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**Effect of teacher- student gender matching on narrowing test scores gender gap  
in Kenyan primary schools:  
A quantile regression approach**

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## Abstract

In Kenya, boys outperform girls in mathematics and science while girls outperform boys in english. The gender gap in academic performance may persist and affect performance in higher learning and career choices. Research has investigated various factors that affect gender gap in academic performance. These include the effect of resources and introduction of free primary education on gender gap in academic performance. However, the effect of teacher- student gender matching on academic performance has not been studied in Kenya. This study uses Uwezo data from Twaweza, a survey done across Kenya in 2015 to analyze the effect of teacher-student gender matching on academic performance. The study analyzes this relationship using the quantile regressions approach. Findings show that teacher-student gender matching has no significant effect on both average test scores and across test score distribution in both mathematics and english.

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### List of Abbreviations

EFA – Education for All

FPE – Free Primary Education

GER – Gross Enrolment Ratio

IV – Instrumental Variable

KCPE – Kenya Certificate of Primary Education

MDG – Millennium Development Goal

NER – Net enrolment Ratio

OLS- Ordinary Least Squares

SDGs – Sustainable Development Goals

STEM- Science, Technology, Engineering and Mathematics.

### Definitions of terms

GER- Gross enrolment ratio: Number of students enrolled in each level of education, regardless of age, expressed as a percentage of the official school-age population corresponding to the same level of education.

NER- Net enrolment ratio: Total number of students in the theoretical age group for a given level of education enrolled in that level, expressed as a percentage of the total population in that age group.

## **CHAPTER ONE: INTRODUCTION**

### **1.1 Background**

Education is a component of human capital (Schultz, 1961). Becker (1962) explains investing in human capital as an action that affects the potential real income of individuals. According to Schultz (1961), human capital is the useful physical and intellectual skills that raise real income possibilities.

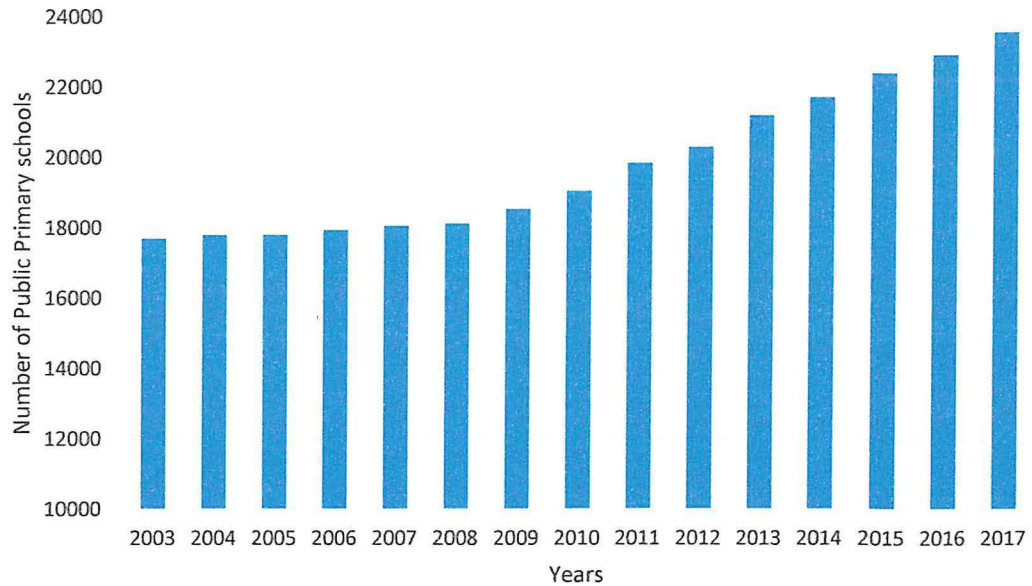
Education is essential to the development of a country. More education attainment leads to economic development and poverty eradication (Mariara & Mwabu, 2007). High levels in educational achievement indicate skilled and productive individuals in a society, who in turn increase economic output in terms of goods and services (Barro, 1991). Primary education, especially for women, promotes economic growth by stimulating a lower fertility rate and has shown to be marginally more profitable than educating males (Barro, 2001; Psacharopoulos, 1994).

Economies have invested a lot of their resources in the education sector. Many sub-Saharan African countries provide free primary education (UNESCO, 2003). Kenya introduced Free Primary Education (FPE) in 2003 and abolished tuition fees in public primary schools (Republic of Kenya, 2003). This increased access to education as the number of primary school enrolment increased by 16% from 2002 to 2003. This was also a step to the attainment of the Millennium Development Goal of universal primary education (Republic of Kenya, 2015). Finally, Kenya is aiming to achieve the Sustainable Development Goal 4. That is, to ensure inclusive and equitable quality education by 2030 (Republic of Kenya, 2015).

The Kenyan government has continually increased budgetary allocation to the basic education department. In the year 2016/2017, the government spent Ksh. 54.5 million in basic education and it was accounted for through the recurrent expenditure allocation (Republic of Kenya, 2018). The increase in expenditure is attributable to the financing of free primary education (FPE) and free day secondary education (FDSE). Recurrent expenditure in education, increased by 37% from 2003/2004 to 2016/2017 (Republic of Kenya, 2004; Republic of Kenya, 2018). The increased allocation of resources in the education sector has in turn led to an increase in number of public primary school as demand for basic education increases. Figure 1

illustrates the increase in public primary school. The number of public primary schools increased from 17,697 in 2003 to 23,584 in 2017, that is a 33.27% increase. While the private primary schools increased from 1,441 in 2003 to 11,858 in 2017, a 7.22% increase. (Republic of Kenya, 2003 and Republic of Kenya, 2018)

