Girls' Achievement in Mathematics In The Upper Primary Schools Of Addis Ababa

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Abstract: This study was designed to make a comprehensive comparative analysis about mathematics achievement for girls and boys at upper primary education level. It was also aimed at investigating the extent of association between girls' mathematics achievement and school ownership, and probing into existing gender stereotypes among the minds of school children. To this end, the study has employed both objective and subjective data gathering instruments. The instruments were applied to 309 boys and 302 girls drawn from 10 schools (five schools each from government and non-government) on the basis of diversified sampling techniques. The results of data analyses revealed that mathematics achievement was strongly associated with student gender and girls' achievement was significantly lower than that of boys. However, girls' mathematics performance did not show significant difference in government and non-government schools. Further, it was evident that traditional stereotypes, which favour male dominance in mathematical ability, were still prevalent at modest level in the schools studied. Thus, a concerted effort by teachers, parents, relevant agencies, and the Government is required to ameliorate the prevailing gender gap in mathematics achievement.

Introduction

It is becoming a well recognized and accepted fact that education is an important instrument for promoting peace and prosperity in a given society. The evidence is also clear that the total benefits to education multiply when schools open their doors to both sexes equally. In particular, female education has become one of the most powerful forces that contribute to all rounded improvement in society's life (Berelson, 1969; Kingdon, 2002). The authors suggest that the benefits of educating women are manifold, ranging from improved productivity, income, and economic development on the national level to a better quality of life on the individual life, notably a healthier and better nourished population and greater autonomy among women. Moreover, educating women is important for all kinds of demographic

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behavior, affecting mortality, health, fertility, and family planning practices. Currently, there are also well-documented links between mothers' education and their children's readiness for learning, and between female education and productive self-employment. Simply stated, education of women has a substantial economic and social return to a given country.

Motivated with such benefits of females' education, the Ethiopian Government, like other governments in the world, has taken series of measures to promote females' education and involvement over the past three decades. Particularly, the present Government has demonstrated its keen interest and taken a number of measures to increase the size of girls' enrollment at various levels. Among these measures, the New Education and Training Policy, which was inaugurated in 1994 by the Transitional Government of Ethiopia (TGE 1994a), strongly addresses such an issue. The Policy was devised as a means to confront complex problems that the then education system was entangled with, such as problems of relevance, quality, accessibility, equity, and medium of instruction (TGE, 1994a). This led to a landmark change in the objectives and structure of the country's educational system. The overall change in the structure of the education system was from **6+2+4** to **4+4+2+2.** This is to mean that the former 6 years of elementary, 2 years of junior secondary and 4 years of senior secondary schooling system has been changed to 4 years of first-cycle primary education (Grades 1-4), 4 years of second-cycle primary education (Grades 5-8), 2 years of general (1^{st} cycle) secondary education (Grades 9 and 10), and 2 years of preparatory (2^{nd} cycle) secondary education (Grades 11 and 12) or vocational and technical training offered parallel to it (TGE, 1994b).

Following the issuance of the policy, school enrolments have been expanded manifold in which case girls have got more access to schooling than before; new schools have been established and more places have been added to the old ones throughout the country (MOE, 1999; 2001). For example, in the period between 1994/95 and 1998/99, the net enrollment rate at primary level (Grades 1-8) had

increased from 20.7 percent to 47 percent for boys and from 14.7 percent to 31.9 percent for girls (MOE, 1999). The same document attests that the overall primary school enrollment for both sexes had increased from 17.8 percent to 39.6 percent in the above-stipulated period, which was an improvement by over 100 percent from the base time (i.e. 1994/95). What is more, the curricula and syllabi of different subjects have been revised and/or introduced afresh. The Government has also put in place an *Education Sector Development Program (ESDP)* in 1997, by means of which an ambitious plan with a target of achieving *Universal Primary Education* by the year 2015 has been stipulated (MOE, 2001). Many people, particularly in the Government, seem to believe that the New Education and Training policy, its Strategy and ESPD are all geared towards achieving such a lofty goal (also called the *Millennium Goal* by the United Nations) to which the Government of Ethiopia had committed itself in front of the United Nations General Assembly in 2000. The pledge was to realize the goal by 2015.

Although the Government has been making a concerted effort and, in some respects, has achieved a considerable level of success in opening access to education for a number of school-aged children in the past 10 years, there are still a great deal of school-aged children who remain out of school (MOE, 2001; UNESCO, 2004). Moreover, the country's education sector is still confronted with a number of other daunting challenges one of which is the multifaceted impediments to females' achievement in mathematics and science subjects. Studies have indicated that there is a remarkable gender difference in achievements of mathematics and science subjects at various levels of educational setting (Assefa, 1991; Bedru and Tilaye, 2001; MOE, 1999, 2001). Furthermore, data from school records indicate that mathematics has been one of the main subjects in which girls scored below the desired national average (Genet, 1991). Thus, the above findings highlight the fact that the country's education system still suffers from a glaring gender inequity problem in math-related performance.

Although the issue of gender-difference in mathematics performance has been discussed commonly by a couple of professionals and practitioners, this general notion has not been well established in our school literature. To the best of this researcher's knowledge, the underlying causes of such a problem were not also thoroughly investigated yet. As one may expect, such gender disparities in mathematics achievement may not necessarily occur due to natural factors but perhaps because of a number of other environmental factors. These may include socio-cultural, socio-economic, school-related, and personal factors. Unless these constraining factors are investigated thoroughly and possible solutions solicited, all efforts directed towards gender equality may end up in vain. Moreover, if they are left untreated on timely basis, such obstacles to females' education may seriously hamper the efficiency of the education system as they could bring about a sizeable number of school dropouts and repeaters into the system. That is exactly what this research has been designed for. Particularly, the major concern of this study was to conduct a diagnostic survey on girls' performance in mathematics at the second cycle of primary education in Addis Ababa.

