Cognitive Entry Grades as Predictors of Students Academic Performance in Mathematics in Nigerian Universities

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Abstract: This study investigated cognitive entry grades as predictors of students academic achievements in mathematics in Nigerian Universities. The data used were the cognitive entry grades of 720 university students in Mathematics, as well as their final GPA in Mathematics. The study samples were selected by using the multi-stage random sampling technique. Multiple regression analysis was the only statistics used. Findings however, showed that there was a significant positive and linear relationship between the basic cognitive entry grades and the final GPA of the students in Mathematics. Findings also showed that the cognitive entry grades contributed significantly to the final overall GPA of the selected students in Mathematics at the B.Sc. Ed. Level. It was however, recommended that any candidates who intends to study Mathematics at the university level should possess at least an O' level credit pass in Mathematics, Physics and Chemistry or Further Mathematics or both plus at least a pass in English Language before he/she is admitted.

Key words: Cognitive entry, predictors, academic performance in mathematics, CGPA

INTRODUCTION

Now that Nigeria is struggling to be self reliant and independent technologically, more attention has to be paid to the teaching and learning of Mathematics, as well as students academic achievement in Mathematics at all level of Nigerias educational strata. As a direct consequence of this, the Federal Government of Nigeria paid particular attention to Mathematics and made it a compulsory subjects in the 1st and 2nd 3 years of secondary education in Nigeria, as specified in the National Policy on Education for the present 6-3-3-4 educational system in Nigeria.

Mathematics is the pivot on which other sciences revolves. This is because the development of all other fields of science especially at the Senior Secondary School level is premised on it Ilugbusi (2002), Ogunniyi (1986) and Adelodun (1998).

The importance of Mathematics cannot be over stressed, it is at the base of all sciences and all environmental professions. All students must learn and pass it at the Junior and Senior Secondary School level before they can advance to the University (NPE, 1991).

In view of the importance of Mathematics to the Nations scientific and technological development, couple with its compulsory status in the SSS curriculum as clearly stated in the National Policy in Education (1981). We should continue to seek for methods and variables which would continue to improve students' mastery of the subject as well as their academic achievement in the subject.

Review of literature according to Ogunniyi (1985) Ogunniyi (1986) Bolarinwa (1995) Oriafo (1983) and Olanrewaju and Balogun (1984) showed that students' school and home environmental variables that have attracted considerable attention are those of gender, location of school, qualification of teachers, socio economic status of students' parents, teachers teaching experience and type of school etc. for instance, Ilugbusi (2002) Olanrewaju and Balogun (1984) Ogunniyi (1985) and Oriaifo (1983). Found in their respective studies that male perform significantly better that their female counterpart in Science and Mathematics. While other researchers, Ogunniyi (1986) and Ilugbusi (2002) affirmed that gender has little or no effect on students academic achievement in Science and Mathematics. Furthermore, many researchers have been carried out on all other students' school and home environmental variables listed above by Olarenwaju (1986) and Olubodun (1986) but not much has been done on the effects of entry grades (qualifications) on the final overall Cumulative Grade Point Average (CGPA) of University students in Mathematics at B.Sc. Ed level in Nigeria.

Before any student could be admitted to study Mathematics in any Nigeria University, there is a minimum entry qualification, which he/she must

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satisfy. This however, varies from institution to institution and from department to department.

In a study carried out by Akindehin (1983) he found that students entry qualifications are good predictors of their academic performance at the degree level. While Majasan and Bakare (1974) found in their study that entry qualification has low predictive value (strength) on the final academic performance of students at the University of Baden. Furthermore, Ojerinde (1975) and WAEC found in their respective studies that there was a positive and significant relationship between candidates' academic performance in SSCE and the University performance of the same set of students and that the SSCE has fair predictive power on University performance.

Resultantly therefore, this study examined the effects of the required minimum academic entry grades on the final CGPA of students at the degree level in the Universities in South Western Nigeria

Objectives of the study: Review of literature showed that a way of initiating curriculum improvement programmes in Schools is to examine the effects of entry grades of students on their final overall academic achievements (Ogunniyi, 1985; Ilugbusi, 2002; Bolarinwa, 1995).

