a rate of 40 words per minute (wpm) or better; (c) though significant difference was observed between children who support themselves after school time and who do not, differences between boys and girls were not considerable; (d) differences in reading fluency were significant across schools; and (e) of all the variables considered, total instructional time and time spent in reading activities were found to be strong predictors of reading fluency.

The other study in this regard was the national Early Grade Reading Assessment (EGRA) study 2010 (Benjamin, 2010). This study covered eight regions (Tigrai, Amhara, Oromiya, Somali, Benishnagul-Gumuz, SNNPR (Sidama), Harari& Addis Ababa), six languages (Tigrigna, Amharic, Afaan Oromo, Af- Somali, Hararigna and Sidamu Afoo). The sample of the study included 13,079 grades 2 and 3 students, 999 teachers and 336 directors from a total of 336 primary schools. The tests aimed at assessing reading abilities of students in the different languages included subtests on letter/fidel naming, phonemic awareness, familiar word reading, unfamiliar (non-sense) word reading, oral reading fluency, reading comprehension, and listening comprehension questions with background questions about individual, family and schools variables. The report depicted totally discouraging findings.

1. Early reading achievements of children in all languages tested were low. Figure 9provides a summary of word reading abilities of children at the time.

Figure 10. Percentage of children unable to read a single word correctly, by language and grade



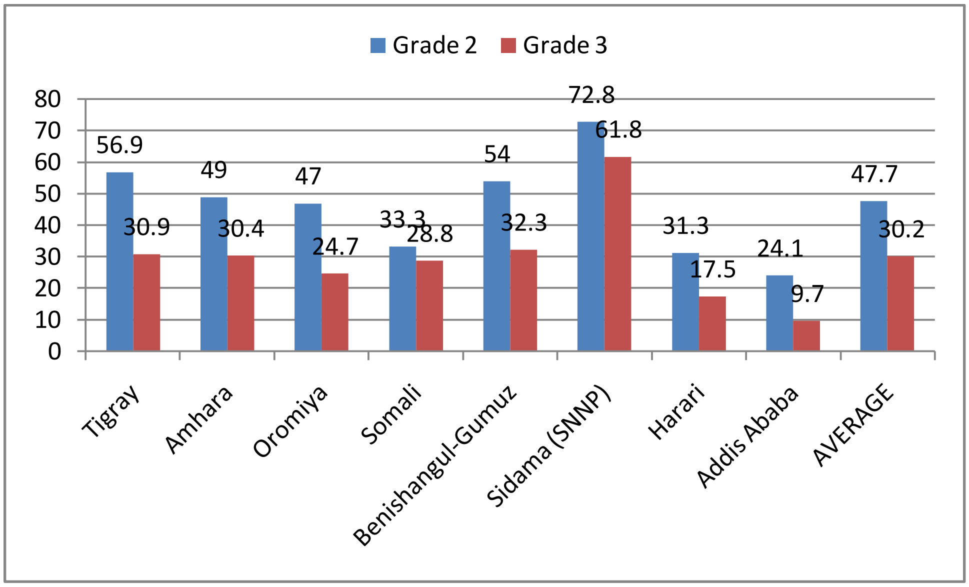
(Source: Benjamin, (2010:20)).

The proportion of children unable to read a single word by the end of grade 2 ranged from 10.0% (Addis Ababa) to 69.2% (Sidama). Children from Tigrai (29.7%), Amhara (27.5%, Somali (26.5%) and Oromiya (33.7%) were also unable to read a word in their own mother tongue language despite their stay in school for about two academic years. Even from those who stayed for three years in schools, considerable number of them could not read a single word correctly (Figure 10).

2. Because of the problems in word reading, many children had problems in meaning making process. Figure 11 also shows that on average 47.7% of grade 2 and 30.2% of grade 3 completers scored zero in comprehension. The details by language showed that as high as 72.8% (Sidama) of the children tested could not answer a single comprehension question despite they are towards the end of grade

2. Even the proportions of grade 3 children who scored zero in comprehension ranged from 9.7% (Addis Ababa) to 32.3% (Benishangul-Gumuz).

Figure11.Percentage of Children Scoring Zero on Reading Comprehension



(Source: Benjamin (2010:21))

5.6. Summary

The review in Chapter 5 showed the history of secular education and the situation of access, equity, relevance and quality indicators at national and in the regional state of Tigrai. The sources showed that formal education was imported from Europe, and its expansion has been differential of sex, location and region up until 1991. The problem of relevance too ranged from direct adaptation of foreign curricula and languages of education to over domination of Amhara culture and language designed and implemented by the oppressive regimes. Since the downfall of the Derg regime, this history of identity negligence has been replaced by the provisions of the National Constitution (and articulated details in the education and training policy) to make education responsive to the local development needs and to ensure the rights of children to learn in their own mother tongue languages (FDRE, 1994, 1995).

Despite the tremendous efforts by the government of Ethiopia in designing and implementing different policy guidelines and plans, existing research findings from the upper grades showed problems in the status of learning in schools. The review also indicated a knowledge gap with regard to the development of learning competencies at the early grades in general and early grade mathematics competency in Tigrai in particular. Such studies not only fill the gap in our understanding but also indicate policy and practice implications to bring about change.

CHAPTER 6
THE STATUS OF BACKGROUND VARIABLES AND EARLY GRADE MATHEMATICS COMPETENCIES (EGMC) IN TIGRAI

6.1. Introduction

This part is fully devoted to the presentation, analysis and synthesis of meanings from empirical evidence collected for this research work. While the first part addresses the status of selected background variables (individual, home &school), the second part focuses on the competency indicators of the two constructs – Counting Concept (CC) and Number Sense (NS) - in early grade mathematics learning. It is believed that the interaction of individual profiles, home environment variables and school operational factors shape the learning conditions of children.

The background variables are composed of two sets of variables - informational and research related. While variables in the first category (such as age and work experiences of teachers and head teachers) characterize the context, the research variables are those discussed in relation to basic hypotheses of the study in the subsequent parts of the report. Besides, the classification as individual, home and school related variables does not entail that each of these are totally independent of the others. For example, school location could be considered as school variable but is also related to home factors and individual variables such as preschool opportunity. Thus, the analysis assumes interrelationships and connectedness of the variables with each other and in affecting the situation of student learning.

6.2. The status of individual, home and school variables

Individual characteristics:

There were three types of respondents in this study - grades 1 and 2 students, their teachers, and school head teachers. Thus, this part provides an overview on the background profiles or individual characteristics of the respondents. With regard to the sampled children, age, sex, grade level, participation in preschool (KG) education, interest towards mathematics, repetition, and absenteeism were the basic variables assessed based on the data obtained from students. In case of teachers and head teachers, however, the characterization was limited to age, sex, qualification, professional service, mathematics instruction related trainings, and self-perception of teachers on their competency to teach early grade mathematics effectively.

Table 7.Number of respondents by school and sex

No.	Sample school	Students			Teachers			Head teachers		
		M	*F*	*Both*	*M*	*F*	*Both*	*M*	*F*	*Both*
1	Adi-Kuhlay	19	20	39	0	2	2	1	-	1
2	Endabagona	20	20	40	1	1	2	-	1	1
3	Enkoy-liham	17	20	37	1	1	2	1	-	1
4	Adi-Tsehafi	20	20	40	-	2	2	1	-	1
5	Gure	20	20	40	-	1	1	1	-	1
6	Sefho	20	20	40	-	2	2	1	-	1
7	Debre-Selam	20	20	40	-	2	2	1	-	1
8	Genahti	20	20	40	-	2	2	1	-	1
9	Sasun	20	20	40	-	2	2	1	-	1
10	Adiwerom	20	20	40	-	2	2	1	-	1
11	Gule	20	20	40	2	2	4	1	-	1
12	Kihen	20	20	40	1	3	4	-	1	1
13	Embamamo	20	20	40	1	4	5	-	1	1
14	Lekatit 11	19	20	39	-	2	2	1	-	1
15	Zikre-Semaetat	20	20	40	-	4	4	1	-	1
16	Adi-Tigrai	19	20	39	1	2	3	1	-	1
17	Daero-Tekli	22	18	40	1	1	2	1	-	1
18	Samre	20	20	40	1	2	3	1	-	1
19	Adi-Selkhi	19	21	40	-	3	3	-	1	1
20	AlmazAlemu	20	20	40	-	2	2	1	-	1
21	Wofri-Selam	20	20	40	-	4	4	1	-	1
Total		**415**	**419**	**834**	**09**	**46**	**55**	**17**	**4**	**21**

Table 7 shows that the study included a total of910 respondents composed of 834 grades 1 and 2 students, 55 teachers and 21 head teachers. Whereas the sex proportion of respondent children was similar (50.2% girls and 49.8% boys), majority of the teacher participants (83.6%) were females, which was directly the opposite of the situation with regard to head teachers where females represented only 19 per cent. That is, though females appear to have better representation in grades 1-4 teaching positions, the head teacher position does not tally with the population proportion of females in the pool.

Table 8. Individual characteristics of respondent children

No	Variable	Grade level			
		Grade 1	*Grade 2*	*Both*	*%*
1.	Age:				
	a. below 7 years old	26	-	26	3.12
	b. 7 - 8 years old	316	248	564	67.63
	c. 9 - 10 years old	57	135	192	23.02
	d. 11 and above years old	20	32	52	6.24
	Sub Total	***419***	***415***	***834***	***100.00***
2.	KG experience (including 'O' class[18]):				
	A. Urban (out of 318)	85	68	153	48.11
	B. Rural (out of 514)	100	51	151	29.83
	Sub Total	**185**	**119**	**302**	**36.30**
3.	Interest towards Math:				
	A. I like math	385	399	784	95.00
	B. I do not like math	30	12	42	5.00
	Sub Total	**415**	**411**	**826**	**100.00**
4.	Absent for more than a week in the academic year				
	A. Yes	103	105	208	25.21
	B. No	289	286	575	69.70
	C. I Don't Know	23	19	42	5.09
	Sub Total	**415**	**410**	**825**	**100.00**
5.	Repetition: what grade were you last year?				
	A. I was not in school	199	9	208	25.12
	B. KG or O class	192	6	198	23.91
	C. Grade 1	21	398	419	50.60
	D. Grade 2	1	2	3	0.36
	Sub Total	**413**	**415**	**828**	**100.00**

The Ethiopian Education and Training policy expects children to start grade one by the age of seven and finish primary education (Grades 1-8), under normal condition, at the

[18]'O' Class is a one year pre-school education (within formal primary schools) to prepare children for grade 1. It is on the process of institutionalization by the Ethiopian government.

age of 14 (MoE, 2002).The profile data analyzed in this regard seemed to showa relative match between the policy suggested age and grade level for about 68 per cent of the children. In fact, over age appears to be more prevalent than under age since more than 29 per cent of the children reported that they were nine or above years old while attending grade 1 or 2 (Table 8).

In terms of KG experiences of the children, it appears that the opportunity is better among urban than rural dwellers for about 48 per cent of children from urban and nearly 30 per cent from rural areas reported they had pre-school experience before they joined formal school. However, the overall coverage of preschool education in the region does not seem to exceed 36 per cent indicating the expansion of such a service is limited in scope.

One of the pre-conditions of formal learning is presence in class or attendance and participation in classroom instruction. With this assumption in mind, students were asked if they were absent for more than a week in the academic year. Results (Table 8) showed that one-fourth of the students were not in class for five or more school days while schools were on duty. Thus, though the situation requires further investigation to identify the underlying reasons, most affected groups and its relationship with academic achievements, the trend indicates higher instructional time wastage which might have adverse effect in academic achievements. There was also a follow-up question regarding repetition - staying in the same class for more than one year. Responses to the item indicated that the incidence is so minimal (a total of 2.78% for both grades). In comparative perspective, however, repetition seems higher among grade 1 than grade 2 students. Figures showed that the grade specific magnitudes were about 5 per cent at grade 1 and 0.4 per cent respectively. The background questionnaire also included an item if students were interested in learning school mathematics. About 95 per cent of the respondent children provided affirmative responses that indicate, at least, attitude towards mathematics is not an issue (Table 9).

Furthermore, the ages of the respondent teachers and head teachers ranged from the 20’s to the 50's. During the data collection time, majority (over 60 per cent of them) were between 20 and 40 years of age and had 6 to 20 years of professional experiences. This is a good professional mix composed of relatively young but experienced teaching staff. Regarding qualification, certificate and diploma seem to characterize the situation at hand. According to professional experiences of the researcher, certificate level of qualification used to be the standard to teach grades 1 through 4. This time, however, the Ethiopian government is introducing diploma level requirement to improve quality of education. Thus, certificate and above qualifications deemed to be appropriate at this transitional time.

Table 9. Individual characteristics of respondent teachers and head teachers

No	Variable	Respondents			
		Teachers	***Head Teachers***	***Both***	***%***
1.	Age:				
	A. 20-30 years old	22	3	25	32.89
	B. 31-40 years old	13	13	26	34.21
	C. 41-50 years old	8	4	12	15.79
	D. 51-60 years old	5	1	6	7.90
	E. Missing	7	-	7	9.21
	Sub Total	**55**	**21**	**76**	**100.00**
2.	Qualification:				
	A. No training	1	-	1	1.32
	B. Certificate	39	-	39	51.32
	C. Diploma	14	16	30	39.47
	D. BA/BSc	-	5	5	6.58
	D. Missing	1	-	1	1.31
	Sub Total	**55**	**21**	**76**	**100.00**
3.	Total professional Service (in years):				
	A. Up to 5 years	5	-	5	6.67
	B. 6-10 years	16	8	24	32.00
	C. 11-20 years	17	7	24	32.00
	D. 21-30 years	11	5	16	21.33
	E. More than 31 years	6	-	6	8.00
	Sub Total	**55**	**20**	**75**	**100.00**
4.	Specific Training in teaching early grade mathematics:				
	A. Yes	5	6	11	14.67
	B. No	50	14	64	85.33
	Sub Total	**55**	**20**	**75**	**100.00**
5.	Self-perception of teachers on their competence to teach mathematics:				
	A. Yes	51	-	51	94.44
	B. No	3	-	3	5.56
	Sub Total	**54**		**54**	**100.00**

Table 9 further indicates that though trainings on early grade mathematics teaching were not common, the teachers expressed confidence on their competency to teach the subject effectively. Such self-confidence might be a precondition for effective classroom instruction but not a sufficient condition because of two reasons: (1) the possible discrepancy between self-perception and actual professional effectiveness; and (2) the dynamics of classroom instruction is requiring teachers to be lifelong learners and to modify their understanding of learners and the learning process.

School variables:

The respondent children, teachers and head teachers were selected randomly from 21 primary schools, located in seven woredas. Of all the 21 sampled schools six of them were from two urban cities (Mekelle & Maichew), two from other two rural woreda head towns (Endabaguna and Samre), and the rest from rural settings.[19] In the background information, both rural and urban respondents indicated that the respective schools follow a shift system where students stay in school only for half a day in the school days (Monday through Friday). Though this kind of arrangement might have its own advantages like creating an opportunity for children to support their parents against their shift, it also limits the duration of instructional time or level of interaction between the teacher and students, the possible support students might get from their teachers and the school, and utilization of school resources or reference books in libraries. Thus, it could be an area of further research to investigate its relationship with the state of student learning.

---

[19]As per the current administrative structure in Tigrai, there are 46 woredas of which 12 are designated as urban. These are:

(a) Urban Woredas - AbiyyiAddi, Adigrat, Adwa, Alamata, Aksum, Endasilase, Humera, Korem, Maichew, Mekelle, Sheraro and Wukro; and

(b) Rural woredas – Abergele, Adwa (rural), Ahferom, Kola-Temben, Laelay-Maichew, Mereb-Leke, Naeder-Adet, Tahtay-Maichew, Werie-Leke, Atsbi-Wemberta, Erob, Ganta-Afeshum, Gulomekeda, Hawzen, Saesie-Tsaedaemba, Kilte-Awlaelo, Asgede_Tsmbla, Laelay-Adiabo, Medebay-Zana, Tahtay-Adiabo, Tahtay-Koraro, Tselemti, Degua-Temben, Enderta, Hintalo-Wejerat, Samre, Alaje, Endamekoni, Ofla, Raya-Alamata, Raya-Azebo, Humera (rural), Tsegede and Welkait.

Additional information was obtained from teachers and students regarding how teachers are assigned. The data from all schools indicated that classroom-based assignment, called self-contained system, prevails in schools. Put in another way, at the time of data collection, teachers were assigned to teach all the curriculum subjects for a given section (Tigrigna, English, Mathematics, Environmental science, and Aesthetics and Sport), and they do not teach a subject (or two) of their expertise or preference to different groups or sections. That is, subject-based curriculum is functioning in primary schools and such self-contained arrangement is aimed at integrating learning experiences in the different areas to create a whole. Notwithstanding the psychological advantages of such teacher assignment in developing useful attachment between the teacher and students, it could also be difficult for teachers to develop comparable competencies in teaching each of the school subjects effectively. Apart from policy provisions to implement self-contained classroom setup in grades one through four, there is no comparative study in the context of Ethiopia so far regarding the relationship between teacher assignment and student learning, and hence the issue is open for investigation.

Table 10 also provides highlights regarding student population in the sampled primary schools of the study. During the time of data collection (2011-12), the schools had a total of 17,902 students of which 9,109 (50.9 per cent) were girls indicating that their proportion was a little bit higher than that of boys. The figures also reflect the regional overall situation in primary education Net Enrolment Rate (NER) in the recent years. For example, in the academic year ending in, Tigrai Regional State NERs for boys and girls were 91.0 and 93.1 per cent respectively (MoE, 2013b).

Table 10.Sampled school distribution, Location, total student population and grade levels enrolled in 2011/12 academic year

Woreda	Sampled school		Level	Total number of students in 2011/12	
	Name of school	*Location*		*Total*	*% of females*
1. Asgede-Tsimbla	1. Adi-Kuhlay	Rural	Grades 1-4	143	61.5
	1. Endabagona	Urban	Grades 1-8	1,671	50.1
	2. Enkoy-Liham	Rural	Grades 1-8	869	59.0
3. Laelay-Maichew	4. Adi-Tsehafi	Rural	Grades 1-8	509	50.1
	5. Gure	Rural	Grades 1-8	923	50.8
	6. Sefho	Rural	Grades 1-8	1,059	49.9
3. Ganta-Afeshum	7. Debre - Selam	Rural	Grades 1-4	153	55.6
	8. Genahti	Rural	Grades 1-8	641	46.5
	9. Sasun	Rural	Grades 1-8	808	50.6
4. Kilte-Awlaelo	10. Adi-Weroma	Rural	Grades 1-8	1,227	48.2
	11. Gule	Rural	Grades 1-8	736	49.2
	12. Kihen	Rural	Grades 1-8	647	53.5
5. Mekelle	13. Embamamo	Urban	Grades 1-8	1,448	51.0
	14. Lekatit 11	Urban	Grades 1-8	791	50.4
	15. Zikre-Semaetat	Urban	Grades 1-8	1,173	51.4
6. Seharti-Samre	16. Adi-Tigrai	Rural	Grades 1-6	429	50.1
	17. Daero-Tekli	Rural	Grades 1-8	793	52.1
	18. Samre	Urban	Grades 1-8	1,602	52.1
7. Maichew	19. Adi-Selkhi	Urban	Grades 1-4	193	47.7
	20. AlmazAlemu	Urban	Grades 1-8	1,065	50.0
	21. Wofri-Selam	Urban	Grades 1-8	1,022	49.0
	Total		**-**	**17,902**	**50.9**

(Source: Data collected from head teachers; Tigrai RSEB. (20012)).

Another feature of interest in the analysis of school profiles was up to which grade level each school was able to enroll. The data collected from head teachers and a report of the regional education bureau indicated that only four of them (Adi-kuhlay, Debreselam, Adi-Tigrai, and Adi-Selkhi) were not complete primary schools though it was evident that each school enrolled grades 1-4 children at minimum (Table 10). Furthermore, home and school language similarity, availability of functional libraries, distribution of textbooks, class size, availability of mathematics teachers' guides, teacher support and monitoring mechanisms in place, and availability of functional water tap, latrine (separate for the two sexes) and electricity were discussed. Results were as presented in Tables 11 - 13.

Table 11.Home and school language congruence, availability of functional library and textbook-student ratio

No	Variable	Respondents		
		Children	***Teachers***	***Head Teachers***
1.	Home and school languages are the same:			
	A. Yes	795 (95.4)	-	-
	B. No	38 (4.6)		
	Sub Total	***833 (100.00)***	**-**	**-**
2.	Availability of functional library:			
	A. Available and functional	234 (28.1)	47 (85.5)	8 (38.1)
	B. Available but not functional	402 (48.2)	-	-
	C. No library at all	134 (16.1)	6 (10.9)	13 (61.9)
	D. I don't know	64 (7.6)	2 (3.6)	-
	Sub Total	**834 (100.00)**	**55 (100.00)**	**21 (100.00)**
3.	Mathematics grades 1 and 2 textbook-student ratio:			
	A. One-to-one	743 (89.1)	31 (56.4)	14 (66.7)
	B. One-to-many	26 (3.1)	19 (34.6)	5 (23.8)
	C. No Textbook	63 (7.6)	2 (3.6)	1 (4.1)
	D. I don't know	2 (0.2)	3 (4.4)	1 (4.1)
	Sub Total	**834 (100.0)**	**55 (100.0)**	**21 (100.0)**

N.B. Figures in parenthesis are percentages

Regarding the similarity of home and school language, over 95 per cent of the respondent children confirmed that the language they speak (Tigrigna) is the medium of instruction in schools. This is in line with the policy of education standards, except for the remaining 4.6 per cent respondent children. In the case of availability of functional libraries, the responses from students, teacher and head teachers indicated mixed perceptions. Majority of the students (over 64%) were of the opinion that libraries are either none existent or dysfunctional. The opinion of teachers, however, was found to be the contrary - over 85 per cent of them confirmed that libraries are available and functional (Table 11).

Table 12 includes information regarding class size, and availability of math grades 1 and 2 teachers' guides and teacher support. As per the information obtained from classroom teachers, it was learned that: (a) teachers are assigned as classroom teachers, called self-contained classroom setup, to teach all the school subjects within a section rather than as subject teachers; and (b) class size in the target grades ranged from 29 to 62 students per section. Of the total respondent teachers, 41 of them (74.56%) indicated that they teach less than or equal to 50 students in a section. The rest had more than 50 students in their respective classes. Regarding availability of teachers' guides, about three-fourth of the school mathematics teachers was able to get copies from their schools. Majority of teachers (87.3%) and head teachers (71.4%) also indicated that schools and woreda education offices provide support to classroom teachers. However, the support may not necessarily be subject specific but general supervision.

Table 12. Class size and availability of math teacher's guides and teacher support

No	Variable	Respondents	
		Teachers	***Head Teachers***
1.	Number of children in a section:		
	A. 50 or less	41 (74.55)	-
	B. Over 50	14 (25.45)	-
	Sub Total	**55 (100.00)**	**-**
2.	Availability of mathematics grades 1 & 2 teacher's guides for teachers:		
	A. Yes	41 (74.5)	-
	B. No	14 (25.5)	-
	Sub Total	**55 (100.0)**	**-**
3.	Availability of teacher support from the school or woreda education office:		
	A. Yes	48 (87.3)	15 (71.4)
	B. No	7 (12.7)	4 (19.0)
	B. No response	-	2 (9.6)
	Sub Total	**55 (100.0)**	**21 (100.0)**

N.B. Figures in parenthesis are percentage representations

On the other hand, head teachers are the school managers and are believed to have better understanding about school situation. Thus, they were requested to provide information regarding availability of functional library, pedagogical center, water tap, separate latrine for the two sexes, and electricity. As per their responses (Table 13), majority of the schools had such facilities and could be considered as having habitable learning environment. However, as resources like water and latrines are necessity issues, the number of schools devoid of such facilities should not be underestimated. That is, though electricity and pedagogical center may not be life and death issues in the school context under discussion, imagining learning without water and latrine (especially for children of age 7 and 8) would mean dissociating thinking or learning from biological needs of human being, and hence should be fulfilled by any means.

Table 13.Views of head teachers on the availability of functional pedagogical center, water tap, latrine and electricity in schools

No	Variable	Responses		
		Yes	***No***	***Total***
1.	Pedagogical Center	16 (76.2)	5 (23.8)	21 (100.0)
2.	Drinking tap water	13 (61.9)	8 (38.1)	21 (100.0)
3.	Separate Latrine for the two sexes	14 (66.7)	7 (33.3)	21 (100.0)
4	Electricity	11 (52.4)	10 (47.6)	21 (100.0)

N.B. Figures in parenthesis are percentage representations

Home variables:

Home variables were intended to describe the home environment of children's learning activities. The factors included in this category were education of parents, parents' ability to provide additional mathematics reference materials, availability of study time for children, and study support for children at home as viewed by the respondent children. Results displayed in Table 14 showed that: (a) three out of four students do not have mathematics supplementary reading materials at home; and (b) over 97 per cent of them responded that they are able to get enough study time at home. Regarding literacy level of parents, it appears that majority of the children believed their mothers and fathers were able to read and write. In comparative perspective, however, the proportion of literacy among fathers (79%) seemed higher than that of mothers (62.3%).

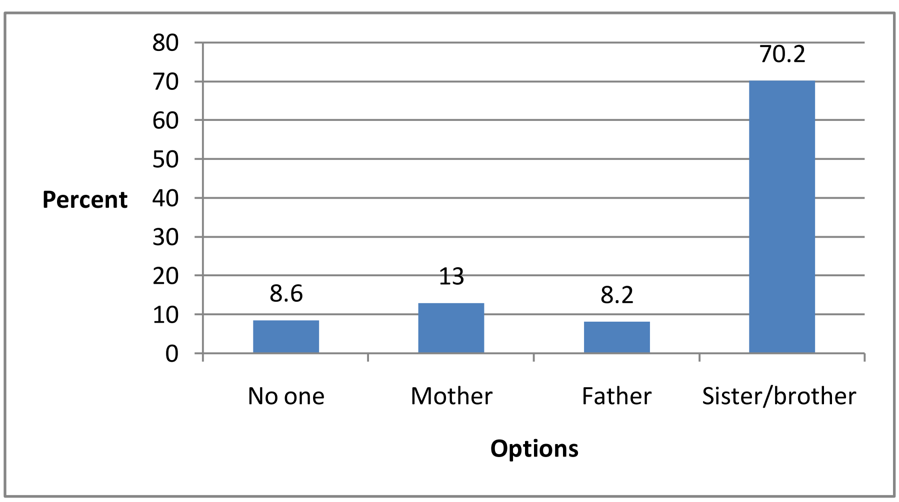
Table 14. The status of selected home related variables as viewed by respondent students

No	Variable	Responses			
		Yes	*No*	*Don't know*	*Total*
1.	Availability of mathematics reference materials at home	147 (17.6)	623 (74.7)	64 (7.7)	**834 (100.0)**
2.	Availability of study time at home	799 (97.3)	18 (2.2)	4 (0.5)	**821 (100.0)**
3.	Education of parents:				
	A. Mother reads and writes	519 (62.3)	293 (35.2)	21 (2.5)	**833 (100.0)**
	B. Father reads and writes	658 (79.0)	160 (19.2)	15 (1.8)	**833 (100.0)**

N.B. Figures in parenthesis are percentages

Another issue of the home environment was the issue of who supports children during their study time at home. Results in Figure 12 indicated that except 72 children (8.6%) who reported no one helps them in their study activity at home, the rest confirmed getting support from mothers (13%), fathers (8.2%), sisters and brothers (70.2%). That is, majority of the respondent children (over 91%) had supporting hands at home. Also, the number of mothers who support their kids (13%) was found higher than that of fathers (8.2%), contrary to the literacy proportion reported in Table 14.

