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Differential In Learning Outcomes Among Secondary School Students In Kenya: A Multilevel Analysis On Effects Of Non-Teacher Resources?

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Abstract: ***Differential in learning outcomes among students in secondary schools continues to raise concern in Kenya. Using multilevel analysis on the 2016 Kenya Certificate of Secondary Education (KCSE) examination data set, this study analyzed the effects of non teacher resources being physical facilities and text books on learning outcome in Busia County, Kenya. A sample of 755 students and 276 teachers drawn from 100 schools was used. The study hypothesized that physical facilities, boarding facilities and text books had no significant effect on learning outcomes among secondary school students. Findings demonstrated that text books and physical facilities had statistically significant effects on learning outcomes.***

Keywords: Text books, physical facilities, learning outcomes, Busia County, Kenya

I. INTRODUCTION

Given the huge massive investment in education (6.5% of GDP), it is a matter of considerable concern to the Kenyan taxpayer that it is not getting value from secondary education investment. So far, learning outcomes in secondary education have not improved. This study examined the causes of variation in learning outcomes among secondary school students by analyzing effects of non teacher resources. Prior studies on differential in learning outcomes indicated that non teacher resources had significant effects on learning outcomes (Adeogun, 2001; Babayomi, 1999; DFID, 2007; Conboy, 2006). But because non teacher resources are varied for instance textbooks, classrooms, boarding facilities, laboratories and workshops and probably they don't influence learning outcomes with equal measure, an investigation on which of the resources have greater effects on learning outcomes is important. This is crucial because the concern for educational planners, policy makers and economists of education is how educational resources can be combined in order to achieve optimal output. Whereas educational resources are limited, economists of education still have to make decisions on how efficiently these resources can be allocated between competing needs.

For instance, a decision has to be made on whether the government should use her limited financial resources to provide text books or pay salaries for additional teachers. Educational planners may also have to choose between creating day or boarding schools. In this study, text books were chosen because the government of Kenya had rolled out a multibillion free text books program for all public secondary schools at the expense of addressing an acute teacher shortage. Physical facilities were chosen because the government is keen on improvement of school physical facilities. But most important, both text books and physical facilities have direct implications on education financing. An understanding of whether diverting more funds to these resources will improve learning outcomes is therefore a fundamental policy and planning issue.

The study employed a multilevel approach to examine whether text books and boarding facilities affected learning outcomes among high school student in Busia County, Kenya. We hypothesized that text books and boarding facilities had no significant effect on secondary school learning outcomes. We

focused on learning outcomes among secondary school students for one simple reason; that secondary education is critical in preparing the youth for further training and the world of work (Achoka, Odebero, Maiyo and Mualuko,2007; Chiuri, 2005 and Changach, 2012). The study was conducted in Busia County where learning outcome among secondary students was consistently below the national average. It was anticipated that findings of the study will assist policy makers and educational planners to provide appropriate non teacher resources to enhance effective teaching and learning that would lead to improved learning outcomes among secondary school students in Kenya.

Prior studies have shown that non teacher resources such as classrooms, dormitories and text books provide a conducive teaching and learning environment and often account for a large proportion of observed variation in learning outcomes (Hanushek, 1997). However findings on the extent to which some of these resources accounted for the variation in learning outcomes are either contradictory or inconclusive. Achoka, 2014; Magriet, Kraaykamp and Pelzer, 2018; Sebro and Goshu, 2017 reported that physical facilities were the most important predictors of students learning outcomes. Psachropolous and Woodhall (1995); Ali (2013); Owoeye and Yara (2012) argued that classrooms, libraries and instructional material had a significant positive effect on students' academic achievement. The studies did not indicate by how much each resource accounted for the variation in learning outcomes.

