JEM

Journal of

EDUCATIONAL MANAGEMENT

A Bi-annual Publication of

THE INSTITUTE FOR EDUCATIONAL PLANNING AND ADMINISTRATION (IEPA)

University of Cape Coast, Ghana.

ISSN 0855 - 3343 Vol.4 Nov. 2002

First Published Nov. 1998

All Correspondence to:

The Editor
Journal of Educational Management
Institute for Educational Planning and Administration
University of Cape Coast
Cape Coast, Ghana

Subscriptions:

	In Ghana	Outside Ghana
Personal	¢40,000	$30.00
Institutions and Libraries	¢50,000	$40.00

Printed by The Advent Press, Osu, Accra

ISSN 0855-3343 VOL. 3 NOV. 2000

JOURNAL OF EDUCATIONAL MANAGEMENT

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Journal of Educational
Management Vol. 4 (46 -59)
November 2002

A Path-Analytic Model of Schooling Situations and Secondary School Students' Academic Performance in Oyo State Nigeria.

M. Fabunmi & J. G. Adewale

Abstract

This study investigated the extent to which schooling situations variables (resource situation, average class size, student – teacher ratio, school size or population, quantity and quality of teachers and number of furnished classrooms) predict secondary school academic performances in Oyo State of Nigerian in 2000/2001 school session. It was conducted ex-post facto under a non-experimental survey research design. 100 out of the secondary schools in Oyo State were randomly selected for the study. The study adopted the use of a confirmatory causal modeling method of analysis. This involves two closely related analytical techniques: multiple regression and path analysis. Findings of the study revealed that out of the six variables hypothesized to influence students' academic performance, four of them (student-teacher ratio, teacher population, resource situation and students' population) have both direct and indirect effect on students' academic performance while the remaining two variables (number of classroom and average class size) have indirect effects on students' academic performance. In all 50.92% of the total effect of all the six independent variables on students' academic performance are direct and indirect while 25.08% are indirect. The implications of the findings are discussed.

Introduction

Schooling situations are recognized as the major determinants of learning outcomes (Ojo, 1989; Fabunmi, 1997 and Sheyin, 2000). Education authorities diagnose the conditions under which students learn in schools under them for the following reasons:

(a) Such diagnoses reveal the actual learning situation of such schools, and form the basis for decision-making. When the schools, and form the basis for decision-making. When the situation is worse, there is a need to rectify it.

(b) Such diagnoses will yield some educational statistics, which are very useful while projecting and planning education for the future.

(c) The statistics generated from such diagnoses are useful for local and international compassion of educational systems.

Enrolment, staffing and school plant situations are regularly diagnosed so as to ensure quality in the school system (Fabunmi, 2001).

The resource situation, average class size, student-teacher ratio, school size or population, quantity and quality of teachers and number of furnished classrooms are major predictions of secondary school performances in senior school certificate examination (SSCE). Previous studies (Fabunmi, 1997, Okore 1998, and Sheyin 2000) have confirmed this assertion. In Oyo State, which is the focus of this study, most secondary schools do not perform well in SSCE.

This study attempts to establish the extent to which the factors highlighted above predicts the performance of secondary schools in SSCE, using the path-analysis methods.

In Oyo state, most secondary schools lack the basic educational resources that can make instruction effective and productive. The average class size is usually above the governing norm of a maximum of 30, which the National Policy on Education (NPE, 1981) recommended. Most secondary schools, particularly in urban areas, are over-populated. Perhaps, the government needs to fix a standard population for schools, so as to pave way for easy management of schools.

Several secondary schools do not have enough qualified teachers hence they often resort to the use of Parent-Teacher Association (PTA) teachers. Adequate, furnished classrooms are often not available in schools. This accounts for classroom congestion in most secondary schools.

Resource situation is a major determinant of secondary school academic performance. Fabunmi, 1997 (a) Fabunmi, 1997 (b) and Fabunmi, explained the extent to which the quality and quantity of educational resources contributed to secondary school academic performance in Edo state between 1989 and 1994. The studies established that allocative inefficiency accounted for the differences in the performance of secondary schools in the state.

