ADDIS ABABA CITY ADMINISTRATION EDUCATION AND TRAINING QUALITY CONTROL AUTHORITY

A STUDY REPORT ON EARLY GRADE MATHEMATICS ASSESSMENT (EGMA) IN ADDIS ABABA CITY ADMINISTRATION

Nov. /2022

ADDIS ABABA

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Acronyms and Abbreviations

ANOVA – analysis of variance

ESDP – education sector development program

EGMA – early grade mathematics assessment

EGRA – Early grade reading assessment

GTP – growth and transformation plan

M – Mean score

MD –mean deviation

MLC - Minimum Learning Competencies

MLL – Minimum levels of learning

MOE – ministry of education

NCTM - The National Council of Teachers

NEAEA – national education assessment and examination agency

OECD – organization of economic cooperation for development

PISA – program for international student assessment

QMIS - quality management information systems

RTI – research triangle institute

SD – standard deviation

SPSS – statistical package for social sciences

TIMSS – trends in mathematics and science studies

UNESCO – united States education and scientific

USAID – united States aid for international development

Abstract

This report is the second early grade mathematics assessment (EGMA) study report in Addis Ababa city administration conducted in grade 2 and grade 3 students with the major purpose of identifying the existing status of students' learning outcome on the foundational early grade mathematics skills and the main factors that influence students' achievement in the area. The study sample was consisting a total of 4238 students, 372 teachers selected from 107 schools in Addis Ababa. During sample selection to accommodate all diversity traits in appropriate proportion composition was taken into account. Through this process and probability random sampling 2118 students from grade 2 (50.20%) and 2110 from grade 3 (49.80%) participated in providing the necessary information at their schools. The gender based composition indicated that 2136 (50.40%) female and 2095 (49.60%) male students as well as school type based selection included equal number of schools from each type (55 schools) in city administration level.

As data gathering instrument tools one standardized achievement test of students and three different questionnaires (questionnaire for students, questionnaire for subject teachers and questionnaire for directors) were used mainly to collect data that were needed for this study purpose. Before the main data collection activity the instruments were tested against reliability and validity to check the internal quality they have. The content validity test procedure was simply revisiting the achievement test questions and check whether they conform with the EGMA framework or not. Accordingly there was no any pitfall found regarding this point. Moreover, Cronbatch's alpha technique applied on the pilot test data revealed that the instrument was reliable though out the learners. Lastly data was collected through the help of these instruments and it was targeting at assessing students learning achievement on the eleven EGMA subtasks collectively producing mathematics foundational skills and their relationship with different socioeconomic and psychological factors of the pupils.

To create a conducive environment for data analysis the data collected and encoded into an excel template was cleaned in the way it fits the process of data analysis. To analyze the data gathered we used SPSS version 25 and both descriptive (mean, standard deviation, skewness, kurtosis) and inferential statistics (independent samples t- test, paired samples t test, one way ANOVA) were applied in their appropriate positions.

The total percent mean score of the EGMA was 81.14 % with standard deviation of 16.08 where the maximum score is 100 and the minimum score was 8.13 and this fact indicated that on average a student has the capacity to perform 81.14 mathematical tasks out of 100 correctly. The mean scores of the tasks number identification, quantity discrimination, missing number , addition level 1, addition level 2, subtraction level 1, subtraction level 2, word problem, pattern recognition, and pattern extension respectively were 81.23%, 91.93%, 62.62% 90.73%, 79.22%, and 92.53%., 70.20%, 71.09%, 84.73%, 87.53%,. Students scored the greatest score in subtraction level 1 and the least in missing number. The minimum score was 62.62% in missing the number and the maximum one 92.53% in subtraction level 1. The percent mean scores in the Subtasks addition level 2, subtraction level 2, missing number and word problem percent mean score were below the overall percent mean score. Moreover, the median value was 91.52% suggesting that half of the participants score a percent mean score of more than or equal to 91.52%.

In this study different group based comparison of students' performance was conducted to identify the difference in percent mean score of students and its significance between and among the groups under consideration. The respective percent mean scores of grade2 and grade 3 was 79.64% and 82.65% while that of males and females was 81.19% and 81.09% where the gender base comparison was not statistically significant. Sub city based comparison of their overall percent mean scores showed that Akaki kality scored the lowest (75.35%) and kolfe keranyo scored the highest (86.31%). Governmental schools scored 76.74% and private 85.45% and there mean difference was statistically significant.

The investigation on zero scores revealed that there were students who scored zero in all the ten different EGMA sub tasks. The maximum number of zero scorers was found in missing the number (6.58%) and the least in number identification (0.01%).

1. INTRODUCTION

1.1 Background of the study

Educating a generation is like planting a tree, what is planted today bears fruit for the next decade, is basis for the economic, social and political wellbeing of a nation. Education is also a Human Rights issue, families and communities are not allowed not to educate their children. Ethiopian Constitution Article 90 dictates on Access to Education for All (ESDP six). These words show us how much education is crucial to all rounded societal growth and development in terms of material and non- material rewards. That is why some educational scholars say that education is a "social force" that can be used for different strong purposes as a tool.

The Ethiopian government of the late twentieth century has attempted to introduce modern education to Ethiopia to benefit from it. From the time it was introduce, it has passed through different stages of development to reach at its current status. The latest Ethiopian education and training policy (ETP) of 1994 mainly focuses upon the provision of skilled man power to the economy and promoting respect for human rights and democratic values. To implement this grand plan effectively and to show the focus area in detail periodic five year implementation plans under the name 'education sector development plan' (ESDP) were introduced. Beginning this year the government is implementing its sixth ESDP plan in which one of its main target areas in the general education part is assuring quality of education and its relevance to the market. Moreover, MOE has launched a GEQIP package that takes a holistic approach to improve the quality of general education by adapting the concept of the school effectiveness model to formulate it (World Bank, 2000; MOE, 2008).

The quality of schooling is monitored in a number of different ways (Ana Craft, 1996). Learning assessment is one of the tools that is widely used for this purpose locally, regionally and internationally in different corners of the world. Early grade mathematics assessment (EGMA) is a large scale assessment package that testifies the efficacy of once educational system to deliver the fundamental mathematical knowledge and skills to early grade learners. Large scale assessment describes the level of student achievement not individually but collectively, that is what makes it peculiar and very important for the improvement of educational systems.

The baseline EGMA assessment of 2019/2020 conducted in Addis Ababa city administration has organized information on the status of the achievement of early grade learners (grades 2 & 3) on the foundational mathematical skills and some of the school related and socioeconomic factors that affected the educational success. Data was mainly collected from 4608 students and 206 teachers concerning school environment and the socio-economic background of the learners. Moreover, an achievement test was given to the student to identify the level of their achievement as well as to relate it with the school - and – socioeconomic factors the learners learn and live in. Based on this assessment report the overall mean score of Addis Ababa was 86.22% with respective means of grade two and three learners 84.27% and 88.20% which indicates the existence of 'value gain' in the system because of an additional schooling year. The EGMA achievement test was built out of six basic mathematical tasks and the maximum and minimum scores were in number identification (90.48%) and missing number (76.01%) respectively.

During the investigation of zero scorers by task, there were higher number of zero scorers in missing number task (3.97%) and least number of zero scorers in number identification (0.38%). Moreover, sub city based comparison of students achievement level indicated that Kirkos sub city students scored maximum aggregate (88.46%) while Gulele was the sub city with the least learners overall mean score value(83.42). similarly school type based comparison of aggregate means was conducted and the mean score of private schools was significantly higher (88.31%) than the governmental schools (84.13%).

To summarize EGMA and any other learning assessment projects play an important role in monitoring the quality of an educational system by identifying what is working and what is not in the system through the help of scientific research procedures. The information gathered through this process is delivered to stakeholders and especially policy makers to intervene in the areas the school system lack to improve the quality of education in an area.

1.2 Objectives of Early Grade Mathematics Assessment (EGMA)

Citizens in every country are increasingly confronted with a myriad of issues involving quantitative, spatial, probabilistic or relational reasoning. The media are full of information that use and misuse tables, charts, graphs and other visual representations to explain or clarify matters regarding weather, economics, medicine, sports, and environment, to name a few. Even closer to the daily life of every citizen are skills involving reading and interpreting bus or train schedules, understanding energy bills, arranging finances at the bank, economizing resources, and making good business decisions, whether it is bartering or finding the best buy.

Thus, literacy in mathematics is about the functionality of the mathematics an individual learned at school. This functionality is an important survival skill for the citizen in today's information and knowledge society (OECD, 2009).

The Ethiopian government is practicing nation wise policy of industrialization as an economic pillar to all rounded and inclusive economic growth and prosperity. And this policy needs a highly trained and skilled man power from science fields that uses mathematics as a tool to possess the required skill and knowledge to realize what is planned by the government. So strengthening the basic foundational knowledge and skills in early grades is fundamentally important. To control and monitor the education system in this grade level together with stakeholders so that it will be the source of proficient learners with bright future of learning is crucial. Early grade mathematics assessment (EGMA) is one of the instruments implemented for this purpose and its objectives are:-

1.2.1 General Objective of the Study

The general objective of this study is gathering information about learners' performance in early grade mathematics foundational skills and provides it to key stakeholders to intervene to alleviate students learning setbacks in early grade mathematics in Addis Ababa city administration.

1.2.2 Specific Objectives of the Study

The early grade mathematics assessment (EGMA) in Addis Ababa has the following specific objectives.

1. To identify and organize information on the overall status of students achievement in early grade mathematics foundational skills in Addis Ababa city administration.
2. To identify some key factors that influence students' mathematics achievement in early grades mathematics.
3. To list down the key strengths and weaknesses of the early grade mathematics learning in Addis Ababa.
4. To make group based comparison of achievement levels (gender, sub city, school type etc.) and test their significance level.

1.3 Basic Research Questions

Following its completion, this study has the following basic questions to answer precisely.

1. To what extent do students perform in learning mathematics at early grades in Addis Ababa city administration?
2. What are the key factors that influence students learning in early grade mathematics?
3. What are the strength and weakness factors of students early grade mathematics learning in Addis Ababa city administration?
4. To what extent students' achievements do significantly vary by group (gender, sub city, school type etc.)?

1.4 Scope of the Study

This EGMA study has both geographic and sample scopes suggesting that areal coverage as well as from where the participants are selected is clearly known and well identified. In terms of geographic setting the study includes all elementary schools that are found in Addis Ababa city administration administrative map. In a similar fashion, sample is selected from all grade 2 and grade 3 students by random probability sampling procedure. Thus, all grade 2 and grade 3 students of the academic year 2021/22 E.C were under the scope of this research.

1.5 Rationale – Why EGMA?

Mathematics is the most international of all curriculum subjects, and mathematical understanding influences decision making in all areas of life — private, social, and civil. Mathematics education is a key to increasing the post-school and citizenship opportunities of young people (Glen Antony & Margaret Walshaw).

A strong foundation in mathematics during the early grades is the key to future success in mathematics, which is instrumental in the development of workplace skills and knowledge (Malloy, 2008; Nunes & Bryant, 1996; Steen, 2001; U.S. Department of Education, 2008). In addition, basic mathematical reasoning is key to everyday activities such as shopping and personal finance. Recent meta-analyses also suggest that early mathematics skills predict later reading skills just as much as early reading skills (Duncan et al., 2007; Romano et al., 2010).

Recent research has emphasized the association between early and later mathematics performance from the viewpoint of predictive (e.g., Aubrey, Dahl, & Godfrey, 2006; Aunio & Niemivirta, 2010; Jordan, Glutting, & Ramineni, 2010) and developmental growth (e.g., Aunola, Leskinen, Lerkkanen, &Nurmi, 2004; Morgan, Farkas, & Wu, 2009). Children who begin with

good mathematics skills seem to perform well later on, but children with weak skills often remain low performers throughout their school career (e.g., Aubrey et al., 2006; Morgan et al., 2009). Moreover, the gap separating low performing children from average performing children can even increase during the school years (e.g., Aunola et al., 2004). For this reason early grade students learning needs special attention of all stakeholders that are active participants in once education system.

Early mathematics has become an area of intense study over the past two decades, and the long-term effects of early exposure are now becoming clear. Mathematics knowledge in preschool, for example, predicts mathematics achievement even into the high school years and preschool mathematics skills predict later academic achievement more consistently than early reading or attention skills. Furthermore, some studies show math to be integral to how children learn to learn. In other words, learning early math is about more than simply learning discrete skills such as naming numerals; it is about reasoning and discovery (RTI, 2015).

Developing a positive disposition towards mathematics and a belief in one's self-efficacy are critical components of a child's present learning and future achievement in mathematics. The learning environment must encourage a positive attitude, promote conjecturing and risk taking, encourage mathematical sense making, and help students make connections with their prior mathematical understanding and with the world around them. Developing and promoting such an environment is the work of the whole community. Specifically, parents, teachers, and children are important partners in the learning process. However, the support of others, such as principals, superintendents, elementary consultants, school boards, and the Ministry of Education, is also necessary to promote a positive mathematics community. By providing children with the necessary conditions for the successful learning of mathematics, our culture can nurture strong mathematics learners who approach mathematics with confidence and competence and continue to use and promote mathematics within today's society.

To realize the goal of education in the long term of pupil's life working in the foundational skill is basic and necessary. Learning assessments play a crucial role in education systems. Through gathering information on student achievement, this information can be used to make decisions about policies and practices with the aim of enhancing student outcomes. For example, information provided through learning assessments may be used to inform decisions on adjusting classroom practices, programs to support groups of learners, or larger structural changes such as curricular reform or approaches to teacher training (RTI, 2011)

An instrument such as the EGMA holds significant promise in providing stakeholders, from Ministries of Education to aid agencies, with the information essential to making informed local and national system changes in teacher education and curriculum development and implementation. Accurate and efficient assessment of early grade mathematical skills does not provide all of the information necessary to effect change for the better in mathematics teaching and learning. However, adding an instrument that is valid across national borders and in multiple languages can provide the Ministries of Education with an overall assessment of students' abilities based on what is known about children's mathematical development, independent of regional curricula. Depending on the level of analyses, this information can be tailored to

examine specific within-country geographical or political sub-regions. The results of these analyses can give Ministries of Education the ability to target interventions, such as teacher training, on specific topics or sub-regions. It is important to understand that students' scores are more than just a measure of their abilities in a specific skill—they are also a measure of the students' environment. Myriad factors can affect student learning, including socioeconomic status, nutrition, skills and education of teachers, instructional time, parental education, civil war or localized violence, and family responsibilities (USAID, 2014).

Early Grade Mathematics Assessment (EGMA) is an assessment of early mathematics learning, with an emphasis on number and operations as well as basic geometric figures recognition and extension. EGMA consists of eleven subtests (referred to as *tasks* in the instrument) that, taken together, can produce a snapshot of children's knowledge of the competencies that are fundamental in early grade mathematics. These competencies include oral counting, number identification, quantity discrimination, missing number, addition levels one and two, subtraction levels one and two, word problem, pattern recognition and pattern extension. EGMA is an oral assessment and individually administered to students by trained assessors. Many mathematics assessments require children to be able to read in order to solve problems. Because EGMA is designed for the early grades, which is when children are just beginning to learn how to read, the oral administration does not confound a child's ability to read or write with a child's ability to do mathematics (RTI, 2014).

General consensus among researchers indicates that elementary school mathematics interventions are essential to avoiding later difficulties. Research is united in the belief that early detection and remedy of math difficulties eliminates future struggles with increasingly complex and abstract mathematical concepts studied throughout secondary grades.

Researchers have identified "fluency and proficiency with basic arithmetic combinations and the increasingly accurate and efficient use of counting strategies" as indicators of early math proficiency. According to the early grade mathematics assessment (EGMA) in Ethiopia baseline report Ethiopia has played a great effort to improve the quality of the learning that occurs through assessment. In addition to teacher made assessments at class room level, public examinations and large scale assessments (early grade reading, grade 4, 8, 10 and 12 national learning assessments) were implemented to assure quality. The Ethiopian Ministry of Education's great interest in ensuring the quality of primary education across regions also demanded the quality of early grade mathematics learning to be assessed.

