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Gender difference in mathematics achievement among students exposed to Embedded Mathematics Language Factor (EMLF) Teaching in Secondary School in Nakuru County, Kenya

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Abstract: **Mathematics is a subject in the school curriculum that has a specialised language with a set of words and symbols that have unique meanings used internationally. Mathematics performance results at the Kenya Certificate of Secondary Education Examination (KCSE) have constantly been poor over the last decade nationally and also in Nakuru County. Findings of most studies partly attribute learners' poor performance in mathematics to ineffective teaching methods practiced by mathematics teachers and the use of specialized language. The purpose of this study was therefore to to determine gender difference in mathematics achievement among students exposed to Embedded Mathematics Language Factor Teaching in Secondary School in Nakuru County, Kenya. The study used Solomon Four Non-Equivalent Control Group design. The target population was 1300 form two students in Nakuru County. A total sample of 180 students and their teachers was drawn from four selected Co-educational Secondary Schools. Purposive and simple random sampling were used to select the schools and the particular streams to be involved in the study. Consulting experts in the School of Education, Laikipia University, determined validity of research instruments. Five different instruments namely Understanding of Mathematical Terms Test (UMTT) whose reliability coefficient was 0.7831, Understanding of Mathematical Symbols Test (UMST) whose reliability coefficient was 0.762, Understanding of Mathematical Structures Test (UMSrT whose reliability coefficient was 0.840, Mathematical Achievement Test (MAT whose reliability coefficient was 0.782 and Mathematics Classroom Observation Schedule (MACOS) whose reliability coefficient was 0.771 were used to collect data. The finding of this study also showed that gender did not affect students' achievement in mathematics when students were taught using EMLF strategy ($t(80)=0.918$, $p=.844$). The EMLF learning strategy reduced gender disparity in achievement of secondary school mathematics. The findings of this study will benefit mathematics teachers, curriculum developers, policy makers, school inspectors and teachers trainers with a view to improving performance in mathematics achievement and understanding of mathematics in secondary schools.**

Keywords: **Gender, mathematics.**

I. INTRODUCTION

Smith (2004) explains that mathematics is a commanding, universal language and scholarly tool kit for concept, generalization and synthesis. Mathematics is also understood as the language of Science and Technology enabling us to have a post-mortem of technologies that aids in control and master our environment, change the expectations of the society and the standards of living. Consequently, training of mathematics disciplines the mind, developing both logical and critical reasoning together with analytical and skills in problem solving to a high extent. The meaning to mathematics varies from one school of thought to another. Mathematics is defined as an approach of describing associations among numbers to other measureable units and it is in position of expressing both simple equations and the interactions between particles that are smallest and the farthest objects in the known universe (Microsoft Corporation, 2003). In general Mathematics is widely applied in physical science, engineering, medicine, geography, business and operations in the industries among many other areas (Smith, 2004). Mathematics is also important in our daily activities in numerous ways. It is used as an art, in beauty design, music and painting. Mathematical analysis of many hours has resulted to generation of computers. Plan to fuel-efficient, automobile and aircrafts, weather prediction, control of traffic, and imaging in medical facilities all are a result of mathematical analysis. Mathematics is also used as a tool in Science, English, Technology, Finance, Business, and Industries and in other school subjects to solve problems pertaining to these disciplines.

In Kenya, mathematics is offered as one of the core subjects in primary and secondary education curricula (KIE, 2002). At tertiary levels, general mathematics is offered in nearly all programmes where it is not a core subject. This emphasizes the importance attached to the subject in development of science and technology and the demand that every child should study mathematics at school (Cockroft, 1982). Mutunga and Brakell (1992) observed that mathematics occupies a major portion of a school study and it is a constituent of the overall education system. In their view, therefore, the government and other stakeholders expect schools to offer children mathematics education that is worthwhile. This expectation is not realizable when learners continue to perform poorly in the subject at national level (KNEC, 2010). Despite its importance to individuals and society globally, mathematics is a subject that is poorly performed at national examinations by many secondary school learners worldwide (TIMSS, 2004) and Kenya in particular (KNEC, 2010). At the international scene, learners' score in mathematics at primary and post primary schools has not been better as indicated by TIMSS (2004). TIMSS showed that there were large differences in performances, across countries in the world as indicated by percentages of students' mathematics scores compared to international benchmarks at the fourth grade. Singapore had 38% of its learners reaching the advanced international benchmark (i.e., the standard mean score), followed by just over 20% of the learners in Hong Kong and those from Japan. The highest performing countries at the eighth grade had about one third or more of their learners reaching the advanced international benchmark. In contrast, 19 of the lowest-performing countries had 1% or less of their learners reaching this benchmark.