Figure 12. Views of children regarding who supports in studying at home (N=833)



Overall, the background description was aimed at providing a context to understand the findings of early grade mathematics competencies in the study area. It shows who the respondents were, what the home environment looked like in terms of supporting children to learn, and how the schools operate to ensure learning. As per the theoretical framework of this study, some of the variables were also included in the subsequent predictive statistical analysis to identify their contribution in the learning process and in shaping policy and practice.

6.3. Achievement scores of children by sub-test and construct

This part focuses on the presentation, analysis and interpretation of the basic descriptive findings by task (or sub-test) as measured by the EGMA instrument. As the marking considered both accuracy and speed issues (the ability to provide correct answer in this case limited to one minute), the process of conceptualizing the findings gave due attention to fluency or competency interpretations. On the other hand, given that the study is the first of its kind in Ethiopia, and there are no established achievement parameters in the context of the country or the region in focus, results were interpreted in view of the policy suggestions by the Ethiopian Ministry of Education, and by linking to what should students know and be able to do rather than being dictated by mere curricular contents.

To repeat, the Ethiopian Education and Training Policy suggests at least 50% achievement to pass from grade to grade or level to level (Transitional Government of Ethiopia, Office of the Prime Minister, 1993: 33). Yet, despite the four-year cyclic research project called National Learning Assessment in Ethiopia, there are no established achievement benchmarks applicable in such research. On the other hand, though TIMSS, PISA and SACMEQ were reviewed in Chapter 4 to learn from the internationally experiences, the set (mean = 500, Standard deviation = 100) could not be used here because of the incomparability of test characteristics and purposes.

In the EGMA test, seven sub-tests or tasks, from two constructs, were included. The Counting Concept (CC) construct was defined by One-to-One Correspondence (OTO), Cardinality (C), and Missing Number (MN). Whereas Number Sense (NS) was measured by Oral Counting (OC), Number Identification (NI), quantity Discrimination (QD), Addition (Add) and Subtraction (Sub). Of those seven subtests, OC, OTO, and NI were timed to one minute. Therefore, the scores of those who had unused seconds when they finished the task were extrapolated to get the number of correct answers within a minute (for details as how the scores were limited, read the methodology section).In the other tasks, the score of a child indicates the number of correct answers out of the total items attempted. Besides, the maximum points indicate the denominators of the respective sub-tests determined in two ways. In the case of OC, OTO and NI the denominators were the highest fluency points achieved in the respective subtests; the others were marked out of the number of items (or attempted)in the given sub-test.

Average achievements by sub-test:

Table 15 shows competencies of children by subtest, construct and overall. Under the CC there were three subtests - OTO, C and MN. The average counting fluency of children (counting correct with speed) using counting objects was found to be about 52 per minute with a standard deviation of 31.71. The minimum score in this sub-test was four and the highest was 144 per minute. This sub-test never allows proceeding after wrong counting anywhere in the process. If the wrong counting occurs before the 60 seconds were finished, then the last number counted correctly indicates the fluency level of the child even if he or she had some seconds left. For those who finished the 60 seconds counting correctly, conversion was made for the remaining seconds to estimate the one minute fluency level. That is, there were three stopping rules: (1) when the child makes an error while counting, and (2) when the child double counts a circle (the counting material), or (3) when the child finishes the time given. Hence, the competency here integrates accuracy of counting, use of counting objects and speed (number of counts within the time given).

The cardinality (the ability of children to recognize that the last number counted designates the number of objects in a set) and Missing Number sub-tests, on the other hand, were corrected out of the total number of items in the sub-test, i.e. out of four and 10 respectively. In both cases, there were zero scorers and the averages were around half of the respective denominators. Thus, the mean value of the CC construct was found to be about 59 out of 158 (or 37.44%), which is far below the requirement set by the Ethiopian Ministry of Education (i.e. at least 50% average achievement).

Table 15.Competency mean scores of students in Tigrai by construct and sub-test

No	Construct and Sub-test	N (valid)	Min.	Max.	Mean per minute or attempted	Standard Deviation
I. Counting Concept (CC) (Total out of 158)						
1.	One-To-One Correspondence (OTO), timed to one minute	834	4	144	51.91	31.71
2.	Cardinality (C)	834	0	4	2.71	1.36
3.	Missing Number (MN)	834	0	10	4.53	2.79
	Total CC	***834***	***5***	***156***	***59.16***	***33.40***
II. Number Sense (NS) (Total out of 263)						
1.	Oral Counting (OC), timed to one minute	834	3	120	58.57	30.58
2.	Number Identification (NI), timed to one minute	834	0	113	20.94	17.43
3.	Quantity Discrimination (QD)	834	0	10	7.67	2.44
4.	Addition (Add)	834	0	10	6.44	3.57
5.	Subtraction (Sub)	834	0	10	5.47	3.53
	Total NS	***833***	***13***	***241***	***103.43***	***47.66***
OVERALL ACHIEVEMENT (out of 421)		***833***	***21***	***349***	***162.61***	***74.32***
OVERALL ACHIEVEMENT (%)		***833***	***5***	***83***	***38.63***	***17.65***

Note: Min = Minimum; Max = Maximum

The results under the NS construct were also similar to that of the CC. The total mean score under this category was about 103 out of 263 (or 39.16%) which indicated less than

50 per cent competency level similar to the case in CC construct. This was a result of competencies ranging from three to 120 per minute in OC, zero to 113 per minute in NI, and zero to 10 accuracy levels in each of the QD, Addition and Subtraction sub-tests. Though the mean scores in OC, QD, Add and Sub indicated about 50% average achievement under each task, the average achievement computed with regard to NI was terribly low with a mean fluency of only about 18.58 per cent (i.e. 21 out of 113). It should also be noted that the average value of OC skill was higher than that of OTO though both focused on counting and were timed to one minute. The combination of the two (better achievement in OC than in OTO and least achievement in NI) indicates that while the influence of the home environment in oral counting is there, the formal school context was not able to connect counting skills with counting objects and with number symbols as expected.

The overall mathematics competency of grades 1 and 2 students was also computed from the achievement scores in each of the sub-tests. The data in Table 16 shows that the achievements of the 833 respondents ranged from 21 to 421 with a mean of 162.61 and standard deviation of 74.32. For convenience purposes, computing the overall achievement score out of 100 provided a mean value of 38.63%, a dispersion value of 17.63 and range of 78 (min= 5, max=83). Hence, it is clear that the average score is about 12 points below the minimum intended target (50%) for student achievement in Ethiopia. At this level, it should be noted that the test administered was prepared based on expected competencies and grade level contents of grade 1 completers. Thus, disaggregating the data by grade level was aimed at comparing the groups and understanding the contribution of the time factor in competency development.

Table 16. Mean scores by sub-test and grade

No	Construct and Sub-test	Scored out of ____	Mean	
			Grade 1 (N=419)	Grade 2 (N=415)
I. CC				
1.	OTO, timed to one minute	144	43.20	60.71
2.	C	4	2.40	3.03
3.	MN	10	3.83	5.25
	Total CC	***158***	***49.42***	***68.99***
II. NS				
1.	OC, timed to one minute	120	49.79	67.46
2.	NI, timed to one minute	113	13.78	28.16
3.	QD	10	6.97	8.38
4.	Add	10	5.45	7.45
5.	Sub	10	4.65	6.31
	Total NS	***263***	***86.09***	***120.98***
OVERALL ACHIEVEMENT		***421***	***135.51***	***190.04***
OVERALL ACHIEVEMENT		***100***	***32.19***	***45.14***

Table 16 shows that, in all sub-tests, mean scores of grade 2 were higher than that of grade 1. The result could be something expected for the items of the test were the same for both grades and the one year experience should have its own impact on student learning. What is interesting was, even after two years of schooling, grade 2 students have problems in identifying (naming) grade 1 level two digit numbers and hence their average value of the sub-test was found to be about 28 out of 113 (nearly 24.8%). Even the mean scores in counting (OC & OTO) were not so much beyond 60 counts per minute despite the number of grade 2 children who scored as high as 144 and 120 counting competencies per minute respectively was greater than those from grade 1. Counting could also be a function of age. Under normal conditions, as age increases, oral counting skill, as a function of life experience and maturity, improves.

The effects of such low performances, specifically in counting and NI should be clear. Without proficiency in those fundamental tasks, children will be in a problem to learn other mathematical skills and concepts properly. When children fail to count and/or identify number names correctly, it is hard to imagine the development of the ability to compare numbers, identify magnitudes and do operations correctly. Besides, failure at this level on the basics of learning will have far reaching consequences on both quality of education and chance of the children to be successful when they move up in the education ladder.

Frequency Distributions:

The results of the frequency distributions were presented in two categories. Category one includes the timed sub-tests (OC, OTO and NI) for comparison purposes; and category two presents frequencies on the rest of the sub-tests. The intention of doing so was of twofold: (1) to get more information on the characteristics of the distribution of scores within the sub-tests; and (2) to compare achievement distribution variations among the sub-tests.

Table 17 shows frequency distributions in the timed sub-tests, which focus on counting and number identification fluencies. To begin with, unlike in NI, there were no zero scorers in OC and OTO. However, the overall frequency distribution in OC and OTO sub-tests showed difficulties in counting concept and counting skill competencies. After one or two years of schooling, more than seven percent of the children could not count beyond the number 10 within a minute. Though they might have time left, they tend to count wrongly when they approach the number 10. About 18 per cent of the students in OC and 27 per cent in OTO too either required at least two seconds to count a single number correctly or they could not count further than 30 correctly until the end of the one minute time. The first shows a problem of speed and the second adheres to problem of extended accuracy in counting.

Table 17. Frequency distribution of competency scores in OC, OTO and NI

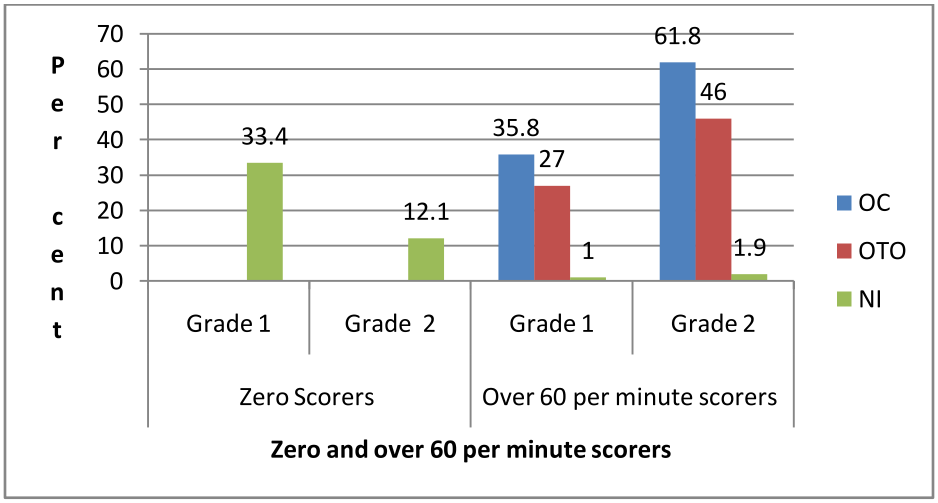
Fluency Intervals	**Proportion by sub-test**			
	OC total correct per minute	***OTO total correct per minute***	***NI attempted***	***NI total correct per minute***
0	-	-	-	190 (22.8)
1-10	76 (9.1)	63 (7.6)	222 (26.6)	96 (11.5)
11-30	154(18.5)	223 (26.7)	296 (35.5)	296 (35.5)
31-60	197 (23.6)	244 (29.3)	300 (36.0)	240 (28.8)
61-90	273 (32.8)	192 (23.0)	14 (1.7)	10 (1.2)
Above 90	133 (16.0)	112 (13.4)	2 (0.2)	2 (0.2)
Total	***833 (100.0)***	***834 (100.0)***	***834 (100.0)***	***834 (100.0)***

Note: Figures in parenthesis are percentages

Putting OC and OTO in comparative perspective, results seem to show some discrepancies. Though the combined effect of time and accuracy showed that the proportion of children who counted above or below 60 per minute was more or less the same in the OC sub-test, majority were on the less side in OTO. If we compare the results in the two sub-tests (OC & OTO), counting using objects seemed more difficult than oral counting implying that children were more comfortable in: (a) counting skills than counting concepts; and (b) in theoretical than application. This might have something to do with oral practices in the home environment, with parents and peers. That is, practicing counting using objects (OTO) seems more formal and practical than just oral counting (OC). In this sense, it would be possible to say that the influence of the school formal setup was not yet strong to bring about changes in children's counting ability.

Regarding NI, the sub-test allows for children to continue naming numbers until the end of the 60 seconds or one minute whether the response at each point was right or wrong. Thus, the analysis compares number of attempts with number of correct answers within a minute. Results showed that though every child made an attempt, about 190 (22.8%) scored zero in this sub-test, i.e. they failed to name one out of 60 numbers from a range of 1 – 99 supposed to be mastered at the end of grade one. Taking the cumulative frequency into consideration, majority the children (nearly 70%) were able to name less than 30 numbers (in the list) correctly within a minute. Therefore, it can be concluded that naming over 60 numbers correctly within a minute was an exceptional phenomenon than a common practice in the schools assessed (Table 17; Figure13). Generally, the low performance being as stated, results by grade provided clear message on difficulties in identifying number names (Figure13).

Figure 13. Proportion of zero and over 60 per minute scorers in OC, OTO and NI by grade level



The findings depicted in Figure 13 show that there were no zero scorers in OC and OTO in both grades. However, one out of three among grade 1 and at least one out of 10 among grade 2 students were not able to identify number names at all. The proficiency level in NI further shows that proportions of grades 1 and 2 students who were able to name more than only one number per second were one and 1.9 per cent respectively. Therefore, comparatively speaking, the problem in NI seems more critical in the early grades under discussion. On one hand, students have difficulties in counting (especially using objects); on the other hand, they are not able to name grade one appropriate numbers correctly. The conclusion would be, therefore, further and independent learning do not have the proper background at this level. Unless students are able to use numbers, proficiency in operations, quantity discrimination, and related skills and conceptions will be challenged.

Cardinality (C), Missing Number (MN), Quantity Discrimination (QD), Addition (Add) and Subtraction (Sub) sub-tests were not timed. Each of these was scored by counting the number of correct answers out of the total items in the sub-test. The frequency distributions in Table 18 are, therefore, computed values out of the total number of items in the respective sub-tests. See the details of the intended distributions in Table 18.

Table 18.Frequency distribution of competency scores in C, MN, QD, Add, & Sub sub-tests

Score	Frequency and percent by sub-test				
	C	***MN***	***QD***	***Add***	***Sub***
0	86 (10.3)	48 (5.8)	5 (0.6)	94 (11.3)	133 (15.9)
1	94 (11.3)	74 (8.9)	2 (0.2)	40 (4.8)	54 (6.5)
2	121 (14.5)	97 (11.6)	15 (1.8)	47 (5.6)	36 (4.3)
3	204 (24.5)	126 (15.1)	31 (3.7)	31 (3.7)	40 (4.8)
4	329 (39.4)	124 (14.9)	63 (7.6)	30 (3.6)	52 (6.2)
5	-	78 (9.4)	70 (8.4)	49 (5.9)	59 (7.1)
6	-	64 (7.7)	60 (7.2)	47 (5.6)	59 (7.1)
7	-	50 (6.0)	99 (11.9)	49 (5.9)	83 (10.0)
8	-	59 (7.1)	91 (10.9)	88 (10.6)	92 (11.0)
9	-	97 (11.6)	91 (10.9)	137 (16.4)	115 (13.8)
10	-	17 (2.0)	307 (36.8)	222 (26.6)	111 (13.3)
Total	***834 (100.0)***	***834 (100.0)***	***834 (100.0)***	***834 (100.0)***	***834 (100.0)***

Note: Figures in parenthesis are percentages

In testing cardinality, students were presented with four questions each with different counting magnitudes (14, 28, 40 & 76). As shown in Table 16, the mean score was found to be 2.71,in a scale of four. Relating the distribution to this mean shows that about 10 per cent of the students scored zero, but nearly 64 per cent were able to answer at least three questions (out of four) correctly. That is, though the proportion of zero scorers is not negligible, the level of competency for the majority seems acceptable (Table 18). Overall, analysis of the response patters of students in the cardinality shows two types of problems: (a) some of them counted correctly but could not understand the last object counted as the number of objects in the set; and (b) others could not finish the counting which could be an extension of the problem in OTO. Obviously, this shows how the skills are interrelated and how problems in one can limit performances in the other.

Table 18 further shows the distribution of scores in MN, QD, Add and Sub, all scored out of 10. Unlike in QD, more than 10 and 15 per cent of the students scored zero in Addition and Subtraction respectively, and nearly six per cent in MN. The proportion of zero scorers was negligible only in the case of QD (0.6%) - the ability to compare numbers - which might be attributed to better oral skills in counting. Overall, the proportions of children who scored less than half of the total under each sub-test were considerable, the highest being those in the MN sub-test followed by subtraction, addition and cardinality (combining counting and quantity) in the same order.

An investigation into the nature of limitations in the responses under each sub-test has interesting clues. In cardinality, the kinds of problems were already stated above. In the other sub-tests, the lessons learned include the following:

- In QD, responses of students indicated problems of proper understanding of place values. If the unit digits in the comparison number were equal, they tend to perceive the numbers as equal despite the magnitude of the numbers in the tenth place. If the unit digit of the smaller number is greater than that of the bigger one, they tended to understand the quantity of the numbers otherwise. Here are some examples: (1) while comparing the numbers 80 and 70, and 99 and 89, about 25 and 27 per cent of the children provided wrong answer because of the equality of the unit digits; (2) In comparing 95 with 79, and 91 with 87, above 30% in each of the questions provided wrong answers by comparing the unit digits. These seem more of difficulties in learning strategy rather than in conceptual difficulties. Had they been aware of the technicalities and procedures of comparing numbers, they could have answered the questions correctly.

- In MN, majority failed to provide correct answers when the question is of the following nature: (a) It is counting by more than 1 (example: counting by 2 or 5). Example, over 70% failed to answer the following question correctly: 40, 42, ____. (b) The missing number is in the middle or requires backward counting. Example: over 85% and 65% of the students respectively missed the following questions: 34, ___, 36, and ____, 70, 71.
- In the cases of addition and subtraction, it should be clear that: (a) every question included less than 100 numbers; and (b) none of the questions involved carrying one, two or what not, or borrowing strategies. Yet, more than 31 per cent of the children failed to answer 3 + 6 and 6 – 2 correctly. Same was true in the rest of the items. Therefore, the low achievements seemed to reflect general difficulties rather than area or strategy specific problems. It should also be noted that this reality was true despite the fact that children were allowed to use and provided with counting objects while dealing with addition and subtraction tasks.

Figure 14. Proportion of zero and below half scorers in C, MN, QD, Add & Sub by grade

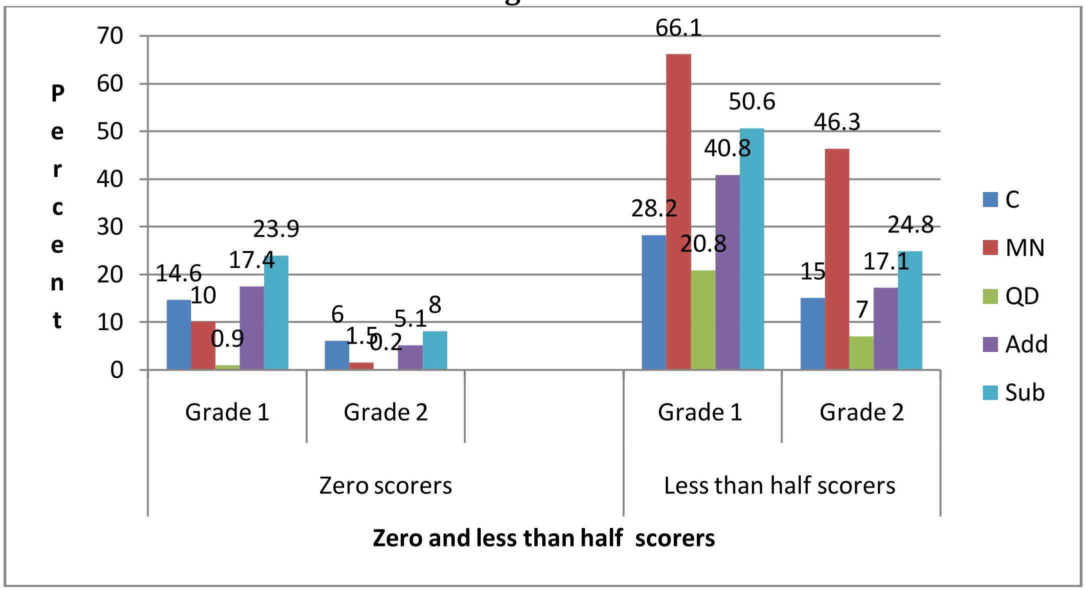


Figure 14 was prepared to show the proportions of zero and less than half of the total in each sub-test by grade level. In this regard, findings convey the following basic messages:

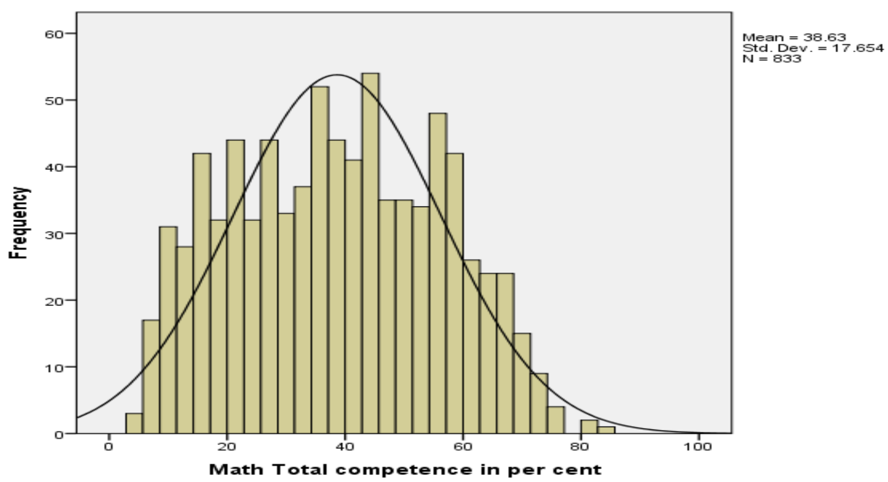
- Generally the number of zero scorers was higher at grade 1 as compared to grade 2, which seem natural due the experience variations.
- The number of zero scorers in both grades was highest in subtraction (about 24% in grade 1 and 8% in grade 2) followed by Addition, Cardinality, and Missing Numbers. The pattern was more or less the same at grade 2, with the highest zero scorers being in Sub, C and Add sub-tests in the same order of magnitudes.
- Though MN stands the fourth in the number of zero scorers in both grades, 66 and 46 per cent of grades 1 and 2 respectively were found to answer less than 50 per cent of the items provided under each sub-test correctly.

Generally, despite the increase in mean scores and proportion of higher scorers between the two grades, the findings seem to have consistency in indicating learning problems in the areas of Sub, Add, C, and MN than in QD.

Normality of the sampling distribution:

The researcher also tried to estimate the normality of the sampling distribution from the raw data distribution for it is one of the assumptions behind analysis of parametric data like this one. That is, statistical tests like t-test and others assume that the sampling distribution is normal (Field, 2009). The result in this regard was found to be as shown in Figure 15.

Figure 15.Normality test of the distribution of the raw scores



Though not perfect, the distribution of the raw scores (used to estimate the sampling diminution) is about normal with values ranging from nearly zero to about 80 with overlapping values of the measures of the central tendency about the middle of the distribution: mean = 38.63, mode =36 and median =38.48. Besides, the frequencies decrease with similar pattern on both left and right sides of the measures of central tendency. In other words, the distribution of scores within the interval of one, two and three standard deviations from the mean to the left and right was obtained to be 60.3, 99.0 and 100 per cent respectively. This spread can be viewed as similar to the standard normal curve distribution of 68.26, 95.44 and 99.74 per cent respectively.

6.4.Summary

This chapter mainly focused on descriptive analysis of the data obtained from 834 respondent students, 55 teachers and 21 head teachers from 21 primary schools in Tigrai using mean scores and frequency distributions. Therefore, the main findings identified at this level included the following:

(1) Selected individual, home and school variables were analyzed to provide context to the analysis of data and conceptualization of findings. Limitations and variability were observed with regard to student absenteeism, pre-school opportunities, tailored training in mathematics teaching, availability of functional library and supplementary materials in mathematics, teacher support system, and availability of functional pedagogical center, separate latrine for the two sexes, and electricity.

(2) The average overall mean was found to be about 38 per cent, a reflection of the low achievement status in the subtests included in the assessment. The mean scores computed (by sub-test) were so low in terms of criterion measurement perspectives. Especially, zero scorers in NI, subtraction, addition, cardinality and missing numbers ranged from 33 per cent to 8 per cent though improvements were observed as students pass from grade 1 to grade 2. That is, low achievement being an overall truth and prevalent in each of the sub-tests, the situation with regard to NI shows a total failure

in the education system. First, it is the least of all with a composite mean of about 21 out of 113 or 19.53%. Second, failure in number naming skills has at least two critical problems: (a) counting skills and concepts will not be transferred to other written skills in mathematics; and (b) operations and further mathematical skill development will be hampered as numbers are the alphabets of mathematics.

(3) The sampling distribution, estimated from the frequency distribution of the raw data obtained, was found to be about normal. This suggests that further statistical techniques (such as t-test and regression analysis) can be applied to test the research hypothesis.

CHAPTER 7
PREDICTIVE VARIABLES OF EARLY GRADE MATHEMATICS COMPETENCY

7.1. Introduction

The data set of this research includes student achievements in mathematics as dependent variable, measured using tests. Information was also collected on individual, home and school variables to investigate the levels of contributions on students' achievements. Thus, this section includes a report on results of bivariate correlations among the constructs and results of sub-tests, t-test (applied on sex, location and age differences), regression analysis on the influence of individual, home and school profiles on students' performances.

In doing so, the four assumptions of parametric data analysis were checked against the research data just to be safe while interpreting findings. The data generated through tests was in a ratio scale; the test results were individual responses and hence no threat for response interdependence; and the data distribution was normal as checked in chapter 6 using the normal curve. The fourth assumption refers to the homogeneity of the variance –whether the extent of variation is similar across the groups. Given that the sample selection was random, the sample size was large enough, and the context of education in Tigrai has more similarities (home language, medium of instruction, education management, government owned schools, etc.) than differences, the researcher assumed equality of variances in the set of data. It should also be noted that in large sample sizes like the case in this study, Levene's test for equality of variances may show significant variation differences even if the group difference, in reality, is so minimal (Field, 2009: 152). Last, accompanying effect sizes were computed for significant tests to provide meaningful interpretation of differences or relationships in standard deviation units.

7.2. Relationships among the Early Grade Mathematics Sub-tests

The study used Counting Concept (CC) and Number Sense (NS) construct in assessing early grade mathematics competency of students. The indictors included under each of these were the following:

(1) Counting Concept measures - One-to-One correspondence (OTO), Cardinality (C), and Missing Numbers (MN); and

(2) Number Sense (NS) measures - Oral Counting (OC), Number Identification (NI), Quantity Discrimination (QD), Addition (Add), and Subtraction (Sub).

Therefore, this part of the analysis focuses on identifying the extent of shared variances (or relationships) between paired sub-tests (indicators). While the Pearson r was applied to find out the magnitudes of relationships, corresponding coefficients of determination were computed to analyze how much shared variance exists between paired variables. Table 19 displays the results of the paired correlation coefficients.

