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Teacher qualification and students' academic performance in science mathematics and technology subjects in Kenya

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Performance in Science, Mathematics and Technology (SMT) subjects among students in Kitui County, Kenya has perpetually been unsatisfactory. The aim of this study was to look into the extent to which teacher qualification influenced students' academic performance in SMT subjects. The study applied ex-post-facto survey research design. Random sampling was used to select eight secondary schools in Kitui County. It included eight head teachers, 40 teachers of SMT subjects and 600 candidates who sat for the Kenya Certificate of Secondary Education (KCSE) in the year 2012. Data were collected using questionnaire and document analysis. It was analyzed using descriptive and inferential statistical tools. The study found that there was no significant difference in means between teacher qualification and students' performance in SMT subjects at form four level $F(1,37)=0.017$, $P>0.05$. The findings of the study further revealed that majority of the teachers of SMT subjects were trained graduates, most of them had attended in-service or refresher courses which resulted in slight improvement in the students' performance in SMT subjects. Recommendation is made for organization of more regular in-service and refresher training of SMT subject teachers to enable them embrace and conform to the emerging technologies in pedagogy.

Key words: Teacher qualification, students, academic achievement, Science, Mathematics and Technology, form four level –Kitui County, Kenya.

INTRODUCTION

Issues of access to quality Education in Kenya have been raised in the Sessional Paper No.1 of 2005 which underscores the government‟s commitment to achieving the "Education for All (EFA)" goals by 2015 and the objectives of Millenium Development Goals (MDGs) by 2030 (MOEST, 2005). Although Kenya has taken measures such as making primary and secondary education free in 2003 and 2008 respectively in an effort to achieve the objectives of EFA and MDGs, recent studies indicate that most developing countries including Kenya are far from achieving them (Murunga et al., 2013).

Many teachers in sub- Saharan Africa, including Kenya, are not able to apply modern information technologies in teaching due to computer illiteracy hence they mostly rely on lecture method of teaching

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(Eboutouet al., 1998; Haambokoma, 2002). Failure to expose learners to hands- on experiences has resulted in their low academic achievement in the SMT subjects namely Mathematics, Biology, Chemistry, Physics and Agriculture.

A study by Adeogun (2001) in Nigeria found that the quality of any education system depends on the quality of teachers. Review of related literature indicates that the most important school-based determining factor of students achievement is the teacher quality (Rockoff, 2004; Rivkin et al., 2005; Aaronson et al., 2007; Harris and Sass, 2008).

Therefore, there is need to assess the characteristics of the secondary school teachers in terms of qualification, experience and teaching methodology in order to ensure quality of education given to the youths. The teachers of SMT should be in-serviced where gaps are identified to enable them to cope with the requirements of the dynamic school curriculum (Murunga et al., 2013).

According to Usman (2012), a qualified teacher can be defined as one who holds a teaching certificate and/or licensed by the state, owns at least a bachelor’s degree from a four-year institution and well qualified in his/her area of specialization. Moreover, Usman quotes the Pakistan Ministry of Education officials who described a qualified teacher as one who possesses knowledge of: the subject matter, human growth and development, ethical values, instructional planning and strategies, assessment, learning environment, communication and advocacy, collaboration and partnership, continuous professional development, code of conduct and skillful use of information communication technologies.

The educators, government, parents and society in general have constantly been interested in the academic achievement of students (Lydiah and Nasongo, 2009; Yusuf and Adigun, 2010). According to Adeyemi (2010), teachers play an important role in determining the students" academic achievement. Researchers have never reached a consensus on the specific teacher factors that influence students" academic achievement (Rivkin et al., 2005). Some studies found that teachers’ experience and educational qualifications significantly influenced students’ academic achievement (Njeru and Orodho, 2003; Ankomah et al., 2005; Ugbe and Agim, 2009; Asikhia, 2010; Yala and Wanjohi, 2011; Olaleye, 2011). When conducting research on factors contributing to under achievement of Zambian female students in O-Level Physics examinations, Maguswi (2011) found that lack of qualified teachers of Physics had a significant contribution. Moreover, a study done by Adaramola and Obomanu (2011) in Nigeria found that lack of qualified teachers led to consistent poor performance of students in SMT subjects.

