



Full Length Research Paper

The Relationship between Secondary School Mathematics Teacher Age, Gender and Students' Academic Achievement in Mathematics in Kenya: A Case Study of Muhoroni Sub County

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ABSTRACT

Mathematics is one of the subjects in secondary school curriculum in Kenya that plays an important role in determining students' choice of most professions. Despite this fact and the fact that all mathematics teachers in Muhoroni Sub County were professionally qualified graduate teachers and experienced, students' academic achievement in mathematics had remained below a mean score of 6.0 which is the average score in Kenya Certificate of Secondary Education examinations. Thus from 2005 to 2009 only one secondary school consistently had a mean score of 7.5 and above. The rest of the secondary schools had consistently mean scores below 4.6 except one school that had a mean score of 5.3 in 2008 and 5.05 in 2009. The study established a positive relationship that was not significant between mathematics teachers' age and students' academic achievement. The coefficient of determination revealed that the four mathematics teachers' characteristics accounted for 33.3% of variations in students' academic achievement. Teacher age and gender should be re-examined with a view to establishing ways and means of ensuring that they contributed significantly to students' academic achievement in mathematics. The findings of this study are useful to school managers, mathematics teachers, Quality Assurance Officers and other stakeholders in diagnosing the shortcomings in teacher characteristics that hinder promotion of student academic achievement.

Keywords: Relationship, Secondary School Mathematics, Teacher Age, Gender, Students' Academic Achievement, Mathematics Muhoroni, sub county, Kenya

INTRODUCTION

The teacher is the most costly educational input in educational systems. In cognizance of this fact, Perry (1995) pointed out that teacher training is expensive. Not only is the unit cost of training high but also training increases the recurrent cost of education, as teachers once trained, command higher salaries. A teacher's role is central in student academic achievement. Of all variables under the control of the school, teaching has the most demonstrable impact upon student academic achievement (Hopkins, 1997). This position is supported by Psacharopoulos and Woodhall (1985) who singled out

the teacher as being the most important factor that if varied, can influence school output. Kenya in response to trained teacher demand expanded her training of secondary school teachers between the years 2005 – 2009 (Republic of Kenya, 2010). The missing knowledge gap that needed to be filled was the scientifically proven relationship between specific mathematics teacher characteristics and student academic achievement in mathematics in Muhoroni Sub county to confirm or contradict assertions by Hopkins (1997) and Psacharopoulos and Woodhall (1985). According to

Rivkin, Hanushek and Kain (2005), teachers' age is not significantly related to students' academic achievement. Kimani, Kara and Njagi (2013) in a study titled teacher factors influencing students' academic achievement in secondary schools in Nyandarua County Kenya, also found that teachers' age was not significantly related to students' academic achievement. Makewa et al (2012) on the other hand in their study evaluated teacher factors associated with mathematics performance in public primary schools in Nandi Central Sub county Kenya but concentrated on mathematics use of learning resources, teaching resources, teaching methodology, teacher preparation, commitment, assessment together with attitude but not the personal characteristics age, gender, number of years of teaching and qualification. The missing knowledge gap that needed to be filled that was not addressed by these studies was the direction of the relationship and the degree of the relationship in Muhoroni Sub County.

Teacher gender does influence students' academic achievement. Saha (1983) found that male teachers were more successful with science subjects while female teachers were more successful in language teaching and related subjects. Thomas (2010) in his study found that learning from a teacher of opposite gender had a detrimental effect on student academic progress and their engagement in schools. Sparks (2013) in a study found that female elementary school mathematics teachers gave boost to female pupils. However male pupil's performance was not affected by mathematics teacher gender. The differences in performance of students therefore is children's gender biases. In this respect Antecol (2012), in a study titled "Elementary school teachers have an impact on girls mathematics learning," found that children express the stereotype that mathematics is for boys not for girls as early as second grade and added that according to a study by University of Washington researchers it was found that children applied the stereotype to themselves, boys identified themselves with mathematics whereas girls did not. The common expression was "mathematics is for boys." This explains why so few women pursue science, mathematics and engineering careers. The missing knowledge gap was the relationship between mathematics teacher gender and students academic achievement in mathematics in Muhoroni Sub County, in view of Saha's (1983), Thomas (2010), Sparks (2013) and Antecol's findings in the United States of America.

Mathematics in Kenya is compulsory and a prerequisite for admission of secondary school learners into post-secondary learning institutions, but majority of students fail to join these institutions and drop out of the education system due to poor performance in mathematics despite the fact that their teachers are well qualified. Umeasiegbu (1991) argued that "the level of performance in any school is intimately related to the quality of its teachers" while "the quality of any school

system is a function of the aggregate quality of its teachers who operate it." Wright, Horn and Sanders (1997) observed that the most important factor influencing student learning is the teacher. Teachers stand in as the interface of the transmission of knowledge, values and skills in the learning process. If the teacher is ineffective, students under the teacher's tutelage will achieve inadequate progress academically.

Bridges (1986) contends that the inefficiency and low quality of secondary school education as was often reflected in the mathematics achievement scores posed a question on the competence and training of the mathematics teachers. Students and parents were not the only ones who were being short changed by incompetent teachers. These poor performances tarnished the vast majority of teachers who were competent and conscientious professionals. Thus, Bridges (1986) points out that the low quality of secondary school education may be attributed to teachers' training and competence. However, Ochieng (2012) in a study titled "Relationship between school factors and girls academic achievement in Kenya Certificate of Secondary Education Examinations in Kiambu East Sub county, Kenya" established that there was a weak positive relationship between teacher qualifications and girls academic achievement in mathematics that was not significant. The other factors studied included the relationship between teaching load, textbooks, class size and girls academic achievement in mathematics. The missing knowledge gap that needed to be filled was; what portion of the variation in student academic achievement in mathematics in Muhoroni Sub County would be accounted for by mathematics teacher qualifications? This was necessary because most teachers in Kenyan secondary schools are graduate teachers and only a few are Diploma holders or approved teachers (Table 1). In Kenya the teacher as one of the inputs into the educational process constitute an important aspect in pupils' learning. Notwithstanding this view staffing of teachers in public secondary schools has not been adequate. For instance, the number of male teachers declined by 2.5% from 28,544 in 2007 to 27,838 in 2008 while the number of female teachers decreased by 3.7% from 15,761 in 2007 to 15,178 in 2008. The student teacher ratio in public secondary schools rose from 23:1 to 28:1 in 2008 (Republic of Kenya, 2009). The qualification of teachers were as follows.

The curriculum based establishment is 1:28. However, due to shortage of teachers, most teachers teach more than 28 lessons per week.

In Kenya the Ministry of Education stipulates that the implementation of 8-4-4, primary school curriculum requires that average teacher-pupil contact hours per week be 28 hours for standard 4 to 8 and 20 hours for the standard 1 to 2, (Abagi and Odipo, 1997). Abagi and Odipo (1997) further observed that, meeting this requirement indicates how efficient the curriculum is

Table 1. Secondary Schools Teacher Qualifications 2009

Category of Teachers	Number of Teachers	Percentage
Trained		
Graduate	44,822	79.4
S1 /Diploma	226	0.4
Approved	10,667	18.9
Technical	727	1.3
Total	56,442	100
Untrained		
Graduate	203	69.3
Technical	90	30.7
Total	293	100

Source: Republic of Kenya (2010) Economic Survey

Table 2. Mathematics performance in Nyakach, Muhoroni and Nyando Sub County 2005 to 2009

Sub county	Year/ Kenya Certificate of Secondary Education Results in Mean Score				
	2005	2006	2007	2008	2009
Nyakach	3.263	3.535	3.053	3.588	4.310
Muhoroni	2.964	3.110	3.176	3.516	3.937
Nyando	3.010	3.108	3.365	3.643	4.100

Source: DEOs Office Muhoroni (2010)

Table 3. Kenya Certificate of Secondary Education Examinations Results in selected Secondary Schools in Muhoroni Sub county for the Years 2005, 2006, 2007, 2008 and 2009

School	YEAR														
	ENG	MATH	PHY	ENG	MATH	PHY	ENG	MATH	PHY	ENG	MATH	PHY	ENG	MATH	PHY
A.	4.6	2.4	2.5	4.7	2.3	3.1	4.9	2.1	3.2	5.0	3.1	2.3	5.56	3.77	4.74
B.	6.8	7.5	6.9	6.9	7.9	7.4	8.9	9.0	8.6	8.9	9.2	9.3	9.33	9.60	9.66
C.	7.7	3.4	6.7	7.63	3.47	5.58	6.9	4.5	5.0	6.4	5.3	4.3	7.35	5.05	4.37
D.	4.4	1.8	3.2	4.6	3.9	3.5	5.4	2.9	4.0	4.9	3.8	4.1	5.56	2.63	4.02
E.	4.5	3.6	4.4	4.7	3.8	3.9	5.1	4.6	4.3	4.8	4.7	3.6	5.56	2.62	4.0
F.	2.6	1.9	2.1	2.8	2.6	3.4	2.6	3.5	2.9	3.4	4.1	2.7	4.7	3.43	4.17
G.	3.4	2.8	3.6	4.2	2.8	3.1	3.9	2.9	3.3	4.1	3.9	3.6	5.25	2.93	4.67

Source: DEOs Office Muhoroni Sub county (2010)

being implemented. If the pupils do not get the specified contact hours, the implication is that the syllabus may not be completed in time and extra time will have to be created for coaching pupils outside the normal classroom hours. Absenteeism of teachers and pupils and lack of supervision and inspection from local education office leads to wastage of teaching and learning time.

