



Quality and Sustainability of Engineering Education: The Role of Teacher and Student Performance Evaluation Review

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study which is an investigative survey carried out in an Engineering department in South East Nigeria was aimed at evaluating the performances of students and teachers in order to ensure quality and review of the intrinsic variables within an educational system. The unique characteristics of teachers were compared with the average performances of students in the final year, to identify the possible cause of poor quality and low Final Cumulative Grade Point Average (FCGPA) by students of that department. The summary results for five consecutive academic sessions were used to determine the performances of students in varied courses taught by their lecturers, while the Pearson Correlation Coefficient was applied to review the students' performances with unique features of gender, qualification and years of experience among lecturers involved in the teaching, research, and service delivery of the final year courses. The results showed 79.76, 53.37, 61.16, 73.33, 59.13, 72.73, 66.12, 79.60, 83.49, 76.85, 87.50, 71.96, 84.00, 88.91, 75.86, 76.48, 72.41, 80.90, 71.93 percentage-teacher-performances respectively, in descending order of codes assigned to lecturers. The application of Mintab software revealed correlation coefficients of 0.28, 0.01 and -0.51 for inherent peculiarities, while the p-values of 0.233, 0.956 and 0.025 were equally obtained. These results will assist the university's management in its administrative function and decisions making regarding students and teachers' quality at intakes and recruitments, by ensuring that requisite standards for engineering education

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study, growth, development and sustainability efforts are effectively achieved in line with its project 200 vision, thereby enabling the lecturers to optimize the quality of their teaching, research, and service delivery.

Keywords: Performance; evaluation; quality; teacher; student; correlation.

1. INTRODUCTION

Defined as citadels of learning and communities that are committed to the teaching and personal advancement of their students, universities play a vital role in impacting knowledge through teaching, learning, research, and development, as well as the provision of professional trainings which are essential for overall human development, which in turn leads to rapid growth and development of a nation's economy. They contribute immensely in ensuring that a nation's best brains in various professions and the entire society are involved in developmental efforts, through the rendering of services that are responsible for the enlargement, development and success in a society, by giving their students insight and theme through passing on knowledge as well as skills of communication which eventually leads to interactions and knowledge transfer.

A sound university education leads to the grooming of sound and highly competent graduates that will contribute immensely to economic development of the society. The roles and impact of the universities in local community and the wider society are viewed from three points of university-industry; entrepreneurship; and its contributions to regional economy [1]. In a similar notion, higher education institutions are currently expected to confront the economic and social realities by being accountable and more responsive to market demands and consumer needs on products, by providing 'value for money', to its teeming clients [2]. As countries struggle to grow their educational sector, an essential part of this growth is human capital development, and Nigeria is indeed not left out of this with its varied plans and programs aimed at establishing, equipping, and training of its teeming university students.

Ever since academic performance has been applied to grade schools and most importantly, to determine career paths amongst students and staff, their successes most likely has become a topical issue in public discussion. The measure of academic performance as a symbol of school

success can be traced way back from the Victorian period [1]

While the students blame their lecturers, curriculum, unconducive environment, etc. for their series of poor academic performance, the lecturers on their part blame the students poor performances the students' distracted lifestyle and other factors which the lecturer has no control over [3]. The unavailability of a robust systematic measure to ascertain the direct causes of poor student performance and factors that affect them necessitated the need for this study which is based on the causality principle that cause and effect are related.

The very essence of studying in the university is knowledge acquisition, transfer, and transformation with respect to reasoning and character. However a school of thought believes that these things can be measured by the performance of students in various courses taught by these lecturers in the department. Regardless of certain factors, the use of students' achievement in academic work to assess the teacher's effectiveness has gained popularity over the years. According to [3], "the teacher is increasingly becoming the focus of interest because of the key role he or she plays in the delivery of quality education to the learner."

Also, [4] opined that "If the learner has not learned, then the teacher has also not taught well enough. Therefore, the need for performance appraisal cannot be over-emphasized as performance evaluation process is seen as the teacher's guide for the improvement of his or her ability to teach and also give the best of what he/she can offer.

