STUDENT, TEACHER AND SCHOOL ENVIRONMENT FACTORS AS DETERMINANTS OF ACHIEVEMENT IN SENIOR SECONDARY SCHOOL CHEMISTRY IN OYO STATE, NIGERIA

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The study constructed and tested an eight-variable model for providing a causal explanation of achievement of secondary school students in chemistry in terms of student variables - attitude to learning chemistry, background knowledge in Integrated Science, teacher variables - attitude to chemistry teaching, attendance at chemistry workshop and school environment related variables-class size, laboratory adequacy and school location. The study adopted an ex-post facto research type the population was made up of 621 senior secondary III chemistry students and 27 Senior Secondary III chemistry teachers in Oyo State, Nigeria. Four sets of instruments were used, these were chemistry Achievement Tests (SACS), Teacher. Attitude Towards Chemistry Teaching Scale (TATCTS) and Laboratory Adequacy Inventory (LAI). The results revealed that 7.20% of the total effect on achievement in chemistry was accounted for by all the seven predictor variables when taken together. It was also revealed that only four variables -school location(X_1) laboratory adequacy (X_3), teachers' attitude to chemistry teaching(X_5) and teachers' attendance at chemistry workshop(X_4) had direct causal influence and also made significant contributions to the prediction of achievement in chemistry (X_8) (the criterion variable). Recommendations based on the significance of these variables were then highlighted.

Key Words: student, teacher, school, determination achievement, environment factors.

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INTRODUCTION

The enviable position which science education system of most countries of the world, including Nigeria is perhaps justifiable. The reason is that science can exert a dominant, if not decisive influence on the life of individual as well as on the developmental effort of a nation (Emovon, 1985). The universal recognition of the above submission is responsible for the prime position that has been accorded science and in particular, chemistry worldwide. Within the context of science education, chemistry has been identified as a very important school subject and its importance in scientific and technological development of any nation has been widely reported. It was as a result of the recognition given to chemistry in the development of the individual and the nation that is made a core - subject among the natural sciences and other science- related courses in the Nigerian education system. Its inclusion as a core subject in science in the secondary school calls for the need to teach it effectively. This is because effective science teaching can lead to the attainment of scientific and technological greatness.

Chemistry teaching can only be result-oriented when students are willing and the teachers are favourably disposed, suing the appropriate methods and resources in teaching the students. With the current increase in scientific knowledge the world over, much demand is placed, and emphasis is laid on the teacher, the learner, the curriculum and the environment in the whole process of teaching and learning of science.

Despite the importance of chemistry to mankind and the efforts of researchers to improve on its teaching and learning, the achievement of students in the subject remains low in Nigeria. Among the factors that have been identified outcomes in chemistry are, poor methods of instruction (Osuafor, 1999) teacher's attitude (Aghadiuno, 1992), laboratory in-adequacy (Okegbile, 1996; Raimi, 1998; Bajah, 1999 and Adeyegbe, 2005), and poor science background (Oshokoya, 1998 and Adesoji, 1999).

Papanastasiou (2001) reported that those who have positive attitude toward science tend to perform either in the subject. The affective behaviours on the classroom and strongly related to achievement, and science attitudes are learned (George and Kaplan, 1998), the teachers play a significant role during the learning process and they can directly or indirectly influence the student's attitudes toward science which in consequence can influence students' achievement. Teachers are, invariably, role models whose behaviours are easily mimicked by students. What teachers like or dislike, appreciate and how they feel about their learning or studies could have a significant effect on their students. By extension, how teachers teach, how they behave and how they interact with students can be more paramount than what they teach.

Student's attitude toward the learning of chemistry is a factor that has long attracted attention of researchers. Ojo (1989) and Adesokan (2002) asserted that inspite of realization of the recognition given to chemistry among the science subjects, it is evident that students still show negative attitude towards the subject, thereby leading to poor performance and low enrolment.

The achievement of students in chemistry is also reported to be causally influenced by the previous experience of the students in integrated science. A student cannot learn chemistry effectively without giving through some experiences in integrated science (Oshokoya, 1998 and Adesoji, 1999).

Other factors that may have causal relationships with students academic achievement is science, particularly, chemistry include teacher attendance at chemistry workshop, laboratory adequacy, class size and school location.

One of the fundamental problems facing science teaching today is the question of how current are the professional teachers. The majority of teachers who have been employed in the past decades have been doing the same thing, the same way all along. They have no knowledge of the current ideas and innovations that have taken place in the educational field in the recent past. What account for this is that teachers have not been given the opportunity for re-training (Ogunbiyi, 2004). He therefore recommended that teachers should be encouraged to go for workshop training in their areas of specialization.

