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Combined Influence of Qualification, Experience and Gender Distribution on Quality of Teaching Mathematics

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Abstract:

Teachers of Mathematics in Kenya have attended in-service program called Strengthening of Mathematics and Science in Secondary Education (SMASSE) INSET for the purpose of enhancing their skills and improving quality of teaching. However, this has not been translated into improved performance as expected. However there has been persistent poor performance in Mathematics in secondary schools in Kisumu County as revealed by the Kenya Certificate of secondary Examination results for the period 2012-2019 during which the mean score dropped from 34.00 to 20.45. This may deny students admission to scientific and technological professions at university due to low performance in the subject. The purpose of this study was to establish combined influence of teacher qualification, experience and gender distribution on quality of teaching mathematics. The study was conducted in public secondary schools in Kisumu County and employed descriptive and correlational designs in which the dependent variable was quality of teaching mathematics and independent variables were teachers' qualification, experience and gender distribution. The study sample was 70 teachers representing 30% of the population of teachers found in the category of sub-county schools. Data collection instruments was Lesson Observation Guide (LOG). Quantitative data was analyzed using descriptive and inferential statistics. Pearson Product Moment Correlation Coefficient was used to determine the strength and direction of the relationship after which regression analysis was run to show the combined influence of teacher qualification and experience on quality of teaching mathematics. The findings established that 56 teachers have a qualification of B.Ed./PGDE, 48 teachers have experience of over 6 years, majority of teachers (47) are male, quality of teaching mathematics was rated as average. Teacher experience was the most significant variable with a correlation coefficient of .261 at the .05 level (2-tailed) while gender was insignificant at a p-value of .452. When regression analysis was run to show relationship between qualification, experience with quality of teaching mathematics, ANOVA produced a p-value of .039 which implies that the two variables are significant. Based on the results it is advisable that teachers with Master's degree to work hand in hand with the other teachers and those with experience of over 10 years to be assigned to be head of mathematics in their department to advise those with difficulties.

Keywords: Teachers' qualification, Teaching experience, quality of teaching mathematics

1. Introduction

For many decades, studies have been conducted to investigate the teaching and learning of Mathematics (Darling-Hammond, 2000). A growing body of research shows that differences in students' achievement are attributed to teachers' and their teaching methods (Ingvarson *et al.* 2004). Teachers' background influences teaching and learning in classrooms (Adeyemo, 2005). It has been established by Olaleye (2011) that there is a relationship between teachers' background and students' performance. Teachers' background is seen as a strong determinant of students' performance in secondary schools (Adu & Olatundun, 2007). Availability of qualified teachers determines the performance of students in schools (Akinsolu, 2010). In contrast a study done by Kosgei (2013) reveals that there is no difference in performance between teachers who have degree or diploma suggesting that teacher professional qualification does not result to increased students' academic achievement. Similarly, Kimani *et al.* (2013) is in support of Kosgei (2013) findings hence concluded that teachers' age, gender, both professional qualification and experience did not have significant effect on academic achievement in secondary schools in Nyandarua County.

Mathematics education has had issues including gender differences and this has been tackled by various researchers (Masanga, 2004; Amelink, 2009; Halls, 2012; Kiptumet *et al.*, 2013 and OCDE, 2014). Most of the studies were focusing on gender issues in mathematics, or gender disparity in mathematics. A study by Antecolet *et al.* (2012), titled 'The effect of Teacher Gender on students Achievement in primary schools' found that female students who were taught by a