From Table 2 mathematics was performed poorly in the three Sub county s at mean scores below the average 6.0 but Muhoroni Sub county 's performance was poorest ranging from 2.964 to 3.937 whereas that of Nyakach Sub county ranged from 3.263 to 4.310 and Nyando Sub county ranged from 3.010 to 4.100. This trend in performance prompted the need for a study to be

conducted in Muhoroni Sub county with a view to establishing the relationship between mathematics teacher characteristics and students achievement. This is because mathematics teachers play a crucial role in students' academic achievement. The knowledge gap that needed to be filled was the actual relationship between mathematics teacher characteristics and students academic achievement in Muhoroni Sub county. In Muhoroni Sub county students' achievement in mathematics was poorer than in other related subjects (Table 3).

From Table 3 it can be observed that students' academic achievement was poor. From the table it is clear that performance in mathematics was indeed poorer

compared to English and Physics, and also varied from school to school. Furthermore, poor performance in mathematics highly contributes to the overall low achievement of students in Kenya Certificate of Secondary Education. The teacher variables were chosen for the study and not the other school factors because the teacher is the most critical factor in the organization of knowledge imparted to the learners and the instructional materials used in the implementation of the curriculum (Hopkins, 1997). The knowledge gap that the study sought to fill was the relationship between selected secondary school mathematics teacher characteristics and students' academic achievement in mathematics in Muhoroni Sub County.

Research Objectives

The research objectives were to:

- i. Establish the relationship between teachers' age and students' academic achievement in mathematics.
- ii. Determine the relationship between teachers' gender and students' academic achievement in mathematics.

Synthesis of literature on relationship between secondary school mathematics teacher age, gender and students' academic achievement

Age and gender are of great concern to both employees and employers. This is because they are crucial in performance indices of employees. Age and gender are in fact considered by employers as a precursor of production in all human ventures and industrial undertakings. Eshiwani (1993) states that youthful better-qualified teachers are quite heavily concentrated at urban schools but are generally less satisfied with their jobs than the older generation of teachers, who feel 'privileged' to be teachers. The minimum qualification requirement of university degree has created a lot of dissatisfaction. Older, less qualified teachers feel discriminated against. Again in the marginalized Sub county s, teachers do not have the opportunities for further trainings. Even though teachers generally feel that they have the required competencies, the extents to which they can upgrade their qualifications and undertake continuous professional development are major motivational factors. In most countries, being able to upgrade ones qualifications is a critically important incentive since it is the only way to improve significantly and offers the opportunity to escape the perceived drudgery of the rural classroom. Further, remote location coupled with relatively poor working conditions results in under-staffing of rural schools with high vacancy rates. The rural teacher usually has more than one class to teach while in contrast, urban schools tend to be over-staffed. According to Rivkin, Hanushek and Kain (2005), there has never been consensus on the specific teacher

factors that influence students' academic achievement. Researchers have examined the influence of teacher characteristics such as gender, age, educational qualifications and teaching experience on students' academic achievement with varied findings. Nevertheless, Rivkin et al (2005) found that teachers' teaching experience, age and educational qualifications were not significantly related to students' achievement, however we do not know whether they are significant in Muhoroni Sub county or not a gap the study sought to fill.

Etsy (2005) in a study in Ghana found that the teachers' factors that significantly contributed to low academic achievement were incidences of lateness to school, incidences of absenteeism, and inability to complete the syllabi. Oredein and Oloyede (2007) concluded that teacher management of homework and assignments given to students have an impact on student achievement especially when it is well explained, motivational, corrected and reviewed during class time and used as an occasion for feedback to students. Their studies did not go further to establish the extent to which the variables influenced students academic achievement. The relationship between the teacher age and students academic achievement was not known in Muhoroni Sub County and therefore the knowledge gap that this study sought to fill. Teaching demands a lot of energy. May be older teachers just "burn out." Younger teachers are probably more up-to-date with National Curriculum and exam requirements and probably make these their main focus. Older teachers probably want to get away from this straitjacket and concentrate on educating their students rather than just getting them to pass examinations. Younger teachers often find they lack a breadth of knowledge about their subject and, sadly, a lack of interest about anything relating to their subject that does not fall within curriculum requirement. It is more difficult for an older teacher to establish a rapport with his or her class. It is also quite probable that the young graduates has more up to date knowledge and enthusiastic for the subject. Indeed young teachers are more enthusiastic and have more up to date knowledge on their subject than experienced teachers. However, they may not be taken seriously by their students because of their age and therefore disadvantaged as instructors. However a research done by Kimani, Kara and Ngugi in Nyandarua County revealed that there is no significant relationship between the age of a teacher and the performance in mathematics. Literature in this area is still inconclusive as it is difficult to separate the age from other variables like experience and qualification. Kimani et al (2013) concluded that teachers' age, gender, professional qualifications and professional experience did not have significant effect on academic achievement in secondary schools in Nyandarua County. However, teachers' job group and workload significantly affected academic achievement. The study also concluded that the frequency of issuing assignments, teachers ensuring that

students completed assignments and timely marking of the assignments significantly affected academic achievement. Teacher background characteristics and classroom instructional practices therefore do make a difference in students' academic achievement (Kimani, 2013). Kimani (2013) and Rivkin (2005) concur that age and gender do not have a significant effect on students' academic achievement but there has never been consensus on the specific teacher factors that influence students' academic achievement and therefore the knowledge gap that this study sought to fill. From the studies reviewed the degree and direction of the relationship between teachers' age and student academic achievement in Muhoroni Sub county was unknown, a knowledge gap this study attempted to fill.

Teacher gender has a variable influence on performance depending on grade level. Male teachers tend to positively influence male students in grade five to eight, but have a negative influence on students of both sexes at the upper secondary level. Simmons (1980) also found positive influence on student performance at higher levels with female teachers, but, a negative influence with the eighth grades. The gender parity in teacher efficiency and productivity therefore needs to be determined. Saha (1983) found that male teachers seem to be more successful with science subjects' performance while female teachers are more successful in language teaching and related subjects. Akiri and Ugborugbo (2008) found that there was a significant relationship between teachers' gender and students' academic achievement. This necessitates research on teacher characteristics relationship with students' academic achievement in mathematics at secondary school level, the findings of which will help in appropriate staff distribution at the different levels for increased efficiency in our schools.

Thomas (2006) in the United States of America in his research on the effect of gender on students' performance, investigated the effect of a teacher's gender using the National Education Longitudinal Survey which contains data on a nationally representative sample of nearly 25,000, 8th graders from 1988. In addition to examining the effect of teacher gender on students' test-score performance, he examined teacher perceptions of a student's performance and student perceptions of the subject taught by a particular teacher. He was especially interested in the influence of a teacher's gender on students' perceptions, because engagement with an academic subject may be an important precursor to subsequent achievement levels, course selection in high school and college, and also occupational choice. For example, the underrepresentation of women in fields like engineering and computer science may be due to levels of confidence and interest in related subjects in high school. Indeed, research confirms that a teacher's gender does have large effects on student test performance, teacher

perceptions of students, and students' engagement with academic material. Simply put, girls have better educational outcomes when taught by women and boys are better off when taught by men. These findings persist, even after he accounted for a variety of other characteristics of students, teachers, and classrooms that may influence student learning. Many variables have long been studied as predictors of mathematics achievement. However, gender issues on mathematics achievement are studied most frequently by researchers. For instance, a study through a meta-analysis reveals that males tend to do better on mathematics test that involve problem-solving (Zhu, 2007). Females tend to do better in computation, and there is no significant gender difference in understanding mathematics concepts. Another study shows that females tend to earn better grades than males in mathematics (Kimball, 1989). Some recent studies have revealed that gender differences in mathematics education seem to be narrowed in many countries. However, studies indicate that as students reach higher grades, gender difference favours increase in mathematics achievement by males (Mullis, Martin, Fierros, Goldberg, and Stemler, 2000). For instance the results from the Third International Mathematics and Science Study showed that mathematics achievement scores of each gender group were close to each other in the primary and middle school years (Mullis et al., 2000). However, in the final year of secondary school, evidence was found for gender differences in mathematics achievement. Another study, which was conducted to analyze factors that affect mathematics achievement of 11th graders in mathematics classes with an identified gender gap, also showed that males scored higher than females on 11th grade mathematics achievement test, but this difference decreased from 10th grade (Campbell & Beaudry, 1998). In addition, gender differences in attitudes and perceptions of the usefulness of mathematics for middle school students were found statistically important (Oakes, 1990). For example, female students show less interest in mathematics and have negative attitude towards mathematics. It is also reported that girls tend to learn mathematical concepts by means of rules or cooperative activities while boys have a tendency to be in a competition to master mathematical concepts. The literature on gender differences provides evidences that gender issues impact on achievement in mathematics. Hence, it is crucial for educators and researcher to pay attention to gender differences in the design of mathematics instructions. Sparks (2011) in his study found female elementary school teachers' comfort with mathematics had an outsize effect on the girls they teach according to new research. Girls taught by a female teacher got a learning boost if that teacher had a strong mathematics background, but had consistently lower mathematics performance by the end of the school year if she did not have a strong background according to a study presented at the American Economic Association's

annual conference. By contrast, boys' mathematics scores were not affected by having a female mathematics teacher, regardless of the teacher's background in that subject, and there were no differences in mathematics performance among male and female students of male teachers of different mathematics backgrounds. The study adds to growing evidence that children's gender biases can significantly affect their own ability.