Another factor which explains the schooling situation is the school population or size. Sheyin (2000) investigated the relationship between certain school-related factors and secondary school internal efficiency in Ogun State between 1992 and 1997. Result of findings revealed a positive and significant relationship between school size and internal efficiency. The study also established that school size made a significant contribution to the internal efficiency of schools. This implies that school population (or size) can predict the performance of a school. Supervision and control can only be effective when the population is minimal. Anecdotal observations show that the performance of schools in public and internal examinations depend to a great extent on the magnitude of administrative control exerted by the principal.

Fabunmi (2001) argued that adequate quantity and quality of teachers should be posted to schools. He recommended that the number of available classes should be used to determine the number

of teachers to be posted to schools. A minimum of 1.25 teachers per class is desirable. This implies that eight teachers should be posted to a school with six classes Fabunmi (1997) used the quality of teachers to explain resource input quality. He discovered that the variable made a significant contribution to secondary school academic performance. The study also revealed that resource input quantity made significant contribution to secondary academic performance.

The classrooms available is another important factor determining the schooling situation. Fabunmi (2001) argued that education authorities base posting of teachers on the number of classrooms available in each of the schools. The availability of adequate number of classrooms and other facilities are necessary for the educational objectives to be achieved (Fiedls, 1974, Adaralegbe, 1983; and Akinwumiju and Onibonje 1987).

This study embarked on the causal modeling of the schooling situations variables discussed above in relation to secondary school academic performance, using Oyo State as the study area. The use of recursive paths in this study is based on the following assumptions:

(a) There is a one-way causal flow in the system. This implies that reciprocal causation between variables is not considered.

(b) The residuals are not correlated among themselves, and with the variables which preceded them in the model.

(c) Every endogenous or dependent variable is directly related to all the variables, which preceded it in the hypothesized causal sequence (Kerlinger and Pedhazur, 1973).

Statement of the Problem

Premised on the background to this study discussed earlier, the study constructed and tested a seven variable (resource situation, average class size, student/teacher ratio, school population, number of classrooms) causal model. Existing literature indicate that each of the first six variables is capable of influencing secondary school academic performance.

The following research questions guided the study:

1. What is the most meaningful causal model involving schooling situation variables (resources situation, average class size, student-teacher ratio, school population, number of teachers and number of classrooms) and secondary school academic performance, using percentage of passes in SSCE as a parameter?

2. What are the directions and estimates of the strengths of the causal paths of the variables in model?

3. What are the direct and indirect effects of schooling situation variables in model?

4. What percentages of the total effect are indirect and indirect?

Research Design

The study was conducted ex-post factor under a survey research design. The design was chosen because the researcher did not have any direct control of the six independent and the only dependent variables, as they have already occurred.

Population

The target population for the study comprised all the principals of secondary schools in Oyo State during the period of this study (2000/2001 school session).

Sampling Procedure

Stratified and proportional to size random sampling techniques were adopted to select 100 out of the 336 secondary schools in Oyo State. Table 1 illustrates the sample.

Sampling Technique

This study adopted the proportional to size random sampling technique for the selection of 100 out of the 336 secondary school principals in the state. Table 0.1 illustrates the sample selection procedure.

Table 1
Selection of Samples

S/No	Local Government Area	No of Schools	Sample size
1	Afijio	13	4
2	Akinyele	20	6
3	Atiba	10	3
4	Atigbo	07	2
5	Egbeda	12	4
6	Ibadan North	22	7
7	Ibadan N.E.	11	3
8	Ibadan N.W	07	2
9	Ibadan S.E.	18	5
10	Ibadan S.W.	26	8
11	Ibarapa Central	08	2
12	Ibarapa East	07	2
13	Ibarapa North	06	2
14	Ido	09	3
15	Irepo	03	1
16	Iseyin	14	4
17	Itesiwaju	07	2
18	Iwajowa	07	2
19	Kajola	11	3
20	Lagelu	18	5