Table 19. Zero-order correlations between the sub-tests (N=833)

Sub-test	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1. OTO	.38**	.37**	.58**	.56**	.48**	.46**	.44**
2. C	-	.35**	.37**	.45**	.47**	.54**	.44**
3. MN		-	.32**	.46**	.51**	.56**	.62**
4. OC			-	.57**	.48**	.48**	.39**
5. NI				-	.66**	.63**	.58**
6. QD					-	.70**	.65**
7. ADD						-	.78**
8. SUB							-

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

NOTE: OTO = One-to-One Correspondence; C = Cardinality, MN= Missing Number, OC=Oral Counting, NI= Number Identification, QD= Quantity Discrimination, ADD= Addition, SUB= Subtraction.

Table 19 shows that the zero-order or bivariate linear correlations within and between the subtests of the two constructs - CC and NS - without controlling the effect of any other variable that might affect the relationships. Surprisingly, all paired Pearson Correlation values (r) were found to be statistically significant, $r > .30$, $p < .01$, 2-tailed). For the sake of clarity and hypothesis testing, the Pearson r's can be categorized into groups of three: two within each of the CC and NS constructs, and one between the constructs. In the correlation matrix, the area of correlation values between the CC sub-tests is shaded light green, that of NS sub-tests blue and the cross correlation is in gray.

Paired relationships within the CC construct subtests (OTO, C & MN) were found to be low ($.35 \leq r \leq .38$, $p<.01$, 2-tailed), in both normative and criterion aspects. First, the r values within the CC construct measures were low compared to the values within the NS construct measures and most of the indices in the cross-construct sub-tests' correlations.

Second, the values of r within CC constructs seem weak to predict linear relationships in the context of early grade mathematics learning. That is, Cohen, Manion and Morrison (2000) suggested that group predictions based on correlations ranging from .35 to .65 are likely to be crude unless combined with other supporting evidence of correlations in multiple regression models. However, correlations within this category do not provide sufficient ground for individual prediction. Correlation values greater than .65, one the other hand, are helpful to make accurate predictions for most purposes. Hence, the correlation values between OTO and C (r=.38), OTO and MN (r=.37) and C and MN (r=.35) were found to be weak indices for prediction purposes. As per the findings, the largest shared variance within the CC construct sub-tests was 14.44 per cent ($r^2 = (.38)^2 = .1444 = 14.44\%$), computed between OTO and C.

The correlation values within the measures of NS construct seemed higher than those within the CC construct. Correlations between ADD and SUB (r=.78), QD and ADD (r=.70), QD and NI (r=.66), and QD and SUB (r=.65) were acceptable to make accurate predictions. NI too showed the next highest correlation values with ADD (r=.63), SUB (r=.58) and OC (r=.57) sub-tests. Based on the findings, (1) QD and NI seem to have better contributions within the measures of NS construct for each demonstrated better relationship with the others in the construct; and (2) ADD and SUB have the highest shared variance, nearly 61%, ($r^2 = (.78)^2 = .6084$) followed by that of QD and ADD which amounted to 49% ($r^2=(.70)^2= .49$).

When it comes to the cross relationship between sub-tests under CC and NS constructs, overall the situation seemed better than the paired correlations within the CC sub-tests but weaker than the r values within the NS construct sub-tests. The three highest paired cross linear correlations between the sub-tests of the two constructs were found between MN and SUB (r=.62), OTO and OC (r=.58), and OTO and NI plus MN and ADD (in both cases r=.56). In terms of coefficient of determination, the shared variance in the cross correlation ranged from 10.56% (r=.32)to 38.44 (r=.62) between MN and OC, and MN and Sub respectively.

To summarize, sub-tests under NS construct were skill tests as opposed to the conceptual questions under the CC construct. As per the findings in Table 20, the skills seem to have higher shared variances (higher r values) than within the concepts of early grade mathematics under NS and CC constructs respectively. The linear correlation between the two constructs was also analyzed. Results showed significant and relatively higher relationship index (r=.67, $p < .01$, 2-tailed). This means CC and NS constructs share about 46% of their variances in the context of the study. The rest of the variance (nearly 54% from each) is defined by other factors of early grade mathematics learning not included in the model.

7.3. The contributions of background variables on early grade mathematics competency

The student background variables analyzed further for their contribution in early grade mathematics achievement were screened using two criteria: (a) logical relationship of the variable with mathematics learning, and (b) the extent of variation in the variable within the sample subjects to bring a difference in achievement. Accordingly, reported children's interest towards mathematics, repetition, home and school language similarity, and availability of study time after school were not included in the predictive analysis because of limited variability within the student respondents. In each of these variables, over 95 per cent of the children share similar characteristics and it is hardly possible to identify the contributions of such independent variables towards the criterion variable. However, the researcher recognizes their vital role as profile variables and could be issues of further investigation to cross check the reality and assess implications.

Sex and urban-rural differences:

In many studies in Ethiopia like those conducted by RTI (2010) and MoE (2000, 2004, 2008, 2012) learning assessment results favor boys than girls, and urban than rural children. In this study, comparison of achievement scores by sex and location indicated inconsistency as depicted in Table 20.

Table 20. Results of t-test on mean differences as a function of sex and location

Variable	Group	N	Mean (%)	SD	Std. error Mean	Mean Diff.*	Std. error Diff.*	t	df	Sig. (2 - tailed)	95% confidence interval
Sex	Boys	414	39.4	17.8	0.9	1.5	1.2	1.203	830	.229	Between 0.93 &3.88
	Girls	418	37.9	17.5	0.9						
Location	Urban	319	46.6	15.4	0.9	12.9	1.2	10.981	831	.000	Between 10.61 &15.23
	Rural	514	33.7	17.2	0.8						

* Diff. = Difference

Table 20 presents analytic data on the significance of the difference in overall early grade mathematics competency as a function of sex and urban-rural dwelling. The mean difference between the two sexes was only 1.5 points and the 95% confidence interval for the estimated population mean difference ranges between 0.93 and 3.88. An independent t-test showed that the different between the mean scores of the two sexes was not statistically significant (t= 1.203, df=830, p= 0.229, 2-tailed). Thus, there is no need of discussing about the effect size of the contribution of sex in achievement at this level.

There could be three possible explanations to the similarities of achievements between boys and girls at this level. The first possibility is that the educational context in the region has been changed through time in supporting female education. However, this is not highly likely for recent findings in mathematics learning showed the consistency of female lower achievements (MoE, 2013a; Tamirie, 2009). In fact, Tamirie (2009) reported that better achievement of boys over girls starts at the early grades and the gap increases with grade level increase. The second reason is related to gender being a reflection of social practice (rather than a natural difference) its influence on academic performance was not yet observable at those early grades. In other words, gender bias and the subsequent consequences on achievement develop through time and not yet powerful to bring differences. The third explanation asserts if sex difference is a characteristic of urban or rural areas. Though the first two assumptions require further data to verify the situation, the researcher made further analysis on the sex difference in competency by disaggregating the data by location. The resulting findings are presented in Table 21.

Another finding included in Table 20 focuses on the comparison of achievements by location of residence. Findings showed that the mean score of urban children (Mean=46.6%) was higher than that of rural students (Mean =33.7%). The mean difference between urban and rural children was 12.9 points with 95% confidence interval for the population mean to lie between 10.61 and 15.23. An independent samples t-test showed that the difference between urban and rural children was statistically significant in favor of urban dwellers (t= 10.98, df=831, p= .000, 2-tailed). The standardized mean difference also showed large effect size (d=0.78),i.e. an average child from urban setting outperformed 78.23 per cent of children from rural schools. In other words, 50 per cent of urban children scored above 78 per cent of their students from rural schools. Therefore, the inequality in achievement at early ages between urban and rural children is considerable, consistent with previous studies in Ethiopia (example: MoE, 2013a; Tilaye and Bediru, 2006; Tamire, 2006), and has huge policy, research and practice implications. On one hand, unless policy intervention is designed and implemented to end the situation, such inequalities in school achievement are likely to be transferred to employment, income and social inequalities. On the other hand, research explanations are required on the underlying reasons that bring about differences between urban-rural schools. That is, we know that there is a difference in achievement between urban and rural children, but we do not know much about the why.

A search for interaction results between school location and sex also provided additional hint on the nature of gender influence on early grade mathematics competency. In other words, is the neutrality of sex on competency development location specific or a general reality of the study area? Table 21 shows results of independent samples ANOVA run on the influence of sex by location.

Table 21. The contribution of sex difference on achievement, by location

Variable	Group	N	Mean (%)	SD	Std. error Mean	Mean Diff.*	Std. error Diff.*	t	df	Sig. (2 - tailed)	95% confidence interval
Urban	Boys	158	45.57	15.69	1.25	-2.21	1.72	-1.29	316	.199	Between - 5.59 & 1.17
	Girls	160	47.48	14.96	1.18						
Rural	Boys	256	35.57	17.95	1.12	3.78	1.51	2.51	512	.013	Between - 0.82 & 6.74
	Girls	258	31.80	16.16	1.01						

* Diff. = Difference

Table 21reports mean differences between boys and girls disaggregated by locations of schools. Accordingly, the average difference in competency between boys and girls in urban schools amounted to -2.21 per cent in favor of girls, with the 95% confidence interval for the population lying between -5.59 and 1.17. An independent samples t-test, however, did not show significant differences between the two sexes, and hence the 2.21 percent difference observed was a characteristic of the sample and not that of the population in urban schools.

The researcher did similar analysis on the contribution of gender on early grade mathematics competency development in the context of rural schools. Results showed that rural boys outperformed ruler girls by 3.78 per cent and produced a statistically significant t-value (*t= 2.51,df = 512, p< .05, 2-taled*). This difference produced an small effect size (d= 0.22) implying that an average performance of rural boys surpasses 58.71 per cent of rural girls. Put in another way, if an urban child with average achievement was placed in the list of rural school children, his or her rank among the rural children is likely to fall on the 58th percentile rank. Such a difference is not acceptable as such early age differences might have adverse effects in later academic achievements in particular and in life in general. Therefore, as per the findings explained, sex difference in early grade mathematics competency in Tigrai is a rural specific feature. It is not a generic characteristic of schools, nor is it an urban school trend.

Student age and mathematics achievement:

Another variable tested at this level was whether age difference contributes to achievement difference or not. For this purpose, one-way-ANOVA was applied in SPSS software. Results are presented in Table 22.

Table 22. One-Way ANOVA on achievement difference as a function of age

Age Interval (in years)	N	Mean	S.D	F	Sig.
6 and below	26	29.91	14.78	16.29	.000
7 -8	564	36.76	17.38		
9-10	191	41.85	17.01		
11 and above	52	51.42	16.83		
Total	833	38.63	17.654		

The Ethiopian Education and Training Policy (EFDR, 1994) stated that the official entry age to grade one is 7 years. With this assumption, children should finish grades 1-4 by the age of 10. Thus, for the purpose of the one-way ANOVA to test the contribution of age on achievement, the ages of the children were classified into four categories:

- 6 and below (under age),
- 7-8 (supposed to be at grades 1 and 2),
- 9-10 (supposed to be at grades 3 and 4), and
- 11 and above (ages of upper primary education).

The mean scores of each of the age range were 29.91, 36.76, 41.85, and 51.42 percent respectively. The between-subjects ANOVA on the mean differences showed a statistically significant effect of age on student achievement (F (3,829) = 16.29, p<.01). According to the guideline indicated by Cohen (1988), about 6 per cent of the variance in achievement was explained by changes in age of the children (Eta-square =0.06). This amount of variability generally showed medium sized effect of age variability on achievement levels of students.

KG experience and absenteeism as predictors of mathematics achievement:

Beyond empirical evidence, the logic behind KG programs is to prepare children for the formal education. The opposite assumption is true with regard to absenteeism as it is likely to reduce the learning competency of children because of missed instructional activities, disconnection in learning progress and uncovered curricular contents. With these assertions in mind, the researcher analyzed the effects of these two variables on early grade mathematics achievements of children in the study area.

A regression analysis run on the overall contributions of KG experience and absenteeism revealed statistically significant effect on the criterion variable ($F(2,830) = 22.94$, $p < .01$, 2- tailed). The model explained for about 5.0% of the variance on student achievements (Adjusted R square= .05). The figures in Table 23 also indicate the coefficients of each of the two variables in the model, controlling for the effects from the other.

Table 23.KG experience and absenteeism as predictors of mathematics achievement

Variable	Response	N	Mean (%)	S.D	B	SE.B	Beta
KG Experience	Yes	302	34.66	17.19	-4.79	1.28	-.13**
	No	531	40.88	17.53			
Absent for a week or more in the year	Yes	208	32.79	15.47	-6.46	1.42	-.16**
	No	625	40.57	17.92			

**t-test (on the Beta respective weight) is significant at *p<.01(2-tailed)*

As indicated in Table 23, both b values and Beta weights were found to be negative in both cases. That is, results suggested inverse relationships between each of the variables and early grade mathematics competency development. From the Beta weights, the implications can be put as follows: whereas every one standard deviation increase in KG experience can cause a decrease of 2.29 points (-.13 x 17.65 = -2.29) in the academic achievement, the case in absenteeism amounts to a decrease of 2.82 per cent on the overall average outcome. The case of absenteeism seems acceptable but the finding with regard to KG experience is unusual and difficult to comprehend in view of the objectives of such programs (i.e. stimulation and preparation for formal education). The plausible explanation to the KG experience inverse relationship with achievements seems to suggest further investigation on the effectiveness and relevance issues of such institutions and associated factors. For sure, the message cannot be interpreted as a general truth. It should rather be used as a hint towards the pervasiveness of questions around relevance and quality of such programs in preparing children in line with the objectives intended.

The contributions of selected home variables on early grade mathematics achievement:

Four variables are presented here for analysis of their contribution on students' mathematics achievements. These were availability of mathematics reference materials at home, whether mother and father read and write, and who supports the children during their study time. While recoding the data for prediction analysis, "I don't know" responses were considered as:

A. As system missing in the case of literacy of fathers and mothers to avoid misinterpretation of findings; and

B. As ‘No’ or negative answer with regard to availability of mathematics supplementary books at home. This was done so for 'I don't know' means, the respondent was not able to get an appropriate use of the resource for learning. Availability per se is not important; what is required is rather proper utilization of what exists to improve learning capabilities.

The regression model on the selected home variables, then, showed statistically significant effect on early grade mathematics achievement, or the predictor variable: $F(4,748) = 10.23$, $p < .01$. However, the overall or aggregated effect amounted only to

4.7% of the variance in the criterion variable (Adjusted R^2 = 0.047). Since R^2 was 0.052, the magnitude of the variance explained by the relationship decreases from 5.2% to 4.7% which means the model would account for about 0.5% less of the variance if it were derived from the population rather than from a sample. Table 24 also shows the magnitudes of the coefficients of each of the variables included in the model.

Table 24. The contributions of reference materials, literacy of mother and father, and support in studying on academic achievements

Variable	B	SE.B	Beta
Family provides support in studying	-0.12	2.33	0.00
Mother reads and writes	-0.87	1.61	-0.02
Father reads and writes	0.90	1.88	0.02
Availability of mathematics reference materials at home	-10.22	1.73	-0.22**

**t-test (on the Beta respective weight) is significant at *p<.01(2-tailed)*

Table 24 provides information regarding the b-values, Beta weights and t-test on each of the predictors. The obtained b-values for family support during study time, the literacy of mothers and availability of supplementary materials in mathematics were found to be negative which indicated inverse relationships with the criterion variable. However, the impact were not statistically significant except for the availability of reference materials (t = -5.90, $p < .01$). That is, the result suggested that everyone standard deviation increase in the availability of reference materials at home is likely to be accompanied by a decrease of 3.88 per cent in the early grade mathematics competency (i.e. -0.22 x 17.65 = - 3.88).

There is an issue here: unlike the logic behind the predictor variables, how can the contributions of family support during study time and parents' literacy be negligible and even negative? The bases of the findings are related to the magnitudes of the mean scores by category of the responses under each item.

Table 25. Mean scores of children by response category towards availability of reference materials at home, literacy of mother and father, and support during study time

Variables	Alternatives	N	Mean Scores (%)	Remark
Who supports during study time	A. No one	72	39.87	Total Valid N= 832
	B. Mother	108	30.61	
	C. Father	68	37.68	
	D. Sister/Brother	584	40.03	
Mother reads and writes	A. Yes	518	37.45	Total Valid N= 832
	B. No	293	40.45	
	C. I don't know	21	41.70	
Father reads and writes	A. Yes	657	38.25	Total Valid N= 832
	B. No	160	40.04	
	C. I don't know	15	40.08	
Supplementary mathematics books at home	A. Yes	147	30.42	Total Valid N= 833
	B. No	622	40.53	
	C. I don't know	64	39.00	

Table 25 provides the mean scores by response category to show why the regression model produced no statistically significant positive contributions from support during study time, literacy of mothers and fathers, and availability of supplementary books in mathematics on achievements. It is clear that those who reported no support during study time from anyone around home scored better than those who were supported by their fathers and mothers. Availability of additional books at home too functioned otherwise. Thus, such findings cannot be representatives of logical reality but indicators of some variables left unexplained in the study (education level of parents achieved, income standard, etc.) and nature of support system at home, and relevance of the available supplementary materials reported to mathematics learning at the early grades.

The system of support may also be disempowering in nature or less engaging for the child in actual learning process. Reported from support from sisters or brothers was relatively effective in improving students' achievements. This seems to suggest something related to the relationship between the child as a beneficiary and the supporting individual. Understanding the need, working for free interaction and engaging the child might be some of the possible areas of inquiry. Relevance and level of utilization of reference materials at home might also be more important than mere presence. Overall, the findings suggest for further investigation on the nature and details of the issues in the given setting - how mothers and fathers support their children, and the relevance of reference materials reported to the education of children of the target age and grade levels.

The contributions of selected school variables on mathematics achievement:

The analysis also included the contributions of two variables: availability of functional library in school and grades 1 and 2 textbook-student ratio. The questions regarding library and textbooks were presented to student, teachers and head teachers to check the agreement of responses obtained from different sources (Table 11). Since there was no major gap in the perceptions among the different respondents and the researcher believes that student perception matters more in the relationship with achievement, the regression analysis was made on the data obtained from students. In recoding the alternatives under availability of functional library, then, 'available but not functional' responses were considered as 'No library at all' for, from learning point of view, both imply denied access to library.

Regression analysis on the two variables showed positive significant interaction of availability of functional library in school and textbook ratio with students' early grade mathematics competency: F (2,764) = 29.94, p< .01, 2-tailed. The overall contribution of the model on the overall achievement of students reaches about 7% (Adjusted R square = .07). Table 26 displays the resulting findings in this regard

Table 26. The contributions of functional library and textbooks on early grade mathematics achievements

Variable	B	SE.B	Beta
Availability of functional library	6.09	2.37	.09**
Textbook-Student ratio	10.40	1.37	.27**

*** t-test significant at p < .01 (2-tailed).*

Table 25 shows that the b-values for both predictors were positive indicating direct relationship between predictors and the criterion variable. The model also produced positive and significant Beta weights (.09 for functional library and .27 for textbook availability). Controlling the effects of other predictors, whereas availability of functional library in schools was likely to increase mathematics achievement by 1.59 points (Beta = .09 and Mean standard deviation = 17.65), the contribution of textbooks amounted to 4.76 points increase in average students' achievement (Beta = .27, Mean Standard Deviation = 17.65).

The findings in this case contradicted with those in Tables 24 and 25, specifically with the availability of mathematics reference materials at home. That is, while reference materials available at home did seem to affect students' achievements negatively, functionality of school library tended to show positive contribution. Had supplementary materials at home been appropriate and properly used, their contribution in students' learning could have been similar to that of availability of functional library and textbooks. Thus, the issue is not only about availability of inputs but relevance and proper utilization. Whereas relevance refers to the match between what the process of learning requires for effective action and the resources mobilized, utilization reflects the level of teacher initiation to make maximum use of the materials available. Without these two, mere affordability may not help to make a difference.

7.4. Summary

Four sets of variables were used for the predictive analysis purpose in this part of the report. These were: (1) the interaction among the early grade mathematics competency areas defining each of the sub-tests; (2) individual variables; (3) home variables; and (4) school variables, each tested on its predictive power for early grade mathematics competency development.

Results showed mixed findings. Support at home, literacy of mother and father showed no statistically significant effect on students' mathematics achievement. Unlike in the previous studies in Ethiopia/ Tigrai (example: MoE, 2012; RTI, 2010), sex was found to be a problem of rural settings than general characteristics of schooling at the lower primary levels. The findings on the contributions of literacy levels of mothers and fathers also confirmed previous findings in the country. National Learning Assessment reports (mathematics included) indicated that children of illiterate family did not score less than those from primary and secondary education graduate parents (though the overall model produced significant results) (MoE, 2012). Rural/ urban residence difference, age increase, and availability of functional library and textbooks, on the other hand, showed statistically significant difference in early grade mathematics competency development. Besides, the regression model produced negative effects on the contributions of KG experience and absent for a week or more in the academic year.

All others tally with the report of the Ministry of Education (MoE, 2013a) except with regard to urban-rural difference, availability of textbook and KG experiences. In the Ministry of Education report, whereas availability of mathematics textbook had a negative b-value indicating an inverse relationship with mathematics achievement, KG experience showed statistically significant difference though the grand mean of those with no experience was not less than the Church and Quran school attendees. The effect of urban-rural difference on mathematics achievement also confirmed the findings of the Third National Learning Assessment (MoE, 2008) but contradicted with that of 2013 report (MoE, 2013a). In general, school variables seemed to have considerable effects on early grade mathematics competency development.

CHAPTER 8
CONCLUSION: INSINUATIONS ABOUT QUALITY

8.1. Introduction

This chapter integrates all parts of the research, including the inquiry-based experiences of the researcher, to make decisions on the final outcomes. That is, the intention is not to repeat things as they appear in the proceeding chapters but to make a synthesis of the essence conveyed to bring the search to its end. Thus, this chapter starts with the revision of the nature of the problem and its approach, and proceeds to the presentation of answers to the hypotheses formulated. It also presents implications to knowledge, research and interventions.

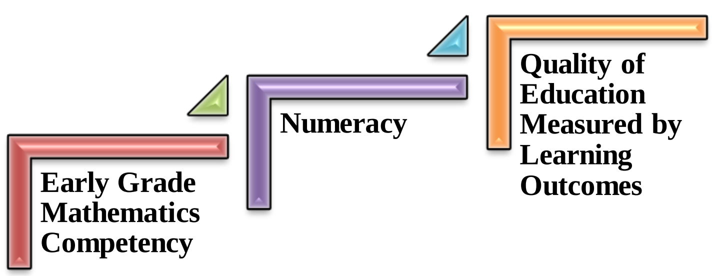
8.2. Revisiting the Problem and its approach

The issue:

It is so logical that children come to school to learn, and schools are there to teach the children. The basis of this research was, therefore, the concern over the status of learning in schools, especially with regard to early grade mathematics competency in the state of Tigrai, to enrich our understanding of quality of primary education in Ethiopia. In doing so, literature in the area was reviewed to explain the situation in context, identify gaps in the existing knowledge and explain the methodological issues of the research.

Essentially, two sets of evidence were presented to substantiate the rationale for the research. The first is related to the importance of early grade mathematics competency in determining quality of education. This research conformed the essence of the Dakar Education For All (EFA) global commitment and defined quality of education in terms of the status of learning in schools (UNESCO, 2000). Three basic elements were noted under this assumption: early grade/age, school mathematics, and focus on essentials. Early grade/age is the formative stage in human development and the gateway to the subject knowledge structured in school curricula. Unless the base is appropriately founded, the growth and development of children into productive adults will be challenged. On the other hand, mathematics defines the information and technology era of our time and the literature linked success in mathematics to success in further learning, professional practice and thereby in life. Therefore, early grade mathematics competency fits into the overall quality education conception and its improvement or intervention strategies, similar to the linkage between reading skills, literacy and quality described by McCormac (2012). Figure 16 shows the pictorial representation of the relationship.

Figure 16. The relationship between quality of education and Early Grade Mathematics Competency



However, the realization of these expected results requires quality of learning without which quality of education is unthinkable. Consequently, the centerpiece of this research was measuring what children should learn rather than what they know and are able to do. Specifically, the research adopted the foundational elements in mathematics learning called Counting Concept (CC) and Number Sense (NS) constructs, measured by respective indicators. Whereas the CC construct was defined by One-to-One (OTO), Cardinality (C) and Missing Number (MN) for CC; the NS indicators included in the data collection were Oral Counting (OC), Number Identification (NI), Quantity Discrimination (QD), and Addition (Add) and Subtraction (Sub). Though there is no major challenge on the logical classification of the constructs and their indicators, research findings on the contributions of each of them to overall mathematics competency, and the interrelationship between the constructs and among the indicators are not yet conclusive.

The second rationale of the research emanated from the absence of research practice and relevant findings in early grade mathematics competency in Ethiopia. The basis of our knowledge in the area is limited to the interpretations of the results from the National Learning Assessment practices at upper grades. Because of such reality, variables that affect early grade mathematics learning in the study area were not specified. Thus, the researcher adopted the situationist theory of learning to analyze the interaction between learning outcomes, and selected individual, home and school related variables in view of the particular schooling contexts.

Hypothesis and the approach:

The formulated hypotheses were derived from the overarching question of the research: *what is the status of quality of primary education in Ethiopia as measured by early grade* *mathematics competency development in Tigrai?* Thus, the first hypothesis claimed early grade mathematics competency to exceed 50% average (the Ethiopian education policy bench mark). This average value was the overall composite mean of achievements of students in each of the sub-tests or indicators of the constructs. Another assumption addressed the interrelationship between the constructs and among the indicators which was followed by an inquiry into the contributions of selected individual, home and school related variables on achievement differences. To verify the assertions, data were collected from 834 randomly selected grades 1 and 2 children (of almost equal sexes representation), 55 mathematics teachers of the children and 21 school head teachers using Early Grade Mathematics Assessment (EGMA) and questionnaires, and analyzed to understand the statistics, prevalence and implications to knowledge, policy and practice.

8.3. Conclusions

This section reviews the key findings and draws conclusions based on the hypotheses formulated. Accordingly, three major conclusions are discussed below:

Conclusion 1: The quality of primary education in Tigrai, measured by Early Grade Mathematics Competency (Learning), is very low.

The evidence analyzed suggested more problems than potential strengths in learning mathematics at this start up stage of development. First, the composite mean score for the two grades (about 39%) fall far below the expectation with similar pattern of performances in both CC and NS constructs. At the level of sub-tests, averages scores for the two grades were a little more than 50 per cent in Cardinality (C), Quantity Discrimination (QD), Addition (Add) and Subtraction (Sub) only. When the data is disaggregated by grade level, whereas grade 1 students achieved less than 50 per cent mean scores in five of the seven categories, i.e. One-to- One Correspondence (OTO), Missing Number (MN), Oral Counting (OC), Number Identification (NI), and Subtraction (Sub); grade 2 students achieved similar in only OTO and NI sub-tests. However, the mean scores of students in each of the constructs and overall remained under 50 percent. Second, though the achievements in all of the sub-tests were not generally encouraging, that of number identification (NI) was the worst of all where, at average, the possibility of a child to provide a correct answer was limited to about 20 per cent (or one out of five questions). Third, though grade 2 completers took end of grade 1 level examination, their average performances were also low, especially in NI category (about 12% for grade 1 and nearly 25% for grade 2). Fourth, counting or number naming fluency of 60 per minute or above in the timed sub-tests and 100 per cent correct answers in the others were exceptions in this research. Fifth, except the cases in OC, OTO and C, considerable proportion of children scored zero in the other sub-tests. However, the number of zero scorers amounted to above one fifth in Sub and NI sub-tests. Thus, the critical problem seems to lie in the case of NI as it is the connector of oral abilities and conceptual understandings with procedural and written approaches to numeracy, problem solving and further learning in the area of mathematics. Unless students are able to identify numbers, they are not likely to deal with operations, and apply their numeracy skills and number knowledge to computations activities and life problems.