The faculty and departmental staff require accurate and valid data for self-improvement in the areas of low performance in order to ensure overall systemic growth and sustainability. As such, when the evaluation is based on facts, the staff will have better measurement of positive improvement and progression. This, therefore, presupposes that the performance evaluation of faculty and departmental system, must equip lecturers to improve teaching methods and bring

about the desired change and increase productivity, by improving the weaknesses identified by the outcome of the research.

This is also applicable to students who are expected to make serious efforts at improving their performance in all areas of deficiency, in order to attain exceptional academic heights. An ongoing project and vision in the university under review is aimed at providing ample opportunity for excellence for its staff and students in the areas of teaching, research and service delivery.

Professional development for staff requires a system for assessing the effective performance during their careers. The need to encourage faculty and departmental members to perform evaluation because of its convenient positive results, and improve effective teaching process on a larger scale in order to create a better education for both staff students, cannot be over-emphasized. According to [5], proper evaluation, thorough research findings, school leadership, teacher's quality, parental support, and students' efforts are contributors to students' high or low academic performance.

This research work approached teacher performance assessment through quantity of student pass rate and quality comparison, based on the lecturer's qualification, gender and experience. All of which tends to be an informative guide and feedback mechanism to the school's leadership when carried out in all units and arms of the institution.

2. SURVEY OF LITERATURE

The 'good schools' are acclaimed to be those that are able groom the students well enough to achieve the set standards, and this is measured by the use of students' academic performance at both school and national levels. The level of students' performance has an impact on the roles played by education stakeholders. Research has shown that school leadership and quality of teacher are top factors that contribute to students' high or low academic performance [5]. Teacher effectiveness has been the interest of policy makers, educators as well as parents and the effectiveness is measured by students' academic performance in both internal and external examinations.

The general feeling according to research, that students who fail in examinations are taught by ineffective teachers; while those who excel are

taught by very effective teachers, has so far shown that teacher's effectiveness has an influence on the students' academic attainment [6]. Every organization or establishment must have certain goals or objectives which it has set out to achieve and humans not machines are the ones directly involved in the actualization of these set goals. Employee performance, therefore, is proportional to the growth or downfall of an organization and this has brought about the need to constantly measure performance to ensure they don't fall short of expectations previously set by an organization or establishment. [7], described performance appraisal as "What is expected to be delivered by an individual or a set of individuals within a timeframe and this expectation could be stated in terms of outcome or inputs, tasks and quality, with specification of conditions under which it is to be delivered."

According to [8], performance appraisal includes a communication event planned between a manager and an employee specifically for the purpose of assessing that employee's past job performance and discussing areas for future improvement. While [9], viewed performance appraisal as the formal assessment and rating of staff by their managers intermittently, or at annual review meetings of an organization or workplace establishment. Performance appraisal is also the process in which works, activities, weak points, competence and incompetence, as well as all aspects of the workers are assessed, no matter what position they occupy and where they work [10].

Performance appraisal also helps workers in the use of their personal abilities and skills, by enabling them to become aware of having the correct abilities and skills that stimulates them to perform their tasks in line with the organization's mission, in order to enhance performance and also attain general growth and development [11]. However [12], further described performance appraisal as the process of obtaining, analyzing and recording information about the relative worth of an employee and in which the focus of the performance appraisal, is to measure and improve the actual performance of the employee and also harness as well as develop the future potential of the employee. Performance therefore is an outcome or result of an individual's actions and that individual's performance becomes a function of his/her ability and motivation [13].

Sound engineering education acquired through suitable structures has a significant influence on the students' ability to excel in their academic performance and also achieve technological advancement. Sadly, engineering education over the years in Nigeria has suffered series of setbacks leading to poor performance of both the undergraduates and postgraduate students. According to [14], the quality of engineering graduates from Nigerian universities and polytechnics has been a major cause of concern to industries as they complain of inadequate skills and competence, lack of confidence, and low practical know-how of the graduates in the current cutting edge technology.