Studies done by other scholars found that teachers" professional qualifications and teaching experience are not significantly related to students’ academic achievement (Rivkin et al., 2005; Buddin and Zamarro, 2009; Mbugua et al., 2012; Kimani et al., 2013; Musau et al., 2013). Furthermore, a study done by Feng and Sass (2010) found that in-service professional development for teachers has little effect on their ability to increase the achievement gains of students. Aaronson et al. (2007) found little or no difference in teacher effectiveness among Chicago Public School teachers with different college majors.

METHODOLOGY

The study employed ex-post-facto survey research design to determine the degree of relationship between the independent variable (teacher qualification) and the dependent variable (students’ academic performance) in SMT subjects at form four level. The advantage of using ex-post-facto research design was that it provided the precise way of stating the extent to which teacher qualification was related to the students’ academic performance. The purpose of this study was to look into the extent to which teacher qualification was related to the students’ academic performance in SMT subjects. The specific research question that guided the study was: *To what extent does teacher qualification influence students’ academic performance in SMT subjects at form four level?* To address this question, teacher qualification was categorized into Diploma certificate holders, trained graduate teachers, untrained graduate teachers and post-graduate degree holders. The four categories of teacher qualification were compared with the students’ average mean scores in SMT subjects for all the teachers who taught the candidates in the sampled schools.

Simple random sampling technique was used to select eight out of 40 secondary schools that presented candidates in SMT subjects for the Kenya Certificate of Secondary Education (K.C.S.E.) in the year 2012 in Kitui Central District, Kitui County of Eastern Kenya. The researcher preferred simple random sampling because it gave equal chance for all secondary schools in the district to be selected. Eight head teachers consisting of two men and six women were purposively selected. It was expected that each sample school had five teachers of SMT subjects who taught the candidates. Therefore, 40 SMT teachers consisting of 27 men and 13 women were purposively included in the study. From the sampled schools, the researcher randomly sampled the results of 600 (20%) students out of 3000 candidates who sat for KCSE examinations in SMT subjects during the year under study. The results were used as a measure of the learners" performance. For schools with more than one form four streams, only one stream was selected randomly. The researcher targeted only the candidates because they had been through all the levels (forms one to four), had covered all areas in the SMT subjects syllabi and had sat for KCSE exams.

The information was collected using questionnaires and document analysis. Two categories of questionnaire were used; a head teachers" questionnaire and a SMT teachers’ questionnaire. The questionnaires had both open and closed-ended items. Document analysis was carried out from published KCSE results in SMT subjects obtained from Kitui Central District Education Office, to establish and confirm responses given in the questionnaire. The SMT teachers’ questionnaire was designed and administered to the SMT teachers of the eight sampled secondary schools in the District. It was used to collect information that made it

Table 1. Performance in the SMT subjects (in percentages).

Grade	Subjects				
	Mathematics	**Chemistry**	**Biology**	**Physics**	**Agriculture**
A	2.78	1.24	1.75	3.60	1.641
A-	4.19	1.27	1.47	5.56	2. 205
B+	3.47	2.49	4.18	6.39	4.605
B	5.48	2.63	7.57	7.17	3.460
B-	8.81	5.95	8.37	8.93	5.125
C+	6.70	11.42	13.77	3.33	7.054
C	5.39	10.02	14.60	3.85	9.615
C-	6.14	11.35	13.39	11.49	11.107
D+	12.12	13.43	16.14	14.27	12.949
D	14.73	23.95	10.74	9.11	10.051
D-	19.91	14. 52	4.30	14.79	19.590
E	10.28	1. 74	2.96	11.51	12.175
X	0.00	0.00	0.76	0.00	0.422
Total	100.00	100.00	100.00	100.00	100.00

Source: Published 2012 KCSE Results in SMT from Kitui Central District Education Office.

possible to understand the relationship between teacher qualification and students' academic performance in SMT subjects. Head teachers' questionnaire covered a wide range of issues concerning details of the teaching staff. The SMT teachers' questionnaire was designed to evoke responses on the general academic and professional background of the SMT teachers and the teachers' assessment of the students' performance in SMT subjects at KCSE in 2012. Most questions in the questionnaire were objective. There were few structural questions to extract more information on performance in SMT subjects. The questionnaires were pre-tested on a population sample similar to the target population to determine their validity and effectiveness.

