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Engineering Education Factors and Academic Performance in South-Western Nigerian Universities

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Abstract— Engineering education has remained the substratum of any society as its contributions towards national development cannot be overemphasized. This is evident in the rapid technological innovations and novel solutions achieved by students with excellent academic performance in universities across the globe. However, some factors have inhibited students' academic performance in many developing countries especially in the Nigeria experience. These factors are attributed to parental influence, societal pressures, outdated curriculum, lack of state-of-the-art equipment's and traditional teaching methods. Based on the aforementioned, this paper examined the effect of engineering education factors on academic performance using a survey research design. Primary method of data collection was utilized for administration of 400 copies of questionnaire amongst final year engineering students in the selected tertiary institution in South West, Nigeria. Data were analyzed using multiple regression and artificial neural network analysis. Multiple regression analysis revealed that engineering education factors significantly affects academic performance (R = 0.713, R^2 = 0.508, F = 35.105). However, parental influence (p=0.078) and equipment availability (p =0.687) were found not to have significant effect on the students' academic performance. Artificial neural network analysis further revealed that that lecturers teaching methods has the highest importance (0.437) while equipment's availability had the least importance (0.050) on the academic performance of the students. It was concluded that engineering educational factors plays a significant role in engendering engineering student performance. The study therefore recommends that an upgrade of the curriculum, innovative teaching methodologies and positive parenting are vital tools for achieving above average learners' academic performance.

Keywords— Engineering Education, Academic Performance, Curriculum, Teaching Methods, Artificial Neural Network

I. INTRODUCTION

Academic performance has remained a pivotal point for learners in which the entire system of education revolves around it. Rating and ranking of institutions are assessed through performance of students in their academics. Concurrently, expectations of parents from their children as regards their academic performance are high, considering they strongly agree that excellent performance in academics is a function of job opportunities and security for their future life [1]. Achieving academic performance in the engineering education globally has gone through a roller coastal as reports on engineering education is concerned with what needs to be changed, how should change be driven and who should drive the change. Engineering is concerned with the application of science and technology in designing, building and maintaining structure, machine and devices [2]. One of the major aim of engineering institutions are to function as frontiers of knowledge by incorporating new innovations from the institutions research facilities to the society. This can be achieved through a rigorous education centered towards training students to become professional engineers and

public growth pioneers [3]. Engineering education is described as the bedrock of any nation although it has been neglected like other fields of education in Nigeria until around the middle of the 19th century which brought about a new phase [4].

Engineering education has been confronted with several challenges ranging from ineffective curriculum, inadequate equipment's for teaching of practical's, under equipped and non-functional laboratories, poor access to teaching aids, non-challant attitude of students, lack off or inadequate university industry linkages, outdated teaching methodologies, obsolete equipment's, inadequate funding of education, inadequate mentoring of engineering lecturers, lack of special remunerations to engineers, teacher-to-student ratio and the use of ineffective teaching methods are among other challenges identified [5]. [6] also stated that the system of education in Nigeria is concerned with socializing with less emphasis on hard work on the part of both students and lecturers. These issues have affected the quality of engineering education in Nigeria and hence, it becomes difficult for students to compete

with peers in the global market. It is due to this aforementioned that this paper will evaluate the extent to which engineering education factors and academic performance of engineering students.

The rest of the paper is structured as detailed below: Section II contains literature review which entails definition of terms as related to the study and empirical

II. RELATED WORK

Engineering education is basically concerned with the training of engineers who are saddled with the responsibility of initating, facilitating and implementating of technological development of a nation [7]. Engineering profession has been said to contribute significantly towards the national welfare of any economy. Despite the significant contribution of this profession towards economic growth, its education and training in Nigeria higher institutions has raised a lot of concerns amongst academics and professionals. Engineering education in the University is based on theoretical and practical works which differs in terms of curriculum and practical content/skill acquisition. These differences have created a huge defect in engineering training in Nigeria when compared on the global index [8].

Poor curriculum development is seen as one of the majors for the decline in the standard of engineering education as syllabuses are overstuffed with many new courses to reflect entrepreneurial development and information technology training to meet inter-national standards [9]. Although, this addition is applaudable but it has overthrown the required time scheduled for learning and reduces the periods for the acquiring practical skills in the workshops and laboratories. Engineering curriculum is expected to accommodate necessary application of engineering that are prevalent in today's environment, reflect the change in emerging engineering and societal problems [10].