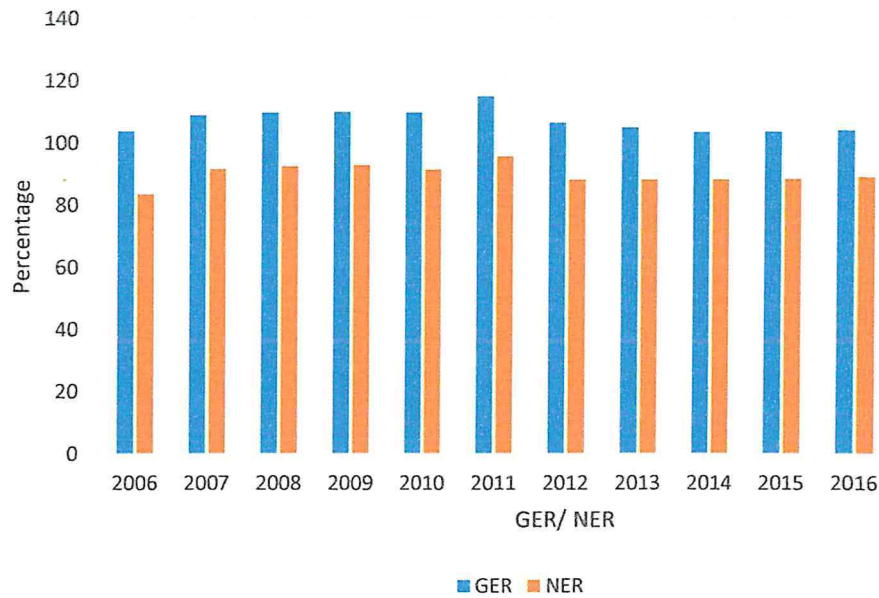
**Figure 1: Number of Public Primary schools, 2003- 2017**



*Source 1: Republic of Kenya, Various Issues*

Primary school enrolment increased after the introduction of FPE as more pupils had access to affordable education (Figure 2). The Net Enrolment Ratio (NER) increased from 83.5% to 89.2% while the Gross Enrolment Ration (GER) increased from 103.8% to 104.1% between the years of 2006 and 2016. (Republic of Kenya, 2007 and Republic of Kenya, 2018)

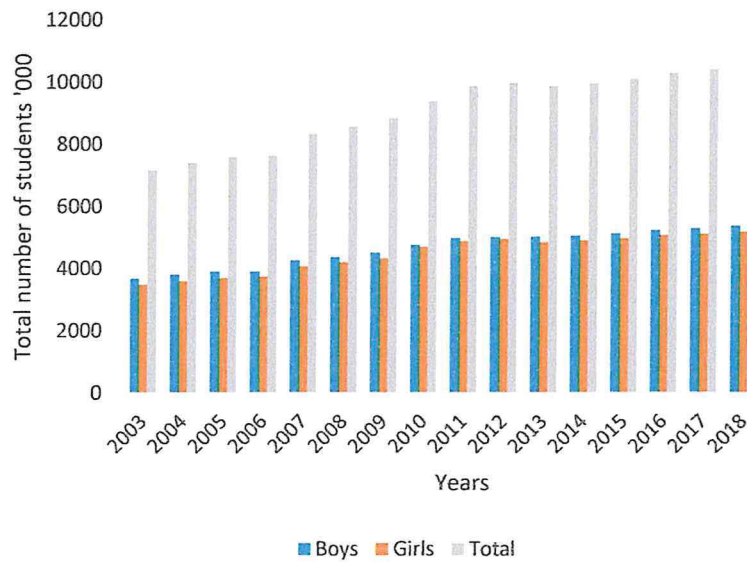
**Figure 2: Primary level GER and NER, 2006- 2017**



*Source: Republic of Kenya (Various issues)*

The increment in enrolment is in both girls and boys. As figure 3 illustrates, on average the ratio of boys and girls in terms of enrolment is 1:1 (Republic of Kenya, 2018). Gender parity in primary school enrolment, as shown in figure 3 has been achieved in Kenya (Grant & Behrman, 2010).

**Figure 3: Primary school enrolment by gender, 2005- 2019**



*Source: Republic of Kenya (Various issues)*

Despite the achievement of gender parity in enrolment, gender gap in student test scores persists (Grant & Behrman, 2010). The boys outperform the girls especially in sciences and mathematics, while the girls outperform boys in English (Lucas & Mbiti, 2012). The gender gap leads to inequality especially in gaining access to high-paying professions (Freeman, 2004). Gender inequalities, especially at lower levels of education, result in continued inequalities in terms of fertility, labor market and even poverty (Lagerlof, 2003). Elimination of gender gap in education would be beneficial to the economy. Knowles et al. (2002) finds that even with diminished returns to education for both genders, higher academic performance of both females and males would bring about higher steady- state per capita income.

There are different factors that affect student achievement, among them being teachers. Studies on the education production function include that of (Nye, Konstantopoulos, & Hedges, 2004) who examine the impact of teacher's experience on academic performance and find a strong positive relation especially for students in the lower classes. Studies on other teacher characteristics, such as race show that being assigned to an own- race teacher has a significant positive effect on academic achievement (Dee, 2004). Research by Ehrenberg et al. (1995) looks at the impact of the teacher's gender on student achievement and finds no significant effect of teacher's gender on test scores.

It is educationally relevant to study the impact of teacher- student gender matching on student's test scores. This is because the role model and stereotype effect may affect the academic achievement of students (Dee, 2007). Studies such as that of (Arulampalam et al., 2012) find that the effect of school absence on academic performance is only significant on the higher performing students and not all students. Hence, the impact of gender matching between the pupils and the teachers on the pupil's test scores may vary along the conditional distribution of test scores and using the quantile regression method may show the differences on the effect along the conditional distribution of the test scores.

This study focuses on the effect of pupil - teacher gender matching in reducing gender gap in numeracy and literacy across the conditional distribution of test scores

of class two pupils. Both subjects are used because they nurture skills and are a good gauge of academic ability of the pupils (Lubienski et al., 2008).

Research on teacher- student gender matching has produced mixed results. Canes & Rosen (1995) and Ehrenberg et al. (1995) find that there is no significant impact of teacher's gender on student's performance while Bettinger & Long (2005) and Rothstein (1995) find a positive impact. The studies have also been conducted across different levels of education. Studies such as (Lim & Meer, 2017; Muralidharan & Sheth, 2016) utilize secondary school and primary school data, respectively, to examine the impact of the teacher's gender on academic performance. Both studies find that having female teachers positively impacts the female student's performance. There is limited research on teacher-student gender matching in developing countries. Hence examining the impact of gender matching in Kenya would be relevant, especially at the primary school level, as the early stages of education have a significant impact on the educational path of the students (Antecol et al., 2015).

### **1.2 Problem Statement**

Gender gap in student enrolment has narrowed as more girls have enrolled to primary school. In 2017, the ratio of girls to boys enrolled in primary was on average 1:1. However, the gender gap in performance at the primary school level persists, as girls tend to perform poorly in mathematics and science subjects, compared to boys, while the boys perform poorly in reading compared to girls. The gender gap may persist in higher learning and in the labor market. This can be observed through the wage gender gap (Marks, 2008).