In Addis Ababa city administration level in a similar fashion and having the direct duplicate together with its necessary task of contextualization but similar objectives of the federal ministry of education and national assessment and examination agency regarding assessment practices to work on early learning assessment began to be conducted in 2016/17. These time the responsibility given by Addis Ababa city administration council to control and monitor city level quality of education is in the hand of Addis Ababa city Administration Education and Training Quality Control Authority. Thus, in Addis Ababa city administration of this authority different

periodic assessment tasks in four different areas - Early grade reading assessment (EGRA), early grade mathematics assessment (EGMA), grades 4 and 8 in targeted five subjects, grades 10 and 12 in targeted five subjects are carried out.

In developed countries, interventions might be applied to individual children or small groups; however, in developing countries, where large numbers of students may be underperforming, interventions must be geared toward entire systems. Assessments of students' mathematical knowledge and skills are thus needed to determine the level of support needed, whether at the national, district, or local level. The EGMA takes a step toward addressing this need (RTI, 2014). In Addis Ababa context the second modality (i.e system based) of intervention is implemented to improve the quality of education delivered to citizens by different types of educational institutions in the city administration.

1.6 Minimum Learning Competencies and EGMA

The competency-based approach begins with the definition of the knowledge, skills, and attitudes required for successful performance in a particular role. Demonstrated competence under realistic conditions becomes the basis for awarding credentials.

To define competence appropriately, we go back to Aristotle. Thomas Ewens suggests that competence is what the Greeks called ''arete, "a power which has been trained and developed so that it has become a characteristic of the person who has it."' He notes that it is not enough to talk about arete in general. It is necessary to specify the End of characteristic or trained ability the person has. Aristotle, Ewens points out, was concerned with high standards as well as constraining circumstances of everyday life. One must possess the ability to function in ways that are most appropriate for a particular situation. "The trick," says Ewens, "is to know how to do it and this is largely a matter of practical wisdom." 'After Aristotle came Rome, France, England, America and dictionaries. Ewens comments that definitions of competence in English and American dictionaries convey "the notion of an adequate supply or sufficiency; a capacity to deal adequately with a subject; a quality or state of being functionally adequate or of having sufficient knowledge, judgment, skill or strength".

Competence, by definition, is tied to a position or role. The ligatures binding the two are abilities, knowledge, skills, judgment, attitudes and values required for successful functioning in the position or role. That is, possession of the critically required abilities, knowledge, judgment, skills, attitudes and values and proficient use of the same is what yields competence in an individual (chikering & claxton, 1981).

In addition, the measurement tools would provide diagnostic feedback that could be made available to teachers and schools (Foegen, Jiban, & Deno, 2007). One of the objectives of EGMA is to choose, and present, the measures in such a way that teachers see how they relate to the curriculum. Waiting until the end of third or fourth grade to see national results only delays the time when these unresolved issues can be identified at the child level and at the country level, making it more difficult to catch students up to the level of mathematics ability they should have reached for their current grade (Fuchs, 2004). Also, the measures should, if possible, even be understandable by community members, to contribute to their and schools' awareness as to where children are in the development of these skills, and where they may need more instruction

and development. This can play an important role in increasing parental involvement and in improving accountability.

This part deals mainly with how much the EGMA measures and the minimum learning competencies we get in the Ethiopia education curriculum for earlier grades agree one to each other.

The following is a table of competencies set by Ethiopian ministry of education for grades one up to three for mathematics.

Table 1:- Statements of Minimum Learning Competencies /MLC/ in Mathematics

Grade 1 - 3

Minimum learning competencies in;-			
Area of competency	**Grade 1**	**Grade 2**	**Grade 3**
I . Numbers **I .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." ="	• read, write, compare and order whole numbers up to 1000 • read and write multiples of 100 and 1000 up to 10,000 • Read and write whole numbers up to 10,000. • Compare and order whole numbers up to 10,000.
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	• identify halves and quarters • divide objects into thirds • show understanding of the relation between whole and halves, quarters and	• use previous knowledge of thirds • identify unit fraction from ½ to 1/10 • divide numbers into halves and quarters • compare simple fractions • use previous knowledge of

	• 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	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	thirds • identify unit fraction from ½ to 1/10 • divide numbers into halves and quarters • compare simple fractions
Area of competency			
II. Addition, Subtraction, Multiplication & Division of numbers	Grade 1	Grade 2	Grade 3
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	• add whole numbers up to 10,000 • 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	• Subtract whole numbers up to 10,000 • solve word problems using subtraction
3. multiplication	• multiply whole numbers up to 10 by 2 and identify the symbol " × " for multiplication	• multiply whole numbers up to 100 by 2 and 10 • multiply by 0 and 1 whole numbers up to 100 • multiply whole	• multiply whole numbers up to 100 by 1-digit number • multiply multiples of 100 by 1-digit and 2-digit numbers • multiply multiples of 1000 by 1-digit numbers • multiply whole numbers by

		numbers up to 100 by 1-digit numbers and 10 • solve word problems using multiplication by 1-digit numbers and 10	1-digit number product less than 10,000
4. division	• divide whole numbers up to 20 by 2 • identify the symbols" ÷ " :for division	• use the ones centimeter and meter in length • identify the symbols cm and m • explain and show the relation between cm and m • add and subtract the same unit if length	• use the units mm, cm and m to measure length • convert units of length, capacity and weight
Area of competency			
III. Measurements	Grade 1	Grade 2	Grade 3
1. Length	• explain the need for measuring in everyday life • use appropriate language to express length, • measure and compare length using non-standard units	• use the ones centimeter and meter in length • identify the symbols cm and m • explain and show the relation between cm and m • add and subtract the same unit if length	• use the units mm, cm and m to measure length • convert units of length, capacity and weight
2. Weight (mass)	• explain the need for measuring in everyday life • use appropriate language to express weigh • measure and compare weight using non-standard units	• use the unit kilogram in weight • add and subtract kilograms • compare weight in kilogram	• use the units g and kg to measure weight (mass) • convert units of weight
3. capacity	• explain the need for measuring in everyday life • use appropriate language to express capacity • measure and compare capacity using non-standard units	• use the unit liter in capacity • compare capacity using liters • add and subtract liters	• use the units ml and l to measure capacity • convert units capacity
Area of competency			
IV. Geometric shapes & solid	• identify straight and	• draw lines of given	• identify and sketch

objects	curves lines in their environment • draw straight and curves lines • recognize simple shapes, triangles, rectangles and circles, in their environment	length using a ruler • draw squares, rectangles, triangles and circles • identify shapes in the environment	intersecting, parallel and perpendicular lines • construct parallel and perpendicular lines • identify and draw rectangles, squares, parallelograms and trapeziums • Construct circles.
Area of competency			
V. Money	• recognize Ethiopian coins and notes • tell the relationship between cents and 1birr • practice using Ethiopian currency for buying and selling	• add and subtract money using Ethiopian currency • do role play of shopping using Ethiopian currency	• convert from one unit of Ethiopian currency to another • calculate the number of coins or notes that are equivalent to another • solve word problems involving money • find the total cost of two or three different items
Area of competency			
VI. Time	• describe events of their lives according to the time of day- morning, afternoon and evening • name the days of the week • tell time in hours from an analogue clock	• tell the time in hours, half hours and quarter hours using an analogue and a digital clock • describe the relation between hours and minutes	• describe the relationship between hours and minutes • read an analogue and a digital clock in hours and minutes • relate days, weeks, months and years • solve word problems involving time • read a simple calendar
VII. Patterns & Graphs	• Record data using simple pictures like the daily weather • read data from simple picture graphs • continue and produce simple patterns of shapes, colors and numbers	• collect simple data • tabulate collected data • complete and compile simple patterns of shapes and numbers	• construct simple picture graphs from data collected • read data from simple picture graphs

Source:- Ethiopian ministry of education (MOE)

Table 2:- And the EGMA foundational skills tasks are listed in the table below:-

Assessment task	*Description*	*Remark*
1. oral counting	***A timed subtask of EGMA that is used to measure students capacity of counting natural numbers starting from 1 as much as they can without committing mistake or jumping.***	
2. Number Identification	The Number Identification subtest is timed (60 seconds) with no stop rules, and it consists of 20 items that increase in difficulty. The first three items of the subtest include the numerals 0, 9, and one other single-digit number. The next 12 items consist of two-digit numbers from 10 to 99, and the last five items are three-digit numbers from 100 to 999. Students are asked to say each number aloud.	
3. Number/Quantity Discrimination	The Number Discrimination subtest is an untimed test of 10 items with a stop rule after four successive errors. Each item consists of a set of two numbers, one of which is greater than the other. The first item is a set of one-digit numbers, the next five items are sets of two-digit numbers, and the last four items are three-digit numbers. Students state the higher of each set of two numbers (pointing at the correct number is insufficient evidence for scoring).	
4. Missing Number	The Missing Number subtest is an untimed test of 10 items with a stop rule after four successive errors. The items are presented as four horizontally aligned boxes, three of which contain numbers and one of which is empty (the target missing number). Eight of the items increase in number from left to right; two of the items decrease in number from left to right. Items 1, 2, and 6 increase by one (in a set of one-, two-, and three-digit numbers, respectively). Items 3, 4, 5, and 8 increase by tens, hundreds, twos, and fives, respectively. Items 7 and 9 decrease by twos and tens, respectively. The last item with numerals within the range of 1–20 increases by fives, but does not begin with a multiple of five. Students are asked to state the number that belongs in the empty box.	
5. **Addition and Subtraction level 1**	The Addition and Subtraction Level 1 subtests are timed tests (60 seconds) consisting of 20 items each that increase in	

	difficulty. No addends are greater than 10, and no sums are greater than 19. The subtraction problems are the inverse of the addition problems. Three of the items mirror three of the Word Problems items. Assessors also keep track of whether the student used one of three problem-solving strategies: finger/tick marks, paper and pencil calculation, or mental arithmetic..	
6. **Addition and Subtraction level 2**	The Addition and Subtraction Levels 2 subtests are untimed tests consisting of five items each that increase in difficulty, with a stop rule of four successive errors. Addition Level 2 is not given to students who receive a score of zero for Addition Level 1, and Subtraction Level 2 is not given to students who receive a score of zero for Subtraction Level 1. No sums are greater than 70. The subtraction problems are the inverse of the addition problems.	
7. ***Word Problems***	The Word Problems subtest is an untimed test consisting of six items each that increase in difficulty, with a stop rule of four successive errors. Three of these items use numbers that match three items from the Addition and Subtraction Level 1 subtest. Assessors also keep track of whether the student used one of three problem-solving strategies: finger/tick marks, paper and pencil calculation, or solved problem in his or her head. Students are also provided with counters that can be used to solve the problem.	
8. ***Pattern/ shape recognition***	This sub task measures how much students are familiar with the basic geometrical figures like circles, triangles and rectangles.	
9. ***Pattern extension***	This sub task measures learners ability to identify patterns of consecutive geometrical figures to determine what the next shape is correctly.	

Source:- EGMA TOOLKIT (RTI, 2014);

From the two tables above it is easy to pick out the commonalities as well as identify the difference in focus areas of the two different domains. The following table shows us that the common target areas of the minimum learning competency and EGMA tasks.

Table 3: Minimum Learning Competencies and Associated EGMA Tasks

Minimum learning competencies	Grade	Content	EGMA task	EGMA competencies measured
✓ Count, read and write up to 100 ✓ Order and compare whole numbers up to100 ✓ Solve problems of addition and Subtraction ✓ Divide a concrete objects in to two and for equal parts	*1*	***Number and operation***	✓ Oral counting ✓ One to one correspondence ✓ Number identification ✓ Quantity Discrimination ✓ Word problems ✓ Addition and subtraction	✓ Children's ability to produce numbers fluently ✓ The child's understanding that the last number-word counted in a group of objects signifies the value of the group. ✓ The ability to identify written number symbols ✓ The ability to make judgments about differences by comparing quantities, represented by numbers. ✓ The ability to interpret a situation (presented orally to the pupil), make a plan and solve the problem. ✓ Basic knowledge of addition and subtraction. It is expected that students should develop some level of automaticity/fluency and conceptual understanding (accuracy)
✓ Read and write whole numbers up to1000 ✓ Perform the four fundamental operations on whole number up to 1000 ✓ Solve simple word problems ✓ Use fractions of ½, 1/3, ¼ and ¾ on concrete objects	*2*			
✓ Read, write and order whole numbers up to 10,000 ✓ Perform the four fundamental operations on whole numbers up to 10,000 ✓ Describe and use fractions of ½, 1/3, ¼,—1/10 on concrete Objects	*3*			
✓ Use pictures to record and read simple data ✓ Continue and produce simple patterns of shapes, colors and numbers	*1*	***Data handling and pattern***	✓ Missing number identification ✓ Pattern Extension	✓ The ability to discern and complete number patterns. ✓ Children's ability to identify objects making up the pattern and make predictions on how the pattern continues
✓ Collect and tabulate simple data ✓ Complete and compile simple patterns of shapes and numbers	*2*			
✓ Construct and interpret simple picture graphs and bar graphs	*3*			
✓ Recognize shapes by size, shape and name ✓ Draw triangular, rectangular	*1*	***Geometry***	Shape Recognition	✓ Ability to recognize geometric Shapes

and circular shapes				
✓ Draw and name lines of five length ✓ Mark points above, below and on a given line ✓ Draw rectangle, square, triangle and Circles	2			
✓ Identify and sketch intersecting, parallel and perpendicular lines ✓ Construct parallel and perpendicular lines ✓ Identify and drew rectangles, squares, parallelogram and trapezium with their properties	3			

Source: - National Examination and Assessment Agency EGMA baseline report (2014)

2. Research Design and Methodology

2.1 EGMA adaptation

Early grade mathematics assessment (EGMA) has its own core tasks that are used to create and develop instruments of learning assessment in the early stages of child development to measure the level of students' achievement in grasping the foundational skills which are believed to have long lasting learning effect upon them that need early intervention by stakeholders for the betterment of entire school system in an area.

According to the RTI early grade mathematics assessment conceptual framework although other assessments measure mathematical knowledge, EGMA specifically focuses on the skills in the early grades of primary school. In the early grades, there is a strong emphasis on numeracy, which is often called "number sense." Numeracy refers to a "child's fluidity and flexibility with numbers, the sense of what numbers mean, and an ability to perform mental mathematics and to look at the world and make comparisons" (Gersten & Chard, 1999, p. 19–20). The EGMA focuses primarily on numeracy but also include some additional knowledge of basic geometric figures/shapes. This is important because EGMA identifies gaps in the mathematics education that children are receiving at an early age. To address this skill differential, students with limited proficiency may need to be identified early and provided with targeted interventions that provide extra support in learning fundamental mathematical concepts. Moreover, the EGMA was designed primarily to measure performance of learners and it can also be used as a formative assessment, informing teachers where children generally are in the assessed skills at the beginning and end of the school year. However, EGMA is not tied to any one curriculum, its utility as a formative assessment tool throughout the school year is limited. The EGMA was designed to assess, on a large scale, the extent to which students have gained specific foundational mathematical skills. By "foundational," we do not mean what exists in a country-specific curriculum in the early years of school, but what research says is reasonable, given what is known about cross-country achievement in mathematics. These skills include number oral counting, number identification, quantity discrimination, missing number, addition, subtraction, word problem, pattern recognition and pattern extension.

The Ethiopian EGMA baseline report of 2014 states that these EGMA instruments were first adapted from the original EGMA developed by RTI international (RTI, 2009) to the Ethiopian context by a group of mathematics experts (curriculum experts, experienced teachers from different primary schools). Following the instrument adaptation, the EGMA was validated, and revised by validation workshops where experts from the regional and federal levels were involved. By 2012 Addis Ababa city administration education and training quality, occupational competence authority (now Addis Ababa city administration education and quality control authority) took similar measures to adapt the international and national level cultures of implementation of EGMA by preparing its own EGMA implementation manual in Addis Ababa city administration. The EGMA task for Addis Ababa city administration was directly adapted from the Ethiopian early grade mathematics assessment framework with some sort of modification based on the task contextualization from the document adapted nationally. Thus, the city administration EGMA task has the following components as its ingredients that are directly manifested in the assessment instruments developed every period:-

1. **Oral Counting**

The oral counting task is a timed task where students will be orally asked to count numbers starting from the number 1 up to what they can without making a jump or mistake as much as they can within a minute.

