Analysis of the Predictive Validity of Students' Performance in Core Sciences on Liberian SHSCE with WASSCE as the Criterion

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Abstract: *The performance of students in public examinations in Liberia has been an issue of serious concern to stakeholders. The quality of education in the country is threatened by the discernible decline in students' performance on public examinations especially after the civil crisis in Liberia. The purpose of this study was to determine the extent to which students 'performance in the core science subjects on Liberian Senior High School Certificate Examination (LSHSCE) influence their performance in the West African Senior School Certificate Examination (WASSCE). The study used an ex post facto design using 9,311 students who sat for both the LSHSCE and the WASSCE in 2013 and 2014 as sample. The result of the independent sample t-test shows that students differ significantly in their overall performance on LSHSCE and WASSCE based on genderand school location.Using multiple regression the study found that students overall performance in the core science subjects on LSHSCE significantly predicted their overall performance in WASSCE. Performance in biology and physics on LSHSCE significantly predicted their performance on WASSCE in the same subjects, but students' performance in chemistry on LSHSCE wasn't a good predictor of their in chemistry on WASSCE. The study concluded that even though students' performance on the national exam influenced their performance on the regional exam, this does not guarantee that the Country is ready to fully adopt the regional examination. The implications and recommendations for practice and policy are presented in the study.*
Keywords:*Performance, core science, LSHSCE,WASSCE, Predictive validity.*

I. Introduction

Education is regarded as the key to success, as a result it is given huge attention by the society, politicians and other stakeholders in their attempt to promote societal norms, national philosophy and vision. It is because of the essential role accredited to education that a substantial portion of national resources is allocated for education. Consequently, the continuous poor performance of students in Liberian senior high schools has been an issue of serious concern to stakeholders for almost two decades after the civil crisis in the country. Experts warn that the quality of education in Liberia is threatened by the discernible decline in students' performance at all level of the education system.

In Liberia like many countries, students are assessed at the terminal stage of secondary education in the form of national examinations. There are two national examinations administered at the end of every academic year in Liberia: The Liberia Junior High School Certificate Examination (LJHSCE) and the Liberia Senior High School Certificate Examination (LSHSCE). Candidates sitting the examination are to enter for all four subjects offered on the examination (mathematics, general science, language arts, and social studies) and obtain the minimum passing mark of 60% per subject. The certificate is only awarded to candidate who passes at least three of the four subjects. On the other hand, the LSHSCE is opened to all students in the 12th grade but candidates are to enter for a minimum of eight subjects and a maximum of nine subjects from three subjects groups; core subjects (English language and mathematics), general subjects (economics, geography, history and literature – in – English) and science subjects (biology, chemistry, and physics). However, unlike the LJHSCE, to qualify for the LSHSCE a candidate must pass at least six subjects including the core subjects and at least a subject each from the other two groups with a minimum grade of 7 – 8 representing a pass mark (WAEC, 2016). Unfortunately, the results published by WAEC from these examinations continue to show decline in secondary school students' performance (The INQUIRY, 2011, Women Voices, 2011, The Editorial, 2009, and The VARSITY PILOT, 2009).

For almost two decades, Liberian secondary school students could not compete with their West African counterparts on regional examinations such as the West African Senior School Certificate Examination (WASSCE). Educational authorities often attributed this to the effects of the civil war in the country; indicating that the country is unprepared to compete beyond the national level (MOE, 2014). However, in order to validate the claims and counter claims regarding students' performance, the ministry of education made a decisive jump into introducing WASSCE to the Liberian people with the plan to begin competing at the international level. WAEC-Liberia was mandated by the Ministry of Education to pilot WASSCE with candidates in 32 schools

around the country as a means of testing the quality of the educational system beyond the national level in 2013. These schools were selected based on their previous performance in LSHSCE; hence they were regarded to have produced the best candidates as far as national performance was concern. Regrettably, the pilot results showed that students' performance was miserable especially in the science subjects. Despite the results, in 2014 follow up WASSCE was also administered with a larger sample of schools. The results also showed very poor performance of students.