The adoption of sound performance evaluation for both the staff and students in the Nigerian tertiary institutions will definitely play a vital role in enhancing the quality of Nigerian engineering graduates.

3. MATERIALS AND METHODS

Descriptive statistics of deducing numerical values from student grades, gender, qualification and years of experience were adopted, and subsequently presented in tables and charts. The quantitative research design approach was considered and focused on the purpose of the study and the size of the target population. This included data generation in quantitative form and strict quantitative analysis in a formal and stiff fashion. Mathematical calculations were used in making deductions from observable and compiled data to express them in terms of quantity, as well as to ascertain effectiveness of teaching and service delivery by lecturers in line with high productivity standards, globally. The primary source data was received from the examination records office of the department, whereas the secondary data was emanated from derivations and deductions from the primary data required in attaining the desired outcome. A department within the faculty of Engineering of a university, South East Nigeria, was formed the population for this research study, while the final year students, the sample size in view. Non-probability and purposive sampling technique was used to select lecturers of the department handling 500 level courses, assess them according to students' average performance in taught courses for teaching, research and service delivery to the students. Ethical conduct was adopted to ensure there are no detrimental effects to the research participants and to reduce

the possibility of harm to all characters considered in this research. Codification was also adopted for all key participants and courses, in order to avoid victimization, bias and consequences of any sort, in the aftermath of any adverse findings in connection with their professional duties. Varied steps were also deployed in analyzing the interplay of cumulative individual lecturers' with unique features of gender, qualification and years of experience, with the performances of students across the reviewed sessions and which unveiled interesting outcomes into this research interest or line of thought. It may also become one of the measures aimed at entrenching quality in educational institutions, for evaluative and/or corrective information, necessary improvements, guidance and decision making efforts, upon its adoption.

Correlation analysis deployed, is a statistical method for checking the nature of relationships between two variables or data sets and equally to determine how that relationship is weighted or impactful. It is also used in analyzing quantitative data gathered from research methods, to identify whether there are any significant connections, patterns or trends between two variables being considered or understudied. The Pearson's correlation approach was used to check the relationship between student performances as response variable with some pre-determined explanatory variables of experience, gender and qualifications respectively which are peculiar to the departmental lecturers.

The Pearson's correlation formula is given as

$$r = \frac{n \sum xy - \sum x \sum y}{\sqrt{[n \sum x^2 - (\sum x)^2][n \sum y^2 - (\sum y)^2]}} \quad (1)$$

Source: (McFatter, 2017)

The ratio of the number of students who scored 50 marks and above, over the total number of participating students in each final year course examination for five academic sessions, was adopted as a measure for obtaining student performance for all courses in the final year. Percentage scores of the ratio outcome of students who scored above 50 marks over the student total in course examination, multiplied by 100%, presents the percentage student performances for each final year course per academic session, and used accumulatively in this analysis.

$$\% \text{ performance} = \frac{\text{No. of students who scored above 50 marks}}{\text{Total number of participating student in exam}} \times \frac{100}{1} \quad (2)$$

Source: Author's design

4. RESULTS

Table 1. Cumulative performance of students in taught courses per session

Session/ Lecturer	Courses Listings only	2014/2015	2015/2016	2016/2017	2017/2018	2018/2019	Cumulative average performance
001	A531		86.72	79.00	70.98	82.28	79.76
002	B533	46.93	27.91	57.45	64.48	70.08	53.37
003	C534	61.16					61.16
004	D537	74.55	88.90	60.63	55.51	87.10	73.33
005	E538	61.81	67.05	33.61	61.65	71.52	59.13
006	F541	72.73					72.73
007	G543	61.19	74.43	54.70	62.77	77.72	66.12
009	H547	78.57	90.82	72.04	61.86	94.73	79.60
010	I536				91.18	75.81	83.49
011	J539	76.60	77.09				76.85
012	K540					87.50	87.50
013	L542	75.80	68.12				71.96
014	M549					84.00	84.00
015	N550					88.91	88.91
017	F541					75.86	75.86
018	P556					76.48	76.48
019	A531					72.41	72.41
020	I536					80.90	80.90
030	F541	71.93					71.93