Table 1 Continued

S/No	Local Government Area	No of Schools	Sample size
21	Ogbomoso North	09	3
22	Ogbomoso South	11	3
23	Ogo-oluwa	07	2
24	Olorunsogo	03	1
25	Oluyole	12	4
26	Ona-ara	10	3
27	Oorelope	04	1
28	Oriire	08	2
29	Oyo East	06	2
30	Oyo West	05	2
31	Saki East	04	1
32	Saki West	08	2
33	Surulere	13	4
	Total	336	100

Instrumentation

The schooling situations and performance questionnaire (SSPQ) was constructed for the purpose of eliciting data from the sampled secondary schools. It consists of three sections, A, B, and C. Section A sought for background information like the name of the school, location and local government area. Section B gathered information on schooling situations, e.g. number of each of the different educational resources available in the school, average class size, student-teacher ratio, school population, number of teachers available and number of furnished classrooms. Section C edited information on the percentage of passes in SSCE from each of the sampled secondary school.

Data Collection

A research assistant was attached to each Local Government Area. In all eight research assistants participated in the collection of data which lasted a period of nine weeks. The number of students who passed is divided by the total number of students enrolled for SSCE, and multiplied by 100. This is taken as a measure of the academic performance of each of the sampled secondary school.

Scoring of the Instrument

Section A was not saved, as it was included merely for identification purpose. In Section B, the crude number of all the educational resources in a school is taken as a measure of

resource situation; the average class size is computed by dividing the school population by the number of furnished classrooms; student-teacher ratio is obtained by dividing the school population by the number of teachers in the school in the school total, students in all enrolment classes is taken as the school population, the number of teachers in a school, and only classrooms under use are counted to obtain the number of classrooms in each school. As for Section C, percentage of passes in SSCE is recorded for academic performance. Students with credits in three subjects including English Language and Mathematics are assumed to have passed.

Method of Analysis

The study adopted the use of a confirmatory causal modelling which involves two closely related analytical techniques; multiple regression and path analysis. This approach enabled the researcher to establish how the different predictor variables act simultaneously with each other and with the criterion variable. A total of five backward regression analyses were run using the SPSS computer programme to obtain the path coefficients of the hypothesized model.

Path Analysis

The recursive path analysis, which isused in this study, is subject to the following assumptions that were made by Kerlinger and Pedhazur (1973):

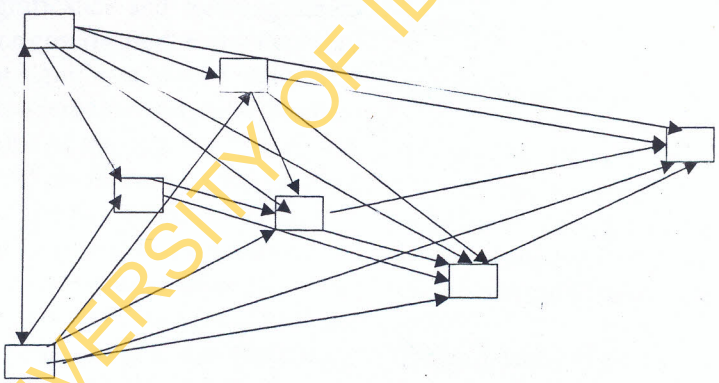

Fig. 1 A Hypothesized Path Model

X_1 = Resource situation
X_2 = Students' population
X_3 = Teacher population
X_4 = Student-Teacher ratio
X_5 = Number of classroom
X_6 = Average class size
X_7 = Students' academic performance

a. There is a one-way causal flow in the system, that is reciprocal causation between variables is ruled out.

b. Residuals are not correlated among themselves and with the variables preceding them in the model; and

c. Every endogenous or dependent variable is directly related to all the variables preceding it in the hypothesized casual sequence.

Based on existing literature (Boyd, 1978) and temporal order X_1 and X_4 (population) causing linked as follows: $X \longrightarrow X_4$.