Previous studies on gender gap in education in Kenya, have investigated the impact of increased resources and textbooks, on performance of both girls and boys (Glewwe et al., 2009). It is educationally relevant to investigate the effect of teacher-student gender matching on student performance, especially in numeracy and literacy due to the role model effect and stereotype threat effect. However, research that has examined the relationship between teacher- student gender matching on performance of the pupils has shown mixed results, with some exhibiting a positive relationship (Carrell et al., 2010; Eble & Hu, 2017 and Muralidharan & Sheth, 2016). Meanwhile other studies found no effect (Ehrenberg et al., 1995 and Sansone, 2019).

According to Dee (2007), teacher- student gender matching can be important to students due to the role model effect and stereotype threat effect. The research that is done, concentrates on the ‘average effect’ which may not explain the differences of response across the test score distribution. Weaker and stronger students can be impacted differently by teacher-student gender matching. Empirical evidence of the effect of student teacher gender matching and education achievement along the test score distribution in Kenya is limited. This study will therefore contribute to literature by addressing the question: Does teacher-student gender matching affect pupils’ test scores across the conditional distribution?

### **1.3 Research Objectives**

The main objective of the study is to examine the effect of gender matching between pupils and teachers in Kenya Primary schools on pupil’s academic achievement, across the test scores distribution.

Specific objectives:

- i. To analyse the effect of teacher- student gender matching on pupil’s average test scores.
- ii. To estimate the effect of teacher- student gender matching on pupil’s test scores across the test scores distribution.

### **1.4 Research Questions**

- i. Does teacher- student gender matching have an effect on the pupil’s average test scores?
- ii. Is the effect of teacher- student gender matching different across the conditional distribution of test scores?

### **1.5 Significance of the Study**

The purpose of this study is to examine whether the matching of gender between the teachers and pupils can contribute to closing the gender gap in mathematics and english test scores in Kenya primary schools. The study will also contribute to literature on measures of closing the gender gap in academic performance, since the existing literature has mostly estimated the effect of educational resources such as

textbooks and teaching hours on closing the gender gap (Asadullah & Chaudhury,2009; Machin & McNally, 2005). This study uses the quantile regression approach to estimate the effect of teacher- student gender match across the test scores distribution. This will help establish to “whom” the gender matching would benefit.

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Theoretical Literature Review**

According to the human capital theory, formal education is essential in improving productivity of a society (Schultz, 1961). Education brings forth productivity by raising the levels of learning stock of economically productive human capability (Nafukho et al , 2004).

The teacher- student gender matching can be educationally relevant due to several reasons. These include role model effect; that is, if students find their identity more with same- gender role models, then it is likely that performance will be improved when students are assigned to a same gender teacher (Dee, 2007). Hence, if female students are assigned to female teachers who they view as their role model at the primary school level, it may improve their performance across their academic path.

Second, the theory of stereotype threats, (spencer et al., 1999) may come into play when explaining relevance of teacher-student gender matching. The theory explains that in case of a negative stereotype against a group, the individuals in the group may internalize the stereotype as explanations of their behavior. Females in primary school are known to underperform in subjects such as mathematics and science. If assigned to a male teacher who is aware of the stereotype may cause the female students to underperform as they will conform to the stereotype.

Lastly, teachers may have preferences over the students of their own gender and hence female(male) teachers will explain concepts and teacher female(male) students better. Discrimination may be a cause of the gender gap if the female students tend to be assigned to male teachers (Tuwor & Sossou, 2008).

## **2.2 Empirical Literature Review**

Various research has been conducted on measures that can contribute to closing the gender gap in education. A study by Lucas & Mbiti (2012) uses difference in differences strategy to analyze the effect of free primary education on gender gap in academic performance. They find that the introduction of free primary education in Kenya did not help in narrowing gender gap in achievement. Lorenzo et al. (2006) showed that interactive engagement in the classroom reduced the gender gap in academic performance. A study by (Ng'ang'a et al., 2018) studies the effect of resources on gender gap in mathematics and finds that boys utilize resources better than girls. Hence the gender gap in mathematics performance. There are studies that have examined the effect on same teacher- pupil gender matching on the effects on students performance (Dee, 2007; Eble & Hu 2017; Ehrenberg et al., 1995).

Studies that have estimated the influence of being taught by a same gender teacher and outcomes have produced mixed results, with some finding a positive effect and others a negative effect. A study by Ehrenberg et al. (1995) regressed students' test scores between the 8<sup>th</sup> grade and the 10<sup>th</sup> grade teacher gender, using the National Educational Longitudinal study (NELS). Their results suggested that a teacher's gender has no effect on test scores. Similarly, NELS data is also utilized by Dee (2007) in a study that uses a matched pair approach and regressions to estimate the grade 8, test scores and student evaluations of both genders if the teacher's gender is varied. The findings of the study show that when assigned to a female teacher, the boy's test scores lower but there is no difference for the girl's test scores.

A study by Eble & Hu (2017) used panel data from Chinese middle schools and applies a fixed effects model to examine whether the student's academic performance is affected by stereotypes about gender- specific ability in mathematics and a same- gender math teacher. Findings postulate that the girls that were perceived to be of low math ability gained more when assigned to a female teacher, compared to a male teacher. Likewise, performance of low ability boys decreased when assigned to a female teacher compared to being placed to a female teacher. The study did not provide evidence on effect of gender matching on average and high ability students.

Muralidharan & Sheth (2016) analyze the impact of female teachers in narrowing the gender gap in student performance in primary school. Using 6 years panel data from India, results from a fixed effects model shows that female students perform better when assigned to a teacher of the same gender. However, male student's performance is not affected by the gender of the teacher. Similarly, Puhani (2018) uses panel data from German administrative data and uses an identification strategy to examine the effect of teacher gender on the performance of students in elementary school. Findings of the study show that the teacher's gender has no impact on the grade of students.

A study conducted by Paredes (2014) examines the impact of same gender teacher on student's academic performance using grade 8 data from Chile in 2009. The study utilizes cross subject analysis with student fixed effects. Findings postulate that female teachers impact female students positively while there is no effect on male students. The study further highlights that the positive effect of female teachers on female students is due to the role model effect.

In the developing countries, Lee et al. (2019) study the relationship between teacher-student gender matching and performance using grade 6 data from ten francophone countries in 2014. The regressions results show that teacher- student gender matching has no significant impact on boy's performance while it has a strong impact on girl's achievement in mathematics and reading.

Sansone (2019), examines the relationship between high school teacher's gender, their beliefs about girl's academic ability in mathematics and the performance. Using data from a longitudinal study and employing a linear probability model, findings show the teacher's gender is not statistically significant in affecting girl's performance in mathematics.

Breda et al (2020) use large scale field experiment from 3 districts in Paris between 2015 and 2016 to investigate role model effect on high school, female students in joining STEM. The study results postulate exposure to female role models with STEM background can increase female participants in STEM.

