

Multivariate Analysis of Variance of Effect of Extra Lesson on Secondary School Students' Academic Performance in English Language and Mathematics in Kwara State

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Abstract— The study examined the Multivariate Analysis of duration and type of extra lessons undertaken by students and their effects on academic performance in secondary school using Multivariate Analysis of Variance (MANOVA). The study covers some selected schools in each of the three senatorial districts (zones) of Kwara State, Nigeria. The data collected was through the use of questionnaire and assessment test in English Language and Mathematics from 1191 randomly selected students. The outcome of MANOVA shown that type and duration of extra lessons contributed significantly to the performance of students in English Language and Mathematics combined together but their interaction was not significant. Further study using Analysis of Variance (ANOVA) revealed that type and duration of extra lessons have significant effect on students' academic performance in English Language as well as Mathematics. The pair of school and home extra lessons with school and holiday extra lessons were responsible for the significant effects. In the duration of extra lesson three pairs of combinations; an hour and more than 3 hours extra lessons, 2 hours and more than 3 hours extra lessons and 3 hours and more than 3 hours extra lessons contributed significantly to the students' academic performance in English Language as well as Mathematics. The holiday extra lesson and home extra lesson did better when compared to school extra lesson, hence the two are recommended for students with a duration that will not affects their extracurricular activities

Keywords: Type of extra lesson, Duration of extra lesson, Academic performance, Assessment, Multivariate analysis of variance

I. INTRODUCTION

Secondary school education in Nigeria has witnessed many policies implementations that led to the current three years in Junior Secondary School (JSS) and three years in Senior Secondary School when the 6-3-3-4 basic educational system was adopted in 1988. This system has been embraced by many for its ability to improve the standard of education which lead to good academic performance. The policy will be a success if is being funded by government with adequate provision of infrastructure and instructional facilities that would create the enabling environment for the policy to succeed [1].

The two subjects, English Language and Mathematics, considered in this paper are compulsory subjects for all the students in secondary schools in Nigeria no matter the

category of subjects' combinations. The students are grouped/categorized into three made up science, arts and commercial at the Senior Secondary School (SSS) with different subjects' combinations while those in Junior Secondary School (JSS) offer all subjects which cut across science, arts and commercial.

Extra lesson has been mostly used for students by stakeholders as parents and teachers for English Language and Mathematics which led to the choice of these two subjects for this study. The issue now is do the extra lesson impart more knowledge on students to make a significant progress in their result? The parents, guardians and other stakeholders have spent so much resources (money and time) on extra lesson which the true worth of it must be investigated to know whether it should be encouraged. The report of the National Population Commission on Basic Education Profile for North East Nigeria revealed that 38 percent of parental contribution and involvement in money and time goes to extra lesson [2].

The extra lesson in the context of this paper is viewed in angle of types as school extra lesson and duration of extra lesson as factors that affects students' academic performance in two compulsory subjects (English Language and Mathematics). The type of extra lesson grouped into school extra lesson, center lesson, home lesson and holiday lesson. While that of duration of extra lesson is categorized into 1hour, 2hours, 3hours and more than 3hours.

This paper is to determine the effects of these two factors on students' academic performance while paying attention to their interactions, leading to determining if the effect of type of extra lesson on students' academic performances in English Language and Mathematics were influence by duration of extra lesson.

II. LITERATURE REVIEW

The use of Multivariate Analysis of Variance (MANOVA) is not new in educational research but applications and results makes the different. One of the applications of MANOVA was to compare the support services to the size of the school's support staff and enrollment [3]. The study reveals among other things that there was significant relationship between enrollment and the provision of academic athletic support services.

One way MANOVA was used in examining the difference between the performance of students classified into non-athletes and athletes on the five ACT Scores in English Language, Mathematics, Science, Reading and composite as dependent variables [4]. It was found that there were significant differences on the ACT Score between the two groups of students. Further investigation using analysis of

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variance shows that athletes significantly performs better than non-athletes in Mathematics and Sciences while non-athletes performed significantly better in Reading than athletes.