In Kenya, Ogweno (2015) demonstrated that physical facilities accounted for about 23.6% of the variation in mathematic achievement. But the study was only restricted to mathematics achievement in Rachuonyo Sub county. Nyamongo (2014) reported that there was no significant relationship between physical facilities and learning outcomes. But the study did not indicate the amount of variation in learning outcomes accounted for by physical facilities. Mumasi (2013), Opula (2013) and Nasimiyu (2015) simply observed a positive relationship between instructional material and academic achievement. Many other studies have reported significant relationship between non teacher resources and students academic achievement (Amukowa and Karue, 2013; Achoka, 2014; Kilaha, 2010; Onyara, 2013; Nakhumicha, 2013). These studies make important contribution to knowledge but suffer methodological deficiencies. First, the studies do not report effects of specific resources on academic achievement. Instead, the researchers lumped various resources together. Secondly, the studies employed the traditional ordinary least square estimation techniques to deal with educational data sets.

Furthermore, most studies reviewed seem to have ignored the fact that there are many factors both at student and teacher level that are likely to interact and collectively or singly influence students' learning outcomes. Instead, the studies analyzed non teacher resources in isolation. By taking such as approach, there are high chances that findings are misestimated. In addition, such techniques cannot account for variances in learning outcomes within and across schools. This study makes an improvement on the previous studies in several ways. First, the study employed a multilevel analysis technique which takes care of the hierarchical nature of data that characterizes educational settings. The researchers therefore brought in many variables both at the student and school level. By so doing the study was able to establish how the variables collectively or singly accounted for the variation in learning outcomes within and across schools.

II. METHODOLOGY

A. STUDY LOCATION

The study was conducted in Busia County, Kenya. The County is located in Western Kenya on latitude 0º and 0º 45 North and longitude 34º 25 East covering a approximately 1694.5 km^2. Figure 1 depicts the study location.

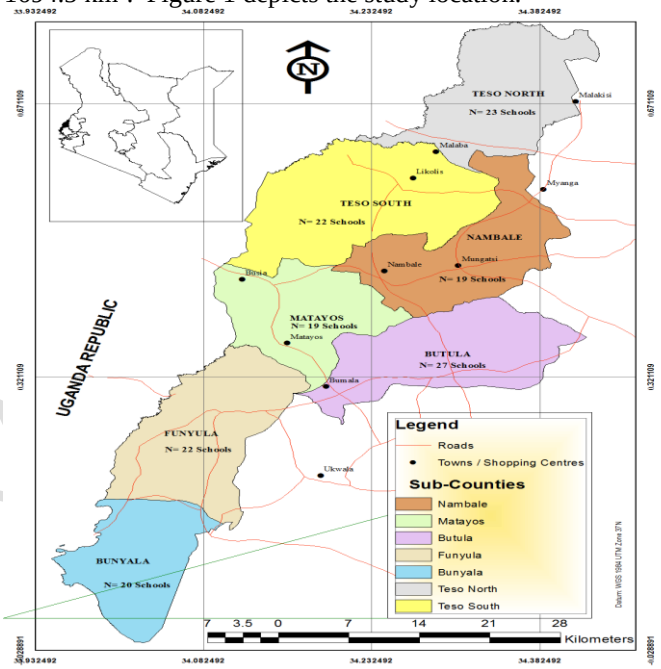

Figure 1: Map of Busia County

B. RESEARCH DESIGN

The study employed a descriptive survey design. According to Mugenda and Mugenda (2003), a descriptive survey research design is a technique that seeks to gather information about a certain phenomenon and goes ahead to describe what exists in respect to the variables or conditions under investigation without necessarily manipulating the variables of the study. This design was employed because there was no intention to manipulate the variables under investigation. Self administered questionnaires were used for data collection.

C. SAMPLING TECHNIQUE AND SAMPLE SIZE

A sample of 100 secondary schools and 1091 respondents was used. The school sample was determined using Yamane's formula.

$$n = \frac{N}{1 + N(e)^2}$$

Where; n = Desired sample size, N = Target population and e = Desired level of precision.

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Using 95 percent confidence level or 5 percent margin of error, the sample size for schools was computed as;

$$n = \frac{152}{1+ 152\ (0.05)^2}$$

$$n = 111$$

But in the final study, 11 (eleven) schools were omitted because they had not presented candidates for the KCSE examination. Omitting the eleven schools could not adversely affect the study since the 100 schools used were still well above the 10-30 percent sample recommended for a descriptive study (Barbie, 2010). Table 1 presents the distribution of the schools in the sample.