Escaribul et al (2013) in a study on teacher gender and student performance in mathematics in Catolina in Spain, using a Heckman two –step procedure, found teacher gender affects students' results and are positively correlated with having a female teacher. The interaction term was not statistically significant thus the teacher gender effect is the same for both male and female students. Students with female teachers received higher marks on the kangaroo test but experience and age did not have statistically significant relationship with pupils' achievement and agrees with findings of Hanushek (2011) on experience and age. The gender gap between teacher and student may cause an efficiency lose more so, if policy on recruitment of female teachers is affected, since female teachers obtain higher results with all their pupils than those of male teachers. The male –female teacher differences should be examined in relation to a wider range of factors related to teachers, such as training, self confidence, job satisfaction and teachers beliefs (Li, 1999; She, 2000; Driessen, 2007) to understand why pupils should benefit from having female teacher.

Another study by Antecol et al, (2012) in USA found that girls taught by a female teacher, as opposed to a male teacher, saw their mathematics test scores drop by 4.7 percentage points by the end of the school year. Moreover those girls performed on average 1.9 percentage points lower than their male classmates, about 10 percent of a standard deviation. The researchers characterized both effects as strong. Thomas (2010) in the USA also found out that learning from a teacher of opposite gender has a detrimental effect on student academic progress and their engagement in school. It was found to lower test scores for both boys and girls by approximately 4 percent of a standard deviation and has even larger effects on various measures on student engagement. In three subject areas Science, Social studies and English it was found out that an overall effect of having a woman teacher instead of a man raises the achievement of girls by 4 percent of a standard deviation and lowers the achievement of boys by roughly the same amount producing an overall gender gap of 8 percent of standard deviation. Furthermore, when taught by a man girls were more likely to report that they did not look forward for the subject and that it was not useful for their future or that they were afraid to ask questions. Thus, female science teachers are far more effective in promoting girls engagement than their male counterparts. Boys also had

fewer positive reactions to their academic subjects when taught by an opposite gender teacher and particular when taught by a female teacher boys were significantly more likely to report that they did not look forward to the subject.

In mathematics, both boys and girls suffered if there was a woman teacher scoring 7 percent and 8 percent of a standard deviation lower respectively than if they had a male teacher. Adverse gender effects have an impact on both boys and girls but that effect falls more heavily on the male half of the population in the middle school because most middle school teachers are female. Unfortunately, in co-educational setting some of these gap closings would take place at the expense of the opposite gender, an outcome few would embrace. Thomas (2010) in the USA, in his study on teachers and gender gaps in students' achievement found out that switching up teachers actually could narrow achievement gaps between boys and girls but one gender would lose at the expense of the other. However, its critics such as Marcia Greenberger, Co-president of the National Women's Law Centre says that his conclusions are questionable and inconsistent and that boys and girls benefit by having male and female teachers as role models. Many parents or students looking back over the educational career have been inspired by a teacher of the opposite sex and have had unhappy experiences with teachers of the same gender that they had and students' success cannot be narrowed by the gender of their teachers. The studies reviewed revealed varying trends in different areas on the relationship between teacher gender and students' performance. The missing knowledge gap that the study sought to fill was the relationship between mathematics teacher gender and student's academic achievements in mathematics with respect to Muhoroni Sub County.

Conceptual Framework

The conceptual framework postulates that there exists relationship between mathematics teacher characteristics and students' academic achievement as independent and dependent variables. A variable is a measurable characteristic that assumes different values among the subjects in a definite population. An independent variable is a variable that a researcher manipulates in order to determine its effect or influence on another variable.

Independent variables are also called predictor variables because they predict the amount of variation that occurs in another variable. A dependent variable attempts to indicate the total influence arising from the effects or influence of the independent variable. A dependent variable therefore varies as a function of the independent variable. Intervening variable is an extraneous variable that is recognized as being caused by the independent variable and as being a determinant of the dependent variable. An intervening variable

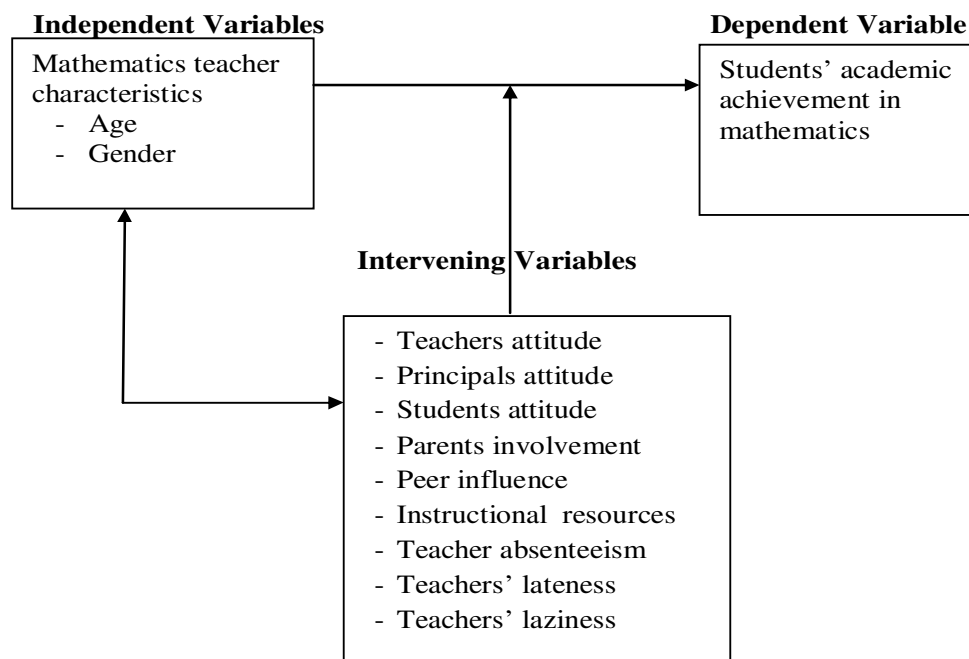


Figure 1: A Conceptual framework showing relationship between selected teacher characteristics age, age and students' academic achievement in mathematics

therefore comes between the independent and dependent variables. When intervening variables are used as control variables one must establish a dominant direction of influence. The independent variables influence moderated by intervening variables.

The independent variables age and gender influence the dependent variable students' academic achievement in mathematics. However, the influence of these are moderated by the intervening variables. The influence is covered under the assumptions of the study. Mathematics teacher characteristics can either influence positively or negatively students' academic achievement. It is expected that as teachers advance in age, they are bound to influence more positively students academic achievement. Mathematics teacher gender based on the view of role models can influence students' academic achievement in mathematics. For instance male mathematics teachers can motivate male students to work hard in mathematics as they serve as role models. Female mathematics teachers would similarly serve as role models to girl students. When this fact is not embraced students academic achievement is bound to decline, that is, when the teacher is of the opposite gender.