MANOVA has also been used to find out if there was any significant different in students' academic performance between three Faculties of Agriculture and Life Sciences, Pure and Applied Sciences and Humanities, Management and Social Sciences of University of Federal University Wukari [5]. The result from the research showed that there exists no significant difference in the academic performance of the students in the three Faculties.

Some researchers also used the univariate aspect of analysis of variance known as NOVA to determine academic performance of students based on some factors. One of these works is the used ANOVA to analyse the data collected on family type and academic performance in which result from the analysis revealed that type of family significantly influenced students' academic performance [6].

The analysis of variance (ANOVA) was the statistical tool used in carrying out investigation on students' academic performance as a function of socio-economic status, parental education and occupation [7]. The study showed that students' academic achievement was only significantly influenced by socio-economic status and parents' education. In general family involvement students' academic performance is important to young children's literacy [8].

There are many other research articles on students' academic performance that uses other statistical tools apart from MANOVA to determine the effect of some factors on academic performance. Logistic regression was used in studying the effect of academic background, percentage of checkmarks in general knowledge, perceived efficiency, aptitude, interest in biological sciences and health, follow established regulations, drive and the pursue of social prestige on first year medical students' academic performance [9]. The research identified logistic regression as an efficient for valid conclusion. Also, Logistic regression as a statistical tool was used to study forty-one factors on academic performance of students of university of Maiduguri in MTH 101 [10].

The statistical tools used in various researches in studying academic performance are numerous but each author tries to use a set of independent variables (factors) that sometimes are different from each other [11], [12], [13], [14].

This paper focuses its attention to extra lesson which was also considered in another research [15] but for this paper extra lesson is considered in terms of type and duration. The extra lesson in this research article will uniquely be considered in two dimensions, which are the type of extra lesson and the duration of extra lesson.

III. RESEARCH INSTRUMENTS

This paper used questionnaire and assessment test as the major instruments of gathering information/data. There were two types of questionnaires which were constructed for JSS II students and another one for SSS II students. The questionnaires were validated by experts and reliability test using split-half reliability with coefficient of 0.86 JSS II questionnaire and 0.82 for SSS II questionnaire.

The assessment were set of questions which covers English Language and Mathematics for JSS II and SS II. The questions were set by professional teachers based on their core areas of interest in teaching.

IV. SAMPLING TECHNIQUES

The secondary schools in Kwara were grouped into the five senatorial districts/zones and in each zone were schools were classified as urban area and rural area. The schools in these two area were subsequently grouped into private and public schools. A total of eight schools were randomly selected from each zone which made up of five public schools and three private schools.

Thereafter, twenty-five students were randomly selected each from JSS II and SS II classes except where the students were not up to twenty-five.

V. DATA COLLECTION

The data used in this study came from the use of questionnaire in which data was collected on the type of extra lesson and duration of extra lesson. The imputation of the data from the questionnaire was done through the use of SPSS. There were a total of 1191 students randomly selected from JSS II and SSS II of the selected schools. The data on academic performance was collected from two assessment test in English Language and two assessment test in Mathematics for JSS II and SS II. The first assessment was based on syllabus while the second one was on general intelligent questions in the two subjects.

It is pertinent to note that the scores obtained from the assessment test may not reflect the scores of these students in other examinations especially in public examinations, where dates of examinations are given for a long period of time for students to prepare, because it was impromptus. That notwithstanding the pattern of performance is believed to be the same based on the knowledge acquired through class lesson and extra lesson.

VI. TWO-WAY MULTIVARIATE ANALYSIS OF VARIANCE (MANOVA)

The use of MANOVA is adopted for this study because of its advantages over univariate Analysis of Variance (ANOVA) with only one response variable. The analysis could as well use performance in English Language as a response variable and performance in Mathematics as a separate response variable as a separate analysis under ANOVA.