According to Wasike (2003), mathematics language is the structure applied by mathematicians in communicating ideas of mathematics using symbols and special language structures. The Dialectal is made of a substance of certain natural linguistic such as English that use both terms that are technical and conventions of grammar which are unique to mathematical dialog, complemented by symbolic notation that are specialized from mathematical formulae. Proficiency in language as a hindrance to understanding mathematics and science is well under documentation (Setati, 2005). This problem is brought about by the learner's lack of conceptual understanding and discourse in the contexts of language and the structure in which the concepts are entrenched (Adler, 2001). Kilpatrick, Swafford and Findell (2001), explain that one of the critical components of mathematical proficiency is its conceptual understanding, which is essential for anybody to study mathematics productively. In their view, conceptual understanding implies an understanding of knowledge that not only revolves around isolated facts but is inclusion of an understanding of the dissimilar contexts informing these facts. Learners having a conceptual understanding have systematized this understanding into a comprehensible whole, enabling them acquire new concepts by linking those concepts with what is already known. Like natural language, those using the linguistic of mathematics can introduce a scale of registers. For Kilpatrick et al. (2001) registers is a variety of special language features that are used in a particular situation. Kilpatrick et al. assert that linguistic is a vital variable in conceptual understanding. Therefore, there is no separation of language and conceptual understanding. Therefore it is important that for any effective training of mathematical concepts, a well prepared register of mathematics needs to be there in the language of instruction.

One of the definitions of mathematics is that it is a language, which may imply a large collection of special symbols and terms such as $+,=,\pi,<,>$ associated with the subject (Davis, 1998). Mathematical language is universal because the symbols employed have acceptance in countries whose other language of communication differ widely. Costello (1991) argued that mathematics is not a spoken language in the sense in which French or English is. He emphasizes this by saying that three people from different countries who have knowledge in mathematics could not use this language to transact the ordinary business of daily life as they could if both were fluent say in Kiswahili. Therefore, the lateral meaning of the word 'language' does not apply to mathematics. Mevarech and Kramarski (1997) say mathematics is a language the way for example fine art is a language, through fine art some messages are conveyed. Mathematics makes available a powerful universal linguistic and academic tool kit for abstraction, generality and symbolism (Smith, 2004). In

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his view, schools do not provide the mathematical language as a communication skill in a learning situation. This in itself is serious because mathematical language can be an external cause of difficulty in learning mathematics if it is ignored (Lamb, 1987). Moreover, one who is considered to have learned it is that who is capable of giving an appropriate response in a mathematical given situation (Otis, 1990). Hence, it is important to realize that learning in mathematics can only occur if mathematical language, that is terms, symbols and structures are clearly understood as communication tools (Davis, 1998). According to Cabillon et al. (2003), mathematical language may be classified into three major facets:

i) The 'terms' or 'words' in mathematics such as 'parallel', 'multiply', 'integers' 'graph' etc.

ii) The symbols used in the subject for example '+', '∑', 'x', '<', '÷'.

iii) The concepts which are formed by both the surface structure (e.g. '45') and deep structure that gives meaning or explains what is represented by the surface structure e.g. '35' represents 3x101+5x100

According to Haylock and Cockburn (2003), the particular language difficulties inherent in mathematics is the vocabulary, abstract syntax, natural linguistic, word problems and the numerousness of structure over content. The prominence of language in understanding mathematics cannot be exaggerated. Ideas in mathematics can only be understood through a connection to language, images, signs and real-life situations. Perry and Docket (2002) argue that with no abundant language to converse the ideas that has been developed, there will be no interaction of pupils, peers and their teachers and this will have a negative influence on their mathematical development. Since language is significance in understanding mathematics, it is essential that teachers are familiar of the specific challenges and complications of how language is applied in this subject. According to Perry and Docket, the ignorance by teachers on the importance on mathematical language as a factor in learning the subject is the cause of students' poor achievement in mathematics. Mathematics must be organized so that it is appropriate and understandable to learners (Reys et al., 2001). Although study has been done in relation to performance of learners in dealing with mathematical problems, (e.g., word problem) more research which deals with mathematics as a language need to be conducted (Perry & Docket, 2002). Regardless of the level of education, lack of exposure by students is the source of problem in learning mathematics especially in the area of word problem solving. Mathematics by itself is a language, made up of mathematical concepts, mathematical symbols, mathematical notations and mathematical words. Unless learners are able to explain their meaning and to sort out ambiguities or misconceptions mathematics will always be poorly performed. This means that if learners lack the vocabulary of talking about concepts of mathematics, they will not make any development in having mathematical knowledge. The connection between the words and its meaning is therefore built as one-to-one and as expressed in terms of other words already known. The meaning of the mathematical terms appears to be identified with its dictionary definitions and understanding of mathematical concepts is implicitly equated to understanding the words with which they are expressed (Adams, 2003).When the term problem solving is used by researchers, they refer to tasks in mathematics having the prospective of providing academic challenges to improve learners' development in mathematics (Marcus & Fey, 2003). In their view, such tasks will stimulate learners' full understanding; foster their capability in reasoning and communicating mathematically thereby capturing curiosity and interest. They argue that difficulty is experienced the moment learners are meant to apply and assemble concepts, procedures and thoughts in solving the problem. Numerous mathematical solving models (Carpenter et al., 1988) compromise the fact that the initial task for the one involved in problem solving is to obtain from the text a precise mental picture of the problem to be be used as a basis for choice of the solution process that will function. Nevertheless, the capacity to understand the structure of the problem entrenched in the word problem is the struggle that students face in solving problem of mathematics (Adams, 2003).