2. **Number Identification**

The Number Identification subtest is timed (60 seconds) with no stop rules, and it consists of 30 items that increase in difficulty level as students go along the numbers selected from number to number as well as from row to row beginning with the number at the left top corner. The items include one digit, two digit and three digit numbers. Students are asked to say each number aloud (orally).

3. **Quantity Discrimination/ Number discrimination**

The quantity/number Discrimination subtest is an untimed test of 10 items with a stop rule after successive errors. Each item consists of a set of two numbers, one of which is greater than the other. Students state the higher of each set of two numbers (pointing at the correct number is insufficient evidence for scoring).

4. **Missing Number**

The Missing Number subtest is an untimed test of 5 items with a stop rule. The items are presented as four horizontally aligned boxes, three of which contain numbers and one of which is empty (the target missing number). Some of the items increase in number from left to right and other items decrease in number from left to right. Students are asked to state the number that belongs in the empty box.

5. **Addition/Subtraction (levels 1 and 2)**

The Addition and Subtraction Level subtests are not timed consisting of 10 items each that increase in difficulty. Addends are either one digit or two digit numbers taken in combination whose sums is less than 100. The subtraction problems are the inverse of the addition problems. Assessors also keep track of whether the student used one of three problem-solving strategies: finger/tick marks, paper and pencil calculation, or mental arithmetic.

6. **Word Problem**

The Word Problems subtest is an untimed test consisting of four items each that increase in difficulty with a stop rule. Assessors also keep track of whether the student used one of three problem-solving strategies: finger/tick marks, paper and pencil calculation, or solved problem in his or her head. Students are also provided with counters that can be used to solve the problem.

7. **Pattern recognition**

Pattern recognition is untimed task with list of different commonly known geometric figures and orally out of the list students are asked to identify those circles, those triangles and those rectangles separately.

8. **Pattern extension**

This is untimed task with a pattern having different geometric figures as its components where students are asked to tell what sort of geometric shape comes next based on the pattern given in the paper.

According to the baseline EGMA national report of Ethiopia (2014) the following points can be identified as the potentials of the tasks mentioned above in enhancing once education system. These tasks enable to:-

- reflect those skills that are most predictive of future performance, according to available research and scientific advice;
- represent skills that to the curricula to be acquired in early grades;
- represent a progression of skills that lead toward proficiency in mathematics;
- target both conceptual and computational skills.
- represent skills and tasks that can be improved through instruction.

From the above discussion we can easily understand that the different components of the assessment are developed based on these assumptions. Moreover, questionnaires for students, teachers and principals were developed to gather important information regarding the background of the students and school factors that directly relate to the learning achievement of the learners.

2.2 Instrument development and Pilot testing

The instrument that were used for this research purpose as data gathering tools were prepared with a collaborative task of experts from Addis Ababa education bureau, national education assessment and examination agency as well as carefully selected and well experienced school teachers from Addis Ababa schools. Before the actual use of these instruments for main research purpose a reliability test was conducted. To do this an orientation program was given to ten assessors selected from governmental and nongovernmental schools in the effective delivery of the assessment task at schools orally. From selected ten schools (five governmental and five nongovernmental) a total of randomly selected 400 students participated for the pilot testing purpose to minimize instrument related error before the conduct of the main research. The goal of this pilot test was checking the instruments for reliability and validity so as to take important measures based on the findings of the instrument. Following the pilot test administration test scores were stored for further use in a Microsoft excel template that fits the paper test in terms of format. Data captured was cleaned before the analysis part was carried out. Students from the five Sub cities were the main targets and participants in the pilot test. The reliability test was subjected to Cronbatch's test which is widely used in this area and the alpha value was found to be 0.78 showing it was an acceptable test value and the test items were considered consistent throughout the learners.

2.3 population and sampling

The population of this study was the set of all students who were attending their schooling in grade 2 and grade 3 in Addis Ababa city administration of both governmental and nongovernmental schools. An abstract of the year 2014 E.C prepared by Addis Ababa city administration education bureau was used as a source document to identify the number of primary schools and the total number of students in the target grade levels of the city administration. Based on this information source the total number of primary schools in the two grade levels was 818 (261 governmental and 557 nongovernmental) where in the governmental and nongovernmental schools the number of students are respectively 316,105 and 553,668 that add up to 869, 773.

A stratified cluster sampling technique was applied to determine the effective sample size together with some basic and helpful concepts in scientific research. Students from all the eleven sub cities were involved in the study and each sub city contributed ten randomly selected primary schools for study. Out of the randomly selected primary schools one grade 2 and one grade 3 sections each contributing 20 students for the study were taken (totally 40 students from each school selected) with the necessary sex, school type, administrative location etc. composition was taken into account during the process of sampling where in the class room level the sampling methodology was systematic. To ascertain required sex composition for classes with more than the required sample 10- 10 (male – female) number compositions was used but in the case where there are number of either sex below what is needed all the fewer numbers taken together with the remaining quantity from the second sex both adding up to 40 students in total.

To determine the final sample size in city administration level we have used the direction given by the world bank(2012) which states national assessment sampling or statistical personnel should use the following formula to calculate the design effect (deff) (Kish 1965; Lohr 1999):

$deff = (1 + roh \times (M - 1))$,

where deff. is the design effect, M is the cluster (class) size and roh is the rate of homogeneity or intra class correlation. In this study from the last entity of the clustering process since 40 (20 grade 2 and 20 grade 3 students) are selected implies that M = 40, roh = 0.22 which is the intra class correlation that examines the degree to which students in the same class resemble each other more than they resemble those in other classes or schools with respect to some variable or variables to be measured with effective sample size of 400 where roh value found to be 0.22 extracted from the baseline learning assessment report on basic literacy and numeracy prepared by Addis Ababa Education bureau in 2011. Here the design effect is calculated to be deff = 9.58 and finally the sample size is the product of the design effect and the effective sample size which is 3432. But actually we have considered 4400 students to participate in this study supposing it will increase the quality of data gathered for the research purpose.

Finally to ensure representativeness of the sample in this study the sampling process and effective planed sample size can be summarized as in the table below.

Table 4 :- The sampling process and the effective sample size of the study in term of the number of schools randomly selected

No	Sub city	No of schools planned to participate			No of schools participated			Perform ance In percenta ge	Number of students planned to participate and actually participated		
		Govern mental	Private	Total	Govern mental	Private	total		Planned number	Achieve d	perform ance
1	Addis ketema	5	5	10	5	5	10	100%	400	400	100%
2	Akakikality	5	5	10	5	5	10	100%	400	400	100%
3	Arada	5	5	10	5	5	10	100%	400	400	100%
4	Bole	5	5	10	4	3	7	70%	400	241	60.25%
5	Gulele	5	5	10	5	5	10	100%	400	400	100%
6	Kirkos	5	5	10	5	5	10	100%	400	397	99.25%
7	Kolfekerany o	5	5	10	5	5	10	100%	400	400	100%

8	Lemikura	5	5	10	5	5	10	100%	400	400	100%
9	Lideta	5	5	10	5	5	10	100%	400	400	100%
10	Nifas silk lafto	5	5	10	5	5	10	100%	400	400	100%
11	Yeka	5	5	10	5	5	10	100%	400	400	100%
Total		55	55	110	54	53	107	97.27%	4400	4238	96.32%

(The percentage of governmental and private achievement is 96.36% and 98.18% respectively.)

As indicated in the table above, although the number of students that were expected to participate was 4400, the actual number was 4238 where its percent coverage is 96.32% in which the performance was without any negative effect upon the representativeness of the sample originally selected.

2.4 Data collection

The data that used for this study was collected from schools that are found in all the eleven sub cities of Addis Ababa city administration through random probability sampling and a total of 4238 students, 107 schools, 184 school directors and 372 Teachers responded for the data gathering instrument they were provided to respond effectively. During the data collection process selected school teachers from different schools, education experts from sub city education bureau and Addis Ababa city administration education and training quality control authority, assessment experts from the authority head quarter participated in facilitating and carrying out the tasks they were given as a responsibility to do well especially those who were engaged as assessors that directly assess students face to face in which it involves a high caliber discipline, commitment and care of the assessor from start to the end.

Moreover, a one day orientation and training program was conducted to those engaged in this program taking different responsibilities in how to administer the overall data gathering process based on their appointed positions appropriately.

2.5 Data Analysis Technique.

The data gathered from students, subject teachers and school superintendents through the help of standardized achievement test and questionnaires as instruments was encoded to an Excel template and cleaned so as to make it ready for data analysis. Following the data collection and the process of data screening and cleaning the data in hand was analyzed using SPSS version- 25 (statistical package for social sciences version - 25). Both descriptive and inferential statistics were used for this purpose. Specifically speaking the descriptive statistics mean value, median,

standard deviation, skewness and kurtosis as well as the inferential statistics t- test, ANOVA (one- way and two-way) and correlation measures were applied to analyze the data.

3. EGMA Results and Findings

Under this heading we are going to investigate both the descriptive and inferential analyses of EGMA in a summarized manner. Here performance of learners by group (Like grade level, gender, sub city, school type, school inspection level and age) across the eleven different tasks as well as the overall achievement level will be presented. These descriptive and inferential statistical outputs are obtained based on the data which was gathered from 2128 grade 2 (50.20%) % and 2110 grade 3 (49.80%) students respectively. Moreover, the sex composition of the sample analyzed was respectively 2136 (50.40%) female and 2095 (49.60%) male students (missing 7; 0.20%). . The data gathered from schools was obtained from 54 private (50.47%) and 53 governmental (49.53%) schools. 99% of the schools included in this study and its analysis part were schools whose inspection level was either level 2 (40.50%) or level 3 (58.50%). Only one school was level 4 and no school was found with the level judgment of 1.

3.1 Summary of EGMA Descriptive Results

One of the major components that EGMA study and report about is regarding how accurately and fluently students answered during test. In a test the measure how much correctly the students answered out of the total provided number of questions regardless of the time restriction imposed upon them is a measure of accuracy while the speeds measure is a measure of fluency. Here for the sake of convenience the scores are converted and reported in terms of percent measures to easily express the whole cumulative result in terms of individual student average performance. Table 5 below presents a summarized scores of students in all the ten objective EGMA sub tasks and based on that table the overall percent mean score of all the students is found to be 81.14 % suggesting that students has correctly answered around 81 questions out of 100 on average. Reversing this fact it implies that each student has missed or they were unable to answer questions they were asked correctly based on the direction they were provided were (actually these are the number of difficult questions for the learners) 19 questions out of 100.

The total percent mean score of the EGMA was 81.14 % with standard deviation of 16.08 where the maximum score is 100 and the minimum score was 8.13. Subtasks missing number, addition level 2, subtraction level 2 and word problem percent mean score were below the overall percent

mean score while the remaining subtasks were above what is the overall percent mean of the sample.

The overall percent mean value being 81.14% the median value of the achievement score was 84.96 suggesting that half of the number of students scored below 84.96 while the remaining half part scored more than the median value indicated.

The skewness of mean scores of all the subtasks as depicted in the table is -0.992 and its meaning in a relative way is interpreted as the majority of the students score was greater than the overall mean score of the entire sample.

The mean scores of the tasks number identification, quantity discrimination, addition level 1, addition level 2, subtraction level 1, subtraction level 2, word problem, pattern recognition, and pattern extension respectively were 81.23%, 91.93%, 62.62% 90.73%, 79.22%, and 92.53%., 70.20%, 71.09%, 84.73%, 87.53%,. Students scored the greatest score in subtraction level 1 and the least in missing number. Thus compared to the other sub tasks students have a learning difficulty in missing numbers and subtraction level 2 sub tasks. Learning number quantity subtraction level 1 and quantity discrimination was not as such problematic. Therefore the overall learning difficulty pattern follows the following path:-

Subtraction level 1 > Quantity discrimination> Addition level 1 > Pattern Extension > pattern recognition > Number identification > Addition level 2 > Word problem > Subtraction level 2 > missing number.

In addition to this half part of the students scored greater than or equal to 100 in five sub tasks: number subtraction level 1, addition level 1, quantity discrimination, pattern recognition and pattern extension. From this fact we can draw the conclusion that there were students with very good and rewarding scores especially in the five different EGMA sub tasks. In the sub tasks with median value 100 more than half part (majority) of the students has completed their task without any mistaken response. This achievement of students is really priceless.

Table 5: **EGMA Percent Mean Scores and accuracy Descriptive Statistics by Subtasks**

EGMA sub Task	N	Mean	Median	SD	Skewness
Subtraction level 1	4210	92.53	100	**16.55**	-3.255
Quantity discrimination	4220	91.93	100	21.94	16.539
Addition level 1	4218	90.73	100	26.65	27.400
Pattern extension	4179	87.53	100	**20.66**	-1.740
Pattern recognition	4191	84.73	100	23.92	-1.333
Number identification	4149	81.23	96.67	24.27	-1.466
Addition level 2	4207	79.22	90	25.56	-1.366
Word problem	4168	71.09	71.43	29.85	4.652
Subtraction level 2	4208	70.20	80	**32.12**	6.562

Missing number	4209	62.62	60	**31.57**	0.227
Overall EGMA score	3956	81.14	84.96	16.08	-0.992

In aggregate more than half of the students scored above the overall percent mean score as well as in the subtasks: subtraction level 1, pattern extension, pattern recognition, number identification and addition level 2. In the sub tasks quantity discrimination, addition level 1, word problem, subtraction level 2, and missing number the number of students whose score is less than or equal to the overall percent mean score is more. In subtraction level 2 and missing number sub tasks students' scores are highly scattered meaning the difference in scores of the pupils is very high compared to others. Similar and nearly close scores among students were observed in pattern extension and subtraction level 1 sub tasks.

Figure 1:- Overall percent mean score of the EGMA by subtasks

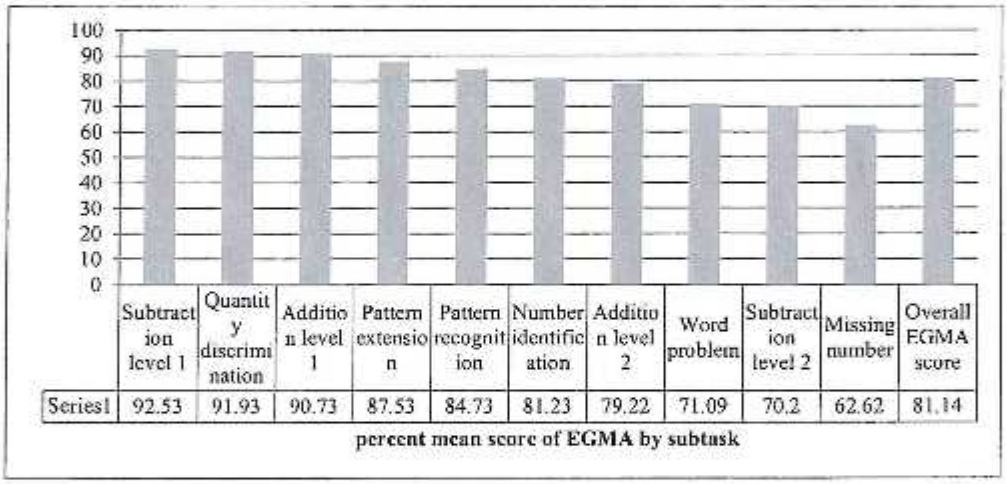


Table 6 below also shows the co relational relationship calculated in terms of Pearson's moment correlation coefficient(r) and accordingly it indicates that there is a positive relationship between and among all the EGMA subtasks. The performance level of students on one sub task determines or influences the performance level on the other explicitly. But the strength of the relationship varies from sub task to sub task when we consider the relationship pair wise separately. For instance, of all the subtasks the strongest relationship is observed between addition level 2 and subtraction level (.678) and the weakest was between oral counting and addition level 1 (.040) relatively. Therefore, some sort of performance gap on one prerequisite makes the learners to highly struggle to fully understand the other and not to perform well in a sub task because of the positive relationship that existed between the sub tasks.