Also, on temporal grounds, average class size (X_2) and student–teacher ratio (X_3) are causally linked. $X_2 \longrightarrow X_5$. Number of teachers (X_5) and number of classrooms (X_6). Are casually linked X_5-X_6. X_2 X_3 X_4 X_5 and X_6 are directly linked to X_7 (Academic performance). X_1 is indirectly linked to X_7.

There is a need to identify the important paths in the model by constructing the resultant structural equation using the technique of path analysis. In order to trim the paths in the model, statistical significance and meaningfulness were the criteria used. Paths were considered significant at 0.05 alpha level and considered meaningful if the absolute value of the path coefficient is at least 0.05 as recommended by Land (1969). The two criteria were applied so as to avoid any uncomfortable situations where certain minute path coefficients may be found to be significant due to large sample size (Pedhazur, 1982) and in order to properly trim the model so as to provide a more adequate testing of the theory under consideration, the following structural equations were used.

$$X_1 = e_1$$
$$X_2 = e_2$$
$$X_3 = P_{32}X_2 + e_3$$
$$X_4 = P_{42}X_2 + P_{43}X_3 + e_4$$
$$X_5 = P_{52}X_2 + P_{53}X_3 + P_{54}X_4 + e_5$$
$$X_6 = P_{61}X_1 + P_{64}X_4 + e_6$$
$$X_7 = P_{71}x_1 + P_{72}x_2 + P_{73}x_3 + P_{74}x_4 + e_7$$

Report of Findings

This is discussed under each of the research questions

Research Question One

What is the most meaningful causal model involving schooling situation variables and secondary school academic performance?

Result

The path coefficients and zero order correlation coefficients are written on each path way with the correlation coefficients in parenthesis. Based on the two criteria stated above (See appendix) the new path model is obtained as shown in figure 2. In the new model, only 10 out of 21 hypothesized paths survived the trimming exercises.

Validation of the new path model

To verify the efficacy of the new model (Fig 2) the reproduced correlation coefficients (using new path model) were compared to the original correlation coefficients.

Tables 1 and 2 show the original and reproduced correlation matrix and the discrepancies between the original and the reproduced correlation's respectively. From table 2 the discrepancies between the original and the reproduced correlation were found to be very minimal indicating that the pattern of correlation in the observed data is consistent with the new model. The new path model is therefore considered tenable in explaining the causal interaction between the predictor

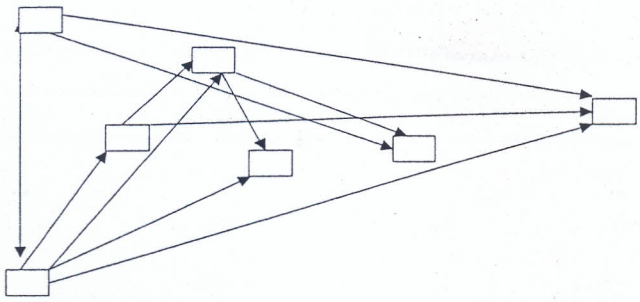

Fig. 2 More Parsimonious Model
X_1 = Resource situation
X_2 = Students' population
X_3 = Teacher population
X_4 = Student-Teacher ratio
X_5 = Number of classroom
X_6 = Average class size
X_7 = Students' academic performance.

variables (variables 1-6) and the criterion variable (Variable 7). Figure 2 thus shows the most meaningful causal model involving the criterion and independent variables.

Research Question 2

What are the directions as well as the estimate of the strengths of the causal path of the variables in the model?

Result

The direction of the causal paths of the variables in the model are shown in pathways which are (i) significant (ii) meaningful and (iii) have a link with criterion variable - students' academic performance. The paths are 66 in number and are shown in Table 3. The beta weight of the paths (path coefficients) which give the estimates of the strengths of the causation are shown in figure 2 as the path coefficients from the new model.

From these weights, the actual values of the indirect paths were obtained simply by multiplying the component single paths.