The teaching approach of engineering courses follows the conventional method of transferring knowledge as the lecturer dictates notes to students or derive equations from old notes used decades ago with same examples, scenarios, assignment and project which cannot meet the current trends in global engineering education [11]. This teaching methodology allows learners to be redundant and as such, does not allow cutting-edge skills acquisition, critical thinking and creativity needed in the field of engineering. Remarkably, some developments have been seen in engineering education which is attributed to diffusion of information communication technology (ICT) into the teaching, and learning process which has allowed some sort of modification on the process. Although, the impact of these is still relatively low as some institutions are yet to fully integrate ICT into the teaching method [12].

reviews of some past works on the study variables, Section III contains the methodology such as the research design and instruments used for data gathering employed in the study, Section IV details the study data analysis, findings and discussion of the findings as related to past studies, Section V presents the study conclusion and recommendations.

Like every other profession studied in Nigerian Universities, engineering education is not immune from inadequate equipment and infrastructure for both theoretical and practical aspect of the course. Majority of the laboratories are not well equipped and the available ones are not functional which has frustrated the efforts of both lecturers and students [10]. This has negatively affected the performance of students as some of them cannot put the theoretical knowledge into practice. Another issue that has affected academic performance is parental influence and societal pressure as some of these students do not possess the passion and interest in the field of engineering. Many of such students were forced by their parents to study the course and this has been attributed to their poor academic performance.

III. METHODOLOGY

The descriptive survey research design was utilized to describe the characteristics of the study population. Four hundred final year engineering students represents the study's population which were selected based on the purposive sampling procedure. Data gathering was achieved through the primary source of data collection using a well-structured, reliable and validated questionnaire. The validity and reliability test were carried out using the exploratory factor analysis (varimax extraction method; AVE $\leq$ 0.50) and Cronbach alpha analysis (with values $\leq$ 0.50) respectively. The retrieved data were treated and subjected to the test for normality, homoscedascity, multicollinearity and linearity. The treated data were further analyzed using the inferential statistics (regression analysis) and Artificial Neural Network (Multilayer Perceptron) through the statistical package for science solutions (SPSS).

IV. DATA PRESENTATION, ANALYSIS AND FINDINGS

Four hundred questionnaires were administered to final year engineering students however, three hundred and seventy-six were retrieved which indicate ninety-four percent response rate.

Hypothesis: Engineering education factors has no significant effect on academic performance of engineering students.

Regression Analysis of Results

Table 1: Model summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.713[a]	.508	.494	6.30377

a. Predictors: (Constant), Teaching Methods, Parental Influence, Equipment Availability, Societal Influence, Curriculum

Table 2: ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	6974.926	5	1394.985	35.105	.000[b]
	Residual	6755.387	370	39.738		
	Total	13730.313	375			

a. Dependent Variable: Academic Performance
b. Predictors: (Constant), Teaching Methods, Parental Influence, Equipment Availability, Societal Influence, Curriculum

Table 3: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	13.194	7.326		1.801	.073
	Parental Influence	.333	.188	.096	1.771	.078
	Societal Influence	-.614	.174	-.194	-3.524	.001
	Curriculum	.926	.200	.306	4.631	.000
	Equipment Availability	.084	.208	.022	.403	.687
	Teaching Methodology	1.016	.157	.432	6.458	.000

a. Dependent Variable: Academic Performance

Table 1 illustrates the regression summary of the effect of engineering education factors on the academic performance of engineering students in a selected Nigerian university. The findings in Tables 1 and 2 reveals that engineering education factors has a strong positive effect on academic performance of the students with an R value of 0.713. The adjusted R^2 shows the proportion of variance of the dependent variable as determined by the independent variable. The result shows that about 50.8% of the variance in academic performance is as a result of engineering education factors (parental influence, societal influence, curriculum, equipment's availability, teaching methodology) while the remaining 49.2% accounts for other factors that were not captured in the model. The F-value of $F(5, 170) = 35.105$ is statistically significant with a P value < 0.05 which suggest that engineering education factors significantly affects academic performance of the selected engineering students.