The results support previous studies but negate policy assumptions and curriculum expectations in Ethiopia. Research results on learning achievements from around the globe reveal that, by and large, children from low-income countries perform low and the situation is skewed in favor of children from high-income countries (UNESCO, 2011, United Nations, 2012, RTI, 2009). Despite many efforts to improve educational quality in Ethiopia including the introduction of GEQIP program, identification of list of competencies by subject and grade level for grades one through four (MoE, 2008a) and setting achievement cut-off point (minimum 50%) (MoE, 1993) to guide classroom practices, the findings of this research showed low quality standards in primary education. Basically, mathematics at this level is about numbers and operations, and numbers are the languages of mathematics without which further learning and mastery of subsequent learning are unthinkable. Failure in this aspect, therefore, would mean not only failing to be productive in schooling but also staying "far behind and likely to have difficulty catching up" (Kilpatrick, Swafford & Findell, 2001:44).

The findings of the research were also consistent with previous findings in Ethiopia like that of the national learning assessment reports. Two new elements from this research were:

(1) Learning problems in mathematics in Ethiopia start in the early grades and are not the characteristics of the upper stages only. In fact, upper grade learning problems could be reflections of failures to fix them when they were amendable and less costly.

(2) This research defined mathematics competency by its essential component parts identified in view of what students should learn for appropriate foundation rather than by the coverage of curricular objectives and contents as we do it to decide on the promotion of children from grade to grade.

Therefore, the research findings did not only inform about level specific status of learning and pragmatic issues but also shaded light about the level of readiness for the upper grades and the kinds of intervention required to mediate the situation. Above all, one of the subtle and critical messages was that children are practicing failure at the outset of formal education. Those children who did not master number naming, for example, not only will face problems in further learning and applying previous knowledge in subsequent learning as well as in life but also their achievement motivation could be affected. Psychologically, they are learning to live with failure.

Conclusion 2: NS construct measures have better interactive effects towards early grade mathematics competency than those under CC construct.

In the methodology section of this research a three level interpretation of correlation magnitudes was adopted: (a) correlation values within the range of .20 to .35 were considered as having no strength for individual or group predictions; (b) those within .35 to .65 were viewed as acceptable for group, not individual, predictions; and (c) magnitudes greater than .65 were accepted as accurate for all purposes. Accordingly, though the interrelationships within the sub-tests of the measures of the two constructs were statistically significant and reflected population characteristics, the magnitudes varied in terms of prediction powers. Whereas the interrelationships within the CC construct sub-tests did not seem to give us confidence about the contribution to the overall competency, the reality within the NS construct indicators as a whole was much better. The magnitudes of correlations between NI and QD (r= .66), QD and Add (r=.70), QD and Sub (r=.65) and Add and Sub (r=.78) (all within the NS construct) provided evidence on the relatively large shared variance between the variables and hence better contribution to the overall changes in individual and group achievements. The trend in the cross correlation between the measures of the two constructs was, however, average, i.e. the values, except those between C and OC, and MN and OC, met the standard for group prediction and could have a role of strengthening regression results that include other variables. Unlike the magnitudes of the cross correlations between the indicators of the two constructs, the correlation value between the composite scores of CC and NS constructs was strong enough, indicating nearly 45 percent shared variance (r= .67). Therefore, it can be concluded that the shared variance within the NS indicators and between the composite scores of the two constructs seemed to have greater contribution to the overall early grade mathematics competency. In other words, the skills included in the NS construct showed greater interactive effect with each other and hence better effect on the overall competency development than the conceptual elements under CC construct. Notwithstanding the contribution of each of the indictors in the composite computation, less correlation magnitude with other measures in the model means limited interaction effect to the overall result.

Conclusion 3: Rural students are at disadvantage and experience higher gender inequality.

The analysis made on the performances of children from the sample schools showed statistically significant variation by location in favor of children from urban schools. Results suggested that an average performance in urban areas qualifies for 78 percentile ranks among rural school children. Put differently, 78 per cent of the rural children are likely to be surpassed by 50 per cent of urban children. This is large enough to bring differences in student progression from grade or level to the next and in educational success as a whole. It is hard to imagine that students lagging behind at this stage will compensate and then catch up with their peers in the upper grades. Nor is a mechanism in place in the country to mediate such realities as early as possible. Thus, in this competitive era, such inequality prevalence might have far reaching effects on access to preferred professions and institutions in higher education as achievement-based student placement in Ethiopia is likely to continue.

The result is consistent with the general trend in Ethiopia though the third national learning assessment reported an exception on their composite means and that of the fourth report showed no difference in mathematics achievement resulting from location variations (MoE, 2008b, 2013a). Consistency, however, does not mean the situation is acceptable. Rather, it shows how grave the situation is and calls for urgent intervention to end the inequality.

Furthermore, the findings of this research showed that girls are at double disadvantage in status of learning. On one hand, rural children (including girls) achieved relatively lower than those from urban schools. On the other hand, the situation of girls is worse than that of boys in the rural areas. Thus, it is possible to conclude that: (a) gender per se is not associated with low achievement, rather the context under which they go to school matters; and (b) gender as a social construct duplicates inequality if left for chance.

Conclusion 4: Results with regard to the contributions of individual, home and school related variables towards early grade mathematics competency development were mixed and in some cases inconsistent with logic and previous research findings.

Variables within the reach of the children to provide accurate information were targeted in this study. Besides, keeping the test length as appropriate as possible to the estimated attention span of the children also detected the number items and thereby variables to be studied. From the individual variables, only age and achievement tended to have positive linear relationship, i.e. within the limit of about 6-12 years old[20] as age increases, achievement improves. KG experience and absenteeism for a week or more in the academic year were other two individual related variables investigated. Though the negative consequence of absenteeism on achievement seemed convincing, that of KG experience was somehow odd. That is, the findings of this research failed to provide supporting evidence to the theoretical assumptions behind KG experience (MoE, MoH & MWA, 2010)and previous research findings like that of Magnuson, Ruhm and Waldfogel (2004).

[20]Though the range focused on the majority of the students, there were also few students aged 13, 14, 15, 17 and 27 years.

The findings in relation to home related variables (family support during study time, and literacy of mothers and fathers) also indicated no noticeable contribution. On the contrary, the contribution of reported available supplementary mathematics materials at home to achievement was negative which does not seem logical. In the case of the two school variables included (availability of functional library and textbook-student ratio), however, the findings supported effectiveness of the resources in enhancing early grade mathematics competency development. Thus, the findings revealed problems than answers in the study and understanding of early grade mathematics learning.

8.4. Implications

The implications of this research emanate from the nature of the research findings identified and conclusions drawn, and the limitations of the research itself. Though there could be limitless issues and questions that require immediate responses, the focus here is on what it means to our knowledge of quality of education, research practices and intervention schemes in the context of primary education in Ethiopia.

1. It has become clear that quality of primary education in Ethiopia, as measured by early grade mathematics competency, is low and consistent with research findings at upper grades. However, this is only one (but critical) element of quality and the identification of quality components of early grade learning in the context of Ethiopia is unfinished agenda. According to the Dakar EFA declaration, quality of education is quality of measurable learning outcomes “achieved by all, especially in

literacy, numeracy, and essential life skills" (UNESCO, 2000: 17). The Ethiopian Policy of education and Training adopted similar conception on the dimensions of learning at early grades (grades 1-4) (FDRE, 1994). However, quality is as broader as life itself, affected by the dynamics of the changing world, and it is very difficult to develop exhaustive and universal model that fits for all purposes and specific contexts. McCormac (2012), for example, described the possibility of defining quality of education in terms of capabilities and human right elements.

The review of this research showed that early grade is the foundation stage for the child and for mastery of knowledge; mathematics is highly applicable in learning other subjects (including reading) and in life; and the demand for mathematical knowledge is even increasing in this information age. However, defining quality as early grade mathematics learning should not imply a reduction effect on the broader conception of quality of education. Nor should it limit the possibility of exploration into its descriptive and/or normative characteristics. On the other hand, there is a limit to human learning capacity and the issue of quality cannot encompass everything deemed desirable. Thus, our understanding of quality should take into account human learning capacity and critical outcome elements to ensure comparative advantage of the Ethiopian society in this human capital guided competitive world.

2. Given the critical nature of school mathematics, our curriculum development and instructional processes should benefit from latest research findings. Mismatch between curricular emphasis and what students should learn may entail learning problems.

While reviewing the contents of the textbooks and competencies for data collection instrument development purposes, the researcher noted discrepancies in curricular emphasis and organization as compared to the early grade mathematics competency constructs applied in this research. Findings of this research also showed that the measures of NS revealed better interactive effect towards competency development than the CC indicators. The best fit in emphasis and curriculum relevance could demand reviewing existing approaches and operational curricula as per the standards in the current literature.

3. The research included selected learning variables to analyze their contributions towards the development of early grade mathematics competency. The definition and measurement of competency itself was limited to oral-based responses of the children. Because of such an approach, mathematics learning outcomes such as writing, and content areas like geometric shapes, fractions, measurement units, and so on were not assessed. Besides, the list of proxy variables included was neither exhaustive nor exclusive on the basis of relevance and theoretical justifications. The guiding principle was limited to the pragmatic aspects of data collection from children. In other words, the data set on the variables that affect early grade mathematics was limited and some of the findings were as well inconsistent with policy assumptions as well as existing literature. Thus, there seems a need for comprehensive study on the critical factors of learning in the Ethiopian, early grade and school mathematics contextual realities.
4. This research showed low level of learning in early grade mathematics, consistent with the literature drawn from upper grades in Ethiopia and from low income countries around the globe. As the conceptualization in this research considered early grade

mathematics competency as integral part but stand-alone element of quality, the implication to intervention should follow similar approach. This researcher agrees with McCormac (2012) on the multifaceted nature of quality of education but disagrees with her suggestion that quality intervention scheme should encompass all factors contributing to its enhancement. The reasons include both experiential and theoretical arguments. First, specific stages like early grade are more important than others, and systemic approach to quality improvement might fail to target accordingly. Second, the review and findings of this research show that all factors do not have comparable influence on quality improvement. Third, if we try to include everything in an intervention model, then nothing will be different from the daily routines of educational activities in schools. It is selectivity that differentiates intervention from the regular programs, and makes it cost effective and affordable. GEQIP (General Education Quality Improvement Package) in Ethiopia is a very good example in this sense. The intervention package was initiated in 2008 and it is in its second phase. It covers Curriculum and Assessment, Teacher Development, School Improvement Program, Management and Administration, and Monitoring and Evaluation. It is in such a situation that low quality indicators are on the increase than otherwise. Intervention schemes should, therefore, be defined, prioritized, systematically designed with simplicity in mind, and operationalized with adequate professional support.

Bibliography

Abraha Asfaw (1997). *"A study of students' and societal needs regarding an approach to the first cycle primary curriculum integration in Tigrai".* Addis Ababa: AAU

Abraha, Asfaw. (1998). *"Curriculum integration vis-à-vis the Ethiopian education policy and its implications for textbook preparation."* ***Proceedings of National Conference held in Awassa College of Teacher Education, 12-18 July 1998.*** IER: Addis Ababa University.

Adams, Don and Robert M. Bjork (1969). ***Education in developing areas.*** New York: David McKay Company, Inc.

Adams, Don, M. Ginsberg, Y. Wang, and J. Sylvester.(1995). ***Improving educational quality: A new approach.*** Arlington VA: Institute for International Research and University of Pittsburgh, USAID, Improving Educational Quality Project.

Adams, Don. (1993). ***Defining educational quality***. Arlington VA: Institute for International Research and University of Pittsburgh, USAID, Improving Educational Quality Project.

Alexander, Robin. (2000). ***Culture and pedagogy: International comparisons in primary education.*** Malden: Blackwell Publishing.

Amare Asgedom (2008). ***Beyond knowledge acquisition: A plea for knowledge application.*** Mekelle (Research Report Submitted to REST).

Anderson, John R. (2005). ***Cognitive psychology and its implications (6th ed.).*** New York: Worth Publishers.

Ashcraft, Mark H. and Jeremy A. Krause.(2007). "Working memory, Math performance, and Math anxiety." ***Psychometric Bulletin & Review.*** 14 (2), 243-248.

Ayalew Gebre Sellassie (1964). 'Three years' experience in education." ***Ethiopia Observer.*** 8 (1), pp. 19-36.

Baroody, Arthur (1993). "The relationship between the order-irrelevance principle and counting skill."***Journal for Research in Mathematics Education,*** 24 (5),415-427.

Batterman, Robert W. (2009). ***On the exploratory role of mathematics in empirical sciences.*** London: Oxford University Press.

Benjamin, Piper. (2010). ***Ethiopia Early Grade Reading Assessment (EGRA): Data analytic report, language and early learning.*** Addis Ababa (Unpublished report presented to the Ethiopian Ministry of Education and USAID).

Bigge, Morris L. and S. Samuel Shermis (2004). ***Learning theories for teachers: Classic edition (6th ed.).*** Boston: PEARSON.

Bjerkan, Ole-Christian (1970).*"Plans, targets, and trends in Ethiopian education".* (PhD Dissertation).University of Maryland.

Brock-Utne, Birgit. (2000). ***Whose education for all? The recolonization of the African mind.*** New York: Falmer Press.

Brown, Margaret. *(1998)."The tyranny of the international horse race." In Slee, Roger, Gaby Weiner and Sally Tomlinson (eds.).* ***School effectiveness for whom? Challenges to the School Effectiveness and School Improvement Movements.*** London: Falmer Press.

Bryka, Anthonys and Kiml. Hermanson. (1993). "*Educational indicator systems: Observations on their structure, interpretation, and use"* ***Review of Research in Education. Vol. 19, pp. 451-484.***

Burbules, Nicholas C. (2004). *”Ways of thinking about educational quality.”* ***Educational Researcher.*** 33 (6); 4 - 10.

Busia, K.A. (1964). ***Purposeful education for Africa.*** London: Mounton and Co.

Camfield, Laura. (2011). ***‘A girl never finishes her Journey’: mixing methods to understand female experiences of education in contemporary Ethiopia.*** Young Lives, Oxford Department of International Development, University of Oxford, UK.

Cheung, K. C. (1994). *“Assessing quality of learning in higher education: methods, models and perspectives.”*Paper presented at the international conference on assessing quality in higher education (6th). Hong Kong: July 19-21.

Clarke, Ben and Mark R. Shinn (2004). ***Test of Early Numeracy (TEN): Administration and scoring of AIMSweb early numeracy measures for use with AIMSweb.*** NCS.

Clarke, Ben and Mark R. Shinn.(2004). "A preliminary investigation into the identification and development of early mathematics curriculum-based measurement." ***School Psychology Review.***33 (2), 234 - 248.

Cohen, Louis, Lawrence Manion and Keith Morrison.(2000). ***Research methods in education.*** (6thed.). New York: Routledge, Taylor & Francis Group.

Cohen, Louis, Lawrence Manion, and Keith Morrison. (2007). ***Research methods in education (7thed.).*** New York: Routledge, Taylor & Francis Group.

Colclough, Christopher. (1980). ***Primary schooling and economic development: A review of the evidence.*** World Bank***:*** World Bank Staff Working Paper No. 399.

Council of Ministers of Canada. (2013). ***Measuring up: Canadian results of the OECD PISA study.*** Toronto, Ontario.

Cronk, Brain C. (2008). ***How to use SPSS: A step-by-step guide to analysis and interpretation.* (5th ed.).** Los Angeles: Fred Pyrczak.

Dasgupta, Satadal (1989). ***Diffusion of Agricultural innovations in village India.*** New Delhi: Wiley Eastern Ltd.

Delors, J. (1996). "Learning: the Treasure Within." ***Report to UNESCO of the international commission on education for the twenty-first century.*** Paris: UNESCO.

DeStefano, Joseph & Nawsheen Elaheebocus. (2009). ***School quality in Woliso, Ethiopia: Using opportunity to learn and early grade reading fluency to measure school effectiveness***. EQUIP2 report submitted to USAID.

Ellis, R. (1993). ***Quality assurance for university teaching*.** Buckinghaum: SRHE & Open University Press.

Ernest, Paul. (1998). ***Social constructivism as a philosophy of mathematics.*** New York: State University of New York Press.

Ernest, Paul. (1991). ***The philosophy of mathematics education.*** London: Falmer Press.

Fafunwa, A. Babs. (1971). *"Some guiding principles of education in Africa."* ***Western African Journal of Education.*** 15(1-3), 5-7.

Fagerlind, I. and lawrence J Saha (1989). ***Education & national development: A comparative perspective (2nd ed.).*** Oxford: Pergamon Press.

Fbye, Douglas, Nicholas Braisby, John Lowe, Celine Maboudas, and Jon Nicholls. (1989). "*Young children's understanding of counting and cardinality."* ***Child Development.*** 60, 1158-1171.

Federal Democratic Republic Government of Ethiopia (FDRE). (2010). ***Education Sector Development Program IV (2010/11-1014/15): Program action plan***. Addis Ababa, Ethiopia.

Federal Democratic Republic Government of Ethiopia (FDRE), Population Census Commission.(2008). **Summary and statistical report of the 2007 population and housing census.** Addis Ababa.

Federal Democratic Republic Government of Ethiopia (FDRE). (2005). ***Education Sector Development Program III (2005/06-2010/11): Program action plan***. Addis Ababa, Ethiopia.

Federal Democratic Republic Government of Ethiopia (FDRE). (2002). ***Education Sector Development Program II (2002/03 – 2004/05): Program action plan***. Addis Ababa, Ethiopia.

Federal Democratic Republic Government of Ethiopia (FDRE). (1998). ***Education Sector Development Program I (1999/2000 -2003/04): Action plan***. Addis Ababa, Ethiopia.

Federal Democratic Republic Government of Ethiopia (FDRE). (1995). ***The Constitution of* the *Federal Democratic Republic Government of Ethiopia.*** Addis Ababa: Birhanena Selam Printing Press.

Federal Democratic Republic Government of Ethiopia (FDRE). (1994a). ***Education and Training Policy (1st ed.).*** Addis Ababa: St. George Printing Press.

Federal Democratic Republic Government of Ethiopia (FDRE).(1994b). ***Education Sector Strategy.*** Addis Ababa.

Feigenson, Lisa, Stanislas Dehaene and Elizabeth Spelke (2004). ”Core Systems of Number." ***TRENDS in Cognitive Science.*** 8 (7), 307 - 314.

Field, Andy. (2009). ***Discovering statistics using SPSS. (3rd ed.).*** Los Angeles: Sage Publications.

Foegen, Anne, Cynthia Jiban and Stanley Deno. (2007). “Progressing monitoring measures in mathematics: A review of the literature” ***The Journal of Special Education.*** 41 (2), 121 -139.

Forsten, Char. (2005). ***MATH strategies you can count on: Tools & activities to build Math appreciation, understanding & skills.*** Peterborough: Crystal Springs Books.

Foshay, Arthur W., Robert L. Thorndike, Fernand Hotyat, Douglas A. Pidgeon and David A. Walker.(1962). ***Educational achievement of thirteen-year-olds in twelve countries.*** UNESCO Institute of Education. Hamburg.

Fuchs, Lynn S. (2004). "The past, present, and future of curriculum-based measurement research." ***School Psychology Review.***33 (2), 188 - 192.

Gardner, Howard. (2011). ***Frames of mind: The theory of multiple intelligence.*** New York: Basic Books (A Member of the Perseus Books Group).

Geary, David C. (1996).***Children’s mathematical development: Research and practical applications.*** Washington, DC: American Psychological Association.

Geary, David C. (2011). “Cognitive predictors of achievement growth in mathematics: A 5- year longitudinal study.” ***Developmental Psychology.***47 (6), 1539-1552.

Gelman, Rochel and Elizabeth Meck. (1983). "Preschoolers' counting: Principles before skill." ***Cognition.*** Vol. 13, pp. 343 - 359.

Gersten, Russell, Nancy C. Jordan, and Jonathan R. Flojo.(2005). "Early identification and interventions for students with mathematics difficulties." ***Journal of Learning Disabilities.*** 38 (4), 293 - 304.

Ghana, National Education Assessment Unit. (2014). ***Ghana 2013: National education assessment, summary of results.*** Ghana Ministry of Education: Accra.

Ginsburg, Mark B., and Jane Schubert.(2001). ***"Choices: Improving educational quality: Conceptual issues, the ideal IEQ approach, and the IEQI experience."*** Paper developed for USAID, IEQ Project. Washington DC: USAID, Improving Educational Quality Project.

Gitelman, Zvi Y. (1972). ***The diffusion of political innovation: From Eastern Europe to the Soviet Union.*** London: Sage Publications.

Goodstein, R. L. (1965). ***Essays in the philosophy of mathematics.*** Leicester: Leicester University press.

Greaney, Vincent and Thomas Kellaghan. (2008). ***Assessing national achievement levels in Education (Volume I).***Washington, DC: The World Bank.

Greeno, James G., Allan M. Collins and Lauren B. Resnick. (1996). "Cognition and Learning", in Berliner, D. & R. Calfee (eds.). ***Handbook of Educational Psychology.*** New York: Macmillan (pp. 15-46).

Halasz, Gabor and Alain Michel. (2011). "key competences in Europe: Interpretation policy formulation and implementation" ***European Journal of Education.***46 (3), 289 -306.

Harvey, Lee and Bjorn Stensaker (2008). "Quality culture: Understandings, boundaries and linkage." ***European Journal Education.***43 (4), pp. 428 – 442.

Harvey, L., and D. Green. (1993). *"Defining quality."* ***Assessment & Evaluation in Higher Education,*** *18*(1), 9 - 34.

Haylock, Derek (2004). ***Mathematics explained for Primary Teachers (2nd ed.).*** London: Paul Chapman Publishing.

Hirst, P.H (1975). ***What is teaching? Knowledge and the Curriculum – A collection of philosophical papers.*** Routledge & Kegan Paul.

Hlebowitsh, Peter S. (2005). ***Designing the School Curriculum.*** Boston: Pearson.

Hoskins, Bryony and R. D. Crick (2010). "Competence for learning to learn and active citizenship: different currencies or two sides of the same coin." ***European Journal of Education,*** 45 (1), 121- 137.

Howson, Geoffrey, Christine Keitel and Jeremy Kilpatrick.(1981). ***Curriculum development in mathematics.*** Cambridge: Cambridge University Press.

Hungi, Njora. (2011). ***Accounting for variations in the quality of primary School Education: Working Paper 7.*** SACMEQ Publishing.

Hyslop - Margison, Emery and Alan M. Sears. (2006).***Neo-Liberalism, globalization and human capital learning: Reclaiming education for democratic citizenship.*** The Netherlands: Springer.

Imperial Ethiopian Government, Ministry of Pen.(1947). ***Negarit Gazeta*** 7th Year No. 3.

Jordan, Nancy C. and Susan C. Levine (2009).**"**Socioeconomic variation, number competence, and mathematics learning difficulties in young children." ***Developmental Disabilities Research Reviews.***15, 60-68.

Jordan, Nancy C., David Kaplan, Chaitanya Ramineni and Maria N. Locuniak. (2009). "Early Math matters: Kindergarten number competence and later mathematics outcomes." ***Developmental Psychology.*** 45 (3), 850 - 867.

Kellaghan, Thomas. (2004). ***Public Examinations, National and International Assessments, and Educational Policy***. Dublin: St Patrick's College, Educational Research Centre.

Kellaghan, Thomas and Vincent Greaney. (2004). ***Directions in development: Assessing student learning in Africa.*** Washington, DC: World Bank.

Kellaghan, Thomas and Vincent Greaney. (2001). *"The globalization of assessment in the 20th Century."* ***Assessment in Education.***18 (1), 87-10.

Kiess, Harold O. (2002). ***Statistical concepts for the Behavioral Sciences (3rd ed.).*** Boston: Allyn and Bacon.

Kilpatrick, Jeremy, Jane Swafford, and Bradford Findell. (2001). ***Adding It Up: Helping Children Learn Mathematics.*** National Research Council (Retrieved from http://www.nap.edu/catalog/9822.html on Oct. 25, 2014)

Kish, Leslie (1965). ***Survey sampling.*** New York: John Wiley & Sons.

Kitcher, P. (1988). "Mathematical naturalism." In Aspray, W. and History and P. Kitcher (eds.) ***Physiology of Mathematics. Minnesota Studies in the Philosophy of Science,*** Vol. XI, pp. 293-325. (Minneapolis: University of Minnesota Press).

Lave, Jean and Etienne Wenger. (1999). S***ituated learning: Legitimate peripheral participation.*** Cambridge: Cambridge University Press.

Lee, Yonghwan.(2003). "*Chapter 31 politics and theories in the history of curricular reform in South Korea."* In Pinar, Williams F. (ed.) ***International Handbook of Curriculum Research.*** New Jersey: Lawrence Erlbaum Associates, Publishers.

Leu, Elizabeth. (2005). ***The Role of teachers, schools, and communities in quality Education: A review of the literature.*** Academy for Educational Development: Global Education Center.

Loveless, Tom (ed.). (2007). ***Lessons learned: What international assessments tell us about Math achievement.*** Washington, D.C.: Brookings Institution Press.

Magnuson, Katherine A., Christopher J. Ruhm, and Jane Waldfogel. (2004). ***Does prekindergarten improve school preparation and performance?*** (Working Papers 10452). Cambridge: National Bureau of Economic Research.

Manuwuike, Emeka. (1978). ***Dysfunctionalism in African Education.*** New York: Vantage Press.

Max Planck Institute for Human Development.(2002). ***PISA 2000: Overview of the Study – Design, Method and Results.*** German, Berlin.

McCain, M. N. and J. F. Mustard. (1999). ***Reversing the real brain drain: Early years study, Final Report.*** Toronto: Publications Ontario.

McGinnis, J. Randy, Carolyn Parker, and Anna O. Graeber. (2004). *"A cultural perspective of the induction of Five Reform-Minded beginning mathematics and Science Teachers"* ***Journal of Research in Science Teaching.***41 (7), 720-747.

McCormac, Meredith. (2012). ***Literacy and Educational Quality improvement in Ethiopia: A mixed methods study.*** University of Maryland. (Unpublished PhD Disseveration).

McNeil, John (1996). ***Curriculum: A comprehensive Introduction.*** Los Angles: Harper Collins College Publishers.

McNeil, J.D. (1990). ***Curriculum: A comprehensive introduction.*** Los Angeles: Harper Collins Publishers.

Meyers, Lawrence S., Glenn Gamst and A.J. Guarino. (2006). ***Applied multivariate research: Design and interpretation.*** London: SAGE Publications.

MoE, Ethiopia. (2013a). ***Ethiopian 4th National Learning Assessment of Grades 4 and 8 Pupils.*** Addis Ababa: National Educational Assessment and Examinations Agency.

___________. (2013b). ***Education Statistics Annual Abstract 2005 E.C. (2012/13)***. MoE Publication.

___________. (2013c). ***General Education Quality Improvement Package II (GEQIP II), 2013 - 2018.*** Addis Ababa.

___________. (2012). ***Education Statistics Annual Abstract 2004 E.C (2011-12).*** Addis Ababa: MoE.

___________. (2010). ***Ethiopian First National Learning Assessment of Grades 10 & 12 Students.*** Addis Ababa).

___________. (2008a). ***Minimum Learning Competencies (Grades 1-4).*** Addis Ababa (Unpublished Working paper).

___________.(2008b). ***Ethiopian Third National Learning Assessment of Grade Four Students.*** Addis Ababa.

___________. (2008c). ***General Education Quality Improvement Package I (GEQIP-II)***. Addis Ababa.

___________. (2008d). ***Annual Intake and Enrolment Growths and Professional Mix of Ethiopian Public Higher Education: Strategy and Conversion Plan, (2001 -2005 E.C).*** Addis Ababa. (Unpublished guideline).

