Differential in Learning Outcomes among Secondary School Students in Kenya: A Multilevel Analysis on Effects of Non-Teacher Resources

Echaune Manasi, PhD[1]

Julius Maiyo, PhD[2]

Ijendi Juma, PhD[3]

[1]Correspondent Author, Department of Education /Vocational Training, County Government of Busia- Kenya, Email: echaunemanasi@yahoo.com

[2] Director Quality Assurance and Performance Contracting, Kibabii University, Kenya

[3]Chairman, Faculty of Education Foundations, Educational Planning and Management, Kibabii University, Kenya

Abstract

The cause of differentials in learning outcomes among secondary schools students in Kenya has remained a matter of concern among education planners and policy makers over a long time. Using a multilevel analysis of the 2016 Kenya Certificate of Secondary Education (KCSE) examination data set, this study sought to establish the causes of the disparity in learning outcomes by analyzing the effects of non-teacher resources namely physical facilities and text books on learning outcome in Busia County, Kenya. A sample of 1031 respondents was used. The study sample comprised of 755 students and 276 teachers drawn from 100 secondary schools. The study hypothesized that physical facilities and text books had no significant effect on learning outcomes among secondary school students. Findings demonstrated that both text books and physical facilities had statistically significant effects on learning outcomes. The study recommended that efforts should be made to provide text books and physical facilities in secondary schools so as to improve students' learning outcomes.

Keywords: Text Books, Physical Facilities, Learning Outcomes, Busia County, Kenya

1. BACKGROUND TO THE STUDY

The Kenya government spends heavily on provision of education to her citizens (approximately 6.5% of GDP). Government expenditure on education includes purchase of non-teacher resources such as text books and development of physical facilities in schools. However despite the large public expenditure, there is evidence that the taxpayer is not getting value money. This is particularly so given the consistent unsatisfactory student achievement in national examinations. This study examined the relationship between learning outcomes among secondary school students, textbooks and physical facilities. 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 including textbooks, classrooms, boarding facilities, laboratories and workshops, an investigation to establish the resources that have greater effects on learning outcomes is worthy. 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 education outcomes. More often, economists of education have to make decisions on how efficiently education resources should be allocated between competing needs.

For instance, a decision has to be made on whether the government should use limited financial resources to provide text books or employ 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 schools. This program was being implemented against a background of an acute teacher shortage in the country. Physical facilities were chosen because the Kenya government was keen on improvement of school physical facilities. But most important, research evidence from other parts of the world suggests that text books and physical facilities had direct implications on education financing. In this regard, an understanding of whether diverting more funds to text books and physical facilities will improve learning outcomes is therefore a fundamental policy and planning issue for the Kenya government.

The study employed a multilevel approach to examine whether text books and physical facilities affected learning outcomes among high school student in Busia County, Kenya. The study hypothesized that text books and physical facilities had no significant effect on secondary school learning outcomes. The study focused on learning outcomes in secondary education 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 outcomes 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 leading 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 conducive teaching and learning environment and often accounted for a large proportion of observed variation in learning outcomes (Hanushek, 1997). However findings on the extent to which some 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 largest predictors of students learning outcomes. Psachropolous and Woodhall (1995); Ali (2013); Owoeye and Yara (2012) on the other hand argued that classrooms, libraries and instructional material had a significant positive effect on students' academic achievement. A review of the studies highlighted above revealed that the studies did not show how much each of the resources accounted for variation in learning outcomes.

In Kenya, Ogweno (2015) demonstrated that physical facilities accounted for about 23.6% of the variation in mathematic achievement. But still 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.

2. STATEMENT OF THE PROBLEM

Several studies have been conducted to establish the causes of unsatisfactory student academic achievement, yet findings seem to contradict one another. More often, findings are inconclusive. Whereas some studies suggest that school variables account for larger variation in learning outcomes, some reported that student characteristics are the major predictors of learning outcomes. Secondary students learning outcomes in Kenya have remained low over the years yet there have been no conclusive studies to explain the causes of the low outcomes. Studies conducted in Busia County have also reported inconsistent results. According to Achoka (2010) school level variables largely explained the variation in student academic achievement but Ndiku and Sang (2015) reported that student characteristics were the major predictors of student academic achievement. The controversy as to what was the cause of unsatisfactory academic achievement in Kenya continues to grow day by day. This study contemplated that this controversy could be resolved by adopting multilevel analysis techniques. The study therefore analyzed relationship between student characteristics, teacher resources and learning outcomes Kenya Certificate of Secondary Education examination in Busia County, Kenya.

