INPUT – OUTPUT RELATIONSHIP AND THE QUALITY OF EDUCATION IN DAY SECONDARY SCHOOLS IN KENYA

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ABSTRACT: *The purpose of the study was to evaluate the extent to which school inputs affect quality of education in day secondary schools in Kenya. The study was carried out in eighteen-day secondary schools in Kisumu County. The input-output relationship or Education Production Function (EPF) was used in this study. Data was analyzed using multiple and Stepwise regression analysis. SPSS Statistical Package was used to determine regression coefficients of the results. From the stepwise regression analysis, it was found that one per cent increase in instructional material supplied will improve the performance of day secondary schools in the district by 0.4827 percent, while one percent increase in laboratory equipment expenditure will improve performance by 0.2313. One percent decrease in teacher-pupil ratio was found to improve performance by 0.3357 percent, while one percent increase in student average admission score would improve the performance by 0.3650 percent. Head teacher's qualification and experience and teacher`s qualification and experience were found to be statistically insignificant at 0.05 confidence level in a two tailed test.*

KEYWORDS: Input- Output Relationship, Quality of Education, Day secondary Schools, Regression Analysis.

INTRODUCTION

The majority of day secondary schools in Kenya were originally established for urban students and children of Asian communities. The boarding tradition began at the turn of 20th century by Anglican and Roman Catholic Missionaries, with an aim of adopting English public school system to the African race. In Kenya boarding schools are justified on Nation building grounds because they bring together students from different regional and ethnic backgrounds (Republic of Kenya, 2005). In addition, they may offer economies of scale with regard to teacher utilization and they avoid commuting costs associated with day schools.

The secondary school sub sector consists of over 4,000 public schools and about 600 private schools with a total population of over 850,000 (Ministry of Education, 2005). However, massive increase in enrolment in primary schools following introduction of Free Primary Education (FPE), is already putting pressure on secondary school system to expand access. Enrolment in primary schools shot up from 5.9 million in 2002 to almost 7.4 million in 2008 as a result of FPE introduced in January 2003. The demand for primary education is likely to be affected by the probability of entering secondary schools (Kigotho, 2009).

Secondary education is an immediate priority, as Kenyan education stakeholders consider how to accommodate hundreds of thousands of new primary school students who will seek places in future (Fleshman, 2005). The immediate challenge of secondary education is how to expand access at relatively low cost while improving the quality of education provided.

According to the World Bank (1988) the transition from a system of boarding schools to one of day secondary schools is another approach to reducing both the capital and the recurrent costs of secondary education. Especially when implemented in conjunction with distance education, which reduces the need for large boarding complexes at any level, a system of small day schools can significantly reduce the unit cost of secondary education.

Government expenditures per student tend to be much higher in boarding schools than in day schools by as much as three and a half times in Somalia, for example (World Bank, 1988). The result is that for a given amount of money, the government can offer fewer places.

Objective
To establish the extent to which school inputs like teacher pupil ratio, student average admission score, head teachers qualification and experience, laboratory equipment supplied, instructional material supplied, teacher`s qualification and experience and parent`s teacher`s association contributions affect the quality of education in day secondary schools as measured by examination performance.

THEORETICAL FRAMEWORK
An input-output relationship which is sometimes called the Education Production Function (EPF) was used in this study. Much controversy surrounds the definition and measurement of inputs and outputs of education. The problem lies in the lack of agreed goals of education which can be translated to operational and measurable objectives. Thus, there can be no standardized units of outputs or inputs. Inputs are teachers' qualifications and experience, teacher pupil ratio, books and other learning materials, laboratory equipment, schools' physical plants, and output is the pupils achievement. The specific measures of output were the grades attained by each day school in the Kenya Certificate of Secondary Education national examination. The problem about the input measures is the qualitative dimensions of the inputs which is not only hard to define, but also, very difficult to measure. In this study quality measures such as teacher`s experience and qualification, teacher pupil ratio, books and other learning materials, laboratory equipment were used as inputs.

The quality of the output of educational system is measured by results of examinations of given standards. There are other school outputs such as discipline and good citizenry. Examination results are always used because it allows for easy comparison. Thus if a school has higher points or scores in such examinations, the school is judged to be of higher quality. It must however be emphasized that there is more to the educational process than competence in cognitive ability. Nevertheless, in this study, the researcher restricted himself to this measure alone since this is the best known and acceptable measure of output quality.