Compared to EGRA always there is higher overall percent mean score in EGMA. But since its concern is all about foundational mathematical skill it needs further improvement in students

proficiency level. Here we want to remind all stakeholders that still a ceaseless and high level of commitment is needed to improve the scores of students in all the sub tasks further and to create conducive learning environment for all pupils by eliminating those factors that are being observed as setbacks to performance of students giving special emphasis to the factors that are linked with the low scorer ones.

Table 6:- **Pearson correlation coefficient for EGMA subtasks**

	Oral counting	Number identification	Quantity discrimination	Missing number	Addition level 1	Addition level 2	Subtraction level 1	Subtraction level 2	Word problem	Pattern recognition	Pattern extension
Oral counting	1	.126	.069	.089	.040	.118	.065	.110	.114	.108	.053
Number identification	.126	1	.272	.321	.207	.395	.324	.363	.334	.054	.231
Quantity discrimination	.069	.272	1	.273	.237	.345	.386	.294	.249	.127	.258
Missing number	.089	.321	.273	1	.281	.542	.370	.503	.519	.116	.340
Addition level 1	.040	.207	.237	.281	1	.443	.418	.354	.311	.146	.210
Addition level 2	.118	.395	.345	.542	.443	1	.575	.678	.568	.211	.357
Subtraction level 1	.065	.324	.386	.370	.418	.575	1	.493	.417	.204	.336
Subtraction level 2	.110	.363	.294	.503	.354	.678	.493	1	.530	.156	.299
Word problem	.114	.334	.249	.519	.311	.568	.417	.530	1	.145	.326
Pattern recognition	.108	.054	.127	.116	.146	.211	.204	.156	.145	1	.125
Pattern extension	.053	.231	.285	.340	.210	.357	.336	.299	.326	.125	1

In addition to this when the timed sub tasks (Oral counting and number identification) were tested against the speed of learners based on the scores they have and the time used to answer together with a simple mathematical concept yielded us the following results.

- The overall oral counting speed of learners was 101.17/min. rounded off 101 suggesting that in average a student in Addis Ababa in the early grades can count until the number 101 within a minute (60 seconds) without committing a mistake starting from the number 1 consecutively if asked to count as much as he/she can within the time frame.
- The overall number identification speed of learners was 40.68/min. rounded off 40 meaning that in average a student in Addis Ababa in the early grades can identify 40 numbers correctly within a minute.

3.1.1 EGMA Summary Results by Subtask and Grade

We can draw some possible conclusions from Table 7 below concerning the performance of students by grade level in all the EGMA sub tasks separately. Moreover, it shows as the relative performance of one grade level compared to the other clearly. The mean score of grade 3 students (82.65%) was higher than the mean score of grade 2 (79.64%) students along all the

subtasks. Grade 2 students scored the highest in subtraction level 1 and quantity discrimination (91.83% and 90.44%) and the lowest scores in missing number and word problem (61.29% and 68.31%) respectively. Grade 3 students scored the highest in quantity discrimination and subtraction level 1 (93.44% and 93.25%) and the lowest scores in missing number and subtraction level 2 (63.97% and 72.51%) in which the sub task difficulty is almost similar in both the two grade levels.

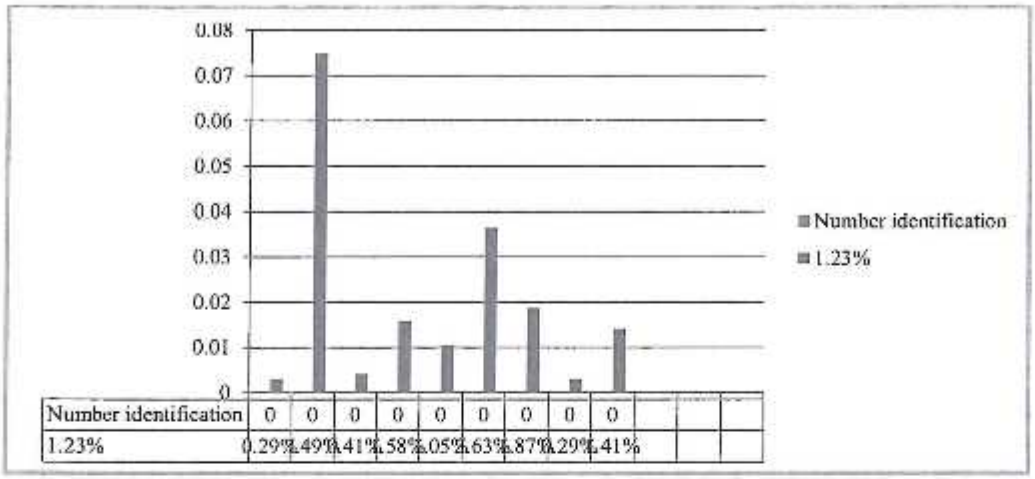
Simple observation on table 7 also suggests that separately in the eleven EGMA subtasks as well as the overall mean score from grade 2 to grade 3 there was an improvement on the performance of students entirely. No extreme results were observed. This is to mean that even though there was a difference in the crude mean scores the difference was not something that shows a special gap or strength.

In addition to this an independent sample t test was conducted to identify whether there was a significant difference between the mean scores of the two grade levels and as a result there was a significant difference in scores for students of grade 3 (M= 82.65%) and grade 2 (M= 79.64%); SD= 16.74; t(3956)= - 5.906; p= 0.013 < 0.05, two-tailed). The mean increment was 3.01% along the 95% confidence interval of the difference.

Table 7: EGMA Summary Percent Mean Scores by Grade and Gender (ACCURACY)

Subtasks	Grade 2	Grade 3
Oral counting	92.95	96.09
Number identification	77.30	85.20
Quantity discrimination	90.44	93.44
Missing number	61.29	63.97
Addition level 1	90.16	91.30
Addition level 2	77.50	80.95
Subtraction level 1	91.83	93.25
Subtraction level 2	67.89	72.51
Word problem	68.31	73.87
Pattern recognition	84.08	85.38
Pattern extension	86.29	88.78
Overall percent mean score	79.64	82.65

Figure 2:- EGMA percent mean along each subtask by grade level



3.1.2 EGMA Results by Gender

From table 8 below which depicts the percent mean score of EGMA sub tasks by gender shows that there is slight difference between male and female performance along all the subtasks. Though the mean difference was small female mean score was higher than male in the areas of addition level 1, subtraction level 2, word problem, and pattern recognition. In the remaining seven sub tasks (oral counting, number identification, quantity discrimination, missing number, addition level 2, subtraction level 1 and pattern extension males score was higher than those of female scores.

Table 8 :- **EGMA Summary Percent Mean Score by Gender**

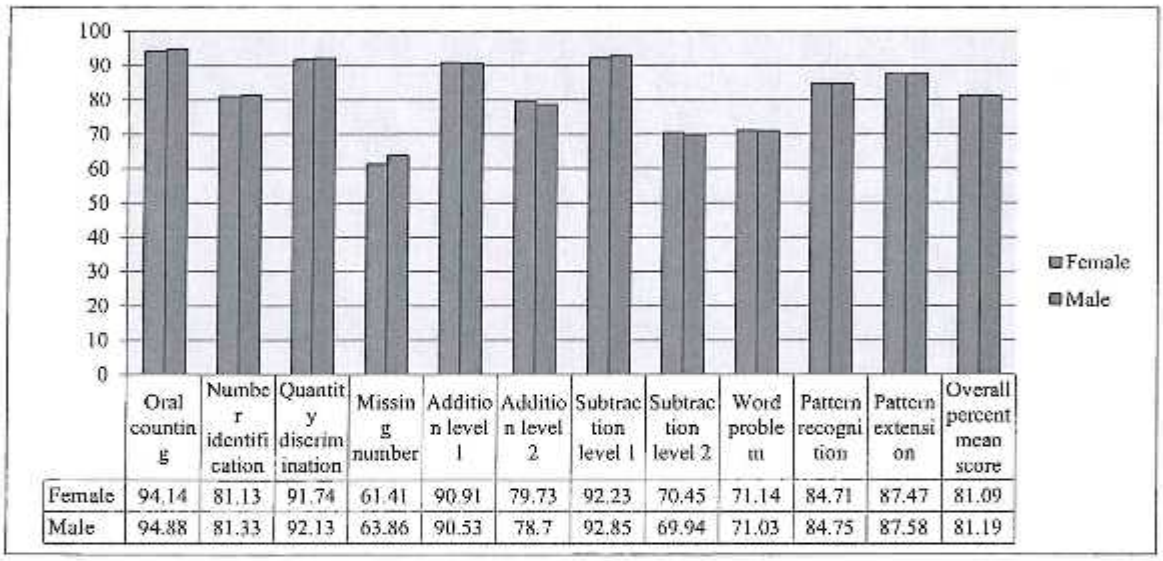
Sub tasks	Female	Male
Oral counting	94.14	94.88
Number identification	81.13	81.33
Quantity discrimination	91.74	92.13
Missing number	61.41	63.86
Addition level 1	90.91	90.53
Addition level 2	79.73	78.70
Subtraction level 1	92.23	92.85
Subtraction level 2	70.45	69.94
Word problem	71.14	71.03
Pattern recognition	84.71	84.75
Pattern extension	87.47	87.58
Overall percent mean score	81.09	81.19

The overall percent mean score for male is greater than female with the mean difference value of 0.10%. The independent samples t test conducted suggests that the mean score for male and

female was not statistically significant (t= -0.201; N= 3953; p = 0.668 > 0.05, 2-tailed) at 95% confidence interval.

The maximum difference was in missing number (MD= 2.45%) and the least difference was in word problem subtasks (MD= 0.09%). Both male and female percent mean score was more than the overall EGMA mean score (M= 81.14%) in quantity discrimination, addition level 1, subtraction level 1, pattern recognition and pattern extension. Moreover, the overall mean score of females (81.09%) was less than the overall mean score of the EGMA test scores.

Figure 3:- EGMA percent mean along subtasks by gender



	Oral counting	Number identification	Quantity discrimination	Missing number	Addition level 1	Addition level 2	Subtraction level 1	Subtraction level 2	Word problem	Pattern recognition	Pattern extension	Overall percent mean score
Female	94.14	81.13	91.74	61.41	90.91	79.73	92.23	70.45	71.14	84.71	87.47	81.09
Male	94.88	81.33	92.13	63.86	90.53	78.7	92.85	69.94	71.03	84.75	87.58	81.19

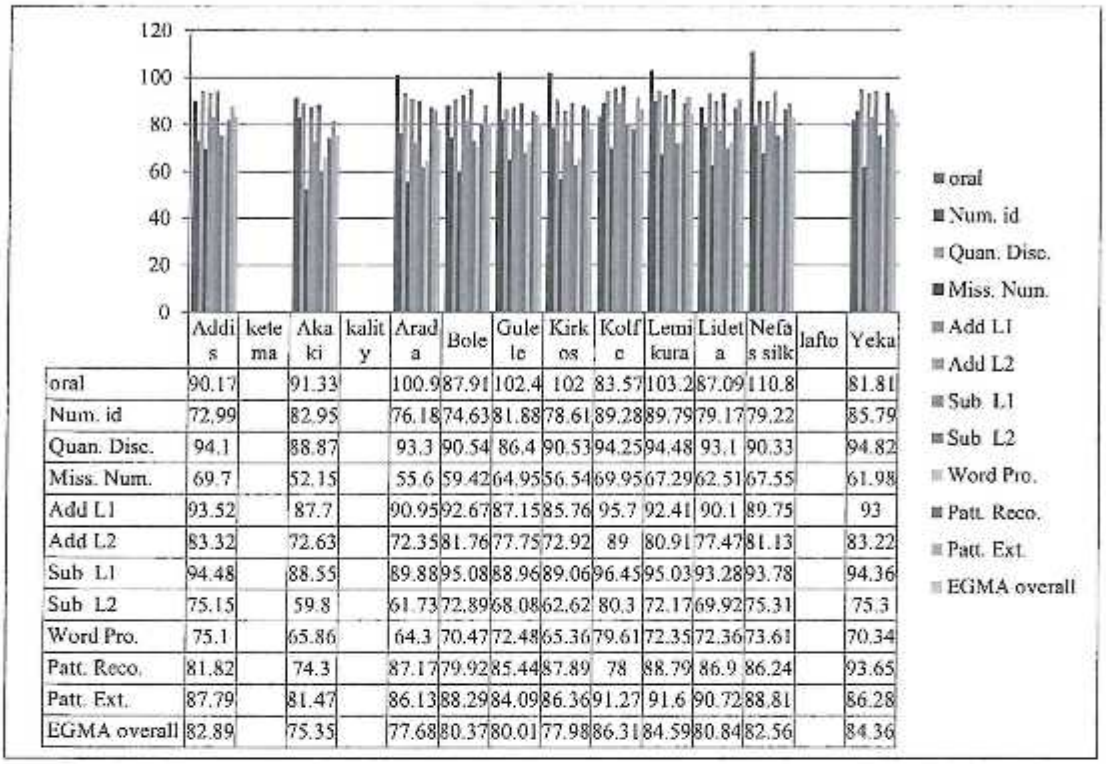
3.1.3 EGMA Results by Sub city

Table 9 below depicts the performance of students along sub cities of Addis Ababa in both the sub tasks as well as the overall percent mean score of students that belong to different sub cities. Based on this information the maximum result was scored by kolfe keranyo sub city on subtraction level 1 (96.45%) and the minimum score was that of akaki kality sub city in missing number (52.15%). In addition the overall percent mean scores of the maximum and minimum values were scored by Kolfe keranyo (86.31%) and Akaki kality sub cities (75.35%) respectively. In six areas areas of EGMA Kolfe keranyo sub city scored the highest (missing number, addition level 1, addition level 2, subtraction level 1, subtraction level 2 and word problem) and similarly lemikura subcity scored highest scores in two sub tasks (number identification and pattern extension). Akaki kality (missing number, subtraction level 1 and pattern recognition) and arada (addition level 2, subtraction level 2 and word problem) sub cities scored minimum in three different sub tasks each.

Table 9:- EGMA Descriptive Percent Mean Score by Sub city

Subcity	oral	Num. id	Quan. Disc.	Miss. Num.	Add L1	Add L2	Sub L1	Sub L2	Word Pro.	Patt. Reco.	Patt. Ext.	EGMA Overall
Addis Ketema	90.17	72.99	94.10	69.70	93.52	83.32	94.48	75.15	75.10	81.82	87.79	**82.89**
Akaki Kality	91.33	82.95	88.87	52.15	87.70	72.63	88.55	59.80	65.86	74.30	81.47	75.35
Arada	100.88	76.18	93.30	55.60	90.95	72.35	89.88	61.73	64.30	87.17	86.13	77.68
Bole	87.91	74.63	90.54	59.42	92.67	81.76	95.08	72.89	70.47	79.92	88.29	**80.37**
Gulele	102.35	81.88	86.40	64.95	87.15	77.75	88.96	68.08	72.48	85.44	84.09	**80.01**
Kirkos	102.04	78.61	90.53	56.54	85.76	72.92	89.06	62.62	65.36	87.89	86.36	77.98
Kolfe	83.57	89.28	94.25	69.95	95.70	89	96.45	80.30	79.61	78	91.27	86.31
Lemikura	103.18	89.79	94.48	67.29	92.41	80.91	95.03	72.17	72.35	88.79	91.60	84.59
Lideta	87.09	79.17	93.10	62.51	90.10	77.47	93.28	69.92	72.36	86.90	90.72	**80.84**
Nefas silk lafto	110.82	79.22	90.33	67.55	89.75	81.13	93.78	75.31	73.61	86.24	88.81	**82.56**
Yeka	81.81	85.79	94.82	61.98	93	83.22	94.36	75.30	70.34	93.65	86.28	**84.36**

Figure 4:- EGMA sub task based percent mean by sub city



	Addis	ketema	Akaki	kality	Arada	Bole	Gulele	Kirkos	Kolfe	Lemikura	Lideta	Nefas silk	Jafto	Yeka
oral	90.17		91.33		100.9	87.91	102.4	102	83.57	103.2	87.09	110.8		81.81
Num. id	72.99		82.95		76.18	74.63	81.88	78.61	89.28	89.79	79.17	79.22		85.79
Quan. Disc.	94.1		88.87		93.3	90.54	86.4	90.53	94.25	94.48	93.1	90.33		94.82
Miss. Num.	69.7		52.15		55.6	59.42	64.95	56.54	69.95	67.29	62.51	67.55		61.98
Add L1	93.52		87.7		90.95	92.67	87.15	85.76	95.7	92.41	90.1	89.75		93
Add L2	83.32		72.63		72.35	81.76	77.75	72.92	89	80.91	77.47	81.13		83.22
Sub L1	94.48		88.55		89.88	95.08	88.96	89.06	96.45	95.03	93.28	93.78		94.36
Sub L2	75.15		59.8		61.73	72.89	68.08	62.62	80.3	72.17	69.92	75.31		75.3
Word Pro.	75.1		65.86		64.3	70.47	72.48	65.36	79.61	72.35	72.36	73.61		70.34
Patt. Reco.	81.82		74.3		87.17	79.92	85.44	87.89	78	88.79	86.9	86.24		93.65
Patt. Ext.	87.79		81.47		86.13	88.29	84.09	86.36	91.27	91.6	90.72	88.81		86.28
EGMA overall	82.89		75.35		77.68	80.37	80.01	77.98	86.31	84.59	80.84	82.56		84.36

A one-way between groups analysis of variance (ANOVA) by sub city was conducted to identify sub cities that had statistically significant difference on the overall percent mean score of EGMA and part of the ANOVA output given in table 9 below shows that there was a significant difference between sub cities' percent mean scores of EGMA at $F = 17.064$ and $p < 0.05$.