Table 1
Original and Reproduced Correlation matrix for the seven (7) variables

Variable	X_1	X_2	X_3	X_4	X_5	X_6	X_7
X_1	1.000	-.052	-.081	.061	-.003	-.327	.160
X_2	-.052	1.000	.889	.287	-.667	-.103	-.149
X_3	-.046	0.889	1.000	-.608	-.872	-.257	.168
X_4	0.06	-0.26	0.099	1.000	-.554	.431	-.023
X_5	.009	-0.698	-0.90	0.584	1.000	-.268	.118
X_6	-.325	-.125	0.277	0.44	-.279	1.000	-.223
X_7	.263	-0.13	-0.13	-0.2	-.097	-.299	1.000

a. Entries above the diagonal are the original coefficients
b. Entries below the diagonal are the reproduced correlation

Table 2:
Discrepancies between original and Reproduced Coefficients

Correlation	Original	Reproduced	Difference
R_{12}	-.052	-.052	000
R_{13}	-.081	-.046	.035
R_{14}	-.061	.06	.001
R_{15}	-.003	.009	.012
R_{16}	-.327	-.325	.002
R_{17}	.160	.263	-.103
R_{23}	.889	.889	000
R_{24}	-.287	-.0.26	-.027
R_{25}	-.667	-.698	-.031
R_{26}	-.103	-.125	-.022
R_{27}	-.149	-0.13	-.019
R_{34}	-.609	.099	.51
R_{35}	-.872	-0.90	-.028
R_{36}	-.257	-.277	-.02
R_{37}	-.168	-0.24	-0.098
R_{45}	-.554	-.584	-.03
R_{46}	.431	.44	-.009
R_{47}	-.023	-.02	.003
R_{56}	-.268	-279	-.011
R_{57}	-.118	-.097	-.021
R_{67}	-223	-.299	-.076

Research Question Three

What are the direct and indirect effects of schooling situation variables on secondary school academic performance?

Result

The significant and meaningful pathways through which all predictors caused variation in the criterion variable are shown in Table 3.

(compound path) is considered significant and meaningful if the consistent single paths are significant and meaningful. The results show that of the five variables that have direct effect on their respective contribution is significant and meaningful.

Research Question Four

What percentages of the total effect are direct and indirect?

Result

Table 4 presents the six-predictor variables and their effects (direct and

Table 3
Significant Pathways through which X_1 (1, 2, 3.....,6) caused variations in the Dependent Variable X_7 P = (0.05)

Normal Equation	Direct Paths	Indirect Paths
R_{23}	-	1:P_{32}
R_{24}	-	1: P_{42}
R_{25}	-	2: P_{54} P_{42}; P_{52}
R_{45}	-	2: P_{54} P_{52}; P_{42}
R_{16}	-	4: P_{65}, P_{54}, P_{42}; r_{12}, $P_{64.}$ P_{42}, $r_{12.}$ $P_{63.}$ P_{32}, $r_{12.}$; P_{61}
R_{36}	-	4: $P_{65.}$ $P_{54.}$ P_{32} r_{32}; etc
R_{46}		4:P_{65}, P_{54}, P_{52}, r_{42}; P_{63} $r_{43.}$ $P_{64\ etc}$
R_{56}	-	4:P_{65}, P_{64} r_{54}, $P_{63.}$ $r_{53.}$ p_{61}, r_{51}
R_{17}	P_{71}	4: $P_{76.}$ P_{65}, P_{54}, P_{42}, r_{12}, P_{64}, P_4 r_{12} P_{11}, P_{21}
R_{27}	P_{72}	4: P_{76}, P_{65}, P_{54}, P_{42} etc
R_{47}	P_{74}	4: P_{76}, P_{65}, $P_{65.}$ $P_{54.}$ P_{42}
R_{57}	P_{57}	4: P_{25} r_{65} $P_{74.}$ r_{64}; $p_{72}r_{62.}$ P_{72} r_{62} P_{71} r_{61}
R_{67}	P_{67}	4: P_{25} r_{65}, P_{74}, r_{64}, P_{72} r_{62}, $P_{71}r_{61.}$

There are forty-seven (47) pathways through which all the predictors X_1 (1-6) caused variation in the dependent variables X_7). Out of these pathways, five (5) are direct while forty-two (42) are indirect. An indirect path

indirect) on the dependent variable. The table also shows the total effects and the proportion of it that is direct and indirect respectively.