1. Statement of the Problem

Mathematics national performance at the KCSE examination has been poor, and Nakuru County has been no exception. Furthermore, girls continue to perform more poorly than boys.This poor performance is partially attributed to difficulties in mathematics language factors such as lack of understanding of mathematical symbols, structures and terms and the inability to communicate using appropriate mathematical terms, symbols and structures. Moreover, methods of teaching rely on the traditional teacher centred method in dissemination of mathematical information. These methods are also the blame lack of ability by students in achieving meaningful learning. There is paucity of research that seeks to determine the effects of using mathematics language factors on learners' achievement. It was against this backdrop that the study was intended to investigate the effect of gender and the use of embedding mathematics language factor teaching strategy on learners Mathematics achievement in secondary school mathematics in Nakuru County, Kenya.

2. *Objective of the Study*

To compare gender difference in mathematics achievement between male and female students exposed to EMLF

3. *Research Hypotheses*

In conducting the study the following hypothesis were tested

Ho: There is no statistically significant gender difference in learners' mathematics achievement between male and female students exposed to EMLF

II. LITERATURE REVIEW

1. *General Achievement in Mathematics*

Colwell (2000) emphasizes that performance in mathematics in many countries has been below average. He studied the performance of American students in international mathematics tests and found out that they were performing poorly in comparison to other countries. However he noted that some countries like Singapore, Taiwan, South Korea and Japan were doing better in mathematics.In Kenya, performance in mathematics has been below average (KNEC, 2010; 2011; 2012). The dismal performance in the subject has been attributed to several factors like social background factors, competitive structured classrooms which raise the level of anxiety and stress while learning mathematics, symbolism and specialized mathematical language, quality of textbooks that do not in all cases provide exhaustive explanation of concepts, unsuitable teaching methods and negative attitudes towards mathematics among others (Githua, 2002; Mondoh, 2000). However, some aspects have now received some attention, for instance in the current mathematics syllabus, guidelines on resources and the number of lessons required for every topic are provided. The new textbooks have an adjusted content structure although the suitability of these changes has not yet been determined.

MoEST has organized a yearly in-service training through the SMASSE project aimed at equipping the mathematics and science teachers with suitable teaching strategies which in turn may improve learners' achievement in these subjects. Despite these positive efforts, the questions of dealing with individual differences remains a major problem especially in African countries where one teacher is expected to handle many students at a time. Mondoh (2000) argued that children differ considerably in their potential to learn mathematics. A review of a number of studies by Walberg (1991) on teaching and learning arrangement identified the following factors as influencing learners achievement; the degree of learners' participation during the teaching – learning process, the availability and quality of textbooks and other references materials, the quality of cues, feedback, correctives and encouragement that learners receive and the duration of time in which learners engage in learning task. Other studies have looked at the impact of these factors on learners' achievement. Sakamato (1985) in a study involving Japanese primary and secondary schools, revealed that learners who study in groups and makes quality use of the library resources achieve superior results in examinations. Later in the same country, Stedman (1994) investigated why Japanese students obtained higher scores in the international assessment in mathematics. The study argued that it was the use of "hand on" teaching methods by Japanese teachers which led to the superior performance.

Kenya National examination Council (KNEC, 2010, 2011, 2012) which is responsible for the National examinations in primary, secondary and middle level college in Kenya recommends the following remedies for continued good performance at national examinations. These are coverage of syllabus, acquisition and use of mathematics textbooks, ensuring thorough mastery of the subject matter and involvement of learners in practical activities. Researchers are presently examining a number of teaching-learning approaches with the hope of developing models which may adequately integrate learning productivity factors. Some of the models that are currently receiving great attention are; mastery learning, experiential learning, problem solving, constructivist approach and cooperative learning. In this study, it is assumed that achievement in mathematics can be enhanced by the influence of embedding mathematics language factors (EMLF) in mathematics teaching.