A test-retest method was used to ensure reliability of the instruments. Data were analyzed by using frequencies, percentages and mean scores. Correlation and regression analysis were used with the level of significance set at 0.01 (2 tailed) and 0.05 (2 tailed). Statistical Package for Social Sciences (SPSS) was used to generate the Analysis of Variance (ANOVA) which was used to test the significance of the variation in the students' performance in SMT subjects (dependent variable) that could be attributed to the regression of teacher qualification (independent variable).

RESULTS

The findings of the study showed that from the selected sample, data were received from 100% of the head teachers comprising 25% men and 75% women. However the researcher got 97.5 % response rate from the SMT teachers consisting of 72.5% male teachers, while the female teachers represented 27.5%. The findings of the study indicated that most of the candidates scored low grades of D plus and below in SMT subjects while only a few scored quality grades of B plain and above (Table 1).

The results further revealed that majority of the SMT teachers (51.7%) were trained graduates, 13.8% were holders of Post Graduate Degree, 27.6% were Diploma / S1 graduates while only (6.9%) were untrained graduate teachers (Figure 1).

Table 2 indicates that the mean score of students taught by Post- Graduates was much higher than that of students taught by Untrained Graduates. However, there was no much difference between the mean scores of students taught by Post- Graduates, Trained Graduates and Diploma/SI SMT teachers.

Table 3 indicates that students taught by Trained Graduates performed significantly better than those taught by Untrained Graduates, while the differences in performance for those taught by Trained Graduates and Diploma/ SI, and Trained Graduates and Post-Graduates were not statistically significant.

Teaching subjects taught by SMT teachers in 2012

The findings of the study revealed that Mathematics was taught by most SMT teachers as represented by 26.4%, followed by Chemistry as represented by 22.6% of the participants. Biology was taught by 20.8% of the SMT teachers while Physics and Agriculture were taught by 11.3% and 18.9% of the teachers respectively.

Career progression was determined using the following criteria: number of years served as an assistant teacher, number of years served as heads of department, number of years served as deputy head teachers, number of years teachers of SMT served as untrained teachers and number of years the teachers

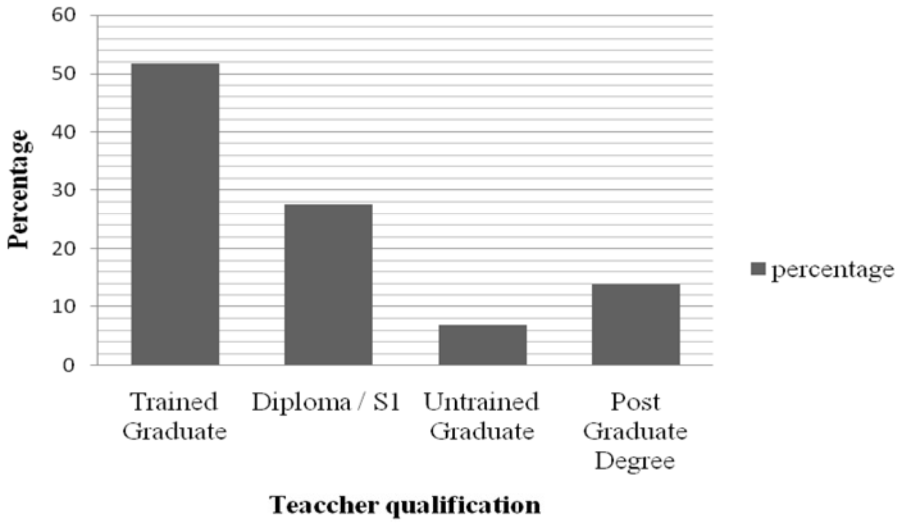

Figure 1. Highest professional qualifications of the SMT teachers (in percentages). Source: Data obtained from questionnaires administered to SMT teachers in the study sample.

Table 2. Students' performance in SMT subjects compared with teacher qualification.

Teacher qualification	No of teachers	Percentage	Mean score
Post Graduate Diploma	6	15.38	7.10
Trained graduate	18	46.15	6.04
Diploma/SI	11	28.21	4.71
Untrained graduate	4	10.26	2.29
Total	39	100	5.56

Table 3. Pair wise comparisons.