Table 4 Effects of the six variables on students' academic performance.

Table 4
Effects of the six variables on students' academic performance.

	Predictor variable 1-6	Total effect	%©	Direct effect	%D	Indirect Effect (a-b)	%E	%F
	1	0.16	12.16	0.20	15.20	-0.04	-3.04	16.0
	2	0.15	11.40	-0.13	-9.88	0.28	21.28	15.0
X_7	3	0.17	12.92	0.26	19.76	-0.09	-6.84	17.0
	4	0.20	15.20	0.34	25.84	-0.14	-10.64	20.0
	5	0.12	9.12	-	-	0.12	9.12	12.0
	6	0.20	15.20	-	-	0.20	15.2	20.0
	Total	1.00	76.00	0.67	50.92	0.33	25.08	100.0

Total effect = Original Correlation Coefficients
Direct Effect = Path Coefficients
Indirect Effect = total effect – Direct effect

Results establish that out of the 5 variables, which have direct effects on secondary school academic performance, population (variable X_4) made the greatest contribution. It is followed by resource situation, classrooms being used, number of teachers, and class size.

Discussion

The study developed a causal model to examine the linkage between the seven variables of the study. The study aimed at determining how these variables when taken together affect students' academic performance. In the recursive model, twenty one (21) hypothesized path (Fig 1) were trimmed to ten (10) significant pathways derived from five (5) structural equations for producing the most meaningful causal model (Fig 2) involving the six independent variables as determinants of students' academic performance. It was shown that 76% of the variation in students' academic performance is accounted for by all the six independent variables when taken together. The remaining 24% of the variation might be due to the influences of other factors not considered in this study such as teaching style, school headship.

Table 4 shows that the total variation (i.e. 76% contribution of all six independent variables when taken together) consists of 25.84% and 50.16% direct and indirect components respectively. In addition, four variables: student-teacher ratio (variable 4), teacher population (variable 3), resource situation (variable 1) and students' population (variable 2) have direct casual influence on students' academic performance. Of the four variables, (variable 4) has the highest contribution to students' academic

performance, followed by variable 3, then variable 1 and variable 2 had the least contribution in that order.

From the table, Student-Teacher ratio accounted for 20.0% of the total effect of the six independent variable and 25.84% of the direct effect on the criterion variable. The teacher population accounted for 17.0% of the total effect of the six independent variable and 19.76% of the direct effect on the criterion variable, resource situation accounted for 16..0% of the total effect of the six independent variable and 15.20% of the direct effect on the criterion variable and students' population accounted for 15.0% of the total effect of the six independent variable and –9.88% of the direct effect on the criterion variable. This indicated that when there are more students for teachers to teach, the academic performance of the students decreases as it is a known fact that the large class does not allow for thorough class management and organization which of course has negative influence on the teaching effectiveness of the teacher and which also will lower students' academic performance.

Summary of Finding and Conclusion

From the results and discussion of findings, the following summary and conclusion could be made.Out of the six variable hypothesized to be influencing students' academic performance, four (student-teacher ratio (variable 4), teacher population (variable 3), resource situation (variable 1) and students' population (variable 2)) have direct effect on students' academic performance while the remaining two variables (number of classroom (variable 5) and average class size (variable 6)) have indirect effects on students' academic performance. In all 50.92% of the total effect of all the six independent variables on students' academic performance are direct while 25.08% are indirect.

The relative order of importance of the six variables in influencing students' academic performance is:

$X_4 > X_3 > X_1 > X_2 > X_6 > X_5$

The variables, especially the four that had direct effects on students' academic performance should be seen as very important by the policy makers, head teachers, teacher trainers and the center administrations who is interested in boosting the quality of students' academic performance.

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