It was therefore imperative to examine the predictive validity of the LSHSCE using WASSCE as criterion because the latter was introduced to validate the former in terms of students' performance. According to Ukwuije (2009), the validity of a test is the most important attribute of a test and concerns with what the test measures and how well. Osadebe (2003) specially described predictive validity as the extent to which test scores relate to a criterion score. In line with the view of Orubu (2012), this study used predictive validity to provide a framework for determining the degree of accuracy or credibility that can be accorded LSHSCE in terms of students' performance. Interest, there is no such study conducted in Liberia and so this current study provides the platform to understanding the extent to which these examinations are valid in terms of students' performance.

Statement of the Problem

Poor performance has been the hall mark of national examinations especially after the civil crisis in Liberia. However, in themidst of public outcry about the poor quality of education in Liberia, the Ministry of Education introduced WASSCE as a pilot examination to determine whether performance would change positively. Unfortunately, since the introduction of WASSCE there is still a discernible decline in high school students' performance at all levels of academic assessment. The MOE failed to convince stakeholders whether performance on LSHSCE would predict performance on WASSCE since the two examinations are more or less similar in purpose and scope. Therefore, there wasan urgent need to establish the predictive validity of students' performance on LSHSCE with WASSCE as a criterion before the MOE make any decision whether to fully embrace WASSCE as an international examination.

Purpose of the study

The purpose of the study was to determine the extent to which students 'performance in the core science subjects on Liberian Senior High School Certificate Examination (LSHSCE) influence their performance in the West African Senior School Certificate Examination. Specially, the study sought to find answers to the following questions:
1. Does students' performance in the core sciences differ significantly on LSHSCE and WASSCE based on gender?
2. Does students' performance in the core sciences differ significantly on LSHSCE and WASSCE based on school location?
3. To what extent does students' performance on LSHSCE predict their performance on WASSCE in the core sciences?

Research Hypotheses
1. There is a significant mean difference between male and female students' performance in the core sciences on LSHSCE and WASSCE based on gender?
2. There is a significant mean difference between male and female students' performance in the core sciences on LSHSCE and WASSCE based on school location?
3. There is a significant influence of students'performance in LSHSCE on their performance in WASSCE in the core sciences.

II. Methodology

The study was underpinned by the positivist paradigm and adopted a quantitative research approach, as a belief system which dominated most of research (Johnson, 2014).A combination of correlational and ex post facto design was used in this study because the combination of these designs facilitated a thorough investigation into the relationship and predictive nature of the variables (Simon & Goes, 2013).

The target population included all secondary school students (N = 9311)who sat for LSHSCE and WASSCE between 2013 and 2014.Stratified random sampling was used by grouping schools according to location (urban & rural) and then grouping students according to gender of students. However, the sample included all students in the target population who had marks for both LSHSCE and WASSCE. The study used LSHSCE and WASSCE results as instruments. To enhance analysis, the target group performance scores in the core sciences were extracted from the country data base in both LSHSCE and WASSCE.Cognizant with the fact that these are standardized examinations, the data were analytically manipulated in line with the research

hypotheses in order to ensure validity of the findings. It was also presumed that the results of these examinations were already standardized holding to Examining body own proceedings.In line with ethical issues, researcher permit was obtained from the Ministry of Education, republic of Liberia and anonymity of students' information was ensured throughout the study. To enhance analysis, the data was extracted from WAEC Microsoft excel spread sheet data and then transfer into SPSS 22 for analysis.Both independent sample t-test and multiple regressions were used to analyze the data. The null hypotheses were tested at the significance level, .05.

III. Results and Interpretation

Ho₁: There is no significant mean difference between male and female students' performance in the core sciences on LSHSCE and WASSCE based on gender?

To test this hypothesis, an independent t-test was carried out. The results in Table 1 show significant mean difference between male and female students' overallperformance in LSHSCE and WASSCE, $t(9054) = -2.90$, $p = .004$ and $t(8435) = 9.266$, $p < .001$ respectively.Furthermore, there is a significant mean difference between male and female students performance in biology, chemistry, and physics on WASSCE, $t(8689) = 10.36$, $p < .001$, $t(8927) = 5.395$, $p < .001$, and $t(9008) = 3.906$, $p < .001$ respectively. However, significant mean difference is found in biology and chemistry on LSSCE but no significant mean difference exist in physics on LSHSCE, $t(9181) = 3.308$, $p = .001$, $t(9257) = 3.378$, $p = .001$, and $t(9110) = 1.867$, $p = .062$ accordingly. The results mean that the overall performance of male students in LSHSCE and WASSCE is different from the overall performance of female students. The results indicate that male students performed differently from female students in all core sciences on WASSCE and they differ in biology and chemistry on LSHSCE, but showed similar performance in physics on LSHSCE. This implies that being a male or female student does determine the extent to which one performs on these examinations. These findings concord with those of Coley (2010), Ugwuda and Abonyi (2013), and Unity and Igbuda (2015) but disagree with those of Agbaje and Alake (2014), and Awodun, Oni, and Aladejana (2014).