The calculations in MANOVA is based on matrix approach because there are more than one response variables which are students' academic performance in English Language and that of Mathematics. The independent variables are types of extra lesson (school extra lesson, center lesson, home lesson and holiday lesson) and duration of extra lesson (1hour, 2hours, 3hours and more than 3hours). The total sum of squares of and cross product matrix (SSCP) is partitioned in terms of between sum-of-squares and cross-products matrix (SSCPB) and a within sum-of-squares and cross-products matrix (SSCPW) with the equation below

$$SSCP_{Total} = SSCP_{Between} + SSCP_{Within} \quad [16].$$

After using matrix approach in computations to get F-ratio and the p – value which in turn are used to decide on which of the following hypotheses to accept.

Hypothesis 1

H₀₁: Students' academic performance in English Language and Mathematics is not significantly influenced by type of extra lesson undertaken by the students

V_s

H₁₁: Students' academic in English Language and Mathematics is significantly influenced by type of extra lesson undertaken by the students

Hypothesis 2

H₀₂: Students' academic in English Language and Mathematics is not significantly influenced by duration of extra lesson undertaken by the students

V_s

H₁₂: Students' academic in English Language and Mathematics is significantly influenced by duration of extra lesson undertaken by the students

Hypothesis 3

H₀₃: There is no significant difference between interaction of type and duration of extra lesson on students' academic performance in English Language and Mathematics

V_s

H₁₃: There is no significant difference between interaction of type and duration of extra lesson on students' academic performance in English Language and Mathematics

VII. RESULT AND DISCUSSION

Table 1: Box's Test for Homogeneity of Variance-Covariance

Box's M	287.812
F	6.295
df1	45
df2	330938.687
Sig.	.000

The Box's test of equality of variance in the table above is significant at with p-value = 0.05 at 5% level of significance, meaning that there is unequal variance among groups. The Pillai's test is therefore recommended for the interpretation of MANOVA output.

Table 2: MANOVA

Effect		Value	F	Hypoth- esis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.995	125087.018 ^b	2.000	1174.000	.000	.995
	Wilks' Lambda	.005	125087.018 ^b	2.000	1174.000	.000	.995
	Hotelling's Trace	213.095	125087.018 ^b	2.000	1174.000	.000	.995
	Roy's Largest Root	213.095	125087.018 ^b	2.000	1174.000	.000	.995
Type_of_Extra_lesson	Pillai's Trace	.011	2.247	6.000	2350.000	.036	.006
	Wilks' Lambda	.989	2.248 ^b	6.000	2348.000	.036	.006
	Hotelling's Trace	.011	2.248	6.000	2346.000	.036	.006
	Roy's Largest Root	.009	3.646 ^c	3.000	1175.000	.012	.009
Duration_of_extra_lesson	Pillai's Trace	.019	3.769	6.000	2350.000	.001	.010
	Wilks' Lambda	.981	3.776 ^b	6.000	2348.000	.001	.010
	Hotelling's Trace	.019	3.783	6.000	2346.000	.001	.010
	Roy's Largest Root	.017	6.643 ^c	3.000	1175.000	.000	.017
Type_of_Extra_lesson * Duration_of_extra_lesson	Pillai's Trace	.023	1.552	18.000	2350.000	.064	.012
	Wilks' Lambda	.977	1.553 ^b	18.000	2348.000	.064	.012
	Hotelling's Trace	.024	1.554	18.000	2346.000	.064	.012
	Roy's Largest Root	.018	2.363 ^c	9.000	1175.000	.012	.018

The table above shows that type of extra lesson has significant influence or effects on a combination of students' academic performance in English Language and Mathematics (p-value = 0.036) at 5% level of significance. Using the same level of significance of 5%, duration of extra lesson has significant effects on a combination of students' academic performance in English Language and Mathematics (p-value = 0.001). Whereas, the interaction of extra lesson and duration of extra lesson do not have significant effect on a

combination of students' academic performance in English Language and Mathematics (p-value = 0.064).

In order to determine the effects of these two factors (English Language and Mathematics) in students' academic performance in English Language separate from its effects in Mathematics, there is need for univariate analysis of variance (ANOVA) which is in the table below.