Laboratory adequacy which is a school environment factor has been reported to affect the performance of students in chemistry (Raimi, 2002 and Adeyegbe, 2005). Farounbi (1998) argued that students tend to understand and recall what they see more than what they hear as a result of using laboratories in the teaching and learning of science.

The question, "Are smaller classes better than larger classes" continues to be debated among teachers, administrators and parents as well as in the research community. However, Robinson (1990) concluded that research does not support the expectation that classes will of themselves result in greater academic gains for students. He observed that the effects of class size on student learning vary by grade level, pupil characteristics, subject areas, teaching methods and other learning interventions. Adeyela (2000), found that large class size is unconducive for serious academic work. Also Afolabi (2002) found no significant relationship among the class size and students' learning outcomes.

The relationship between school location and student academic achievement in science has been widely reported. Adepoju, (2001) found that students in urban schools manifest more brilliant performance than their rural counterparts. Also, Ogunleye (2002) Ndukwu (2002), Odinko (2002) and Warwick (1992) reported a significant difference in the achievement of students in urban peri-urban areas. However, Daramola cited in Ogunleye (2002), and Orji (1997) did not found any significant difference in the urban and peri-urban schools.

In view of these conflicting reports, there is the need to carry out a study with a view to determining which of the selected variables will have causal relationship with student achievement in chemistry.

THE PROBLEM

The importance of science, particularly chemistry in the technological development of a nation cannot be over -emphasized. However, we cannot lose sight of the fact that in any teaching - learning situation, the students, the teachers, the curriculum and the learning environment are the four pivots. It is on the basis of this that the study constructed and tested an eight-variable model for providing a causal explanation of secondary school students' achievement in chemistry, in terms of student variables (attitude and background knowledge in Intergrated Science), teacher variables (attitudes, attendance at chemistry workshop) and school environment-related variables - (class size, school location and laboratory adequacy). Based on the stated problem the study attempts to provide answers to the following questions.

1. What is the most meaningful causal model for students' achievement in secondary school chemistry?
2. To what extent will the seven independent variables when taken together, predict students achievement in chemistry?
3. What is the relative contribution of each of the seven independent variables to the prediction of student's achievement in chemistry?
4. What is the most significant direction as well as estimates of the strength of causation (path coefficients) of the variable in the model?
5. Which of the significant paths are direct and which ones are indirect?
6. What proportion (%) of the total effects are (i) direct and (ii) indirect?

SIGNIFICANCE OF THE STUDY

The study would throw more light into the causal relationships among the student, the teacher and the school environment - related variable under investigation and achievement of students in chemistry. The outcome of the study is therefore expected to stimulate the stakeholders to improve upon the isolated variables which have been found to have direct causal relationships with students achievement in chemistry, with a view to enhancing student performance in the subject.

UNDERLYING THEORETICAL FRAMEWORK

The target of the study is premised on student, teacher and school environment. Therefore, theories that have to do with the characteristics of these entities as they affect learning would be applicable. Since the learning of any subject-matter depends on the way it is presented to the learner by his or her teacher, the way the learner interacts with the learning experiences presented to him and the environment within which the learning takes place, it is therefore expected that these entities will be affected by variables that have to do with them; these include laboratory adequacy school location attitudes, and background knowledge in Integrated Science that are considered in this study.

The theories of Maslow 91954) and Gogue (1965) would therefore provide theoretical basis for the study.

Maslow's motivational theory expresses that there are two groups of needs, these are deficiency needs and growth needs. When the deficiency needs are met, pupils are likely to function at the higher levels (that is growth needs level). This means that when the deficiency needs are met, self directed learning or the desire to know and understand would be engaged in more easily. The implication of this is that teachers can encourage pupils to meet their growth needs by enhancing the attractiveness of learning situation. In the light of these, when the environment where the child is learning (in this study, class, laboratory, and location of school) is made attractive, effective learning is likely to take place.

Gagne's theoretical formulations are attempts to identify aspects of learning and to match these with the intellectual demands of the individual. While development is subordinated to learning, Gagne's paradigm insists on identifying valid ordered sequences of instruction (pre-requisites) that can facilitate the learning of intellectual skills. Gagne's theory offers an opportunity for the chemistry teacher to diagnose students' limitations and strengths more effectively, thus permitting more adequate individualization and personalization of chemistry instruction. Gagne's learning hierarchy also offers chemistry teachers the opportunities of developing and conceptualizing agreed-upon chemistry goals and objectives in reality-oriented and learner - centred way. It is on this premise that Gagne anchors his belief that children learn an ordered additive capabilities. That is, the simpler and more specific capabilities is learned before the next more complex and general capability. Gagne therefore considered previous experience to have a major role in determining an individuals performance. It is within this framework that the present study looked into the student's background knowledge in Integrated Science vis-a-vis their performance in chemistry in the senior secondary school.