Consequently, this study is specifically designed to examine the relative contributions (effects) of predictor variable (entry grades) i.e., Mathematics, Physics, Chemistry, Further Mathematics and English Language on the criterion variable i.e., final cumulative grade point average CGPA of students in Mathematics at the Bachelor Degree's level in some selected universities in South Western Nigeria.

Research hypotheses: The following null hypotheses were generated and tested at PO = 0.05 level of significance in this study.

- There is no significant relationship between the basic entry grades and the final Cumulative Grade Point Average (CGPA) of students in Mathematics at Bachelor Degree's level in Nigeria Universities
- There is no significant contribution from the basic entry grades of University students to their final Cumulative Grade Point Average (CGPA) in Mathematics at the degree level.

Research design: The design adapted in this study was an Ex-post facto design. This is because all the research variables had already existed before the commencement of the study and hence the researcher neither controlled not manipulated the research variables. He just collected the data and used them as they occurred naturally.

MATERIALS AND METHODS

The study sample consisted of 720 Mathematics students, which were selected from 4 Universities in the South Western in Nigeria by using Simple random sampling technique in 3 consecutive sessions. The Universities are:

- University of Ado-Ekiti, Ado-Ekiti.
- University of Lagos, Lagos.
- University of Ibadan.
- Obafemi Awolowo University, Ile-Ife.

It is however, expected that the randomization procedure would control for other variables and other environmental effects.

Research instrument: The major instruments from which the data used for this study were obtained were of 2 sets. The first set consisted of the record which contained all the entry subjects as well as the grades of all the sampled students with which they were admitted for the degree programme in Mathematics in the selected university during the 2000/2001 Academic Session.

The second set consisted of the record which contained all the final Cumulative Grade Point Average (CGPA) of all the students sampled in Mathematics at the degree level in selected University during that 2000/2001, 2001/2002 and 2002/2003 academic sessions i.e., final overall CGPA in rain semester in Part III.

Methods of data collection: The entry grades of all the entry subjects of all students sampled were collected directly form the Directorate of Admissions and Statistics of the Universities after obtaining all the necessary approval, while the final overall Cumulative Grade Point Average (CGPA) of the students sampled were obtained from the Directorate of Examinations and records of the selected universities after getting all the necessary permission.

Methods of data analysis: All the data collected were analyzed by using the multiple correlational and regression analyses as well as the Analysis of Variance (ANOVA).

The multiple regression equation was fitted as $Y = a + b_1x_1 + b_2x_2 + \ldots\ldots + b_nx_n$ where b_i (i = 1,2,3 …n) are the multiple regression coefficients and x_i(I = 1, 2, …n) denote the relevant entry qualification subjects, such as Mathematics, Physics, etc. and 'a' is the regression constant.

The βeta-weights of the listed entry subjects will show the relative contributions of the predictor variables

to the criterion variable, while the value of R^2 will indicate the proportion of the variation in the criterion variable which can be attributed to the predictor variables. Also. The multiple R will be a measure of the strength of association between the predictors and criterion variables. The F-test (ANOVA) will show whether there is any significant difference the various R-values.

RESULTS AND DISCUSSION

The data collected were separately analyzed for 4 different universities as shown in the Table 1-3:

Table 3 a-c showed that there were significant contributions from the 5 entry subjects to the final years CGPA in Mathematics. The regression model fitted is CGPA = 1.42 + 0.38 (Maths) + 0.31 (Phy) + 0.18 (Chem) + 0.52 (F/M) + 0.05 (Eng). The equation and results above showed that F/M (one of the basic entry subjects) had the highest predictive strength among all the variables for Mathematics. This is closely followed by mathematics, Physics and Chemistry. English Language contributed least to the overall CGPA in Mathematics.

The 5 basic entry subjects jointly contributed 46.17% to the overall CGPA of the students. This implies that the fitted regression model left 53.86% unexplained in the total variation in the CGPA. The major implication of this is that there are other salient factors (extraneous variables), which also contributed to the students' CGPA other that the basic entry qualification (subjects). Furthermore, the multiple R = 0.5360 indicated that there was a significant positive and linear relationship between the basic entry (subjects) qualifications and the final CGPA in Mathematics.

Lastly, a significant F_c of 5.80 showed that there was a significant difference between the various R-values.