Table 10:- EGMA overall mean score comparison by sub city using one way ANOVA

ANOVA					
EGMA OVERALL PERCENT MEAN SCORE					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	42398.044	10	4239.804	17.064	.000
Within Groups	980174.947	3945	248.460		
Total	1022572.991	3955			

Post hoc section of the ANOVA output using Tukey HSD method together with simple reading of the table 11 to check sub city groupings with statistically close mean scores or to mark category of homogeneous sub cities suggests that the sub cities were categorized into four different groups of homogeneous performance category. As to this categorization Kolfe keranyo, was in the category with the maximum possible percent mean score and Gulele was in the low category with the least percent mean score at the top in terms of mean and in all the categories there was a coincidence in percent mean values of different sub cities with no significant difference in it. A statistically significant difference was discovered between the pairments in the

columns of the following table where the left hand row is with relatively lower overall EGMA percent mean score than the right bottom category.

Table 11:- **homogeneous sub set groupings of EGMA overall percent mean scores by sub city using one- way ANOVA (TUKEY HSD method)**

Sub city	N	Sub set for alpha=0.05			
		1	2	3	4
Akaki kality	395	75.35			
Arada	398	77.68			
Kirkos	364	77.98			
Gulele	385		80.01		
Bole	231		80.37		
Lideta	344		80.84		
Nifas silk lafto	378			82.56	
Addis ketema	376			82.89	
Yeka	354				84.36
Lemikura	339				84.59
Kolfe keranyo	392				86.31
Sig.		0.499	0.220	0.352	0.06

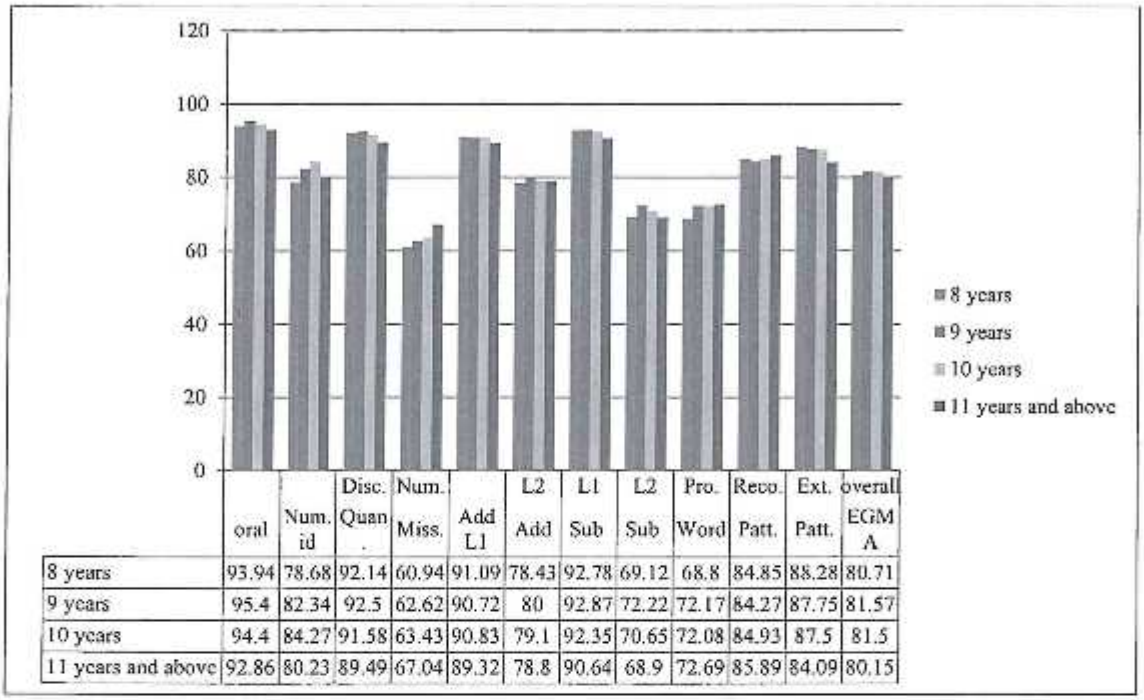
3.1.4 EGMA Results by Age

A one way ANOVA was again conducted on the final data to compare different age group performances and check the differences whether they are statistically significant or not. Based on the information gathered concerning the descriptive statistics part the age group 9 yrs. scored the maximum overall percent mean (81.57%) and minimum scoring group was the age group 11 years and more (80.15%). Task wise examination yielded us that students of age 8 years scored the least in missing number (60.94%) and students of age 9 scored the maximum result in subtraction level 1 (92.87%) out of all the EGMA sub task scores recorded.

Table 12:- EGMA Descriptive Percent Mean Score by Age

Age	oral	Num. id	Quan. Disc.	Miss. Num.	Add L1	Add L2	Sub L1	Sub L2	Word Pro.	Patt. Reco.	Patt. Ext.	EGMA Overal l
8 years	93.94	78.68	92.14	60.94	91.09	78.43	92.78	69.12	68.80	84.85	88.28	**80.71**
9 years	95.40	82.34	92.50	62.62	90.72	80	92.87	72.22	72.17	84.27	87.75	81.57
10 years	94.40	84.27	91.58	63.43	90.83	79.1	92.35	70.65	72.08	84.93	87.50	**81.50**
11 years and above	92.86	80.23	89.49	67.04	89.32	78.80	90.64	68.90	72.69	85.89	84.09	**80.15**

Figure 5:- EGMA overall percent mean score by age



	oral	Num. id	Disc. Quan.	Num. Miss.	Add L1	L2 Add	L1 Sub	L2 Sub	Pro. Word	Reco. Patt.	Ext. Patt.	overall EGMA
8 years	93.94	78.68	92.14	60.94	91.09	78.43	92.78	69.12	68.8	84.85	88.28	80.71
9 years	95.4	82.34	92.5	62.62	90.72	80	92.87	72.22	72.17	84.27	87.75	81.57
10 years	94.4	84.27	91.58	63.43	90.83	79.1	92.35	70.65	72.08	84.93	87.5	81.5
11 years and above	92.86	80.23	89.49	67.04	89.32	78.8	90.64	68.9	72.69	85.89	84.09	80.15

Table 13 below indicates that there was a percent mean difference in the overall percent mean scores among the different age categories at $F(3, 3952) = 1.281$; $p = 0.279 > 0.05$. Moreover, the post hoc comparison output suggests that there was not a significant overall percent mean difference among the age groups.

Table 13:- **EGMA overall mean score comparison by age using one way ANOVA**

ANOVA					
EGMA OVERALL PERCENT MEAN SCORE					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	993.130	3	331.043	1.281	.279
Within Groups	1021579.860	3952	258.497		
Total	1022572.991	3955			

To test the age groups against homogeneity a post hoc Tukey test was applied and it shown that the students were grouped into a single group of homogeneity indicating that there is no statistical difference between and among the overall percent mean scores of the four different age group categories.

Table 14 :- **homogeneous sub set groupings of EGMA overall percent mean scores by age using one- way ANOVA (TUKEY HSD method)**

EGMA OVERALL PERCENT MEAN SCORE		
Tukey HSD[a,b]		
AGE (Binned)	N	Subset for alpha = 0.05
		1
4 11.00+	377	80.1538
1 <= 8.00	1319	80.7142
3 10.00 - 10.00	665	81.4996
2 9.00 - 9.00	1595	81.5747
Sig.		.335
Means for groups in homogeneous subsets are displayed.		
a. Uses Harmonic Mean Sample Size = 721.841.		
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.		

3.1.5 EGMA Results by School type

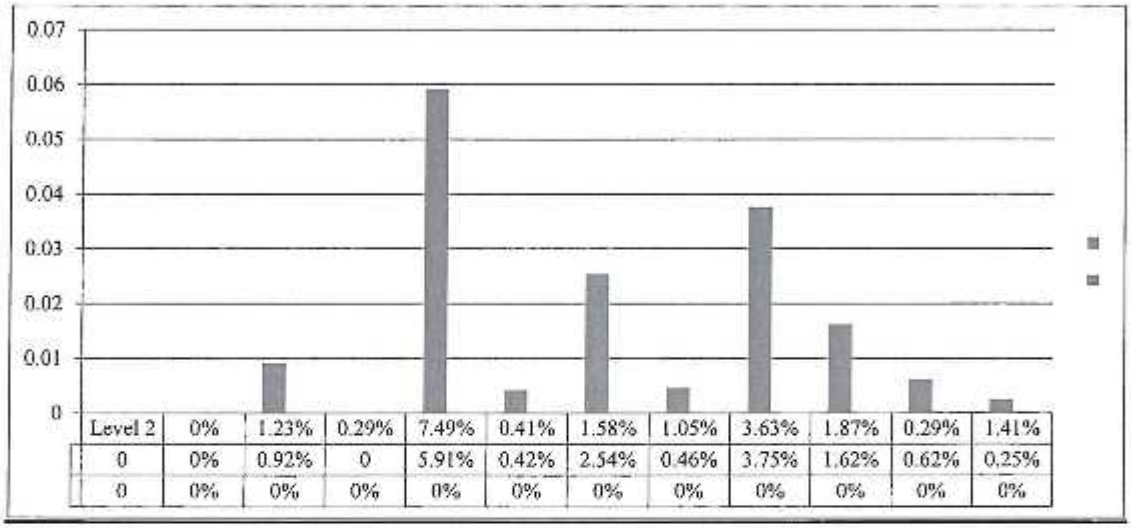
In this research school type is defined according to their ownership and administration. Those schools under full control and financial support of the government are termed as governmental schools and those owned and administered by investors of different type are named by private schools. Both the school types work based on the government curriculum framework. As shown in the table below in all the eleven sub tasks private schools scores was higher than private schools. Task wise inspection indicated that the maximum difference was in subtraction level 2 (12.69%) and the minimum difference was in addition level 1 (6.33%).

Table 15:- EGMA descriptive result along sub tasks by school type

Sub task	Governmental schools	Private schools
Oral counting	91.72	97.06
Number identification	77.67	84.67
Quantity discrimination	88	95.87
Missing number	58.42	66.82
Addition level 1	87.56	93.89
Addition level 2	74.90	83.54
Subtraction level 1	89.27	95.80
Subtraction level 2	64.03	76.36
Word problem	65.76	76.53

Pattern recognition	81.28	88.17
Pattern extension	83.15	91.92
Overall percent mean score	76.74	85.45

Figure 6 :- EGMA RESULTS along sub tasks by school type



Level 2	0%	1.23%	0.29%	7.49%	0.41%	1.58%	1.05%	3.63%	1.87%	0.29%	1.41%
0	0%	0.92%	0	5.91%	0.42%	2.54%	0.46%	3.75%	1.62%	0.62%	0.25%
0	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

In addition to this an independent sample t test was conducted to identify whether there was a significant difference between the mean scores of the two school types and as a result there was a significant difference (MD= 8.71&) in percent mean scores of students in private schools (85.45%) and in government schools (76.74%); SD= 13.20; t (3956)= - 17.02; p= 0.00 < 0.05, two-tailed). The mean increment was 3.01% along the 95% confidence interval of the difference

Table 16:- ANOVA test by school type

Group Statistics					
	SCHOOL TYPE	N	Mean	Std. Deviation	Std. Error Mean
EGMA OVERALL PERCENT MEAN SCORE	1.00 GOVERNMENTAL SCHOOL	1959	76.7410	17.50146	.39542
	2.00 PRIVATE SCHOOL	1997	85.4547	13.19935	.29537

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
EGMA OVERALL PERCENT MEAN SCORE	Equal variances assumed	178.087	.000	-17.702	3954	.000	-8.71371	.49225	-9.67881	-7.74862
	Equal variances not assumed			-17.655	3640.715	.000	-8.71371	.49356	-9.68139	-7.74604

3.1.6 EGMA Results by Inspection School Level

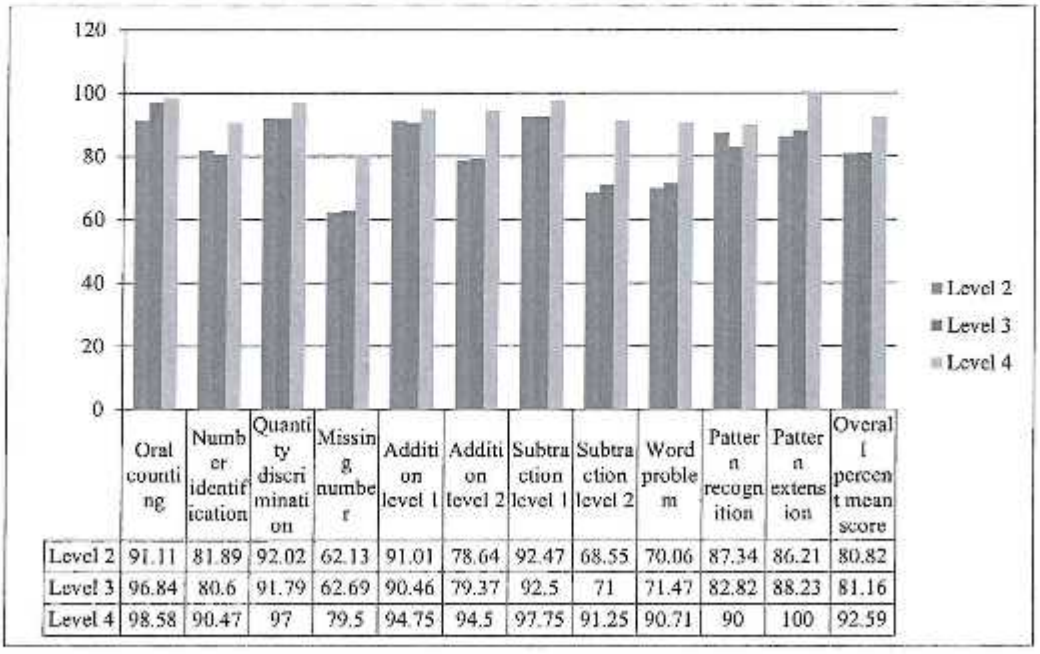
The school level evaluative dimension forms an important part of school inspectors' roles, which means that inspections have at their core an element of judgment, using a framework that allows for some level of comparison between schools. These frameworks include standards on school quality, or indicators to check compliance to legislation and judgments are generally presented in inspection reports with a description of the school's functioning on each of the standards or in summary scores. (C.M. Ehren, 2016) in the Ethiopian school inspection framework there are four different levels that show the status and quality of schools in terms of the standards put in three major areas (input, process and output) containing different measurable indicators within them. These inspection school levels extend from level one to level four from the lowest quality to the optimum one in order. Levels 1 and 2 are categorized as below standard. Thus, all schools are expected to be level 3 and above to deliver quality education to students. Under this sub heading we are going to compare the scores of students against the school inspection levels. Actually there was no any level one school found during this study analysis.

