AFRICAN JOURNAL OF CROSS-CULTURAL PSYCHOLOGY AND SPORT FACILITATION

PATH ANALYTICAL STUDY OF TEACHERS' CHARACTERISTICS, STUDENTS' ATTITUDE AND INSTRUCTIONAL FACILITIES ON STUDENTS' PERFORMANCE IN MATHEMATICS

By

Olaoye, L.A.A.

Abstract

The study determined the effect of teachers' characteristics like qualification, knowledge of subject matter, experience, workload, effectiveness, students' attitude and instructional facilities caused variation in students' performance in Mathematics. Study adopted an expost-facto design covering the colleges of education in Nigeria. Samples to the study consisted of 165 NCE III students of Mathematics and 30 Mathematics lecturers from the 6 colleges of education in the southwestern part of Nigeria. Six instruments were developed, validated and used to collect data: context questionnaire, input questionnaire, process questionnaire, product questionnaire, inventory of Mathematics resources in the colleges and inventory of resources in the Mathematics laboratory studio. Data were analyzed through the mean, standard deviation and path analysis. The findings showed that there was dismal performance of students in Mathematics with mean scores of 44.4% and standard deviation of 2.9. Twenty one significant pathways (seven direct and fourteen indirect = 82.2%) through which the identified variables caused variation in students' performance in Mathematics. The implication of the finding was that persistent students' dismal performance in Mathematics was due to accumulated problems in their preparation which failed to adhere strict to the conditions of programme accreditation.

INTRODUCTION

All the subjects in the school system are significant but some of these subjects are more significant than others due to the educational philosophy of the society in which the school system is expected to serve. A cursory look at Nigerian educational system from the pre-primary levels to the secondary school levels revealed the importance being placed on the teaching and learning of Mathematics, which is believed to have wide application in the area of science and technology. According to some scholars like Anya (1982) and Gomwalk (1986), modern development is now conceptualized in terms of science (Mathematics inclusive) so much that 'development' is no longer possible outside the framework defined by science. To this end, the federal and state governments of Nigeria have recognized the actual development of both human and non-human resources to the development of sciences (including Mathematics), as shown in the National Policy on Education (1981).

In spite of this exalted position which Mathematics occupied, it is disheartened to note that the subject often recorded dismal performances among the students compared to liberal subjects, as acknowledged by Bojuwoye (1985) and Adamolekun (2002). Various reasons, according to those studies, have been advanced to have contributed to the students' dismal performance in Mathematics. These range from teachers' factor, environment factors and the students' factors. Other factors as advanced by different studies to have caused dismal performance of students in Mathematics included the qualification of science teachers (Mathematics inclusive) (Bajah, 1983; Ferguson, 1991; Obemeata, 1996; Ogunwuyi, 2000); effectiveness of the teachers in the course of teaching (Dunkin and Biddle, 1974; Onocha and Okpala, 1995; Puma et al, 1997); experience of the science teachers (Mathematics inclusive) on the job (Ajayi, 1981; Eta, 1986; Aghadiuno, 1992); knowledge of the subject by the teachers (Fakuade, 1980; Jones, 1991; Olaoye, 1998); Workload entrusted to the teachers to handle (Gage, 1984; Greenwald, Hedges and Lane, 1996);

instructional facilities available to enhance teaching and learning of the subject (Osafehinti, 1984; Onocha and Okpala, 1988; Emeke, 1996; Popoola, 1998), and attitudes of students towards the learning of Mathematics (Russel, 1959; Brodie, 1964; Fakuade, 1979; Adetula, 1994; Oyeniran and Farayola, 1999).

All the aforementioned studies have in one way or the other, identified the extent to which these factors had affected the performances of students in Mathematics and provided solution accordingly, but non-of these studies had considered these factors together to the variation of students' performance in Mathematics. Apart from this, it was necessary to explore the efficacy of these variables on the students' performance in Mathematics at the higher level where the training of teachers of Mathematics often take place, in order to avert the transitive problems of students' ailment in Mathematics.