female teacher without a strong mathematics background had low scores in mathematics at the end of academic year. In contrast, they did not find any effect of having a female teacher on male students' scores in mathematics. Few studies have focused on female teachers' quality of teaching mathematics in elementary schools (Dee, 2006; Zogheib *et al.*, 2015). Dee, (2010) findings of gender interactions within classrooms have centered on controversial claims that teachers consistently privilege boys over girls. However, the literature on student teacher interactions (Dee, 2006) has also focused on whether student outcomes differ when a student and teacher share the same gender. Assignment to a same-gender teacher could be educationally relevant for a number of reasons such as it could influence student engagement or behavior through role-model effects and stereotype threat. Furthermore, same-gender teacher may also communicate different expectations to the boys and girls in their classrooms (Dee, 2006). An analysis of upper-secondary education students in 69 schools in Stockholm (Sweden), found no evidence to show that teacher gender improves student outcomes (Holmlund & Sund, 2008). One way of improving the quality of education is through quality of teaching. Examining the quality of teaching will improve understanding of what happens in the classrooms that may explain differences in performance among schools. Some researchers (Hattie, 2009; Morrison *et al.* 2005), assert that teacher's pedagogy and interaction with students in classrooms can determine how much is learned. One of the most important school-based factors influencing students' achievement are teachers (Rice, 2003), though there is no consensus on how best to measure quality of teaching. Understanding what quality mathematics pedagogy looks like has not been finalized (Walshaw & Antony, 2008). Teachers need to have a good command of mathematical knowledge to enable them to use a variety of teaching strategies at their disposal when faced with different situations in classroom (Darling-Hammond & Bransford, 2005). Teachers' mathematical knowledge can better be assessed when they are observed in class. Since the study proposed to establish quality of teaching mathematics there was need for the researcher to observe teachers in class to establish their interaction with students in the process of teaching learning.

Mathematics is one of the core subjects in secondary school curriculum in Kenya. Performance in the subject is crucial for students' admission to scientific and technological professions. Despite the implementation of the in-service program and the importance attached to mathematics by society there has been low performance in secondary school Mathematics in Kisumu County as provided in Table 1.

Year	Kisumu
2012	34.00
2013	29.42
2014	27.33
2015	25.50
2016	23.75
2017	24.33
2018	20.68
2019	20.45
Average	25.68

Table 1: KCSE analyzed Results in Mathematics for Kisumu County for the years 2012-2019

Source: County Director of Education – Kisumu

Performance of Mathematics in Kisumu County shows that it is below average as compared with an average mean of 50 percent. At the same time the performance shows a negative deviation. These results are indication that INSET attended has not been matched with improved academic performance of students. It is evident from the results that quality of teaching mathematics is lacking which determines high performance in mathematics hence quality grades in the subject. Most of the studies conducted (Akinsolu, 2010; UNESCO, 2009; Holmlund, 2008; Adeyemo, 2005; Ingvarson *et al.* 2004), have looked at either teacher background variables or perception of teachers on in-service program but have not reached a conclusion on which variable is the most significant which influences quality teaching.

Therefore, the specific objectives of the study were to:

- Establish teachers' qualification, experience, gender distribution and quality of teaching mathematics.
- Determine the combined influence of teachers' qualification, experience, and gender distribution on quality of teaching mathematics.

2. Research Methodology

2.1. Venue and Sample

The study was carried out in Kisumu County, Kenya. The study population comprised of 234 mathematics teachers who have attended SMASSE in-service program. Out of the population 70 (30%) teachers were selected by proportionate simple random sampling technique which was used to select teachers from sub-county schools located within the 7 sub-counties of Kisumu County.

2.2. Data Collection Instruments

One tool was used. This was called Lesson Observation Guide (LOG) which was used to provide data on teachers' qualification, experience and gender distribution. It was also used to measure quality of teaching mathematics in

secondary schools as teachers were handling various topics in mathematics in different forms (classes). The LOG is attached as Appendix A.

2.3. Validity and Reliability of the Instruments

The face and content validity of the LOG was established after experts in the field of study in Maseno University evaluated the relevance of each item in relation to objectives. Mulusa (1990) notes that validity is the extent to which a measuring instrument measures what it is supposed to measure and reliability is when the instrument measures what it is supposed to measure consistently. The suggestions made by the experts were used to revise the instruments before collecting data. The results of LOG were established through test retest and application of Pearson Product Moment Correlation Coefficient reliability at 0.78. Kathuri and Pals, (1993) recommends for a 0.7 and above threshold. The pilot study involved 16 teachers (not part of the study sample), representing 10% of the total number of SMASSE in-service trained teachers found within sub-county schools in Kisumu County.

