Performance Determinants of Kenya Certificate of Secondary Education (KCSE) in Mathematics of Secondary Schools in Nyamaiya Division, Kenya

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Abstract

The study found the performance determinants of students' performance in mathematics Kenya certificate of secondary education (KCSE) in Nyamaiya division of Kenya. The study employed descriptive survey design of the ex-post facto type with a total student population of 151 and 12 teachers. Four validated research instrument developed for the study were Mathematics Achievement Test (MAT) (r = 0.67), Students Questionnaire (SQ) (r = 0.75), Teachers Questionnaire (TQ) (r = 0.60 and Head teachers Questionnaire (HQ) (r = 0.70). Three research questions were answered. The data was analyzed using multiple regression analysis. There was a positive correlation among the six independent variables and the dependent measure – mathematics performance(R= 0.238; $F_{(6,151)}$=1.53843; $p<0.05$). The six variables accounted for 45.6% of the total variance in the independent measure (R^2 = 0.564). Teachers' experience (B=0.972, t=2.080; $p<0.05$), teachers' qualification (B=0.182, t=2.390; $p<0.05$), teachers/students' attitude (B=0.215, t= 2.821; $p<0.05$) and school category (B=0.064, t=0.352; $p<0.05$) could be used to predict students' academic performance in mathematics. It is therefore recommended that adequate attention should paid to these variables that can predict students' performance by the government and other stakeholders of education in Kenya.

Keywords: Performance determinants, Students performance, Secondary school mathematics, Kenya certificate of education

1. Introduction

Schools are social organizations with defined rules and procedures that determine the degree of activities and behavior of each member (Mbithi, 1974). Schools are in a sense factories in which raw children are to shaped and finished to meet the various demands of life. The specifications for manufacturing come from the policies laid down by the government. The system of education in Kenya is highly selective even in primary level, while access to schooling is limited. Advancement is solely based on students' performance in examinations. Examinations are used above all to identify and define those adjudged suitable to proceed to the next stage of education.

Success in educational institution is measured by the performance of students in external examinations. Examinations are used among others to measure the level of candidates' achievements and clarify the candidates' level of education, training and employment. They also provide the basis for evaluating the curriculum both at local and national level. Examinations can when used properly, improve the quality of teaching and learning and because of this reason when Kenya Certificate of Secondary Education (KCSE) results are released the feedback is sent to schools through a report indicating not only how students have performed but also what teachers and students should do to improve on future examinations.

The government through its policy documents has outlined several strategies to be adopted in order to enhance the field of science and technology. Key among them is the strengthening of technical capabilities through training of personnel and provision of equipments. Through partnership with development partners, the

government has embraced several initiatives such as the strengthening of mathematics and science subjects in secondary schools (SMASSE) project. This is a joint venture between Japanese government through the Japanese international Development Agency (JICA). It was established in 1998 to improve the capacity of young Kenyans in science and mathematics through In-training (INSET) centre for mathematics and Technology Education in Africa (CEMASTEA News letter, 2008).

In South Africa, Mji and Makgato (2006) observed that many schools do not offer mathematics and those that offer do not have adequate facilities for effective teaching and learning. Pupil-textbook ratio has been high especially in rural and urban slums where students do not perform to expectations. A survey conducted by Education Insight (2005) in Kenya revealed that inadequate learning facilities are a common feature in many schools. Yeya (2002) agreed with the above studies that schools with adequate facilities perform better in National Examination especially in core subject such as mathematics. He however asserted that facilities alone cannot count while other factors should be taken into consideration.

Recent studies carried out to determine the relationship between teacher experience and students' performance in mathematics found that teacher experience and competence were the prime predictors of students' performance in all subject in secondary schools in Ondo state Nigeria (Adeyemi, 2008). Jones (1997) observed that teachers are a key input and a force to reckon with in school. Sweeney (1998) made similar observation about schools in Mississippi, USA that scored better in mathematics when taught by teacher with more years of teaching, considering the common saying that experience is the best teacher.