More so, students are the patients to be treated of dismal performance in Mathematics it is imperative to diagnose their trainers of existing ailments so as to ensure adequate preparation. In another angle, the perennial problem facing the teaching and learning of Mathematics by students could be stopped from the root as soon as the problems facing the trainer of Mathematics teachers into the primary and lower secondary schools level were solved once and for all the generation to come. An half-baked surgeon is likely to kill a person at a time before discovery but an half-baked teacher kills million of minds and that is why the study is imperative at the moment and in general.

Problem

The study investigated the path analytical ways (direct and indirect) through which teacher's characteristics, students' attitude towards Mathematics, and available instructional facilities caused a variation in students' performance in Mathematics. Specifically, the study provided answer to research questions.

1. What is the level of NCE Mathematics students' performance in Mathematics?
2. What is the significant path (direct and indirect) through which teachers' characteristics, students' attitude towards Mathematics and available instructional facilities caused variation in students' performance in Mathematics?

Population

All the final year Mathematics students and Mathematics lecturers of the accredited colleges of education that ran Mathematics education programme constituted the target population for the study.

Sample and Sampling Procedure

There were 165 final year students of Mathematics and 30 Mathematics lecturers drawn from the 6 colleges of education in the southwestern part of Nigeria. These colleges were chosen purposively due to the approved Mathematics subject combination of 10 out of 20 approved for all colleges of education in Nigeria (PCE, 2000); and they all lied in the same route for researcher's convenience. 30 Mathematics lecturers were chosen as the minimum approved number of personnel to handle Mathematics education programme by the National commission for colleges of Education (NCCE), thus making use of 5 Mathematics lecturers in each college. All the available final year Mathematics students numbered 165 that ensured minimal course attrition and adequate coverage of over 90% of the syllabus in Mathematics in the second semester of part III were used for the study. This was to ensure that no aspect of Achievement Test in Mathematics and Methodology (ATIM) given to the students had not been covered by prospective Mathematics lecturers in the colleges.

Instruments

There were 6 instruments used to collect the data. They were context questionnaire, Input questionnaire, process questionnaire, product questionnaire, inventory of Mathematics resources in the colleges (IMRC) and inventory of resources in the Mathematics laboratory studios.

Validation and Reliability of Instruments

Context questionnaire was developed by researcher in line with standard minimum guide of NCCE, and was given both face and content validity through an expert in teacher education and evaluation

before trial tested on students and lecturers of Mathematics to ensure its reliability.

Input questionnaire was self-developed instruments to elicit responses from Mathematics lecturers, and it contained 3 sections. Section A contained respondents' biodata, section B contained 2 scales available or non-available of listed Mathematics resources and section C contained 4 scales of very often, often, rare and not at all of using the listed Mathematics resources by lecturers. A test-retest of the instrument provided reliability of 0.75.

Process questionnaire consisted of 30 items on classroom interaction of lecturer and students, prepared on 4 likert format. It was developed by researcher and adapted from Massialas (1969) and Olakulehin (1995), patterned towards Flander (1970) that suggested the criteria to ensure effective teaching in the classroom. The internal consistency of the items was done using KR-formula 20 and coefficient alpha 0.69 was obtained. A test-retest method of two weeks interval by 2 trained research assistants confirmed reliability of cronbach alpha - value 0.72, and these coefficients were considered high for the study.

Product questionnaire contained two sections. Section A contained Students Attitude towards Mathematics (SATM) and Students Attitude towards Mathematics Lecturers (SATML) with 20 and 5 items, respectively, on 4 likert format as adapted from Aiken (1970). These instruments contained statements that reveal respondents' attitude towards Mathematics and lecturer, having a test-retest reliability of 0.88 and cronbach alpha value 0.72. Section B contained 30 items multiple choice questions, tagged Achievement Test in Mathematics and Methodology (ATIM), which measured 6 objectives of NCE Mathematics curriculum. Developed by researcher, it was administered to 20 final year NCE Mathematics students for trial tested and KR- 21 formula was used to measure its internal consistency with observed reliability 0.86.