2.4. Data Collection Procedures

A research authorization letter was obtained from School of Graduate Studies (SGS), Maseno University before embarking on the study. After which the proposal was presented to Maseno University Ethics Review Committee (MUERC) for approval. On obtaining a letter of approval from (MUERC), the researcher sought for a research permit from the National Commission for Science, Technology and Innovation (NACOSTI) in Nairobi before embarking on data collection process as dictated by ethics. In order to observe teachers in class and administer the questionnaire effectively, a personal visit to all the sampled schools was done by the researcher who explained the purpose of the research to the school principals and mathematics teachers and agreed on schedule of time. The 70 teachers were observed in classroom using the students' they teach regularly.

2.5. Data Analysis Procedure

Data from Lesson Observation Guide (LOG) provided information which was first serialized, coded then keyed in Statistical Package for Social Sciences (SPSS) version 21, computer programme to provide analyzed results. Data on quality of teaching mathematics was worked out as percentage score for individual teacher depending on the scores assigned for each construct to be measured from the LOG.

The LOG was used again to provide information on teacher qualification, teacher experience and teacher gender. Teacher qualification was given different percentages during analysis depending on the category. Diploma in Education- 25%; B.Ed./PGDE-50%; M.Ed- 75%; PhD in Mathematics-100%. From the same questionnaire, teachers professional experience was put in categories and also measured in percentages as follows: below 3years (novice) - 25%; 3-5years (little experience) 50%; 6-10 years (medium experience)-75% and over 10years (experienced)- 100%. Gender being a dichotomous variable was either male or female. Male was denoted using zero (0) while female was denoted using one (1). During data analysis each construct within the LOG was scrutinized to find out which areas teachers were weak. After that percentage score for individual teacher was done depending on the scores assigned for each construct to be measured from the LOG. The mean for teachers performance was worked out and rated on the researcher made scale as follows: Very high quality- (70% and above), High quality-(60% - 69%), Average quality-(50% -59%), Low quality- (40% -49%) and Very low quality- (0 -39%).This grading scale was adapted from University of Nairobi grading system for undergraduates. The results of LOG are given in Appendix B.

Quantitative data analysis involved the use of descriptive and inferential statistics. Descriptive statistics involved use of arithmetic mean, standard deviation, frequencies and percentages. These were presented in form of tables. Inferential statistics involved correlation analysis, and ANOVA (one-tailed) to determine gender distribution on quality of teaching mathematics. To determine combined influence of qualification, experience and gender distribution, correlation analysis was used to predict the strength of linear relationship between independent variables which are teacher qualification, experience and gender distribution and dependent variable which is quality of teaching mathematics. ANOVA (one-tailed) was used to analyze influence of gender on quality of teaching mathematics. Inferential statistics was used to draw conclusions and generalization for Kisumu County using information collected from 70 teachers teaching in sub county public schools.

3. Results and Discussion

3.1. Teachers' Qualification, Experience, Gender Distribution and Quality of Teaching Mathematics

Qualification	Frequency	Percentage
Diploma	6	8.57
B.Ed. /PGDE	56	80
Masters in Mathematics	8	11.43
PhD in Mathematics	0	0
Total	70	100

Table 2: Teachers' Qualification in Secondary Schools in Kisumu County

Table 2: indicates that majority of the teachers who were observed in class 56(80.00%) were B.Ed./PGDE out of a total number of 70. Very few teachers 6(8.57%) were Diploma holders and 8(11.43%) were Masters Holders in mathematics who were observed. None of the teachers had PhD in mathematics.

Categories of Experience in years	Frequency	Percentage
0-below 3years	5	7.14
3- 5 years	17	24.29
6-10 years	26	37.14
Over 10 years	22	31.43
Total	70	100.00

Table 3: Teachers' Experience in the Teaching of Mathematics

From Table 3, a large number of teachers 26(37.14%) teachers had experiences of between 6 -10 years and was followed by 22(31.43%) teachers who had experiences of over 10 years. A few teachers 17(24.29%) had served in the teaching profession between 3 -5 years. Very few teachers 5(7.14%) are the ones who had served between 0 -3 years. Analysis shows that most teachers in Kisumu County are more experienced while a few of them are less experienced.