METHODOLOGY

An ex-post facto research type was adopted for the study. The population for the study was made up of all senior secondary school year three (SSIII) and their teachers, in the three senatorial districts of Oyo State Nigeria namely, Oyo South, Oyo central and Oyo north. Oyo State is in the South western part of the country. It is comprised of thirty-three (33) local government areas. It has a population of about 3,488,789 by 1991 census-Ibadan is the capital of the state and invariably the seat of the government. Ten secondary schools were used in each of the three senatorial districts. The ten sampled schools were the only ones that met the criteria, which were:

1. The school must have completed the senior secondary school II chemistry scheme of work for her S.S. III students at the time of data collection.

2. The teacher must have taught the students in SSI and SSII

3. The school must have a laboratory or room where chemistry practicals are being conducted.

4. The chemistry students must have sat for and passed integrated science in their Junior secondary certificate examination (JSCE).

5. Availability of records of teachers sent to attend chemistry workshops and

6. Availability of a separate class for chemistry students so as to determine the class size.

In all, six hundred and twenty-one (621) students and twenty-even (270 chemistry teachers were used in the selected schools. Four sets of instruments were sued which were (1) Chemistry Achievement Test (CAT) (r=0.80) (ii) Teachers' Attitude Towards Chemistry Scale (SACS) (r=0.80). (iii) Teachers' Attitude Towards Chemistry Teaching Scale (TATCTS) (r = 0.89) and (iv) Laboratory Adequacy Inventory (LAI)

(r = 0.080).

The CAT was a 25 - item instrument used to assess the level of acquisition of concepts in chemistry by the students. It was a multiple choice test with four alternatives, one correct answer and three distractors. SACS was developed to measure the attitude of students towards chemistry. The TATCTI was constructed to measure the attitude of teachers to the teaching of chemistry. The LAI was used to measure the adequacy of resources in the teaching of the senior chemistry curriculum. All the instruments were validated and their reliability determined before they were used. The above instruments were used to collect the data used for the study. The administration and collection of all the necessary information were done during the normal class hours. Two statistical procedures were employed to analyse the data. These were multiple regression and path analysis.

The hypothesized causal model was produced through the linear relationships between the sets of variables involved in the study derived from the three factors that were suggested by Black (1964). These were temporal order, previous research and sound theory (theoretical grounds). This causal model is presented in fig 1.