Lim & Meer (2017) use secondary school cross-sectional data from Korean Educational Development Institute (KEDI) in 2004 and run regressions to examine whether teacher-student gender matching would influence the performance of secondary school students. Findings show that female student's performance in mathematics and reading benefits from having a female teacher while male students' performance in the same subjects is not affected by gender matching.

At the university, the gender matching studies have covered both undergraduate and post graduate levels. Bettinger & Long (2005) investigate whether the presence of female faculty members in an introductory college course affects the performance of female and major choice of undergraduate students. The study uses longitudinal data from 51 colleges in Ohio and analysis uses an instrumental-variables (IV) strategy. Results suggest that presence of a female faculty member increases the likelihood of a female student major in the subject, particularly mathematics and science.

The concept of role model effect in choice of major at the university is investigated by Canes & Rosen (1995), using panel data from three educational institutions: Princeton university, University of Michigan, and Whittier college. The study uses a fixed effects model to investigate whether a student's major choice is affected by the staff gender composition. Results of the study postulate that there is no evidence for a relationship between the gender composition of the faculty members and the student's gender composition while choosing subject majors. Similarly, Neumark & Gardecki (1996) study the role model effect in Economics Ph.D. courses and results show no relationship between female faculty and future success for the female students.

Rothstein (1995) uses the National Longitudinal survey and finds a positive relationship between presence of female faculty and female postgraduate education. Similarly, Nixon and Robinson (1999) extend Rothstein (1995) model and regresses educational outcome on presence of female faculty in the high school level, using the National Longitudinal Survey of Youth (NLSY). The results show that an increase in female faculty in a high school lead to a rise in high school and college completion among girls but the inverse for boys as it decreases.

Carrell et al. (2010) utilize the random assignment of United State Air Force college students in mathematics and science to investigate impact of professor's gender on academic performance. The results of the study show that the gender of the lecturer has little impact on male students. Meanwhile, the effect is significant for female students' performance as well as in increasing the chances of taking a future course in mathematics and science.

In contrast, Price (2010) uses university data from Ohio Board of Regents to examine whether female students have a higher chance of persisting in a science, technology, engineering, and mathematics (STEM) after enrolling in classes taught by female faculty. The IV estimation approach finds that presence of a female lecturer does not have a positive effect on the possibility that a female student chooses to remain in STEM.

Some studies have utilized the quantile regression approach in the education sector. Arulampalam et al. (2012) used panel data for economics students from the UK to examine the effect of school absence on student performance using a fixed effects model. The findings show that the effect of absentism on student's performance is higher on high performing students compared to the low performing students.

Similarly, Bandiera et al (2010) examines the effect of class size on performance of students cross the distribution using quantile regressions. Using administrative data form 1999- 2004 in the UK, the results show that only the students at the top of the distribution are effected by class size changes. They are more likely to gain from a larger class size compared to the rest of the students.

### **2.3 Overview of Literature**

Several studies have explained the educational relevance of examining the impact of teacher- student gender matching on student's academic performance. Gender matching may be relevant due to reasons such as the role model effect, stereotype threat effect and gender discrimination among students (Dee 2007; Spencer et al., 1999; Tuwor & Sossou, 2008).

The reviewed studies have used different types of models to study effect of teacher gender on the education production function. Bettinger & Long (2005) and Price (2010) apply an IV strategy to test for relationship between teacher- student gender matching and student performance. While Sansone (2019) uses a linear probability model to examine gender matching effects on student's performance in mathematics. The studies have investigated the relationship at different levels of education. Paredes(2014) examines the impact of teacher- pupil gender matching at the primary school level and finds a postive effect for girls. Lim & Meer (2017) uses secondary school data to investigate the impact of teacher-student gender matching on Korean students performance and finds a postive impact on girls test scores. Meanwhile Price (2010) uses university school data to investigate the role model effect in STEM subjects and finds no effect of female role models in university.

The studies have exhibited mixed results, with some finding a postive relationship between student- teacher gender matching (Carrell et al., 2010; Eble & Hu, 2017 and Muralidharan & Sheth, 2016) . While other studies results show no effect of gender matching on academic achievement (Ehrenberg et al., 1995 and Sansone, 2019).

None of the reviewed studies have looked at teacher- student gender matching in developing countries, specifically Kenya. This study extends the literature to Kenya, a developing country and estimates the effects of teacher- student gender matching on gender gap in primary schools using a quantile regression approach.

## **CHAPTER THREE: RESEARCH METHODOLOGY**

### **3.1 Theoretical Framework**

Economic theory explains that households act in a way to maximize utility (Glewwe & Kremer, 2006). Households, particularly parents maximize their utility but are subject to some constraints. According to Glewwe & Kremer (2006), the arguments to the utility function are consumption of goods and services, including leisure and children's schooling. This is constrained by a production function which can be shown as:

$$A = f(Y, S, B, H, E) \quad (1)$$

Where A is defined as educational outcome, Y is the years of schooling, S is a vector of school characteristics, B is a vector of child characteristics, H is a vector of family background characteristics and E is a vector of educational inputs that are controlled by parents. The price of schooling, P is an important factor however it is not included in A, as it does not directly affect education outcome. It affects A through endogenous Q and E, for example through school fees and school supplies.

Assuming a scenario where there is only one type of school, then parents can only choose Y and E to maximize utility. This implies that Y, years of schooling and E, educational inputs can be expressed as functions of the homogenous variables:

$$Y = g(S, B, H, P) \quad (2)$$

$$E = h(S, B, H, P) \quad (3)$$

Inserting (2) and (3) into (1) leads to a reduced form causal relationship:

$$A = j(S, B, H, P) \quad (4)$$

If changes are made in S, B, H and P, the effect on schooling years, Y would be observed through (2) and the change in A would be seen through (4). The impact on changes in S can also be estimated through the same function (4). Equation 4 allows for changes in years of schooling, Y and educational input, E when changes are made to school and teacher characteristics S (Glewwe & Kremer, 2006).

### 3.2 Econometric Model

The education production function model, according to (Hanushek, 2008) is related to inputs that are directly governed by policy makers, such as school characteristics and those that are not in the control of policymakers such as family background of the students.

In order to analyze the effect of teacher- student gender matching, the following linear regression is utilized (Lim & Meer, 2017):

$$Y_t = \beta_0 + \beta_1 \text{FemStud}_i + \beta_2 \text{FemTeach}_i + \beta_4 \text{FemStud}_i \text{FemTeach}_i + \beta_n X_{i,j} + \varepsilon_t \quad (5)$$

Variable FemStud is a dummy variable that takes the value of 1 if the pupil is female and FemTeach is used as dummy variable that take the value of 1 if the teacher is female. X represents a vector of other regressors that affect the test scores such as, pupil, school, and household characteristics.