Gender	Frequency	Percentage
Male	47	67.14
Female	23	32.86
Total	70	100.00

Table 4: Teacher Gender

It is evident from Table 3 that majority of teachers 47(67.14%) were male whereas female teachers were 23 (32.86%), these were the ones included in the study. Based on the findings there are many male teachers than female teachers teaching mathematics in secondary schools in Kisumu Count.

Gender	Qualification			
	Diploma	B.Ed./PGDE	Masters	PhD
Male	3	38	6	0
Female	3	18	2	0

Table 5: Teachers' Gender and Their Qualifications

Table 5 indicates that the male teachers' with their academic qualification is as follows: 3 diploma holders, 38 B.Ed./PGDE, 6 Masters holders and none has a PhD in Mathematics education .For female teachers their qualification is as follows: 3 diploma holders like the male teachers, 18 B.Ed./PGDE, 2 Masters holders and like their male counterparts none of them has a PhD in Mathematics education.

Gender	Experience			
	Below 3yrs	3- 5yrs	6- 10yrs	Over 10yrs
Male	5	12	14	16
Female	0	5	12	6

Table 6: Teachers' Gender and Their Teaching Experiences

Table 6 indicates that male teachers in this study with teaching experience of below 3 years were 5, experience between 3-5 years were 12, while experience between 6-10 years were 14 and experience over 10 years were 16. For female teachers, there was no female teacher with experience below 3 years. Those with teaching experience between 3-5 years were 5, between 6-10 years were 12 and those with over 10 years' experience were 6.

3.2. Quality of Teaching Mathematics

The results to quality of teaching mathematics is shown in Table 7.

Score	Frequency	Rating scale
70 and above	4	Very high quality
60 - 69	21	High quality
50 -59	44	Average quality
40 -49	1	Low quality
0 -39	0	Very low quality

Table 7: Results to Quality of Teaching Mathematics

Teachers who scored between 70% and above were 4. Those who scored between 60% -69% were 21. While teachers who scored between 50%-59% were 44 teachers. And finally, teachers who scored between 40% -49% was only one teacher. None of the teachers scored between 0 -39%. When descriptive statistics for the 70 teachers was worked out, it produced a minimum score of 48% and a maximum score of 75% with a mean of 59.03 and a standard deviation of 5.843 as shown in Table 8.

M in	Max	Mean	SD
48	75	59.03	5.843

Table 8: Results of Quality of Teaching Mathematics as Provided by Descriptive Statistics N =70

Using the rating scale, the mean of 59.03 was rated as average. This result mean that teachers in Kisumu county can improve their quality of teaching if they can embrace the pedagogy of the in-service program and implement it in classroom situation.

The strength between dependent variable that is quality of teaching mathematics and independent variables which were teacher experience and teacher qualification whose result was obtained from LOG was analyzed together to produce correlation coefficients as shown in Table 9.

3.3. Combined Influence of Teachers' Qualification, Experience and Gender Distribution on Quality of Teaching Mathematics

	Y₁	X₂	X₃
Y₁	1.000		
X₂	.261*	1.000	
X₃	.244*	.285*	1.000

Table 9: Correlation Coefficient between Quality of Teaching Mathematics and Teacher's Qualification and Experience

**Correlation Is Significant at the .05 Level (2 Tailed)*

Key Y₁ = Quality Of Teaching Mathematics, X₂ =Teacher Experience, X₃ =Teacher Qualification

Referring to Table 9, Variable X₂ had a correlation coefficient of 0.261 with quality of teaching mathematics. Variable X₃ had a correlation of 0.244. All the two variables were significantly associated with quality of teaching mathematics at 0.05 level (2-tailed).

The correlation coefficients for teacher experience was the most important variable which would determine teachers' quality of teaching mathematics. This is in line with a study done by Obumanu (2011) who found that lack of qualified teachers' contributed to consistent poor performance in mathematics, science and technology. A large number 26 out of 70 teachers in Kisumu county had experience of between 6 -10 years, while another number of teachers 22 had experience of over 10 years. This finding is in line with studies done by Adeyemi (2008); Yara and Wanjohi (2011) and Temitope and Olabanji (2015) who found that teachers experience influence students' academic performance. In other words, schools having more teachers with over 10 years teaching experience are in a position to achieve better results from students. If teachers could use their teaching experience in teaching mathematics in secondary schools there would be quality results from students hence majority being admitted direct to the university (Betts et al.2003; Rivkin et al. 2005).