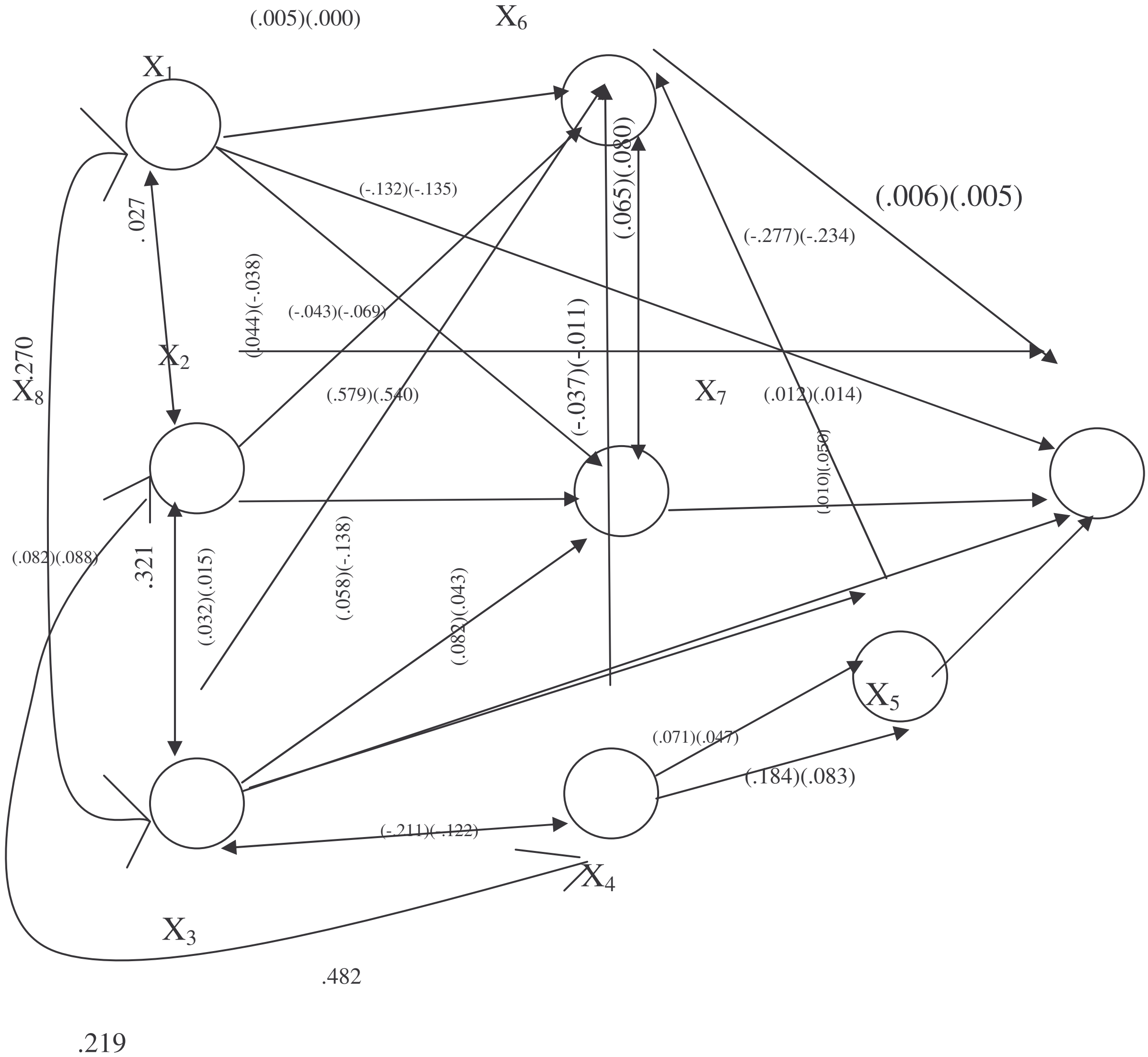

FIG 1: the hypothesized causal model

Key

X_1 = school location

X_2 = class size

X_3 = laboratory adequacy

X_4 = teachers' attendance at chemistry workshop

X5 = teachers' attitude to chemistry teaching

X_6 = students' background knowledge in Integrated Science

X7 = students' attitude towards chemistry

X8 = Students' achievement in chemistry.

In order to identify which paths in the model are important, the investigator explained all the hypothesized linkages by forming the following set of structural equations (a recursive system) from the hypothesized model. The structural equations are labeled (i) - (iv), each equation corresponding to each dependent variable xi (i = 5, 6, 7 and 8)

STRUCTURAL EQUATIONS:

(i) $X_5 = P_{54}\ 1 + P_{53}\ X_3 + e_5$ ....

(ii) $X_6 = P_{65}X_5 + P_{64}X_4 + P_{63}X_3 + P_{62}\ X_2 + P_{61}X1 + e_6$

(iii) $X_7 = P_{76}X_6+P_{75}X_5+P_{74}X_4+P_{73}X_3+P_{72}X_2+P_{71}X_1+e_7$ ...

(iv) $X_8 = P_{86}X_6+P_{85}X_5+P_{54}X_4+P_{83}X_3P_{82}X_2+p_{81}X1+e_8$ ...

To compute values of the path coefficients for the hypothesized causal model, four regression analysis were run.

RESULTS

ANSWERING OF RESEARCH QUESTIONS RESEARCH QUESTION ONE

What is the most meaningful causal model for student's achievement in secondary school chemistry?

Table 1 presents the path coefficients and their levels of significance

TABLE 1: PATH COEFFICEINTS AND THEIR LEVEIS OF SIGNIFICANCE (Significant at P<0.05)

PATHS	PATH COEFFICIENTS
PATHS	**STANDARD PATH COEFFICIENT**
P_{81}	.277*
P_{82}	-0.43
P_{83}	.082*
P_{84}	.071*
P_{85}	.082*
P_{84}	.006
P_{87}	.012
P_{71}	.132*
P_{72}	.579*
P_{73}	.058*
P_{74}	.092*
P_{75}	.088*
P_{76}	-.065*
P_{61}	.005
P_{62}	.004
P_{63}	-.032
P_{64}	-.037
P_{65}	-.010
P_{53}	-.215
P_{54}	.184*

From table 1, it is obvious that twelve out of twenty hypothesized paths are significant at .05 level. These paths survived the trimming exercise and are therefore represented in the parsimonious model. The paths put together in the model resulted in some pathways through which the independent variables caused variations in students' achievement in chemistry.