No.	Sub County	N	N	Percent
1	Teso North	23	15	65
2	Teso South	22	14	63
3	Nambale	19	14	73
4	Butula	27	15	55
5	Matayos	19	14	73
6	Funyula	22	14	63
7	Bunyala	20	14	70
	Total	**152**	**100**	

N=Population, n=Sample

Table 1: Sample of schools

A sample of 1091 respondents which comprised of students, teachers and principals was used in the study. Table 2 displays the distribution of the study respondents.

S/No.	Respondent	Population	Sample	Sampling Technique
1	Students	7550	755 (10.0)	Simple Random
2	Teachers	2360	236 (10.0)	Simple Random
3	Principals	152	100 (65.8)	Purposive
	Total	**10,062**	**1,091**	

Table 2: Respondents Population and Sample

The researcher used convenient sampling to select 236 teachers representing 10 percent of the teachers' population. In each of the schools that participated in the study, at least two but no more than three teachers were selected from a school. The decision to settle on a sample of 10 percent for both the students and teachers was based on two assumptions. First of all, the researcher assumed that all respondents in the sample would respond to the questionnaires and secondly, that a very high level of statistical significance (significance level of .001) was not necessary for this kind of study.

III. RESULTS

A. DATA AND VARIABLES USED IN THE STUDY

Since students were nested in schools, data used in the analysis was collected at two levels namely; level 1 (student, prefixed "a") and level 2 (school, prefixed "b"). Student academic achievement was therefore assumed to be dependent on learning resources, type of school and the student. Table 3 depicts the description of the variables used in the study.

Var.	Variable Label	Scale	Variable values
a1z	Student's KCSE z-score	Ratio	-2.04 - 2.59
a1a	Female student	Nominal	0=Male; 1=Female
a1c	Student's prior academic achievement	Interval	150 – 410
a2a	Student's parent involved in discussing academic issues	Interval	0=Non existent 4=Fully existent
a2b	Student's parent's provision of school requirements	Interval	0=Non existent 4=Fully existent
a2c	Student's parent involved in attendance of meetings	Interval	0=Non existent 4=Fully existent
s0e	Rural school	Nominal	0=Urban school; 1=Rural school
s2a	Boys secondary schools	Dummy	0=Other classification;1=Boys secondary schools
s2b	School is boarding	Nominal	0= Not Boarding; 1=Boarding School
s2f	Number of streams	Interval	1 – 6
s2g	School enrolment	Interval	144 – 845
s2h	School mean score 2015	Interval	2 - 8.931
s2i	School mean score 2016	Interval	2 - 5.992
s2j	Average school mean score 2015/16	Interval	2.31 - 7.308
s3p	Students participation in co-curricular	Interval	0=Very poor;4=Excellent
s2c	Number of TSC teachers	Interval	0 -28
s2d	Number of BoM teachers	Interval	4 – 16
s2e	Total number of teachers	Interval	8 – 40
s3a	Teacher's lessons missed	Interval	2 -5
s3b	Teachers cover missed lessons	Interval	0=Not at all; 4=Yes, Fully
s3c	Teachers assist weak students	Interval	0=Not at all; 4=Yes, Fully
s3d	Teachers adhere to code of conduct	Interval	0=Not at all; 4=Yes, Fully
s3f	Teacher teamwork	Interval	0=Very poor; 4=Excellent
s3g	Teacher relationships	Interval	0=Very poor; 4=Excellent
s3h	Teacher-parent relationships	Interval	0=Very poor;4=Excellent

s3i	Teacher-student relationship	Interval	0=Very poor;4=Excellent
s3j	Teachers duty reporting time	Interval	0=Very late;4=Excellent
s3k	Teachers commitment to duty	Interval	0=Very poor;4=Excellent
s3l	Availability of text books	Interval	0=Very poor;4=Excellent
s3n	Availability of physical facilities	Interval	0=Not available;4=Excellent

Note. Student Level-1 variables are prefixed with letter "a" and School Level-2 with letter "s"

Table 3: Description of Variables in the study

Results shown in Table 3 indicate five and twenty four level 2 variables respectively. The outcome variable was the KCSE z-score (a1z).