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Table 3: ANOVA

Source	Dependent Variable	Type I Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	English_Score	11476.335 ^a	15	765.089	2.668	.001	.033
	Mathematics_Score	16980.227 ^b	15	1132.015	2.675	.001	.033
Intercept	English_Score	4588501.784	1	4588501.784	16001.008	.000	.932
	Mathematics_Score	4103147.637	1	4103147.637	9696.345	.000	.892
Type_of_Extra_lesson	English_Score	2950.282	3	983.427	3.429	.017	.009
	Mathematics_Score	4235.109	3	1411.703	3.336	.019	.008
Duration_of_extra_lesson	English_Score	5602.280	3	1867.427	6.512	.000	.016
	Mathematics_Score	8119.990	3	2706.663	6.396	.000	.016
Type_of_Extra_lesson * Duration_of_extra_lesson	English_Score	2923.773	9	324.864	1.133	.336	.009
	Mathematics_Score	4625.127	9	513.903	1.214	.282	.009
Error	English_Score	336946.881	1175	286.763			
	Mathematics_Score	497218.136	1175	423.164			
Total	English_Score	4936925.000	1191				
	Mathematics_Score	4617346.000	1191				
Corrected Total	English_Score	348423.216	1190				
	Mathematics_Score	514198.363	1190				

The result from analysis of variance as exhibited in table 3 shows that there is significant influence of type of extra lesson on students' academic performance in English Language as well Mathematics at 5% level of significance with p-values of 0.017 for English language and 0.019 for Mathematics. The work of [15] also supported that extra lesson has effect on students' academic performance.

There is also a significant influence of duration of extra lesson on students' academic performance in English Language as well Mathematics but at any level of significance with p-values of 0.000 for English language and 0.000 for Mathematics.

Table 4: Post Hoc (Type of extra lesson)
LSD

Dependent Variable	(I) Type of extra lesson	(J) Type of extra lesson	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
						English_Score	School extra lesson
Home Lesson	-2.89 [*]	1.253	.021	-5.35	-.44		
Holiday lesson	-3.74 [*]	1.331	.005	-6.35	-1.13		
Center lesson	School extra lesson	1.87	1.667	.262	-1.40		5.14
	Home Lesson	-1.02	1.828	.577	-4.61		2.57
	Holiday lesson	-1.87	1.883	.322	-5.56		1.83
Home Lesson	School extra lesson	2.89 [*]	1.253	.021	.44		5.35
	Center lesson	1.02	1.828	.577	-2.57		4.61
	Holiday lesson	-.85	1.528	.580	-3.84		2.15
Holiday lesson	School extra lesson	3.74 [*]	1.331	.005	1.13		6.35
	Center lesson	1.87	1.883	.322	-1.83		5.56
	Home Lesson	.85	1.528	.580	-2.15		3.84
Mathematics_Score	School extra lesson	Center lesson	-2.06	2.025	.308	-6.04	1.91
		Home Lesson	-3.48 [*]	1.522	.022	-6.47	-.50
		Holiday lesson	-4.48 [*]	1.617	.006	-7.65	-1.31
	Center lesson	School extra lesson	2.06	2.025	.308	-1.91	6.04
		Home Lesson	-1.42	2.221	.523	-5.78	2.94
		Holiday lesson	-2.41	2.287	.291	-6.90	2.07
	Home Lesson	School extra lesson	3.48 [*]	1.522	.022	.50	6.47
		Center lesson	1.42	2.221	.523	-2.94	5.78
		Holiday lesson	-1.00	1.856	.592	-4.64	2.65
	Holiday lesson	School extra lesson	4.48 [*]	1.617	.006	1.31	7.65
		Center lesson	2.41	2.287	.291	-2.07	6.90
		Home Lesson	1.00	1.856	.592	-2.65	4.64

Looking for the pair of type of extra lesson that bring about the significant effects on students' academic performance in English Language as well as Mathematics at 5% level of significant. Table 7 shows that two pairs of combinations, school extra lesson and home extra lesson (p-value = 0.021)

and school extra lesson and holiday extra lesson (p-value = 0.005) contributed significantly to the students' academic performance in English Language. The same two pairs of combinations, school extra lesson and home extra lesson (p-value = 0.022) and school extra lesson and holiday extra

lesson (p-value = 0.006) contributed significantly to the students' academic performance in Mathematics.