Inventory of Mathematics Resources in the college (IMRC) and Inventory of Mathematics laboratory studios were compiled along with inventories of the standard minimum guides of the NCCE of 1990 and 1996. On IMRC relevant available Mathematics textbook was scored 1mk and irrelevant/not available one scored o mk. A test-retest reliability of these instruments was 0.82 using the appropriate places and lecturers in the colleges over an interval of 2 weeks.

Data Collection and Analyses

With the assistance Mathematics lecturers 12 trained research assistants, all the instruments were administered and collected. Each of these instruments was scored appropriately, and in line with the standard minimum guide of NCCE towards measuring the identified variables, thereafter employed the services of data analyst to use SPSS package in path analysis to run the data.

Findings

Table 1: Mean scores and standard deviation of students' performance

Count(n)	Mean	Standard	Instrument score	
			Minimum	Maximum
165	44.4%	2.90	0%	100%

Table 2: Criterion referenced scores of NCCE

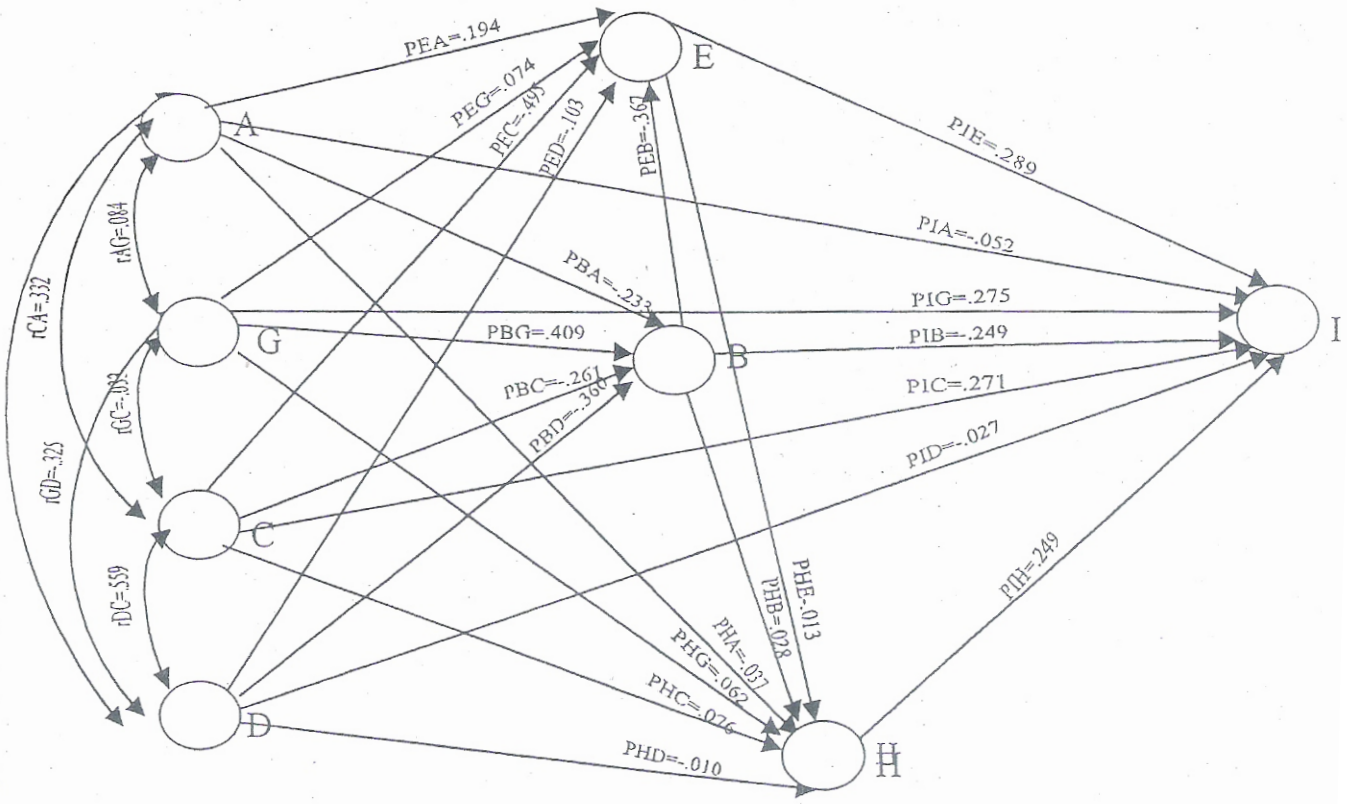
Scores in %	70-100	60-69	50-59	45-49	40-44	0-39
Level of Pass	Distinction	Credit	Merit	Pass	Lower pass	Failure