___________. (2004a). ***Ethiopian Second National Learning Assessment of Grade 4 Students.*** Addis Ababa.

___________. (2004b). ***Ethiopian Second National Learning Assessment of Grade 8 Students.*** Addis Ababa.

___________. (2002). ***The Education and Training Policy and Its Implementation.*** Federal Democratic Republic of Ethiopia, Ministry of Education.

___________. (2000a). ***Ethiopian National Baseline Assessment on Grade Four Pupils' Achievement: Technical report.*** Addis Ababa: National Educational Assessment and Examinations Agency.

___________. (2000b). ***Ethiopian National Baseline Assessment on Grade Eight Students' Achievement.*** Addis Ababa: National Educational Assessment and Examinations Agency.

___________. (1986). ***Evaluative Research on the General Education System of Ethiopia: A quality study.*** Addis Ababa.

___________. (1984). ***Education in Socialist Ethiopia: Origins, Reorientation & Strategy for Development.*** Addis Ababa.

MoE, Imperial Ethiopia. (1972).***Education Sector Review.*** Addis Ababa.

___________. (1955). ***A Ten-Year plan for the controlled expansion of Ethiopian education.*** Addis Ababa: MoE.

___________.(1954). ***Imperial Ethiopian Ministry of Education Year Book, 1951 - 1953.*** Addis Ababa: Ministry of Education.

___________. (1952). ***Imperial Ethiopian Ministry of Education Year Book, 1949 - 1951.*** Addis Ababa: Ministry of Education.

___________. (1950). ***Imperial Ethiopian Ministry of Education Year Book, 1947 - 1949.*** Addis Ababa: Ministry of Education.

MoE, MoH, and MWA, Ethiopia. (2010). ***National Policy Framework for Early Childhood Care and Education (ECCE) in Ethiopia.*** Addis Ababa.

MoE, Ethiopia and USAID-AED/EQUIP II Project (2008). ***Review of the Ethiopian Education Training Policy and its Implementation.*** Addis Ababa.

Ministry of Finance and Economic Development (MoFED), Ethiopia. (2010). ***Growth and Transformation Plan (2010/11-2014/15): Volume I (Main Text).*** Addis Ababa: MoFED.

Moon, Bob. (2002). "Learning perspectives on the teachers' task." In Moon, Bob, Ann Shelton Mayes, and Steven Hutchinson (eds.) **Teaching, Learning and the Curriculum in Secondary Schools.** New York: Routledge/ Falmer, Taylor & Francis Group

Mullis, Ina V.S., Michale O. Martin, Pierre Foy, and Alka Arora. (2012). ***TIMSS: TIMSS 2011 International Results in Mathematics.*** Boston College, Lynch School of education: TIMSS & PIRLS International Study Center.

Mullis, Ina V.S. *et al*. (2000). ***TIMSS 1999: International Mathematics Report, Findings from IEA's Repeat of the Third International Mathematics and Science Study at the Eighth Grade.*** Boston: International Study Center, Lynch School of Education, Boston College.

Mullis, Ina V.S. *et al*. (1997). ***Mathematics Achievements in the Primary School Years: IEA's Third International Mathematics and Science Study (TIMSS).*** Boston College, TIMSS International Study Center: Chestnut Hill, MA, USA.

Muluemebeat, Kiar. (2007). "Children in Ethiopian Media and School Textbooks," in Poluha, Eva (ed.). ***The World of Girls and Boys in Rural and Urban Ethiopia.*** Addis Ababa: Save the Children.

Myers, Anne and Christine H. Hansen.(2002). ***Experimental Psychology.*** Belmont: Wadsworth.

National Academy of Sciences, USA. (2001). ***Adding it up: Helping Children Learn Mathematics.*** Washington, DC.: National Academy Press.

National Council of Teachers of Mathematics, USA.(2000). ***Principles and standards for school mathematics*****.** Reston, VA: Author.

National Mathematics Advisory Panel, USA. (2008). ***Foundations for Success: The Final Report of the National Mathematics Advisory Panel.*** Washington, DC.:U.S. Department of Education.

Nitko, A.J. (1996). ***Educational Assessment of students.*** Ohio: Merrill.

Odora, Hoppers, Catherine (1998). ***Structural violence as a constraint to African policy Formulation in the 1990s: Repositioning Education in International Relations.*** Doctoral Dissertation. University of Stockholm, Institute for International Education.

OECD. (2014). ***PISA 2012 Results: What Students Know and Can Do – Student Performance in Mathematics, Reading and Science (Volume I, Revised edition, February 2014*****).** PISA, OECD Publishing.

OECD. (2013). ***PISA 2012 Results in Focus: What 15-year-olds know and what they can do with what they know.*** PISA, OECD Publishing.

OECD. (2004). ***Learning for Tomorrow's World: First Results from PISA 2003***. PISA, OECD Publishing.

OECD. (1999). ***Measuring Student knowledge and Skills: A New Framework For Assessment.*** PISA, OECD Publishing.

Osttveit, Svein (2000). "Education For All: Ten years after Jomtien." ***Prospects.*** Vol. XXX, no.1.

Pankhurst, Richard. (1962). *"The foundations of education, printing, News Papers, Book production, libraries and Literacy in Ethiopia."* ***Ethiopian Observer.*** 6 (3), 241 - 290.

Pankhurst, E. Sylvia. (1955). ***Ethiopia: A Cultural History.*** London: The Leighton - Straker Book Publishing Ltd.

Poluha, Eva. (2004). ***The Power of Continuity: Ethiopia through the eyes of its Children.*** Stockholm: Flanders Gotab.

Pratt, David. (1980). ***Curriculum: Design and Development.*** London: Harcourt Brace Jovanovich, Publishers.

Robeyns, Ingrid. (2003). "Sen's Capability Approach and Gender Inequality: Selecting Relevant Capabilities." ***Feminist Economics.***9 (2-3), 61 -92.

Roche, Chris. ((2009). ***Impact Assessment for Development Agencies: Learning to Value Change.*** New Delhi: Samakriti.

Rogers, Everett M. (2003).***Diffusion of Innovations.***(5th ed.). New York: Free Press.

Romberg, Thomas A. (1996). "Problematic Features of the School Mathematics Curriculum", in Jackson, Philip W. (ed.) ***Handbook of Research on Curriculum.*** New York: Simon & Schuster Macmillan.

Rose, Kenneth N. (2005). ***Sampling Design for Educational Survey Research (Module3).***UNESCO International Institute for Educational Planning.(Soft Copy).

Rose, Pauline and Samer Al-Samarrai. (2001). *"Household constraints on schooling be gender: Evidences from Ethiopia."* ***Comparative Education Review.*** Vol. 45. No. 1: 36-63.

RTI. (2014). ***Early Grade Mathematics Assessment Toolkit.***RTI International.

RTI. (2012a). ***Primary Math and Reading (PRIMR) Program: Kenya, Education Policy Study Report.***RTI International.

RTI. (2012b). ***Pupil Performance, Pedagogic Practice, and School management: An SSMME Pilot in Zambia.*** RTI International.

RTI. (2012c). ***Student Performance in Reading and Mathematics, Pedagogic Practice, and School Management in Jordan.***RTI International.

RTI. (2009a). **Early *Grade Mathematics Assessment (EGMA): A Conceptual Framework Based on Mathematics Skills Development in Children.*** USA, North Carolina.

RTI. (2009b) .***Early Grade Reading Assessment Toolkit.***USA.(Unpublished EGRA Manual).

SACMEQ. (2012). ***About SACMEQ.***SACMEQ Publishing.

SACMEQ. (2010a). "*What are the Levels and Trends in Reading and Mathematics Achievement?"* ***SACMEQ Policy Issue Series.*** SACMEQ, Publishing.

SACMEQ. (2010b). ***SACMEQ III Project Results: Pupil Achievement Levels in Reading and Mathematics: Working Document No. 1.*** SACMEQ Publishing.

Saylor, J. Galen, William M. Alexander and Arthur J. Lewis (1981).***Curriculum Planning for Better Teaching and Learning.*** New York: Holt, Rinehart and Winston.

Scheerens, Jaap (2001) "School effectiveness research." In Snelser, N.J. and Paul B. B. (eds.) ***International Encyclopedia of the Social & Behavioral Sciences***. Vol. 20, pp. 13567-13572.

Sen, Amartya. (1989). "Development as Capability Expansion."***Journal of Development Planning.*** 19: 41 – 58.

Skemp, Richard R. (1989). ***Mathematics in the Primary School.*** London: Routledge Falmer.

Smith, Cara. (2010). ***Mathematics in Early Childhood: An Investigation of Mathematics Skills in Preschool and Kindergarten Students. (PhD Dissertation, Alfred University).***New York: ProQuest, LLC.

Smith, Susan Sperry. (2006). ***Early Childhood Mathematics (3rd).***Boston: Pearson.

Staub, F. C and Elsbeth Stern. (2002). "The Nature of Teachers' Pedagogical Content Beliefs matters for Students' Achievement Gains: Quasi-experimental Evidence from elementary mathematics," ***Journal of Educational Psychology.*** 94 (2), 344-355.

Stemhagen, Kurt. (2003)."Toward a pragmatic/ contextual philosophy of mathematics: Recovering Dewey's "Psychology of Number"," in ***Philosophy of Education Year Book 2003.*** Pp. 436 – 444.

Taba, Hilda. (1962). ***Curriculum Development: Theory and Practice.*** New York: Harcourt, Brace and World, Inc.

Taddele, Hagos. (2008). *"The Feasibility of Achieving UPE by 2015 in the State of Tigray (Ethiopia): Opportunities and Challenges."* National University of Ireland, Cork (Unpublished PhD Dissertation).

Tekeste, Negash. (2010). "The Curse of English as a Medium of Instruction in Ethiopian Education System."In Paulos, Milkias and Messay Kebede. (eds.). ***Education, Politics and Social Change in Ethiopia.*** Los Angeles: Tsehai Publishers and Distributors.

___________. (1990). ***The Crisis of Ethiopian Education: Some Implications to Nation Building.*** Uppsala: Uppsala University.

Tamirie, Andualem. (2009) "Trend Analysis of Males' and Females' Education in Different School Levels and School Types in Addis Ababa," In Ege, Svein, Harald Aspen, BirhanuTeferra and Shiferaw Bekele (ed.) ***Proceedings of the 16th International Conference of Ethiopian Studies.*** Trondheim.

Tamirie Andualem (2006)."Trend Analysis of Females' and Males' Academic Achievement in Different Educational Levels", ***Journal of Education for Development.*** Vol.I, No. 1.

Tatek, Abebe. (2008). "*Trapped between disparate worlds: The livelihoods, socialization and school contexts of rural children in Ethiopia.*" **Childhoods Today.** Vol. 2, No. 1: 1-29.

Tatek, Abebe. (2007). *"Changing livelihoods, changing childhoods: Patterns of children's work in rural Southern Ethiopia".* ***Children's Geographies.*** Vol. 5, no. 1: 77-93.

Tekeste Negash. (1990). ***The Crisis of Ethiopian Education: Some Implications for Nation-Building.*** Sweden, Uppsala University.

Teshome, Emana. (2001). ***Gender differences in mathematics achievement in primary schools of Addis Ababa.*** Addis Ababa: OSSREA.

The Expert Panel on Early Math in Ontario. (2003). ***Early Math strategy: The report of the expert panel on early Math in Ontario.*** Ontario.

The Inter-Agency Commission (UNDP, UNESCO, UNICEF, World Bank). (1990). ***Meeting basic learning needs: A vision for the 1990s*** (Background document for the World Conference on EFA.

Tiana, Alejandro, José Moya and Florencio Luengo. (2011). *"Implementing key competences in basic education: reflections on curriculum design and development in Spain."* **European Journal of Education.**46(3), 307 – 322.

Tigrai Regional Education Bureau. (2012). ***Tigrai, list of schools in 2004 E.C. (2011-12 Academic Year).***(Unpublished document).

Tigrai Regional State Education Bureau. (2010). ***Education Statistics Abstract 2002 E.C (2009/2010).*** Mekelle.

Tilaye Kassahun, and Bedru Kedir. (2006). "Girls' performance in mathematics in upper primary schools of Addis Ababa."***Indian Journal of Gender Studies***13: 401–24.

U.S. Department of Education. (2008). ***Foundation for success: The final report of the National Mathematics Advisory Panel.*** Washington, DC.

UNESCO & UN-ECA (1961). ***Conference of African States on the development of education in Africa: Final report.*** Addis Ababa.

UNESCO (2014).*"Teaching and Learning: Achieving quality for all"* ***EFA Global Monitoring Report 2013/14.*** Paris: UNESCO Publishing.

UNESCO. (2011). ***EFA Global Monitoring Report 2011: The hidden crisis: Armed conflict and education.*** Paris: UNESCO publishing.

UNESCO. (2008). ***EFA Global Monitoring Report 2009: Overcoming inequality: Why governance matters***. Paris: UNESCO publishing.

UNESCO. (2007). ***EFA Global Monitoring Report 2008: Education for All by 2015: Will we make it?*** Paris: UNESCO publishing.

UNESCO. (2004). "*Education For All: The quality imperative."* ***EFA Global Monitoring Report 2005.***Paris: UNESCO Publishing.

UNESCO. (2000).***The Dakar Framework for Action, Education for All: Meeting our Collective Commitments.*** Paris, France.

UNESCO. (1990). ***World Declaration on Education For All.*** Jomtien (Thailand).

UNESCO and UNICEF. (2005). ***Children out of school: Measuring exclusion from primary education.*** UNESCO Institute for Statistics, Montreal.

United Nations Secretary-General. (2012). ***Education First: An initiative of the United Nations Secretary-General.*** New York, NY10017.

United Nations. (2012). ***The Millennium Development Goals: Report 2012***. United Nations: New York.

UWEZO. (2011). ***Improving learningoOutcomes in East Africa 2009-2013: Strategy update.*** Twaweza.

Wadeley, Alison, Ann Birch, and Tony Malim. (1997). ***Perspectives in Psychology (2nd ed.).*** London: Macmillan Press Ltd.

Walle, John A. Van De and Lou Ann H. Lovin. (2006). ***Teaching Student-Centered Mathematics: Grades K-3.***Boston: Pearson.

Watty, Kim. (2010). *"When Will Academics Learn about Quality?"****Quality in Higher Education.*** 9(3), 213 – 221.

Wells, Thomas Rodham. (2013). "Reasoning about Development: Essays on Amartya Sen's Capability Approach." Erasmus University Rotterdam.(PhD Dissertation).

Whitehead, A. North. (1959). ***The Aims of Education and Other Essays.*** New York: The MacMillan Company.

Work, Ernest. (1934).*"A Plan for Ethiopia's Educational system."****Journal of Negro Education.***3, 66 - 68.

Work, Ernest. (1931b). *"A suggested plan for Ethiopia's school system in education in Modern Ethiopia."*Addis Ababa University.(Mimeographed).

Work, Ernest. (1934).*"A plan for Ethiopia's Educational system",* ***Journal of Negro Education.*** Vol. 3, pp. 66-68.

World Bank, Independent Evaluation Group (2006). ***From schooling access to learning outcomes – An unfinished agenda: An evaluation of World Bank support to primary education.*** Washington, DC: World Bank.

_________ . (1998). ***Ethiopia: The social sector report.*** Washington, DC: World Bank.

__________. (1995). ***Priorities and strategies for education: A World Bank review.*** Washington, DC: The World Bank.

Yamada, Shoko. (2007). ***Overview and Synopsis.*** In Yamada, Shoko (ed.). ***The local meanings of Educating All, and the process of adapting EFA Development Goals in Kenya, Tanzania, and Ethiopia.*** Tokyo: National Graduate Institute for Policy Studies, Development Forum.

Yonemura, Akio. (ed.). (2007). ***Universalization of primary education in the historical and developmental perspectives.*** Research Report (Chousakenkyu - Houkokusho), Institute of Development Economics.

Young, John. (1997). ***Peasant revolution in Ethiopian: The Tigray People's Liberation Front, 1975-1991.*** Cambridge: Cambridge University Press.

Zevenbergen, R., Shelley Dole and Robert J. Wright. (2004).***Teaching mathematics in primary schools.*** Australia: Allen & Unwin.

በኢትዮጵያ የሽግግር መንግስት፣ የጠቅላይ ሚኒስትር ፅ/ቤት፤ (ሰኔ 1985 ዓ.ም)፤ *አጠቃላይ የትምህርት ስልጠና ረቂቅ ፖሊሲ ማብራሪያ /ጥራዝ ሁለት/፤* ኣዲስአበባ፡፡

ትምህርት ሚኒስቴር፣ ስርዓተ ትምህርት ዝግጅት፣ ጥናትና ምርምር ኢኒስቲትዩት (1985 ዓ.ም)፣ *የትግራይ ስርዓተ ትምህርት ግምገማ፣ የማጠቃለያ ሪፖርት*፣ አዲስአበባ፣ ኢትዮጵያ፡፡

ANNEXES

Annex 1: Numbers and operations related National Minimum Learning Competencies /MLC/ in Mathematics (Grades 1 & 2)

Area of Competency	*Grade 1*	*Grade 2*
I. Numbers 1. Whole Numbers	• Read and write natural numbers up to 9. • Order natural numbers up to 9. • Use the symbols "<", ">" and "=" to compare natural numbers up to 9 • Recognize the number zero and write the symbol for zero "0" • Read, write and order whole numbers up to 20. • Apply place value to numbers up to 20 • Count in 10s up to100 • Read, write and order whole numbers up to 100 • Compare whole numbers up to 100 using the symbols ">","<" and "=" • Identify place value in tens and units	• Read, write, compare and order whole numbers up to 100 • Determine multiples of 100 which are less than 1000. • Read and write the whole numbers from 101 to 1000 • Describe the place value of numbers up to 1000 • Compare whole numbers up to 1000, using the symbols"<", " >"and" ="
2. Fractions	• Divide a concrete object into two equal parts and show understanding of the term a "half" • Divide objects into four equal parts and show understanding of the terms quarter and three quarters • Divide a concrete object into two equal parts and show understanding of the term a "half" • Divide objects into four equal parts and show understanding of the terms quarter and three quarters	• Identify halves and quarters • Divide objects into thirds • Show understanding of the relation between whole and halves, quarters and thirds • Write symbolic form of fractions for halves, quarters and thirds • Identify halves and quarters • Divide objects into thirds • Show understanding of the relation between whole and halves, quarters and thirds • Write symbolic form of fractions for halves, quarters and thirds

Area of Competency	*Grade 1*	*Grade 2*
II. Operations 1. Addition	• Add three natural numbers up to 9. • Add three numbers whose sum is not more than 9. • Add up to 20 • Add multiples of 10 whose sums are less than 100.	• Add whole numbers whose sums are less than 100 without and with carrying. • Solve word problems using addition
2. Subtraction	• Subtract multiples of 10 which are less than 100. • Solve problems of addition and subtraction on whole numbers up to 20.	• Subtract 1-and 2-digit number from 2-digit numbers without and with borrowing • Identify the relationship between addition and subtraction of numbers. • Solve word problems using subtraction
3. Multiplication	• Multiply whole numbers up to 10 by 2 and identify the symbol "$\times$" for multiplication	• Multiply whole numbers up to 100 by 2 and 10 • Multiply by 0 and 1 whole numbers up to 100 • Multiply whole numbers up to 100 by 1-digit numbers and 10 • Solve word problems using multiplication by 1-digit numbers and 10
4. Division	• Divide whole numbers up to 20 by 2 • Identify the symbols"$\div$" :for division	• Divide whole numbers up to 100 by 2 and 10 without remainder • Multiply and divide whole numbers up to 100 by 1-digit numbers and 10 • Solve word problems using division by 1-digit numbers and 10

Extracted from: *MoE, Ethiopia (2008).**Minimum Learning Competencies: Grades 1-4.** Addis Ababa.*

Annex 2A. Student Data Collection Format (Tigrigna)

መፅናዕቲ ክእለት ትምህርቲ ሒሳብ ተምሃሮ ታሕተዋይ ቀዳማይ ብርኪ ትግራይ

ፈተና፣ መምርሕን ኣመዘጋግባ መልስን

ሓፈሻዊ መምርሒ፣ እዚ መፅናዕቲ ክእለት ሒሳብ ተምሃሮ 1ይን 2ይን ክፍሊ ትግራይ ንምፍታሽ ዝዓለመ እዩ፡፡ ስለዚ ኣብ እዋን ፈተና ተምሃሮ ከይተደናገፁ፣ ነፃ ኮይኖም ክፍተኑ ምግባር ኣገዳሲ እዩ፡፡ ሓድ ሓደ መምርሒታት ንፈታኒ ዝምልከቱ እዮም፣ ገሊኦም ግና ንተፈታኒ/ት ዝንብቡሉ/ላ ወይ ዝቕርቡ ሕቶታት እዮም፡፡ ንፈታኒ ዝምልከቱ መምርሒታት ካብ ሳንዱቕ ወፃኢ ዝተፅሓፉ እዮም፣ ንተምሃራይ ክንበብሉ ዘይኮኑስ ፈታኒ ክግንዘቦም ዝግብኡ እዮም፡፡

እቶም ንተፈታናይ ዝንበቡሉ መምርሒታት ወይ ሕቶታት ኣብ ሳንዱ'ቕ ውሽጢ ዝተፅሓፉን ዝደመቑን እዮም፣ ፈታናይ ኩሎም ሕቶታት፣ ኣብነታት፣ መምርሒታት ብህድኣትን ብት'ኽክልን ንተፈታናይ ክንብበሉ/ላ ኣለዎ፡፡ ዝተሰመረሎም ቃላት እንተልዮም ጠመተ ዘድልዮም ሓሳባት ም'ዃኖም ምርዳእ የድሊ፡፡

ብተወሳኺ ቅድሚ ምጅማር ፈተና እቲ ፈተና ሙሉእ ም'ዃኑ ምርግጋፅ የድሊ፡፡ ተምሃራይ ቅድሚ ወዲኡ/ኣ ም'ኻዱ/ዳ እውን ዝተረፈ ከምዘየለ ምርግጋፅ ኣገዳሲ እዩ፡፡ ኣድለይቲ ዝተብሃሉ መምርሒታትን ሓሳባትን ዝተ'ኻተቱ እኳ እንተ'ኾኑ ኣቐዲምካ ምፍላጦምን ግና ኣገዳሲ እዩ፡፡

ኣብ እዋን ፈተና፣ ንህፃን መልሲ ዘመላኽት ነገር ምዝራብ ወይ ዝተውሃበ መልሲ ቅኑዕ ወይ ጌጋ ም'ዃኑ ዘመላኽቱ ሓሳባት ም'ቕራብ ክልኩል እዩ፡፡ ኮይኑ ግና

ንቁዕ/ንፍዕቲ!

ፅቡ'ቕ ፈተነ! ወዘተ

እናበልካ ምትብባዕ ኣድላዪ እዩ፡፡ እዙይ እውን ኣብ መወዳእታ ሕድ ሕድ ክፋል ጥራሕ ክ'ኸውን ኣለዎ፡፡

ቃላዊ ስምምዕነት

ከመይ ትሓድር/ሪ፡፡ ሽመይ ________________ ይበሃል፡፡ ካብ መቐለ እየ መፂአ፡፡ ሐዚ ብአዲስ አበባ ዩኒቨርስቲ ኣብ ዝካየድ መፅናዕቲ ተሳታፊ እየ፡፡ • ሎሚ ናብዚ ንምንታይ ከምዝመፃ'ኹ ክነግሪካ/ኪ፡፡ በዚ መፅናዕቲ ኣቢልና ክእለት ትምህርቲ ሒሳብ ተምሃሮ 1ይን 2ይን ክፍሊ ትግራይ ንምፍላጥ/ንምርዳእ ፃዕሪ እናገበርና ኢና፡፡ • ሐዚ ናትካ/ኪ ሰናይ ምትሕብባር ንደሊ ኢና:: ፍቓደኛ እንተዘይኮይንካ/ኪ ግና ምግዳፍ ይከኣል'ዩ፡፡ • ሓቢርና ክንሰርሖ እንደልዮ ብዛዕባ ምቑፃርን ቁፅሪታትን እዩ፡፡ • እዛ ትሪኣ/ኢያ ሰዓት ተጠቒመ መልሲ ንምሃብ ዝወስደካ/ኪ ጊዜ ክርኢ እየ፡፡ • እዙይ ነጥቢ ዝወሃቦ ፈተና ኣይኮነን፡፡ ኣብ ቤት ትምህርቲ ንዝወሃበካ/ኪ ውፅኢት'ውን ኣይትንክፍን፡፡ • ኣብ መወዳእታ ከዓ ብዛዕባ ስድራን ካብ ቤት ትምህርቲ ወፃእ ዝምልከቱ ንጥፈታትን ሕቶታት ኣለዉ፡፡ • ኣብዚ ፈተና ወረቐት ሽምካ/ኪ ኣይፀሓፍን፡፡ እዙይ ማለት ዝኾነ ሰብ ናይ መን ወረቐት መልሲ ም'ዃኑ ኣይፈልጦን ማለት እዩ፡፡ • ሐዚ'ውን ደጊመ ዝላበወካ/ኪ ድልየት እንድሕር ዘይብልካ/ኪ ክትሳተፍ/ፊ የብልካን/ክን፡፡ ብተወሳኺ ንዝቐርቡልካ/ኪ ሕቶታት እንተዘይመሊስካ/ኪ'ውን ኣይትስጋእ/ኢ፣ ፀገም የለን፡፡ ሕቶታት ኣለውካ'ኻ/'ኺ ዶ? ንምጅማር ተዳሊካ/'ኺ ዶ?