RESEARCH METHODOLOGY

Descriptive survey and correlation research designs were adopted. The target population consisted of 22 principals,

41 mathematics teachers and 1344 form IV students of 2010. Saturated sampling technique was used to select a sample size of 21 Principals and 31 mathematics teachers and simple random sampling was used to select 300 of the 2010 form IV students. Data were collected by use of questionnaire, document analysis guides and interview schedules. Face and content validity of the instruments was established by experts in educational administration, whose input was incorporated. Reliability of the instruments was determined by test re-test method involving 10 mathematics teachers. Pearson r coefficient of the mathematics teachers' questionnaire was 0.84 at set p-value of 0.05. Quantitative data were analyzed using descriptive statistics in form of percentages, frequency counts and means. Inferential statistics that is Pearson r and coefficient of determination were used. Qualitative data was transcribed, analyzed and reported in emergent themes and sub them

RESULTS

Demographic Characteristics of Mathematics Teachers

The selected demographic characteristics of mathematics teachers in Muhoroni Sub county were as shown in Table 4. Table 4 shows that there were more male mathematics teachers 24(77.42%) than female mathematics teachers 7(22.58%). This means that

Table 4. Demographic characteristics of Mathematics Teachers

Demographic characteristic	Frequency (F)	Percentage (%)
Gender		
Male	24	77.42
Female	7	22.58
Total	31	100
Range of Ages in years		
29 -34	09	29.0
35 -39	04	13.0
40 - 44	05	16.0
45 - 49	11	35.5
50 - 54	02	6.5
Total	31	100
Range of Teaching Experience in years		
04 - 09	12	38.7
10 - 14	03	9.7
15 - 19	08	25.8
20 - 24	06	19.4
25 - 29	02	6.4
Total	31	100
Professional Qualifications		
DIP.ED	05	16.1
B.ED	19	61.3
BA/PGDE	02	6.5
BSC/PGDE	05	16.1
Total	31	100

students were taught mainly by male mathematics teachers. Nevertheless, both gender did contribute in secondary school mathematics. This made it possible to study the relationship between mathematics teachers' gender and students' academic achievement in mathematics. Most of the teachers 11(35.5%) were within age range of 45 to 49. Nine (29%) of the teachers were within age range 29 to 34, five (16%) within the age range of 40-44, four (13%) within the age range of 35-39 while 2(6.5%) were within age range of 50-54. The distribution made it possible for the study to establish the relationship between mathematics teachers' age and students' academic achievement in mathematics.

Mathematics teachers experience in teaching mathematics ranged from 4 years to 26 years. 12 (38.7%) of mathematics teachers had a teaching experience of 4 to 9 years, eight (25.8%) had a teaching experience of 15 to 19 years, 6(19.4%) had a teaching experience of 20 to 24 years, 3(9.7%) had a teaching experience of 10 to 14 years and 2(6.4%) had a teaching experience of 25 to 29 years. This distribution enabled the study to find out the relationship between mathematics teachers' teaching experience and students' academic achievement in mathematics. Most of the

mathematics 19(61.3%) were holders of Bachelor of education degree, 5(16.1%) were holders of Bachelor of science with Post graduate diploma in education, 2(6.5%) were holders of Bachelor of Arts with Post graduate diploma in education and 5(16.1%) were holders of Diploma in Education. This distribution helped the study in establishing the relationship between mathematics teachers' professional qualifications and students' academic achievement in mathematics. Mathematics teachers' performance indices for the year 2010 were as shown in Table 5.

The performance index for mathematics teachers in Kenya Certificate of Secondary Education examinations for the year 2010 ranged from mean score of 1.14 to 9.69. The range was quite big. This distribution enabled the study to find out the relationship between the selected mathematics teacher characteristics and students' academic achievement in mathematics. It is important to note that in schools where team teaching was undertaken the performance indices were the same, otherwise no teachers from different schools were found to have similar performance indices.

Most male mathematics teachers 16(66.7%) had a performance index range of 2.04 to 4.04, six (25%) had a

Table 5. Muhoroni Sub county Mathematics Teachers (n= 31) Performance Index in Mathematics 2010

Mathematics teachers S/N	Mean Score
1	2.96
2	2.69
3	2.71
4	4.22
5	2.91
6	4.06
7	9.69
8	2.43
9	3.25
10	3.14
11	3.06
12	9.69
13	4.15
14	4.01
15	5.34
16	2.67
17	3.29
18	2.26
19	2.24
20	2.06
21	4.01
22	2.04
23	3.29
24	4.06
25	2.69
26	2.26
27	3.14
28	5.34
29	4.15
30	4.01
31	3.25

Table 6. Mathematics Teachers Performance Index in mathematics by Gender 2010

Gender	Range of Mean scores	Frequency (f)	Percentage (%)
Male	2.04 - 4.04	16	66.7
	4.05 - 06.05	6	25.0
	6.06 - 8.06	0	0.00
	8.07 -10.07	2	8.3
Total		24	100
Female	2.04 - 4.04	6	85.7
	4.05 -06.05	1	14.3
	6.06 - 8.06	0	0.0
	8.07 -10.07	0	0.00
Total		7	100

Table 7. Mathematics Kenya Certificate of Secondary Education examination Results 2010 by Schools

Range of Mean Scores	Frequency (F)	Percentage (%)
1.00 - 2.90	10	45.5
3.00 - 4.90	09	40.9
5.00 - 6.90	02	9.1
7.00 - 8.90	0	0.0
9.00 - 10.9	01	4.5
Total	22	100

performance index range of 4.05 to 6.05 and 2(8.3%) had a performance index range of 8.07 to 10.07. Six (85.7%) female mathematics teachers had a performance index range of 2.04 to 4.04 and 1(14.3%) had a performance index range of 4.05 to 6.05. Mathematics teachers' performance index by gender revealed that most male mathematics teachers performed better than female mathematics teachers (Table 5) did. Male mathematics teachers' performance indices ranged from 2.26 to 9.62 while that of female mathematics teachers ranged from 2.04 to 4.22.

From Table 7, it can be observed that 10(45.5%) of the schools had a mean score range of 1.0 to 2.9. Nine (40.9%) of the schools had a mean score range of 3.0 to 4.9, two (9.1%) of the schools had a mean score range of 5.0 to 6.9 and 1(4.5%) of the schools had a mean score range of 9.0 to 10.9. Nineteen (86.4%) of the schools performed below 5.00 mean score which was below the average mean score of 6.0 and only 3(13.6%) attained the average mean score and above hence in 2010 Kenya Certificate of Secondary Education examination mathematics achievement attest to the poor performance in Muhoroni Sub county. The distributions of these mean score were useful in establishing the relationship between mathematics teachers characteristics and students academic achievement.

Research Objective: Relationship between Mathematics Teachers' Age and Student Academic Achievement in Mathematics

The null hypothesis that was tested to establish the relationship between mathematics teacher age and student academic achievement was: There is no significant relationship between mathematics teacher age and students academic achievement in mathematics in Muhoroni Sub County. To test this null hypothesis, the teachers' age was first established (Table 4) and later the students' academic achievement in mathematics in Kenya Certificate of Secondary Education (Table 5). The outcome was shown in Table 8.

Table 8 shows that there was a weak positive relationship between mathematics teachers' age "X" and

students academic achievement in mathematics "Y" as the Pearson correlation coefficient was 0.247. The relationship was not significant because the calculated p-value .181 is greater than the set significance level of 0.05. The null hypothesis was therefore accepted. It means the relationship was not strong. When the coefficient of determination (R^2) was run the outcome was 0.061, which means 6.1% of the variation in students academic achievement was accounted for by mathematics teacher age in the correlation. This means that only 6.1% of the variation in students' academic achievement in mathematics can be explained by mathematics teachers' age. The rest (93.9%) cannot be explained by age. Nevertheless the fact that the correlation was positive it also means that, as age increases students' academic achievement in mathematics increases as well by 6.1%. The rest (93.9%) could not be explained by the teacher age. Mathematics teachers in their questionnaire stated that age is a factor that determines students' academic achievement in mathematics.

Research Objective 2: Relationship between Mathematics Teachers Gender and Students Academic Achievement in Mathematics

The null hypothesis that was tested to establish the relationship between mathematics teachers' gender and students' academic achievement was: There is no significant relationship between mathematics teacher gender and students academic achievement in mathematics in Muhoroni Sub County. To test this null hypothesis, the teachers' gender was first established (Table 1) and later the students' academic achievement in mathematics in Kenya Certificate of Secondary Education examination (Table 4). The outcome was as shown in Table 9.

Table 9 shows that the relationship between mathematics teachers' gender "X" and students' academic achievement in mathematics "Y" was negative and weak. The relationship was also not significant because the calculated p-value of 0.373 was greater than the set level of significance of 0.05. Therefore the null hypothesis was accepted. This means that the

Table 8. Correlation between Teacher Age and Student Academic achievement in Mathematics

		X	Y
Age X	Pearson Correlation	1	.247
	Sig. (2-tailed)	.	.181
	N	31	31
Mathematics mean score Y	Pearson Correlation	.247	1
	Sig. (2-tailed)	.181	.
	N	31	31

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

* . Correlation is significant at the 0.05 level (2-tailed).

Key: X – Mathematics Teacher Age

Y – Mathematics mean score

Table 9. Correlation between Teacher Gender and Students Academic achievement in Mathematics

		X	Y
Gender X	Pearson Correlation	1	-.166
	Sig. (2-tailed)	.	.373
	N	31	31
Mathematics mean score Y	Pearson Correlation	-.166	1
	Sig. (2-tailed)	.373	.
	N	31	31

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

* . Correlation is significant at the 0.05 level (2-tailed).