To estimate the effect of gender matching across the test scores distribution, the study will use the quantile regressions approach. According to Koenker & Basset (1978) quantile regressions are viewed as a ‘robust’ technique such that the coefficients are not sensitive to outliers in the dependent variable. It is a more robust technique when the error terms are non- normal compared to least square estimators.

The quantile regression is defined as the solution to the minimization of:

$$\text{Min } \sum_{t=1}^T \theta |y_t - x_t \beta| + \sum_{t=1}^T (1 - \theta) |y_t - x_t \beta| \quad (6)$$

The regression model, is estimated as:

$$y_i = x_i' \beta_\theta + \mu_\theta \quad (7)$$

$$\text{Quant}_\theta(y_i | x_i) = x_i' \beta_\theta \quad (8)$$

Where the conditional quantile of y given x, while x is a regressor vector.

In this case:

$$Quant_p(y_t|FS_i FT_i) = (FS_i FT_i)' \beta_4 \quad (9)$$

represents the effect of teacher- student gender matching on student scores, for the  $p^{\text{th}}$  quantile of the student scores. The quantile regression estimation method can be used to describe the whole conditional distribution of an independent variable given a vector of regressors. The approach is based on minimizing the sum of weighted asymmetrical absolute deviations, this reduces over/under estimation (Buchinsky, 1998).

### **3.3 Definition and Measurement of Variables**

The variables in this study range from pupil's family background, school factors and classroom factors. The dependent variable in the study is the test scores of the pupils in mathematics and english. The independent variables are a vector of regressors that characterize the school inputs and the household inputs and are described in the table below.

**Table 1: Definition and Measurement of Variables**

<b><u>Variable</u></b>	<b><u>Measurement</u></b>
<b><u>Dependent variable</u></b>	
English score	Percentage score in math test
Mathematics score	Percentage score in english test
<b><u>Control Variables</u></b>	
<b><u>School characteristics</u></b>	
School type	=1 if public, 0 if private
Number of Child Friendly Trained Teachers	Number of teachers trained on child friendly program
<b><u>Classroom characteristics</u></b>	
Teacher gender	= 1 if Female, 0 if Male
Class size	Total number of pupils in a class
Displayed charts	=1 if yes,0 if no
Writing Books available	=1 if yes,0 if no
Usable Board	=1 if yes,0 if no
English textbook- pupil ratio	Number of english books per pupils
Mathematics textbook- pupil ratio	Number of mathematics books per pupils
<b><u>Household Characteristics</u></b>	
Pupil's age	Age of pupils in years
Pupil's gender	=1 if Female, 0 if male
Number of children in a household	The total number of children in a home
Wealth Index	Measure of Social economic status
Mother's level of education	=1 if primary education attained, 0 if not

### **3.4 Estimation Issues**

Issues that may affect estimation include, ability bias and the use of cross-sectional data. The issue of ability bias may affect estimation if the female students who have a higher propensity to score end up with a female teacher. Lastly, using cross sectional data only gives information about the students at a point and cannot account or control for prior educational attainment.

### **3.5 Data Source and Data Type**

The data is obtained from Uwezo, which is part of Twaweza. This is an initiative that assess the numeracy and literacy levels in East Africa. Surveys are conducted in schools, households and in the villages to get information on children learning. The data used in this study is cross-sectional data from the year 2015 and is the latest publication of data from Uwezo. The sample consist of Standard 2 pupils in primary schools in Kenya.

The sample was selected using a 3-stage sampling method. First, the selection of the districts by random sample, followed by enumeration areas selection which is done by probability proportional to size and finally, by random systematic sampling, the households are selected. This study measures student outcome in mathematics and reading in both public and private schools. According to Lubienski et al. (2008) mathematics is an appropriate indicator of school efficiency as it is primarily learnt in school. Both numeracy and literacy are a good measure of students' academic ability because they reflect basic reasoning capabilities, necessary for success in academic path (Koljatic et al, 2013).

## **CHAPTER FOUR: RESULTS**

### **4.1 Descriptive Statistics**

The sample data was described in two ways. First is in terms of gender and the second in terms of academic performance in both mathematics and english. Table 2 shows the difference in characteristics in terms of gender. Table 3 and 4 show the difference in pupil's characteristic in english and mathematics.

From table 2, girls on average perform better than boys in both mathematics and english, with girls scoring 69.88% and 66.52% in mathematics and english, respectively. While the boys scores are 65.63% and 61.51% in mathematics and english, respectively. However, this difference in marks is statistically significant. The results show that, on average, the age of boys of 8.750 is statistically higher than that of girls which is 7.989. This can be explained by parents finding it more economical to educate boys compared to girls (Lucas & Mbiti, 2012).

The social economic status of the girls and boys as measure by wealth index show that there is no statistically significant difference in the wealth level of both genders. The resources available for the students in terms of textbooks per pupil are on average, 1 english and mathematics book shared among 2 pupils for both genders. The background of the pupils shows that boys' mothers have 0.504 more years of education compared to girls' mothers, however this difference is not statistically significant. There is no statistical difference between the girls being taught by a female teacher and the boys being taught by a female teacher.

The girls have a 0.681 chance of having a female teacher while boys have a 0.667 likelihood of having a female teacher. This difference is not statistically significant hence they have an equal chance of having a female teacher. In terms of the class sizes, the boys on average have a larger class of 45 pupils compared to the girls who have a class size of 41 on average.