As we can see from the table below students of level 4 school has scored the maximum overall percent mean score (92.59%) and the minimum was scored by level 2 school students score (80.82%). In all the eleven EGMA sub tasks the maximum score was observed to be that of students from level four school while the minimum sub tasks score fluctuating from level 2 to level 3 differently. In seven sub tasks (oral counting, missing number, addition level 2, subtraction level 1, subtraction level 2, word problem, and pattern extension) students of level 2 schools scored least and in four sub tasks (number identification, quantity discrimination, addition level 1, pattern recognition) learners of level 3 schools scored minimum.

Table 17:- EGMA results along sub tasks by school inspection level

Sub task	Level 1	Level 2	Level 3	Level 4
Oral counting	-	91.11	96.84	98.58
Number identification	-	81.89	80.60	90.47
Quantity discrimination	-	92.02	91.79	97
Missing number	-	62.13	62.69	79.50
Addition level 1	-	91.01	90.46	94.75
Addition level 2	-	78.64	79.37	94.50
Subtraction level 1	-	92.47	92.50	97.75
Subtraction level 2	-	68.55	71	91.25
Word problem	-	70.06	71.47	90.71
Pattern recognition	-	87.34	82.82	90
Pattern extension	-	86.21	88.23	100
Overall percent mean score	-	80.82	81.16	92.59

Figure 7:- EGMA results along sub tasks by school inspection level



	Oral counting	Number identification	Quantity discrimination	Missing number	Addition level 1	Addition level 2	Subtraction level 1	Subtraction level 2	Word problem	Pattern recognition	Pattern extension	Overall percent mean score
Level 2	91.11	81.89	92.02	62.13	91.01	78.64	92.47	68.55	70.06	87.34	86.21	80.82
Level 3	96.84	80.6	91.79	62.69	90.46	79.37	92.5	71	71.47	82.82	88.23	81.16
Level 4	98.58	90.47	97	79.5	94.75	94.5	97.75	91.25	90.71	90	100	92.59

A one way ANOVA was again conducted on the final data to compare different inspection school level based performances and check the differences whether they are statistically

significant or not. The post hoc part of ANOVA output on homogeneity of groups suggested that the achievement level was categorized into two statistically different groups. There was statistically significant mean difference between scores of students from level 4 school and any other level 2 or level 3 school students. No statistically significant mean difference was observed between level 2 and level 3 school students achievement.

Table:_ 18- ANOVA TEST BY SCHOOL INSPECTION LEVEL

EGMA OVERALL PERCENT MEAN SCORE			
Tukey HSD[a,b]			
INSPECTION LEVEL	N	Subset for alpha = 0.05	
		1	2
2.00 LEVEL 2	1606	80.8233	
3.00 LEVEL 3	2310	81.1614	
4.00 LEVEL 4	40		92.5933
Sig.		.986	1.000
Means for groups in homogeneous subsets are displayed.			
a. Uses Harmonic Mean Sample Size = 115.139.			
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.			

3.1.7 EGMA ZERO SCORES

The zero scorer students are those who are unable to answer any question correctly from the given achievement test questions of different EGMA subtasks. These types of students are with learning difficulty in the entire sub task.

3.1.7.1. EGMA zero scores by sub tasks

Table 19 below provides us with the percentage of zero scorers in the eleven EGMA sub tasks. According to this information a relative comparison was carried out and a large number of students who scored zero were found in missing number (6.58 %) and subtraction level 2 (3.71%) where small number of zero scorers were in the sub tasks oral counting (0%) and number identification (0.01%) of the EGMA sub task results. When zero score results are compared to the percent mean score of sub tasks it clearly suggests that areas with students' scores are high are also with minimum zero scoring students in it where as in lower percent mean score sub tasks there were high number of zero scorers showing there is a pattern like relationship between zero score percentage and sub task mean score percentage. Moreover, as students proceed from simple tasks to additional skill requiring tasks the percentage of zero score tends to increase. But there was no even a single student who scored zero in the overall EGMA percent mean score.

Table 19 :- EGMA zero score by subtask

Sub task	Zero score (%)
Oral counting	0%
Number identification	0.01%
Quantity discrimination	0.22%
Missing number	6.58%
Addition level 1	0.41%
Addition level 2	2.14%
Subtraction level 1	0.71%
Subtraction level 2	3.71%
Word problem	1.73%
Pattern recognition	0.49%
Pattern extension	0.73%

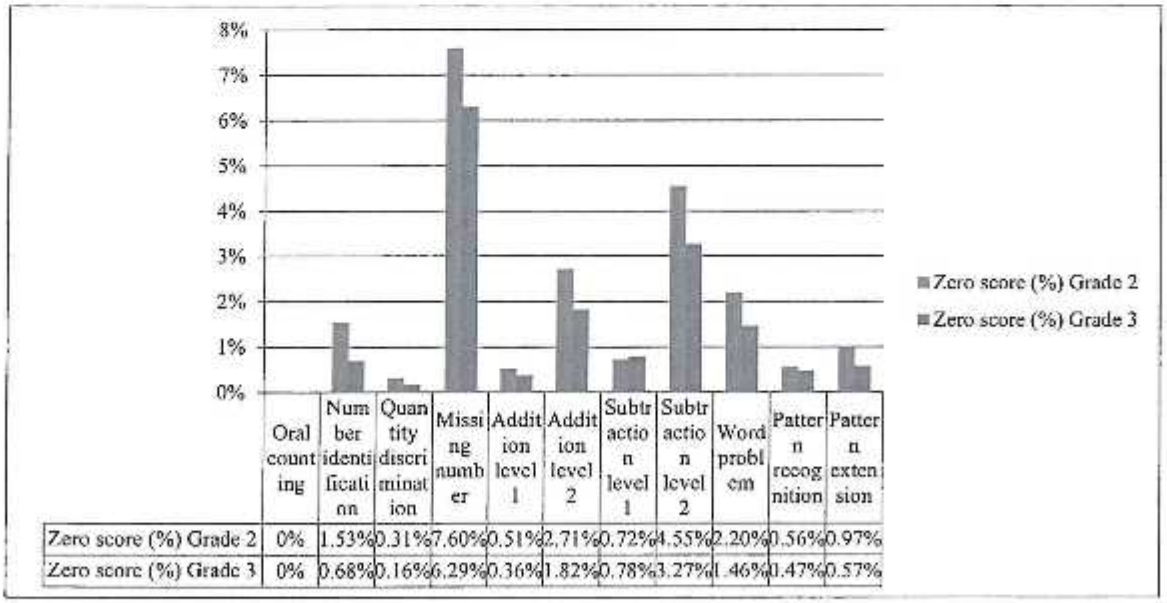
3.1.7.2 EGMA ZERO SCORE BY GRADE LEVEL

The percentage of students who scored zero by grade level along each sub task is shown by table 20 and figure 9 below and based on it both grade 2 and grade 3 has students with zero scores along all the sub tasks except oral counting. Maximum percent mean score of zero score was observed in missing number (7.60%) by grade 2 students and the minimum zero percent mean score was in oral counting (0%) in both the grade levels. Other than oral counting the minimum score was in 0.16% in quantity discrimination by grade 3. In grade 2 alone the maximum and minimum zero score percent mean scores were found in missing number (7.60%) and quantity discrimination (0.31%) respectively. For grade 3 the greatest and least zero percent mean scores were in the subtasks missing number (6.29%) and quantity discrimination (0.16%). In the sub tasks missing number, addition level 2, subtraction level 2 and word problem there were large number of students in both grades who scored zero.

Table 20:- EGMA zero percent mean score along sub tasks by grade level

Sub task	Zero score (%) Grade 2	Zero score (%) Grade 3
Oral counting	0%	0%
Number identification	1.53%	0.68%
Quantity discrimination	0.31%	0.16%
Missing number	7.60%	6.29%
Addition level 1	0.51%	0.36%
Addition level 2	2.71%	1.82%
Subtraction level 1	0.72%	0.78%
Subtraction level 2	4.55%	3.27%
Word problem	2.20%	1.46%
Pattern recognition	0.56%	0.47%
Pattern extension	0.97%	0.57

Figure 8:- EGMA zero percent mean score along sub tasks by grade level



	Oral counting	Number identification	Quantity discrimination	Missing number	Addition level 1	Addition level 2	Subtraction level 1	Subtraction level 2	Word problem	Pattern recognition	Pattern extension
Zero score (%) Grade 2	0%	1.53%	0.31%	7.60%	0.51%	2.71%	0.72%	4.55%	2.20%	0.56%	0.97%
Zero score (%) Grade 3	0%	0.68%	0.16%	6.29%	0.36%	1.82%	0.78%	3.27%	1.46%	0.47%	0.57%

3.1.7.3 EGMA ZERO SCORES BY GENDER

A close look at gender based comparison between male and female zero percent score along sub tasks was made and both sexes have a zero score in each sub task except oral counting. A high zero percent coverage registered by female in missing the number (6.70%) while the least zero percentage was registered by male in quantity discrimination (0.20%) when oral counting is excluded because of its unique nature in oral assessment. Relative comparison shown us that a large number of students in both gender types scored high zero percent mean score simultaneously in missing the number (F= 6.70% and M= 6.45%). Females scored more zeros than males all the EGMA sub tasks except addition level 1. Less percent coverage was found in females (0.39%) than males (0.44%) addition level 1 sub task. There was also an increasing pattern in the zero percent mean score as the difficulty level of the sub task increases. For instance we can look at the scores in addition and subtraction levels 1 and 2.

Table 21:- **EGMA zero percent mean score along sub tasks by Gender**

Sub task	Female	Male
Oral counting	0%	0%
Number identification	1.53%	0.68%
Quantity discrimination	0.31%	0.16%
Missing number	7.60%	6.29%
Addition level 1	0.51%	0.36%
Addition level 2	2.71%	1.82%
Subtraction level 1	0.72%	0.78%
Subtraction level 2	4.55%	3.27%
Word problem	2.20%	1.46%
Pattern recognition	0.56%	0.47%
Pattern extension	0.97%	0.57

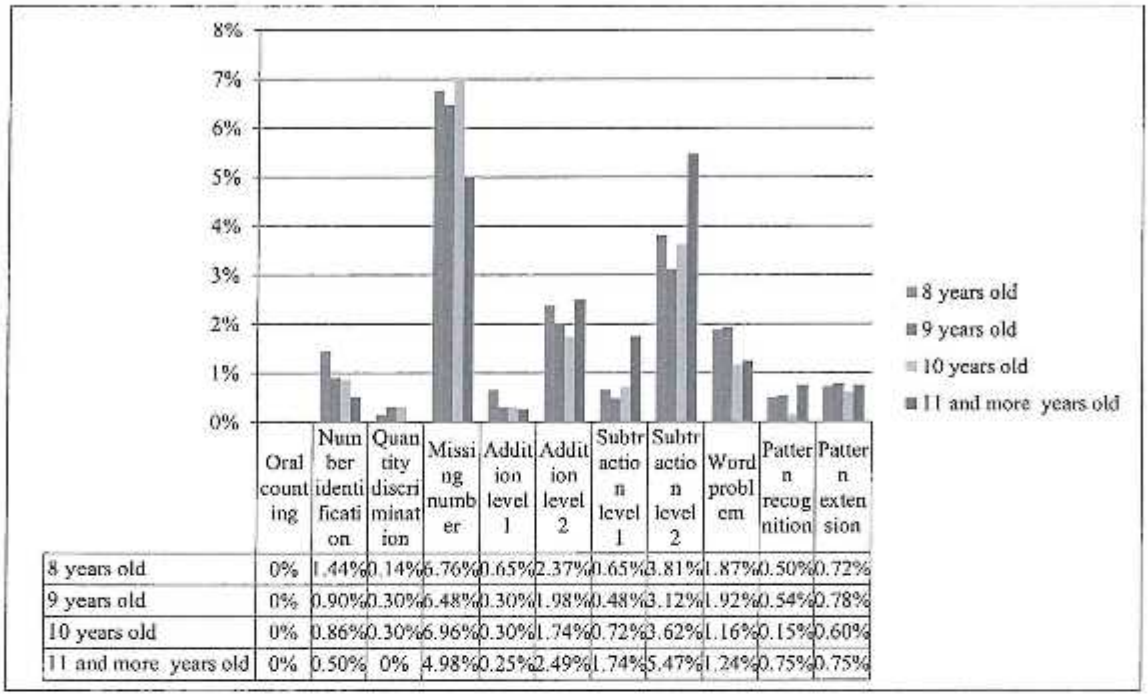
3.1.7.4 EGMA ZERO SCORE ALONG SUB TASKS BY AGE

The zero score EGMA result in the commonly known EGMA sub tasks is shown in figure 9 below and it indicates that students has high percentage of zero scores in missing number (6.96%) in the age group 10 years old and subtraction level 2 (5.47%) in age group 11 years and above and low scores in quantity discrimination in age groups 11 years and above and 8 years old (0% and 0.14%) respectively. The 11 and above age group has scored the maximum zeros in four different sub tasks which is counted as maximum multiplicity addition level 2, subtraction level 1, subtraction level 2 and pattern recognition).

Table: **22- EGMA zero percent mean score along sub tasks by Age group**

Sub task	**8 years old**	**9 years old**	**10 years old**	**11 and more years old**
Oral counting	0%	0%	0%	0%
Number identification	1.44%	0.90%	0.86%	0.50%
Quantity discrimination	0.14%	0.30%	0.30%	0%
Missing number	6.76%	6.48%	6.96%	4.98%
Addition level 1	0.65%	0.30%	0.30%	0.25%
Addition level 2	2.37%	1.98%	1.74%	2.49%
Subtraction level 1	0.65%	0.48%	0.72%	1.74%
Subtraction level 2	3.81%	3.12%	3.62%	5.47%
Word problem	1.87%	1.92%	1.16%	1.24%
Pattern recognition	0.50%	0.54%	0.15%	0.75%
Pattern extension	0.72%	0.78%	0.60%	0.75%

Figure 9:- EGMA zero percent mean score along sub tasks by age



	Oral counting	Number identification	Quantity discrimination	Missing number	Addition level 1	Addition level 2	Subtraction level 1	Subtraction level 2	Word problem	Pattern recognition	Pattern extension
8 years old	0%	1.44%	0.14%	6.76%	0.65%	2.37%	0.65%	3.81%	1.87%	0.50%	0.72%
9 years old	0%	0.90%	0.30%	6.48%	0.30%	1.98%	0.48%	3.12%	1.92%	0.54%	0.78%
10 years old	0%	0.86%	0.30%	6.96%	0.30%	1.74%	0.72%	3.62%	1.16%	0.15%	0.60%
11 and more years old	0%	0.50%	0%	4.98%	0.25%	2.49%	1.74%	5.47%	1.24%	0.75%	0.75%

3.1.7.5 EGMA zero score along sub tasks by school type

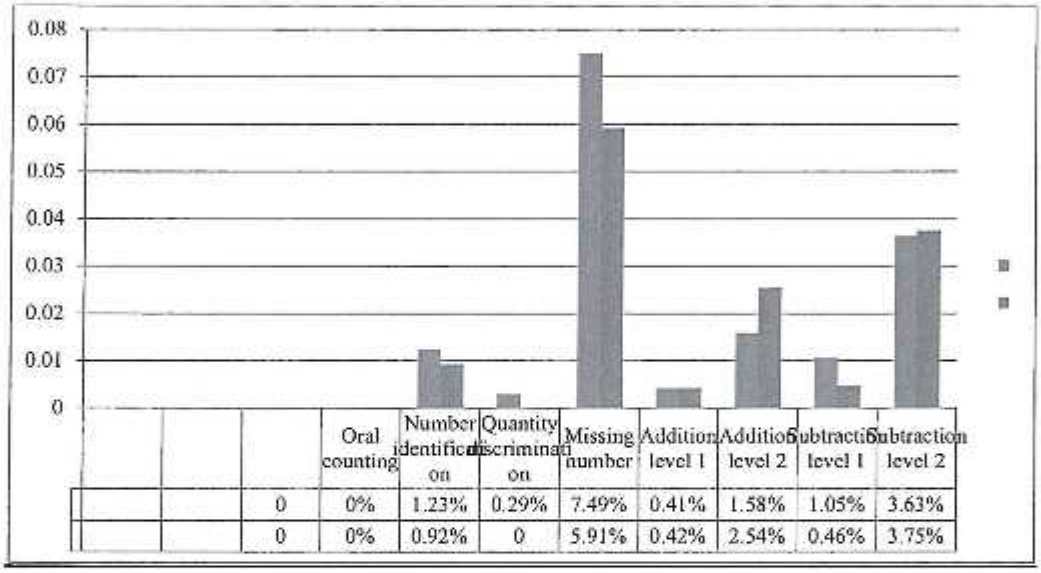
From the table below school type based comparison between governmental and private schools zero percent score along sub tasks was made and both school types have a zero scorer in each sub task except quantity discrimination other than oral counting. A high zero percent score registered by governmental schools in missing the number (8.53%) and minimum zero percentage was registered by private school types in quantity discrimination (0%) when oral counting is excluded because of the reason mentioned above. Relative comparison shown us that a large number of students in both school types scored high zero percent frequency simultaneously in missing the number (Gov = 8.53% and Priv. = 4.55%). In all the ten sub tasks government school students scored more zeros than private school children. There was also an increasing pattern in the zero percent mean score as the difficulty level of the sub task increases. For instance we can look at the scores in addition and subtraction levels 1 and 2.