2. *Factors associated with Gender Differences in Mathematics Achievement*

Researchers internationally have undertaken studies in various contexts examined factors that influence gendered achievement in mathematics. Many studies have focused on factors related to differences in the performance of boys and girls in mathematics (e.g., Abiam, & Odok, 2006; Mahlomaholo & Sematle, 2005; Opolot-Okurut, 2005; Zhu, 2007).

One body of research comes from feminist researchers who have tried to make meaning of the experiences of girls and boys in the mathematics classrooms, and to interpret male-female power relations (Jungwirth, 1991). These findings reveal that often girls are marginalised and given a subordinate status in the mathematics class. The findings suggest that perceptions of teachers are that girls' performances in mathematics are dependent on rote learning, hard work and perseverance rather than natural talent, flexibility and risk taking which are the learning styles of boys. Teachers are also of the view that girls "learn" mathematics whilst boys "know" mathematics. The studies argue that hegemonic masculinity is played out in mathematics classes in that the behaviour of some boys negatively impacts on the ability of girls to learn, and those girls who perform well in mathematics experience the mathematics class as outsiders. Other studies have looked at the attitude of boys and girls as a factor that impacts on the differences in mathematics performance. In a study by Opolot-Okurut (2005) it was found that for all the attitudinal variables (anxiety, confidence and motivation), males had higher mean scores than females. Mutemeri and Mygweni (2005) argue that the idea that mathematics is for boys may result in low motivation in girls and could widen the gender gap in mathematics achievement in favour of boys.

According to Fennema and Leder (1990) gender differences in mathematics teaching, learning and achievement have been explained on the basis of gender differences in cognition and brain lateralization. In a similar argument, Paechter (1998) argues that male and female students do experience the world in different ways. Firstly, because they are differently positioned in society, and secondly, because of their different learning styles and how they perceive and process reality. These researchers emphasize that most mathematics classroom discourse is organized to accommodate male learning patterns, hence their high achievement in mathematics. These differences have implications for the kind of instructional procedures that are to be adopted for setting up an appropriate teaching and learning environment from mathematics instruction that is suitable to both genders.There have been studies that suggest that teachers and schools structure the teaching and learning of mathematics to place boys at an advantage. Fennema and Leder (1990) reported that teachers treat male and female students differently and the treatment favours male students.

Classroom interaction has emerged as a factor in explaining the gender gap in mathematics (Jungwirth, 1991). These studies have found that boys' use of verbal and non-verbal language tends to command more of the teacher's time in both attention and classroom control. Furthermore, boys are more mobile in the classroom than girls, and this tends to influence some teachers' beliefs that boys are more competent than girls. Curricular materials used in the schools have also been singled out as an influencing factor in the study of mathematics. For example, in some textbooks women are portrayed as insignificant or invisible as compared to men who dominate texts, and are referred to as pioneers and great scientists. Contrary to these findings, Epstein, Elwood, Hey and Maw (1998) discovered that female students receive more attention from teachers than male students. They also found that female students' contacts with teachers were mainly about seeking help and encouragement. It was also found that teachers' acceptance of female students' low self-confidence in mathematics classrooms served as reinforcement for feelings of helplessness. Boaler (1997) has shown how the different learning goals of girls and boys leave girls at a disadvantage in competitive environments. Boys and girls preferred a mathematics curriculum that enabled them to work at their own pace as their reasoning was different. Girls valued experiences that allowed them to think and develop their own ideas as their aim was to gain understanding. Boys, on the other hand, emphasised speed and accuracy and saw these as indicators of success. Boys were able to function well in a competitive environment of text-book based mathematics learning.

Other important factors that emerge in research on gender and mathematics are cultural and family influences, socio-economic status of parents, and cultural and traditional influences (Kaino & Salani, 2004). Such factors could influence girls' performance and subject selection in respect of mathematics. Collins, Kenway and McLeod (2000) argued that schools establish symbolic oppositions between male and female students through gendering of knowledge and defining of certain subjects as masculine, for example, mathematics. In contrast, female students are conditioned in society to believe that mathematics is a male subject, and it is acceptable for them to drop it. A study done in Botswana by Kaino (2001) indicated that cultural expectations of society could result in differences in performance between girls and boys in certain school subjects such as mathematics. In Nigeria it has been argued that nurture entrenches male dominance over the female gender (Bassey, Joshua & Asim, 2007). Sex-stereotyping is pervasive from birth. Society fixes gender roles and conditions males to engage in intellectually and physically more challenging tasks like construction, football, palm-wine tapping, agriculture and fishing. In contrast, females are relegated to the kitchen and domestic chores. As a result of this kind of gender stereotyping, female students in the school tend to select subjects such as home economics, biology, chemistry, physics and mathematics are seen by girls as subjects exclusively from ales.