B. MODEL SPECIFICATION

Mixed linear modeling ordinarily starts with a null (empty or unconditional) model. A null model is basically one way ANOVA model with no predictor variables (Raudenbush and Bryk, 2002). The null model estimated the variance in learning outcomes available at the two levels of the hierarchy being student and school level. The null model was therefore used to partition the variance in the learning outcomes into school and student component. The results of the null model are given in Table 4.

Fixed Effect			
Variable	Variable label	Null Model	
		Est. (Std. Err.)	*P*
	Intercept, β_{0i}	0.012 (0.078)	0.874
Random Effect		*Variance Component*	
Student (Level-1), e_{ij}		0.4116 (0.02)	
School (Level-2), u_j		0.5426 (0.08)	
Variance Partition Coefficient (VPC)			
Student (Level-1), σ^2_e		0.4314	
School (Level-2), σ^2_u		0.5686	
Model Fit Statistics			
Deviance		1913	
Akaike Information Criterion (AIC)		1919	
Bayesian Information Criterion (BIC)		1933	
Likelihood Ratio test vs. OLS Regression		chibar2(01) = 513	<.001

Note. N= 755; Est. = Estimate; Std. Err. = Standard Error (in parentheses); AIC and BIC statistics = smaller-is-better fit; OLS=Ordinary Least Squares

Table 4: Two Level Null Model

The results presented in Table 4 depict that the random intercept (β0, student's z-score) or the overall mean academic achievement in KCSE examination across schools was 0.012, Std. Err. = 0.078 and p=.874. The random intercept was approximately normalized with an estimated random intercept of zero, total variance of approximately one and a non-significant intercept. The random effects in the model indicate the Variance Partition Coefficient (VPC) for the two level hierarchies.

C. DESCRIPTIVE STATISTICS OF THE VARIABLES USED IN THE ANALYSIS

The study sought to estimate the effects of non teacher learning resources on students' academic achievement in Kenya Certificate of Secondary Education examination. Table 5 presents the descriptive statistics of the variables used to run the two levels mixed linear modeling of the effects of non teacher learning resources.

Var.	Variable Label	Mean	SE	SD	Min	Max
a1z	Student's KCSE z-score	0.00	0.03	1	2.04	2.59
a1c	Student's prior academic achievement	274.89	1.29	37.81	150	410
a2a	Student's parent involved in discussing academic	2.77	0.04	1.06	0	4
a2b	Student's parent's provision of school requirements	2.77	0.04	1.03	0	4
a2c	Student's parent involved in attendance of meetings	2.69	0.04	1.05	0	4
s2f	Number of streams	2.28	0.04	1.27	1	6
s2g	School enrolment	374.69	5.78	168.90	144	845
s2h	School mean score 2015	4.80	0.05	1.58	2	8.931
s2i	School mean score 2016	3.42	0.03	0.92	2	5.992
s2j	Average school mean score 2015/16	4.08	0.04	1.08	2.31	7.308
s3p	Students participation in co-curricular	2.17	0.04	1.08	0	4
s2c	Number of TSC teachers	10.37	0.19	5.69	0	28
s2d	Number of BOM teachers	6.96	0.10	2.80	4	16
s2e	Total number of teachers	17.34	0.27	7.78	8	40
s3a	Teacher's miss lessons	3.43	0.03	0.93	2	4
s3b	Teachers cover missed lessons	2.31	0.03	0.85	0	4
s3c	Teachers assist weak students	2.31	0.03	0.88	0	4
s3d	Teachers adhere to code of conduct	2.70	0.03	0.86	0	4
s3f	Teacher teamwork	2.49	0.03	0.89	1	4