The analyses in Table 4 a-c above showed that were significant contributions from the 5 entry subjects to the final year CGPA in Mathematics. The regression model fitted is CGPA = 1.25 + 0.64 (Maths) + 0.76 (Physics) + 0.32 (Chem) + 0.24 (F/M) + 0.20 (Eng).

The results and multiple regression equation above showed that Physics (one of the basic entry subjects) had the highest predictive strength among all the variables. This is followed by Mathematics, Chemistry and F/M, English Language contributed least to the overall CGPA in Mathematics.

The 5 basic entry subjects jointly contributed 35.52% to the CGPA of students that is, the model left 64.48% unexplained but only explained 35.52% of the total variation in the final CGPA of the students.

Consequently, the entry subjects had significant effect (influence) on the CGPA of the students in Mathematics.

Table 1: The SSCE stanine scores and their weights

Stanine score	A1	A2	A3	C4	C5	C5	P7	P8	F9
Weights	4.00	3.50	3.00	2.50	2.00	1.50	1.00	.50	0.00

Table 2: The university CGPA level and their grades

CGPA	4.50-5.00	3.50-4.49	2.40-3.49	1.50-2.39	1.00-1.49	0.00-0.99
Grade	A	B	C	D	E	F

Table 3a: Multiple regression analysis between predictor and criterion variables, CGPA as criterion variable for mathematics students at UNAD

Multiple R	0.5360
R^2	0.4614
Adjusted R^2	0.2861
Standard Error	0.7355

Table 3b: Analysis of variance between predictor and criterion variables, CGPA as criterion for mathematics students at UNAD

Source of variance	DF	SS	MS	F_c	F_t	Result
Regression	5	42.16	8.64			
				5.80	2.21	*
Residual	174	123.82	1.49			
Total	179	165.98				

p = 0.05, *: Significant result

Table 3c: Relative contribution of predictor variables. CGPA as criterion variable for mathematics students at UNAD

Variables	β	SEB	BETA	T
Mathematics (X_1)	0.3751	0.1524	0.2220	4.6150
Physics (X_2)	0.3114	0.5825	0.1524	2.4931
Chemistry (X_3)	0.1781	0.0890	0.0347	0.6610
F/M (X_4)	0.5150	0.5311	0.1653	1.5650
English Language (X_5)	0.0453	0.0734	0.0874	1.9456
Constant	1.4201	0.1670		0.5835

Table 4a: Multiple regression analysis between predictor and criterion variables, CGPA as criterion variable for Mathematics students at UNILAG

Multiple R	0.5864
R^2	0.3552
Adjusted R^2	0.1932
Standard Error	0.6041

Table 4b: Analysis of variance between predictor and criterion variables, CGPA as criterion for mathematics students at UNILAG

Source of variance	DF	SS	MS	F_c	F_t	Result
Regression	5	32.35	9.77			
				7.24	2.21	*
Residual	174	120.58	1.35			
Total	179	152.93				

p = 0.05, *: Significant result

Table 4c: Relative contribution of predictor variables. CGPA as criterion variable for mathematics students at UNILAG

Variables	β	SEB	BETA	T
Mathematics (X_1)	0.6435	0.1672	0.2530	1.7394
Physics (X_2)	0.7561	0.1520	0.2247	2.3521
Chemistry (X_3)	0.2356	0.0927	0.1055	1.8271
F/M (X_4)	0.3211	0.3511	0.1266	0.6684
English Language (X_5)	0.2006	0.0843	0.1334	1.9221
Constant	1.2451	0.1234		0.5922

Furthermore, the multiple R = 0.5864 indicated that there was a significant linear and positive relationship between the basic entry subjects (qualifications) and the final CGPA in Mathematics. Lastly, a significant F_c of 7.24 showed that there was a significant difference between the various R-values.