Table 1 Independent Sample t-Test of Gender Mean difference in performance on WASSCE and LSHSCE

Variable	Gender	X	SD	Mean Diff	Std. Diff	Error	t	df	Sig. (2-tailed)
	Male	11.57	4.381	.930	.090				
WB	Female	10.64	4.038				10.364	8689	.000*
		7.89	3.097	.352	.064		5.495		.000*
WC	Male							8927	
	Female	7.54	2.891						
		7.76	2.739	.218	.056		3.906		.000*
WP	Male							9008	
	Female	7.54	2.494						
	Male	16.82	7.467	.517	.156		3.308	9181	.001*
LB	Female	16.30	7.416						
	Male	19.64	9.758						
LC	Female	18.95	9.731	.688	.204		3.378	9257	.001*
		22.41	11.130	.442	.237		1.867		.062
LP	Male								
	Female	21.96	11.371					9110	
	Male	9.20	2.760						.000*
OW	Female	8.67	2.470	.525	.057		9.266		
								9054	
	Male	19.74	8.556						
OL	Female	19.21	8.623	.527	.182		2.900		.004*
								8435	

Note: WB, WC, and WP = performance in biology, chemistry, and physics on WASSCE respectively.
LB, LC, and LP = performance in biology, chemistry, and physicson LSSCE respectively.
*Significant at .05 two-tailed

Ho₂: There is no significant mean difference between urban and rural students' in their performance on LSHSCE and WASSCE in the core sciences.

This hypothesis was tested using independent t-test on the data. Table 2 reveals that on average, urban students obtained higher marks ($M = 19.57$, $SD = 8.38$) then rural students ($M = 19.14$, $SD = 9.29$) on LSHSCE as there was a significant difference in their overall performance$t_{(8866)} = 1.977$, $p = .048$. Similarly, on average urban students performed better ($M = 9.02$, $SD = 2.810$), than their rural counterparts, ($M = 8.85$, $SD = 2.175$) on WASSCE as the difference between the two groups is significant, $t_{(8866)} = 2.946$, $p = .003$. Furthermore, theresults show that there is a significant difference between urban and rural students' performance in biology and chemistry on LSHSCE, $t_{(8866)} = 2.946$, $p = .003$ and $t_{(8866)} = 2.946$, $p = .003$ and on WASSCE, $t_{(8866)} = 2.946$, $p = .003$ and $t(8866) = 2.946$, $p = .003$ respectively. However, urban and rural students' performance in physics

onLSHSCE and WASSCE does not significantly differ, $t_{(8866)}$ = 2.946, p = .003 and t (8866) = 2.946, p = .003 respectively. This means that urban students though performed better than rural students in biology and chemistry on LSHSCE and WASSCE, their performance in physics on LSHSCE and WASSCE do not significantly differ.In other words, urban students' performance on LSHSCE and WASSCE in the core sciences is better than rural students except for their performance in physics, which seems not to differ. These findings confirmed those of Owoeya and Yara (2011), Nwafor (2014) Ezeudu and Obi (2013), Yara and Catherin (2011), and Onah (2010) but contrary to the finding of Bosede (2010) who found no significant difference between urban and rural students' performance.