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The challenge for effective teaching in mathematics is to try to ensure that both male and female students are able to receive a broad-based education, with equal opportunities to follow up specific interests and activities, without students' progress and subject choices being unjustifiably constrained by gender differences (Mondoh, 1995; Brown & Riddell, 1992). Student teachers' and other stakeholders' perception that boys always do much better in science and mathematics than the girls promotes the girls' perception that good academic achievement in these subjects is appropriate to boys. According to Archer and Macrae (1991), when students rate school subjects along a seven-point rating scale in regard to either masculine or feminine affiliated subject, gender difference on the perception of the rated subjects was very clear. The boys perceived subjects that were highly rated as masculine subjects as 'interesting' and feminine ones as 'boring'. In contrast, the girls' perception of the masculine rated subjects was that they were 'difficult' and feminine subjects were 'easy'. The greater emphasis now evident in schools to promote equal opportunities demonstrates that much more effort has been made to improve school practices in this respect, and programmes of personal and social education typically deal with gender issues and how related problems may be overcome (Mondoh, 1995; Myers, 1992). Many interventions put forth included arranging for visits by women engineers to talk to female students about careers in engineering, hanging posters on the wall of a mathematics classroom of great male and female mathematicians, and encouraging boys to take part in feminine rated subjects or areas of the curriculum such as home economics, singing and dances activities. These strategies were done with the hope of changing both boys' and girls' attitudes towards activities regarded by the society as more of boys' or girls'.

One of the most interesting interventions is the use of girls'-only and boys'-only mathematics discussion groups in co-educational schools. This has given girls the chance to participate in Mathematics discussions without boys' dominance of the teacher's attention and teacher-students interactions. Anti-sexist initiatives in schools can also sometimes unwittingly promote or confirm sexist assumptions, Mondoh (2001). For example, by making efforts to encourage more girls to study physics, schools are implicitly conveying the message that this is usual for girls, and may make a girl who was intending to do physics think twice about doing so as a result. For this reason, promoting equal opportunities in this way requires careful thought. In addition, it needs to be recognized that the efforts being made in schools to promote equal opportunities, are limited by factors outside the school, which have a powerful impact on students' attitudes and aspirations towards mathematics. These include the influence of the family and the attitudes generally held in the local community and by society at large. For example, a parent may comment about his/her child's performance to the effect that poor Mathematics marks are common among the family members. There are also realistic choices that need to be made by individuals based on how they feel that things typically operate at the moment rather than how they might operate in an ideal world or at some point in the distant future. For example, whereas some girls may well have the ability to develop a professional career of some sort, their perception might be that becoming a wife and mother is a much more attractive and compelling lifestyle, and at the moment they feel that it is not possible, or that it is at least very difficult, to do both (Mondoh, 1995)

3. Gender and Academic Achievement in Secondary School Mathematics

There has been a renewed debate on the controversial issue of gender differences on mathematics and science achievement (Linver, Davis-kean & Eccles, 2002). This debate currently focuses on why women are not seeking careers in information technology occupations. Work by Eccles, Lord, Roeser, Barber, and Jozefowicz (1997) found that gender differences in enrollment in advanced mathematics courses in high school are mediated by gender differences in expectations for success in mathematics and physics and perceived value of competence in math. Jacob, Lanaz, Osgood, Eccles, and Wigfield (2002) found that self-concept of ability and task value in mathematics decline for both genders between first and twelfth grades with no real difference between girls and boys trajectories over time. In fact, by the twelfth grade, girls valued mathematics more than boys when controlling for self-concept of ability in math. This research might suggest that women should be just as represented in the technology or mathematical work force as men. This, however, is not the case. Even though women have made great strides in the law, medical, and social science professions, very few can be found in graduate programs or professions in mathematics, computer science, physics, engineering, or information technology jobs (Eccles, 2001). Many ideas have been put forth on why high achieving women may not be entering these professions. For example, discrimination, gender-typed socialization, self-concept of ability in these areas, and the value and interest that women have in these professions (Eccles, 2001). From any years, most studies attempting to account for differences in attainment between male and female learners looked at the biological difference. However, it becomes increasingly clear that it was social influence rather than biological differences that was having the effects on attainment (Mondoh, 1995).

Mondoh (2001) gives some aspects of differences between male and female learners in education as due to biological basis. But, the vast literature in this areas indicates that the main differences reported during the school years such as learning to read in the early years and choice of subjects of study in later years of education appear to result mainly from gender-linked experiences, both at home and at school. Indeed, even developments at infancy, such as the tendency for girls to develop their use of language earlier, or for boys to develop greater spatial ability, seems to be more a reflection of the type and pattern of parent-child interactions rather than biological development. The persistent underachievement by the female learners in mathematics has as well been the main reason for the continuous research in this field. Mondoh (2001) in her study to establish whether nature was responsible for putting the girls and women in an inferior position when it come to participation and academic achievement found that boys are never superior to girls in the learning of mathematics but girls are subjected to enculturisation from the beginning of their lives. The other causes of girls' underachievement and under participation in mathematics as compared to boys have been identified as sociological. O'Connor (2000) gave the following factors that are related to girls' underachievement and under representation in mathematics: lack of female role models, interaction, gender bias in textbooks and unfriendly teaching methods.