**Table 2: Difference between boys and girls: t-test, mean (standard deviation)**

VARIABLES	(1) Boys	(2) Girls	(3) Difference (boys-girls)
Pupils age	8.750 (1.949)	7.989 (1.548)	0.761** (0.250)
Mother's education	8.104 (2.829)	7.600 (2.477)	0.504 (0.487)
Number of children in a household	3.731 (1.812)	3.606 (1.574)	0.125 (0.241)
Wealth Index	0.430 (0.138)	0.436 (0.171)	-0.006 (0.225)
English score	61.51 (21.50)	66.52 (25.35)	-5.012 (0.1339)
Mathematics score	65.63 (26.21)	69.88 (1.936)	-4.242 (0.270)
Number of Child Friendly Trained Teachers	2.108 (2.971)	2.208 (3.215)	-0.100 (0.497)
Teacher's gender, =1 if female,0 if male	0.667 (0.474)	0.681 (0.469)	-0.014 (0.067)
Displayed charts, =1 if yes,0 if no	0.741 (0.440)	0.809 (0.396)	-0.678 (0.059)
Writing Books available, =1 if yes,0 if no	0.944 (0.230)	0.926 (0.264)	0.019 (0.035)
Usable Board, =1 if yes,0 if no	0.954 (0.211)	0.968 (0.177)	-0.014 (0.028)
Class size	45.99 (29.76)	41.71 (21.99)	4.278 (3.729)
English textbook- pupil ratio	0.620 (0.855)	0.567 (0.463)	0.053 (0.104)
Mathematics textbook- pupil ratio	0.644 (0.934)	0.574 (0.528)	0.070 (0.114)
School type, =1 if public,0 if private	0.898 (0.304)	0.926 (0.264)	-0.027 (0.04)

Table 3 and 4 explains characteristics of the boys and girls in terms of the test score distribution of english and mathematics, respectively. The sample was divided into the categories, that is the 25th quantile that contains the academically weaker pupils, the 50th quantile that contains the average pupils and the 75th quantile that has the academically stronger pupils.

The score for the academically stronger pupils is 100% for both boys and girls in english and mathematics. This is represented by the 75th quantile. The second group contains the students the second one third of the distribution. Their testcores are 80% for both boys and girls in english and 76.69% and 76.85% for boys and girls, respectively mathematics. The last category contains pupils in the last one third of the test distribution of test scores. Their scores are 48.73% and 46.67% for boys and girls respectively in english. 40.06 and 38.24% for boys and girls, respectively in mathematics.

In terms of individual characteristics, the pupil's in the 75<sup>th</sup> quantile, both girls and boys are younger than the pupils in the 2<sup>nd</sup> and 3<sup>rd</sup> quantile in english for both genders. The mother's level of education is significantly higher for the students who have a higher propensity to perform well in english and mathematics compared to the other pupils, for both genders. In terms of their socioeconomic status, the wealth index indicates that the both boys and girls in the 75<sup>th</sup> quantile for both english and mathematics are wealthier than the boys and girls in the 2<sup>nd</sup> and 3<sup>rd</sup> quantile.

In terms of classroom characteristics, the class size is bigger for both girls and boys in the 25<sup>th</sup> quantile compared to the 1<sup>st</sup> and 2<sup>nd</sup> quantile in both mathematics and english. In term of resources, the available writing books are higher for the girls with a higher propensity of performing higher compared to the girls in the 2<sup>nd</sup> and 3<sup>rd</sup> quantiles. The english text-book to pupil ratio is higher for the girls in the 75<sup>th</sup> quantile in english compared to the 25<sup>th</sup> and 50<sup>th</sup> quantile. The boys in the 75<sup>th</sup> quantile in mathematics have more textbooks per pupil compared to the boys in the 2<sup>nd</sup> and 3<sup>rd</sup> quantile. Both boys and girls in the 75<sup>th</sup> quantile in english have a higher chance of having a female teacher in their class compared the pupils in the 2<sup>nd</sup> and 3<sup>rd</sup> quantile.

In terms of school characteristics, both boys and girls who are in the 25<sup>th</sup> quantile in mathematics have a higher chance of coming from a public school compared to the boys and girls in the 75<sup>th</sup> and 50<sup>th</sup> quantile.

**Table 3: Difference in pupil's characteristics along the test score distribution in english: mean and (sd)**

VARIABLES	Boys	Boys	Boys	Girls	Girls	Girls
	75th quantile	50th quantile	25th quantile	75th quantile	50th quantile	25 <sup>th</sup> quantile
Pupils age	8.154 (1.908)	8.955 (2.058)	8.901 (1.845)	7.957 (1.522)	(8.111) 1.278)	8.078 1.585
Mother's education	10 (2.494)	8.364 (2.693)	7.636 (2.862)	8.308 (2.689)	7.632 (3)	7.483 (2.262)
Number of children in a household	3.462 (2.332)	3.364 (1.399)	3.915 (1.811)	2.696 (1.259)	4.222 (1.734)	3.824 (1.519)
Wealth Index	0.539 (0.140)	0.467 (0.159)	0.391 (0.114)	0.472 (0.165)	0.425 (0.137)	0.426 (0.187)
Number of child friendly trained teachers	1.125 (1.458)	3.056 (3.918)	1.964 (2.770)	2.222 (2.819)	3.071 (5.370)	1.897 (2.349)
Teacher's gender=1, if female,0 is male	0.923 (0.277)	0.727 (0.456)	0.606 (0.492)	0.739 (0.449)	0.667 (0.485)	0.667 (0.476)
Displayed charts=1 if yes, 0 if no	0.692 (0.480)	0.864 (0.351)	0.718 (0.453)	0.826 (0.388)	0.722 (0.461)	0.863 (0.348)
Writing books available=1 if yes,0 if no	0.923 (0.277)	1 (0)	0.944 (0.232)	0.957 (0.209)	0.889 (0.323)	0.922 (0.272)
Usable Board=1, if yes,0 if no	0.923 (0.277)	0.955 (0.213)	0.972 (0.167)	0.913 (0.288)	0.944 (0.236)	1 (0)
Class size	35.08 (9.050)	30.82 (12.81)	52.55 (33.79)	39.26 (23.74)	36.56 (21.96)	44.82 (21.55)
English textbook-pupil ratio	1.118 (2.258)	0.742 (0.609)	0.502 (0.356)	0.546 (0.358)	0.643 (0.453)	0.562 (0.516)
School type, =1 if public,0 if private	0.846 (0.376)	0.955 (0.213)	0.901 (0.300)	0.870 (0.344)	0.944 (0.236)	0.941 (0.238)
English score	100 (0)	80 (0)	48.73 (12.06)	100 (0)	80 (0)	46.67 (13.66)