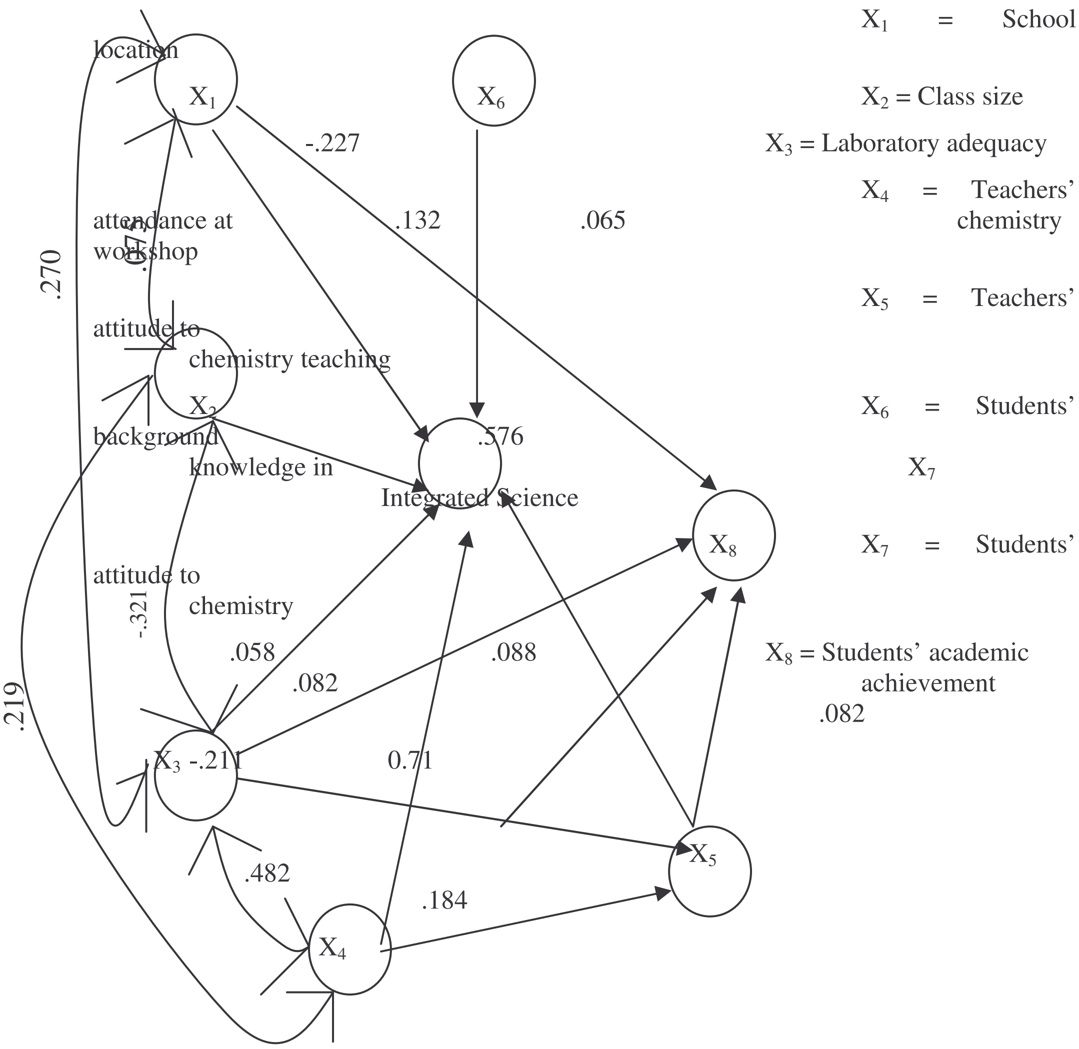

FIGURE 2 THE PARSIMONIOUS MODEL

The above figure shows the most meaningful convert model (involving school location, class size, laboratory, adequacy, teacher's attendance and chemistry workshop, teachers' attitude to chemistry teaching, students' background knowledge, integrated science and students' attitude to chemistry) is predicting students' achievement in chemistry.

RESEARCH QUESTION TWO

To what extent will the seven independent variables when taken together, predict students achievement in chemistry?