Theoretical Background of the Study

Over the past 30 years or so, the study of girls' mathematics and science achievement has attracted immense attention among multitudes of scholars in various countries. Some studies conducted abroad (e.g. Morgade and Bonder, 1995) found that girls' mathematics achievement in the elementary grades was equal to boys' but decreased in the middle school. In their review of various works, Morgade and Bonder pointed out that mathematics performances of boys and girls were more or less the same till the end of primary education. However, the performances of girls in mathematics dropped considerably at the end of the first cycle of secondary school, when they lost confidence in their ability to master the subject (Morgade and Bonder, 1995). In another study, Callaham

and Clements (1984) reported that gender differences were unlikely to surface until age ten.

However, other studies (e.g., Sherman and Fennema, 1977) suggest that although girls' confidence in their mathematics ability tends to match that of boys in the earlier primary school years, it deteriorates more rapidly during high school. Similarly, other studies conducted on standards of achievement in science at age 11, 13 and 15 and in technology at age 15 in UK revealed that the performance of boys was higher than girls on problems set in industrial and laboratory context. If, on the other hand, the task was based in the kitchen or the office, or involved children's toys, girls appeared to have an advantage (Murphy, 1993). Similarly, studies which focused on different subjects have pointed out that girls tend to perform better than boys in work requiring verbal ability while boys tend to perform better than girls in tasks requiring science and technological skills (Maccoby and Jacklin, 1974; Fennema, 1996).

Studies that were conducted in Africa (Wasanga, 1995; FAWE, 1997) also revealed that a significant gender difference was recorded in mathematics and science achievements in favor of males against females. The marked differences in these subjects have been observed from Grade 4 onwards (Maccoby and Jacklin, 1974). In another study, Hilton and Bergland (1974) found that significant gender differences in favor of males were recorded in grades over five.

Similarly, some studies conducted in different vicinities of Ethiopia other than Addis Ababa in the last few years had established theoretical bases that there were glaring gender differences with respect to mathematics and science achievements (e.g. Anbessu and Barbara, 1988; Assefa, 1991). These researchers have documented the existence of pronounced differences between males' and females' achievements in science and mathematics. Particularly, Assefa (1991) on his study of primary school students in various locations in the country indicated that in almost all the sample grades he

considered, boys had performed better than girls in mathematics. Another achievement study conducted by Genet (1991) disclosed that girls have performed very unsatisfactorily in mathematics and science subjects in Ethiopian School Leaving Certificate Examination (ESLCE) at the national level. Similar results were obtained from the findings of Seyoum (1986).

Studies which proved the existence of gender difference in mathematics achievement seem to suggest that the prevailing differences were attributed to a number of factors including personal and social factors. For example, Keynes (1989) suggests that parental interest in and supports to their children's mathematics learning affect their (children's) achievement in mathematics. Since most parents think that mathematics is a pro-male subject, they tend to praise their daughters' hard work in attaining good grades, while attributing their sons' success to talent. In another study, Sander (1985) confirmed that families were willing to put more money to enhance their sons' mathematical mastery than they did for their daughters'.

In addition, the way a given school handles gender outlooks also does have a bearing on girls' achievement. In principle, teachers are expected to be fair and friendly to all of their students regardless of their sex. However, research findings indicate that in practice teachers typically interact differently with their male and female students (UNESCO, 1984; Keynes, 1989; Robinson, 1992). In particular, Keynes (1989) and Robinson (1992) found that differential responses of teachers and guidance counselors to girls' and boys' learning desire had seriously affected mathematics achievements. Studies conducted in Africa (e.g., Cammish and Brock, 1994; UNESCO, 1984), indicate that there exists implicit and explicit gender discrimination in the classrooms by various teachers. Research portrays girls in co-educational classrooms, especially in mathemathics classrooms as displaying passive, quiet, and subservient behavior. By observing the classroom interaction between teachers and students, Warnerson (1982) in Sweden and Spender

(1982) in UK have invariably reported that boys and boys' work are valued more highly and schools are structured to provide special privilege for boys. They continue saying that intellectually boys' work is valued more positively and even when girls and boys do the same work, it is evaluated differently in favor of boys. Similarly, after going through the experiences of different countries' teachers at schools, UNESCO (1984) summarized its findings as follows: (1) teachers tend to spend more time talking to males and allow male students to talk more than females in classrooms; (2) girls had to wait longer for answer or assistance; (3) most teachers happen to know a great deal more about the boys they teach than girls; (4) teachers prefer to introduce topics which are usually associated with males; (5) majority of teachers prefer to teach boys, even though more has been stated it was easier to teach girls; and (6) teachers tend to have different expectations for achievements of males and females.

It has also been observed that teachers, specially in Africa, not only denigrate female capability in academic achievement in general, and mathematics in particular, but also transmit their perceptions of what constitute the correct behavior and lifestyle for educated girls. Girls who deviate from the "correct behavior" risk being labeled "abnormal" (Wamahiu, 1996). Similarly, Masemann (1974), who conducted a study in a Ghanaian boarding school, concluded that teachers usually encourage girls to internalize the view that men have authority over women both at home, school and the workplace. The above findings indicate that schoolteachers no matter how well they were educated seemed to promote their traditional attitudes towards their female students.

However, the differential treatments of girls from boys or low expectations of girls may lead to an erosion of confidence and development of negative attitudes towards school learning in general and towards science subjects in particular. Moreover, classroom observations made by Fox (1981) had verified the differential treatment of students by gender on the part of teachers in mathematics classes, which in turn led to the development of sex-

stereotyping of mathematics subjects as a male domains. It is no wonder then that many girls score lower grades in mathematics and repeat grades many times. For example, the Ethiopian education statistics of 2000/01 reveal that females' repetition rate at the upper primary level (Grade 5-8) was consistently higher than that of boys' (MOE, 2001).

A factor which is equally important to attitude is one's motivation for achievement or expectation for future achievement. A general agreement, in this regard, is that a student with higher achievement motivation is likely to be competitive and successful in his/her school work (Brimer and Pauli, 1971). After reviewing the works of various scholars in mathematics achievement, Rosser (1995) suggests that the self-concept of students in mathematics achievement (i.e. personal confidence in their mathematical ability) may contribute to the differences in mathematics achievement between boys and girls. Evidence shows that females are not likely to believe that mathematics has utility in their lives (Fennema and Sherman, 1978). Such a mental set prevents them from making efforts to improve their mathematical skills.