**Table 4: Difference in pupil's characteristics along the test score distribution in mathematics: mean and (sd)**

VARIABLES	Boys	Boys	Boys	Girls	Girls	Girls
	75th Quantile	50th Quantile	25 <sup>th</sup> Quantile	75th Quantile	50th Quantile	25th Quantile
Pupils age	8.636 (1.364)	9.211 (2.158)	8.587 (1.869)	7.690 (1.105)	8.517 (1.724)	7.971 (1.527)
Mother's education	9.625 (2.579)	7.773 (2.910)	7.519 (2.779)	7.909 (2.091)	7.500 (2.410)	7.235 (3.153)
Number of children in a household	3.227 (1.688)	3.947 (2.053)	3.826 (1.623)	3.517 (1.724)	3.793 (1.521)	3.559 (1.561)
Wealth Index	0.460 (0.149)	0.450 (0.144)	0.392 (0.122)	0.499 (0.152)	0.438 (0.150)	0.380 (0.191)
Number of child friendly trained teachers	1.647 (1.902)	1.900 (1.561)	2.543 (4.140)	1.640 (1.868)	2.261 (2.700)	2.783 (4.641)
Teacher's gender=1, if female, 0 is male	0.909 (0.294)	0.553 (0.504)	0.652 (0.482)	0.724 (0.455)	0.690 (0.471)	0.647 (0.485)
Number of teachers	12.91 (5.004)	12.21 (4.670)	12.51 (4.538)	14.25 (7.183)	12.57 (6.015)	11.78 (5.247)
Displayed charts=1 if yes, 0 if no	0.682 (0.477)	0.789 (0.413)	0.739 (0.444)	0.862 (0.351)	0.828 (0.384)	0.794 (0.410)
Writing books available=1 if yes, 0 if no	0.909 (0.294)	1 (0)	0.935 (0.250)	0.931 (0.258)	1 (0)	0.853 (0.359)
Usable Board=1, if yes, 0 if no	0.955 (0.213)	0.947 (0.226)	0.978 (0.147)	0.897 (0.310)	1 (0)	1 (0)
Class size	48.95 (46.91)	40.63 (19.47)	48.78 (26.72)	38.48 (20.90)	41.97 (25.70)	44.53 (20.32)
Math textbook-pupil ratio	0.846 (1.058)	0.755 (1.308)	0.465 (0.283)	0.463 (0.366)	0.567 (0.266)	0.674 (0.757)
School type, =1 if public, 0 if private	0.864 (0.351)	0.895 (0.311)	0.935 (0.250)	0.897 (0.310)	0.897 (0.310)	0.971 (0.171)
Math score	100 (0)	76.69 (6.984)	40.06 (14.64)	100 (0)	76.85 (7.054)	38.24 (13.94)

## **4.2 Results and Discussions**

### **4.2.1 Effects of teacher- pupil gender matching on average test scores**

The aim of the first analysis is to test the hypothesis that there is an impact of gender matching on mathematics and english test scores. Table 5 shows the estimated effects of different variables in the model on test scores for mathematics and english.

The estimates show that in terms of the pupil's characteristics, a mother's level of education has a positive but small statistically significant effect on mathematics test scores. However, the mother's level of education does not have a significant effect on the english test scores. The pupil's age has a statistically significant, positive effect with the performance of the pupils in both english and mathematics. This can be explained by Bar-On model of (Bar-On, 2006) which explains that an increase in age increases cognitive abilities. The number of children in a household has a significant and negative effect on english tests cores. This can be explained by the dilution model which states that due to limited parental resources an increase in number of children dilutes the resources available for each child which in turn leads to a decrease in academic performance (Downey, 1995). Lastly, the pupils gender has a statistically significant effect on mathematics test scores. Being a girl increases mathematics test scores by 43.8 percentage points. This contrast results by (Lucas & Mbiti, 2012) who find being a boy has a positive effect on test scores.

In terms of the classroom factors, the classroom size has a small and negative significant effect on test scores in english. A unit increase in the number of students reduces the english test scores by 0.03 percentage points which is quite small. This corroborates evidence by (Glass & Smith, 1979) who find a negative relationship between class size and academic achievement. In terms of teacher- student gender matching, the estimates show a negative effect of gender matching on test scores in both mathematics and english. However, these estimates are not statistically significant hence there is no effect of gender matching on average academic performance in this case. This is consistent with results by (Puhani, 2018) that there is no statistical significance of gender matching on academic test scores.

Table 5: OLS regression results

VARIABLES	(1) English	(2) Mathematics
Pupils age	0.0632** (0.0315)	0.0742** (0.0358)
Mother's education	0.0264 (0.0176)	0.0609*** (0.0198)
Number of children in the household	-0.0671** (0.0269)	-0.0222 (0.0305)
English textbook- pupil ratio	-0.110 (0.113)	-
Class size	-0.00341** (0.00143)	-0.000396 (0.00162)
Wealth Index	-0.443 (0.356)	-0.470 (0.406)
Teachers gender, =1 if female,0 if male	-0.0784 (0.153)	0.0668 (0.173)
Pupils- Teacher Gender matching, =1 if both female ,0 if not matched	-0.0983 (0.227)	-0.247 (0.256)
Pupils Gender, =1 if female,0 if male	0.215 (0.216)	0.438* (0.243)
Number of Child Friendly Trained Teachers	0.00831 (0.0154)	-0.0144 (0.0174)
Usable Board, =1 if yes,0 if no	0.315 (0.403)	0.519 (0.457)
Writing Books available, =1 if yes,0 if no	0.0979 (0.200)	0.269 (0.216)
Displayed charts, =1 if yes,0 if no	0.0146 (0.125)	0.0516 (0.143)
School type, =1 if public,0 if private	-0.124 (0.184)	-0.262 (0.209)
Mathematics textbook- pupil ratio	-	0.0148 (0.0913)
Constant	3.729*** (0.612)	2.746*** (0.682)
Observations	86	86
R-squared	0.235	0.254

Standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

#### **4.2.2 Effects of teacher- pupil gender matching on conditional distribution of test scores**

This section of the results aims at testing the hypothesis that there is an impact of gender matching on mathematics and english test scores across the conditional distribution. The estimates of the quantile regressions are in table 6 and 7.

The estimates show that, in terms of the pupil's characteristics, the age of the pupils has a positive significant effect on test scores in mathematics for the 50<sup>th</sup> and the 25<sup>th</sup> quantile. The effect is stronger for the lower quantile, which has a 14 percentage points effect. The mother's level of education has a positive and significant effect on english test scores in the lower quantile. There is also a positive effect in mathematics test scores, although only the average students (2<sup>nd</sup> quantile) show a statistically significant effect of mother's education. In terms of the household size, there is a negative effect of number of children on english test scores. This is statistically significant for the 1<sup>st</sup> and 2<sup>nd</sup> quantiles. The effect is however larger on average students compared to the higher performing students. The socioeconomic status of the pupils as represented by the wealth index has a large and statistically significant effect on the english test scores of the 25<sup>th</sup> quantile. Being a girl has a positive effect on the mathematics test scores for the 25<sup>th</sup> and 50<sup>th</sup> quantile.