The co-efficient of the regression model in Table 3 showed a positive effect of societal influence, curriculum and lecturers teaching methods with significance (P) values of 0.001, 0.000 and 0.000 respectively on the students' academic performance. These P values are <0.05 hence their positive significant effect. However, parental influence and equipment's availability are shown to have no significant effect on academic performance of the students with significance (P) values of 0.078 and 0.687 which are both greater than > 0.05. Table 3 further implies that a unit increase in parental influence, societal influence, curriculum, equipment's availability and lecturers teaching methods will result in 0.333, -0.614, 0.926, 0.084, 1.016-unit improvement in the academic performance of the student's respectively.

The regression equation explaining the key results of the analysis is expressed as follows:
Model for (H_0) is stated as $Y = f(X) = f(x_1, x_2, x_3, x_4, x_5)$ and
$AP = \beta_0 + \beta_1 PI + \beta_2 SI + \beta_3 CU + \beta_4 EA + \beta_5 TM + e_i$
Where: AP = Academic Performance;
PI = Parental Influence; SI = Societal Influence;
CU = Curriculum; EA = Equipment's availability;
LTM = Teaching Methodology
The regression equation for hypothesis is thus represented as:
Academic Performance = 13.194 + 0.333 PI - 0.614 SI
$+ 0.926 \, CU + 0.084 \, EA + 1.016 \, TM + e_i$

Artificial Neural Network (Multilayer Perceptron)
The artificial neural network architecture diagram (Figure 1) when the synaptic weight <0 shows higher relationship between the independent variable of lecturers teaching methods and curriculum in contrast to the synaptic weights of parental influence, societal influence and equipment's availability. This is supported by the parameter estimates as shown in Table 4 considering both the hidden and output layers of the analysis. lecturer's teaching methods and parental influence are the strongest determinants with parameter estimate values of -0.663 and -0.275 in the H(1:1) hidden layer. However, Curriculum and lecturers teaching methods are the strongest determinants of the students' academic performance in the H(1:2) hidden layer. Cumulatively, Hidden layer H(1:1) has out effect of -0.796 while hidden layer H(1:2) has output effect of -0.305 mainly due to the effect of curriculum and lecturers teaching methods which significantly affects the academic performance of the selected engineering students.
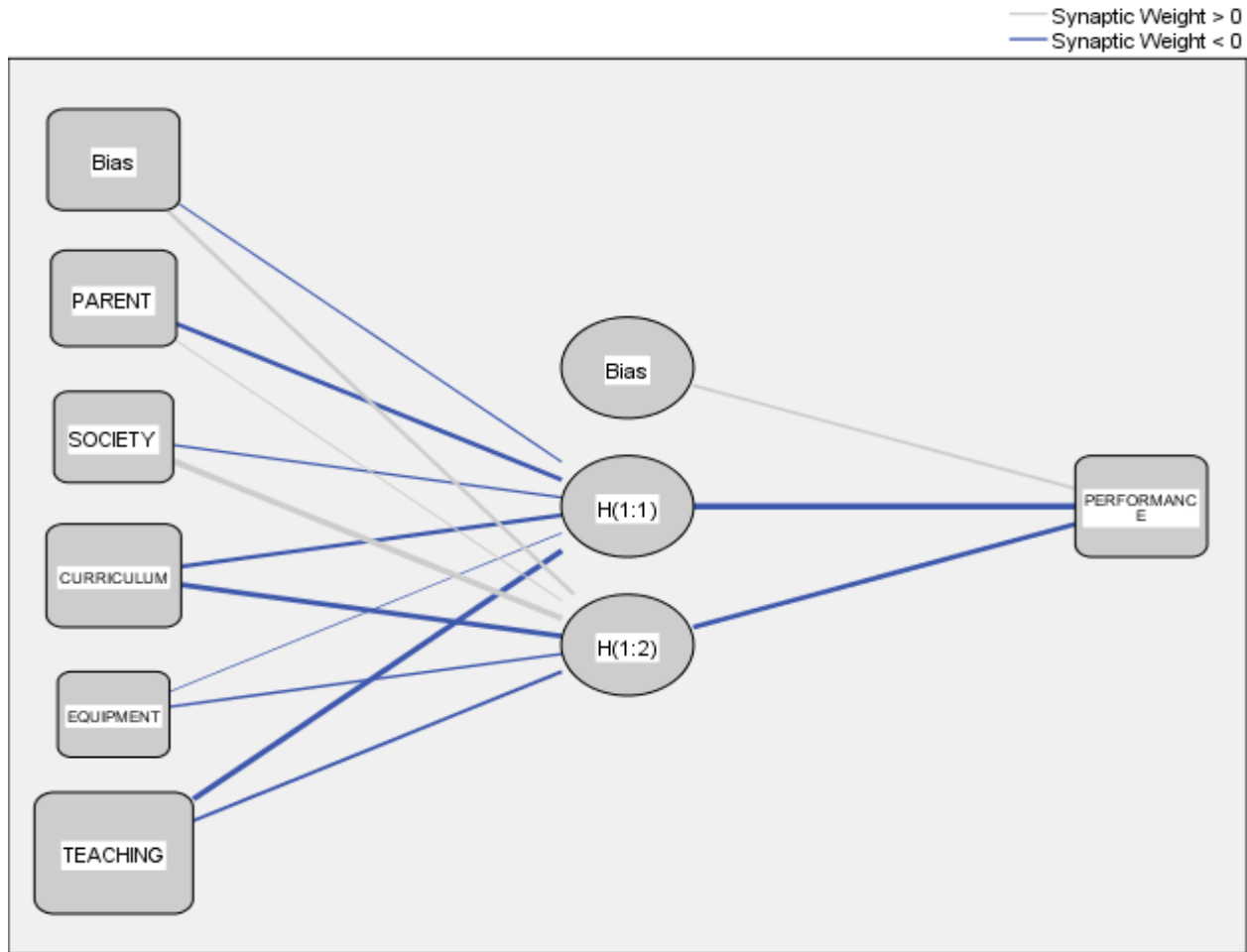
Hidden layer activation function: Hyperbolic tangent