Table I showed the mean score of students' performance in Mathematics as 44.4%, and by comparison to the criterion referenced score of NCCE in table 2 this fell under lower pass. The implication was dismal performance of students in Mathematics test administered.

Table 3: Correlation matrix for variables in the study

Variable	A	B	C	D	E	G	H	I
A=Qualification of Lectures	1.000	-.223	.332	.257	.194	.084	-.037	-.052
B=Effectiveness of Lecturers	.124	1.000	-.261	-.360	-.367	.409	.028	-.249
C=Relevant available Instructional facilities	.286	-.632	1.000	.559	.495	-.033	.076	-.249
D=Knowledge of Mathematics by Lecturers	.230	-.168	-.321	1.000	-.103	-.325	-.010	-.024
E=Workload of Lecturers in Mathematics	-.337	-.267	.507	.338	1.000	.074	-.013	.289
G=Experience of Mathematics Lecturers	-.310	-.251	.261	-.302	.011	1.000	.062	.275
H=Students attitude towards Mathematics	-.043	-.086	-.046	-.227	.072	.048	1.000	.249
I=Students' performance in Mathematics	.013	-.248	.304	-.100	.049	.046	.123	1.000

Upper diagonal for original correlation. Lower diagonal for reproduced correlation at significant P < -0.05