Key: X – Mathematics Teacher Gender

Y – Mathematics mean score

association between mathematics teacher gender and students' academic achievement in mathematics was not strong. It also means that the variation in teacher gender reduces students' academic achievement in mathematics marginally. Coefficient of determination (R^2) was performed and the outcome was 0.028. This means that only 2.8% of the variations in students' academic achievement in mathematics can be explained by teachers' gender. The rest (97.2%) cannot be explained by teacher gender. The negative correlation means that variation in the teacher gender reduces students' academic achievement in mathematics by 2.8%.

DISCUSSION

Mathematics teachers in their questionnaire stated that age is a factor that determines students' academic achievement in mathematics. This finding was corroborated by interview findings in which one principal stated;

"In most cases age has very little influence on the teachers' performance as it is just but a number. What matters is the competence, commitment and responsibility. In some cases I have noted younger

teachers performing better than old teachers and vice versa."

During focus group discussion, one student on the other hand stated;

"Chronological age seems not to play a major role in the manner in which a teacher teaches. Some younger teachers are keen to help students master skills in solving mathematical problems, whereas some do not care, they are always in a hurry."

From literature review there seem to be no clear consensus on the influence of mathematics teachers' age on students academic achievement in mathematics. Generally one would expect teachers' age to influence students' achievement due to maturity. That is, as mathematics teachers advance in age they should have better mastery of content, better utilization of educational resources, motivational techniques and effective content delivery. This finding is consistent with Hanushek's (1996) finding that teachers' age was consistently related to pupil achievement than their educational quality. Hanushek's (1996) study did not attempt to establish whether the relationship was significant or not. Contrary to this finding is Fuller's (1987)

study which found out that 10 studies confirmed the hypothesis of significant relationships outcome. Rivkin, Hanushek and Kain (2005) found that teachers' age was significantly related to students' achievement. Kimani's (2013) study in Nyandarua County on the other hand found that teachers' age did not have significant effect on schools. Darling-Hammond (1999) studies revealed a negative relationship between teachers' age and students' achievement. The weak positive relationship established by this study somewhat attest to the finding of these studies.

Indeed teaching mathematics demands a lot of energy. It involves problem solving, which is a practical dimension and has many lessons, six per week. The situation is aggravated by the Free Secondary Education policy that has increased student teacher ratio to the extent that some schools cannot effectively implement the curriculum. In such circumstances, teachers advancing to mandatory retirement age are bound to experience burnout easily. Younger teachers in this respect may be more up-to-date with curriculum and examination requirements, and probably make these their main focus. On the other hand, young inexperienced teachers may be easily overwhelmed by work. In which case learning achievements may be minimal and the contrary may be for the older teachers. Rapport is very important in learning outcomes, an aspect that is associated more with younger teachers, in whereas it may be more difficult for an older teacher to establish rapport with his or her class. Furthermore in most cases younger teachers often find teaching interesting and become more enthusiastic and have more up-to-date knowledge on their subject than older teachers. However, they may not be taken seriously by students because of their age and therefore disadvantaged as mathematics teachers. This is supported by Kimani's (2013) study in Nyandarua Sub county which revealed that there is no significant relationship between age of a teacher and the performance in mathematics.

Mathematics teachers in their questionnaires indicated that the gender of a teacher thus influence students academic achievement in mathematics, particularly students of the same gender as the teacher. This is because the teachers serve as role models. They also argued that there are few exceptions where opposite gender impacts positively on students' academic achievement in mathematics. That is male mathematics teachers impacting positively on female students and vice versa. This finding was not corroborated by interview findings. Thus during interviews with the principals, it emerged that change of mathematics teachers gender well accounted for change in students' achievement in mathematics. In fact one principal categorically stated:

In my career as a teacher and a principal, I have noted that male teachers perform better in mathematics teaching than female counterparts.

Classes taught by female teachers have always performed poorer, while those streams taught by male teachers have always excelled. It is therefore no wonder that in Muhoroni Sub county majority of mathematics teachers are male (Table 4.3). This is perhaps, because male mathematics teachers in their teaching tend to demystify the old adage that mathematics is difficult to learn. Notwithstanding this view, mathematics is very demanding as it thrives on the fact that practice makes perfect. It means the teacher has to be as busy as the student, giving exercises and expeditiously marking, returning and revising the exercises. Indeed given the traditional role of female teachers in the home, they cannot afford sacrifice their time and domestic chores as their male counterparts do.

Another principal added;
Indeed change in gender does affect learning achievements in mathematics.

If you substitute a male teacher with a female teacher and vice versa the learners' achievement is affected negatively. It is for this reason that in my school we do not change teachers anyhowly. A teacher has to teach some class longitudinally, that is, from form one to form four. This is because we discovered that any change mid-way affects learner's performance and more so substituting one gender with another. This may be due to drastic change in social contact between the teacher and students. All in all it is better to hold constant gender when changing teachers, unless it is based on indiscipline or inability to produce results.

The students during focus group discussion were of the same view. They advanced the fact that mathematics is meant for men rather than women. Thus, one female student stated:

Mathematics require stamina, the teacher must be authoritative as many students fear mathematics and try to find lots of excuses for their poor performance. Where mathematics teachers are aggressive and assertive students perform better. Since most male teachers are characterized by these characteristics they outperform their fellow female mathematics teachers. Just check the results in this school and you will confirm what I am saying.

However some students were of contrary opinion, they stated that students' performance depends on talent rather than teachers' gender. In this regard one male student noted:

There are some cases where female mathematics teachers have done better than male teachers. Female teachers teach at a pace that allows students to grasp the mathematical concepts. Male mathematics teachers on the other hand are arrogant and always in a hurry. In fact at worst they assume a don't care attitude and only concentrate on students who prove to be good in mathematics.

This finding is consistent with that of Simmons (1980) who found that gender accounts for variation in students' academic achievement. Specifically, Simmons (1980) found a positive influence on student performance at higher levels with female teachers, but, a negative influence with the eighth grades. Since personality dynamics vary with gender, the gender disparity in teacher efficiency and productivity is bound to vary. This also applies to students' dynamics with regard to teacher gender. The findings of this study concur with those of Saha (1983) who found that male teachers were more successful with science teaching and related subjects while female teachers were more successful in language teaching and related subjects. Saha's (1983) findings mean that gender can have either a positive or negative correlation with student's achievement in mathematics. The finding of this study also concur with those of Thomas (2010) who found out that learning from a teacher of opposite gender has a detrimental effect on student academic progress and engagement in school. It was found to lower test scores for both boys and girls by approximately 4% of a standard deviation and has even larger effects on various measures on student engagement.

CONCLUSIONS

Mathematics teachers age influences students academic achievement, however it does not account much for the variation in students' performance in mathematics. Mathematics teachers gender accounts for a small variation in students' academic achievement in mathematics. Mathematics teachers gender negatively influence students' academic achievement in mathematics. Teacher's age and gender should be re-examined with a view of establishing the genesis of their minimal contribution to students' academic achievement in mathematics. This would enhance not only students academic achievement but also teachers level of job satisfaction. Job satisfaction is a crucial factor in enhancement of performance.

RECOMMENDATIONS

Mathematics teachers regardless of age should undergo capacity-building process to invigorate them to improve students' academic achievement.

Principals of schools should adopt a longitudinal approach in assignment of mathematics teachers to classes, so that genderwise mathematics teachers teach a full cycle for students, forms I to IV. Where changes are inevitable, the replacement be of the same gender.