To provide answer to research question two, reference was made to tables 2

TABLE 2: SUMMARY OF REGRESSION ANALYTICAL ON SAMPLE DATA

MULTIPLE R^2	R^2	ADJUSTED R^2	STANDARD ERROR		SIGNIFICANCE
0.286	.082	0.072	12.25	7.839	.000*

From table 2, it could be seen that there is a positive multiple correlation among the seven independent variables, which are; school location, class size, laboratory, which are school location class size, laboratory adequacy, attendance at chemistry workshop, teachers attitude to chemistry teaching, students' background in Integrated Science and students attitude to chemistry; and students' achievement in chemistry, which is the dependent variable (R=0.286). This implies that the factors are quite relevant towards the determination of the dependent measure. Also, the adjusted R_2 value of 0.072 revealed that the seven factors accounted for 7.2% of the total variance in the dependent measure. The remaining 92.8% could be due to factors and residuals in the model that are not considered in this study.

RESEARCH QUESTION THREE

What is the relative contribution of each of the seven independent variable to the prediction of students' achievement in chemistry.

The answer to this question is provided in table three.

TABLE 3: ESTIMATE OF THE RELATIVE CONTRIBUTIONS OF THE PREDICTOR VARIABLES TO STUDENTS' ACHIEVEMENT IN CHEMISTRY

UNDER-DEPENDENT VARIABLE (Predictor)	B	Standard Error	Beta	Rank	T	
	B	Standard error	Beta	Rank	t	Sig
School location	-7.420	1.108	-.277	1st	6.696	.000*
class size	-6.00	.070	-.043	5th	-.807	.392
Laboratory adequacy	7.837	.45	.082	2nd	1.724	.085
Teachers' attendance at chemistry workshop	1.586	1.023	.071	4th	1.551	.121
Teachers' attitude to chemistry teaching	.211	.104	.082	2nd	2.019	.044*
Students' background knowledge	.169	1.027	.006	7th	.164	.870
Students' attitude to chemistry	2.31	.087	.012	6th	.265	.761
Constant	35.810	7.706			4.6471	.000

Significant at $P<0.05$

Table 3 reveals that out of the student factors, school location (X_1) made the greatest contribution (β-0.82) and teachers' attitude (X_5) (β=.082). The fourth in rank of contribution is teachers' attendance at chemistry workshop (R_4) (β=.071). The 5th, 6th and 7th contributors in order of decreasing magnitude are class size (X_2) (β= .043). Students' attitude to chemistry (X_7) (β =.0120 and students' background knowledge in Integrated science (X_6) (β=.0.006), respectively the order of decreasing magnitude in terms of relative contributions of the factors is school location > laboratory adequacy? Teachers' attitude to chemistry teaching> teachers' attendance at chemistry workshop? Class size? Students' attitude to chemistry? Students' background in Integrated science. School location and teacher attitude to chemistry teaching could predicting between achievement in chemistry. The regression equation is: = 35.8 - 7.4X_1 + 0.21X_2 where Y = standard activity in chemistry

X_1 = school location

X_2 = T. attitude to chemistry

RESEARCH QUESTION FOUR

What is the most significant direction as well as estimates of the strength of causation (path co-efficient) of the variable in the model?

All the significant paths as well as their strengths (path coefficients) are presented in Table 4

TALBE 4: SIGNIFICANT PATHS AND THEIR PATH COEFFICIENTS

1.	P_{85}	.82
2.	P_{84}	.071
3.	P_{83}	.082
4.	P_{81}	-.277
5.	P_{76}	.065
6.	P_{75}	.088
7.	P_{74}	.092
8.	P_{73}	.058
9.	P_{73}	.579
10.	P_{71}	.132
11.	P_{54}	.184
12.	P_{53}	-.211

Table 4 shows that there are only twelve paths with significant coefficient. These paths survived the trimming exercise and are therefore represented in the parsimonious model (Fig 2).

These paths put together in the model resulted in some pathways (direction) through which the independent variables caused variations in students' achievement in chemistry. These pathways are represented in Table 5.

TABLE 5: SIGNIFICANT PATHWAYS AND THEIR COEFFICIENTS

S/N	PATHWAYS	NATURE PATH	PATH COEFFICIENTS
1.	P_{85}	Direct	.082
2.	P_{84}	Direct	.071
3.	P_{83}	Direct	.277
4.	P_{81}	Direct	.065
5.	P_{76}	Direct	.088
6.	P_{75}	Direct	.065
7.	P_{74}	Direct	.088
8.	P_{73}	Direct	.092
9.	P_{72}	Direct	.058
10.	P_{71}	Direct	.132
11.	P_{70}	Direct	.184
12.	P_{53}	Direct	-.211
13.	$P_{85}p_{54}$	In Direct	(.082) (.184) = .015
14.	$P_{85}p_{54}$	In Direct	(.082) (.184) = 017
15.	$P_{75}P_{53}$	Indirect	(.088) (.184) = .016
16.	$P_{75}P_{54}$	Indirect	(.088) (-.211) = .018

Table 5 shows all the significant pathways as well as their path coefficients.