Population and Sample

According to the Kisumu District Education Office, in April 1995 the District had a total of 112 secondary schools. Out of these, 70 (62.5%) were government maintained or assisted schools. The rest were either private or church-sponsored. This study focused on the government maintained or assisted schools, since the study could have been more complex. Out of the 70 government schools, 56 (80%) were day secondary schools. The study involved a total of 18 head teachers, 123 teachers and 600 students.

METHODS OF DATA ANALYSIS

Multiple regression analysis techniques was also used since it showed the individual effect of each independent variable on the dependent variable. It is also a statistical technique for exploring the strength of relationship between several independent variables and one dependent variable. The advantage of multiple correlation analysis and multiple regression analysis is that it permits one to analyze the relationships among a large number of variables in a single study (Borg R, et al,1983).

$$P = a + bx_1 + cx_2 + dx_3 + ex_4 + fx_5 + gx_6 + hx_7 + ix_8$$

Where   P = Pupil performance in Kenya Certificate Secondary Education
   x_1= Teacher pupil ratio
   x_2= Student average admission score
   x_3= Headteacher`s qualification and experience
   x_4= Laboratory equipment supplied
   x_5= Instructional Material supplied
   x_6= Parent`s Teacher`s Association and other school related bodies.
   x_7= Teacher`s qualification and experience.
   a,b,c,d,e,f,g,h,i are constants

Using SPSS computer Statistical Analysis Package the values of the constants were established. The step-wise multiple regression analysis was appropriate since it eliminated the independent variables whose contribution to the regression model had declined to a non significant level and all the included independent variables in the regression model were significant at 0.05 confidence level in a two tailed test.

Table 1: Linear multiple correlation for school inputs of day secondary schools in Kisumu district N=18

	X1	X2	X3	X4	X5	X6	X7	X
X1	1							
X2	0.471	1						
X3	0.216	0.255	1					
X4	0.143	0.571*	0.460	1				
X5	0.138	0.542	0.410	0.654*	1			
X6	0.673	0.621*	0.371	0.861**	0.752*	1		
X7	0.082	0.464	0.375	0.657*	0.305	0.441	1	
X	-0.078	0.522	0.318	0.592*	0.732**	0.764**	0.259	1

** significant at 0.001 confidence level in a one tailed test.
 * significant at 0.01 confidence level in a one tailed test.

Multiple Regression Analysis
Multiple Regression Analysis was also used to show the individual effect of each independent variable on the dependent variable. It can also show the combined effects of a set of independent variables.When using regression, the independent variables should be correlated with dependent variable, but not with one another. A condition when two or more of the independent variables are highly correlated with each other is called multicollinearity. If the intercorrelations are as high as 0.655 among the independent variables in regression analysis, then a group of highly correlated variables should be used (Hedderson, 1991).

Since Parent`s Teacher`s Association (X6) was highly correlated with laboratory equipment expenditure (X4), instructional material supplied (X5) and student average admission score (X2) it was removed from the school inputs to be analyzed by regression using SPSS statistical analysis package.The equation for the Regression analysis was as below
P = a + bx1 + cx2 + dx3 + ex4 + fx5 + gx7... 4.1
where P = Performance
        X1 = Teacher - pupil ratio
        X2 = Student average admission score

X3 = Head teacher's experience
X4 = Laboratory equipment expenditure
X5 = Instructional material supplied
X7 = Teacher qualification and experience
a is a constant. b,c,d,e,f,g are regression coefficients.

Table 2: Linear multiple regression analysis for school inputs of day secondary schools in Kisumu District N = 18

Multiple R   0.894
R square (R^2)   0.671
Standard Error   4.2086
Analysis of variance

	DF	Sum of squares	Mean square
Regression	6	398.104	66.3011
Residual	11	194.836	17.7124
F = 3.746		Sig F = 0.028	

.............variables in the equation ....   Variable

	B	SEB	Beta	T	Sig T
Teacher-pupil ratio (X1)	-0.148	0.0839	-0.3640	-1.760	0.1062
Admission score (X2)	0.3405	0.2251	0.3941	1.512	0.1586
H/teacher experience (X3)	0.0260	0.0457	0.1174	0.457	0.5809
Lab. expenditure (X4)	0.0158	0.0235	0.2048	0.675	0.5138
Ins. Material (X5)	0.0388	0.0221	0.4481	1.759	0.1063
Teacher exp. (X7)	0.053	0.0644	0.2021	0.825	0.4270
(Constant)	43.745	10.3679		4.219	0.0014