Table 1 summarizes the average performance of lecturers in codes for all final year courses taught within the department. All courses are merely for listing for each semester per session for the five years academic sessions understudied and as a measure of teaching effectiveness, based on the

students' performance. Other information such as expertise/experience, qualification, and gender may as well be used as a measure of comparison for performance, individually or collectively. The coding adopted for lecturers was meant to avoid victimization and probable bias.

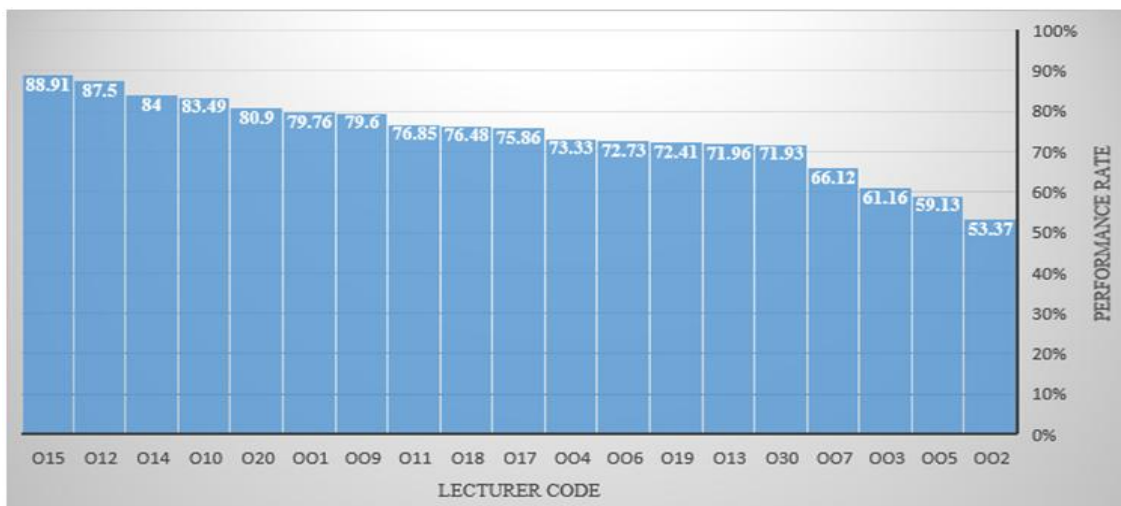


Fig. 1. Plot of overall lecturer performance from 2014/15 - 2018/19 sessions

Fig. 1 is a pictorial presentation, showing the cumulative performance distribution of each lecturer, in taught courses for five consecutive academic sessions being studied. The lecturers were also represented by codes whereas their

cumulative performances are premised on students' average percentage performance in taught courses, for final year students, for the five years under review.

Table 2. Variables for correlation analysis

Course	Code	Average performance	Qualification	Experience	Gender
A531	001	79.76	3	15	1
B533	002	53.37	3	14	1
C534	003	61.16	3	13	1
D537	004	73.33	3	12	1
E538	005	59.13	3	11	1
F541	006	72.73	2	10	1
G543	007	66.12	3	9	1
H547	009	79.60	3	8	1
I536	010	83.49	3	9	2
J539	011	76.85	3	7	1
K540	012	87.50	3	6	1
L542	013	71.96	2	4	1
M549	014	84.00	3	5	1
N550	015	88.91	3	3	1
F541	017	75.86	2	3	1
P556	018	76.48	2	2	1
A531	019	72.41	3	3	2
I536	020	80.90	3	2	1
F541	030	71.93	3	15	1