Gender researches conducted on science achievement (Hilton and Bergland, 1974; Fox, 1981) have documented that girls happened to be less confident in science and mathematics achievements. Specifically, it seems that, during the later stages of schooling, girls seem to develop a lower estimation of their own abilities in math-related subjects than boys. This hampers their achievement in mathematics adversely. Substantiating this viewpoint, Hilton and Bergland (1974) reported in their findings that sex-related differences in achievement are partly the result of *self-efficacy* of girls for their achievement in mathematics subjects. Comparative studies that were conducted on achievements of quantitative-oriented subjects (Bryne, 1978) reveal that boys have a higher expectancy of success than do girls in upper primary schools. Such self-confidence of boys has been associated with higher performance in mathematical subjects against their counterparts, girls.

To sum up, the above research findings indicate that mathematics performance differs by sex towards the later part of primary education. A number of factors are attributed to such a difference such as parental bias, stereotypes favoring males, mistreatment of teachers, and lack of personal confidence in mathematical ability. Most girls experience very low self-confidence towards mathematics learning. Their positive view deteriorates as they ascend through the hierarchy of schooling. Such negative images, however, adversely affect their performance in the subject.

Having observed such diverse findings on the subject, the researcher of the present study attempts to examine whether there was a clear-cut association between gender and mathematics achievement in Addis Ababa upper primary schools.

Objectives of the Study

The main purpose of this study was to examine the level of gender disparity in mathematics performance in the second cycle of primary education in Addis Ababa with a view to provide basis for developing appropriate strategies. More specifically, the main objectives of the study were:

- to make comparisons of girls' achievement with that of boys in mathematics in the upper primary education in Addis Ababa;
- to examine the extent of relationship between female student performance in mathematics and school ownership;
- to examine the attitudes of both sexes towards mathematics and pinpoint some of attitudinal stereotypic barriers to girls' achievement in mathematics.

Research Questions

As a derivation of the objectives stated above, this study was intended to answer the following basic questions:

- Is there significant association between student gender and mathematics achievement in the upper primary education in Addis Ababa?
- Is there significant difference between girls and boys in mathematics performance?
- Is there significant relationship between school ownership and mathematics achievement among upper primary school female students?
- Do girls and boys differ in their attitudes towards mathematics achievement-cum-gender related stereotypes-cum-subject matter preferences?

Research Design and Methodology

Samples and Sampling Procedures

The study includes the student population of Addis Ababa City, especially those who were attending in the upper primary schools (i.e. Grades 5-8) in the year 2000/01. At the time of data collection, there were 89,042 boys and 100,484 girls registered to attend upper primary schooling (Grades 5-8) in Addis Ababa. The researcher followed multi-stage sampling procedure to select the subjects of study. In the first stage, one grade level (Grade 6) was randomly chosen from the four grade levels in the target population to constitute the primary sample unit. In the second stage, the primary schools of Addis Ababa were stratified into two broad categories based on the ownership of the school as government schools and non-government schools. The researcher had prepared the list of all primary schools operating in Addis Ababa on the basis of school ownership. The list was limited to co-educational upper primary schools whereby both

boys and girls learn together. This list was used to select sample schools in the third stage of the sampling process. All in all 10 schools (5 from government and 5 from non-government) were selected based on stratified sampling procedure. Finally, one section of Grade 6 from each school selected in stage three was selected and all students of the section chosen at this stage participated in the study. The following table shows the summary of sample distribution.

Table 1: Sample Distributions by School

School Name	School Ownership*	No. of Sections Taken	No. of Students	Respondents in (%)
Ras Abebe Aregay	NGS	1	70	11.5
Medhane Alem	GS	1	54	8.8
Betelihem	NGS	1	65	10.6
Meskerm 2	GS	1	59	9.7
New Era	NGS	1	68	11.1
Arbegnoch	GS	1	57	9.3
Belay Zeleke No. 2	GS	1	63	10.3
J.F. Kennedy No. 2	NGS	1	61	10.0
Menelik II	GS	1	50	8.2
Africa Andinet No. 1	NGS	1	64	10.2
Total		10	611	100.0

* GS stands for "Government school", while NGS stands for" Non-Government school."

Out of the total samples of 611 students, 302 were girls while 309 of them were boys. In terms of age, about 51.3 percent of the respondents were under 13 years of age, 43.9 percent of them were in the range of 13 to 15 years inclusive, and the remaining 4.8 over 15.

Instruments and Measurement of Variables

As stated earlier, the main purpose of this study was to investigate the level of relationship between gender and performance in mathematics. To achieve this goal, the researcher employed both *objective* and *subjective* instruments of data collection. To maintain

the objectivity of data collection, standardized mathematics test and documentary analyses were used. The test was developed and refined at different stages by variety of experts. More specifically, standardization of the achievement test was undertaken based on the following procedures:

1. Seven major content areas of Grade 6 Mathematics syllabus that were commonly covered by lessons of all sample schools till the time of data collection were identified based on thorough analysis and in consultation with Grade 6 mathematics teachers in respective schools. The areas include: *Working with Whole Numbers, Set Theory, Prime Numbers and Fractions, LCM and GCF, Simplifying Fractions, Terminating and Non-Terminating Numbers, and Operations with Fractions*.