4. Factors that Influence Differences in Gender in Mathematics Achievement

Scholars worldwide have undertaken studies in different contexts by examining factors influencing gender achievement in mathematics. A great numbers of studies have focused on factors related to differences in the performance of boys and girls in mathematics (e.g., Abiam, & Odok, 2006; Mahlomaholo & Sematle, 2005; Opolot-Okurut, 2005; Zhu, 2007). One body of research comes from feminist researchers who have tried to make meaning of the experiences of girls and boys in the mathematics classrooms, and to interpret male-female power relations (Miriam, Pamela & Jacquelynne, 2002). The findings by Miriam et al., reveal that often girls are marginalised and given a subordinate status in the mathematics class. The findings suggest that perceptions of teachers are that girls' performances in mathematics are dependent on rote learning, hard work and perseverance rather than natural talent, flexibility and risk taking which are the learning styles of boys. Teachers are also of the view that girls "learn" mathematics whilst boys "know" mathematics, which argue that hegemonic masculinity is played out in mathematics classes in that the behaviour of some boys negatively impacts on the ability of girls to learn, and those girls who perform well in mathematics experience the mathematics class as outsiders. In a study by Opolot-Okurut (2005) it was found that for all the attitudinal variables (anxiety, confidence and motivation), males had higher mean scores than females. Mutemeri and Mugweni (2005) argue that the idea that mathematics is for boys may result in low motivation in girls and could widen the gender gap in mathematics achievement in favour of boys.

Mbugua (2004) conducted a survey research on influence of mathematics language on students' achievement in mathematics amongst Form Three mathematics students in various districts of Kenya. The study found that the level of achievement in mathematics was not affected by gender and that the student understanding of mathematical language was poor. According to the study, achievement in mathematics was highly correlated to students understanding of mathematical language. The study also showed that difficulty of mathematical language is not examined and that syllabus does not allow time for definition of mathematical language. The study also found out that mathematical language is not included in lessons and teachers rarely ask or set questions that would require explanation or definition of mathematical terms, symbols and structures. However, this study did not take into account mathematics language factor as a teaching strategy, the gap this study intends to fill. Pondel (2006), in London, conducted a research on the role of language in learning mathematics at school. The study found out that students were not conversant with mathematical terms. The study also showed that there was lack of knowledge of synonyms of mathematical terms. However, this study did not take into account gender aspect. The study intends to look at whether there is gender difference in understanding of mathematical terms, symbols and structures when learners' are taught using mathematics language factor as a teaching strategy, the gap the study intends to fill.

III. METHODOLOGY

1. Research Design ,Target Population

The research design used in this study was Solomon Four Non-Equivalent Control Group Design. This design used non-equivalent groups (Fraenkel & Wallen, 2000; Mugenda & Mugenda, 2003). This design was considered appropriate because the subjects were already constituted and it was not possible to randomly select them individually. The design involved a random assignment of intact classes of subject to four groups with Two groups being experimental and other Two as controls. The target population constituted of form two students drawn from 13 public co-educational secondary schools in Nakuru County, Kenya. There are approximately 1300 Form Two students in Nakuru County, Kenya (Nakuru County, Kenya Educational statistics, 2012). The co-educational schools were selected because the study was to look into gender differences in performance. Samples were drawn from Form Two mathematics students. These students were involved because the topics “Linear inequalities”, “Further measurements” and “Indices and Logarithms” are taught at this level in Kenya’s secondary schools curriculum (KIE, 2002). The four topics were chosen because they are rich in symbols and terms.

2. Sampling and Sampling Size

The study involved public secondary schools within Nakuru County, Kenya. Purposive sampling and simple random sampling were used so as to select Co-educational secondary schools within the Nakuru County from the sampling frame. Generally, a sample size is determined by the number of variables in the study, type of research design, method of data analysis and the size of accessible population. However, according to Mugenda and Mugenda (1999), at least 30 members per group in the design are required for experimental research. Information from the DEO’s office shows that there are 13 co-educational schools in Nakuru County. Simple random sampling was used to select 4 schools from the 13 co-educational schools. The sampling unit was secondary schools and not the individual learners since learners are taught as intact groups. However, the individual learners were units of observation. The four sampled schools were randomly assigned to the control and the treatment groups. If a selected school assigned to an experimental group had more than two streams, all the streams were exposed to the treatment but two streams randomly selected for analysis. All mathematics teachers of selected schools participated..