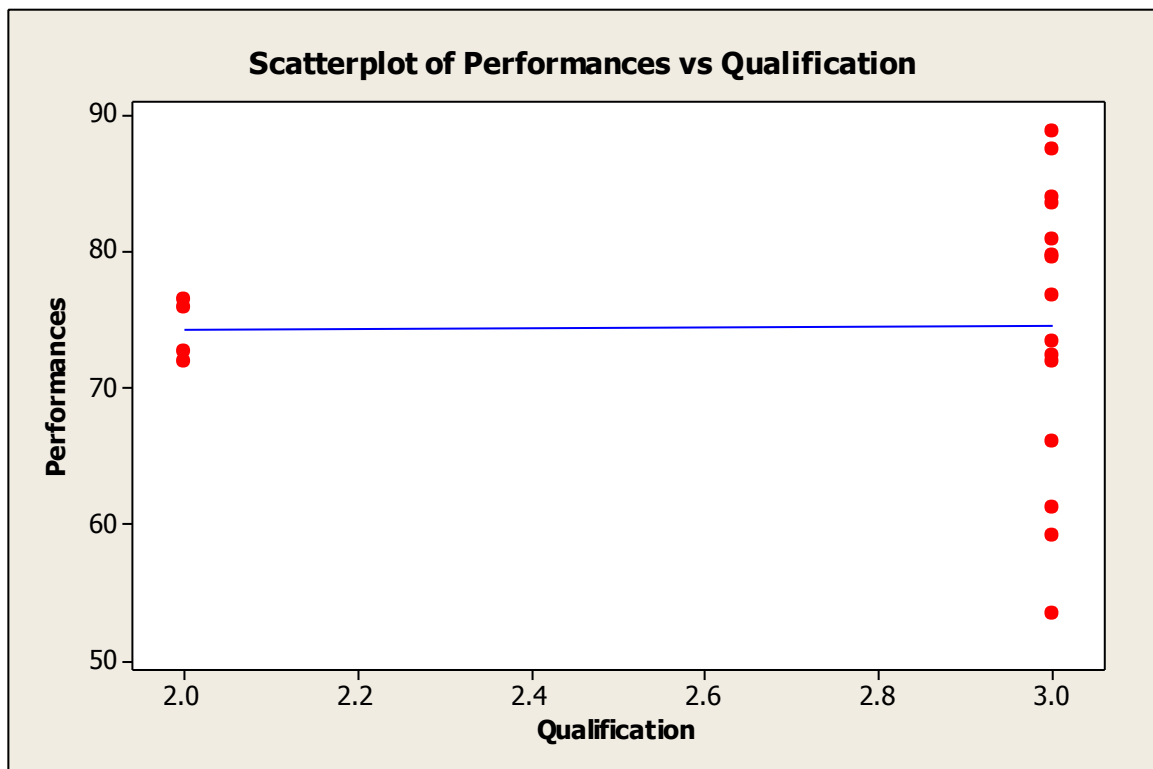


Fig. 2. Plot of correlation between performance and qualification

Fig. 2 shows the Pearson correlation sample plot between performances of students against their lecturers' qualifications, using the Minitab software. The correlation function r , obtained from the plot thereof is 0.014 and a P -value of 0.96.

Fig. 3 shows the Pearson correlation sample plot between performances of students against their lecturers' qualifications, using the Minitab software. The correlation function r , obtained from the plot thereof is 0.287 and a P -value of 0.23.