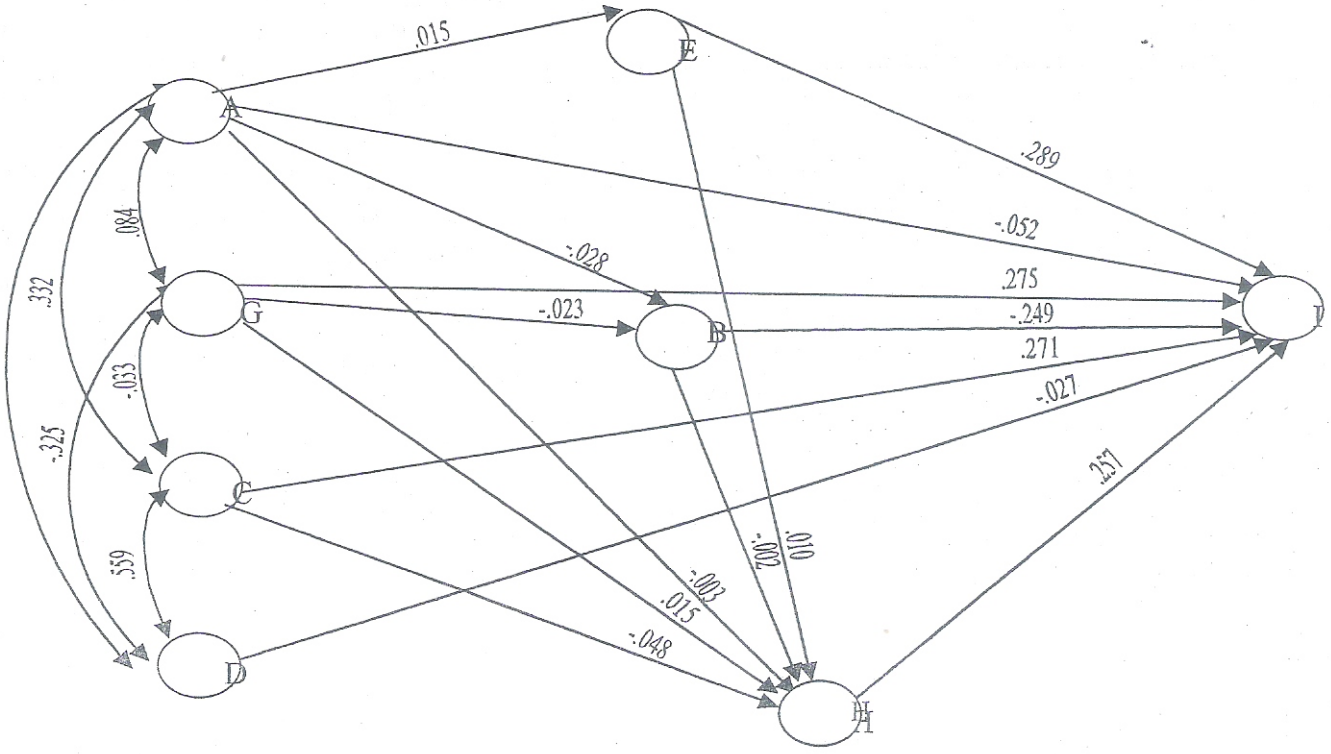
A= Qualification of Lecturer
B= Effectiveness of Lecturer
C= Relevant available instructional facilities
H= Students attitude towards Mathematics
D= Knowledge of Mathematics by Lecturers
E= Workload of Mathematics Lecturers
G= Experience of Lecturers
I= Students' performance in Mathematics

Figure 1: causal model of the eight variable systems.

Table 3 showed the correlation matrix for all the eight variables in the study, and these were used in the path analysis in figure 1 tagged causal model of the eight variables system.

Table 5: Trimmed significant pathways of all variables on I

S/N	Normal/Equation/Pathway		Nature of path	Path coefficients	
1	AI	IA	direct		-.052
2	BI	IB	"		-.249
3	CI	IC	"		.271
4	DI	ID	"		-.027
5	EI	IE	"		.289
6	GI	IG	"		.275
7	HI	IH	"		.249
8	IE, EA			(.067) (.225)	. 015
9	IB, BA			(.204) (.265)	-.028
10	IH, HA			(.217) (-.013)	-.003
11	IH, HB,BA			(.217)(-.035) (.265)	-.002
12	IH, HE, EA			(.217) (.048) (.225)	.002
13	IB, BG			(-.104) (.219)	-.023
14	IH, HE, EG			(.217) (.048) (.213)	.002
15	IH, HB, BG			(.217) (-.035) (.219)	-.002
16	IH, HG			(.217) (.067)	.015
17	IE, EG			(.067) (.213)	.014
18	IE, EC			(.067) (-.026)	-.002
19	IH, HC			(.217) (-.220)	-.048
20	IH, HB			(.217) (-.035)	-.008
21	IH, HE			(.217) (.048)	.010



A= Qualification of Lecturer
B= Effectiveness of Lecturer
C= Relevant available instructional facilities
H= Students attitude towards Mathematics
D= Knowledge of Mathematics by lecturers
E= Workload of Mathematics lecturers
G= Experience of Lecturers
I= Students' performance in Mathematics

Figure 2: casual model of significant path of eight variables systems

From table 3 correlation matrix of the variables were obtained to draw the path analysis in figure 1. In this casual model there were 34 pathways which were shown in table 4

But table 5 showed the trimmed pathways that were significant based on meaningful/research findings or both. So, there were 21 significant pathways to which teachers' characteristics, students attitude towards Mathematics and relevant instructional facilities caused variation in students' performance in Mathematics. These were shown in figure 2 where there were 7 direct pathways and 14 indirect ways.