3. OBJECTIVES OF THE STUDY

The general objective of this study was to investigate the relationship between secondary students learning outcomes and non-teacher resources in Busia County Kenya.

The specific objectives of the study were;

   i) To establish the student characteristics that accounted for variation in achievement in KCSE examination in Busia County, Kenya
   ii) To establish the effect of text books on students' academic achievement in KCSE examination in Busia County Kenya
   iii) To examine the relationship between physical facilities and students' academic achievement in KCSE examination in Busia County, Kenya

4. RESEARCH METHODOLOGY

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 approximately 1694.5 km². 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.

The study used primary data collected from the field. Self-administered questionnaires were used for data collection. The study targeted one hundred and fifty two (152) secondary schools, one hundred and fifty two (152) secondary school principals, two thousand, three hundred and   sixty (2360) secondary school teachers and seven thousand, five hundred and fifty (7550) students. A sample of 100 secondary schools 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. 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

Table 1 Sample of schools

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

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.

Table 2 Respondents Population and Sample

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**	

The study employed convenient sampling to sample 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. The decision to use 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.

5. DATA AND RESULTS

5.1 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 assumed to be dependent upon learning resources, type of school and the characteristics of the student. Table 3 depicts the description of the variables used in the study.

Table 3. Description of Variables 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

Table 3. Description of Variables in the study

Var.	Variable Label	Scale	Variable values
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"

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

5.2 Model Specification

The study employed a mixed linear modeling technique. 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). In this study, the null model was used to estimate the variance in learning outcomes available at two levels of the hierarchy namely the student and school levels respectively. 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.

Table 4 Two Level Null Model

Fixed Effect			
Variable	Variable label	Null Model	
		Est. (Std. Err.)	*P*
	Intercept, β_{0j}	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

The results presented in Table 4 depicted that the random intercept ($\beta0$, 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 indicated the Variance Partition Coefficient (VPC) for the two level hierarchies.

5.3 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.

Table 5. Descriptive Statistics for the Variables Used in Analysis

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

Table 5. Descriptive Statistics for the Variables Used in Analysis

Var.	Variable Label	Mean	SE	SD	Min	Max
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)					
s2a 3	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

5.4 Bivariate Analysis

The researchers conducted 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

Table 6. Correlation between non teacher resources and learning outcomes

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)

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

5.5 Random Intercept Model for Non Teacher Resources

Table 7 displays the results of the MLM. The results show that student's parents getting involved in discussing academic issues (a2a) had the highest standardized regression coefficient.

Table 7 Random intercept model for non-teacher resources

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)	0.065
a1c	Student's prior academic achievement	0.00 (0.00)	0.012	0.00 (0.00)	0.012	0.00 (0.00)	0.040
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)	0.510
s3n	Availability of physical facilities			0.04 (0.02)	0.083	0.04 (0.02)	0.898
s2f	Number of streams				0.078	0.16 (0.06)	0.003
s2h	School mean score 2015				0.064	0.06 (0.04)	0.139
s3f	Teacher teamwork				0.055	0.02 (0.03)	0.589
	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)

	Model 1	Model 2	Model 3
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

	Model 1		Model 2		Model 3	
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	chibar2 (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

6. DISCUSSIONS

6.1 Students Characteristics and Academic Achievement

The first objective of the study sought to establish the student characteristics that accounted for variation in achievement in KCSE examination in Busia County, Kenya. 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 the study, 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 and the remaining 45.74% being explained by student characteristics namely; gender (female student), student's prior academic achievement, student's parent involved in discussing academic, student's parent's provision of school requirements and student's parent involved in attendance of meetings. The random intercept model depicted in Table 7 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).

6.2 Effects of Textbooks and Physical Facilities on Students Academic Achievement

The second objective sought to establish the effects of text books on students' academic achievement while the third objective sought to examine the relationship between physical facilities and students academic achievement in KCSE examination in Busia County, Kenya 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). 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.

7. CONCLUSION

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.

8. RECOMMENDATIONS

Based on the findings and conclusions, the study recommends that governments should invest in provision of text books and physical facilities for improved secondary school learning outcomes.

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