    - The common areas of coverage identified in the list stated in step1above were used to serve the construction of items that could constitute the achievement test. The size of the items from each content area was determined based on the content analysis of the syllabus under consideration. Moreover, the researcher in consultation with curriculum experts had also decided to incorporate items to measure the three-levels of *cognitive* dimension (viz., knowledge, comprehension, and application).
    - Three test experts among mathematics teachers in the city were recruited to prepare achievement test for the subject of study (i.e. Grade 6 Mathematics). The main criteria for selection of the candidates were qualification (i.e. minimum college diploma in mathematics), experience (i.e. minimum 10 years of teaching Grade 6 Mathematics), and ability to develop a standardized test (i.e. some experience in standardized test development). Once these criteria were set, a strategy that helped to reach out the right people was devised. To this end, the researcher had met with and sought advice from a number of experts in the field based on which he was able to select highly qualified experts. All of the chosen test developers had

qualification of at least diploma in mathematics, had a an average of 13 years in teaching elementary school mathematics, and had participated as test developers in the *National Baseline Assessment Project*, which was undertaken by the National Examinations Organization (NOE) in 2000. In their capacity as test developers of the national project, the selected test developers had received basic training on principles of test construction and refresher courses on elementary school mathematics offered by experts from MOE, NOE, and foreign consultants. With such combination of backgrounds, the test developers were expected to develop a high quality assessment test for the subject under investigation.

- The selected experts were also provided with a one-day training on important issues, such as *Principles and Techniques of Test Construction, Bloom's taxonomy of objectives, the New Education and Training Policy of Ethiopia* and its *Strategy* by the researcher and an expert from the National Organization for Examinations (NOE).
- Following training, the experts were provided with the necessary documents and advised to develop at least 50 items from the portions covered by each school during that period. The researcher and two senior experts from NOE reviewed the draft items thoroughly in order to ensure that the requirements of a test construction were adequately met.
- The reviewed test was further pilot-tested in one school with 45 Grade 6 students (21 boys and 24 girls). The pilot test helped to identify the right items depending on item (discrimination) analysis. Forty items were chosen to constitute the final version of mathematics achievement test as per the discrimination index and level of difficulty index computed from the pilot-test results.
- The final version of the test was administered towards the end of the first semester of the academic year. This time was chosen because it was believed to minimize the probability of achievement differences due to differences in students'

preparations. It was believed that all students had made sufficient preparations for their first semester examination at the time of test administration. Furthermore, extra care was taken to avoid information leakage about the achievement test up until the administration of the test. In short, every effort was made to control the effects of extraneous variables and to ensure the quality of the test.

- The test papers were corrected by a group of experts using an appropriate software. To facilitate the ease of understanding the analyses and to have a clear picture about the extent of relationship between the two constructs (viz., gender and mathematics achievement), a *two-stage* coding scheme was used. In the first stage, each individual's score out of 40 was converted into 100% using appropriate formula. In the second stage, the old coding scheme was improved by recoding the original score out of 100%. At this stage, a *four-level* performance coding system was created in reference to each individual's new score: ***Poor, Low, Medium***, and ***High*** level of performance. The levels meant: (a) ***Poor*** when an individual's total score is below 25 percent, (b) ***Low*** when the score has fallen in the category of 25-49 percent, (c) ***Medium*** when the score is in the range of 50 and 74 percent inclusive, and (d) ***High*** when it is 75 percent and above**.**

In addition, the study had also used questionnaire to gather the opinions of same students pertaining to different aspects of schooling as a part and parcel of *subjective* data collection technique. The questionnaire items focused on demographics of the students; their attitudes towards their teachers, towards mathematics and other subjects, towards their household responsibilities, and towards their parental support. The items were adapted from one of the earlier works of the researcher (Tilaye, 1997). The items were selected from the scale that showed a high level of reliability coefficient ($\alpha = 0.88$). Moreover, a team of four experts from NOE evaluated and recommended the validity of these items for the study of the problem under consideration. What is more, the study employed documentary

analyses to gather the right information from relevant sources (viz., Ministry of Education, Addis Ababa Education Bureau, and sample schools).

Methods of Data Analysis

Before analyzing the collected data from different schools, effective data entry tasks were done using EXCEL software. Following data entry, the researcher and assistant data collectors performed intensive data cleaning, editing, checking and re-checking activities. After having gone through the process of data management stage, data analyses tasks were performed with the help of SPSS for Windows 10.0. This was used to produce the following: (1) *Descriptive statistics* (mean, standard deviation, minimum, maximum, percentages) of basic information and distribution of scores. This facilitated an easy understanding of the level of mathematics achievement by gender and school type. Further, the attitudes of pupils towards parental support, their ability and confidence in mathematics, teachers' treatment of students, and level of subject preference were described in terms of percentage. (2) *The Chi-square* was computed to check whether there were associations between mathematics achievement and other variables such as gender and school ownership. (3) Finally, repeated *t-tests* were conducted to see whether or not the observed mean score differences between sexes and school types were significant.

Results and Discussion

The results of achievement test, the responses of the students and results of documentary scrutiny have been analyzed and interpreted with the help of Statistical Package for Social sciences (SPSS). Most of the results have been organized using tables followed by discussions. For the sake of convenience, related items or concepts have been treated together. Thus, following are findings and discussions with respect to the variables of this study.

Relationship between Gender and Mathematics Achievement

As has been stated earlier, one of the main purposes of this study was to examine the degree of relationship between gender and mathematics performance. The results of the computation are summarized in Table 2 below.

Table 2: Level of Mathematics Achievement by Gender

Gender	Level of achievement (%)				Total	Min (%)	Max (%)	Mean (%)	Std. Dev	χ2 (df=3)
	Poor	Low	Medium	High						
Male	4.9	48.2	30.1	16.8	100.0	8	97	51.2	20.1	
Female	10.9	56.0	24.8	8.3	100.0	11	94	43.6	18.4	19.33
Total	7.9	52.0	27.5	12.6	100.0	8	97	47.4	19.6	*

*p< 0.001. N=611 (males=309, females=302)

It is evident from Table 2 that about 4.9 percent of boys and 10.9 percent of girls had scored below 25 percent and fallen under the category of 'poor' scorers. Similarly, about 48.2 percent of boys and 56.0 percent of girls fell under 'low' level of performance, about 30.1 percent of boys and 24.8 percent of girls had achieved 'average' level of performance, while 16.8 percent of boys and 8.3 percent of girls had achieved a 'high' level of performance in mathematics test. A closer look into the distribution of the achievement score indicates that about 66.9 percent of girls had achieved below the desired national average score (i.e. 50%). The minimum and maximum scores of girls were 11 percent and 94 percent, respectively. For boys, the minimum score was 8 percent, while the maximum was 97 percent. With regard to score dispersion, it was higher for boys' group (20.1%) than females' group (18.4%). The overall average score for the sample boys was 51.2 percent, while it was 43.6 percent for the girls. The computed chi-square ($\chi 2 = 19.33$, $p < .001$) shows that the levels of mathematics achievement and student gender were not independent. Instead, the results in the above table show that there was a significant association between student gender and the level of mathematics performance. In other words, the results of the analysis

indicate that mathematics performance was significantly related with a student's gender background, i.e. being a male or female.