ንኽትቅፅሉ እንተተሰማሚዕኩም ኣብቲ ሳንዱቅ ምልክት ኣ'ቕምጥ እወ ☐

(ምናልባሽ ቃላዊ ስምምዕነት እንድሕር ዘይተረ'ኺቡ ነቲ ህፃን ኣመስጊንካ/ኪ ናብ ዝ'ቕፅል ህፃን ም'ሽጋር የድሊ)፡፡

ሀ. ፍተሻ ዝተ'ኻየደሉ ዕለት	---/------2010
ለ. ስም ገምጋሚ	
ሐ. ስም ቤት ትምህርቲ	
መ. ከባቢ	1. ከተማ 2. ገጠር
ረ. ወረዳ	
ረ. ፈረቓ/ሽፍቲ/	01= ሙሉእ መዓልቲ 02 =ናይ ንጉሆ 03= ድሕሪ ሰዓት

ሸ. ስም መምህር	
በ. ክፍሊ	(1) 1ይ (2) 2ይ
ተ. ሴክሽን	
ቸ. ኮድ መለለዩ ተምሃሮ	
ነ. ዕድመ ተምሃራይ	
ኘ. ፆታ	01 ተባዕታይ 02 ኣነስታይ
ዝተጀመረሉ ሰዓት________: _________	

ተግባር 1፣ ብቓል ምቑፃር

ዘድሊ ማተሪያል፣ ሰዓት

መምርሒ፣

1. እቲ/ታ ህፃን ምቑፃር እንትጅምር ካብ 60 ሰከንድ ንታሕቲ ንምቑፃር ሰዓት ተጠቐም/ሚ፡፡ ሰዓት ምቑፃርትጅምረላ ምስ ምጅማር መልሲ ምሃብ ማዕረ ክኸውን ኣለዎ፡፡
2. **ሕጊ ጠጠው ምባል፣** ህፃን ብጌጋ ምቑፃር እንትጅምር፣ ካብ 3 ሰከንድ ንላዕሊ ሱቕ እንተይሉ/ላ ወይ ከዓ ኣብ መወዳአታ እተን 60 ሰከንድታት ይኸውን፡፡
3. ድሕሪ ጠጠው ምባል ናይ መወዳኣታ ብትኽክል ዝተፀወዐ ቁፅርን ዝተረፈ ሰከንድ እንተልዩን መዝግብ/ቢ፡፡

ከምዝስዕብ በል/ሊ፣
ኣበዚ ክፋል ካብ ሓደ ጀሚሩ ክሳብ ዝኽኣልካዮ/ክዮ ሐደ፣ ክልተ፣ ሰለስተ … ብምባል ክትቆፅር/ሪ ኣለካ/ኪ፡፡ ጀምር/ሪ ክብል እንተለኹ ምጅማር፣ ጠጠው ኣበል/ሊ እንትብል ድማ ጠጠው ምባል የድሊ፡፡ ዝተጠቐምካሉ/ክሉ ጊዘ ንምርኣይ እዛ ሰዓት ክጥቀም እየ፡፡ ክንዲ ዝተኽኣለ ብፍጥነት ምቑፃር የድሊ፡፡ግልፂ ድዩ? ፅቡቕ! ጀምር/ሪ፡፡

ኣብ ወዳኣታ እዞም ዝስዕቡ ይምዝገቡ፣

ኣብ መቑፀሪ ሰዓት ዝተረፈ በዝሒ ሰከንድ: ____________________

ናይ መወደእታ ብትኽክል ዝተቖፀረት ቁፅሪ፣____________________

ተግባር 2፣ ሓደ ንሓደ ምፅማድ

ዘድሊ ማተሪያል፣ ንጥፈት 1፣ ሰዓት

መምርሒ፣

1. ንተምሃራይ/ሪቲ ቅዳሕ ተምሃራይ ምሃብ፡፡ ተምሃራይ/ሪት ተግባር 1 ክምልከት ምግባር፡፡
2. ሰዓት ካበ 60 ሰከንድ ንታሕቲ ክትቆፅር ምጅማር፡፡ እቲ/ታ ህፃን ደጊሙ/ማ ምቑፃር እንትጅምር፣ ወይ ብጌጋ ምቑፃር እንትጅምር ወይ ኣይፈልጠን እትብል እቲ ህፃንን ሰዓትካን ብተመሳሳላይ ጠጠው ከብሉ ምግባር፡፡
3. **ሕጊ ጠጠው ምባል፣**ህፃን ጠጠው ኣብል ዝበሃል ንሓደ ቁፅሪ ደጊሙ/ማ እንትቖፅር፣ ወይ ብጌጋ እንትቆፅር፣ ወይ እታ ዝተፈቐደት 60 ሰከንድ እንትውዳእ ይኸውን፡፡
4. **ኣተኣራርማ፣** ኣብ መወዳእታ በትኽክል ዝተውሃበ መልሲ እዛ ምልክት "]"ምቕማጥ፣ ዝተረፈ ሰከንድ ምምዝጋብ፡፡
5. **ክምዝገብ ዘለዎ፣** ዝተረፈ ሰከንድ

ካብ ፀጋም ናብ የማን ነቶም ክብታት ብምምልካት ከምዝስዕብ ምባል፣ቀፂሎም ክቢታት ኣለዉ፡፡ ኣብነት እውን ቀሪቡ ኣሎ፡፡ ነቶም ክቢታት ብምቑፃር በዝሐም ክንደይ ከምዝኾነ ትነግረኒ/ርኒ ኢኻ/ኺ፡፡ ንፉዕ/ንፍዕቲ ብምባል ንህፃን ምብርትታዕ የድሊ፡፡
ድሕሪ እዚ ተግባር ድማ ከምዝስዕብ ምባል፣ ሐዚ ኣብ ንጥፈት 1 ዘለዉ ክብታት ክትቆፅረለይ/ርለይ ኢኻ/ኺ፡፡ ሐዚ እውን እዛ ሰዓት ክጥቀመላ እየ፡፡ ጀምር/ሪ እንተይለ ምጅማር፣ ጠጠው ኣብል/ሊ እንተየለ ድማ ጠጠው ምባል ኣገዳሲ እዩ፡፡
ካበይ ጀሚርካ ምቑፃረ ከምዘድሊ ኣርእዮ/ያ፡፡

ኣብነት: ነዞም ዝስዕቡ ቁፀር/ሪ

ዝቑፀሩ ክቢታት:

						(6)
						(12)
						(18)
						(24)
						(30)
						(36)
						(42)
						(48)
						(54)
						(60)

ዝተረረፈ ሰከንድ: ________________

ኣብ መወዳእታ ብትኽክል ዝተፀወዐ ቁፅሪ: ________________

ተግባር 3: ቁፅሪ ምፍላይ

ዘድሊ ማተሪያል፣ ንጥፈት 2፣ ሰዓት

መምርሒ፣

1. ህፃን ምቑፃር እንትጅምር ሰዓት ካብ 60 ሰከንደ ንታሕቲ ክትቆፅር ኣስተኻኺልካ ምጅማር፡፡ ቅኑዕ መልሲ ምልክት ኣይግበረሉን፣ ንጌጋ መልሲን ዝተዘለሉን ግና '/' ምልክት ይሕንፀፀሎም፡፡ ዓረሰ እርማት እንተተገይሩ ከምልክዕ ይሕሰብ፡፡ ስለዚ ጌጋ ተገይሩ ዝነበረ መልሲ ብዓርሰ እርማት እንተተስተኻኺሉ ኣብ ርእሲ እቲ ጌጋ መልክት ይኽበብ፡፡ እቲ ህፃን ን3 ሰከንደ ዝኣክል መልሲ ምሃብ ተዘይክኢሉ መልሲ ብምንጋር ቀፃሊ ክምልስ ምሕታት፡፡ እቲ መልሲ ዘይተውሃቦ ሕቶ ጌጋ ምልክት ይግበረሉ፡፡
2. **ሕጊጠጠውምባል፣**ህፃን ጠጠው ኣብል ዝበሃል ነቶም ናይ መጀመርታ ሪጋ ቁፅሪታት ኩሎም ብጌጋ እንትምልስ፣ ወይ እታ ዝተፈቐደት 60 ሰከንድ እንትውዳእ ይኸውን፡፡ ናይ መጀመርታ ሪጋ ቁፅሪታት ዋላ ሓደ ብትኽክል ብዘይ ምምለሱ ተግባር እንተተቋሪፁ፣ ኣብቲ 'ተቋሪፁ'ኣብ ዝብል ሳንዱቕ ምልክት ብምግባር ናብ ዝቕፅል ምሕላፍ፡፡
3. **ኣተኣራርማ፣** ኣብ መወዳእታ ብትኽክል ዝተውሃበ መልሲ እዛ ምልክት "]"ምቕማጥ፣ ዝተረፈ ሰከንድ ምምዝጋብ፡፡
4. **ክምዝገብ ዘለዎ፣** ንጌጋ መልሲ '/' ምልክት ምቕማጥ፣ ኣብ መወዳእታ ዝበፅሐሉ ']' ምልክት ምዕፃውን ዝተረፈ ሰከንድ ምምዝጋብን

ካብ ፀጋም ናብ የማን ነቶም ቁፅሪታት ብምምልካት ከምዝስዕብ ምባል፣ ቀፂሎም ቁፅሪታት ኣለዉ፡፡ ክንደይ ከምዝኾኑ ክትነግረኒ/ርኒ ኢኻ/ኺ፡፡ ኣብነት እውን ቀሪቡ ኣሎ፡፡ ዝተጠቐምናሉ ጊዘ ንምፍላጥ እዛ ሰዓት ክጥቀም እየ፡፡ ንፉዕ/ንፍዕቲ ብምባል ንህፃን ምብርትታዕ የድሊ፡፡
ንኣብነት: ነዞምዝስዕቡ ቁፅሪታት ኣንብብ/ቢ: 47 94 70

12	**68**	**69**	**2**	**82**	*(5)*
74	**52**	**92**	**73**	**55**	*(10)*
50	**98**	**89**	**13**	**9**	*(15)*
51	**49**	**80**	**61**	**66**	*(20)*
69	**40**	**53**	**67**	**99**	*(25)*
10	**71**	**62**	**63**	**60**	*(30)*
3	**66**	**78**	**15**	**30**	*(35)*
54	**7**	**37**	**43**	**24**	*(40)*
25	**10**	**43**	**72**	**86**	*(45)*
51	**95**	**64**	**84**	**96**	*(50)*
88	**44**	**60**	**48**	**83**	*(55)*
59	**97**	**57**	**3**	**38**	*(60)*

ዝተረፈ ሰከንድ: ☐

ኣብ መጀመርታ ሪጋ ዘለዉ ቁፅሪታት ዋላ ሓደ ብትኽክል ብዘይምምላሱ/ሳ ዝተቋረፀ እንተኾይኑ ኣብዚ ሳንዱቕ ምልክት ግበር/ሪ: ☐

ተግባር 4: በዝሒ ምፅራሕ

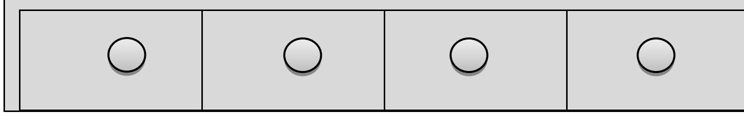
ዘድሊ ማተሪያል፣ ንጥፈት 3

መምርሒ፣

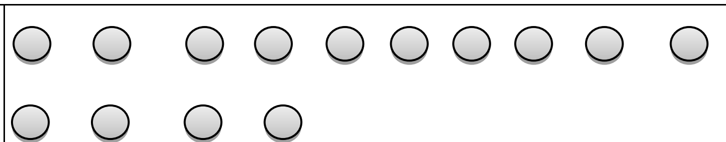
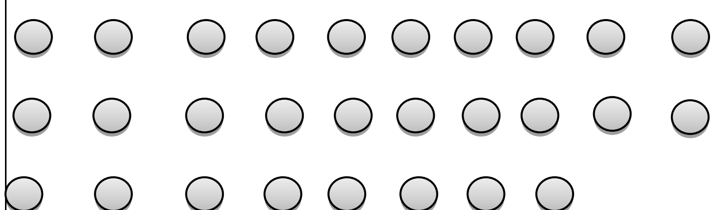
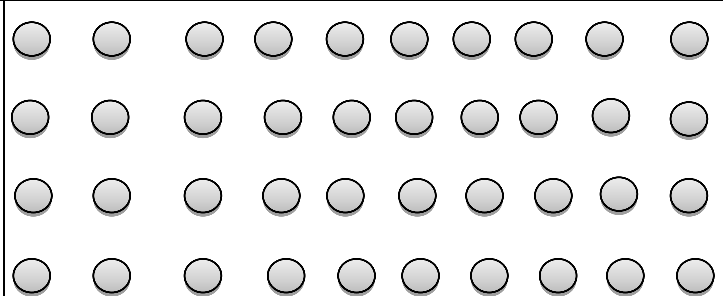
1. ንህፃን ንጥፈት 3 ዝሓዘ ቅዳሕ ይወሃቦ/ባ፡፡
2. እዙይ ጊዘ ዝተሓዘሉ ንጥፈት ኣይኮነን፡፡ ህፃናት ክብታት ክቖፅሩን በዝሖም ክዛረቡን ምሕታት፡፡ ነቶም ክብታት ብትኽክል ክቖፅር ዘይከኣለ ህፃን በዝሖም ኣይሕተትን፡፡
3. **ሕጊጠጠውምባል፣**ህፃን ጠጠው ኣብል ዝበሃል ንሓደ ቁፅሪ ደጊሙ/ማ እንትቖፅር፣ ወይ ብጌጋ እንትቆፅር፣ ወይ ኣይፈልጦን እንትብል ይኸውን፡፡
4. **ኣተኣራርማ፣** ንጌጋ መልሲ '/' ምልክት ምቕማጥ፣ ኣብ መወዳእታ ዝበፅሐሉ ']' ምልክት ምዕፃውን ዝተረፈ ሰከንድ ምምዝጋብን፣ ክንደይ ኣለዉ ንዝብል ሕቶ ዝተውሃበ መልሲ ድማ ይምዝገብ፡፡

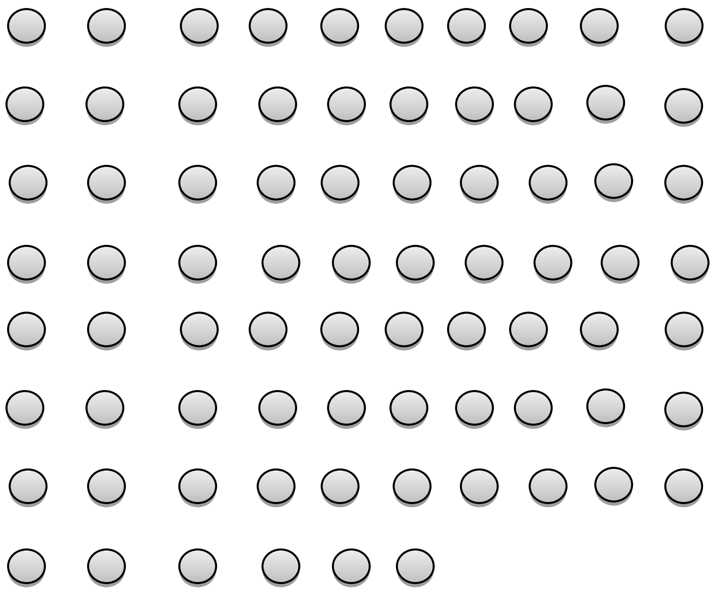
ከምዚ ዝስዕብ ምባል፣

ቀፂሎም ክብታት ኣለዉ፡፡ ነቶም ከቢታት ብምቑፃር በዝሖም ምዝራብ የድሊ፡፡ መልስኻ/ኺ ክሰምዕ እየ፣ ሐዚ ሰዓት ኣይጥቀምን፡፡ ዝተረፉን ዝተመለሱን ሕቶታተ ንምፍላይ እቶም ቁፅሪታት ብወረቐት ምሽፋንን ብቕደም ሰዓበ ምግላፅን ስለዘደሊ ንተምሃራይ በዚ መልክዕ ምርኣይ፡፡ ዝስዕብ ኣብነት ንስራሕ፣ ብምቑፃር በዝሖም ንገረኒ/ርኒ፡፡



(4)

1		**(14)** ብትኽክል ስለዘይቆፀረ በዝሒ ኣይተሓተተን:
2		**(28)** ብትኽክል ስለዘይቆፀረ በዝሒ ኣይተሓተተን::
3		**(40)** ብትኽክል ስለዘይቆፀረ በዝሒ \ኣይተሓተተን:

4		**(76)** ብትኽክል ስለዘይቆፀረ በዝሒ ኣይተሓተተን:: ☐

ተግባር 5: በዝሒ ምንፅፃር

ዘድሊ ማተሪያል፣ *ንጥፈት 4ን መሸፈኒ ወረቐትን*

መምርሒ፣

1. *ንህፃን ንጥፈት 4 ዝሓዘ ቅዳሕ ይወሃቦ/ባ፡፡*
2. *እዚ ጊዜ ዝተሓዘሉ ንጥፈት ኣይኮነን፡፡ ንምጅማር ድልዊ ዝኾነ ኩነታት ክሳብ ዝፍጠር ነቶም ሕቶታት ብወረቐት ምሽፋን፡፡ ኣብ ምጅማር ሕቶታት ሓደ ብሓደ ምቕላዕን ተምሃራይ መልሲ ክህብ ምትብባዕን፡፡*
3. ***ሕጊጠጠውምባል፣****ህፃን ጠጠው ኣብል ዝበሃል ኣብ መጀመርታ ኣርባዕተ ተኸታተልቲ ሕቶታት እንትጋገ ይኸውን፡፡ ስለዚ ናብ ዝቕፅል ተግባር ንሓልፍ ማለት እዩ፡፡*
4. ***ኣተኣራርማ፣*** *ንሕድ ሕድ ሕቶ ህፃን ዝሃቦ መልሲ ምምዝጋብ፣ ዘይተውሃበ ቁፅሪ እንተፀዊዑ ግና ኣብቲ ክፍቲ ቦታ ይፅሓፍ፡፡*

ክምዝስዕብ በል/ሊ፣ *ፅምዲ ፅምዲ ቁፅሪታት ተዋሂቦም ኣለዉ፡፡ ኣየናይ ክምዝዓቢ ትነግረኒ/ርኒ ኢኻ/ኺ፡፡ እቲ/ታ ተምሃራይ መልሲ ተዘይሂቡ/ባ እቲ ሕቶ ሓደ ጊዜ ጥራሕ ብምድጋም ን3 ሰከንድ ተፀበ፣ ሐዚ'ውን መልሲ ተዘይሂቡ/ባ ኣብቲ ክፍቲ ቦታ ጌጋ ምልክት '/'ብምግባር ናብ ዝቕፅል ምሕላፍ፡፡* *ኣድላዪ እንተኾይኑ ንሓደ ሕቶ ክልተ ጊዜ ምንባብ ይከኣል፡፡* **ንኣብነት**: 6 ________ 9 21________ 12

1.	**5 _________________7**
2.	**13 _________________ 31**
3.	**27 __________________ 21**
4.	**44 __________________ 54**
5.	**66 _________________ 55**
6.	**80 _________________ 70**
7.	**99 _________________ 89**
8.	**95 _________________ 79**
9.	**59 _________________ 85**
10.	**91 _________________ 87**

ውፅኢት:____/10

ተግባር 6: ዝጎደለ ቁፅሪ ምምላእ

ዘድሊ ማተሪያል፣ *ንጥፈት 5ን መሽፈኒ ወረቐትን*

መምርሒ፣

1. *ንህፃን ንጥፈት 5 ዝሓዘ ቅዳሕ ይወሃቦ/ባ፡፡*
2. *እዙይ ጊዘ ዝተሓዘሉ ንጥፈት ኣይኮነን፡፡ ንምጅማር ድልዊ ዝኾነ ኩነታት ክሳብ ዝፍጠር ነቶም ሕቶታት ብወረቐት ምሽፋን፡፡ ኣብ ምጅማር ሕቶታት ሓደ ብሓደ ምቕላዕን ተምሃራይ መልሲ ክህብ ምትብባዕን፡፡*
3. ***ሕጊጠጠውምባል፣****ህፃን ጠጠው ኣብል ዝበሃል ኣብ መጀመርታ ኣርባዕተ ተኸታተልቲ ሕቶታት እንትጋገ ይኸውን፡፡ ስለዚ ናብ ዝቕፅል ተግባር ንሓልፍ ማለት እዩ፡፡*
4. ***ኣተኣራርማ፣*** *ንሕድ ሕድ ሕቶ ህፃን ዝሃቦ መልሲ ኣብቲ ክፍቲ ቦታ ምምዝጋብ፡፡*

> ***ካበ ፀጋም ናብ የማን ብምምልካት ከምዝስዕብ በል/ሊ፣***
> *ቀፂልና ቁፅሪታት ክንርኢ ኢና፡፡ ነቶም ዘለዉ ብምርኣይ ዝጎደለ ቁፅሪ ክትነግረኒ/ርኒ ክሓተካ/ኪ እየ፡፡ ንሕድሕድ ሕቶ ናብቲ ክፈቲ ቦታ ብምምልካት 'ኣብዚ ዝኣቱ ቁፅሪ መን'ዩ?' ብምባል ሕተት/ቲ፡፡ ተምሃራይ መልሲ ተዘይሂቡ ንካልኣይ ጊዘ ብምድጋም ን3 ሰከንድ ተፀበዮ/ይዮ፣ መልሲ ተዘይሂቡ/ባ ኣብቲ ክፍቲ ቦታ N/Rብምፅሓፍን ኣብ ልዕሊ እቲ ኣብ ቅንፍ ዘሎ ቁፅሪ '/' ብምስራዝን ሕለፎ/ፍዮ፡፡ ሕድ ሕድ ዝተውሃበ መልሲ'ውን ኣብቲ ክፍቲ ቦታ ፀሓፍ/ፊ፡፡*
> **ኣብነት (ሀ)** 1, 2, 3, 4, _________ **(ለ)** _____, 16, 17 **(ሐ)** 40, _____, 20

1. ____________(13)
2. ____________(35)
3. ____________(90)
4. ____________(69)
5. ____________(44)
6. ____________(60)
7. ____________(20)
8. ____________(30)
9. ____________(90)
10. ____________(69)

ውፅኢት: _____/10

ተግባር 7: ምድማርን ምጉዳልን

ዘድሊ ማተሪያል፣ ንጥፈት 6ን ዝቼፀሩ ነገራትን
መምርሒ፣

1. ንህፃን ንጥፈት 6 ዝሓዘ ቅዳሕ ይወሃቦ/ባ፡፡
2. እዙይ ጊዘ ዝተሓዘለ ንጥፈት ኣይኮነን፡፡ ንምጅማር ንጥፈት 6 ዝሓዘ ቅዳሕን ዝቼፀሩ ነገራትን /ኣድላዪ እንተኾይኑ ተምሃራይ ዝጥቀመሎም/ ንተምሃራይ ምሃብ፡፡
3. **ሕጊጠጠውምባል፣**ህፃን ጠጠው ኣብል ዝበሃል ኣብ መጀመርታ ኣርባዕተ ተኸታተልቲ ሕቶታት እንተጋገ ይኸውን፡፡ ስለዚ ናብ ዝቕፅል ተግባር ንሓልፍ ማለት እዩ፡፡
4. **ኣተኣራርማ፣** ንሕድ ሕድ ሕቶ ተምሃራይ ዝሃቦ መልሲ ኣብቲ ክፍቲ ቦታ ምምዝጋብ፡፡ተምሃራይ ዘሃቦ/በቶ መልሲ እንተዘይሃልዩ N/R፣ ኣይፈለጦን እንተይሉ DK ዝብሉ ምልክታት ፀሓፍ/ፊ፡፡

ክምዝስዕብ ብምባል ጀምር/ሪ፣ ቀፂሎም ሕቶታት ምድማርን ምጉዳልን ኣለዉ፡፡ ስለዚ ውፅኢት ክሓተካ/ኪ እየ ትምልሰለይ/ስለይ፡፡ ማለት ክንደይ ይኸውን? እንትብለካ/ኪ መልሲ ትህበኒ/ብኒ ኣነ ክፅሕፍ 'የ፣ ሕራይ'ዶ? በሎ/ላ፡፡ ሕቶ ምስቀረበ ተምሃራይ ዝሃቦ/በቶ መልሲ እንተዘይሃልዩ፣ ደጊምካ/ኪ ኣንብበሉ/ላ፣ ን 3 ሰከንድ ተፀበ/ዪ፣ መልሲ ተዘይሂቡ/ባ '/' ምልክት ኣብ ልዕሊ እቲ ኣብ ቅንፍ ዝተውሃበ ቅኑዕ መልሲ ብምሕንፃፅ ናብ ዝቕፅል ምሕላፍ፡፡ ጌጋ መልሲ'ውን ብተመሳሳሊ '/' ዝብል ምልክት ኣብ ልዕሊ እቲ ቅኑዕ መልሲ ብምሕንፃፅ ይግለፅ፡፡
ተምሃሮ መልሲ ንመሃብ ዝቼፀሩ ነገራትን እርሳስን ወረቐትን ምጥቃም ይኽእሉ'ዮም፡፡

ንኣብነት: (ሀ) 4 + 2 = ___ (6) (ለ) 11 + 9 = _____ (20)

7.1. ምድማር	7.2. ምጉዳል
1. **3 + 6 = ____ (9)**	**1.** **6 – 2 = _____ (4)**
2. **13 + 5 = ____(18)**	**2.** **10 – 3= ____ (7)**
3. **10 + 10 = _____(20)**	**3.** **20 – 10 = ___(10)**
4. **6 + 10 = ______(16)**	**4.** **15 – 5 = ____(10)**
5. **8 + 6 = _____ (14)**	**5.** **17 – 10 =____(7)**
6. **11 + 11 = _____(22)**	**6.** **13 – 11 = _____(2)**
7. **30 + 10 = _____(40)**	**7.** **34 – 11 = ____(23)**
8. **80 + 10 =_____(90)**	**8.** **60 - 50=_____(10)**
9. **34 + 5 = ______(39)**	**9.** **90 – 90= ____(0)**
10. **20 + 20 = _____(40)**	**10.** **89 – 9 = _____(80)**

ምድማር፣ውፅኢት _____/10**ምጉዳል፣ ውፅኢት**: _____/10

ተግባር 8. ቃለ መሕትት ተምሃራይ

1.	መዋእለ ህፃናት ተማሂርካ/ኪ'ዶ ነርካ/ኪ?	1. እወ 2. ኣይፋሉን
2.	ኣብ ገዛ ምስ ወለዲ እትዛረቡዎ ቋንቋን ኣብ ቤት ትምህርቲ ዘሎ መምሃሪ ቋንቋን ሓደ ዓይነት ድዮም?	1. እወ 2. ኣይፋሉን ኣይፋሉንእንተይልካ/ኪ ኣብ ገዛ እንታይ ቋንቋ ትዛረቡ?____________________
3.	መፅሓፍ ተምሃራይ ሒሳብ ኣለካ/ኪ'ዶ?	1. እወ፣ ናበይነይ 2. እወ፣ ንብዙሓት 3. ኣይፋሉንመፅሓፍ ሒሳብ የብለይን 4. ካሊእ፣ ይገለፅ________
4.	ኣብ ገዛ ተወሰኽቲ መፃሕፍቲ ትምህርቲ ሒሳብ ኣለካ/ኪ'ዶ?	1. እወ 2. ኣይፋሉን 3. ኣይፈልጥን

5.	ኣብቤት ትምህርቲ ቤተ ማፃሕፍቲ ኣሎ'ዶ?	1. እወ፣ ንጥቀመሉ 2. ኣሎ፣ ግና ኣይንጥቀመሉን 3. ኣይፋሉን፣ የለን 4. ኣይፈልጥን
6.	6.1. ትምህርቲ ሒሳብ ትፈትዎ/ዊዮ'ዶ?	1. እወ 2. ኣይፈትዎን
	6.2. መልስኻ/ኪ ኣይፈትዎን እንተኾይኑ ንምንታይ?	1. ትምህርቲ ሒሳብ ከቢድ'ዩ 2. መፅሓፍ ሰለዘይብለይ 3. ፃዕሪ ስለዝሓትት 4.ካሊእ/ይገለፅ/ ________________ ________________________________
7.	ዓሚ ክንደይ ክፍሊ ነይርካ?	1. ኣብ ቤት ትምህርቲ ኣይነበርኩን 2. መዋእለ ህፃናት 3. 1^{ይ} ክፍሊ 4. 2^{ይ}ክፍሊ 5. ካሊእ /ይገለፅ/___________
8.	ኣብዚ ዓመት ሓደ ሰሙን ወይ ካብኡ ንላዕሊ ዝተረፍካሉ/ክሉ ኣጋጣሚ ኣሎ'ዶ?	1. እወ 2. ኣይፋሉን 3. ኣይፈልጥን
9.	ኣብ ገዛ ንምፅናዕ እኹል ጊዜ ኣለካ/ኪ'ዶ?	1. እወ 2. ኣይፋሉን 3. ኣይፈጥን
10.	ኣብ ገዛ ንኽተፅንዕ ዝሕግዘካ/ኪ መን'ዩ?	1. ማንም የለን 2. ኣደይ/ኣብሻይ 3. ኣቦይ 4. ሓፍተይ/ሓወይ 5. ካሊእ ይገለፅ ____________
11.	ኣዴኻ/ኺ ምንባብን ምፅሓፍን ይኽእላ'ዶ??	1. እወ 2. ኣይፋሉን 3. ኣይፈልጥን
12.	ኣቦኻ/ኺ ምንባብን ምፅሓፍን ይኽእሉ'ዶ??	4. እወ 5. ኣይፋሉን 6. ኣይፈልጥን
13.	ኩሎም ዓይነታት ትምህርቲ ሓደ መምህር ድዮም/የን ዘመሀርኹም/ሯኽን?	1. እወ 2. ኣይፋሉን 3. ኣይፈልጥን

መወዳእታ – ዝተወደአሉ ሰዓት ይመዝገብ:

ዝተወደአሉ ሰዓት	__________: __________

Annex 2B. Student Data Collection Format (English)

Research on:
Quality of primary education in Ethiopia: the case of Early Grade Mathematics Competency in Tigrai: Items, Administration and response recording instructions and procedures

General Instructions: This study focuses on understanding children's mathematics competence at grades 1 and 2. During the interview, therefore, the child should relax and feel happy. Some instructions are for the assessor (for you) and others are for the child to be read or asked by the assessor. The protocols for the assessor (for you) are described in each part and not in boxes. Do not read these for the child.