Further, it was necessary to find out if the hypothesized model (Fig 1l) was consistent with the parsimonious model (Fig 2). Here, the original correlation data were reproduced using the path coefficients in the new model (Fig 2). These reproduced correlation co-efficient were obtained from a set of normal equations based on the new set of structural equations. This new set of structural equations are:

(i) $X_5 = P_{54} X_4 + P_{53} X_3 + e_5$

(ii) $X_6 = e_6$

(iii) $X_7 = P_{76}X_6+P_{75}X_5+P_{74}X_4+_{73}X_3+P_{72}X_2+P_{71}X_1+e_7$

(iv) $X_8 = P_{85}X_5+P_{84}X_4+P_{83}X_3+P_8X_1+e_8$

These equations were based on the significant paths of the pansinuous model. When the original correlations data was compared with the reproduced correlation data, it was found that the hypothesized model was consistent with the parsimonious model.

RESEARCH QUESTION FIVE

Which of the significant paths are direct and which ones are indirect?

The significant paths through which the predictors caused variation in students' achievement in chemistry are shown in table 6.

Table 6: SINGIFICANT PATHWAYS THROUGH WHICH THE INDEPENDENT VARIABLE CAUSED VARIATION IN STUDENTS' ACHIEVEMENT IN CHEMISTRY (P<0.05)

SIGN	CORRELATIONS	DIRECT PATHS	INDIRECT PATHS
1.	r_{18}	P_{81}	-
2.	r_{28}	-	-
3.	r_{38}	P_{83}	$P_{85}P_{53}$
4.	r_{48}	P_{84}	$P_{85}P_{54}$
5.	r_{58}	P_{85}	-
6.	r_{67}	-	-
7.	r_{78}	-	-

The result obtained in table 6 shows that of all the six pathways that are significant, meaningful and have link with the criterion/dependent variable (X_8), four are direct while two are indirect.

RESEARCH QUESTION SIX

What proportion (%) of the total effects are (i) direct and (ii) indirect?

Table 7 presents the proportions of the direct and indirect effects of the predictors on the criterion variable.

Table 7 reveals that 4.56% of the total effects (7.20) is direct while 2.65% indirect. This implies that the proportion of direct effects is greater than that of indirect effects.

Criterion	Predictor	Total effects	%	Direct effect	%	Indirect effect	%	%
	VAR. 1-7	(a)	(c)	(b)	(d)	(a-b)	E	F
	1	-.234	15.89	-.277	18.82	.043	-2.920	220.81
	2	-.069	4.69	-.043	292	-.026	1.770	65.14
	3	.043	-2.92	.082	-5.569	-.039	2.650	-40.56
VAR. 8	4	0.47	-3.19	.071	-.4.823	-.024	1.630	-44.33
	5	0.88	-5.98	.082	-5.569	.006	-.408	-83.05
	6	.005	-340	.006	-.408	-.001	.608	-4.72
	7	.014	-951	.012	-.815	.002	-.136	-13.21
	Total	-.0106	7.20	-.067	4.56	-.039	2.65	100.00

KEY:

a = Total effects = original correlation coefficient b = Direct effect = path coefficient

a-b = Total effect - direct effect= Indirect effect d = % direct effect

E = % Indirect effect F = % relation or total effects

C = a/Ta x 7.2% F = c/TC x 100%

Direct effects = 4.56% Indirect effects = 2.65%

Total effects = 7.2%

Variables:

Variables:

X_1 = school location

X_2 = class size

X_3 = laboratory adequacy

X_4 = teachers' attendance at chemistry workshop

X_5 = Teachers' attitude to chemistry teaching

X_6 = Students' background knowledge in Integrated Science

X_7 = Students attitude to chemistry

X_8 = Students' achievement in chemistry

DISCUSSION

The findings of the study revealed that twenty hypothesized paths were reduced to twelve significant pathways derived from four structural equation which were used in explaining the causal model of the student, teacher and school environment factors as determinants of achievement in senior secondary school chemistry. The efficacy of the new model was verified by reproducing the original matrices of the variables. The original correlation data when verified, is consistent with the new model. Hence, the model is retained.

