Some Correlates of Senior Secondary Students' Achievement in Chemistry Practical Skills

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Abstract

This study investigated correlates of contributory factors to learning outcomes in chemistry. The study adopted a survey research design. The samples were stratified randomly and selected from five (5) local Government Area of Rivers Stale, with 600 students, 20 schools, and 20 SS2 chemistry teachers in Rivers State taking part in the study. Four (4) instruments were used for data collection, check list of chemistry Apparatus (CCA). Students Practical Skills Test in Chemistry (SPSTC), Students Chemistry Achievement Test (SCAT) and Teachers Attitude Questionnaire in Chemistry (TAQC). All the instruments were constructed by the researcher and data obtained were analyzed using multiple regressions. The results of the study showed a linear relationship between the predictor variables and students' achievement in chemistry. The obtained regression equation resulting from the set of the nine (9) predictor variables allow reliable, predictor of students achievement in chemistry and the nine predictor variable accounted for approximately 0.8% of variance in students practical skills ($R^2 = 126$, Adjusted $R^2 = 113$). The Beta weight are significant corresponding to the variables regressed against the dependent variable. Class Size, ($\beta = .206$; $t = 4.691$, $p < .000$). Laboratory adequacy ($\beta = 106$, $t = -2.506$, $p < .013$), Teacher qualification ($\beta = 110$; $t = 2.249$, $p < .025$), and Workshop attendance ($\beta = 123$; $t = 2.889$, $p < .004$) were found to be significantly contributing to the achievement in Chemistry.

Keywords: Correlate, Senior Secondary Achievement, Practical skills.

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INTRODUCTION

Nigeria like other developing countries invests heavily in the teaching and learning of practical work in skill and chemistry in particular. However this high input of resources does not seem to be reflected in the assessment of student's performance in practical skill or work. Chemistry is a practical subject which is concerned with the study of matter and its transformation through such processes as heating, electrolysis and other chemical processes (Twoli, 2006).

Chemistry is one of the important subjects in sciences. It is widely accepted and made compulsory for all science students because of its importance in life. Chemistry is unique; being a subject that deals with matter, its knowledge therefore is required in all aspects of human endeavor such as medicine, pharmacy, Bio-technology, food production in Industries, Agriculture and horticulture, nursing, organs transplant, development of vaccines and drugs, and so on. This distinguishable factor is so important that every student needs to have at least an attempt in (WACE) with a credit pass in order to further his or her studies in tertiary institutions. Therefore it has become a force to reckon with in the field of academics. To achieve this aim, teachers need to put in all it takes to ensure their students pass the subject in both the internal and external examinations (Pepple, 2010).

Despite the importance of Chemistry as a natural science, it has long been a problem to students. This is reflected in the declining success in it over a decade ago. It has constituted a lot of problems to Chemistry teachers, school principals, parents, and even school counselors. This general concerns stems from the prevailing poor achievement recorded by students almost each succeeding year at the end of their secondary school course. Attaining a high level of academic achievement is what every parent or guardian wishes for his or her children. Teachers wish the same thing for their students because schools and teachers are generally graded qualitatively by the achievement of their parents, students and teacher wants to associate themselves with schools that have recorded a high level of achievement both in the past and in the present.

In spite of the important nature of chemistry to life and the need students have for chemistry for their academic pursuits, students do not seem to do as well as expected in it. Many of the studies on Nigerian students achievement in the SSCE conducted over 15 years, such as Ivowi (2005), Sowole (2006), indicated that students' achievement in chemistry had been very poor. Also Alonge (2006) examined the potential science output of Nigerian schools. He found that only 10 of the candidates who enter the mathematics, chemistry and physics, in four selected years, had appropriate grades which could qualify them to register for any of the science and technology based courses.