In terms of classroom characteristics, the class size has a small negative effect on test scores in english for the 50<sup>th</sup> and 75<sup>th</sup> quantile in english. The pupils in the last quantile may need extra attention that is not available in larger classes hence the negative effect. Presence of writing books has a 41 percentage point increase on the test scores of the 75<sup>th</sup> quantile in english. While the effect of writing books is only significant for the 50<sup>th</sup> and 25<sup>th</sup> quantile in mathematics. The presence of usable boards has a positive effect on the mathematic test scores for the 75<sup>th</sup> quantile. Having a usable board increases the mathematics test scores by 72 percentage points. Matching the teacher-student gender has no effect on the test scores in english and mathematics for all the quantiles.

In terms of school characteristics, being in a public school has a negative and significant effect of 41.6 percentage points on the 50<sup>th</sup> quantile test scores of mathematics. The number of child friendly trained teachers has a small positive

effect on the performance of the 25<sup>th</sup> quantile in english test scores. While it has a negative effect of 3.74 percentage points on the 75<sup>th</sup> quantile in mathematics scores.

**Table 6: English Quantile Regression Results**

VARIABLES	(3) 75 <sup>th</sup> quantile	(2) 50 <sup>th</sup> quantile	(1) 25 <sup>th</sup> quantile
Pupils age	0.0343 (0.0294)	0.0652 (0.0506)	0.0478 (0.0421)
Mother's education	0.0175 (0.0164)	0.0140 (0.0282)	0.0530** (0.0235)
Number of children in the household	-0.0581** (0.0251)	-0.0855* (0.0433)	-0.0509 (0.0360)
English textbook- pupil ratio	-0.0715 (0.106)	-0.214 (0.182)	-0.179 (0.152)
Class size	-0.00217 (0.00134)	-0.00398* (0.00230)	-0.00369* (0.00192)
Wealth Index	0.219 (0.332)	-0.0945 (0.572)	-0.931* (0.476)
Teachers Gender, =1 if female,0 if male	-0.0443 (0.142)	-0.0905 (0.245)	-0.262 (0.204)
Pupils- Teacher Gender, =1 if both female ,0 if not matched	0.0408 (0.211)	-0.00622 (0.364)	-0.0349 (0.303)
Pupils Gender, =1 if female,0 if male	0.0554 (0.200)	-0.0298 (0.345)	0.346 (0.287)
Number of Child Friendly Trained Teachers	-0.00365 (0.0143)	0.0107 (0.0247)	0.0353* (0.0205)
Usable Board, =1 if yes,0 if no	0.476 (0.376)	0.232 (0.648)	0.196 (0.539)
Writing Books available, =1 if yes,0 if no	0.411** (0.186)	0.0926 (0.321)	-0.114 (0.267)
Displayed charts, =1 if yes,0 if no	0.121 (0.117)	0.0937 (0.201)	-0.174 (0.168)
School type, =1 if public,0 if private	0.0908 (0.171)	-0.0295 (0.295)	-0.260 (0.246)
Constant	3.136*** (0.571)	3.816*** (0.984)	4.194*** (0.819)
Observations	85	85	85

Standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Table 7: Mathematics Quantile Regression**

VARIABLES	(3) 75 <sup>th</sup> quantile	(2) 50 <sup>th</sup> quantile	(1) 25 <sup>th</sup> quantile
Pupils age	0.0182 (0.0263)	0.0908** (0.0427)	0.140* (0.0750)
Mother's education	0.00437 (0.0145)	0.0581** (0.0236)	0.0663 (0.0415)
Number of children in the household	-0.00963 (0.0224)	-0.0397 (0.0364)	-0.0640 (0.0639)
Mathematics textbook- pupil ratio	0.00890 (0.0670)	0.0295 (0.109)	-0.0306 (0.191)
Class size	0.000102 (0.00119)	0.000376 (0.00193)	0.000802 (0.00338)
Wealth index	-0.113 (0.298)	-0.792 (0.484)	-0.311 (0.850)
Teachers Gender, =1 if female,0 if male	0.206 (0.127)	0.0655 (0.206)	-0.0590 (0.363)
Pupils- Teacher Gender, =1 if both female ,0 if not matched	-0.273 (0.188)	-0.292 (0.306)	-0.107 (0.537)
Pupils Gender, =1 if female,0 if male	0.346* (0.178)	0.543* (0.290)	0.530 (0.509)
Number of Child Friendly Trained Teachers	-0.0374*** (0.0127)	-0.0179 (0.0207)	-0.0172 (0.0364)
Usable Board, =1 if yes,0 if no	0.721** (0.335)	0.416 (0.545)	0.197 (0.957)
Writing Books available, =1 if yes,0 if no	-0.0878 (0.159)	0.525** (0.258)	0.782* (0.453)
Displayed charts, =1 if yes,0 if no	0.0110 (0.105)	0.219 (0.171)	0.0544 (0.300)
School type, =1 if public,0 if private	-0.198 (0.153)	-0.416* (0.249)	-0.0435 (0.438)
Constant	3.796*** (0.500)	2.704*** (0.813)	1.687 (1.428)
Observations	85	85	85

Standard errors in parentheses  
 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## **CHAPTER FIVE: CONCLUSION**

### **5.1 Summary and conclusion**

The study focused on the effect of teacher- student gender matching on academic performance. The relationship between gender matching and academic performance may inform ways to narrow the gender gap in education. The study uses regression analysis and a quantile regression approach to estimate the effect of gender matching on average test scores, as well as across the test score distribution.

The data used indicates that, girls perform better than boys in both mathematics and english. This contrasts national data from KCPE that shows boys outperforming girls in mathematics while girls outperforming boys in english. The results show that the effect of teacher- student gender matching both on average and according to quantiles is has no statistical significance on mathematics and english test scores. This may need more validation by research that uses a different dataset in Kenya.

### **5.2 Policy Recommendation**

This study shows evidence that teacher- student gender matching has no effect on pupil's test scores. It would not be advisable for policy makers and school administration to commit resources in teacher- student gender matching to narrow gender gap in academic performance. Further research should be conducted on how other factors affect gender gap in academic performance.

### **5.3 Limitations of Study**

The main limitation of the study is the type of data used. The sample size used in this study is small and does not accurately represent the national data in Kenya. The dataset used in the study does not contain additional pupil and school characteristics to adequately explain the education production function. A panel dataset would be advisable as it contains more information about the pupils. Lastly, qualitative data could also be used to further explain the dynamics between the pupil's and teacher's interactions in the classroom setup.

### **5.4 Areas of Further Research**

Gender matching has shown to have no effect on academic performance for all pupils. Additional research can be conducted to investigate the effect of gender

matching on test scores using panel data which contains more information about the pupils, their background and school characteristics. Further research should be conducted on other factors that affect academic performance such as other teacher characteristics.

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