In Table 2, the multiple R is a correlation between the dependent variable (performance) and the entire set of independent variables. It can be seen from the table that the correlation between the dependent variable and independent variables was as high as 0.894. The multiple R squared (R^2) is the proportion of variance in the dependent variable associated with variance in the dependent variables. This proportion is a good indicator of the explanatory power of the regression model. The beta column indicates the values of the standardized regression coefficient. Beta represents the effect that a standard deviation difference in the independent variable would have on the dependent variable in standard deviation(the standardized scores of the dependent variable).

The beta for teacher-pupil ratio (X1) is -0.3640 as can be seen from Table 2. It means that a difference of one standard deviation in teacher-pupil ratio is predicted to cause a difference of -0.3640 standard deviation in performance. Since the regression coefficient is negative, it can be concluded that day secondary schools with high teacher-pupil ratio perform poorer than those with low teacher-pupil ratio in the national examinations. It can be concluded that one percent decrease in teacher-pupil ratio will improve performance of day secondary schools in the district by 0.3640 per cent.

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The beta for student average admission score(X2) was 0.3941. That means that one percent increase in student average admission score in day secondary schools will improve performance by 0.3941 per cent. One per cent increase in head teachers experience will improve the performance of day secondary schools in Kisumu district by 0.1174 per cent, since the beta for head teachers qualification experience (X2) was 0.1174. Beta for laboratory equipment (X4) was 0.2048, which means that one per cent increase in laboratory equipment expenditures in day secondary schools in the district will improve the performance by 0.2048 per cent. One per cent increase in purchase of instructional materials will improve the Kenya Certificate of Secondary Education performances in day secondary schools in the district by 0.4481 per cent, while one per cent increase in the years of teaching experience by teachers in day secondary schools in the district will improve the performance by 0.2021 per cent.

From the regression analysis results, equation 4.1 can be written as

$P = 43.745 - 0.3640X1 + 0.3941X2, + 0.1174X3 + 0.2048X4 + 0.4481X5 + 0.2021X7$...... (4.2).

Stepwise Regression Analysis

In a stepwise regression analysis, independent variables are added into the equation model one by one, and at each stage, any variable which is already included in the model, but whose extra sum of squares (R^2) contributions had declined to a non-significant level is eliminated. Selection stops when all unused variables are non significant and all included variables significant at 0.05 confidence level in a two tailed test.

Table 3 Stepwise multiple regression analysis for school inputs of day secondary schools in Kisumu district N = 18.

Multiple R   0.81348

R square (R^2)   0.66174
Standard Error   4.8088

Analysis of variable

		Sum of squares	Mean square
Regression	4	392.378	78.4756
Residual	12	200.567	16.7139

F = 4.6952   Sig. F = 0.0132
.... Variables in equation....................

Variable	B	SE B	Beta		Sig T
Teacher/Pupil ratio (X1)	-0.1362	0.07913	-0.33571	-721	0.1109
Student Adm. Score (X2)	0.31529	0.21440	0.36496	1.471	0.1671
Lab./expenditure (X4)	0.01788	0.02254	0.23126	0.7940	0.4429
Ins./Material (X5)	0.04173	0.02080	0.48271	2.008	0.0677
(constant)	45.2935	9.7181		4.661	0.0006

According to the data, headteacher`s experience (X3) and teacher`s qualification and experience (X7) were not statistically significant in the regression model at 0.05 confidence level in a two tailed test.

From the stepwise regression analysis head teacher`s experience and teacher`s qualification and experience were eliminated from the regression model as shown in Table 3. The elimination of head teacher's qualification and experience (X3) could be explained by the fact that all head teachers from day secondary schools under the study were qualified and the majority had many years of experience. Even teachers from almost all day secondary schools were qualified as can be seen from Table 3, that means there was a little co-variation in teachers and head teachers qualification and experience in the day secondary schools in the district.