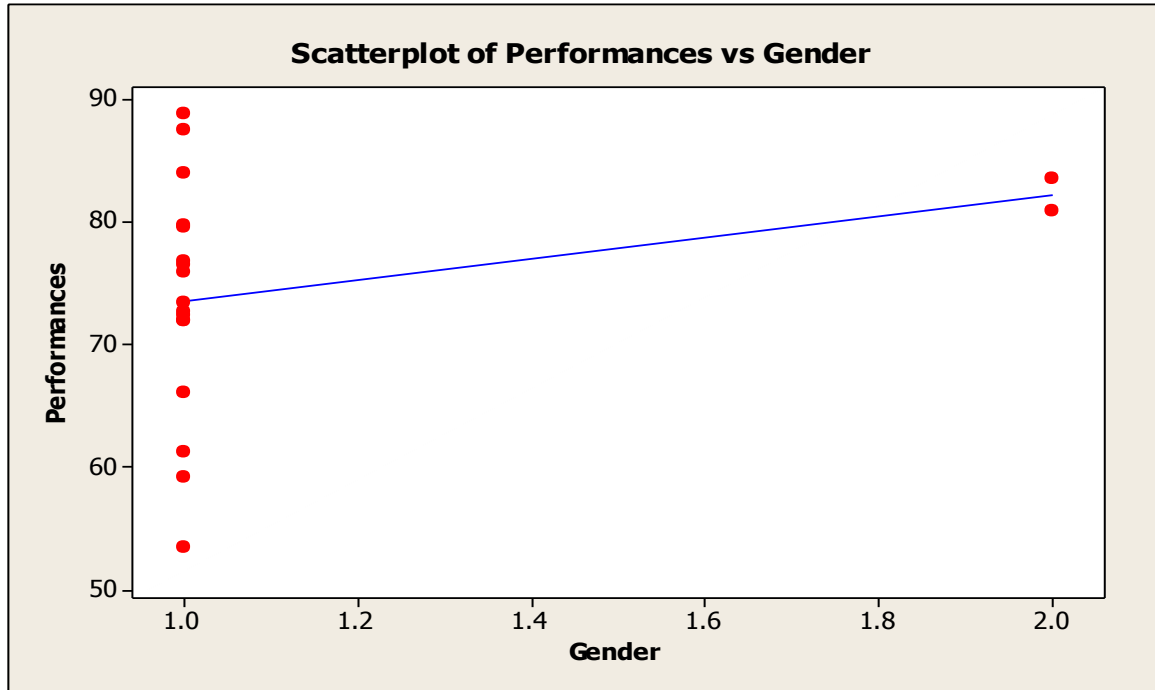


Fig. 3. Plot of correlation between performance and gender

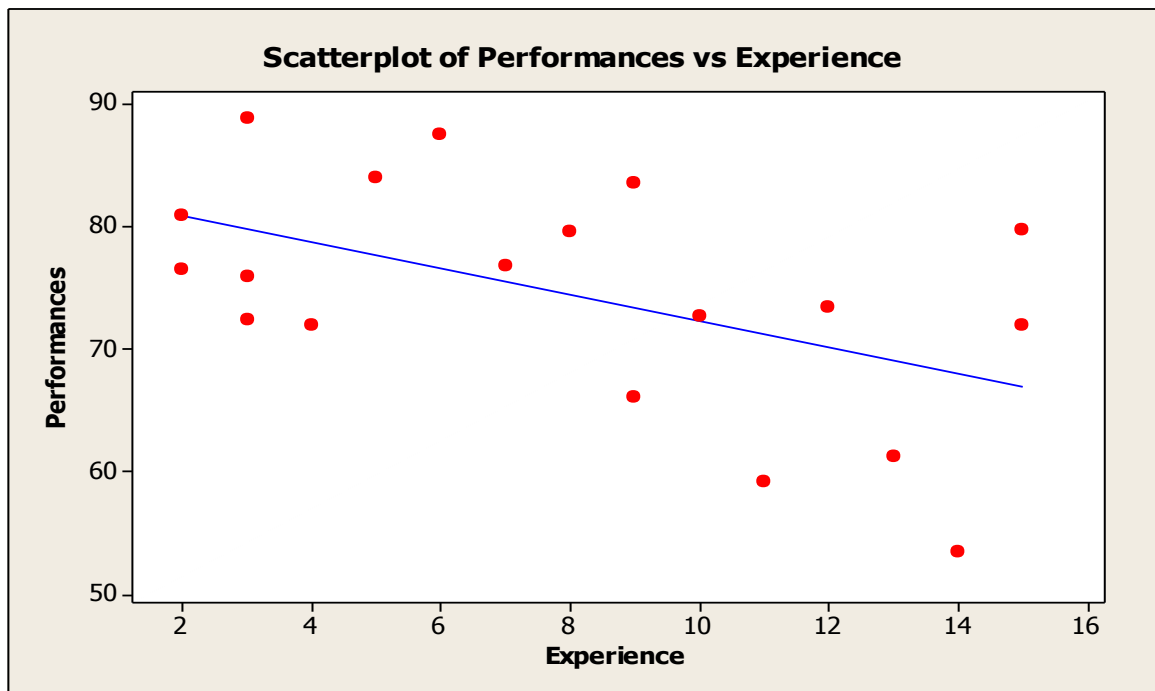


Fig. 4. Plot correlation between performance and experiences

Fig. 4 depicts the Pearson correlation sample plot between performances of students against their lecturers' qualifications using the Minitab software. The correlation function r , obtained from the plot thereof is -0.513 and a P -value of 0.02.

5. DISCUSSION

The scatter plots showed the trend and model development for each interaction and relationship between performance and each of the independently and unique variables of experience, gender and years of experience among lecturers. These tend to raise further questions as to other germane but invisible criteria for which could contribute to student performances, and/or lecturer performances outside students' results or performances in examinations, other than covered here. From the result, when performance is correlated and compared to qualification, a correlation coefficient of 0.01 was obtained, which is an indication that there is no significant relationship between student performance and lecturers' qualification garnered or as a requirement for teaching within the department being understudied.

In the same vein, when performance was correlated with gender, the obtained coefficient of correlation of 0.28, posits that there is a weak correlation between student performance and lecturers' gender within the department. This, therefore, paves way for gender equality in recruitment exercises, of teaching staff for the department unlike the apathy and phobia to the study of STEM related courses and subjects by the female gender, on grounds of its difficulty.

Also, when the cumulative performance of students was compared to the years of lecturers' experience, the coefficient of correlation of -0.5 was obtained, this shows a strong negative relationship between both variables and which implies that performance decreases as age or years of experience increases, and vice versa. This worrisome development, should therefore, be of great concern to the department, with respect to its lecturer progression and performance of taught students as they progress in service year, stay and experience within the department.

The p -values of 0.956 for qualification, 0.233 for gender and 0.025 for experience showed the levels of significance of the relationships within