Discussion

Many studies have discussed extensively the factors responsible for the dismal performance of students in Mathematics (Onocha and Okpala, 1995; Olaoye, 1998; Oyeniran and Farayola, 1999). The result of this study confirmed that dismal performance of students in Mathematics was real, as shown by the mean score of 44.4% of the administered test on Mathematics, the score that represented lower pass in the criterion referenced standard of the colleges of education. The study also confirmed the stand of WAEC chief examiner report (1981) that inadequate preparation of students in Mathematics resulted to their poor performance in the subject.

The study revealed 21 significant (direct and indirect) pathways through which identified variables caused a variation in students' dismal performance in Mathematics with difference magnitude (see Table 5). It was shown that 7 direct pathways accounted to 76.4% dismal performance in Mathematics while 14 indirect pathways contributed 5.8% to the poor performance of the students. The result also demonstrated the findings of other studies that had shown how teachers' characteristics, students' attitude towards Mathematics and the available relevant instructional facilities contributed to the students' performance in Mathematics (Adetula, 1994; Olaoye, 1998). Other factors not accounted for in this study contributed remaining percentage to the dismal performance of students in Mathematics, as total direct and indirect contribution was 82.2%.

Conclusion

The primary goal of teaching and learning is to ensure good performance of students in a given task. Since the students are the patients that deserved the learning ailments, according to Okey (1979), it is imperative to diagnose their trainers so as to pin down other problems associated with the teaching and learning of Mathematics in particular. This study was carried out to determine contribution of the identified variables as a caused variation in students' performance in Mathematics. As a result, a strict attention has to be developed towards the preparation of teachers through adequate facilities, improved attitudes and teachers' characteristics. This would bring out the dismal performance of students in Mathematics to glorified neighbourhood of success.

More importantly, the contexts of establishing the colleges of education need to be monitored in the course of implementation in order to guide against production of half-baked teachers of Mathematics. As half-baked Mathematics teachers endangers the nation educational system, which determines the pace of modern development.

REFERENCES

Adamolekun, L. O. (2002) Effect of gender on students' performance and attitude towards Mathematics in junior secondary schools in Lagos state. *Unpublished B. Sc (ed.) Mathematics project.* University of Ado-Ekiti, Ado-Ekiti.

Anya, A. O (1982). Science development and the future –the Nigeria case. Nsukka. UNN Press.

Ajayi, S. A. (1981) Job satisfaction and commitment among Nigerian University teachers. *Unpublished Ph.D. Thesis* University of Ibadan.

Aghadiuno, M. C. K. (1992) A path analysis study of cognitive style,
understanding of science and latitudinal variables as correlates achievement in secondary school chemistry. *Unpublished Ph.D. Thesis*. University of Ibadan.

Adetula, I. O. (1994) Effect of modified matching analysis teaching
technique on students' Mathematics achievement at the JSS level. The Nigerian teacher (today) *A Journal of teacher education* 3, No. 1 and 2.

Aiken, R. R. (Jr.) (1970) Attitude towards Mathematics. *Reviews of*
Education researcher 40, 551-596.

Bojuwoye, O. (1985) Crisis in science classroom, poor enrolment of
secondary school students in science subjects and its implication for science teachers. *STAN* 23, 214-220

Bajah, S. T. (1988) Problems of teaching science in West and East Africa, a commissioned work for Educafrica, Wellington, New Zealand.

Brodie, T. A. (1964) Attitude towards schools and academic achievement. *Personal and guidance Journal* 43, 375 – 378.