   From Table 3, equation 4.2 will now take that following form:

$$P = 45.2935 - 0.33571X1 + 0.36496X2 + 0.2313X4 + 0.4827X5 ....(.4.3)$$
   Equation 4.3 shows that one percent increase in teacher - pupil ratio (X1) will decrease the performance of day secondary schools in Kisumu district by 0.3357 per cent.

Table 3, shows that one per cent increase in the student average admission score (X2) will improve the performance of day secondary schools in the district by 0.3650 per cent. Since the beta for instructional material supplied (X5) is 0.4827,one per cent increase in instructional material supplied will improve performance of day secondary schools by 0.4827 per cent. Increasing laboratory expenditure (X4) by one per cent in day secondary schools in the district, will improve the performance by 0.2313 per cent, since the beta for laboratory expenditure supplied is 0.2313.

CONCLUSIONS:

From the regression analysis, schools which supplied more instructional materials performed better in the national examination in the district. This can be seen from Table 2 where the regression coefficient for instructional materials supplied (X4) was 0.4827. The conclusion was that one per cent increase in the instructional material supplied will improve the performance by 0.4827 per cent. Those day secondary schools in the district which supplied more laboratory equipment performed better in the national examination. It can be concluded from Table 2 that one per cent increase in laboratory equipment expenditure will improve the performance by 0.2313 per cent in day secondary schools in Kisumu District.

Day secondary schools which admitted to form one students with high average marks in Kenya Certificate of Primary Education performed better in the national examinations. Teachers and head teachers noted that the performance of students in day secondary schools were affected by the admission of weak students. This is because those students who scored high marks in Kenya Certificate of Primary Education were admitted to boarding schools. Boarding secondary schools had a wider catchment area than day secondary schools. Day secondary schools' selection was limited to nearby primary schools especially in rural areas where students had to walk to and from school.

From the multiple correlation analysis, average student admission score (X2) had high correlation with performance. The correlation coefficient was 0.522. The regression analysis coefficient was 0.3650. That means one per cent increase in student average admission score will improve performance of day secondary schools in the district by 0.3650 per cent.

From this study it was found that Parent`s Teacher`s Association and other school related bodies had the highest correlation with performance. The correlation was 0.764 and it was significant at 0.001 confidence level in a one tailed test as can be seen from Table 1. What it means is that schools with strong Parent`s Teacher`s Association and other school related bodies performed better in national examinations. Parent`s Teacher`s Association and other school related bodies had put up many facilities in day secondary schools in the district as mentioned earlier. Those bodies also ensured that smooth running of day secondary schools.

From the multiple correlation and multiple regression analysis, it was shown that teacher`s qualification and experience had insignificant effect on student performance in day secondary schools in the district. This was because the majority (85.3%) of the teachers was qualified. Since there was very little co-variation between the qualification and experience of the teachers of the day secondary schools, that could explain why teacher qualification and experience was insignificant.

Though the teacher-pupil ratio in the day secondary schools was generally low, as can be seen from Table 4.21, from multiple correlation and multiple regression analysis results, there was a negative relationship between teacher-pupil ratio and performance. This could be seen from Tables 4.23 and 4.25. What it means is that schools with high teacher-pupil ratio tended to perform more poorly than day secondary schools with low teacher-pupil ratio. The study also found out that head teachers' qualification and experience had insignificant effect on student performance. This could be seen from the multiple regression analysis where qualification and experience was eliminated from the

regression model, since it was insignificant at 0.05 confidence level in a two tailed test. This could be explained by the fact that all the head teachers in day secondary schools were qualified and the majority had over eight years experience, showing very small co-variation among secondary schools in the district.

RECOMMENDATIONS

Textbook funds should be levied from students, so that all day secondary schools should have necessary textbooks to be shared by at least two students per textbook to improve performance. Levying textbook funds from students will be cheaper than the requirement from the majority of day secondary schools that each student buys the necessary textbooks. The government should change its policy, in order to provide equal opportunity for all types of schools to select their candidates to form one. Day schools should also be given a chance to compete with the boarding schools favourably when selecting students to form one.

Parent`s Teacher`s Association and other school related bodies, should be strengthened so that they could contribute to the provision of physical facilities in day secondary schools. The provision of more physical facilities in day secondary schools will make them attract students with higher average scores in Kenya Certificate of Primary Education.
Day secondary schools' head-teachers should strive to form Old Student Associations so as to get funds from the old students who would contribute generously to improvement of the schools.

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