Studies carried out to determine the relationship between teacher quality and student performance in mathematics revealed that there exists a strong relationship. For instance, Kaur (2004) asserts that in Singapore the problem of teaching mathematics needed qualified teachers/educators and recommended that the Ministry of Education equip mathematics teachers with the necessary skills through in-service courses. Teacher's shortage in South Africa has been a stumbling block to performance of mathematics (Mji and Makgato, 2006). Schools are characterized by huge enrollments leading to overcrowding. Odhiambo (2006) pointed out that there is a shortage of mathematics teachers in Kenya but in urban schools the problem is not as pronounced. He further revealed that the student/teacher ratio in many secondary schools in Kenya is 40:1 and proposed that for effective teaching of mathematics, it should be 25:1 hence the need to employ more mathematics teachers.

Mji and Makgato (2006) observed that non-completion of the syllabus is a major determinant to students' performance in mathematics. The principal of a leading school in Kenya noted that students fail in mathematics because they do not cover their syllabus and are therefore unprepared for examinations (Education Insight, 2005). In the same vein, Yeya (2002) observed that students in boarding schools cover the syllabus in time and are exposed to more remedial exercises because they are ever in school as compared to day schools which are characterized by absenteeism of both teachers and students which lead to non-completion of the syllabus in a given year. This view was also supported by Maundu (1986).

In Jamaica, poor attitude to mathematics as a subject is evident among many students and some view the subjects as being of little or no use to them outside schools as noted by the Ministry of Education Youth and Culture (2003). In South Africa, Mji and Makgato (2006) pointed out that few students take mathematics and those who do so do not perform well because they are not motivated which ultimately may lead to mass failures. Yeya (2002) had similar views that many teachers, students and parents have a negative attitude towards the teaching and learning of mathematics. Chiriswa (2003) agreed with the above view and recommended that mathematics teachers and students be given incentives to raise their morale for better grades in mathematics.

A number of studies have approached the question of mathematics performance from the school category status, type and location view. Many studies dating as far back as the eighties have maintained that single-sex schools are solution to poor female performance (KNEC, 2006). Survey carried out by USAID education program strategy revision (2003) revealed that rural schools in South Africa have poor facilities and teachers lack rudimentary training in key subjects for example mathematics. Odhiambo (2006) observed that urban schools are not badly hit by teacher shortages as many prefer teaching in urban areas. Yeya (2002) noted that students with impressive marks avoid day schools in favor of boarding schools. He further observed that students in boarding schools perform better in national examinations.

Available literature in Nigeria has not been able to identify a single direction of difference in performance in mathematics between male and female students (Kadiri, 2004). Although most studies have found boys performing better (Fennema and Sherman, 1978) a few others saw girls out-performing boys while others established no significant difference. Fennema and Sherman (1978) asserted that mathematics is a subject of male domain. This view was supported by Alao and Adeleke (2000) that girls recorded low performance than

boys in mathematical activities in Nigeria secondary schools. Girls were found to exhibit more mathrophobies than boys. Manger (1996) in Norway had the same view, but observed that the difference was small. In New Zealand, Blith, Forbes, Clerk and Robinson (1994) reported a consistent difference in performance in favor of boys while Armstrong (1981) noted that sex difference existed at high level and not at the junior level in mathematics achievements.

In Kenya, mathematics is a core subject in school curriculum for both primary and secondary schools and yet the performance is very dismal. While poor performance is applicable to most parts of the country, some areas have a record of perennial mass failures in mathematics. This is especially so in Nyamira District. Even though studies have been carried out to determine the reasons for general poor performance in the district, mathematics has not been singled out as a subject that students do perform poorly. This study therefore seeks to find the determinants of poor performance in mathematics in Nyamira District of Kenya.

2. Research Questions

The following research questions are answered in this study.

1. What is the composite effect of performance determinants (teachers' experience, teachers' qualification, teachers' and students' attitude, school category, school facilities and students' gender) on students' performance in mathematics?
2. What are the relative effects of performance determinants (teachers' experience, teachers' qualification, teachers' and students' attitude, school category, school facilities and students' gender) on students' performance in mathematics?
3. Which of the performance determinants (teachers' experience, teachers' qualification, teachers' and students' attitude, school category, school facilities and students' gender) will predict students' performance in mathematics?