3. Data collection instruments

The research instruments used in this study were Understanding of Mathematical terms test (UMTT), Understanding of Mathematical symbols test (UMST), Understanding of Mathematical Structures test (UMSrT), The Mathematics Observation Schedule (MACOS), Mathematics Achievement test (MAT). The observation schedule provided information on what goes on in class in relation to embedding of mathematics language factors from the secondary school mathematics teachers and students. The researcher used it to follow the teaching of Embedding Mathematics Language Factors (EMLF) during the lesson. Understanding mathematics test sets I, II and III provided information on learners understanding of mathematical terms, symbols and structures respectively. Mathematics Classroom Observation Schedule (MACOS): The researcher sat in all Form Two classes in the selected schools and using the observation schedule recorded, all the mathematical terms, symbols and structures that were presented in the lesson. The researcher was very keen on the level of explanation and also identification of any mathematical term, symbol and structure that was ignored or left out in relation to the content given. Observation was also carried out on how the learners were interacting with mathematical terms, symbols or structures presented in the lesson and whether teachers asked questions that required learners to discuss and give their meaning. Activities in the mathematics classroom were observed and data captured using the mathematics classroom observation schedule. This was to help the research to monitor the implementation of the instructional module.Mathematical Achievement Test (MAT) : This provided information on scores on the students’ Mathematical Achievement as affected by mathematics language factors. This consisted of 20 structured questions. The scores were used as a means of measurement

4. Data Collection, Processing and Analysis

The researcher followed the following procedure: data collection procedures started from the graduate school, Laikipia University where the researcher obtained an introductory letter to help in seeking permission to carry out study in different areas and institutions. The letter was taken to National Commission for Science, Technology and Innovation in order to obtain a research permit authorising one to visit selected schools in order to carry out the research. After the research permit was obtained (appendix G) letters were prepared and taken by the researcher to the District Education Officer and to the Head Teachers of the selected schools, seeking permission to allow the research to be conducted. The research agreed with teachers in the experimental schools on the appropriate date for training. The mathematics teachers in the two experimental schools (E1 and E2) were trained during the recess for one week (during the April holiday 2015) on use of the mathematical language factor teaching strategy module by the researcher. The duration taken by the researcher to complete the work was 9 weeks. This study provided quantitative data that was used to produce both descriptive and inferential statistics using the SPSS software version 20. Raw data was summarized in the form of tables and descriptively analysed using means, standard deviations and percentages. Hypotheses were tested using the one-way Analysis of Variance (ANOVA) since it tested the significance of difference between more than two means at once. LSD Post-Hoc comparison was used to find out whether the difference occurred on pairs of groups and the direction of the difference.

IV. RESULTS AND DISCUSSIONS

1. Gender based deference in achievement in mathematics in pre-test before exposure to EMLF

The differences on mathematics achievement and understanding mathematics pretests by gender were also examined during the pretest analysis. The test of differences by gender was determined using the t-test

Table:1: Comparison of the Students' Pre-test Mean Scores on Mathematics Achievement and Understanding Mathematics by Gender

Scale	Group	N	Mean (M)	SD	df	t-value	p-value
1.Mathematics achievement	Male	41	19.93	10.57	80	1.388	.169
	Female	41	23.66	13.60			
2.Understanding mathematics terms	Male	41	23.41	14.11	80	0.445	.657
	Female	41	24.85	15.14			
3.Understanding mathematics symbols	Male	41	28.02	14.77	80	0.429	.669
	Female	41	26.66	14.08			
4.Understanding mathematics structure	Male	41	30.61	13.24	80	0.434	.666
	Female	41	31.98	15.20			
5.Understanding of mathematics (i.e., combined 2,3,4)	Male	41	27.35	8.89	80	0.235	.815
	Female	41	27.83	9.61			

Mathematics achievement pretest mean score (M = 19.93) of male students was not significantly different from that of the females (M = 23.66) at the .05 level (t(80) = 0.1388, p = .169). The two groups were similar on mathematics achievement before the commencement of the programme. Male students understanding of mathematics terms mean score ((M = 23.41) was not significantly different from that of the females (M = 24.85) at the .05 level (t(80) = 0.445, p = .657). This is an indication that the two groups were similar at the point of entry. The difference between the male students' understanding of mathematics symbols mean score (M = 28.02) was not significantly different from that of the females (M =26.66) at the .05 level (t(80) = 0.429, p = .669). This means that the two groups were homogenous before the commencement of the programme.Male students understanding of mathematics structure mean score (M = 30.61) was not significantly different from that of the females (M = 31.98) at the .05 level (t(80) = 0.434, p = .666. This implies that the males and females were comparable at the point of entry. The results in Table 1 further shows that the male students understanding of mathematics combined mean score ((M = 27.35) was not significantly different from that (M = 27.83) of the females at the .05 level (t(80) = 0.235, p = .815). Given that the E1 and C1 had comparable characteristics on the two measures; mathematics achievement and understanding of mathematics, they were considered suitable for the study as the pre-test analysis shows that they were drawn from a similar population.