Once the association between mathematics achievement and student's gender was ascertained, the data was further analyzed using t-test to find out whether the observed difference between the means of the two groups (viz., 51.2% for boys and 43.6 for girls) was significant. This analysis yielded a t-value of 4.89 with 609 degrees of freedom, which was found to be significant at the confidence level of 99.9 percent. The gender gap observed between male and female achievements was 7.6 percent, which could be considered high enough to explain the difference between the sexes at the 6^{th} grade level. Thus, the results indicated that girls had once again scored significantly lower than their counterpart-boys-in Grade 6 mathematics achievement test. A close look at Table 2 above shows that the number of girls who scored "Poor" (below 25%) was more than double the size of boys who scored the same. However, the size of girls who scored a "High" grade was less than half the size of boys who scored the same.

The results of the present study supported the findings of previous researchers (e.g., Assefa, 1991; FAWE, 1997; Genet, 1991; Morgade and Bonder, 1995; Seyoum, 1986). For example, a study conducted by Morgade and Bonder (1995) revealed that an individual's sex had appeared as one of the most powerful predictors of achievement differences among school children in mathematics. Similarly, studies conducted by FAWE (1997), Anbessu and Barbara (1988) invariably revealed that a significant gender difference was observed in mathematics achievements in favor of boys.

Thus, the results of the present study and a great deal of previous studies confirmed the rhetoric that there is a remarkable gender difference in the achievement of mathematics. In particular, it seems that mathematics is likely to be one of the subjects in which school girls lag behind the boys. This might lead them (girls) to boycotting or discontinuing further studies that involve mathematics. In connection

to this viewpoint, Rosser (1995) reported that by far, more girls than boys tend to quit secondary school mathematics prematurely. This had severely crippled their (dropout girls') adult lives as mathematics is often considered as a gate-keeping course for controlling access to the most lucrative professions, such as science, engineering and others. In this regard, it is not uncommon to observe in the world of work that many individuals, mainly women, are removed from recruitment for these professions due to their lack of ability and/or low performance in quantitative courses.

Girls' Mathematics Performance and School Ownership

In this study, an attempt was also made to investigate whether there was significant association between government and non-government schools in terms of level of girls' performance in mathematics. To this end, girls' mathematics achievement results were put to statistical analyses. Table 3 depicts the summary of the results of such analyses.

Table 3: Girls' Mathematics Achievement by School Ownership (Type)

School Type	Level of Achievement (%)					Mean	St. Dev.	Min	Max	χ^2 (d.f.=3)
	Poor	Low	Medium	High	Total					
GS	9.4	58.0	23.2	9.4	100.0	42.8	18.4	11.0	94.0	
NGS	12.2	54.3	26.2	7.3	100.0	44.5	18.5	11.0	92.0	1.39*
Total	10.9	56.0	24.8	8.3	100.0	43.4	18.4	11.0	94.0	

***p< 0.708. N=302 (GS=138, NGS=164).**

As can be observed from Table 3, about 67.6 percent of girls from government schools and 66.5 percent of girls from non-government schools had achieved below the desired 50 percent national average score. About 9.4 percent of girls from the government schools and 7.3 percent of girls from the non-government schools attained a very good grade (i.e. greater than or equal to 75%). The minimum from both types of schools was found to be 11 percent, while the maximum were 94 percent and 92 percent for government and non-government schools respectively. The girls' average score in government schools

was found to be 42.8 percent, whereas it was 44.5 percent for the non-government schools. The computed Chi-square value ($\chi 2$= 1.39, p> 0.05) failed to show significant relationship between school ownership and the level of girls' achievement in mathematics. The observed difference between the means in girls' mathematics achievement in government schools (42.8%) and non-government schools (44.5%) was also found to be not significant (t_{300}=0.21, p> 0.05). This indicates that the girls' performance in mathematics in government schools may not be significantly different from that of non-government schools in the upper primary schools of Addis Ababa.

These results seem to contradict the assumptions of most people in the City that students in non-government school tend to perform better than their counterparts in government schools. The underlying reason for such generalization is that private schools are thought to be providing better educational facilities and are able to control students better than their counterparts in government schools as they are running limited number of students. Since private schools are run mainly with profit motives, their monetary pluses depend on the quality of their facilities and senior students' performance both of which are often thought to favor them. However, such generalizations had failed to materialize in this study. Thus, further and more extensive study is required to validate the findings of the present study.

Students Attitudes Towards Girls' Performance in Mathematics

Feminist researchers have forwarded a variety of explanations for female underachievement in mathematics. Generally speaking, differences in achievements of girls and boys emanate from the interplay of personal, social, cultural, and institutional factors (e.g., FAWE, 1997; Fuller, 1987; Genet, 1991; Keynes, 1989; Rosser, 1995; UNESCO, 1984). For example, Keynes (1989) reported that differential expectations of parents, school teachers, guidance counselors, peers, and community as a whole in a patriarchical

society are responsible for students' performance in quantitative subjects. As this favors males it has a detrimental influence on girls' performance in mathematics. Further, research has also succeeded in proving that, more often than not, majority of girls do not show interest in learning mathematics as they think it is a masculine subject (Fox, 1981). Research has documented that girls happened to be less confident in school mathematics ability than boys. Their confidence even deteriorates as they climb up the ladder of schooling (Fox, 1981). However, educational researchers (e.g., Brimer and Pauli, 1971) contend that lack of self-confidence in a given subject curtails one's effort and seriously hampers the person's achievement in the subject.