Output layer activation function: Identity

Figure 1: Artificial Neural Network (ANN) architecture diagram

Table 4: Parameter Estimates

Predictor		Predicted		
		Hidden Layer 1		Output Layer
		H(1:1)	H(1:2)	Academic Performance
Input Layer	(Bias)	-.064	.214	
	Parental Influence	-.275	.055	
	Societal Influence	-.066	.674	
	Curriculum	-.260	-.365	
	Equipment's Avail.	-.051	-.075	
	Teaching Methods	-.663	-.180	
Hidden Layer 1	(Bias)			.124
	H(1:1)			-.796
	H(1:2)			-.305

The independent variable importance is as shown in Figure 2. This reveals that lecturers teaching methods has the highest importance (0.437) on academic performance of the selected engineering student. This was followed by the curriculum (0.240), parents influence had 0.162 importance, societal influence had 0.111 importance while equipment's availability had the least importance (0.050) on the academic performance of the students.
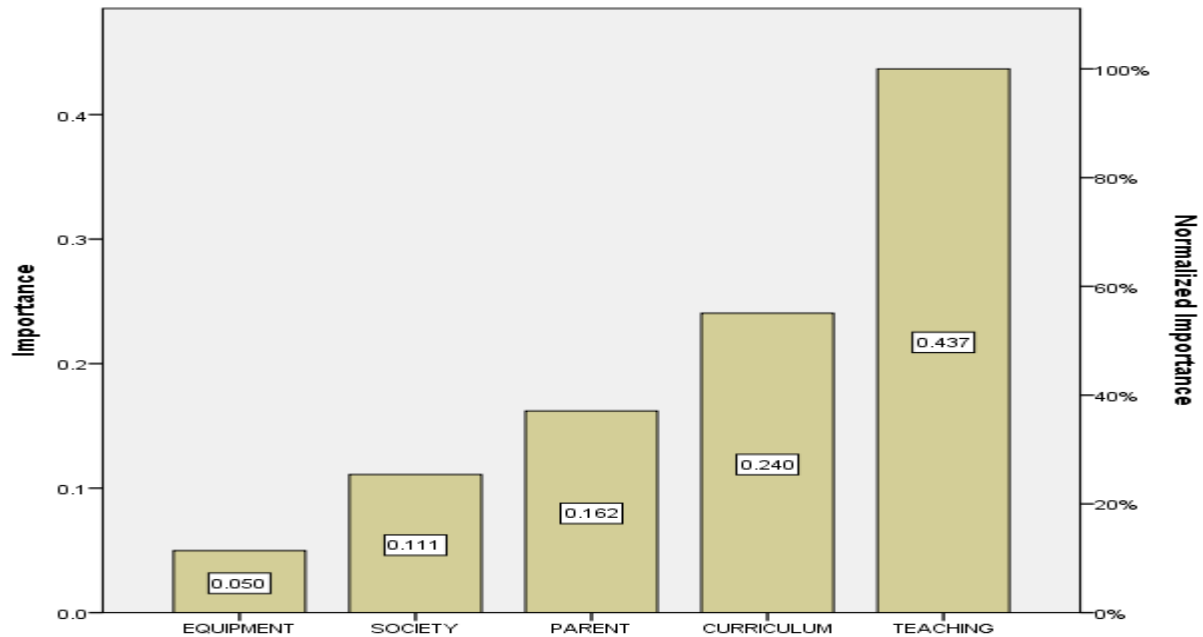
Figure 2**:** Importance ranking of study variables influence on students' academic performance