s3g	Teacher relationships	2.44	0.03	0.80	0	4
s3h	Teacher-parent relationships	2.55	0.03	0.90	0	4
s3i	Teacher-student relationship	2.58	0.03	0.91	0	4
s3j	Teachers duty reporting time	2.33	0.03	0.84	0	4
s3k	Teachers commitment to duty	2.31	0.03	0.87	0	4
s3l	Availability of text books	2.83	0.04	1.16	0	4
s3n	Availability of physical facilities	2.34	0.04	1.06	0	4
	Nominal and Dummy Variables [Frequencies preceding % in ()]					
s0e	Rural school: 0=Student is in urban school, 312 (36.49); 1=Student is in rural school, 543 (63.51)					
a1a	Female student: 0=Male, 413(60.00); 1=Female, 342 (40.00)					
s2a3	Boys secondary schools: 0=Other classification, 672 (90.29); 1=Boys secondary schools 83 (9.71)					
s2b	School is boarding: 0=School is not boarding 438 (51.23); 1=School is boarding 417 (48.77)					

Note. SE=Standard Error; SD=Standard Deviation; Min=Minimum; Max=Maximum;
Var. =Variable

Table 5: Descriptive Statistics for the Variables Used in Analysis

D. BIVARIATE ANALYSIS

The researcher carried out a pair wise correlation between the students' standardized KCSE examination scores and selected non teacher resources. The correlation results for the non teacher resources that were statistically significant are displayed in Table 6.

Variable	Variable		a1z	s3l	s3n
a1z	Student's KCSE z-score	[a]	1		
s3l	Availability of text books	[a]	0.079	1	
		[b]	0.022		
s3n	Availability of physical facilities	[a]	0.113	-0.027	1
		[b]	0.001	0.440	

Note. Pair-wise correlation: ≤0.35 = Weak correlation; 0.36-0.67 = Moderate correlation; 0.68-0.89=Strong correlation; ≥0.90 = Very strong correlation; Adapted from "Interpretation of Correlation Coefficient, " by R. Taylor, 1990, Journal of Diagnostic Medical Sonography, 6(1), p. 37

[a] Pearson correlation coefficient; [b] *p*-values (α=.05)
Source: Field Data (2017)

Table 6: Correlation between non teacher resources and learning outcomes

The results shown in Table 6 suggest that availability of physical facilities (s3n) had the strongest positive correlation with students' academic achievement in KCSE examination (r= 0.113, p<0.001). Contrary to expectations, text books had a positive but weak correlation with learning outcomes (r=.079, p<0.001).

a. RANDOM INTERCEPT MODEL FOR NON TEACHER RESOURCES

Table 7 shows the results of the MLM. We discuss the results in the two sub sections that follow

Fixed Effect								
Variable	Variable label	Model 1		Model 2		Model 3		
		Est. (SE)	*P*	Est. (SE)	*P*	Est. (SE)		*P*
a1a	Female student	0.12 (0.05)	0.030	0.11 (0.05)	0.039	0.10 (0.05)	.065	0
a1c	Student's prior academic achievement	0.00 (0.00)	0.012	0.00 (0.00)	0.012	0.00 (0.00)	.040	0
a2a	Student's parent involved in discussing academic	0.16 (0.03)	<.001	0.16 (0.03)	<.001	0.16 (0.03)	.001	<
a2b	Student's parent's provision of school requirements	0.15 (0.03)	<.001	0.15 (0.03)	<.001	0.15 (0.03)	.001	<
a2c	Student's parent involved in attendance of meetings	0.12 (0.03)	<.001	0.12 (0.03)	<.001	0.12 (0.03)	.001	<
s3l	Availability of text books			0.00 (0.02)	0.769	-0.00 (0.02)	.510	0
s3n	Availability of physical facilities			0.04 (0.02)	0.083	0.04 (0.02)	.898	0
s2f	Number of streams				0.078	0.16 (0.06)	.003	0
s2h	School mean score 2015				0.064	0.06 (0.04)	.139	0
s3f	Teacher teamwork				0.055	0.02 (0.03)	.589	0
	Intercept	-1.68 (0.21)	<.001	-1.77 (0.22)	<.001	-2.36 (0.26)	.001	<
Random Effect		*Variance Component*		*Variance Component*		*Variance Component*		
Student (Level-1), e_{ij}		0.3577 (0.02)		0.3570 (0.02)		0.3556 (0.02)		
School (Level-2), uo_j		0.2688 (0.05)		0.2645 (0.05)		0.2064 (0.04)		
Variance Explained % (continued)								
Student (Level-1), σ^2_e		0.0565		0.0572		0.0587		
School (Level-2), σ^2_u		0.2869		0.2914		0.3523		
Model Fit Statistics								
Deviance		1743		1740		1716		
Akaike Information Criterion (AIC)		1759		1760		1742		
Bayesian Information Criterion (BIC)		1797		1807		1804		
Likelihood Ratio test vs. OLS Regression		chibar2 (01) = 213	<.001	chibar2 (01) = 203	<.001	chibar 2 (01) = 182	.001	<
Likelihood Ratio test (Preceding Model vs. Next)		χ^2 (5) = 169	<.001	χ^2 (2) = 3	0.223	χ^2 (3) = 24	.001	<