Dunkin, M and Biddle, B (1974). *The study of teaching* New York: Holt, Rinehart and Winston.

Eta, O. I. (1986) The relationship between teachers characteristics and pupils academics performance. *Unpublished M. Ed. Dissertation*. University of Ibadan.

Emeke, A. (1996). The teachers as a curriculum developer and an evaluator in S. O. Ayodele (Edt.) education in the service of humanity. The education study and research groups, Ibadan.

Ferguson, R. (1991). Paying for public education. New evidence on how and why money matters. *Havard Journal of legislation* 28, 438-465.

Federal Republic of Nigeria (1981). *National policy on Education* (revised). Lagos. NERDC Press.

Fakuadè, R. A (1979). An investigation on the problem involves in the teaching and learning of Mathematics in some Nigeria secondary schools in Oyo State (former Western Region). *Unpublished Ph.D. Thesis*. University of Wales.

Fakuade, R. A. (1980). The case for modern Mathematics. *West African Journal of Education* 2 (3), 140 – 149.

Flander, Ned. A (1970). *Analyzing teaching behaviour*. Addison – Wesley publishing Company, In.

Gomwalk, U. D. (1986) Welcome address. *27th STAN annual conference proceeding* Pxii.

Gage, N. C. (1984). *The scientific basis of the art of teaching.* New York. Columbia teachers' college press.

Greenwald, R; Hedges, L. and Lane, R. D. (1996). The effect of school resources on student achievement. *Review of education research* 66, 361 – 396.

Jones, M. G. (1991). Gender difference in science conception. *Science education* 12, 341 – 346.

Massiales, B. G. (1969). Social studies versus social science. The end of an era. *The social studies.*

NCCE (1990) *Standard minimum guides for the NCE teachers (Science)* NCCE, Kaduna. 1st edition.

NCCE (1996) *Standard minimum guides for the NCE teachers (science).* NCCE, Kaduna. Revised edition.

Obemeata, J. O (1996). Evaluation of a distance learning programme. *Nigeria education forum* 8, 251 – 58.

Ogunwuyi, A. O. (2000) A casual model of teachers and students factors as determinants of achievement in secondary school integrated science. *Unpublished Ph.D. Thesis*. University of Ibadan.

Onocha, C. O. and Okpala, P. N. (1988) Classroom interaction pattern of Nigeria physics trainees' physics education. *Journal of the British institute of physics* 23 (5), 228- 290.

Onocha, C. O. and Okpala, P. N. (1995) Effects of systematic assessment procedures on students' achievement in Mathematics and science subject. *ISSN* 10 (11)

Olaoye, L. A. A. (1998) Learners' difficulties in Mathematics a case study of secondary schools in Ibadan, Oyo State of Nigeria. *Unpublished M.Ed. Dissertation.* University of Ibadan.

Osafehinti, I. O. (1984) Correlates of the level of achievement in Mathematics at end of secondary education in Oyo state of Nigeria.. *Unpublished Ph.D. Thesis*. University of Ibadan.

Oyeniran, J. O. and Farayola, P. I. (1999) Effect of students attitude and gender difference on performance in Mathematics in senior secondary school in Oyo State, Nigeria. *Journal of research in science teaching*, 16, 33-37.

Puma, M. J. Karweit, N. Price, C. Ricciutti, A. Thompson, W, Vadenkiernan, M. (1997). *Prospects: Final report on students' outcomes*. Washington, D. C. Planning and evaluation service, us department of education.

Popoola, A. A. (1998). Teachers' competency on the perception of the content of the syllabus. *Ikere journal of Education* 1 (1) 161-171.

P.C.E. (2000). *Bronchure for the polytechnics and colleges of Education entrance examination*. UME/PCE Kaduna.

Russel, T. I. (1959) Development of attitudes, interests and values in educational psychology in Skinner E. L. (1959) educational psychology. Prentice-Hall, Inc. Englewood cliffs New Jessey, U. S. A