Those to be read or asked for the child are in boxes, printed in **bold** and the assessor is supposed to read these slowly but aloud. You (the assessor) need to be very sure to read all questions, examples and instructions completely and precisely. Any **underlined** text or item should be read with emphasis.

Besides, before starting testing it is important to check the completeness of the test paper. It is equally important to check each subtask for incompleteness before you return the child to her/his classroom. Though both general and specific instructions are included, it is important to be familiar with the necessary information before starting testing.

During the assessment, do not give the child a hint to the correct answer or never give any hint whether the child is providing correct response or not. However, it is important to encourage the child by saying:
That's great! You are doing great! You are working hard!
Do it **ONLY** at the ends of each subtest.

CONSENT

Good morning. My name is ________________. I live in ______________. I am now working for Addis Ababa University.

- **We are trying to know how children in Tigrai are learning math. It is by chance that you are selected to this test, like in a lottery.**
- **We would like you to participate in the test. But you do not have to take part if you are not convinced.**
- **We are going to do some counting and number sense questions.**
- **This stopwatch is just to see how long it takes you to give response.**
- **This is not a test and it will not be included in your certificate.**
- **There are also some questions related to your family, home activities, and the like.**
- **I will not write down your name on this paper. That means no one will know your answers.**
- **Even once we begin, you do not have to take part in this test if you do not want to.**

Check box if verbal CONSENT was obtained: ☐.

A. Date of assessment	Day _____Month______
B. Name of assessor	
C. School Name	
D. Location	1. Urban 2. Rural
E. Woreda	
F. School Shift	◯ 1= Full day ◯ 2= Morning ◯ 3= Afternoon

F. Teacher's Name		
G. Grade	1	2
H. Section		
H. Student Age		
I. Student's Sex	1= Male	2= Female
Time started : _______:______		

Task 1: Oral Counting

Material needed: Stopwatch

Instructions:

1. Start the stopwatch to count down from 60 seconds when the child begins to count. Start the stopwatch as soon as the child starts counting.
2. **Stop Rule:** Stop the child if child makes an error while counting, when the child pauses for more than three seconds, or at the end of a minute.
3. Stop **child and the stopwatch** as soon as the child makes an error in counting or at the end of one minute recorded time or when the child pauses for more than three seconds and record the last number the child says correctly and the remaining seconds (if any) on the spaces provided below.
4. **Scoring:** Record the last correct number and the remaining time (seconds) on the stopwatch.

SAY: In this section I want you to count for me starting from one, i.e. ONE, TWO, THREE, …. You should begin counting when I say **"BEGIN"** and stop when I say **"STOP".** I will use this stop watch to see the time you used. Count as fast as possible. Is it clear? Are you ready to begin counting? Good, begin.

RECORD:

Remaining Time on the stopwatch: ___________________

Last number child counted correctly:___________________

Task 2: One-To-One Correspondence

Material needed: Student Stimuli **(Sheet 1) and** Stopwatch

Instructions:

1. Give the stimuli paper to the child. Ask the child to open sheet 1.
2. Start the stopwatch to count down from 60 seconds when the child begins to count. Stop **child and the stopwatch** as soon as the child double counts a circle or incorrectly counts a circle or the 60 seconds time is finished, or if the child says I do not know.
3. **Stop Rule:** Stop the child if child double counts a circle or incorrectly counts a circle or the 60 seconds time is finished, or if the child says I do not know.
4. **Scoring:**Mark with a bracket**"]"**the last circle counted correctlyand the remaining time (seconds) on the stopwatch.
5. Record the response to the remaining seconds (if any) on the stopwatch on the spaces provided.

Sweep your hand from right to left over the circles and say: Here are some circles presented for practice (as an example). Count them and tell me how many circles there are. Encourage the child for responding by saying 'Good trial'.

After the practice activity, Say: I want you now to point and count the circles on **Sheet 1**. This time I am going to use the stopwatch and will tell you when to begin and stop.

Point to the first circle and say: Start here and count the circles.

Example: Count the following

Count using the circles:

						(6)
						(12)
						(18)
						(24)
						(30)
						(36)
						(42)
						(48)
						(54)
						(60)

Remaining seconds on the stopwatch: ________________

Last number Child counted correctly: ________________

Task 3: Number Identification

Material needed: Student Stimuli **(Sheet 2) and** Stopwatch
Instructions:

5. Start the stopwatch to count down from 60 seconds when the child begins to name numbers. Follow the responses and **slash (/)** for each non-response or for each incorrectly named numbers**.** Count self-corrections as correct. If you have already marked the self-corrected number as incorrect, circle the number and continue. If the child hesitates for **3 seconds**, provide the name of the number, point to the next and say **"Please go".** Mark the number you provide to the child as incorrect.
6. **Stop Rule:** Stop the child after the 60 seconds or if the child gives incorrect answers to the numbers on the first line. If the child was discontinued, check the box at the bottom and proceed to the next task.
7. **Scoring:** Mark with a **Slash (/)** for incorrect answers, and put a **Bracket (])**at the final number read. Record the remaining time (seconds) on the stopwatch.

Sweep your hand over the numbers from left to right and SAY: Here are some numbers. Point to each number and tell me what the number is. I am going to use this stopwatch and tell you when to begin and when to stop.
Example: Read the following: **47 94 70**
Point to the first number and say: Start here.

12	**68**	**69**	**2**	**82**	*(5)*
74	**52**	**92**	**73**	**55**	*(10)*
50	**98**	**89**	**13**	**9**	*(15)*
51	**49**	**80**	**61**	**66**	*(20)*
69	**40**	**53**	**67**	**99**	*(25)*
10	**71**	**62**	**63**	**60**	*(30)*
3	**66**	**78**	**15**	**30**	*(35)*
54	**7**	**37**	**43**	**24**	*(40)*
25	**10**	**43**	**72**	**86**	*(45)*
51	**95**	**64**	**84**	**96**	*(50)*
88	**44**	**60**	**48**	**83**	*(55)*
59	**97**	**57**	**3**	**38**	*(60)*

Time left on the stopwatch (in seconds): ☐

Check this box if child was discontinued because the child had no correct answer in the first line: ☐

Task 4: Cardinality

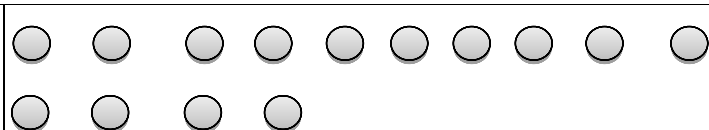
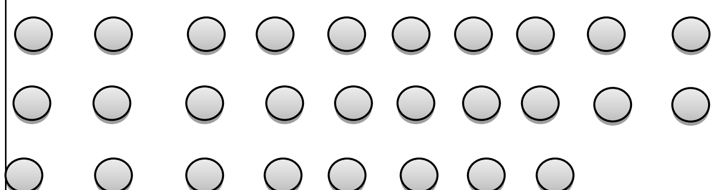
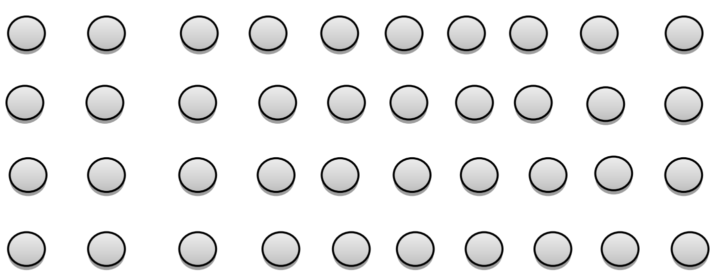
Material needed: Student Stimuli **(Sheet 3)**
Instructions:

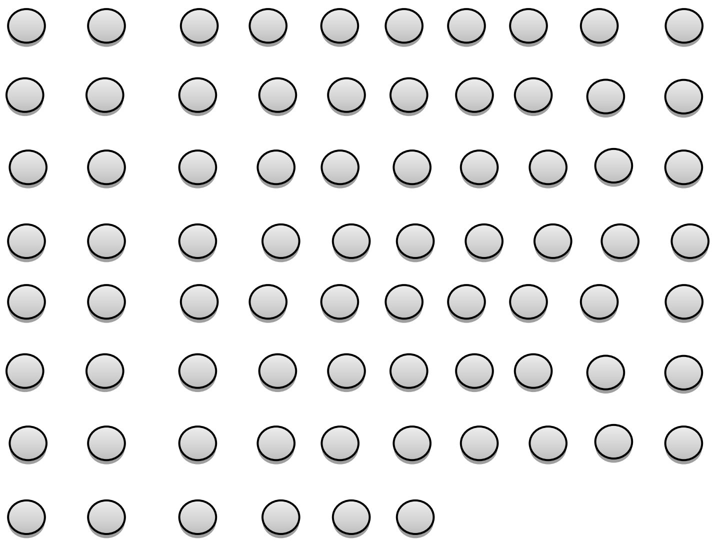
5. Give the stimuli paper to the child. Ask the child to open **Sheet 3**.
6. This is not timed task. Ask the child to count the number of circles in each set and how many circles there are. If the child could not finish counting the number of circles correctly, do not as the follow up questions "how many circles are there?"
7. **Stop Rule:** Stop the child if child double counts a circle or incorrectly counts a circle or child says I do not know or gives no response.
8. **Scoring:** Slash (/) incorrect responses; put "]" at the final circle counted correctly; and write the response of the child the follow up questions "How many circles are there?"

Say: Here are some circles. Count the number of circles in each and tell me how many circles are there. I am going to follow up your responses. This time I am not going to use the stopwatch. Cover the items and bring the cover sheet down to reveal the item to be answered by the child.

Let's do this example together: Count the number of circles below. How many are there?

(4)

1		**(14)** Child did **not** count correctly: ☐
2		**(28)** Child did **not** count correctly: ☐
3		**(40)** Child did **not** count correctly: ☐

4		**(76)** Child did **not** count correctly: ☐

Task 5: Quantity Discrimination Measure

Material needed: Student Stimuli **(Sheet 4)** and coversheet
Instructions:

1. Give the stimuli paper to the child. Ask the child to open **Sheet 4**.
2. This is not timed task. Ask the child to look at Sheet 4. Cover the items until the child is ready to begin. Bring coversheet down to reveal the items one by one to the child.
3. **Stop Rule:** Stop the child if s/he misses the first four consecutive questions.
4. **Scoring:** For each item, circle the number the child says. If the child says an incorrect number for an item (a number not listed for the item), record the number on the space between the two numbers to be compared.

Say: Look at these numbers. Tell me which one is bigger? Tell me the number name. If the child does not respond to an item, repeat the question once, wait three seconds, if no answer mark with a **slash (/)**on the space between the two numbers and move on to the next item.

Repeat the question for each of the items once if needed.
Example: 6 ________ 9
21________ 12

1.	**5 ________________7**
2.	**13 ________________ 31**
3.	**27 _________________ 21**
4.	**44 _________________ 54**
5.	**66 ________________ 55**
6.	**80 ________________ 70**
7.	**99 ________________ 89**
8.	**95 ________________79**
9.	**59 _______________ 85**
10.	**91 _______________ 87**

Child score:____/10

Task 6: Missing Number

Material needed: Student Stimuli **(Sheet 5)** and coversheet
Instructions:

1. Give the stimuli paper to the child. Ask the child to open **Sheet 5**.
2. This is not timed task. Place Sheet 5 with the covering sheet on the top in front of the child. Slide the coversheet down when you are ready to begin with the practice item.
3. **Stop Rule:** Stop the child if s/he misses the first four consecutive questions.
4. **Scoring:** Record the child's response for each item.

Point from left to the right over the item and Say: Here are some numbers. Tell me the missing number over this line. For each line point to the item and say **'What number goes here?'**If the child does not respond, repeat the item once, wait three seconds, if no response still put N/R the space provided and continue to the next. Write the response for each on the space provided.

Example: (A) 1, 2, 3, 4, ________ (B) ____, 16, 17 (c) 40, ____, 20

1. ___________(13)
2. ___________(35)
3. ___________(90)
4. ___________(69)
5. ___________(44)
6. ___________(60)
7. ___________(20)
8. ___________(30)
9. ___________(90)
10. ___________(69)Child score: _____/10

Task 7: Addition/ Subtraction Problems

Material needed: Student Stimuli **(Sheet 6)** and Counters
Instructions:

1. Give the stimuli paper to the child. Ask the child to open **Sheet 6**.
2. This is not timed task. Place Sheet 6 with the counters in front of the child.
3. **Stop Rule:** Stop the child if s/he misses the first four consecutive questions.
4. **Scoring:** Enter the child's response on the space provided for each item. If child does not respond enter NR, if the child says 'I do not know', enter DK.

Say: Here are addition/ subtraction problems. Tell me the sum or difference of the numbers. That is, answer the question: **How much is …**Enter the answers of the child in the space provided. If the child does not respond, repeat the item once, wait three seconds, if no response still put slash **(/)** on the correct answer in bracket and continue to the next. For incorrect response also, mark the answer in bracket with a slash (/).

You can use counters or pencil/pen and paper to find the sum or the difference, you need to. Here are the counters.

Example: (A) 4 + 2 = ___ (6) (B) 11 + 9 = _____ (20)

7.1. Addition Problems	**7.2. Subtraction problems**
1. **3 + 6 = ____ (9)**	**1.** **6 – 2 = _____ (4)**
2. **13 + 5 = ____(18)**	**2.** **10 – 3= ____ (7)**
3. **10 + 10 = _____(20)**	**3.** **20 – 10 = ___(10)**
4. **6 + 10 = ______(16)**	**4.** **15 – 5 = ____(10)**
5. **8 + 6 = _____ (14)**	**5.** **17 – 10 =____(7)**
6. **11 + 11 = _____(22)**	**6.** **13 – 11 = _____(2)**
7. **30 + 10 = _____(40)**	**7.** **34 – 11 = ____(23)**
8. **80 + 10 =_____(90)**	**8.** **60 - 50 =_____(10)**
9. **34 + 5 = ______(39)**	**9.** **90 – 90= ____(0)**
10. **20 + 20 = _____(40)**	**10.** **89 – 9 = _____(80)**

Addition: Child score: _____/10 **Subtraction: Child score: _____/10**

Task 8. Student Background questionnaire

1.	Have you been in KG before you join grade 1?	3. Yes 4. No
2.	Do you speak the same language at home as you speak at school?	3. Yes 4. No If No, specify____________________
3.	Do you have mathematics textbook?	5. Yes, I have one 6. Yes, but shared with friends 7. No textbook copy at all 8. Other (specify) __________
4.	Do you have additional mathematics books at home?	4. Yes 5. No 6. I do not know
5.	Is there a library in your school?	5. Yes, we use it 6. Yes, but we do not use it 7. No, there is not 8. I do not know
6.	6.1. Are you interested to learn mathematics?	3. Yes 4. No
	6.2. If you are not interested to learn mathematics, why?	1. Mathematics is difficult subject 2. I have no textbook 3. It needs repeated practice 4. Other (specify) ________________
7.	What grade were you last year?	6. Not in school 7. KG 8. Grade 1 9. Grade2 10. Other (specify)___________
8.	Were you absent for a week or more this year?	4. Yes 5. No 6. I do not know
9.	Do you have sufficient time to study at home?	4. Yes 5. No 6. I do not know
10.	Who supports in your study at home?	6. No one 7. My mother 8. My father 9. Sibling 10. Other (specify) ____________
11.	Does your mother read and write?	7. Yes 8. No 9. I do not know
12.	Does your father read and write?	1. Yes 2. No 3. I do not know
13.	Is one teacher teaching you all subjects?	4. Yes 5. No 6. I do not know

END – Record time of completion:

Time of Completion	**__________: __________**

Annex 3A. Teacher Questionnaire (Tigrigna)

ብመምህራን ዝምላእ መሕትት:

ዕላማ መፅናዕቲ፣

እዚ ፅሑፍ ንዶክትሬት ድግሪ ዝተዳለወ መፅናዕታዊ ፅሑፍ ኮይኑ 1ይን 2ይን ክፍሊ ተምሃሮ ትግራይ ዘለዎም ብቕዓት ምምሃር ትምህርቲ ንምፍታሽ መሰረት ዝገበረ'ዩ፡፡ ርዕሲ እዚ መፅናዕቲ: ***ክእለት ሒሳብ ታሕተዋይ ቀዳማይ ብርኪ ተምሃሮ ትግራይ*** *እንትኸውን፣ እትህብዎ ሓበሬታ ድማ ነዚ ዝተጠቐሰ ዓላማ ጥራሕ ዘገልግል ኾይኑ ንምሽጥራዊነቱ ድማ ሽምኩም ኣብ ዝኾነ ቦታ ናይዚ ቅጥዒ ምፅሓፍ ኣየድልን፡፡ ነገር ግን ሽም ቤት ትምህርቲኹምን እተምህሩሉ ክፍልን ኣብዚ መፅናዕቲ ዝካተቱ ብምዃኖም ክፀሓፉ ኣለዎም፡፡ ውፅኢት ናይዚ መፅናዕቲ ከገልግሎ ዝኽእል ኣይወሰን 'ምበር ናይ ዩኒቨርስቲ ሙሁራንን ሰብ ሙያ ትምህርትን ዝጥቀምሉ ከምዝኽእሉ ኣየጠራጥርን፡፡ ከይኑ ግን መጠይቕ ንምምላእ ድልየት እንተዘይሃሊዎም/ወን፣ ኣብዚ መጠይቕ ምንም ዓይነት ምልክት እንተይገበሩ ንእባላት ኣከበቲ መረዳእታ ምምላሰ ይኽእሉ'ዮም፡፡*

ቃላዊ ስምምዕነት፡- ኣነ ነዙ መጠይቕ ብምሉእነትን ብትኽክልን ብምምላእ ኣብዚ ናይ ትምህርቲ ሒሳብ ክእለት መፅናዕቲ ክሳተፍ ተሰማሚዐ ኣለኹ፡፡

ኣዎ ☐

ንምትሕብባርኩም የመስግን!
ኣካየዲ መፅናዕቲ

መምርሒ፡ *በይዘኦም/ኣን ንኹሎም ሕቶታት ቅኑዕ ምላሽ ይሃቡ/ባ፡፡ መልስኹም ኣብቲ መልሲ መውሃቢ ፀሓፉ ወይ ነቲ ቅኑዕ እትበልዎ መልሲ ዝሓዘ ፊደል ወይ መማረፂ ብምኽባብ መልሱ፡፡ ክእለት ሒሳብ ተምሃሮ 1ይን 2ይን ክፍሊ ንምርዳእን መፍትሒ ንምቕማጥን ዝዓለመ መፅናዕቲ ስለዝኾነ ሓሳብኩም ክተካፈሉና ንላቦ፡፡*

	ዕለት፡	________/ /2004
	ሽም ገምጋሚ፡	
1.	*ወረዳ፡*	
2.	*ሽም ቤት ትምህርቲ*	
3.	*ዘምህሩ/ራ/ሉ ደረጃ ክፍሊን ሴክሽንን፡*	1. 1ኛ ክፍሊ ሴክሽን _____ 2. 2ኛ ክፍሊ ሴክሽን _____
4.	*ፆታ:*	1. ተባዕታይ 2. ኣነስታይ
5.	*በዝሒ ተምሃሮ ኣብ ዘምህሩሉ ክፍሊ:*	ተባዕትዮ______ ኣንስትዮ_______ድምር _______
6.	*ዕድመ*	_________ ዓመት
7.	*ደረጃ ትምህርቲ*	1. ዘይሰልጠነ 2. ሰርቲፊኬት 3. ዲፕሎማ 4. ካልእ_____(ይግለፁ)___________
8.	*ኣገልግሎት:* 8.1. ብሓፈሻ ብሞያ መምህርነት ክንዳይ ዓመት ሰሪሖም/ሐን?	______ ዓመታት
	8.2. ብሞያ መምህርነት ድሕሪ ምስልጣን ንኽንደይ ዓመት ኣገልጊሎም/ለን?	______ ዓመታት

9.	9.1. ኣብ ኣሃዳዊ ድዮም ዘምህሩ/ራ?	1. እወ 2. ኣይኮነን
	9.2.እንድሕር ደኣ ኣሃዳዊ ኮይኑ ኩሉ ናይ ትምህርቲ ዓይነት ድዮም/የን ዘምህሩ/ራ?	1. እወ 2. ኣይኮነን 3. ካሊእ (ይገለፅ) ________
10.	ኣብዚ ደረጃ ክፍሊ ንምስትምሃር ድሌት ኣለዎም/ን'ዶ?	1. እወ 2. የለን የለንእንተኾይኑ ምኽንያቱ ይግለፁ/ፃ ____________
11.	ትምህርቲ ሒሳብ ንምስትምሃር ብቕዓት ኣለኒ'ዶ ይብሉ/ላ?	1. እወ 2. ኣይፋሉን
12.	ንሕቶ 11 ዝተውሃበ መልሲ 'ኣይፋሉን' እንተኾይኑ፣ ንምንታይ?	1. ትምህርቲ ሒሳብ ከባድ ስለዝኾነ 2. እኹል መምሃሪ ማተሪያል ስለዘየለ 3. ሒሳብ ንኽምህር ስለዘይሰልጠንኩ 4. ሒሳብ ፍሉይ ብቕዓት ስለዘድልዮ 5. ካልእ (ይገለፅ) _____________________ __________________________ ________
13.	13.1. ኣብ ቤት ትምህርትኹም ቤተ-መፃሕፍቲ ኣሎ ዶ?	1. እወ 2. የለን 3. ኣይፈልጥን
	13.2. ኣብ እተምህረሉ/ርሉ ክፍሊ ናይ ሒሳብ መፅሓፍ —ተምሃራይ ጥምርታ ከመይ እዩ?	1. 1: 1 2. 1: 2 3. 1: 3 4. 1: ንብዙሓት 5. ንተምሃሮ ዝኸውን ናይ ሒሳብ መፅሓፍ የለን 6. ካልእ (ይገለፅ) _____________________
	13.2. ኣብ ቤተ-መፃሕፍቲ እኹል ናይ ሒሳብ መፃሕፍቲ ኣለዉ ዶ?	1. እወ 2. የለን 3. ኣይፈልጥን
	13.3. ትምህርቲ ሒሳብ ንምስትምሃር እኹል መፃሕፍቲ ኣለዉ'ዶ ዶ?	1. እወ 2. የለን
14.	ናይ ትምህርቲ ሒሳብ መምርሒ ንመምህር ኣለኩም ዶ?	1. እወ 2. የብለይን
15.	ናይ መምርሒ ንመምህር ትምህርቲ ሒሳብ እንተልዩ ኣብ ምስትምሃር ሓጋዚ ድዩ?	1. እወ 2. ኣይፋሉን
16.	ኣብ ከይዲ ምምሃር ካብ ርእሰ መምህር ቤት ትምህርቲ ወይ ወረዳ ሱፐርቫይዘር እኹል ሓገዝ ትረኽቡ ዶ?	1. እወ 2. ኣይረኽብኩለን
17.	ምስ ወለዲ ኣኼባ ተካይዱ ዶ?	1. እወ 2. ኣይነካይድን

18.	ወለዲ ብዛዕባ ኩነታት ትምህርቲ ደቆም ንኽመያየጡ ናብ ቤት ትምህርቲ ይመፁ'ዶ?	1. ይመፁ፣ ነገር ግን ብቤት ትምህርቲ ወይ መምህር እንተተፀዊዖም'ዮም ዝመፁ 2. ይመፁ፣ ብድሌቶም ምስ ቤት ትምህርቲ ዝመያየጥሉ እንተልዩ ዋላ ኣይፀውዑ ይመፁ 3. ተፀዊዖም ውን ኣይመፁን
19.	ኣብ ኣመሃህራትምህርቲ ሒሳብ ዝዓለመ ስልጠና'ዶ ኣብዚ ዓመት ተሳቲፍኩም/ክን ትፈልጡ/ጣ ?	1. እወ 2. አይተሳተፍኩን መልሲ እወ እንተኾይኑ፣ ርእሲ እቲ ስልጠና እንታይ ነይሩ ይጥቀሱ? ንኽንደይ መዓልቲ?
20.	ትምህርቲ ሒሳብ ኣብ ሰሙን ክንደይ ክፍለ ግዜ ኣለዎ?	________________ክፍለ ግዜ ብሰሙን
21.	21.1. ምስ ካልኦት ናይ ትምህርቲ ዓይነት እንትወዳደር፣ ተምሃሮ ሒሳብ ንኽመሃሩ ድልየት አለዎም ምባል ይከኣል'ዶ?	1. እወ 2. ኣይፋሉን
	21.2. ሒሳብ ንኽመሃሩ እንተደኣ ድልየት ዘይብሎም፣ ንምንታይ?	1. ተምሃሮ ምድላው ስለ ዘይገብሩ 2. ሒሳብ ከቢድ ትምህርቲ ስለዝኾነ 3. እኹል መፃሕፍቲ ስለዘየለዉ 4. ካልእ (ይገለፅ) ________________
22.	ትምህርቲ ሒሳብ ኣብ ምስትምሃር ኣብዛሓ እንታይ ዓይነት ኣገባብ አመሃህራ ይጥቀሙ/ማ?	1. ገለፃ 2. ገለፃን ምይይጥን 3. ሰራሕኻ ምርኣይ 4. ዕዮጉጅለ 5. ዕዮ ገዛ 6. ካልእ(ይገለፅ) ________________________
23.	ካብ እዞም ዝስዕቡ ኣገባባት ፍተሻ ተምሃሮ መባዛሕትኡኣየናይ ይጥቀሙ/ማ?	1. ፈተና 2. ዕዮገዛ 3. ዕዮክፍሊ 4. ትዕዝብቲ 5. ናይ ተምሃራይ ተግባራት/ውዕኢታት ብምእካብ 6. ካልእ (ይገለፅ) _______________________

የቐንየለይ!

Annex 3B. Teacher Questionnaire (English)

Objective: This is a PhD dissertation aimed at improving our understanding of how children are learning mathematics in Tigrai at grades 1 and 2. The research is entitled as: ***Early Grade mathematics competence in Tigrai.*** The information you provide will be used for this purpose only and for the sake of anonymity, you are not requested to write your name on any part of this paper. The name of your school and class you teach will, however, be recorded for the purpose of making some link at the analysis level. Though not necessarily limited, the findings will be shared among scholars in the university for academic purposes. If you do not prefer to participate in providing data for the study, please do not make any markings on questionnaire and return it to the study team.

Consent: *I understand and agree to participate in providing data for the mathematics competence study.*

Yes ☐

I appreciate for your cooperation!