Discussion of Findings

The findings of the study revealed that teaching, curriculum and parental influence are major predictors of academic performance amongst engineering students in Nigerian universities. These findings are supported by the study of [9] who stated that teaching methodology of lecturers plays a vital role in the conceptual understanding of students as it helps to evoke analytical, creative and innovative thinking which they can use to solve the problems of real world. Adding to the discourse is [13] who posited that parental influence in terms of educational status and economic standing are major factors affecting academic performance of engineering students. The study further revealed that students from parents with good educational and economic status were seen to outperform those from low income background. However, the findings of [13] is not in tandem with the findings of this study which revealed that parental influence has no significant effect on academic performance of engineering students. This implies that whether or not an engineering student comes from a poor background or was compel to study the course, it does not necessarily affect their academic performance. Congruently, the findings of [14] revealed that curriculum and teaching methods adopted by lecturer has positive influence on academic performance of engineering students.

The position of [15] was in line with the findings of this study which revealed that professionally qualified teachers, teaching methods and effectiveness of teachers has an impact om academic performance of students. [16] revealed that the academic performance of students is dependent on the interaction between students and teachers and also that academic performance of students is largely affected by teaching methods adopted by their lecturers. Also, [17] revealed that insufficient study materials and ineffective teaching methodology were crucial factors affecting the students' academic performance. [18] posited that some of the engineering students are distracted on campus due to social activities and are negatively influenced by their peers as such, this has led to their poor academic performance. Although, this finding is not tandem with this study as it revealed that societal pressures have no effect on academic performance of engineering students. [19] posited that teachers that are well-equipped with information communication technology devices and skills are pioneers of success in technology driven teaching and learning in engineering education.

Correspondingly, the findings of [8, 20] revealed that a moderate relationship exist between academic performance of engineering students and parental and societal influence. Although the finding of [8] was contrary to the findings of this study as it found an insignificant impact on academic performance of engineering students. Based on the analysis, the study revealed that curriculum and teaching methodology were the significant engineering education factors that has an influence on academic performance of engineering students of Nigerian universities.

V. CONCLUSION AND RECOMMENDATIONS

A critical evaluation of findings of the study revealed that engineering education factor with reference to teaching, curriculum and parental influence significantly predicts academic performance in Nigeria Universities. However, the findings further revealed that society and equipment does not necessarily influence engineering student academic performance. It is due to the aforementioned that this study therefore concluded that engineering education factors plays a role in the academic performance of

engineering students in Nigerian universities. Based on the findings, some injunctions can be derived from the study for policy implication such as an upgrade of the current curriculum to meet with world-class standards. It is imperative that engineering lecturers upgrade their teaching methodologies through professional development training programs and integration of ICT in order to meet with global standards. Engineering education in Nigeria should be at the same pedestal with other countries by meeting the goal of creating an environment which will help students to become better engineers. As such, they can use the obtained knowledge of engineering to solve social and infrastructural challenges plaguing Nigeria thereby enhancing human development. It is also imperative for accrediting bodies in Nigeria to review and harmonize the engineering education curriculum in the Nigeria so as to harness the needs of both the industry and society.

CONFLICT OF INTEREST

The authors declare NO conflict of interest whatsoever.

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