Furthermore, 7.2% of the total variance in students' achievement in chemistry is accounted for by all the seven independent variables when taken together. This figure is very significant in the sense that there are many variables that can cause variance in students' learning outcomes. For the selected seven independent variables among many others, to have accounted for 7.2% of the total variance in the students' academic achievement implies that those seven variables should be given much attention in the teaching and learning of chemistry. The remaining difference (92.8) in the variance might be due to the influence of other factors not considered in this study such as study habit (Abe, 1995), self - concept, home background (Umoinyang, 1999), teaching style, effect of peer influence (Adebusuyi, 2002) and others. Also, the total variance (that is 7.2% contribution of all the seven independent variables when taken together) to chemistry achievement consists of 4.56% direct and 2.65% direct components respectively.

In addition, only four variables, school location (Var. 1) (β=-.277), laboratory adequacy (Var. 3) (β= .082), teachers, attitude to chemistry teaching (Var. 5) (β=.082), and teachers' attendance at chemistry workshop (Var. 4) (β=.071) have direct causal influences on students' achievement in chemistry. Of the four variables, school location (Var. 1) has the highest contribution to students' achievement in chemistry through laboratory adequacy (Var. 3), teachers' attitude to chemistry teaching (Var. 5) and teachers' attendance at chemistry workshop (Var. 4). The finding is in agreement with Ogunleye (2002) and Aworanti and Olakanmi (1997) that school location produced a significant difference in the performance of students in chemistry. However, studies such as those of Daramola cited in Ogunleye (2002) and Ajayi (1998) did not find such significant difference.

It is noted in this study that the path coefficient of school location is a negative value (β=-.277), yet the variable makes the highest contribution to the variance in students' achievement in chemistry. The implication is that schools cannot just be sited anywhere without following some laid down procedures. The education authorities in each state of the federation should decide where a particular type of school should be located, the size of a school in each location and whether or not a new school should be built, among others (Mbaekwe, 1986). To avoid schools being wrongly sited, the issue of locational planning should be addressed, more so that this study has established strong causal effect of school location on the students' achievement in chemistry.

A further look at the results of this study shows that variables 3 and 4 (laboratory adequacy and teachers' attendance at chemistry workshop) also have indirect causal influences on students' achievement in chemistry. The findings corroborate those of Wisconsin et al. (1991), Okegbile (1996). The interpretation of this result is that a well-equipped laboratory can positively change teachers' attitude to chemistry teaching, which will in turn enhance students' learning outcomes in chemistry (Var. 3 Var. 5 Var. 8). Also, the indirect causal effect of variable 4, that is teachers' attendance at chemistry workshop on students achievement in chemistry can be illustrated with the assertion that when chemistry teachers attend workshops, there, they would rub minds with their counterparts on issues and problems confronting them in their respective classes with a view to improving their teaching. At workshops teachers may find solution to some impediments in the course of their duties which might have dampened their morale and interest towards chemistry teaching. In essence, teachers' attendance at chemistry workshop can re-orientate teachers' attitude positively towards chemistry teaching and this is likely to increase students' achievement in the subject (Var. 4 - Var. 5 - Var. 8).

In the final analysis, it could be concluded from the results that school location, laboratory adequacy, teacher attitude to chemistry teaching and teachers' attendance at chemistry workshop are directly linked with achievement of students in chemistry. In other words, students in urban setting with well-equipped laboratory who happened to be taught by teacher with positive attitude to teaching and who have interest in attending chemistry workshop are expected to perform very well in chemistry. However, teachers' attitude could be said to influence students' achievement in chemistry through attendance at workshops. This is not unexpected because attendance at chemistry workshops is likely to enhance positive attitudes of teachers to chemistry teaching.

Laboratory adequacy was also found to enhance achievement through attendance at chemistry workshop. The interpretation one could give to this is that attendance at chemistry workshop is expected to enhance the understanding of teachers as to the facilities which are necessary for students' achievement in chemistry.

Based on the data and findings from the study, it can be submitted that students' achievement in chemistry is jointly determined and significantly influenced by the listed variables in this relative order of importance: school location (X_1)> laboratory adequacy (X_3)> teachers' attitude to chemistry teaching (X_5)> teachers' attendance at chemistry workshop (X_4).

CONCLUSION

The study has established that school environment and teacher-related factors exert potent and positive influence on students' achievement in chemistry. This was in agreement with previous findings of Onocha (1985), Olatoye (2002), Ogunleye (2002) and Okoro (2004).

These factors directly and indirectly pointed to areas which have to be addressed in order to enhance the learning outcomes of students in chemistry. If the government and other stakeholders in education industry could improve on the learning environment of students and motivate teachers who are the curriculum implementers, is most likely that student's achievement in chemistry will be highly enhanced.

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