Table 2 Independent Sample t-Test of urban and rural students Mean difference in performance on WASSCE and LSHSCE (df=8,866)

Variable	Gender	X	SD	Mean Diff	Std. Error Diff	t	Sig. (2-tailed)
	Urban	11.38	4.460	.763	.094	8.107	.000*
WB	Rural	10.61	3.623				
	Urban	7.65	3.049	-.358	.074	-4.848	.000*
WC	Rural	8.01	2.938				
	Urban	7.64	2.717	-.066	.061	-1.080	.280
WP	Rural	7.71	2.437				
	Urban	16.45	7.333	-.364	.186	-1.958	.050*
LB	Rural	16.81	7.857				
	Urban	19.53	9.626	1.086	.240	4.534	.000*
LC	Rural	18.44	10.133				
	Urban	22.30	11.071	.397	.281	1.410	.159
LP	Rural	21.90	11.891				
	Urban	9.02	2.810	.172	.058	2.946	.003*
OW	Rural	8.85	2.175				
	Urban	19.57	8.376	.432	.219	1.977	.048*
OL	Rural	19.14	9.288				

Note: WB, WC, and WP = performance in biology, chemistry, and physics on WASSCE respectively.
LB, LC, and LP = performance in biology, chemistry, and physics on LSSCE respectively.
*Significant at .05 two-tailed

Ho₃:*There is no significant influence of students' performance in LSHSCE on their performance in WASSCE in the core sciences.*

Multiple regression analysis (Enter method) was performed using overall performance on WASSCE and performance in biology, chemistry, and physics on WASSCE as criterion variables and overall performance on LSHSCEalong with performance in biology, chemistry, and physics on LSHSCEas the predictorvariables. The results in Table 3reveal a significant fit of the overall model, F (1, 8419) = 295.587, $p<.001$, with an R^2 of .034. Students' overall performance in LSHSCE significant predictor their overall performance in WASSCE, t(8420) = 17.193, p < .001. This means thatstudents' overall performance in LSSCE (OPL) is a good predictor of their overall performance in WASSCE (OPW). The result also showed a significant fit of the performance in LSSCE biology, chemistry, and physics, F (1, 8865) = 171.59, $p< .001$, R^2 =.019, F (1, 8865) = 87.10, $p< .001$, R^2=.019, and F (1, 8865) = 72.71, $p< .001$, R^2 =.024 respectively. Students' performance in biology and physics on LSHSCE significantlycontribute to the variability in students'performance in the same subjects on WASSCE, t(8866) = 13.099, p< .001 and t (8866) = 6.564, $p<$ .001respectively. However, students' performance in chemistry on LSHSCE do not significantly predict their performance in chemistry on WASSCE, t(8866) = -1.607, p= .108.This means that students' performance in biology on LSHSCE (PBL) and physics on LSHSCE (PPL) account for significant portion of the variability in their performance in biology on WASSCE (PBW) and physics on WASSCE (PPW). In other words, the results imply that students' performance in biology and physics on LSHSCEdetermines their performance in the same subject on WASSCE. However, students' performance in chemistry on LSHSCE(PCL) does not influence the way they perform in chemistry on WASSCE (PCW). Several studies (Moreetsi & Mbako, 2008; Evroro, 2015; Kpolovie, Ololube, & Ekwebelem, 2011) found similar findings, but diverge from those of Komba, Kafanabo, Tryphone, and Kira (2013), Ojedapo and Nwaji, (2012), Elishama (2014), and Edokpayi and Suleiman (2011). Hence, the four regression models can be represented by the equations:

OPW_i = 7.860 + .057 $OPL_;$
PBW_i = 6.857 + .049 $PBL_;$
PCW_i = 6.878 -.007 $PCL_;$
PPW_i = 6.814 + .026 $PPL_;$

Table 3 Multiple Regression analysis of the Influence of Attitude towards Practical Work on Their Perceived Achievement in Biology

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
1	.184[a]	.034	.034	2.604	
2	.138[a]	.019	.019	2.610	
3	.139[b]	.019	.019	2.610	
4	.155[c]	.024	.024	2.604	
	Sum of Squares	df	Mean Square	F	Sig.
Regression	2003.594	1	2003.594	295.587	.000[b]
Residual	57066.886	8419	6.778		
Total	59070.480	8420			
Regression	1168.968	1	1168.968	171.594	.000[b]
Residual	60391.879	8865	6.812		
Total	61560.847	8866			
Regression	1186.568	1	593.284	87.104	.000[c]
Residual	60374.279	8865	6.811		
Total	61560.847	8866			
Regression	1478.642	1	492.881	72.707	.000[d]
Residual	60082.205	8865	6.779		
Total	61560.847	8866			
	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	7.860	.071		111.063	
Overall SHSCE	.057	.003	.184	17.193	.000[a]
(Constant)	6.857	.068		100.554	
performance in LSSCE biology	.049	.004	.138	13.099	.000[b]
(Constant)	6.878	.069		99.047	
performance in LSSCE chemistry	-.007	.004	-.026	-1.607	.108[c]
(Constant)	6.814	.070		97.386	
performance in LSSCE physics	.026	.004	.109	6.564	.000[b]