REFERENCES

- Abagi O, Odipo G (1997). Efficiency of Primary Education in Kenya. Situational Analysis and Implications for Education Reform. Nairobi: Kenya Institute of Policy Analysis Public and Research. <http://www.scribd.com/doc/45911560/kenya-effedupri-5-6211>. retrieved on 13/05/2012 at 3.p.m.
- Adeyemi B (2010). Teacher Related Factors as Correlates of Pupils Achievement in Social Studies in South West Nigeria. *Electronic J. Res. Educ. Psycho.* Vol. 8(1): 313-332.
- Adeyemi TO (2008). The Influence of Class-Size on the Quality of Output in Secondary Schools in Ekiti State, Nigeria. *American-Eurasian Journal of Scientific Research* Vol. 3(1): 7-14.
- Agyemang D K (1993). *Sociology of Education for African Students*: Tema: Ghana Publishing Corporation.
- Akiri AA, Ugborugbo NM (2008). An Examination of Genders Influence on Teachers productivity in Secondary Schools. *J. Soc. Sci.*, Vol. 17(3): 185-191.
- Akpan AA (1987). Correlates of Mathematical Problem-Solving Ability among Secondary School Students. Unpublished PhD. Thesis University of Ibadan, Ibadan.
- Alderman M K (2008). *Motivation for Achievement: Possibilities for Teaching and Learning*. New York: Routledge.
- Ale SO (1989). School Mathematics in the 1990's some Major Problems for Developing Countries: *Int. J. Math. Sci. and Technol.* Vol. 20(5): 655-659.
- Alele-William G (1988). Keynote Address Delivered at the Silver Jubilee meeting of mathematics Association of Nigeria Sept. 1982. *Abacus* 18(1): 15-19.
- Alexander M, Simmons J (1980). Policy Issues in developing Countries in the 1980s. www.hku.hk/cerrc/3a.html retrieved on 28/05/2011 at 2.00pm.
- Almaz E, Junge B (1990). Female teachers and girls education: Implications for Selection, training and placement. Paper presented at the first Annual seminar. The Faculty of Education, Addis Ababa University.
- Aminu J (1990). Address by the Honourable Minister of Education. *Abacus* Vol. 20(1):22-29.
- Anderson LW (1991). Increasing teacher effectiveness. *Fundamental of Educational Planning*. No. 39 Paris: UNESCO – HEP.
- Ankomah Y, Koomson J, Bosu R, Odoro GK (2005). *Implementing Quality Education in Low Income Countries*. Institute for Educational Planning and Administration. University of Cape Coast Ghana.
- Antecol H (2011). Elementary School teachers have an impact on girls mathematics learning. <http://www.wordpress.com> site. Retrieved on 20/06/2011 at 4.00pm.
- Antecol H, Ozbeklik S (2013). Teacher Gender affects girls' mathematics performance. Retrieved on 27/08/2012 from <http://www.uft.org/new-briefs/teacher-gender-affects-girls-mathematics-performance> at 9.00pm.
- Antecol H, Eren O, Ozbeklik S (2012). The effect of teacher gender on student achievement in primary school. Vol. 32 Issue 17, 11. <http://www.connection.ebscohost.com/tag/ANTECOL>. Retrieved on 16/05/2011 at 4.00pm.
- Asikhia OA (2010). Students and Teachers' Perception of the Causes of Poor Academic Performance in Ogun State Secondary Schools in Nigeria: Implications for Counseling for National Development. *Eur. J. Social Sci.* Vol. 13 (2): 229-242.
- Ayot HO, Briggs H (1992). *Economics of Education*. Nairobi Educational Research and Publications.
- Ayot, HO Briggs H (2009). "Who Leaves? Teacher Attrition and Student Achievement." CALDER Working Paper 23. Washington, DC: The Urban Institute.

- Beeby C E (1966). *The Quality of Education in developing Countries*. Massachusetts: Harvard University press.
- Boyd DJ, Grossman P, Hamilton L, Sussana L, Wyckoff J (2008). "Teacher Preparation and Student Achievement." CALDER Working Paper 20. Washington, DC: The Urban Institute.
- Boyd DJ, Grossman P, Hamilton L, Sussana L, Wyckoff J (2009). *Who Leaves? Teacher Attrition and Student – Urban Institute*. www.urban.org/PDF/1001270_teacher_a..Retrieved_on_10/05/2011_at_12.00pm.
- Boyd DJ, Grossman P, Hamilton L, Sussana L, Wyckoff J (2007). "The Narrowing Gap in New York City Teacher Qualifications and Its Implications for Student Achievement in High-Poverty Schools." CALDER Working Paper 10. Washington, DC: The Urban Institute.
- Bridges EM (1986). *The incompetent Teacher*. The Stanford series on Education and Public policy. Philadelphia: Falmer press.
- Curriculum Goals. *American International Journal of Contemporary Research*, Vol. 2(2): 179–182.
- Caillods F (1989). *The prospects for Education Planning*. IIEP. Paris: UNESCO.
- Campbell JR, Beaudry JS (1998). Gender Gap lined to differential socialization for high achieving 11th grade mathematics. www.stjohns.edu. Retrieved on 1/1/2011 at 6pm.
- Clotfelter CT, Ladd HF, Vigdor JL (2007a). "How and Why Do Teacher Credentials Matter for Student Achievement?" CALDER Working Paper 2. Washington, DC: The Urban Institute.
- Clotfelter CT, Ladd HF, Vigdor JL (2007b). "Teacher Credentials and Student Achievement in High School: A Cross-Subject Analysis with Student Fixed Effects." CALDER Working Paper 11. Washington, DC: The Urban Institute.
- Clotfelter CT, Ladd HF, Vigdor JL, Wheeler J (2007). "High-Poverty Schools and the Distribution of Teachers and Principals." CALDER Working Paper 1. Washington, DC: The Urban Institute.
- Cole M, Walker S (1989). *Teaching and stress*. Philadelphia. Open University press.
- Coombs PH (1984). *The World's crisis in education. The view from the eighties*. New York: Oxford University press.
- Darling-Hammond L, Holtzman DJ, Su Jin Gatlin, Heilig JV (2005). "Does Teacher Preparation Matter?" *Education Policy Analysis Archives*, Vol.13 (42).
- Darling-Hammond L (1999). *Teacher Quality and Student Achievement: A review of state policy evidence*. www.centerforpubliceducation.org/ma. Retrieved on 21/01/2011 at 6pm.
- Driessen G (2007). The feminization of primary education: Effects of teachers 'sex on pupil achievement, attitudes and behaviour. *International Review of Education*, Vol. 53 (2): 183-203. <http://dx.doi.org/10.1007/s11159-007-9039-y>. Retrieved on 27/08/2012 at 3.00pm.
- Edwards A, Knight P (1974). *Effective Early Years Education*. Teaching Young Children. Buckingham: Open University Press.
- Ehrenberg RG, Brewer DJ (1994). Evaluating the Effect of Teacher Degree level on Educational performance www.nces.ed/gov/pubs97/97535i.pdf. Retrieved on 22/05/2011 at 10pm.
- Escardibul JO, Calero J (2007). Evaluacion de servicios educativos: el rendimiento en los centros publicos y privados medido en PISA – 2003. *Hacienda publica Espanola*, Vol. 183(4): 33-66.
- Eshiwani GS (1993). *Education in Kenya since independence*. Nairobi: Print pak.
- Eshiwani GS (1986). *A study of women's access to higher education in Kenya with a Special reference to Mathematics and Science Education*. Kenyatta University College.
- Etsy K, (2005, November 1st -2nd). *Causes of Low Academic Performance of Primary School Pupils in Theshamia Sub-Metro of Shama Ahanta East Metropolitan Assembly of Ghana*. Regional Conference of Education in West Africa, Dakar Senegal.
- Fajemidagba O (1999). Trends in Mathematics Education in Nigeria: Issues and Problems *Abacus* 2 (1) :19-27.
- FEMSA. (1997). *Teachers Attitude to the study of Science, mathematics and Technical Subjects by Girls secondary school*. Dissemination Report No.7. Academy Science Publishers.
- FEMSA. (1997). *Dissemination Report No. 10. Status of Girls' participation and performance in SMT subjects in secondary schools*. Nairobi Academy Science Publishers.
- Fraenkel J R, Wallen N E (2009). *How to design and Evaluate research in education*. New York: Mc Grown Hill Inc.
- Flynt SW, Morton RC (2009). The teacher shortage in America: Pressing concerns. *National Forum of teacher education journal* Vol. 19 No.3. www.nationalforum.com/electronics%25. Retrieved on 15/05/2010 at 6.15pm.
- Gay I R (1987). *Educational Research . Competencies for Analysis Application*. Florida International University.
- Georgewill JW (1980). Causes of poor achievement in WAEC Mathematical Examination in River State. *Secondary School Nigeria. International journal of Mathematical Education in Science and Technology* Vol. 21 (3): 379-385.
- Gleitman H (1981). *Psychology*. (2nd Edition). New York: W.W Norton and Company.
- Goe L (2007). "The Link between Teacher Quality and Student Outcomes: A Research Synthesis." Washington, D.C: National Comprehensive Center on Teacher Quality
- Goldhaber DD, Brewer DJ (1999). "Teacher Licensing and Student Achievement." *Better Teachers, Better Schools*. Washington, D.C. Thomas B. Fordham Institute.
- Goldhaber DD, Brewer DJ (1997). "Evaluating the Effect of Teacher Degree Level on Educational Performance." In W. Fowler, ed., *Developments in School Finance*, 1996 NCES 97–535. Washington, DC: U.S. Department of Education, National Center for Education Statistics.
- Goldhaber DD, Brewer J, Anderson JD (1997). "A Three-Way Error Component Analysis of Educational Productivity." *Education Economics*, Abingdon.
- Goldhaber DD, Gross B, Player D (2007). "Are Public Schools Really Losing Their Best? Assessing the Career Transitions of Teachers and Their Implications for the Quality of the Teacher Workforce." CALDER Working Paper 12. Washington, DC: The Urban Institute.
- Guthrie JW (1970). *A Survey of school Effectiveness. Do teachers make a Difference?* Washington DC: Department of Health, Education and Welfare.
- Haddad WD (1985). *Teacher training: A review of World Bank experience*. World Bank Discussion Paper, Washington DC: World Bank.
- Hanushek EA (1992). "The Trade-off between Child Quantity and Quality." *Journal of Political Economics*, Vol. 100 (1): 84-117.
- Hanushek EA, Steven GR (2010). "Generalizations about Using Value-Added Measures of Teacher Quality." *American Economic Review: Papers & Proceedings* Vol. 100 (2): 267-271.
- Hanushek EA (2011). The Economic value of higher teacher quality. *Economics of Education Review*, Vol. 30(3): 466-479. Retrieved from <http://dx.doi.org/10.1016/j.econedurev.2010.12.006> on 22/05/2011 at 10pm.
- Hanushek EA, John FK, Steven GR (1998). "Teachers, Schools, and Academic Achievement." New York: National Bureau of Economic Research Working Paper No. 6691.
- Harris DN (2011). *Value-Added Measures in Education: What Every Educator Needs to Know*. Cambridge: Harvard Education Press.
- Harris DN, Sass TR (2007). "Teacher Training, Teacher Quality and Student Achievement." CALDER Working Paper 3. Washington, DC: The Urban Institute.
- Harris DN, Sass TR (2009). "The Effects of NBPTS-Certified Teachers on Student Achievement." *Journal of Policy Analysis and Management* Vol. 28 (1): 55-80.
- Harris DN, Sass TR (2011). "Teacher Training, Teacher Quality, and Student Achievement." *J. Public Econ*. Vol. 95 (7):798-812.
- Heck RH (2009). *Teacher Effectiveness and Student Achievement. Investigating a Multi-level Cross-Classified Model*. *Journal of Education Administration*, Vol. 7(22): 227-249.
- Heckman JJ (1979). Sample selection bias as a specification error. *Econometrica*, Vol. 47(1):153-161.
- Hill HC, Brian R, Deborah LB (2005). "Effects of Teachers' Mathematical Knowledge for Teaching on Student Achievement." *Am. Educ. Res. J.* Vol. 42(2) : 371-406.
- Hopkins D (1997). *Powerful learning, Powerful teaching and Powerful school*. Retrieved from link.springer.com/article/10.1023%2010/08/2010_at_2.00pm.