The attempts made in this study with regard to the attitudes of students towards girls' achievement in mathematics and a host of other related views are summarized in the sections that follow.

Parental Attitudes Towards Girls' Education: Available literature abounds that parental preference to their sons' success and more support to them influences daughters' school performance in general and mathematics achievement in particular (FAWE, 1997; Genet, 1991; Seyoum, 1986). In relation to this viewpoint, the subjects of this study were requested to furnish their views pertaining to their parents' preference to schooling of their children. The results have been summarized in Table 4.

Table 4: Parental Affiliations towards Children's Education

Parental Status	Respondents	Among their children parents encourage to pursue more and achieve high			
		Sons	Daughters	Both Sexes	Total
Father (Male guardian)	Boys (%)	8.5	7.0	84.5	100
	Girls (%)	5.7	8.1	86.2	100
	Both (%)	7.2	7.4	85.4	100
Mother (Female guardian)	Boys (%)	7.2	7.2	85.6	100
	Girls (%)	6.1	9.3	84.6	100
	Both (%)	6.5	8.3	85.2	100

It is evident from Table 4 that an overwhelming majority of boys and girls agreed that both of their parents (guardians) did not show any favor for sons against daughters or vice versa when it comes to their schooling. More specifically, about 84.5 percent of boys and 86.2 percent of girls responded that their fathers (male guardians) had encouraged all of their children, irrespective of their sex, to pursue their study and perform well in schooling. Similarly, about 85.6 percent of boys and 84.6 percent of girls viewed that their mothers (female guardians) had shown equal interest in their sons' and daughters' education.

From the remaining few respondents, about 7.2 percent believe that fathers favor sons' education more than daughters', while 7.4 percent believe to the contrary (i.e. fathers favor and encourage the education of their daughters more than their sons). When it comes to mothers' preference, about 6.5 percent of the combined respondents agree that mothers tend to show more preference to their sons' education than to their daughters', while about 8.3 percent of the respondents opinionated that mothers give more preference to their daughters' education and high performance of their sons'. The results of this study revealed a very important finding leading to the conclusion that girls in Addis Ababa seem to get either equal or more encouragement and support from their parents as compared to boys. This indicates that there might be change of attitudes among parents towards their daughters' role in the society. These might have happened because of aggressive campaigns by the government against gender stereotypes favoring male dominance in social institutions like schools and other organizations. It is also likely that a relentless effort among women activists and viable government policy changed the attitudes of people towards women in the country. What is more, the fact that the samples were drawn from the Capital City whose parents were likely to be better educated and gender-conscious might have contributed to preferential treatment of girls to boys in schooling matters. Future research need to address these issues in detail so that the effect of each and every factor on girls' school performance can clearly be identified.

Household responsibilities of schoolgirls: Learning mathematics requires a lot of time and energy as a student is required to do lots of exercises from time to time. However, if the student is excessively engaged in household chores and other responsibilities, she or he may perform badly in the subject. In this study, an attempt has been made to assess the level of household burden the subjects of this study were carrying apart from their school tasks. Table 5 summarizes the results of the analysis.

As can be discerned from the table, both boys and girls were participating in domestic works after their school. The results indicated that about 31.4 percent of the girls and 25.2 percent of the boys reported they participate "Always" in household works, while 52.6 percent of the girls and 56.4 percent of boys reported they do this only "Sometimes." A closer look into Table 5 shows that, all in all, about 84 percent girls and 81.6 percent of boys work at home after or before their school time regularly or occasionally. This implies that an overwhelming majority of both sexes have domestic responsibilities, which share the time of their school works.

Table 5: Household Responsibilities of Students

Item	Response	Respondents (in %)		
		Boys	Girls	Both
The frequency of students' participation in domestic Chores (works)	Always	25.2	31.4	28.3
	Sometimes	56.4	52.6	54.5
	Never	18.5	16.0	17.8
	Total	100	100	100
Daily working hours	1-3 hrs	64.4	57.8	61.2
	4-6 hrs	16.3	13.6	15.0
	7-9 hrs	10.5	10.5	10.5
	Above 9 hrs	8.6	18.2	13.4
	Total	100	100	100

With regard to the length of time students spend on household tasks, about 64.4 percent of boys and 57.8 percent of girls reported that they were required to work up to 3 hours in a day. About 26.8 percent of boys and 24.1 percent of girls described that they were required to

spend from 4 to 8 hours of their time to involve in domestic affairs. Further, about 8.6 percent of the boys and 18.2 percent of the girls reported that they were asked to spend more than 9 hours of their time to undertake household duties on daily basis. Moreover, the analysis indicates that girls were asked to spend more time on domestic chores than boys. This implies that more girls had to sacrifice their time doing domestic activities, which they could have otherwise used for schooling activities. Thus, such out-of school tasks might have contributed to the girls' low performance in mathematics achievement test.

Teachers' treatment of individual students: Another critical factor, which was found to obstruct girls' achievement in mathematics, was teachers' bias in favor of boys in classrooms (e.g., UNESCO, 1984). This is believed to inhibit girls' ability to successfully learn mathematics. This study has tried to examine the opinions of students' towards their teachers' level of gender-sensitivity in classrooms. This is shown in Table 6.

Table 6 depicts that about 28 percent of boys and 30.6 percent of girls believed that most mathematics teachers were biased against girls in their classroom activities. On the other hand, about 30.5 percent of the boys and 26.3 percent of the girls reported their mathematics teachers were in favor of girls in their classroom activities. A sizeable number of boys (41.5%) and girls (43.1%) reported their mathematics teachers were gender-neutral in their acts in classrooms. When the aggregate data were closely scrutinized, an overwhelming majority (57.8%) of students believe that their mathematics teachers were gender-sensitive in their classroom actions such as asking questions; giving related examples, recognizing students' efforts, etc. Of this size, about 29.2 percent of the respondents believe their teachers favor boys than girls, while 28.6 percent of the respondents believe that their mathematics teachers favor girls more than boys. Thus, it can be generalized that most mathematics teachers in the sample schools were gender-sensitive in which a slim majority of them favor boys than girls in their classroom activities. However, the reliance of

teachers on teaching methods that emphasize male dominance can create a 'chilly climate' for girls, which may lead to their (girls') underachievement in mathematics.