a. Predictor: LSSCE biology, Dependent Variable: WASSCE biology
b. Predictor: LSSCE chemistry, Dependent Variable: WASSCE chemistry
c. Predictor: LSSCE physics, Dependent Variable: WASSCE physics
d. Predictors: LSSCE biology, LSSCE chemistry, LSSCE physics, Dependent variable: Overall WASSCE

IV. Discussionand Implications

Given the results of the study, it can be deduced that on average male students performed better than female students in their overall performance in the core sciences on LSHSCE and WASSCE. Furthermore, male students performed better than female students in all core sciences on WASSCE as well as in biology and chemistry on LSHSCE, but their performance did not differ from female performance in physics on LSHSCE. This finding can be attributed to the fact that male students are considered to excel in the sciences as compare to their female counterpart. Another explanation for this could be that most science teachers tend to focus on male students than female especially in chemistry and physics.

The study also foundthat the overall performance of urban students' both on LSHSCE and WASSCE in the core sciences is better than rural students' performance. Specifically, urban students out performed rural students in biology and chemistry on LSHSCE and WASSCE, but their performance in physics both on LSHSCE and WASSCE did not significantly differ. This is possibly due to the common fact that most qualified teachers often prefer urban schools because of many opportunities found in the urban settings. In the instance where they are sent to rural schools, they tend to abandon their duties thus affecting students' learning in those areas.

Students' overall performance on LSHSCE significantly predicts their overall performance in WASSCE. This implies that if students' perform well on LSHSCE then they are expected to perform well on WASSCE. The vice versa also holds true, if students' poorly perform on LSHSCE they are likely to poorly perform on WASSCE. It can be concluded that students' performance on LSHSCE is a good predictor of their performance on WASSCE. The study also found that students' performance in biology and physics on LSHSCEsignificantly predict their performance in biology and physics on WASSCE. But their performance in chemistry on LSHSCE did not influence the way they perform in chemistry on WASSCE. The results imply that students' performance in biology and physics on LSHSCE determines their performance in the same subject on WASSCE, but their performance in chemistry on LSHSCE cannot possibly influence their performance in chemistry on WASSCE. It can be inferred from the results that students' performance in biology and physics on LSHSCE are good predictors of their performance on WASSCE in the same subjects. But their performance in

chemistry on LSHSCE is a poor predictor of their performance in chemistry on WASSCE.

The difference found in performance between male and female as well as urban and rural students, though significant, the overall performance in the core sciences on these examinations was very poor. The results do not imply that male or female, urban or rural students are better off than the other because all of them fell below national average on these examinations. Importantly, even though most of the predictors were significant, students' performance in the core sciences on these examinations was very poor. Therefore, the significant results found do not imply that Liberian students are well prepared to compete with their West African counterparts on WASSCE, but rather it indicates that more is yet to be done in order to compete at the region stage.

V. Recommendations

Given the results of the study, it is recommended that:

1. Science teachers should ensure that all students; male and female, are given equal opportunity in science lessons. To achieve this, teachers should give students equal attention, fair tasks, and inspire students through mixed group works and projects. This will help close the gap between male and female students in regards to their performance in the sciences.
2. The Ministry of Education (MOE) should employ and deploy qualified teachers in all of the public schools regardless of location. This can be done by implementing a stringent vetting process for would be teachers, providing necessary support and conducive habitat for teachers, and ensure that rural teachers receive attractive compensation so as to reduce attrition.
3. The Ministry of Education should delay the adoption of WASSCE for another decade so as to adequately prepare future candidates. The MOE should use the results of WASSCE and LSHSCE to revitalize the education system by providing professional development training for in-service teachers, intentionally hiring qualified teachers, and reforming the curriculum to align it with contemporary trend.
4. The MOE should establish a national assessment authority, which will be solely responsible for developing and administering national examinations such as LSHSCE and LJSCE instead of using the West African Examination Council (WAEC). This will help to revamp the educational system by aligning instruction objectives with appropriate assessment tasks while attempting to meet international standard.

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