the variables and therefore the null hypothesis must therefore be rejected for all as they are all less than 1.

This research method of developing, determining and measuring teacher performance from students' performance, further buttressed the views of [6], as a necessary ingredient to overall student's performance. However, the expository aspects of this research, on the roles played by several features and qualities of the teacher, as a variable for close observation and scrutiny, based on their impact on performances of students, is novel in its approach, as they would go a long way in shaping the educational system for products' optimum performance and societal development.

6. CONCLUSION

A correlation analysis has been conducted to unravel the nature of relationships between performance and teacher unique attributes of qualification, experience, and gender. The ensuing outcome has shown that there are no tangible as well as strong positive relationship between performance and variables, such as qualification and gender, whereas a negative and yet significant correlation coefficient value, as obtained for years of experience, should be of great concern to departmental administrators and the university management in its decision making at personnel engagement.

The nature of these outcomes also goes on to open new areas for further research on other viable performance indicators and measures, necessary for the student, other than the use of results from examination scores and records. This is because there may possibly be other factors that when considered and summed up, could be added to determine and ascertain the overall performance of not just students but also their lecturers in an engineering department of an academic institution, for improvement and sustainability of engineering education quality in Nigeria.

In line with the findings of [4], this research work presented cumulative academic performances of students for teacher performance assessment through quantity of student pass rate and quality comparison, based on teacher attributes, all of which tend towards useful informative guide and feedback mechanism to the school's leadership, when implemented in all units and arms of the institution.

ETHICAL APPROVAL

No ethical approval was sought as the basic information of organization personnel, understudied were masked to avoid victimization, bias and negative outcomes.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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