Table 6: Students' Attitudes towards Teachers' Treatment of Students

Item	Responses	Respondents (in %) Boys	Girls	Both
Most mathematics teachers in classrooms often:	Favor males	28.0	30.6	29.2
	Favor females	30.5	26.3	28.6
	Treat both sexes equally	41.5	43.1	42.2
	Total	100	100	100

In support of this viewpoint, Robinson (1992) found out that most teachers knowingly or unknowingly tended to organize classroom discussions to accommodate male learning patterns by disregarding females' interest. Similarly, after having extensive observation of teachers' interaction in classes in France, Loudet-Verdier and Mosconi (1995) reported that teachers tend to have more and longer interaction with boys than with girls. They further witnessed that girls were asked simpler questions than boys. These characteristics were even more accentuated in mathematics and science courses.

Students' attitudes towards girls' mathematics performance: Research over the last few decades has shown that girls' performance in quantitative-oriented subjects was seriously affected by gender stereotypes. Traditionally, mathematics is believed to be a masculine subject and girls often find advanced mathematics achievement as elusive. Historically, the adage, "mathematics is not for girls" and the belief that girls should not reveal their intelligence lest it compromise their sexual desirability (and, thus, their social role as wife/mother) have obstructed girls' achievement and interest in advanced mathematics. In addition, females seem to believe that mathematics has limited utility in their lives and it is unconnected to their mode of thinking (Fennema and Sherman, 1978). The attitudes of male students, teachers, relatives, and society in general reinforce girls' low self-efficacy in mathematical ability. In this regard, the

present researchers assessed the opinions of school children towards girls' achievement in mathematics, as they were very interested in knowing the level of gender stereotypes prevalent in school children in Addis Ababa. The results were summarized in Table 7.

Table 7: Students' Attitudes towards Girls' Mathematics Performance

Item	Response	Respondents (in %) Boys	Girls	Both
Biological difference in sex brings about difference in mathematics achievement.	Agree	28.3	28.7	28.5
	Disagree	58.3	59.1	58.7
	No idea	13.4	12.2	12.8
	Total	**100**	**100**	**100**
Female students' mathematics performance as compared to male students'.	Very high	14	13.4	13.7
	High	12.1	12.6	12.4
	Same	40.8	42.9	41.8
	Low	24.2	23.4	23.8
	Very low	9.1	7.7	8.4
	Total	**100**	**100**	**100**
Which is the most preferred subject of study for you?	Mathematics	23.5	13.7	18.6
	General Science	30.6	42.4	36.5
	English	29.5	31.0	30.2
	Social Science	16.4	12.9	14.7
	Total	**100**	**100**	**100**

As can be observed from Table 7, it is indicated that an overwhelming majority of primary school students (58.3% of boys and 59.1% of girls) did not believe in the stereotypic views that biological difference is somehow reflected in mathematics achievement. On the other hand, there were some (28.3% boys and 28.7% girls) students who still believed that the biological differences between male and female can bring about differences in mathematics performances of the two sexes. These students held the viewpoint that males are naturally superior to females in mathematics ability. This implies that traditional stereotypic views pertaining to human academic performance did not lose the ground in the minds of the upper primary school students of

Addis Ababa. This might have been reinforced by the attitudes of children's parents, teachers, and other conservative (orthodoxy) groups in the society.

In its comparative analysis attempt, this study had further sought the views of the students pertaining to performance of girls in mathematics against boys. Once again, the results indicated in Table 7 reveal that about 40.8 percent boys and 42.9 percent girls seem to believe that the performances of both boys and girls in mathematics are more or less equal. Further, the results in the table indicate that about 26.1 percent of boys and 26.0 percent of girls believe that girls perform either higher than or much higher than boys in mathematics. On the other hand, the second majority of both sexes (33.3% of boys and 31.1% girls) believe that girls perform either lower or much lower than boys in mathematics at the same level of education under equivalent circumstances.

When the students were asked to choose the best subject they had to study for their future career out of four (see Table 7), the findings revealed that only 13.7 percent of girls opted for mathematics, while 23.5 percent of boys opted for the same. In this regard, the most preferred subject for both sexes (30.6% boys and 42.4% girls) happened to be General Science. As a whole, the orders of the choices of the two sex groups were identical by which General Science, English, Mathematics, and Social Science had occupied in descending order of priority of choices by both boys and girls in this study, albeit huge disparities in voter size by gender with respect to each subject. The bottom line of this analysis is that more girls than boys seem to show less interest in studying mathematics at the upper primary educational level.

The findings of the present study were in concurrence with the findings of previous researchers (e.g., Assefa, 1991; Genet, 1991; Seyoum, 1986). These researchers invariably reported that the patriarchic or orthodoxy nature of Ethiopian society had contributed its share to the persistence of gender-related stereotypes in the country.

These stereotypic views largely favor males against females and cause more harm to females than males in their roles in the society. Research evidence in this regard is very scanty. The mysterious question which is yet to be answered in this regard is, 'Are these differences really a result of biology, or do other factors come in to play a significant role?' Attitudinal research evidence (e.g. Maccoby and Jacklin, 1974) indicates that a great deal of people believed that male-female differences in mathematics were caused by biology. In other words, girls' and boys' brains are thought to be different, so they are better suited for different things. The notion is that boys have superior spatial abilities, making them better suited for certain mathematical manipulations. Girls, on the other hand, are supposed to be better at language and writing. But this claim has not been well founded.