Table 23:- **EGMA zero percent mean score along sub tasks by School Type**

Sub task	Governmental	Private
Oral counting	0%	0%
Number identification	1.86%	0.24%
Quantity discrimination	0.44%	0 %
Missing number	8.53%	4.55%

Addition level 1	0.53%	0.28%
Addition level 2	3.18%	1.09%
Subtraction level 1	1.13%	0.28%
Subtraction level 2	5.19%	2.18%
Word problem	2.40%	1.04%
Pattern recognition	0.73%	0.24%
Pattern extension	1.13%	0.33%

Figure 9:- EGMA zero percent mean score along sub tasks by School Type



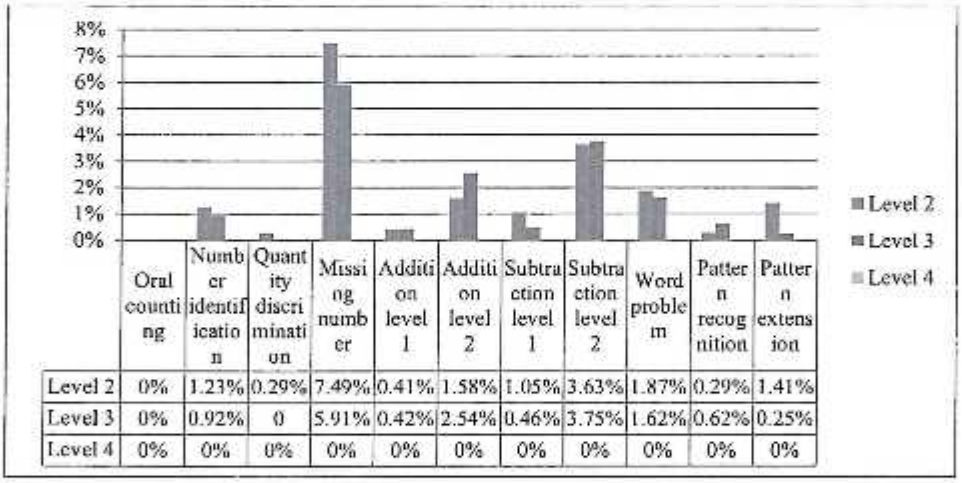
3.1.7.6 EGMA ZERO SCORE ALONG SUB TASKS BY SCHOOL INSPECTION LEVEL

From the table below school inspection level based comparison between and among schools zero percent score along sub tasks indicated that level 2 and level 3 schools have a zero scorer in all the EGMA sub task except oral counting. A high zero percent score registered by level 2 schools in missing number (7.49%) and minimum zero percentage was registered by inspection level 4 school types in all the sub tasks. Large number of students from both level 2 and level 3 schools scored higher zeros in missing the number (Level 2= 7.49% and Level 3= 5.91%). In the sub tasks number identification, quantity discrimination, missing number, subtraction level 1, word problem and pattern extension level 2 schools has more zero scorers than level 3 and in the remaining four subtasks (addition levels 1 and 2, subtraction level 2 and pattern extension) level 3 schools scored more. There was also an increasing pattern in the zero percent mean score as the difficulty level of the sub task increases.

Table 24:- **EGMA zero percent mean score along sub tasks by School inspection level**

Sub task	Level 2	Level 3	Level 4
Oral counting	0%	0%	0%
Number identification	1.23%	0.92%	0%
Quantity discrimination	0.29%	0 .17%	0%
Missing number	7.49%	5.91%	0%
Addition level 1	0.41%	0.42%	0%
Addition level 2	1.58%	2.54%	0%
Subtraction level 1	1.05%	0.46%	0%
Subtraction level 2	3.63%	3.75%	0%
Word problem	1.87%	1.62%	0%
Pattern recognition	0.29%	0.62%	0%
Pattern extension	1.41%	0.25%	0%

Figure 10:- **EGMA zero percent mean score along sub tasks by School inspection level**



	Oral counting	Number identification	Quantity discrimination	Missing number	Addition level 1	Addition level 2	Subtraction level 1	Subtraction level 2	Word problem	Pattern recognition	Pattern extension
Level 2	0%	1.23%	0.29%	7.49%	0.41%	1.58%	1.05%	3.63%	1.87%	0.29%	1.41%
Level 3	0%	0.92%	0	5.91%	0.42%	2.54%	0.46%	3.75%	1.62%	0.62%	0.25%
Level 4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

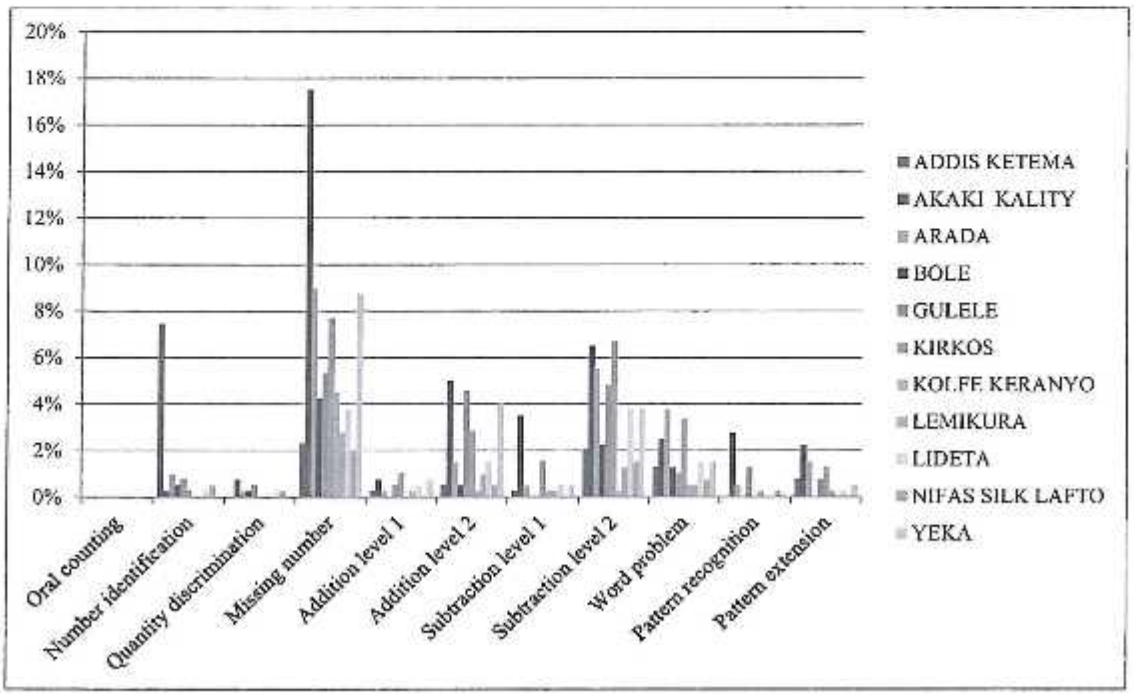
3.1.7.7. EGMA percent zero score along sub tasks by sub city

The percentage of students who scored zero by sub city along the EGMA sub task is shown by the figure in number 11 and based on it the maximum zero score was in missing number by akaki kality sub city (17.50%). There are many zero scores in different sub tasks by different sub cities that can be taken as minimum scores. All sub cities has zero scores in missing number, subtraction level 2 and word problem. In addition to this Lemikura sub city has non zero scores in four sub tasks other than oral counting. Akaki kality and Arada sub cities has students' scores of zero in all the EGMA sub tasks except oral counting.

Table:25 - **EGMA zero percent score along sub tasks by Sub city**

Sub task	Oral counting	Number identification	Quantity discrimination	Missing number	Addition level 1	Addition level 2	Subtraction level 1	Subtraction level 2	Word problem	Pattern recognition	Pattern extension
ADDIS KETEMA	0%	7.44%	0%	2.31%	0.26%	0.51%	0.26%	2.05%	1.28%	0%	0.77%
AKAKI KALITY	0%	0.25%	0.75%	17.50%	0.75%	5%	3.5%	6.5%	2.5%	2.75%	2.22%
ARADA	0%	1%	0.25%	9%	0.25%	1.50%	0.50%	5.50%	3.75%	0.50%	1.50%
BOLE	0%	0.50%	0.25%	4.25%	0%	0.50%	0%	2.25%	1.25%	0%	0%
GULELE	0%	0.76%	0.51%	5.32%	0.51%	4.56%	0%	4.81%	1.01%	1.27%	0.76%
KIRKOS	0%	0.26%	0%	7.69%	1.03%	2.82%	1.54%	6.67%	3.33%	0%	1.28%
KOLFE KERANYO	0%	0%	0%	4.50%	0%	0.25%	0.25%	0.25%	0.50%	0.25%	0.25%
LEMIKURA	0%	0%	0%	2.75%	0.25%	1%	0.25%	1.25%	0.50%	0%	0%
LIDETA	0%	0.25%	0.25%	3.75%	0.50%	1.50%	0.50%	3.75%	1.50%	0%	0.25%
NIFAS SILK LAFTO	0%	0.50%	0.25%	2%	0%	0.50%	0%	1.50%	0.75%	0.25%	0%
YEKA	0%	0%	0%	8.75%	0.75%	4%	0.50%	3.75%	1.50%	0%	0.50%

Figure11 :- **EGMA zero percent score along sub tasks by Sub city**



4. Findings of Background Variables

Student learning is affected by a lot of factors that can't be listed one by one at a time. Though most of students learning is highly supported by student readiness and motivation the environment they live if not conducive it is improbable for them to be successful in the area of their learning. Thus, in the process of assessing students educational achievement one of the most crucial factors that must be deeply investigated is the socioeconomic, psychological and technological factors and its relation to the achievement level of the students in order to identify and alleviate problems linked with this point and strengthen the positive face of these grand issues to further improve the system for students overall learning. In this section we will discuss the findings regarding students existing situation and their learning based on the responses from students, teachers and school superintendents related factors.

4.1 student related variables

School quality, teachers' quality and a system that is able to deliver best instruction are the most important factors in students learning and learning outcomes. In addition to these three major factors of learning socioeconomic background, textbooks, culture and attitude, assessment practices has their own role in advancing or deteriorating learner outcomes. From this perspective it is necessary and important to consider and study how many such types of factors are affecting students' success in the early childhood education and adjustments to make the environment that is related to student factors nurturing students learning and overall development. In this study the factors instructional language, learner home facility, preschool education, drop out, teachers assessment and feedback provision, support at home, absenteeism, reference books at home, parents educational background, attitude of people toward mathematics learning are investigated.

Table 26 below represents percentage of student responses to student related factors and indicated that 89.20% of the learners' instructional language was the same with their mother tongue. It is very well known that students live in houses with different ownership types. Based on the information gathered on this point it was found that 47.30% live in houses owned by their parents, 17.20% live in kebele/housing agency owned rental houses and 35.50% live in houses rented from individual owners. Only 44.80% of the students have an access to a radio while 94.80% of the students do have the access to a mobile at home. There are around 6.60% pupils that do not have an access to electricity. Access to television at home is 93.30%. Easily

accessible toilet is available for 88.20% alone. Here there is a point that needs a special attention regarding availability of study table for learners at home. Only 32.50% of the students have their own table to study regularly. 91.30% of the students have passed through preschool education before they joined grade one. Out of all the totality 2.47% from both the grade levels were identified as drop outs. All teachers (100%) provide a constructive and positive feedback to their students following good jobs and 2.1% of the students responded that teachers react negatively following students poor jobs. The number of weekly home work given to students has varied from class to class. For 5.30% of the students almost no homework is given and the remaining 16.20% - once, 29.80% twice, 26.70% - thrice, 10.40% - four times, 11.40% - five times got the opportunity to engage in home works. 91.10% of the students responded that their teachers check their homework and give the necessary feedback to them. Students especially children at early ages need support from family when engaged in homework activities. Here the students reacted that 40.90% of they are supported by either brother or sister. 8% didn't get any support at all. 45.60% are supported by either mother or father. Grandparents supported students percentage is 1.10% and 4.50% get the support and follow up from their tutors. 3.60% of the students do not have textbooks. It is believed that absenteeism and school achievement are negatively correlated. Thus it is another important area that should be tested in educational assessment. According to the responses gathered it was reached at the conclusion that one day (12%), two days (7.8%), three days (2.70%), four days (0.90%), and five days (0.80%) absentees were recorded. Students with subject reference books at home were 41.40%. Students Parent educational background is another factor that must be taken into consideration. The information gathered regarding this point revealed that 15.5% (Illiterate), 19.10% (Certificate), 10.40% (Diploma), 22% (Degree), 5.40% (Masters), 2.70% (PHD) and 21.9% others (general education and religious) level and type of education. Attitude toward a subject matter is also a factor studied in this research and 49.60% of the students responded to one question in this area as different people around them say that learning Mathematics is difficult. To further get a specific answer to this question they were also asked who says that it is difficult to learn mathematics. Thus, 11.40% of the students responded that at least either of their mother or father said that it is difficult. Who mentioned brother/sister were 18.90%. Major percent coverage 38.50% responded that their neighborhood friends said learning mathematics is difficult. The remaining response parts 27% (classmate), 1.50% (teachers), 0.40% (school superintendents), 0.10% (mass media) and 0.50% (others) were

associated with the bodies in the brackets. The percentage of students who really believe that learning mathematics is difficult is 18.80% and 81.20% by themselves do not believe that it was really difficult.