Note. N= 755; Est. = Estimate; Std. Err. = Standard Error (in parentheses); AIC and BIC statistics = smaller-is-better fit; OLS=Ordinary Least Squares

Table 7: Random intercept model for non teacher resources

IV. DISCUSSIONS

A. STUDENT LEVEL PREDICTORS

The results of null (empty or unconditional) model displayed in Table 2 suggested that the variance in students' learning outcomes partitioned into within group and between

group variance components was 95.42% (0.4116+ 0.5426)*100. From findings of this study the Variance Partition Component (VPC) that explained the within school-between-student variances in learning outcomes was estimated as; e_{ij} / (e_{ij} + u_j). These results gave the impression that a larger proportion (54.26%) of the variation in learning outcomes among secondary school students was explained by school level variables. Otherwise 45.74% of the variation in learning outcomes was explained by student related factors.

The random intercept model depicted in Table 7 suggests that all the five student level variables had weak correlation with learning outcomes. The results show that student's parents getting involved in discussing academic issues (a2a) had the highest standardized regression coefficient. In total, the five student level variables explained up to 0.3434 (34.34 %) of the variance in learning outcomes among students across the two levels. This finding gave the implied that learning outcomes improved significantly as parents got involved in discussing academic issues with teachers. These findings were consistent with previous studies (Echaune, Ndiku and Sang, 2015).

B. NON TEACHER RESOURCES

The results depicted in Table 6 suggested that availability of physical facilities and text books had a weak but significant relationship with learning outcomes among secondary school students. When physical facilities and text books were modeled controlling for student level variables, the five student variables were still statistically significant (model 1 and 2). The proportion of variance that was accounted for by school level variables improved by 0.0045 (0.45 %) from 0.2869. In total, 0.3487 of the variation in learning outcomes was explained across the two levels. In model 3, there were three other school variables namely; number of streams; school mean in 2015 and team work among teachers which were introduced. The two school non teacher variable namely; availability of physical facilities (s3n) still had statistically significant effects on learning outcomes at 0.05. But the student variables except student gender remained statistically significant.

Findings of this study further demonstrated that the variance in learning outcomes among secondary students improved by 6.09%, from 0.2914 in model 2 to 0.3523 when physical and facilities and text books were introduced into the model. Findings of the study therefore implied that availability of physical facilities and textbooks alone accounted for 6.09% of the variation in learning outcomes. This variance was considered to be relatively huge. The results therefore meant that students who attended schools with adequate physical facilities and text books were likely to attain 0.04 standard deviation unit scores over and above their counterparts who attended schools that had no text books or physical facilities. Findings of this study were consistent with earlier studies (Hanushek, 1997; Glewwe and Kremer, 2006; Ejakait, et al., 2016), who demonstrated that physical facilities are vital inputs in an educational system; emphasizing that even though they do not teach, their use may facilitate or impede learning.

V. CONCLUSION AND RECOMMENDATIONS

Findings of this study revealed that non teacher resources namely text books and physical facilities had statistically significant effects on secondary school learning outcomes. The finding gave the implication that text books and physical facilities influenced students' academic achievement at secondary school. Coming at a time when the government of Kenya was implementing a policy to supply free text books to all public secondary schools, the study recons that the initiative should be lauded because it would promote the quality of secondary education outcomes in the country.

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