The researcher

Instruction: Please answer all questions. Write your response on the space provided or circle the letter or number of the option that corresponds with your response. To understand the factors that affect students' mathematics competence and thereby recommend relevant solution, please try to answer questions honestly.

	Date of Assessment:	_________/________/2012
	Name of the assessor:	____
1.	Name of the woreda:	
2.	Name of the school:	
3.	Location	1. Urban 2. Rural
4.	Grade and section you teach:	3. Grade 1 Section _____ 4. Grade 2 Section _____
5.	Your Gender:	2. Male 2. Female
5.	Number of students in you class:	Boys ________ Girls _______ Total _______
6.	Your age:	_________ years
7.	Qualification:	5. Untrained 6. Certificate 7. Diploma 8. Other (specify)______________________
8.	Service: 8.1. How many years have you been teaching (total)?	______ Years
	8.2. How many years have you been teaching as a trained teacher?	______ Years

9.	9.1. Are you teaching in self-contained approach?	3. Yes 4. No
	9.2. If you are teaching in self-contained classroom, are you teaching all subjects?	1. Yes 2. No (specify) ________
10.	Are you interested to teach Mathematics at this grade level?	**3.** Yes **4.** No If No, specify______________________________
11.	Do you feel competent to teach mathematics in your class?	3. Yes 4. No
12.	If your answer to question no. 11 is 'NO', why?	7. Mathematics is difficult to understand 8. There are no enough materials for teaching the subject 9. I were not trained to teach mathematics 10. Mathematics needs special talent 11. Other (specify) ______________________ ____________________________________
13.	13.1. Is there a library in your school?	2. Yes 2. No
	13.2. What is the mathematics textbook –student ratio in your class?	1. 1: 1 2. 1: 2 3. 1: 3 4. 1: to many 5. There is no textbook for students 6. Other (specify)____________________
	13.2. Are there sufficient mathematics learning materials in the library?	1. Yes 2. No
	13.3. Do you have sufficient learning materials to teach mathematics?	1. Yes 2. No
14.	Do you have mathematics teacher's guide?	1. Yes 2. No
15.	If you have the mathematics teacher's guide, is it useful to guide you in teaching mathematics?	3. Yes 4. NO
16.	Do you get sufficient support from the school principal or other supervisors in teaching?	3. Yes 4. No
17.	Do you have meetings with parents?	3. Yes 4. NO

18.	Do parents come to school to discuss about their children's learning situation?	4. They come when they are invited by the school or the teacher 5. They come when they need to discuss with the school regarding students' learning 6. The do not come even if they are invited
19.	Was there short term training in teaching mathematics this year?	3. Yes 4. No If yes, what were the titles of the training? For how many days?
20.	How many periods do you teach mathematics in a week?	________________periods per week
21.	21.1. Compared to other subjects, are students interested to learn mathematics?	3. Yes 4. No
	21.2. If they are not interested to learn mathematics, why?	1. Students do not have preparation 2. Mathematics is difficult subject 3. Because there are no textbooks 4. Other (specify) ________________
22.	Which methods of teaching do you use mostly in teaching mathematics?	7. Lecture 8. Lecture and discussion 9. Demonstration 10. Group work 11. Assignment 12. Other (specify) ______________________
23.	Which of the following assessment techniques do you use mostly?	7. Test 8. Homework 9. Classwork 10. Observation 11. Portfolio 12. Other (specify) _____________________

THANK YOU!

Annex 4A. Head Teacher Questionnaire (Tigrigna)

ብርእሳነ መምህራን ዝምላእ መሕተት:

ዕላማ መፅናዕቲ፣

እዚ ፅሑፍ ንዶክትሬት ድግሪ ዝተዳለወ መፅናዕታዊ ፅሑፍ ኮይኑ 1ይን 2ይን ክፍሊ ተምሃሮ ትግራይ ዘለዎም ብቕዓት ምምሃር ትምህርቲ ንምፍታሽ መሰረት ዝገበረ'ዩ፡፡ ርዕሲ እዚ መፅናዕቲ: ***ክእለት ሒሳብ ታሕተዋይ ቀዳማይ ብርኪ ተምሃሮ ትግራይ*** እንትኸውን፣ እትህብዎ ሓበሬታ ድማ ነዚ ዝተጠቐሰ ዓላማ ጥራሕ ዘገልግል ኾይኑ ንምሽጥራዊነቱ ድማ ሽምኩም ኣብ ዝኾነ ቦታ ናይዚ ቅጥዒ ምፅሓፍ አየድልን፡፡ ነገር ግን ሽም ቤት ትምህርቲኹምን እተምህሩሉ ክፍልን ኣብዚ መፅናዕቲ ዝካተቱ ብምዃኖም ክፀሓፉ አለዎም፡፡ ውፅኢት ናይዚ መፅናዕቲ ከገልግሎ ዝኽእል አይወሰን 'ምበር ናይ ዩኒቨርስቲ ሙሁራንን ሰብ ሙያ ትምህርትን ዝጥቀምሉ ከምዝኽእሉ ኣየጠራጥርን፡፡ ከይኑ ግን መጠይቕ ንምምላእ ድልየት እንተዘይሃሊዎም/ወን፣ አብዚ መጠይቕ ምንም ዓይነት ምልክት እንተይገበሩ ንአባላት ኣከበቲ መረዳኢታ ምምላሰ ይኽእሉ'ዮም፡፡

ቃላዊ ስምምዕነት፡- ኣነ ነዚ መጠይቕ ብምሉእነትን ብትኽክልን ብምምላእ ኣብዚ ናይ ትምህርቲ ሒሳብ ክእለት መፅናዕቲ ክሳተፍ ተሰማሚዐ ኣለኹ፡፡

አዎ ☐

ንምትሕብባርኩም የመስግን!

አካየዲ መፅናዕቲ

መምርሒ፡ በይዘኦም/አን ንኹሎም ሕቶታት ቅኑዕ ምላሽ ይሃቡ/ባ፡፡ መልስኹም አብቲ መልሲ መውሃቢ ፀሓፉ ወይ ነቲ ቅኑዕ እትበልዎ መልሲ ዝሓዘ ፊደል ወይ መማረፂ ብምኽባብ መልሱ፡፡ ክእለት ሒሳብ ተምሃሮ 1ይን 2ይን ክፍሊ ንምርዳእን መፍትሒ ንምቕማጥን ዝዓለመ መፅናዕቲ ስለዝኾነ ሓሳብኩም ክተካፈሉና ንላቦ፡፡

	ዕለት፡	___________/_____/2004
	ሽም ገምጋሚ፡	
1.	ወረዳ	
2.	ሽምቤትትምህርቲ	
	ውልቃዊመረዳእታ	
3.	ኣብዚቤትትምህርቲዘለዎም/ንሓላፊነት	1. ርእሰመምህር 2. ምክትልርእሰመምህር 3. ተወካሊርእሰመምህር
4.	ፆታ	1. ተባዕታይ 2. ኣነስታይ
5.	ኣጠቓላሊኣገልግሎትኣብምምሃር	______________ዓመት
6.	ደረጃ ትምህርቲ	9. ሰርቲፊኬት 10. ዲፕሎማ 11. ናይ መጀመሪያ ዲግሪ 12. ካልእ______(ይግለፁ)____________
7.	7.1. ኣብ ሰሙን ክንደይ ክፍለ ግዘ የምህሩ/ራ?	___________ ክፍለ ግዘ
	7.2. ዘምህሩ/ራ እንተኾይኖም፣ ኣየናይ ዓይነት ትምህርቲ?	ደረጃ ክፍሊ___________ ዓይነት ትምህርቲ___________
8.	ኣብ ሰሙን ንኽንደይ ሰዓታት ዝኣክል ንመምህራን ሓገዝ ትህቡ?	___________ሰዓታት
9.	9.1. ኣብ ኣመሃህራ ትምህርቲ ሒሳብ ታሕተዋይ 1ይ ብርኪ ስልጠና ወሲዶም/ን	1. እወ 2. ኣይፋሉን

	ይፈልጡ'ዶ?	3. ኣይዝክርን
	9.2. ስለጠና ወሲዶም/ደን እንተነይሮም/ረን፣ ንኽንደይ እዋን?	________መዓልቲ ዘይዝክርዎ/ረኦ እንተኾይኖም/ነን 'ኣይዝክሮን' ዝብል ይፅሓፉ/ፋ
10.	ኣመሃህራ ትምህርቲ ሒሳብ ብዝምልከት ን1ይን 2ይን ክፍሊ መምህራን ሓገዝ ተዋሂቡ'ዶ ይፈልጥ?	1. እወ 2. ኣይፋሉን 3. ሒሳብ ብዝምልከት ዘየኮነስ ኣጠቓላሊ ሓገዝ ይግበር
11.	ኣብ ቤትምህርትኹም ብውፅኢት ትምህርቲ ሒሳብ ተምሃሮ 1ይን 2ይን ክፍሊ ዕጉብ ድዮም/ን?	1. እወ 2. ኣይፋሉን 99. መልሲ ንምሃብ የፀግም
ሓበሬታ ብዛዕባ ቤት ትምህርቲ		
12.	እዚ ቤት ትምህረቲ ክሳብ ክንደይ ክፍሊ የምህር?	ክሳብ________ክፍሊ
13.	ኣብ 1ይን 2ይን ክፍሊ በዝሒ ክፍለ ግዘ ትምህርቲ ሒሳብ ኣብ ሰሙን ክንደይ'ዩ?	1ይ________ክፍለ ግዘ ኣብ ሰሙን 2ይ________ክፍለ ግዘ ኣብ ሰሙን
14	መፅሓፍ ተምሃራይ ትምህርቲ ሒሳብ 1ይን 2ይን እኹል ኣሎ'ዶ?	1. እወ፣ ሓደ ንሓደ ይበፅሕ 2. እወ፣ ግና ሓደ ንበዙሓት ተምሃሮ 3. ንተምሃራይ ዝወሃብ መፅሓፍ የለን 99. ኣይፈለጥኩን
15.	15.1. ኣብ ቤት ትምህርቲ ቤተ መፃሕፍቲ ኣሎ'ዶ	1. እወ፣ ዝሰርሕ ኣሎ 2. እወ፣ ግና ኣይሰርሕን 3. የለን 99. ኣይፈለጥኩን
	15.2. ቤተ መፃሕፍቲ እንተልዩ፣ እኹላት መፃሕፍቲ ኣለዉ'ዶ?	1. እወ 2. የብሉን 99. ኣይፈለጥኩን
	15.3. ቤተ መፃሕፍቲ እንተልዩ፣ 1ይን 2ይን ክፍሊ ይጥቀሙሉ'ዶ?	1. እወ 2. ኣይፋሉን 99. ኣይፈለጥኩን
16.	ኣብ ቤት ትምህርቲ ኣብ ክፍሊ መምህራን ትዕዝብቲ ምክያድ ናይ መን ሓላፍነት እዩ?	1. ትዕዝብቲ ዘካይድ የለን 2. ርእሰ መምህር 3. ምክትል ርእሰ መምህር 4. ካሊእ /ይገለፅ/ 99. ኣይፈለጥኩን
17.	ዕለታዊ ትልሚ ትምህርቲ መምህን ኣብ	1. ኣይሪኦን

	ሰሚስተር ንኽንደይ ግዘ ትረኡዎ?	2. ሓደ ጊዘ 3. 2 ጊዘ 4. 3 ጊዘ 5. 4 ጊዘ 6. ካሊእ ይፀሓፍ________ 99. ኣይፈለጥኩን
18.	ተምሃሮ ብውፅኢት እናመሓየሹ ምኺኖም ብኸመይ ትፈልጡ?	1. ናይ ክፍሊ ትዕዝብቲ ብምኽያድ 2. ውፅኢት ሓፀርቲ ፈተናታት ብምርኣይ 3. ብርእሰ መምህር ብዝወሃብ ናይ ቃል ሕቶ 4. ዕዮታት ገዛነ ክፍልን ብምርኣይ 5. መምህራን ብዘቕርቡዎ ፀብፃብ 6. ሱፐርቫየዘር ዘቕረቦ ፀብፃበ ብምርኣይ 7. ካሊእ________ 99. ኣይፈለጥኩን
19.	ወለዲ ውፅኢት ተምሃሮ ኣብ ምምሕያሽ ይሳተፉ’ዶ?	1. እወ 2. ኣይፋሉን 99. ኣይፈለጥኩን
20.	እብዚ ቤት ትምህርቲ ፅሩይ ዝስተ ማይ ኣሎ’ዶ?	1. እወ 2. ኣይፋሉን
21.	እብዚ ቤት ትምህርቲ መብራህቲ ኣሎ’ዶ?	1. እወ 2. ኣይፋሉን 99. ኣይፈለጥኩን
22.	እብዚ ቤት ትምህርቲ ማእኸል ፔዳጎጂ ኣሎ’ዶ?	1. እወ 2. ኣይፋሉን 99. ኣይፈለጥኩን
23.	እብዚ ቤት ትምህርቲ ንቂ ኣንስትዮ ዝኸውን ዝተፈለየ ሽቓቕ ኣሎ’ዶ?	1. እወ 2. ኣይፋሉን 1. ኣይፈለጥኩን

የቐንየለይ!

Annex 4B. Head Teacher Questionnaire (English)

Objective: This is a PhD dissertation aimed at improving our understanding of how children are learning mathematics in Tigrai at grades 1 and 2. The research is entitled as: ***Quality of Primary Education: The Case of Early Grade Mathematics Competence in Tigrai.***The information you provide will be used for this purpose only and for the sake of anonymity, you are not requested to write your name on any part of this paper. The name of your school and class you teach will, however, be recorded for the purpose of making some link at the analysis level. Though not necessarily limited, the findings will be shared among scholars in the university for academic purposes. If you do not prefer to participate in providing data for the study, please do not make any markings on the questionnaire and return the blankcopy to the study team.

Consent:*I understand and agree to participate in providing data for the mathematics competence study in Tigari.*

Yes ☐

I appreciate for your cooperation!
The researcher

Instruction: Please answer all questions. Write your response on the space provided or circle the letter or number of the option that corresponds with your response. To understand the factors that affect students' mathematics competence and thereby recommend relevant solution, please try to answer questions honestly.

	Date of Assessment:	_________/________/2012
	Name of the assessor:	____
1.	Name of the woreda:	
2.	Name of the school:	
	Personal Information	
3.	What is your position at this School?	School Director……………………………. 1 Deputy Director …………………….............. 2 Delegated…………………………………... 3
4.	Your Gender:	3. Male 2. Female
5.	How many years have you been teaching (total)?	Years ☐☐
6.	Your qualification	TTI…………………………………… 1 Diploma ……………………………… 2 First /Bachelor Degree.. ………………3 Other(specify)…………………………5
7.	7.1. How many periods do you teach, if any, in a week?	_______Periods per week
	7.2. What class do you teach?	Grade (s)_____________________ Subject (s)______________________

8	How many hours, per week, do you provide instructional support for your teachers?	Number of hours per week [ ][ ]
9	9.1. Did you take training or course on numeracy?	Yes ……………………………………….. 1 No ………………………………………... 2 Does not know …………………………… 99
	9.2. If yes, what was the length of the program?	[ ][ ] Days If you cannot remember write, I do not know (DK)
10	Do you support teachers on how to teach mathematics at grdaes 1 and 2?	Yes ………………………………………….. 1 No …………………………………………... 2 Not mathematics specific as such…………… 3
11	Are you satisfied with the performance in mathematics in Grades 1 and 2 in your school?	Yes ………………………………………… 1 No ………………………………………….. 2 No Response ……………………………….. 99
Information about the school		
12.	What is the highest Class taught in this school?	Gra[ ]
13.	What is the weekly period allocation of mathematics at grades 1 and 2?	Grade 1_______ periods per week Grade 2 ______periods per week
14.	Are there sufficient math textbooks for grades 1 and 2 studensts?	Yes, one to one……………………………1 No, one to many ……………………………2 No math textbook for students……….......3 I do not know………………………………..4
15.	15.1. Is there a library in the school?	Yes, functional………………………………1 Yes, but not functional ……………………...2 No at all……………………………………....3 I do not know ………………………………..4
	15.2. If there is a library, are there sufficient math books for the lower grades?	Yes…………………………………………1 No……………………………………………..2 I do not know………………………………3
	15.3. If there is a library, do grades 1 and 2 use it?	Yes…………………………………………1 No……………………………………………..2 I do not know………………………………3
16.	In your school, who is responsible for observingteachers in their classrooms?	No one observes . . . . 0 Head teachers . . . .1 Deputy head teacher .2 Other(specify) . . . .….3 Don't know/Refuse to respond ……………..99

17.	In class, how often are you observing teachers' plans in a semester ?	I don't observe ……………………….……. 0 Once ……………………………………..… 1 Twice ……………………………………. 2 Three times ……………….……………..…….. 3 4 times ……………………………………... 4 If other, explain ________________________ Don't know/Refuse to respond ……………...99
18.	How do you know whether the school children are progressing?	Classroom observation . . . . 1 Monitor students' results on short tests . . . . .2 Evaluate children orally myself . . . . 3 Review children's assignments or homework….4 Teachers provide me progressreports . . .. 5 Review supervisor's reports………………….. 6 Other . . . .…….…… . .7 If other, specify_________________________8 Don't know/Refuse to respond …………….99
19.	Do parents participate in improving students' achievements?	Yes…………………………………………1 No……………………………………….2 I do not know……………………………3
20.	Is there clean, safe water supply available on school premises?	Yes ………………………………………… 1 No …………………………………………..2
21.	Does the school have electricity?	Yes . . . .……….….. . . 1 No . . . .……………….. . . . 2 Don't know/no response 99
22.	Does the school have pedagogical center?	Yes . . . .……….….. . . 1 No . . . .……………….. . . . 2 Don't know/no response 99
23.	Does the school have separate toilet for girls?	Yes . . . .……….….. . . 1 No . . . .……………….. . . . 2 Don't know/no response 99

THANK YOU!

Annex 5. Early Grade Math Assessment (EGMA) Administration Guideline- Abridged

General reminder:

1. The objective is not marking or any other decision making on the schooling of the children or the profession of the teachers. IT IS RATHER DIAGNOSTIC.
2. Administration: one-on-one basis
3. The general data at the beginning of the instrument should be filled out correctly
4. If the child wishes not to participate in the consent section on the first page, the child will not be forced to do so.

General rules:

1. Make sure, at each section that the child has understood what needs to be done.
2. The time that the interview will begin and end should be registered.
3. Time should be taken even if the child can not answer.
4. Explain that the stopwatch measures the time taken to give answers and it would be best to continue until asked to STOP.

EGMA administration particulars:

1. Start the time when the child names the first number, not when s/he indicates readiness to start.
2. <u>Clearly</u> mark any incorrect numbers with a slash (/)
3. Count self-corrections as correct. If you've already marked the self-corrected number as incorrect, circle the number and go on.
4. If the child hesitates for 3 seconds, provide the name of the number, point to the next number and say "Please go on". Mark the number you provided to the child as incorrect.
5. If the child escapes a line of numbers consider all as incorrect and make a line through the row. DONOT interrupt, let the child continue and if later the child realizes and reads it within the given time (1 minute) mark it as per the rule (circle the correct ones).
6. Timing:
   - When it is timed subtest say STOP after the time given (usually 60 seconds or one minute)
   - Mark the final number named with a bracket (])
   - ***Early stop rule:*** If the child responds incorrectly or does not respond to the first line numbers or the first questions, say "**Thank you!**" discontinue this exercise, check the box at the bottom of the page, and go on to the next exercise.

7. Materials needed:

- Stop watch
- Scoring pencil for assessor and for each child assessed
- Eraser
- Clip-board
- Student assessment forms (including student stimuli)
- Head Teacher Questionnaire
- Teacher Questionnaire
- Sampling sheet
- School field visit summary sheet
- Plastic bag to carry materials

Annex 6. Student Sampling Sheet

School ______________________ Woreda ______________________

Systematic sampling technique:

Calculation of Sampling Interval		**Divided by**			
	_______ Grade 1 Girls		10	=	
	_______ Grade 1 Boys		10		
	_______ Grade 2 Girls		10		
	_______ Grade 2 Boys		10		
	Total number of students		Desired sample size		Sampling interval: Use this number for systematic sampling

NOTE: Use this sheet to write down the names of selected students for Grade 1 and Grade 2. At the end of the day, the group leader is responsible to ensure on this sheet that every child is assessed.

	Grade 1 PUPIL'S NAME	**GENDER (M or F)**		**Grade 2 PUPIL'S NAME**	**GENDER (M or F)**
01			21		
02			22		
03			23		
04			24		
05			25		
06			26		
07			27		
08			28		
09			29		
10			30		
11			31		
12			32		
13			33		
14			34		
15			35		
16			36		
17			37		
18			38		
19			39		
20			40		

Annex 7. School Field Visit Summary Sheet

Name of field work group leader:		Name of school:	
Date:		Woreda:	
		School Telephone Number:	

SUMMARY OF STUDENT SAMPLING, AND TEACHER AND HEAD TEACHER INFORMATION COLLECTED.

Group	No. of assessments collected	Completed Director questionnaire collected?	Completed Teacher questionnaire collected?
Grade 2 Boys______		N =	N =
Grade 2 Girls______			
Grade 3 Boys______			
Grade 3 Girls______			
Total:			

Signature of Group Leader: ________________________ Date: ________________

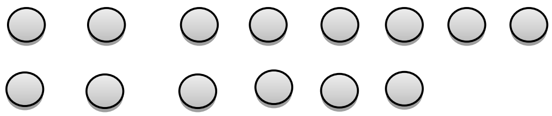
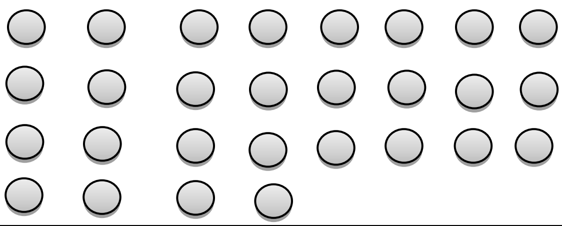
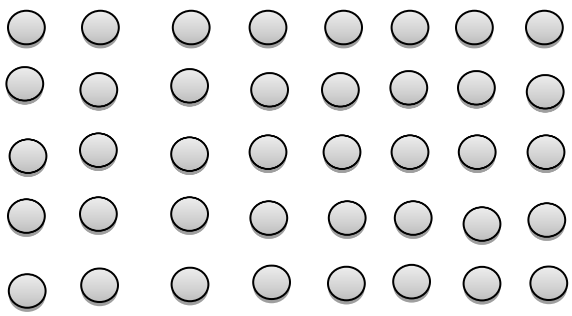
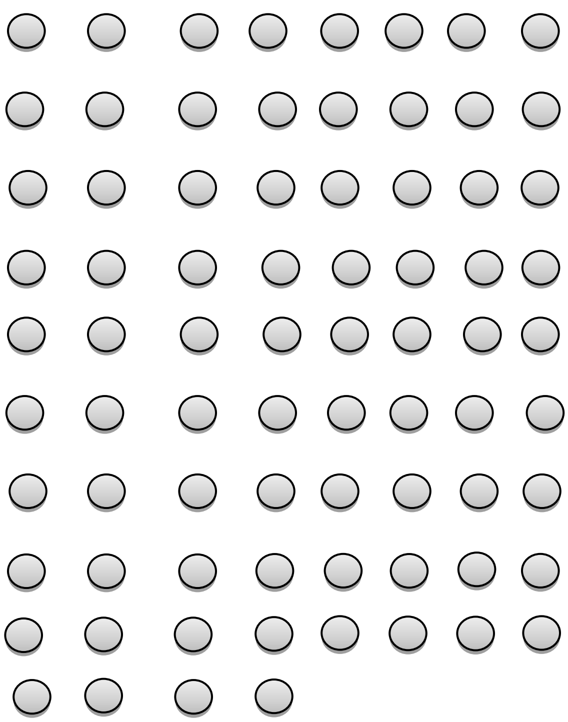
Annex 8. Student Responses by Task and Item

8A. Number Identification

No	Item	Response		
		Right	Wrong	Total
1	12	613	221	834
2	68	515	317	834
3	69	525	309	834
4	2	626	208	834
5	82	525	306	831
6	74	535	104	639
7	52	555	73	628
8	92	518	105	623
9	73	511	106	617
10	55	546	65	611
11	50	528	64	592
12	98	466	123	589
13	89	450	133	583
14	13	488	83	571
15	9	499	61	560
16	51	414	128	542
17	49	446	90	536
18	80	453	71	524
19	61	394	113	507
20	66	407	87	494
21	69	405	87	492
22	40	425	59	484
23	53	393	69	462
24	67	372	74	446
25	99	357	70	427
26	10	388	25	413
27	71	339	57	396
28	62	342	43	385
29	63	324	40	364
30	60	310	34	344

No	Item	Response		
		Right	Wrong	Total
31	3	308	14	322
32	66	271	34	305
33	78	273	21	294
34	15	255	21	276
35	30	238	15	253
36	54	204	28	232
37	7	199	14	213
38	37	181	17	198
39	43	172	14	186
40	24	161	15	176
41	25	133	14	147
42	10	136	6	142
43	43	119	12	131
44	72	107	9	116
45	86	91	8	99
46	51	77	5	82
47	95	74	4	78
48	64	66	4	70
49	84	60	5	65
50	96	58	4	62
51	88	63	0	63
52	44	53	0	53
53	60	52	0	52
54	48	42	1	43
55	83	40	1	41
56	59	36	0	36
57	97	32	2	34
58	57	29	0	29
59	3	27	0	27
60	38	23	0	23

8B. Cardinality

No	Item	Responses			
		Right	Wrong	Didn't finish counting	Total
1		704	59	69	832
2		621	41	170	832
3		559	48	225	832
4		380	61	391	832

8C. Quantity Discrimination

No	Item	Response		
		Right	Wrong	Total
1	5_______7	782	51	833
2	13______31	752	82	834
3	27______21	677	157	834
4	44______54	719	115	834
5	66______55	640	191	831
6	80______70	615	217	832
7	99______89	546	286	832
8	95______79	483	349	832
9	59______85	654	178	832
10	91______87	529	302	831

8D. Missing Number

No	Item	Response		
		Right	Wrong	Total
1	11, 12, _____	760	74	834
2	34, ____, 36	124	710	834
3	70, 80, _____	539	295	834
4	____, 70, 71	287	547	834
5	40, 42, _____	250	584	834
6	50, 55, _____	298	536	834
7	10, 15, ____, 25	308	526	834
8	40, _____, 20	391	443	834
9	89, _____, 91	525	309	834
10	70, _____, 68	299	535	834

8E. Addition and Subtraction

Addition:

No	Item	Response		
		Right	**Wrong**	**Total**
1	3 + 6	569	265	834
2	13 + 5	480	354	834
3	10 + 10	686	148	834
4	6 + 10	593	241	834
5	8 + 6	451	383	834
6	11 + 11	431	403	834
7	30 + 10	608	226	834
8	80 + 10	549	285	834
9	34 + 5	430	404	834
10	20 + 20	577	257	834

Subtraction:

No	Item	Response		
		Right	**Wrong**	**Total**
1	6 - 2	554	280	834
2	10 – 3	519	315	834
3	20 – 10	611	223	834
4	15 – 5	515	319	834
5	17 – 10	446	388	834
6	13 – 11	326	508	834
7	34 – 11	188	646	834
8	60 – 50	422	412	834
9	90 – 90	546	288	834
10	89 - 9	438	396	834

Declaration:

I declare that this doctoral dissertation is my original work.

Name: Abraha Asfaw Signature: ____________

Date of submission: 28/01/2015

This doctoral dissertation has been submitted for examination by my approval as a university advisor.

Name: Amare Haregedom Signature: ____________

Date of submission: 28/01/15