Chemistry is one of the science subjects taught at secondary school level, others being physics and Chemistry. It is presented in the syllabus as a practical subject in which scientific concepts, principles and skills are experimentally investigated. It is examined nationally through two theory papers, 233/1 and 233/2 and one practical paper, 233/3. A pass in the practical paper is mandatory for a student to be considered to have pass chemistry (WAEC, 2005). This requirement shows the importance attached to practical skill in chemistry and science in general. Practical examination in chemistry tests whether candidates have acquired certain skills and competencies which include;

- Manipulative skills for example, correct measurement of volume using a variety of measuring instruments;
- Ability to make accurate observations, those that lead to useful deductions;

- Ability to record observations accurately;
- Ability to follow a set of instructions and carry out experiments (WAEC, 2005).

The skills and competencies assessed by WAEC in practical examination are in line with some of the general objectives of teaching/learning chemistry a prescribed in the chemistry syllabus. Examples of such objectives are;

- To select and handle appropriate apparatus for use in experimental work;
- To make accurate measurements observations and draw logical conclusion from experiments. The chemistry practical examination is usually marked out of 40 marks but the performance has been below average.

Chemistry laboratory equipment and chemicals are indispensable for effective teaching" and learning of chemistry. But they are rarely adequately available due to their high costs. As a result many chemistry teachers could not conduct practical's as at when due. Instead they wait until the period of external examinations is at hand. The conscientious and resourceful chemistry teachers resort to demonstration, even though it cannot replace the experience students have when they perform the experiment themselves (Ezeano, 2008).

Correlate is defined as a process of bringing into mutual or reciprocal relation, establish in orderly connection. The government of Nigerian recognizes the importance of sciences and mathematics in the realization of its vision, to become a globally competitive and prosperous country. This is reflected in the amount of resources both human and otherwise that are channeled toward enhancing the teaching and learning of science and Mathematics at all levels of any school level. A number of intervention strategies have been put in place to ensure that the teaching/ learning of these subjects are effective as possible. Apart from providing trained teachers to handle these subjects the government has institutionalized in-service Education and training (INSET) of serving science and Mathematics teachers programme and quite a substantial amount of the Ministry of Education's budget goes toward this (M O E, 2005).

The roles and place of teachers can never be over emphasized. It is the teachers who are the closest to the students and who are responsible for translating the curriculum content into achievable terms. In doing this, it is likely to be influenced by some characteristics such as: Qualification, Areas of specialization, teaching experience, workload and so on. Adedigba (2006) stated that in term of specific contributions of (1) Experience contributed the highest followed by (2) teachers workload, (3) teachers' qualification, (4) teachers' areas of specialization, (5) teachers' attitude to teaching, (6) gender, (7) class size, (8) laboratory adequacy, (9) Teachers attendance at workshops. Ogidiolu (2008) stated that experience in Nigeria has shown that the academic achievement of learners in primary and secondary schools depend largely, but certainly not entirely, on the competence and dedication of the teachers who has a significant role to play in the reshaping of his pupils who will perform very well.

This present study therefore, focused on investigating the effect of some contributory factors (teachers' experience, teachers' qualification, teachers' areas of specialization, teachers' attitude, teachers' attendance at workshop, laboratory adequacy, teachers' gender, teachers' workload, class size) on student's achievement and practical skills in Rivers Slate.

Research Questions

The researchers formulated the following research questions to guide the study;

- Are there relationship among the independent variables (Class size, workload, laboratory adequacy, teachers experience, teacher's qualification, teacher's attitude, and teacher's areas of specialization, teacher's attendance at workshop and teacher gender) and dependent variables (Achievement in Practical skills)?
- What are the composite contributions of school factors (Class size, Laboratory adequacy, work load, teachers qualification, teachers attitude, teachers attendance at workshop, teachers experience and teachers gender) on achievement in practical skills;
- What is the relative contribution of the school teachers and students factors on achievement in chemistry practical skills?

METHODS

Research Design

This is a survey study in which there is no manipulation of variables. The variables were used as they exist.

Variables in the Study

The independent variables in the study consist of the teachers experience, class size, laboratory adequacy, teachers' qualification, workload, teacher's attitude, workshop and gender. The dependent variable is the students' achievement in chemistry practical skills.