- Husen J, Saha LJ, Noonan R (1978). Teacher training and Student Achievement in Less developed countries. World Bank staff working paper No.310. Washington D.C. USA. World Bank.
- Ingersoll R, Smith T (2003). The wrong solution to the teacher shortage. *Educational leadership* Vol.60 (5):30-33 (Eric document reproduction service No. EJ 66112). Retrieved on 05/11/2010.
- Jones M (1997). Trained and untrained secondary school teachers in Barbados. Is there a difference in classroom performance? *Educational Research* Vol. 39(2): 1175-1184.
- Kapambwe WM (2010). The Implementation of School Based Continuous Assessment in Zambia. *Education Research and Reviews*, Vol. 5(3): 99-107.
- Kathuri NJ, Pals DA (1993). Introduction to Educational Research. Njoro: Educational media. Egerton University.
- Kerlinger FN (1985). Foundation of Behavioural Research. Rinehart Holt and Winston.
- Kimani NG, Kara MA, Njagi WL (2013). Teacher Factors Influencing Students' Academic Achievement in Secondary Schools in Nyandarua County, Kenya. *International Journal of Education and Research* Vol. 1 No. 3 March 2013.
- Kimball MA (1989). Differences in Mathematics Achievement between males and Females retrieved from <http://www.ideas.repec.org/e/pki97.html>. on 01/01/2011 at 6.00pm.
- Kirabo JC, Elias B (2009). "Teaching Students and Teaching Each Other: The Importance of Peer Learning for Teachers." *American Economic Journal: Applied Economics* Vol. 1(4): 85-108.
- Kirabo JC (2010). "Match Quality, Worker Productivity, and Worker Mobility: Direct Evidence from Teachers." New York: National Bureau of Economic Research Working Paper No. 15990.
- Koedel C, Betts JR (2007). "Re-Examining the Role of Teacher Quality in the Educational Production Function." Unpublished Working Paper, University of Missouri.
- Koedel Cory, Julian R Betts (2009). "Does Student Sorting Invalidate Value-Added Models of Teacher Effectiveness? An Extended Analysis of the Rothstein Critique." Unpublished working paper, University of Missouri.
- Kothari CR (2004). Research Methodology. Methods and Techniques: New Delhi. New Age International Publishers.
- Kyriacou C (1975). School teachers. A sociological study. Chicago: University of Chicago press.
- Li Q (1999). Teachers' beliefs and gender differences in mathematics: A Review. *Educational Research* Vol. 41(1): 63-76. Retrieved from <http://dx.doi.org/10.1080/0013188990410106> on 04/07/2010 at 2.00pm.
- Ladd H F (2008). "Value-Added Modeling of Teacher Credentials: Policy Implications." Paper presented at the second annual CALDER research conference, "The Ins and Outs of Value-Added Measures in Education: What Research Says," Washington, D.C., November 21. Retrieved from http://www.caldercenter.org/upload/sunny_Ladd_presentation.pdf. on 23/03/2011 at 3.00pm.
- Leedy PD, Ormond JE (2005). Practical research Planning and Design. New Jersey: Pearson Merrill. Prentice Hall.
- Lewin KM, Wasanga P, Wanderi E, Somerset A (2011). Participation and Performance in Education in Sub-Saharan Africa with Special Reference to Kenya: Improving Policy and Practice. Create pathways to Access. Research Monography No. 74: University of Sussex.
- Lindy B (2011). "The Impact of Teacher Collective Bargaining Laws on Student Achievement: Evidence from a New Mexico Natural Experiment." 120 Yale Law Journal 11-30.
- Makewa NL (2012). Evaluation of Teacher Factors Associated with Mathematics Performance in Primary Schools in Kenya. *Int. J. Sci. Res. Educ.* Vol. 5(1): 47-62.
- Maundu JC (1986). A student's achievement in science and mathematics: A case study of extra provincial and Harambee secondary schools in Kenya. Montreal: Unpublished PhD Thesis McGill University, Montreal.
- Ministry of Education (2005). Sessional Paper No.1 of 2005: A Policy Framework for Education Training and Research. Government printer, Nairobi.
- Monk DH, King JA (1994). Multilevel teacher resource effects in pupil. www.ets.org/..position_paper.pdf. Retrieved on 28/05/2011 at 3.00pm.
- Mugenda OM, Mugenda AG (2003). Research Methods, Quantitative and Qualitative Approaches. Nairobi: Acts Press.
- Mullis IVS, Martin MO, Fierros EG, Goldberg AL, Stemler SE (2000). Gender differences in achievement. Retrieved from http://www.tmssandpirls.bc.edu/isc/publication_on_15/08/2012.
- Muola JM (2010). A study of the relationship between academic achievement motivation and home environment among standard eight pupils selected from urban and rural areas of Machakos Sub county Kenya. *Educational Research and Reviews* Vol. 5 (5): 213-217 <http://www.academicjournals.org/ERR2>. on 10/10/2011 at 5.00pm.
- Ndirangu P (2007). An investigation of the relationship between test anxiety and academic performance in secondary schools in Nyeri Sub county, Kenya. Unpublished Master's Thesis, Egerton University.
- Ngecu JM (1985). An Investigation of some factors pertaining to 'O' Level mathematics performance in selected Kenya secondary schools from 1965-1983. Kenyatta University. Unpublished P.G.D.E Thesis.
- Nherera C (1999). Capacity building in Education Research in Southern Africa. Empirical insights into Qualitative research. Harare. Published by Human Resources Research Centre. University of Zimbabwe.
- Norris I (1993). Evaluation, Economics and Performance Indicators. In J. Ellist: Reconstruction teacher education. London: Falmer Press.
- Nye B, Spyros K, Larry H (2004). "How Large Are Teacher Effects?" *Educational Evaluation and Policy Analysis*, Vol. 26(3).
- Oakes J (1990). Opportunities, achievement and choice: Women and minority students in science and mathematics. Retrieved from www.nsf.gov/..c3.html on 06/05/2010.
- Ochieng JA (2012). Relationship between School factors and Girls Academic Achievement in Mathematics in KCSE examinations in Kiambu East Sub county, Kenya. Master of Education Thesis in Planning and Economics of Education, Maseno University.
- Odhiambo G (2005). Elusive search for Quality Education. The Case of Quality Assurance and Teacher Accountability. *Int. J. Educ. Manage.* Vol. 22(5): 417-431.
- Odogwu HN (1994). Primary School Teachers and the Teaching of Time Concept in School' *Education Today* Vol. 7(21): 24-30.
- Ohuche RO (1978). Recent attempts at Mathematics Curriculum Renewal in English Speaking West Africa *Abacus Today* Vol. 12 (1):17-26.
- Ojwang' JA (1995). A study of quality education in private secondary schools in Siaya and Kisumu Sub county s. Unpublished M.Phil Thesis, Moi University, Kenya.
- Onsomu EN, Kosembei G, Ngware MW (2005). Impact of Gender and Socio-Economic Factors on Learning Achievements in Primary Education in Kenya: Empirical Evidence, Kenya Institute for Public Policy Research and Analysis KIPPRA Discussion Paper No. 56. <http://www.kippira.org/docs/DP56.pdf> 15-6-2011. <http://www.sacmeq.org/downloads/05/conf/onsumu.pdf>. Retrieved on 27/08/2011 at 5.00pm.
- Oreidin AO, Oloyede DO (2007). Supervision and Quality of Teaching Personnel Effects on Student Academic Performance. *Educ. Res. and Rev.* Vol. 2 (3): 032-035.
- Oshibodu BM (1988). Mathematics at Primary level'. *Abacus* Vol. 18(1):13-20.
- Oshibodu BM (1984). An investigation of Teacher's Instrumental problems in mathematics. *Benin J. Educ. Studies*. Vol. 11(3): 43-54.
- Otieno K (1997). The relationship of role overload, locus of control, years of teaching Experience and gender to perceive burnout among secondary school teachers in Nairobi. Unpublished M.ED Thesis, Kenyatta University. Variables and Students' Academic Perform.
- Parmaj S (1979). Education and jobs. New Delhi: Leeladevi.
- Perry PD (1995). Quality of teacher work life and classroom practices in Botswana *International journal of education development*, Vol. 15(20): 115-125.
- Psacharopoulos G, Woodhall M (1985). Education and development: and analysis of Development choices. Washington D.C: Oxford University Press.