3. Methodology

3.1 Research Design

The research design used for this study is the descriptive survey design of the ex-post facto type. This is because the researchers had no direct control over the independent variables as they have manifested already.

3.2 Population and Sample procedure

The target population for this study consists of head-teachers, mathematics teachers and the students of all the thirteen public secondary schools in Nyamaiya Division. For this study, a sample of six secondary schools was purposively selected from the thirteen schools. Schools were selected across categories and type which includes day, boarding, single-sex and co-educational. Intact classes were selected. Simple random sampling technique was used to select the teachers and students for the study. A total of 12 teachers and 151 students were selected for the study.

3.3 Instruments

The research instruments designed by the researchers include Mathematics Achievement Test (MAT) Students Questionnaire (SQ), Teachers Questionnaire (TQ) and Head teachers Questionnaire (HQ). Each of the questionnaires will have three parts. Part A contains profile of the respondents and Part B contains respondents' views on the determinants of poor performance in mathematics. The MAT was validated using Kuder Richardson 20 (KR-20) with the calculated value of 0.067 while the other instruments (SQ, TQ and HQ) were validated using Cronbach alpha coefficients. The calculated values were 0.75, 0.60 and 0.70 respectively.

3.4 Data Analysis

Multiple regression analysis was used to analyze the data.

4. Results

4.1 Research question one

What is the composite effect of performance determinants (teachers' experience, teachers' qualification, teachers' and students' attitude, school category, school facilities and students' gender) on students' performance in mathematics? This question is answered using tables 1 and 2.

From Table 1, it could be observed that there is positive multiple correlation (R =0.238) among the six independent variables and the dependent measure. These variables are teachers' experience, teachers' qualification, teachers' and students' attitude, school category, school facilities and students' gender and

students' performance in mathematics, which is the dependent variable. This implies that the factors are relevant towards the determination of the dependent measure. Also the adjusted R^2 value of 0.456 revealed that the six variables accounted for 45.6% of the total variance in the dependent measure (academic performance in mathematics). The remaining 54.4% could be due to errors and factors that are not considered in this study.

The result in the analysis of variance in Table 2 showed that the F-ratio of the regression analysis is significant ($F_{(6,151)} = 4.478$; $p<0.05$). This shows that the R value is not due to chance.

4.2 Research Question Two

What are the relative effects of performance determinants (teachers' experience, teachers' qualification, teachers' and students' attitude, school category, school facilities and students' gender) on students' performance in mathematics? Table 3 was used in answering this question.

From Table 3 out of the six variables, school category made the greatest contribution ($\beta = 0.192$). This implied that the type of school (whether single sex or mixed or public or private) has effect on the academic performance of students in mathematics. The type of school students go to greatly influenced their performance in mathematics because some of the schools have qualified mathematics teachers and good learning environment. Next was teachers/students' attitude ($\beta = 0.181$). The implication of this contribution to the academic performance of students in mathematics is that the attitudes of the teachers and students to mathematics have a very great influence in the academic performance of the students in mathematics. The positive attitude of the students to mathematics and their teachers has an impact on the good performance of the students in mathematics. Teachers' qualification ($\beta = 0.152$) also made contribution to the academic performance of the students in mathematics. This means that the qualification of the teachers affect the performance of the students in mathematics. The more qualified the teachers are the better the students' performance in mathematics. The fourth in the rank of contribution is teachers' experience ($\beta = 0.118$). This implies that the more experienced the teachers are, the better they are able to teach better and hence the students perform better. The fifth and sixth contributions in order of decreasing magnitude are students' gender ($\beta = 0.031$) and school facilities ($\beta = 0.024$). This means that gender and school facilities even though made contributions to the academic performance of students in mathematics, they do not have much influence neither do they affect in greater measure the performance of students in mathematics.

4.3 Research Question Three

Which of the performance determinants (teachers' experience, teachers' qualification, teachers' and students' attitude, school category, school facilities and students' gender) will predict students' performance in mathematics? This question was answered using table 3.