Population, Sample Techniques and Sampling

The target population for this study comprised of SSII chemistry students who completed SSI chemistry curriculum syllabus in Rivers State. The sample was stratified from five (5) Local Government Areas in Rivers State. four (4) public schools were randomly selected from each of the selected Local Government Area. This gave a total number of twenty (20) public schools that were selected. Stratified sampling was used to select 30 students in one arm of the SS II students in each of the 20 schools, and the chemistry teachers taking the selected classes was part of the sample. Hence, 600 students and twenty (20) teachers participated in the study. In all, the sample size consisted of 600 SS II chemistry students and 20 chemistry teachers in selected schools in Rivers State.

Instrumentation

- Checklist of Chemistry Apparatus (CCA);
- Students Practical Skills Test in Chemistry (SPSTC);
- Students Chemistry Achievement Test (SCAT);
- Teachers Attitude Questionnaire in Chemistry (TAQC)

Validation of Instruments

The four instruments; Checklist of Chemistry Apparatus (CCA), Students Practical Skill Test in Chemistry (SPSTC), Students' Chemistry Achievement Test (SCAT) and Teachers Attitude Questionnaire in Chemistry (TAQC), were given to some experts in test construction who determined their face and content validities. Their suggestions and commends formed the basis for the authentication of the instruments. To establish the reliability coefficient of the Students Chemistry Achievement Test (SCAT) an initial 70 items test with content drawn from past chemistry questions were pilot tested on two non-participating schools in Rivers State. 30 items were selected after item analysis. A kuder Richardson formula was used to obtain reliability formula was used to obtained reliability coefficient of 0.77. However, the other instrument checklist of Chemistry Apparatus in Chemistry (SPSTC) which is Test of Students Skills in Practical Chemistry and Teacher Attitude Questionnaire in Chemistry (TAQC) were also pilot tested in one non-participating school in Obio/Akpor Local Government Area of Rivers State. Results of the trail testing exercises provided some measure of experience for the research for the study. Test-retest analysis was used to obtain the reliability co-efficient of (r) = 0.89, 0.72 and 0.83 for Checklist of Chemistry Apparatus (CCA), Students Practical Skills in Chemistry and Teacher Attitude Questionnaire in Chemistry respectively.

Data Collection Procedure

After the due processes of selecting the participating schools, the school principals were met for appropriate approval. Through the principals, the cooperation of the chemistry teachers was also solicited.

To ensure low mortality rate in the return of the questionnaire, and to ensure that the respondents do not have the opportunity of comparing their responses, the researcher ensured that the respondents completed the questionnaires in the classroom setting. This enables them to give objective responses.

The research instruments were administered in the following order:

- Checklist of Chemistry apparatus (CCA) - with reliability co-efficient of 0.89;
- Students Practical Skills Test in Chemistry (SPSTC) with reliability co-efficient of 0.72;
- Chemistry Achievement Test (CAT) - with reliability co-efficient of 0.77;
- Teachers Attitudes Questionnaire in Chemistry (TAQC) with reliability co-efficient of 0.83.

Method of Data Analysis

Data collected will be analyzed using multiple regression analysis at significance level set of 0.05, This was used to provide answers to the research questions raised in this study.

RESULTS

Research Question 1: Are there significant relationship among the independent variables (class size, workload laboratory adequacy, teachers' qualification, teachers' attitude, and teachers'

areas of specialization, teachers' attendance of workshop and teacher gender and dependent variables achievements in practical skills?