Table 5a: Multiple regression analysis between predictor and criterion variables, CGPA as criterion variable for mathematics students at the university of Ibadan

Multiple R	0.5056
R^2	0.5761
Adjusted R^2	0.2780
Standard Error	0.1622

Table 5b: Analysis of variance between predictor and criterion variables, CGPA as criterion for mathematics students at university of Ibadan

Source of variance	DF	SS	MS	F_c	F_t	Result
Regression	5	26.86	6.09			
				3.46	2.21	*
Residual	174	109.27	1.76			
Total	179	136.13				

$p = 0.05$, *: Significant result

Table 5c: Relative contribution of predictor variables. CGPA as criterion variable for mathematics students at university of Ibadan

Variables	β	SEB	BETA	T
Mathematics (X_1)	0.5510	0.2611	0.2802	2.4487
Physics (X_2)	0.4320	0.1930	0.2422	2.2261
Chemistry (X_3)	0.5641	0.1752	0.3075	2.5634
F/M (X_4)	0.6862	0.1403	0.3640	3.3740
English Language (X_5)	0.2236	0.2467	0.0561	2.5991
Constant	1.1452	0.2346		1.6211

Table 6a: Multiple regression analysis between predictor and criterion variables, CGPA as criterion variable for mathematics students at the Obafemi Awolowo University

Multiple R	0.6625
R^2	0.5820
Adjusted R^2	0.3211
Standard Error	0.1712

Table 6b: Analysis of variance between predictor and criterion variables, CGPA as criterion for Mathematics students at Obafemi Awolowo university

Source of variance	DF	SS	MS	F_c	F_t	Result
Regression	5	21.98	8.35			
				4.01	2.21	*
Residual	174	122.04	2.08			
Total	179	144.02				

$p = 0.05$, *: Significant result

Table 6c: Relative contribution of predictor variables. CGPA as criterion variable for mathematics students' at Obafemi Awolowo university

Variables	β	SEB	BETA	T
Mathematics (X_1)	0.5771	0.2300	0.1621	1.0990
Physics (X_2)	0.4290	0.1281	0.0581	0.8520
Chemistry (X_3)	0.4855	0.1732	0.1120	0.5546
F/M (X_4)	0.7641	0.3406	0.2258	2.6340
English Language (X_5)	0.2062	0.2111	0.0610	0.3568
Constant	1.3534	0.1322		1.2840

The analysis in Table 5 a-c revealed that there was a significant contribution to the final CGPA in Mathematics by the 5 basic entry qualifications (subjects). The multiple regression fitted is CGPA = 1.15 + 0.55 (Maths) + 0.43 (Phy) + 0.55 (Chem) + 0.69 (F/M) + 0.22 (Eng).

The result and equation showed that F/M ahd the highest predictive strength of all the basic qualifications for Maths students at University of Ibadan. The 5 basic entry qualifications jointly contributed 57.61% to the final CGPA in Mathematics and left 42.39% unexplained.

Furthermore, the beta and T-values of 0.36 and 3.37 associated with Further/Maths also confirmed that Further/Maths had the highest predictive strength for all students in Mathematics.

The analyses in Table 6a-c revealed that there was a significant contribution to the final year CGPA by the 5 basic entry qualification subjects. The regression model fitted is CGPA = 1.35 + 0.58 (Maths) + 0.43 (Phy) + 0.49 (Chem) + 0.76 (F/M) + 0.21 (Eng). The result and equation above showed also that F/M had the highest predictive strength of 0.76, followed by Maths, Chemistry and Physics for Mathematics. English Language has the least predictive strength. All the 5 basic entry subjects jointly contributed 58.20% to the final CGPA of the students in Mathematics.

Hence the fitted model left 41.80% unexplained, but only explain 58.20% of the total variation in the students' final CGPA in Mathematics.

Furthermore, the multiple R = 0.6625 indicated that there was a significant linear and positive relationship between the basic entry qualifications (subjects) and the final CGPA of the students in Mathematics.

CONCLUSION

The values of the multiple R = 0.5360, 0.5864, 0.5056 and 0.6625 in Table 3a, 4a, 5a and 6a, respectively showed that there was a significant linear and positive relationship between the basic entry grades and the final CGPA of the students in Mathematics. Hence, the null hypothesis I is thus rejected. This findings corroborated previous and similar researchers by Ojerinde (1975), WAEC (1992), Akindehin (1983), Majasan and Bakare (1974) who found in their studies that there was a significant positive and linear relationship between students entry qualifications and their final academic achievements in Universities.

Furthermore, the relative contributions (β-weights) of the entry grades (i.e., predictors variables) which are vividly shown in Table 3-c, respectively showed that there was a significant contribution from the grades of the selected university students to their final Cumulative Grade Point Average (CGPA) in Mathematics at degree level. Hence, the null hypotheses II is also rejected. These findings are also in line with previous similar studies by Akindehin (1983) and Ilugbusi (2004) a significant contribution from entry grades to the final academic achievements of students in Tertiary Institutions.