A closer look at difference in mean of the combinations indicates that both home and holiday extra lessons contributes

more to the performance of students in both English Language and Mathematics.

Table 5: Post Hoc (Duration of extra lesson)
LSD

Dependent Variable	(I) Duration of extra lesson	(J) Duration of extra lesson	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
English_Score	An Hour	2Hours	-.46	1.294	.724	-2.99	2.08
		3 Hours	.27	1.375	.842	-2.42	2.97
		More than 3 Hours	-6.43*	1.609	.000	-9.58	-3.27
	2Hours	An Hour	.46	1.294	.724	-2.08	2.99
		3 Hours	.73	1.275	.567	-1.77	3.23
		More than 3 Hours	-5.97*	1.525	.000	-8.96	-2.98
	3 Hours	An Hour	-.27	1.375	.842	-2.97	2.42
		2Hours	-.73	1.275	.567	-3.23	1.77
		More than 3 Hours	-6.70*	1.594	.000	-9.83	-3.57
	More than 3 Hours	An Hour	6.43*	1.609	.000	3.27	9.58
		2Hours	5.97*	1.525	.000	2.98	8.96
		3 Hours	6.70*	1.594	.000	3.57	9.83
2Hours		-.70	1.571	.655	-3.79	2.38	
An Hour		.25	1.670	.883	-3.03	3.52	
More than 3 Hours		-7.79*	1.955	.000	-11.63	-3.96	
Mathematics_Score	An Hour	.70	1.571	.655	-2.38	3.79	
	2Hours	.95	1.549	.541	-2.09	3.99	
	More than 3 Hours	-7.09*	1.852	.000	-10.72	-3.45	
	An Hour	-.25	1.670	.883	-3.52	3.03	
	3 Hours	-.95	1.549	.541	-3.99	2.09	
	More than 3 Hours	-8.04*	1.937	.000	-11.84	-4.24	
More than 3 Hours	An Hour	7.79*	1.955	.000	3.96	11.63	
	2Hours	7.09*	1.852	.000	3.45	10.72	
		3 Hours	8.04*	1.937	.000	4.24	11.84

Considering the Post Hoc test for the pair of durations of extra lesson that contributed significantly to the students' academic performance in English Language separate from Mathematics at 5% level of significant. Table 5 shows that three pairs of combinations, an hour extra lesson and more than 3 hours extra lesson (p-value = 0.000), 2 hours extra lesson and more than 3 hours extra lesson (p-value = 0.000) and 3 hours and more than 3 hours extra lesson (p-value = 0.000) contributed significantly to the students' academic performance in English Language. The same three pairs of combinations; an hour extra lesson and more than 3 hours extra lesson (p-value = 0.000), 2 hours extra lesson and more than 3 hours extra lesson (p-value = 0.000) and 3 hours and more than 3 hours extra lesson (p-value = 0.000), also contributed significantly to the students' academic performance in Mathematics.

A closer look at difference in mean of the combinations indicates that more than 3 hours extra lessons contributes more to the performance of students in both English Language and Mathematics than an hour, one hour and three hours of extra lesson.

VIII. CONCLUSION

The introduction of extra lesson has brought improvement on students' academic performance in English Language and Mathematics. The type of extra lesson that can be encouraged in order of their important are holiday extra lesson, home extra lesson and school extra lesson. Considering the duration of extra lesson, the result shows that the longer period of lesson (more than three hours) are of advantage of a better result.

IX. RECOMMENDATIONS

The participation of students in extra lesson is very important to improve their performance in the core subjects of English Language and Mathematics.

Therefore, holiday extra lesson and home lesson is recommended for students with a duration that will not affects their extracurricular activities, even though the longer the duration the better. Further researches is encouraged in this area, especially on duration to really determine a duration based on other factors to bring about equilibrium on the negative effect of being too longer.

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