2. Difference in mathematics Achievement between Boys and Girls Taught using EMLF

The objective (Ho) of the study sought to establish whether there was difference by gender in achievement in mathematics of students exposed to EMLF. The comparison of the students' posttest achievement by gender was done using the t-test. The results of the independent sample t-test are in Table 2

Table 2: Differences by gender in Posttest mean scores of students exposed to EMLF

Group	N	Mean	SD	Df	t-value	p-value
Male	41	53.73	19.09	80	0.466	.642
Female	41	51.93	15.81			

The results of the t-test in Table 2 reveal that the mean score (M = 53.73) of the males was higher than that of their female counterparts (M = 51.93). However the difference between the two means was not statistically significant (t(80) = 0.466, p=.642).

Table 3: The Adjusted Mathematics Achievement Posttest Mean Scores of Students exposed to EMLF with KCPE as the covariate

Gender	N	Mean	Standard Error
Male	41	53.80	2.758
Female	41	51.86	2.758

The results contained in Table 3 show that the adjusted mean score (M = 51.86) of the female students was lower than that (M= 53.80) of the males. The results of the ANCOVA test comparing the adjusted means of the two groups are in Table 31

Table 4: Comparison by Gender of Students exposed to EMLF Mathematics Achievement Posttest Mean Scores using ANCOVA

Scale	Sum of Squares	Df	Mean Square	F-ratio	p-value
Contrast	76.674	1	76.674	0.247	.621
Error	24523.500	79	310.424		

The results in Table 4 reveal that the difference between the mean score of the male students was not significantly different from that of the females at the .05 level, (F(1, 79) = 0.247, p= .621). The results of both the t-test and ANCOVA analysis (see Table 31) showed that the difference between the posttest mathematics achievement mean score of the females and that of their male counterparts were not significantly different. This means that gender does not affect the achievement of students exposed to EMLF. Therefore, the fourth null hypothesis (Ho4) which stated that there no significant difference in mathematics achievement between boys and girls taught using ELMF was accepted.

V. CONCLUTION

The objective of the study sought to establish whether there was difference by gender in achievement in mathematics of students exposed to EMLF. To achieve this objective, the following null hypothesis was formulated and tested using t-test analysis and ANCOVA. Ho4: There is no statistically significant difference by gender in achievement in mathematics of students exposed to EMLF strategy Results generated by the analysis revealed that the EMLF post mean score of male (i.e., 53.73) was found to be higher than the mean score of females (i.e., M=51.93) in the experimental groups. The results using the t-test analysis, revealed that the mean score (M=53.73) of the males was higher than that of their females counter parts (m=51.93). however, the difference between the two mean was not statistically significant (t(80) = 0.0466, p = .642). Therefore, the null hypothesis (Ho) which stated that there is no significant difference in mathematics achievement between girls and boys taught through EMLF was accepted. Finally, the study has revealed that gender does not affect students' achievement in mathematics when students are taught using EMLF strategy. The EMLF teaching strategy reduces gender disparities in achievement of secondary school mathematics. Based on the findings from the four objectives, gender does not affect students' achievement in mathematics when students are taught using EMLF teaching strategy. The study concludes that EMLF teaching strategy reduces gender disparities in achievement of secondary school mathematics.

Mathematics educators in Kenya can use the following recommendation to enhance students' mathematics language factor skills and in turn increase their likelihood of success in mathematics examinations as well as satisfaction in learning mathematics. Secondary school mathematics should often be taught using the EMLF. This can be achieved by in-servicing the mathematics teachers on how to adequately use this method in order to exploit the many advantages in presents to both the teacher and student. The understanding of mathematical terms, symbol and structures be included in the writing of mathematics textbooks in order to enable the authors to know how best, to guide teachers on how to apply each of them during mathematics instruction. The EMLF should be incorporated in the content of teacher training programs in both the teacher training colleges and undergraduate level at the university. The Ministry of Education should take appropriate measures to improve the quality of secondary school mathematics teachers by planning for seminars and workshops where methods of improving learning and teaching mathematics using EMLF modules are discussed. The in-service courses organized by the Ministry of Education (MoEST), and Teacher Service Commission (TSC), such as SMASSE, should incorporate EMLF teaching method in their teaching programmes. This is because the quality of teachers and the kind of training they have is a major determinant of the quality education in any nation. The teacher training programmes should equip the teachers with the knowledge and skills necessary to achieve educational goals and objectives.

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