Table 1: Summary of Pearson product moment correlation on the relationship among the dependent and independent variables

		1	2	3	4	5	6	7	8	9	10	11
1	Class size	1										
2	Workload	.066	1									
3	Laboratory adequacy	-.162**	-.008	1								
4	Teacher experience	.200**	.085	.013	1							
5	Qualification	.168**	.012	-.110*	.308**	1						
6	Teacher attitude	.275**	.126**	-.177**	.136**	.196**	1					
7	Specialization	.091*	.025	.034	-.047	.121"	.067	1				
8	Workshop attendance	.024	-.003	-.139*	.108*	.190**	.170**	-.044	1			
9	Teacher gender	-.128**	.053	-.011	.055	-.071	-.179**	-.123**	.015	1		
10	Achievement	-.003	.009	.028	-.081	-.003	-.052	-.058	.086*	-.026	1	
11	Practical skills	.265**	.048	-.175**	.114**	.188**	~171**	-.008	.171*	-.060	-.017	I

Table 1 shows that class size(r=-.003), workload (r=.009), laboratory adequacy(r=.028), teacher experience(r=-.081), teacher qualification(r=-.003), teacher attitude(r=-.052), area of specialization(r=-.058), teacher attendance at workshop(r=.086) and teacher gender(r=.171) and achievement. Table 4.1 further show that class size(r= .265), workload (r=.048), laboratory adequacy(r= -.175), teacher experience (r= .114), teacher qualification (r=.188), teacher attitude(r= .171), area of specialization(r=-.008), teacher attendance at workshop(r= .171) and teacher gender (r= -.060) and practical skills.

Research Question 2: What are the composite contributions of school (class size, workload, laboratory adequacy, teacher experience, teacher qualification, teacher attitude, area of specialization, teacher attendance at workshop and teacher gender) on achievement in chemistry practical skill?

Table 2: Summary of regression analysis on the composite contributions of school variables on achievement

Model	Sum of Square	Df	Mean of Square	F	Sig.
Regression	672.761	8	84.095	1..522	.147[a]
Residual	28842.188	522	55.253		
Total	29514.949	530			

R = 151
R Square = 023
Adjusted R Square = 008

Table 2 shows that the multiple regression correlation coefficient R indicating the relationship between the independent variables, (class size, workload, laboratory adequacy, teacher experience, teacher qualification, teacher attitude, area of specialization, teacher attendance at workshop and teacher gender) and achievement and practical skill is 151 adjusted R^2 is 008.

Further verification using Multiple Regression (ANOVA) produce F (1.522) = 55.253, P < 0.05. Meaning that there is a significant linear relationship between the independent variables and student achievement.

Table 3: Coefficients[a] of joint contributions of the school variables to the dependent variables

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	28.312	2.732		10.362	.000
Class size	.242	.364	.031	.665	.507
Laboratory adequacy	.585	.683	.038	.857	.392
Workload	.230	.390	.026	.590	.555
Qualification	.136	.395	.016	.343	.732
Teacher attitude	-.568	.375	-.072	-1.516	.130
Workshop attendance	.963	.393	.110	2.451	.015
Teacher experience	-.797	.393	-.095	-2.03 1	.043
Teacher gender	-.487	.701	-.031	-.695	.488

Table 3 showed the joint contributions of school variables (class size, workload, laboratory adequacy, teacher experience, teacher qualification, teacher attitude, area of specialization, teacher attendance at workshop and teacher gender) to the observed variance in the achievement. Class size, workload, laboratory adequacy, teacher experience, teacher qualification, teacher attitude, area of specialization, teacher attendance at workshop and teacher gender were used in a enter model of multiple regression analysis to predict student achievement. Table 3 confirmed that Class size, workload, laboratory adequacy, teacher experience, teacher qualification, teacher attitude, area of specialization, teacher attendance at workshop and teacher gender when regressed with achievement accounted for approximately 0.8% of variance in achievement (R~ =.023, Adjusted R^2 -.008). The result on Table 3 (ANOVA) further indicated that the independent variables were not significant joint predictors of student achievement (F([, 522, =1.522, p<.147).

Research Question 3: What is the relative contribution of teachers and student factors on Practical skills?