Contrary to this finding, Martin et al. (2000) and Wenglinsky (2002) found that the number of years in teaching is not associated with student's achievement. Those teachers who make students perform well and are not experienced could be as a result of effective training they got when they were in college. Other studies done on teachers' professional qualification and teaching experience found that they were not significantly associated with student's achievement (Kimani et al.2013; Mbugua et al.2012). The contrary results show that researchers have not reached a consensus on which variable is the most significant and can influence quality of teaching mathematics.

When regression analysis was run to show the relationship between quality of teaching mathematics with qualification and teacher experience. The results were summarized in Table 10

Model	SS	df	MS	F	Sig
Regression	218.233	2	109.116	3.416	.039
Residual	2140.067	67	31.941		
Total	2358.300	69			

Table 10: ANOVA Results on Relationship between Qualities of Teaching Mathematics with Teacher Qualification and Experience

Table 10 shows that from ANOVA test the p-value is .039 which is less than .05 indicating that at 95% level of significance, both teacher qualification and experience are significant. This implies that the two variables contribute to quality of teaching mathematics.

3.4. Relationship between Teacher Gender on Quality of Teaching Mathematics

This study was to find out the relationship between teacher gender on quality of teaching mathematics. The sampled 70 teachers were observed in class as they were teaching mathematics and recorded in LOG. Analysis of Variance test was run to determine whether gender has an effect on quality of teaching mathematics and the results are summarized in Table 11.

Source	SS	df	MS	F	p-value
Model	19.774	1	19.774	.572	.452
Residual	2349.298	68	34.548		
Total	2369.072	69	54.322		

Table 11: Anova of Gender Effect on Quality of Teaching Mathematics

Table 11 shows that from ANOVA test the p-value is 0.452 which is greater than 0.05 indicating that at 95% level of significance, quality of teaching mathematics for male and female teachers did not differ significantly therefore gender does not affect quality of teaching mathematics.

In this study the quality of teaching mathematics for male and female teachers respectively was at a mean score of 59.10 and 59.74. The slight difference in mean score on teacher gender on quality teaching of mathematics implied that gender did not affect teachers' quality of teaching mathematics. Mathematics is a science subject and some gender-based science researchers have reported that both the 'feminists empiricists' and the Liberal feminists critic' seem to agree is that, female in principles will produce exactly the same scientific knowledge as males provided that sufficient rigour is under taken in scientific inquiry (Howes, 2002, Sinnes, 2005). In line with the current study, Escardibut et al. (2013) on their study on teacher gender and students' performance found that interaction term was not statistically significant meaning that teacher gender effect is the same for both male and female students though the study was done in primary schools.

Contrary to findings of the current study, Sparks (2013) study found that female elementary school mathematics teachers gave boost to female pupils and did not affect male student's performance. Antecol et al. (2011) also found that female students who were assigned to a female teacher without a strong mathematics background suffered from lower mathematics test scores at the end of academic year. These contrary findings are found in elementary schools but gender effect is not the same in secondary schools as was established by the current study on quality of teaching mathematics during lesson observation which found out that female teachers performed better than male teachers.

4. Conclusion

On teacher qualification, majority of teachers in Kisumu County are holders of Bachelor of Education degree /Postgraduate Diploma in Education (B/Ed./PGDE). On teacher experience, majority of teachers in secondary schools in Kisumu County have teaching experiences of between 6 – 10 years in the teaching of mathematics. On teacher gender distribution, majority of teachers teaching mathematics in secondary schools are male teachers.

The study sought to establish combined influence of qualification, experience and gender distribution. When the strength between dependent variable, that is quality of teaching mathematics and independent variables which are teacher qualification and teacher experience was measured using correlation analysis, teacher experience had a correlation coefficient of .261 while teacher qualification had a correlation coefficient of .244 which were significant at 0.05 level (2 tailed). When ANOVA test was run to establish the relationship between gender and quality of teaching mathematics, the difference was insignificant given that the p-value was .452. When regression analysis was to show relationship between teacher qualification, and teacher experience with quality of teaching mathematics ANOVA produced a p-value of 0.039. This means that the two variables are significant. In conclusion, amongst the independent variables experience influences quality of teaching mathematics most.