Findings further showed that the basic entry grades jointly contributed 46.17% to the final CGPA of maths

students in UNAD, but left 53.86% unexplained in Table 3a. The basic entry grades also contributed 35.52% jointly to the final CGPA of Mathematics students at UNILAG and left 64.48% unexplained in Table 4a.

Similarly, the basic entry grades contributed 57.61% jointly to the final CGPA of maths students at the University of Ibadan and left 42.39 unexplained in Table 5a. Lastly, the basic entry grades also contributed 88.20% to the final CGPA of Mathematics students and left 41.80% unexpected in Table 6a by the multiple regression model.

The various result obtained from the various universities revealed that, although the basic entry grades contributed significantly to the students final CGPA in Mathematics at degree level in Nigeria Universities, there are still some other important or salient factors which affect students academic achievement in the universities aside the basic entry grades. Some of these factors may be social. Psychological, school environmental factors and so on.

Consequently, any student with very good entry grades and who is affected favourably or positively by listed and home environmental factors will definitely end up a very good final CGPA in Mathematics at degree level in the University.

Recommendations: Based on the finding of this study, the following recommendations were made:

- Any candidate who intends to study mathematics at the university should be made to possess at least an O' level credit pass in Mathematics, F/M and Chemistry or Physics or both plus at least a pass In English Language, as prerequisites for admission.
- In view of the fact that other salient factors also contributed to students final academic achievement in Mathematics at the university, multiple screening devices should be used to interview and select candidates for admission to study Mathematics.
- Consequent on the fact of analysis of the skills needed in the various aspects of mathematics should be carried out and suitable and standardized aptitude tests on the basis of these skills are used for selection and admission of candidates to study Mathematics.
- In designing the aptitude tests mentioned the mathematics educators involved should consult and involve test experts so that the psychometric properties of the aptitude test will be ascertained and ensured and hence avoid capricious item selected.

- Finally, it was recommended that students who offered only Biology or Agricultural Science or both without Chemistry and Physics should not be admitted to study Mathematics in Universities as is presently being done in some Universities.

REFERENCES

Akindehin, O., 1983. Predicting academic performance form entry qualification at Adeyemi College of Education, Ondo. Unpublished master's Thesis. University of Ife., (Now OAU) Ile-Ife, Nigeria.

Bajah, S.T., 1983. Teaching integrated science creatively-. Ibadan University Press Plc.

Bolarinwa, A.O., 1995. Introduction to science education-. Abeokuta. Zent Press Ltd.

Federal Republic of Nigeria, 1981. National policy on education. Lagos. Federal Ministry of Education Printing Division.

Ilugbusi, A.A., 2002. Effects of school environmental variables on students academic achievement in mathematics at the JSS level. J. Edu., 2: 15-22.

Kolawole, E.B. and Ilugbusi, 2006: Comparative effectiveness of three problem solving instructional strategies on students heuristic transfer on the SSS Mathematics Curriculum. Int. J. Sci. Tech.

Majasan, J.A. and C.G.M. Bakare and 1974. The predictive validity of baden entry qualifications. West Afr. J. Edu. Res., 67: 111-115.

Ogunniyi, M.B., 1985. The rhetorics of science education for rural transformation. J. Sci. Nig., 3: 1-163.

Ogunniyi, M.B., 1986. Teaching science in Africa. Baden Salem Media Ltd. Nigeria.

Oriafo, S.O., 1983. The concept of individualization of instruction: Implications for science teaching. J. Sci. Teachers Asso. Nig., 2: 2-11.

Olanrewaju, A.O. and T.A. Balogun, 1984. Attitude and teaching methods of some integrated science teachers and students achievement. J. Res. Curriculum., 2: 15-27.

Olubodun, J.B.O., 1986. Effect of mastery learning startegy on studnets' learning outcomes in mathematics. Thesis. University of Baden, Nigeria.

Ojerinde, A., 1975. Predicting Academic Success in School Certificate Examination from National common entrance examination scores, unpublished master's Thesis, University of Ife, Ile-Ife, Nigeria.