Table 4: Coefficients

Model	Coefficients[a] Un standardized Coefficients Std.		Standardized Coefficients		t	Sig.
	B	Error	Beta			
1 (Constant)	59.347	1.350			43.954	.000
Class size	2.929	.463	.265		6.323	.000
2 (Constant)	53.714	1.941			27.667	.000
Class size	2.884	.457	.261		6.313	.000
Workshop attendance	2.036	.511	.165		3.988	.000

3 (Constant)	51.447	2.089			24.630	.000
Class size	2.667	.460	.241		5.794	.000
Workshop attendance	1.760	.517	.143		3.408	.001
Qualification	1.425	.504	.120		2.827	.005
4 (Constant)	56.332	2.806			20.075	.000
Class size	2.489	.463	.225		5,376	.000
Workshop attendance	1.594	.518	.129		3.079	.002
Qualification	1.346	.502	.113		2.681	.008
Laboratory adequacy	-2.329	.899	-.108		-2.590	.010

Table 4 (Coefficients) gives the predictor variables in the regression equation, the Beta values, and significant T corresponding to the variables regressed against the dependent variable. A glance at Table 4 reveals that the Beta values for workshop attendance (β =.165; t = 3988, p< 0.05), highest qualification (120, t =2.827, p = < 0.05) and laboratory adequacy $(\beta = -.108, t = -2.590, p = 0.05)$ we are found to have significant relative contribution with practical skills.

DISCUSSION OF FINDINGS

The findings of the study indicated the relationship among the independent variables and dependent variables (achievement and practical skills). The finding shows that class size, teacher experience, area of specialization and teacher qualification had inverse relationship with student's achievement, while workload, laboratory adequacy, teacher attendance at workshop and teacher gender had positive or direct relationship with student's achievement. Similarly, laboratory adequacy, area of specialization, and teacher gender had negative relationship with practical skills while class size, workload, teacher experience, teacher qualification, teacher attitude and Teacher attendance at workshop had positive relationship with practical skills.

Finally, the result on Table 2 showed the joint contributions of school variables to the observed variance in the student's achievement. The result shows that class size, workload, laboratory adequacy, teacher experience, teacher qualification, teacher attitude, area of specialization, teacher attendance at workshop and teacher gender when regressed with achievement accounted for approximately 0.8% of variance in achievement (R^2 = .023, Adjusted R^2 - 008). The finding corroborates with the findings of Ajileye (2006); Popov (2008), Olatoye (2007) Dawson, (2006) Ifeako (2006) Chris and Brain (2006) and others that contributes to the findings and effect on students' achievement and interest towards a particular discipline. Students attitude towards science have been extensively studies, Dhindsa and Cheung (2007). The result on Table 1 (ANOVA) farther indicated that the independent variables were not significant joint predictors of student achievement. Table 1 reveals that the Beta values for workshop attendance and teacher experience were found to be significant.

CONCLUSION

There was no regular pattern in the relationship between the independent variables and the dependent variables. Some independent variables negatively correlated with the dependent variables. The independent variables were not significant joint predictors of student achievement. Class size was the best predictor of student practical skills among secondary students in Rivers State when compared with others. Class size and Teacher workshop attendance was a significant predictor of student achievement. The independent variables were significant joint predictors of student achievement.

Recommendations

Based on the findings of the present study, the following recommendations were made:

- The class size, teacher attitude, teachers experience, area of specialization and teacher qualification, workload, laboratory adequacy, teacher attendance at workshop and teacher gender should be give due attention by policy makers when planning the steps to enhance student achievement.
- Practical skills of the students should be developed with a good knowledge of the class size, teachers attitude, teachers experience, area of specialization and teacher qualification, workload, laboratory adequacy, teacher attendance at workshop and teachers gender variables.

Limitation

The study had the following limitations:

- It was not possible to generalize the results of the five (5) Local Government Area of study.
- It was not possible to generalize the results of chemistry students since only the practical aspect of secondary school chemistry was seen to be hard in this study.
- Lack of poor funding to get materials.
- Some variables such as student/parental involvement and teachers assessment competence among others were not included in the present study

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