From the results in Table 3, teachers' experience ($B=0.972$, $t=2.080$; $p<0.05$), teachers' qualification ($B=0.182$,$t=2.390$; $p<0.05$), teachers/students' attitude ($B=0.215$,$t= 2.821$; $p<0.05$) and school category ($B=0.064$, $t=0.352$; $p<0.05$) could be used to predict students' academic performance in mathematics. The other variables like students' gender and school facilities cannot be used to predict students' academic performance in mathematics.

5. Discussions

The results of the findings showed that teachers' experience is significant and can be used to predict students' performance in mathematics. This result is in accordance with the findings of Adeyemi (2008) who said that teacher experience and competence were the prime predictors of students' performance in all subject in secondary schools in Ondo state, Nigeria. It also agrees with the findings of Sweeney (1998) and Jones (1997) who opined that the teacher is a prime factor in the performance of students. Teachers' qualification was found to be significant and can also used to predict students' performance in mathematics. This is in agreement with the findings of Kaur (2004) who opined that in Singapore the problem of teaching mathematics needed qualified teachers/educators and recommended that the Ministry of Education equip mathematics teachers with the necessary skills through in-service courses.

Teachers' attitude towards the teaching of mathematics plays a significant role in shaping the attitude of students towards the learning of mathematics. The result of this study confirmed this because teachers' and students' attitude was significant and can be used to predict students' performance in mathematics. The results also agrees with that of Onocha (1985) who reported in one of his findings that teachers' attitude towards science is a significant predictor of pupils' science achievement as well as their attitude towards science. The result also agrees with that of Miji and Makgato (2006), Yeya (2002) and Chiriswa (2003). Also, Ogunniyi (1985) found that students' positive attitude towards science could be enhanced by teachers' enthusiasms, resourcefulness and helpful behaviour, teachers' thorough knowledge of the subject matter and their making science quite interesting.

All these factors could also be applicable to mathematics learning since mathematics is regarded as the language of science.

School category was found to be significant and can be used to predict students' performance in mathematics. This result was in accordance with that of Odhiambo (2006) and Yeya (2002) who observed that urban schools are not badly hit by teacher shortages as many prefer teaching in urban areas and also noted that students with impressive marks avoid day schools in favor of boarding schools. They further observed that students in boarding schools perform better in national examinations. The implication of this result is that the government should endeavour to build more schools in the rural areas with adequate facilities and qualified teachers. This will improve the students' performance in mathematics as all benefits that urban teachers enjoy will be made available to teachers in rural schools.

6. Conclusion

The study found out performance determinants of academic performance of students in mathematics. Out of the six variables, four of them (teachers' experience, teachers' qualification, teachers' and students' attitude, school category) could be used to predict academic performance in mathematics. It is therefore important that these variables should be taken into consideration by the government and stakeholders in formulating policies in our Ministries of Education. For good academic performance in mathematics, great attention should be placed on qualified and experienced teachers, enhanced remuneration to boost their attitude towards the teaching of the subject in order to retain them in the classroom. Moreover, adequate attention should be placed on students' attitude towards their teachers and the subject in order for them to perform well in mathematics.

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Table 1. Summary of Regression Analysis on Performance determinants

Multiple R	R^2	Adjusted R^2	Standard Error	F ratio
.238	.561	.456	1.53843	4.748

Table 2. Analysis of Variance on Performance determinants

Source of Variance	Sum of Squares	Df	Mean Square	F	Sig.
Regression	33.709	6	11.236	4.748	.003
Residual	563.287	145	2.367		
Total	596.996	151			

*sig. at $p<0.05$

Table 3. Estimate of the Relative Contribution of Performance determinants and Students' academic performance in Mathematics

Independent Variables (Predictors)	Unstandardized Coefficients		Standardized Coefficients			
	B	Standard error	Beta	Rank	T	Sig.
Teachers' Experience	0.972	0.331	0.118	4th	2.080	0.009*
Teachers' Qualification	0.182	0.078	0.152	3rd	2.390	0.018*
Teachers/Students' Attitude	0.215	0.076	0.181	2nd	2.821	0.005*
Students' gender	0.083	0.176	0.031	5th	0.472	0.637
School category	0.229	0.078	0.192	1st	2.917	0.004*
School Facilities	0.064	0.182	0.024	6th	0.352	0.725