Table 26:- **Percentage of student responses to student related factors.**

No	Factor	Responses in percentage
1.	Instructional language	Mother tongue (89.20%)
		Non- mother tongue (10.80%)
2.	Home where family live in	Parents ownership (47.30%)
		Kebele/housing rent (17.20%)
		Rent from individual owners (35.50%)
3.	Radio at home	Yes there is (44.80%)
		No there is not (55.20%)
4.	Mobile phone at home	Yes there is (94.80%)
		No there is not (5.20%)
5.	Electricity at home	Yes there is (93.40%)
		No there is not (6.60%)
6.	Television at home	Yes there is (93.30%)
		No there is not (6.70%)
7.	Toilet at home	Yes there is (88.20%)
		No there is not (11.80%)
8.	Table for study at home	Yes there is (32.50%)
		No there is not (67.50%)
9.	Preschool access	Yes there is (91.30%)
		No there is not (8.70%)
10.	Drop out	Yes (2.47%)
		No (97.53%)
11.	Teacher feedback for good job	Positively (100%)
12.	Teacher feedback for poor job	Positively (97.90%)
		Negatively (2.10%)
13.	Number of homework (weekly)	None (5.30%)
		Once (16.20%)
		Twice (29.80%)

		Thrice (26.70%)
		Four times (10.40%)
		Five times (11.40%)
14.	Do teacher check home works?	Yes (91.10%)
		No (8.90%)
15.	During home work who support learners?	None (8%)
		Brother/sister (40.90%)
		Mother/ father (45.60%)
		Grandparents (1.10%)
		Tutor (4.50%)
16.	Mathematics textbook	Yes I have (96.40%)
		No I didn't have (3.60%)
17.	Last week number of days class unattended	One day (12%)
		Two days (7.80%)
		Three days (2.70%)
		Four days (0.90%)
		Five days (0.8%)
18.	Reference book at home	Yes (41.40%)
		No (58.60%)
19.	Mother/father level of education	Illiterate (15.50%)
		Certificate (19.1%)
		Diploma (10.40%)
		Bachelor Degree (22%)
		Masters (5.40%)
		PHD (2.7%)
		Others (21.90%)
20.	People say mathematics is difficult	Yes (49.60%)
		No (50.40%)
21.	Who says learning mathematics is difficult?	Mother/ father (11.40%)
		Sister/ brother (18.90%)
		Neighbor friends (38.50%)
		Classmates (27%)
		Teachers (1.50%)

		School superintendents (0.40%)
		Mass media (0.10%)
		Others (0.50%)
22.	Is really mathematics a difficult subject?	Yes (18.80%)
		No (81.20%)

4.2 Teacher related variables

Successful teaching is teaching that brings about effective learning. The decisive question is not what methods or procedures are employed, or whether they are old fashioned or modern, time tested or experimental, conventional or progressive. All such considerations are really important, but none of them is ultimate, for they have to do with means, not ends. The ultimate criterion for success in teaching is – results! Thus, for a successful learning a successful teacher is required.

In order a teacher to become a successful teacher the main factor is his/her psychological and intellectual readiness to actually teach students. Though these two factors are mentioned as prior factors there are a lot of internal and external factors in terms of a school that affect teachers effectiveness and learners outcome concomitantly. Under this heading we will discuss some teacher related factor findings to identify which factors are working well and which are malfunctional to make them part of different future programs and packages to improve students' learning through the improvement of teachers professional career.

In this study totally 374 mathematics subject teaching teachers from both grade 2 and grade 3 participated to provide information according to what is asked via a questionnaire. The information gathered suggested that the participant teachers were with different level of education. The following table 27 below shows that the educational level of teachers and its percent coverage.

Table 27:- **educational level of participant teachers and their percent coverage**

Educational level	Percentage
Certificate	0.8%
Diploma	49.60%
Degree	47.40%
Masters	2.20%
Total	100%

From the table we can see that 49.60% were diploma and 47.40% were degree. The degree and diploma holder teachers add up to 97%. In terms of teacher level of education the grade levels require it seems there is a success in hiring prepared and qualified teachers in schools.

A finding concerning the type of educational system schools are implementing indicated that 20.40% practice the self- contained mode and the great majority 77.60% follow subject based system of teaching. Moreover, out of the participant teachers only 84.20% are trained in educational fields of study. Thus, 15.80% are strange to education and educational thought. Similarly, out of the participant teachers that were engaged to teach mathematics at schools 37.50% didn't have any training in teaching Mathematics as a subject. In schools around 24.50% of the respondents mentioned that they are denied with the access to read in school libraries of their separate teachers reading room. Mathematics reference books are available for 80.90% of the teachers in libraries of the school they are in. It is also observed that 77.40% of the teachers have the culture of helping students when reading in their school libraries. 91.30% of the teachers do not have a problem with textbooks and teachers guide. Around 94.5% believed that mathematics text book distribution to their students reached 1:1. Concerning students engagement in a class most of the teachers (50.80%) responded that majority of the students participate actively in a class and 37.1% of them reported all their students are highly engaged and active in their classes while the rest 12.10% suggested only limited number of students actively participate. Only 36.20% of the respondents assured that all their students come to their class with their home work properly done, the remaining said only majority (55.40%) and limited (8.40%) do their home work as expected.

It is well known that students must be treated and supported according to their needs by teachers. The finding in this area revealed that 96.20% of the teachers have the habit of classifying and supporting based on their actual needs. From 92% of the respondents it is conceived that in their schools there were well organized and functional parent, student and teachers association. In addition to the existence of PSTA in schools 91.50% of the teachers responded that they had periodic plan of contact and discussion with student parents concerning their students learning. Teachers contact with parents at least once (17.7%) and at most five and above (15.40%) in a semester with the majority contacting twice (39.30%) with parents.

It was also investigated if school calendar was properly followed by schools. Based on this investigation it was from 14.40% of the respondents obtained that there were school days closed

by schools out of the school calendar permitted. Some of the most repeated reasons posed for this closure were: staff meeting, get together programs, sport festival, grade 8 model examination and eve and the morrow of holidays.

Based on the information found from 70% of the teachers in their schools there is a committee with the responsibility of following up students' achievement and its status. Moreover, 93.20% of teachers responded that they support students with special needs.

Teachers also need periodic and consistent support of school leadership aiming at improving their teaching. Related to this point 95.80% of the teachers mentioned that there is a body in schools who support and monitor teachers activities permanently. In addition to this 99.20% of the respondents responded that they had been supervised at least once in a year in their classes. Most of the supervision activities were facilitated by department heads (97%); directors (46.90%); deputy directors (56.10%) and supervisors (56.40%) in schools.

To monitor students' development and progress easily schools should have well devised tools of follow up and monitoring in their schools. Related to this issue 96.40% of respondent teachers ascertained that there is a tool and mechanism that is used to follow up and monitor students overall development in their schools. Specifically speaking the teachers listed the tools used as class supervision (63.40%); classroom tests (70.50%); oral tests (34%); and report from teachers (58.50%) which are implemented in their schools for the follow up purpose.

On the coverage of fee expenses of textbooks 42.30% of the participants responded that it was paid by and the responsibility of parents with the remaining part mentioning either education bureau, sub city education office, schools taking the responsibility.

Continuous assessment of students is expected to be practiced in schools continuously. Different tools of continuous assessment exist to be used appropriately based on situations. One Week based investigation of the practice of this mode of assessment was conducted on teachers and the maximum teachers' responses on each strategy revealed that written tests once in a week (36%); oral tests twice in a week (29.2%); home and class works five times every week (32.6%); students exercise book inspection five times each week (31.2%) are used to assess students as soon as they are given a lesson by a teacher.

5. Conclusion and recommendation

5.1 Conclusion

This part contains the main findings of EGMA in a nutshell. The study tried to reveal the overall status of students' achievement in EGMA and factors that relate to it to stakeholders of education in Addis Ababa. The factors were both student and teacher related factors that were investigated separately that impact directly or indirectly students' performance.

Achievement test containing eleven EGMA sub tasks i.e. oral counting, number identification, quantity discrimination, missing number, addition level 1, addition level 2, subtraction level 1, subtraction level 2, word problem, pattern recognition and pattern extension was used directly to measure the performance of students in Addis Ababa. In addition to this three different questionnaires prepared for students, teachers and school directors were used to gather the necessary information that relate to students performance especially student background related factors to rate how much they are affecting students in their learning and at the end their performance. Following the entry of the data collected and the task of cleaning it in the analysis part both descriptive and inferential type of statistics were implemented to analyze the data appropriately.

The overall percent mean score of EGMA was 81.14% with all the eleven sub tasks are more than 62.62% where this score is the minimum performance level in missing the number. The maximum percent mean score was found to be in subtraction level 1 (92.53%) followed by quantity discrimination (91.93%). Performance of students in the Sub tasks number identification, quantity discrimination, addition level 1, subtraction level 1, pattern recognition and pattern extension was higher than the overall percent mean score but in the rest four EGMA sub tasks individual percent mean scores were less than the overall EGMA percent mean score.

Group based comparison of performance and test of significance indicated that grade 3 students overall score was significantly higher than grade two. Moreover, there was not any gender based statistically significant mean difference observed. There was a statistically significant mean difference between private and governmental schools where the students in private schools were favored in this case. The information on sub cities performance indicated that there were differences between and among sub cities with a maximum range of 10.96 between Akaki kality and kolfe keranyo sub cities.

According to the information on zero scores along sub tasks students who didn't answer a single question from each subtasks was in descending order listed as missing the number (6.58%), subtraction level 2 (3.71%), addition level 2 (2.14%) , word problem (1.73%), pattern extension (0.73%), subtraction level 1 (0.71%), pattern recognition (0.49), addition level 1 (0.41%), quantity discrimination (0.22%) and number identification (0.01%) respectively. A sever learning difficulty in students was observed in missing the number and subtraction level 2. For instance in missing the number students close to 7% was unable to answer even one question correctly.

In student learning different socioeconomic, psychological and cultural factors as well as the general school environment has their own role in either facilitating or hindering achievement of students in different areas. Here we will put some points to be included in the conclusion part of this study.

Only 32.30% of the students have their own table to study regularly. Thus it indicated that little focus and attention is given to students regarding creating a conducive and sustainable reading room and tables at home. 91.30% of the students have passed through preschool education before they joined grade one. Out of all the totality 2.47% from both the grade levels were identified as drop outs. All teachers (100%) provide a constructive and positive feedback to their students following good jobs and 2.1% of the students responded that teachers react negatively following students poor jobs. The number of weekly home work given to students has varied from class to class. For 5.30% of the students almost no homework is given and the remaining 16.20% - once, 29.80% twice, 26.70% - thrice, 10.40% - four times, 11.40% - five times got the opportunity to engage in home works. 91.10% of the students responded that their teachers check their homework and give the necessary feedback to them. Students especially children at early ages need support from family when engaged in homework activities. Here the students reacted that 40.90% of they are supported by either brother or sister. 8% didn't get any support at all. 45.60% are supported by either mother or father. Grandparents supported students percentage is 1.10% and 4.50% get the support and follow up from their tutors. 3.60% of the students do not have textbooks. It is believed that absenteeism and school achievement are negatively correlated. Thus it is another important area that should be tested in educational assessment. According to the responses gathered it was reached at the conclusion that one day (12%), two days (7.8%), three days (2.70%), four days (0.90%), and five days (0.80%) absentees were recorded. Students

with subject reference books at home were 41.40%. Students Parent educational background is another factor that must be taken into consideration. The information gathered regarding this point revealed that 15.5% (Illiterate), 19.10% (Certificate), 10.40% (Diploma), 22% (Degree), 5.40% (Masters), 2.70% (PHD) and 21.9% others (general education and religious) level and type of education. Attitude toward a subject matter is also a factor studied in this research and 49.60% of the students responded to one question in this area as different people around them say that learning Mathematics is difficult. To further get a specific answer to this question they were also asked who says that it is difficult to learn mathematics. Thus, 11.40% of the students responded that at least either of their mother or father said that it is difficult. Who mentioned brother/sister were 18.90%. Major percent coverage 38.50% responded that their neighborhood friends said learning mathematics is difficult. The remaining response parts 27% (classmate), 1.50% (teachers), 0.40% (school superintendents), 0.10% (mass media) and 0.50% (others) were associated with the bodies in the brackets. The percentage of students who really believe that learning mathematics is difficult is 18.80% and 81.20% by themselves do not believe that it was really difficult.

Different schools under the same system are implementing different (Dual system) school systems that are around 20.40% practice the self- contained mode and the great majority 77.60% follow subject based system of teaching. Moreover, out of the participant teachers only 84.20% are trained in educational fields of study. Thus, 15.80% are strange to education and educational thought. There are mathematics teachers in schools (37.50%) who didn't have any training in the subject. In schools around 24.50% of the teachers are denied with the access to read in school libraries of their separate teachers reading room. 19.10% of the teachers do not have Mathematics reference books in libraries of the school they are in. those the participation of students in classes is good but it is not a sort that ascertain full engagement of learners. Some students do not work their homework properly.

From 92% of the respondents it is conceived that in their schools there were well organized and functional parent, student and teachers association. In addition to the existence of PSTA in schools 91.50% of the teachers responded that they had periodic plan of contact and discussion with student parents concerning their students learning. Teachers contact with parents at least once (17.7%) and at most five and above (15.40%) in a semester with the majority contacting twice (39.30%) with parents.

Some schools close school days because of different reasons. Some of the common ones were due to eve/morrow of holidays, staff meetings, sport festivals etc. there is a habit of supporting students by teachers who are in need.

Teachers also need periodic and consistent support of school leadership aiming at improving their teaching. Related to this point 95.80% of the teachers mentioned that there is a body in schools who support and monitor teachers activities permanently. Most of the supervision activities were facilitated by department heads.

To monitor students' development and progress easily schools should have well devised tools of follow up and monitoring in their schools. Related to this issue 96.40% of respondent teachers ascertained that there is a tool and mechanism that is used to follow up and monitor students overall development in their schools. Specifically speaking the teachers listed the tools used as class supervision (63.40%); classroom tests (70.50%); oral tests (34%); and report from teachers (58.50%) which are implemented in their schools for the follow up purpose.

Continuous assessment of students is expected to be practiced in schools continuously. Different tools of continuous assessment exist to be used appropriately based on situations. Written test and home/class works are the most common and frequently used strategies.

5.2 Recommendations

Based on the points discussed in the conclusion the following recommendations are pinpointed.

- The EGMA finding suggests that the difference between the percent mean scores of students was statistically significantly between grade 2 and grade 3; between and among sub cities and between the two different school types. Grade 3 students overall mean score is higher than grade 3 and the ten sub cities are categorized into four sub groups of homogeneity based on the percent mean score of the sub cities scored with Akaki kality being the lowest scorer in the lowest score group and kolfe keranyo the highest scorer from the highest group. Hence, there was a significant difference between and among groups in percent mean score that needs an intervention by policy makers, administrators and education experts in different students success related areas.
- Students had a critical learning difficulty in missing number and subtraction level 2 than the remaining nine sub tasks. This difficulty is expected to prevail due to poor learning strategies that are followed by teachers in class room level in addition to its nature to find real life situation in students' environment that can teach techniques that support missing

number learning strategies informally. Teachers should be equipped with alternative teaching strategies of this sub task to create different alternative learning strategies for students and avoid learning difficulties that may arise related to this problem in students' future learning like calculating the difference i.e. the process of subtraction in forward and backward counting. Moreover, a moderate learning difficulty of students was identified in word problem and subtraction subtasks. The word problem difficulty may be linked with factors such as number identification difficulty, oral listening difficulty and absence of alternative teaching strategies provided by teachers etc. Thus, policy makers, administrators and education experts should intervene in the teaching strategies of teachers in these sub tasks as well as the way oral listening is linked with the sub task word problem in EGMA.

- The study also showed that different student–related factors are influencing students' performance negatively. These were reading table and room at home, unavailability of mathematics reference books at home. Some students are living in an environment at school and around home with people who think and say learning mathematics is difficult. Thus, policy makers, administrators, education experts, parents and schools should take the necessary measures upon improving the access of students to reference books and strengthen the support made to students at home. Moreover, it is important to make sure that all students pass through preschool before joining the regular classes to enhance children learning. Students at all level must be influenced to believe that learning mathematics is simple and enjoyable as well as its importance in today's science and technology era to promote socioeconomic progress in once society.
- The city administration education system is unitary according to its syllabi. But there are schools that use self contained system as a way to teach learners where others are following subject based. Thus, responsible bodies should take the necessary measure to alleviate this problem of dual system of education in the city.
- There are teachers engaged in schools without taking the necessary training in education as well as mathematics as a subject. Thus, all parties should play their own role so that school teachers are well trained in the field and subject they are teaching.
- Most of the teachers believe that majority of the students engage in the learning process leaving others unengaged. If students are not made to be engaged in a class properly

learning for such students will undoubtedly be difficult. Thus, stakeholders should strive so that all teachers in our schools are doing their job with all students under their control are always engaged.

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