5. Implication

Quality of teaching mathematics in secondary schools in Kisumu County was rated as average. Considering that most of the teachers are qualified with B/Ed./PGDE degree and given that most of the teachers have experience of over 6 years in the teaching of mathematics and have attended in-service program in mathematics, they are in a position of improving students' performance in the subject.

6. Recommendations

- Teachers with a qualification of Master's degree to work hand in hand with teachers having qualification of diploma and B/Ed./PGDE in handling topics they have difficulties in teaching.
- Teachers with experience of over 10 years should not be transferred unless with proper reasons since they contribute to quality of teaching mathematics
- Since teacher gender does not influence quality of teaching mathematics, any teacher regardless of gender should handle any class in secondary schools including examination class.
- Teachers with experience of over 10 years in teaching mathematics should be assigned as head of subject (Mathematics) in schools to oversee and advise teachers with difficulties in handling certain topics hence improve quality of teaching mathematics.

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Appendix

Lesson Observation Guide (LOG)

Section I: General Information

Sub-County: ... Form Time:.....
 Topic:..... Sub-Topic
 Date Teachers' Background: a). Gender.....
 b). Qualification..... c). Teaching experience.....
 d). No. of students.....

Section 2: Rating of Teachers' Quality of Teaching Mathematics

Criterion of Assessment	Performance	
	Marks Distribution	
	Mark range	Score
1.PREPARATION (T/Marks 12)		
a) Scheme of work: Availability of scheme of work & relevance from current syllabus	0-2	
b) ASEI-Lesson PlanFormat (T/ Marks 10)		
i) Rationale for the lesson: needs of subject area, student, society	0 -3	
ii) Objectives (SMART): any three features of lesson objectives	0- 3	
iii) Prerequisite Knowledge/ skills: at least two skills	0-2	
iv) References: use of at least two different textbooks	0-2	
2.PRESENTATION (T/Marks 80)		
a) Introduction: Use of at least 5 learners' experiences and link with current lesson.	1-5	
b) Lesson development		
i). Logical presentation of content: depends on flow of information	1-5	
ii). Relevance of content to class level: Use of varied recommended text book.	1-5	
iii) Adequacy of content to lesson time: use of time appropriately	1-5	
iv) Strategies and methods appropriate to content (at most 5	1-5	
v) Use of teaching skills: motivation, reinforcement, questioning, stimulus variation, verbal exposition	1-5	
vi) Mastery of content	1-5	
c) Communication (T/Marks 6)		
i) Verbal communication: fluency, audibility and use of appropriate language.	1-3	
ii) Nonverbal communication: appropriate use of gestures, eye contact and body movement	1-3	
d) Use of ASEI-PDSI Approach (T/Marks 6)		
i) Use of activities: manipulative, intellectual, discussions	0 -3	
ii) Learning is student-centered: learners, not involved, partly involved, fully involved	0 -3	
e) Use of resource materials (T/Marks 15)		
i) Attractiveness of resource materials: not attractive, attractive, very attractive	1-3	
ii) Originality and creativity of resource materials: improvised, modified, new use	1-6	
iii) Appropriateness of resource material: moderately suitable, suitable, very suitable	1-3	
iv) Innovativeness of resource material: not original, partly original, original,	1-3	
f) Classroom organization & Management (T/Marks 20)		
i) Control of learners in class: not noisy, no rudeness, no disobedience	1-3	
ii) Knowledge of learners by names	1-2	
iii) Learner participation: individual, group, whole class	1-5	
iv) Use of groups in doing work (same ability, mixed ability, social grouping, age grouping, sex grouping)	0 -5	
v) Provision for individual differences (physically, temperamentally, intellectually)	0 -3	
vi) Teacher / Learner rapport (friendly, not friendly)	0 -2	
g) Conclusion (T/Marks 6)		
i) Closure skills: review, questions	0 -2	
ii) Concluding activities, evaluation	0 -2	
iii). Assignment	0 -2	
Total Marks: 100%		

Table 12: Rating of Teachers' Quality of Teaching Mathematics