(I) Highest professional qualification of the respondent	(J) Highest professional qualification of the respondent	Mean Difference (I-J)	Significance
Trained Graduate	Diploma/S1	1.329	0.073
	Untrained Graduate	3.750*	0.005
	Post Graduate Diploma	-1.055	0.259
	Trained Graduate	-1.329	0.073
Diploma/S1	Untrained Graduate	2.421	0.071
	Post Graduate Diploma	-2.384*	0.024
	Trained Graduate	-3.750*	0.005
Untrained Graduate	Diploma/S1	-2.421	0.071
	Post Graduate Diploma	-4.805*	0.002
	Trained Graduate	1.055	0.259
Post Graduate Diploma	Diploma/S1	2.384*	0.024
	Untrained Graduate	4.805*	0.002

Source: Data obtained from questionnaires administered to the teachers of SMT in the study sample.*The mean difference is significant at the 0.05 level.

Table 4. Effect of in-service courses in SMT subjects on students' performance.

Impact	Frequency	Percentage
Slight Improvement	27	69.23
A drop in performance	2	5.13
Great Improvement	8	20.51
Not applicable	2	5.13
Total	39	100.0

Source: Data obtained from questionnaires administered to SMT teachers in the study sample.

Table 5. Correlation between teacher qualification and students' performance in SMT subjects.

	Mean grade	Teacher qualification
Pearson Correlation	1	-.025
Sig.(2-tailed)		.897
N	39	39

had been in their current stations. The findings of the study showed that 34.5% of the SMT teachers had served for less than five years as assistant teachers, 31.0% had served for between 6 and 10 years, 17.2% had served for between 11 and 15 years, while 13.8% served between 16 and 20 years. Only 3.4% of the participants had served for over 20 years.

The study revealed that 50% of the participants served for less than five years as heads of departments, 40% served between 6 and 10 years, while 10% served for between 11 and 15 years as heads of departments. Only one of the participants had served as a deputy head teacher for a period of between 6 and 10 years. The study further revealed that 80% of the participants had served as untrained teachers for less than five years and only 20% had served for a period between 6 and 10 years as untrained teachers.

Most teachers of SMT subjects (48.3%) had stayed in their current stations for less than five years followed by 20.7% who had stayed for a period of between 6 and 10 years and another 20.7% who had stayed for between 11 and 15 years. Those who had stayed for a period lasting between 16 and 20 years accounted for 10.3%.

Teachers' attendance to in-service courses in SMT subjects between 2008 and 2012

The findings of the study revealed that most of the SMT teachers (69.23%) had attended in- service or refresher courses over three times, 25.64% of the teachers attended between 1 and 2 times while only 5.13% had not attended any in- service course within the stipulated period.

Table 4 shows that most the teachers of SMT subjects (69.23%) stated that the refresher courses resulted in slight improvement in students' performance in SMT subjects. Only 20.51% of the participants stated that the courses resulted in great improvement while 5.13 indicated that the effect of the courses was a drop in students' performance. Another 5.13 % of the teachers stated that they did not attend any course in SMT subjects hence they did not give any response on the effect of the courses on SMT subjects.

Data obtained from the study indicated that there was a very weak negative correlation between the teacher qualification and students' performance in SMT subjects at form four level at 0.01 level of significance (2-tailed) with a variation of 2.5% (table 5).

Table 6 indicates that there was no significant difference in means between teacher qualification and students' performance in SMT subjects at form four level in Kitui County $F(1, 37) = 0.017; p>0.05$. This meant that the qualification of teachers did not significantly contribute to students' academic performance in SMT subjects at form four level in Kitui County.

The coefficient of determination (R square) in Table 6 implied that only 0.1% of the variation in students' performance in SMT subjects was associated with the regression of teacher qualification. Therefore, the results suggested that the students' poor performance in SMT subjects was caused by other factors other than teacher qualification.

DISCUSSION

The purpose of this study was to look into the extent to which teacher qualification was related to the students' academic performance in SMT subjects. The study found that teacher qualification and experience did not significantly contribute to low academic achievement among students in the SMT subjects. The findings of the study showed that majority of the teachers of SMT (51.7%) were trained graduates while 13.8 % possessed post graduate degrees. The study further revealed that the teachers taught SMT subjects in which they were trained. This implied that the teachers were well qualified hence they were expected to help the students produce good results in SMT subjects. Although the findings of the study showed that a great percentage (96.6%) of the SMT teachers had attended in-service or refresher courses the findings revealed that the impact of the courses had just a slight improvement on students' performance in SMT subjects. This confirmed that the teachers' professional qualifications did not have a significant influence on students' academic performance in SMT subjects (Table 4).