More recently, researchers (e.g., Fennema and Sherman, 1977, 1978; Robinson, 1992) have focused on the influence of the social environment on children's mathematics achievement. Very early on, boys are given the chance to tinker with toys or objects (for example, building blocks, racing cars, and simple machines) that involve many of the principles inherent in mathematics and science. Girls often lack these experiences, so they enter mathematics and science classrooms feeling insecure about their abilities. Girls then begin to believe they cannot do mathematics and science as well as boys. This belief is consistent with a stereotype in our culture that defines mathematics and science as male domains. That is, males are better suited for mathematics and science, and mathematics and science are more useful to males than to females. Also, personality traits attributed to mathematicians and scientists are associated more with males. Mathematicians and scientists are often thought to be competitive, achievement-oriented, and not very social.

Furthermore, some parents, teachers, or school counselors who believe these stereotypes are less likely to encourage or support a young girl's decisions to take mathematics and science in upper primary school and beyond. It has been found that when parents

believe boys are better at mathematics than girls, they are willing to let their daughters drop out of mathematics class when the going gets tough. With sons, however, the same parents encourage persistence. In the classroom, teachers, often unaware of their own biases, call on boys more, praise boys more for correct answers, and are more likely to ask boys for help in science and mathematics demonstrations. The message girls get is that they are not as good as boys. As a result, girls do not make effort the subject requires in order to score better marks and thus quit advanced mathematics studies.

Conclusion

The main purpose of this study was to investigate the extent of gender disparity in mathematics performance among upper primary school students of Addis Ababa and bring about prevailing traditional gender stereotypes into perspective. To achieve this broad objective, the study involved 611 sixth grade students (309 boys and 302 girls) drawn from 10 schools (5 government and 5 non-government) on the basis of multi-stage sampling technique. The study had employed diversified data collection instruments, mainly standardized mathematics achievement test, questionnaire, and documentary analysis. The collected data were analyzed with the help of SPSS by means of which relevant statistics have been produced.

The results of the analyses indicated that, among other things, there was a significant degree of association between student gender and mathematics achievement ($\chi 2= 19.33$, $p< .001$). The number of girls who achieved below 25 percent (poor achievers) was more than twice the number of boys who did the same. However, the number of girls who scored “high” grade (75% and above) was less than half of the boys who scored the same. The average score for the girls was found to be 43.6 percent, while it was 51.2 percent for the boys. Thus, a gender gap of 7.6 percent was found to be large enough to conclude that girls had performed significantly lower than boys in Grade 6 mathematics test in Addis Ababa ($t_{609}= 4.89$, $p< 0.001$).

When girls' mathematics performance was analyzed in terms of school ownership, the results revealed that there was neither significant relationship between school ownership and girls' mathematics performance ($\chi 2= 1.39$, $p> 0.05$) nor significant difference between the average scores of girls in government and non-government schools ($t_{300}= 0.21$, $p> 0.05$).

When students' opinions pertaining to selected gender stereotypes favoring males were probed, the results indicated that most students appeared to believe theoretically in the equality of the two sexes in mathematics performance. Specifically, about 85 percent of the students (both sexes combined) reported that their parents did support and encourage their children, irrespective of their gender, to pursue further and achieve high in their studies, although a few of them tended to favor either of them (e.g., fathers for sons and mothers for daughters). Both boys and girls were mostly involved in household chores at considerable level with girls' weight of domestic workload being slightly heavier than boys'. About 57.8 percent of students believe that their mathematics teachers were gender-sensitive in their classroom actions. Of these, 29.2 percent reported that their teachers favored boy, while 28.6 percent agreed that their teachers favored girls. A great majority of sample students (58.3% boys and 59.1% girls) opinionated that they did not believe in differences in mathematics achievements as attributed to biological differences in sex, while the second majority of them (28.3% boys and 28.7% girls) believe that differences in mathematics ability were inherent in biological differences favoring males. Although a huge majority of respondents (40.8% boys and 42.9% girls) believe that girls can perform equally as boys in mathematics under similar circumstances, there were considerable numbers of students (33.3% boys and 31.1% girls) who held the viewpoint that girls often perform lower or much lower than boys in the same subject. The findings also revealed that mathematics was neither the most nor the least favored subject of choice for both girls and boys to study on. Only 13.7 percent of girls had chosen mathematics as the priority subject of study for their future career, while 23.5 percent of boys chose the

same. The most preferred subject for both sexes happened to be general science while the least appeared to be social science.

Therefore, the responsible bodies should strive to address the problem of female underachievement in mathematics and other quantitative subjects through devising viable community-based intervention mechanisms. Particularly, schools should provide a pleasant school environment, improved services, and directly attack the causes of female harassments by conducting rigorous research on the field. Besides, the educational leaders in different levels should try to discuss the matter with the students' parents and sensitize them on the importance of modern education for their female children's future. The Government should enforce laws against any gender inequity and stereotypes in the academic front. Finally, the viability of the present findings should be tested in a more comprehensive study. Future research might embrace elementary, secondary, and tertiary levels in urban and rural settings.

Implications of the Study

In a country where social and educational research has not been well established, a study of this sort will have a far-reaching implication in both theory building exercise and addressing performance inequity problem by gender. As it has been mentioned earlier in the article, little has been known about gender differences in mathematics achievements and the reasons underlying such differences in the Ethiopian education system in general and in Addis Ababa City Administration in particular. Thus, this study will provide the necessary theoretical background on the nature of the factors affecting girls' achievements in mathematics in the upper primary grades and build up existing theoretical knowledge in the field. Particularly, the techniques and methods applied in this study are expected to arouse motives for academic rigors (or scientific adventures) among young social scientists, professionals, and practitioners in the country. In addition, this study has highlighted important findings that can serve as key indictors for practical

measures taken by the concerned authorities. Thus, the results of this study are expected to provide the necessary basis for policy makers, planners, teachers and school administrators to realize the magnitude of the problem and design viable and effective community based intervention measures for mitigating the problem under consideration. Finally, the findings of this study may generate interest or assist as a stepping-stone for those who have the intention for further study in the field.

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