- Rebers' D (2011). Why Education and Experience matter. "No Teachers in island. Retrieved from <http://www.nea.org/home/43100> on 27/08/2013 at 10.00pm.
- Reche GN, Bundi TK, Riungu JN, Mbugua ZK (2012). Factors Contributing To Poor Performance In Kenya Certificate of Primary Education in Public Day Primary Schools In Mwimbi Division, Maara Sub County, Kenya. *Int. J. Humanities and Social Sci.* Vol. 2 No. 5; March 2012.
- Republic of Kenya (1998). Draft paper on national policy on gender equity for Sustainable development. Nairobi: Jomo Kenyatta Foundation.
- Republic of Kenya (1998). Master Plan of Education and Training 1997-2010. Nairobi: JomoKenyatta Foundation.
- Republic of Kenya (2010). Economic Survey. Nairobi: Government Printer.
- Rivkin SG, Hanushek EA, Kain JF (2005). Teachers, Schools, and Academic Achievement. *Econometrica* Vol. 73 (2): 417-458. <http://www.utdallas.edu/research/tsp/pulications.htm>. (May 12, 2012).
- Rockoff J (2004). "The Impact of Individual Teachers on Student Achievement: Evidence from Panel Data." *American Economic Review* Vol. 94(2): 247-252.
- Rockoff JE, Brian AJ, Thomas JK, Staiger DO (2008). "Can You Recognize an Effective Teacher When You Recruit One?" New York: National Bureau of Economic Research Working Paper No. 14485.
- Rothstein J (2009). "Student Sorting and Bias in Value-Added Estimation: Selection on Observables and Un observables." *Education Finance and Policy* Vol. 4(4): 537-571.
- Rothstein J (2010). "Teacher Quality in Educational Production: Tracking, Decay, and Student Achievement." *The Quarterly Journal of Economics*, Vol. 125(1): 175-211.
- Rowan Chiang BF, Miller RJ (1997). Where We Stand on Teacher Quality. www.ets.org/position_paper.pdf retrieved on 28/04/2011 at 5.00pm.
- Saha LJ (1983). School Structure and Teacher Effects on Academic Achievement. *Comparative Education Review*. Vol. 27(1): 69-88.
- Sass TR (2007). "The Determinants of Student Achievement: Different Estimates for Different Measures." Paper presented at the first annual CALDER research conference, Washington, D.C., October 4.
- Sass TR, Jane Hannaway Zeyu Xu, Figlio DN, Li Feng (2010). "Value Added of Teachers in High-Poverty Schools and Lower-Poverty Schools." CALDER Working Paper 52. Washington, DC: The Urban Institute.
- She HC (2000). The interplay of a biology teacher's beliefs, teaching practices and gender-based student-teacher classroom interaction. *Educational Research*, Vol. 42(1): 100-111. Retrieved from <http://dx.doi.org/10.1080/001318800363953> on 18/07/2012 at 8.00pm.
- Sifuna DN (1989). The Quality of primary schools and pupils Achievement in Kenya *Journal of Education* Vol. 4 (2): 90 – 125.
- Simmons J (1980). *The Education Dilemma. Policy issues for Developing countries in the 1980s*: Washington D.C Pergamon Press.
- Simkin J (2006). Reactions to Research by Nottingham University and London University's Institute of Education on teacher age and student results. Retrieved from <http://www.educationforum.ipbhost.com/index.php?showtopic=8063> on 27/08/2011 at 11.00pm.
- Sparks S (2013). Segregating boys and Girls improves education. Retrieved from <http://www.edweek.org/ew/articles/2013/01/16/17gender.h32.html> on 30/08/201 at 8.00pm.
- Sparks S (2013). Education Week. Journal Article for Girls, teachers' gender Matters. retrieved from www.npr.org/news/education on 30th June 2013 at 12.00pm.
- Tella A (1998). An Investigation into poor performance and Attitude of Secondary school students towards mathematics in Oyo State, Nigeria. Unpublished B.Ed. Project University of Ibadan, Ibadan.
- Thias H, Carnoy M (1972). *Cost- Benefit analysis in Education. A case study of Kenya*. Baltimore: John Hopkins.
- Thomas KJ, Staiger DO (2008). "Estimating Teacher Impacts on Student Achievement: An Experimental Evaluation." New York: National Bureau of Economic Research. http://ies.ed.gov/ncee/edlabs/regions/midwest/pdf/REL_2007030.Pp df. Retrieved on 18/05/2011 at 2.00pm.
- Thomas KJ, Rockoff JE, Staiger DO (2006). "Evaluating Teacher Effectiveness: The what, How, and why of Educator Evaluation" New York: National Bureau of Economic Research. www.nber.org/authors/douglas_staiger. Retrieved on 22/06/2011 at 1pm.
- Thomas SD (2005). "A Teacher like me: Documents Race, Ethnicity or Gender Matter? *American Economic Review*, American economic Association. Vol.95(2):158-165 Retrieved on 27/06/2012 at 3.00pm.
- Thomas SD (2006). The Effect of a teacher's Gender Using the National Education Longitudinal Survey. educationnext.org/the-why-chromosome.
- Thomas SD (2010). Identifying Effective Classroom practices using student Achievement Data. NBER Working papers 15803, National Bureau of Economic Research Incorporation. Retrieved from www.serve.org/VAM_3_resources.pdf on 27th August, 2011.
- Thomas SD (2010). Teachers and the Gender gaps in Students achievement. New York: National Bureau of Economic Research. www.nber.org/papers/w11660. Retrieved on 27/06/2013 at 3.00pm.
- Tsion D, Wanna L (1994). Educational waste. The case of female students in selected and secondary schools in Ethiopia. Addis Ababa: UNESCO.
- Tsion D (1990). A critical look into Women's Education. Paper presented at a seminar on The Research Report; Gender analysis of primary school textbooks. Addis Ababa: German Foundation for Internal development.
- Twoli NW (1986). Sex difference in science achievement among secondary schools Students in Kenya. Unpublished PhD Thesis, Kenyatta University, Kenya.
- UNESCO (1998). *Education for All, Status and Trends (1998). Wasted Opportunities: When Schools Fail. Repetition and Dropout in Primary schools*. Retrieved from <http://unesdoc.unesco.org/images/0011/001139/113958E.pdf> 23/11/2011. on 20/05/11 at 4pm.
- UNESCO. (1989). *Education and Employment Booklet No. 3*. IIEP. Paris: UNESCO.
- UNESCO. (1994). *Learning for the 21st Century Africa. Possible ways of Improvement in the next decade*. Paris: UNESCO.
- UNESCO. (1996). *Gender Inequalities in Education in the Southern Africa region. An Analysis on intervention strategies*. Paris: UNESCO.
- Willms JD (2000, April). Standards of care: Investments to improve children's educational outcomes in Latin America. Paper presented at the "Year 2000 Conference of Early Childhood Development" sponsored by the World Bank, Washington, D.C.
- World Bank (2004). *Strengthening the Foundation of Education and Training in Kenya: Opportunities and Challenges in Primary and General Secondary Education. Report*. Retrieved from. <http://www.siteresources.worldbank.org/INTAFRR>. 22/06 2012 at 2.00pm.
- Wright SP, Horn SP, Sanders WL (1997). Teacher and classroom context effects of student's achievement: Implications for teacher evaluation. *Journal of Personnel Evaluation In Education*. Vol. 11: 57-67.
- Zietman A, Mbano N, Spoule S, Makowe M (1997). *Girls in Math's and Science Classroom: A Study in Malawi and South Africa*. Nairobi Academy Science Publishers.
- Zhu Z (2007). Gender differences in mathematical problem solving patterns: A review of Literature. *International Education Journal* Vol. 8(2): 187-2003.