Table 6. Analysis of variance table.

Source of Variation	Sum of squares	DF	Mean square	F	Significance
Regression	0.066	1	0.066	0.017	0.897
Residue	105.775	37	3.918		
Total	105.841	38			

Table 7. Model summary.

R	R Square	Adjusted R square	Std Error of the Estimate
0.025	0.001	-0.036	1.979289

Correlation analysis showed that there was no significant relationship between teacher qualification and students' performance in SMT subjects at form four level in Kitui County F (1,37) =0.017, P>0.05. This finding agreed with the findings of studies done by other scholars (Betts et al., 2003; Rivkin et al., 2005; Aaronson et al., 2007; Buddin and Zamarro, 2009; Feng and Sass, 2010) who established that teachers' educational level and teaching experience are not statistically significant in explaining students' academic performance.

The coefficient of determination (R square) indicated that only 0.1 % of the variation in students' performance in SMT subjects was associated with the regression of teacher qualification. Therefore, 99.9% variations in SMT Performance were explained by other factors other than teacher qualification. This finding agrees with the findings of the study done by Kimani et al. (2013) who contended that factors that contribute significantly to students' academic performance in secondary schools include teachers' job group, teaching workload, administration, marking and revision of students' assignments and provision of individualized attention to weak students, but not teacher qualification.

Pair wise comparisons showed that there was a least significant mean difference between the different categories of teacher qualification and students' performance in SMT subjects. The finding concurred with the views of Rivkin et al. (2005) who did not find any convincing evidence that a master's degree raises teachers' effectiveness at secondary school level. The finding further concurred with Kimani et al. (2013) who asserted that additional professional qualifications beyond the first degree do not necessarily lead to improved competence of teaching at the secondary school level.

However, the findings of this study were contrary to the findings of studies done by other scholars who found that teachers' qualification and experience play a crucial role in determining the students' academic achievement (Njeru and Orodho, 2003; Ankomah et al., 2005; Asikhia, 2010; Yala and Wanjohi, 2011; Olaleye, 2011; Maguswi, 2011).

In terms of experience, information obtained from the study revealed that a greater percentage of the participants (51.7%) had stayed in their current stations of work for a period of more than five years. This finding suggests that the teachers of SMT subjects had a long experience in handling these SMT subjects hence the poor performance among students could not be attributed to the teachers' experience.

Regarding teachers' career progression over the years, the study established that majority of the teachers (65.5%) had served as assistant teachers for more than five years, 50% of the participants had served as heads of department for a period of between six and fifteen years while only one participant had served as a deputy head teacher for a period of between six and ten years. This finding suggests lack of career growth among SMT subject teachers which could have negatively affected the teachers' commitment towards teaching leading to students' low performance in SMT subjects. The finding echoes the study done by Kimani et al. (2013) in Nyandarua County who opined that teachers in Job Group L might have been registering lower mean scores compared to those in Job Groups K, M and N due to lack of career growth.

Conclusion

The findings of the study suggest that teacher qualification and experience does not significantly influence the students' academic performance in SMT subjects. Thus, the student performance may be improved by other factors such as career growth of the teachers which may lead to teachers' satisfaction resulting in being more committed to the teaching job. Teachers of SMT should be encouraged to attend more in-service or refresher courses to acquire skills which will enable them to embrace and conform to the emerging technologies in pedagogy in order to improve students' academic performance in SMT subjects.

RECOMMENDATIONS

1. The government should use meritocracy to promote long-serving teachers of SMT subjects so as to motivate them to be more committed to their work in order to help students improve their performance in SMT subjects.
2. The Ministry of Education should organize for more regular in-service and refresher courses for teachers of SMT subjects in order to acquaint them with the emerging technologies in instruction.
3. The government and Non- Governmental Organizations (NGOs) should provide Computers and internet infrastructure to schools at subsidized costs to enable teachers of SMT use information communication technologies for instructional delivery. This will help to improve students' performance in SMT subjects.

Recommendation for further research

Further research should be conducted to establish other factors which determine students' academic performance in SMT subjects since the findings of this study revealed that teacher qualification does not significantly determine students' performance.

Conflict of Interests

The authors have not declared any conflict of interests.

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