Educational Assessment of Engineering Students on Foundation Courses in Tertiary Institutions: A Case Study of Kebbi State University of Science and Technology, Aliero, Nigeria

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Abstract
The study evaluated the academic performance of engineering students in compulsory courses (Engineering Mathematics; MTH 121, Engineering Drawing; MEE 212 and Strength of Materials; CVE 211) during their sophomore year at Kebbi State University of Science and Technology, Aliero. This research comprised of 150 (male and female) students, involved three (3) different lecturers and ex-post-facto design which is a quasi-experimental study was adopted. Secondary data inform of students’ results/scores were obtained from official records in the Faculty of Engineering, to compare their performance. The scores in each course followed the normal distribution with score of letter grade of C (i.e. 50 – 59 %) as the mean and the percentage of students that fall in these categories was measured. The results revealed that the students performed better in MTH 121 with 62.9 %, passing with grade ‘C’ and above, followed by MEE 212 and CVE 211 with 54.6 % and 36.6 % respectively. Statistical analysis from the mean, standard deviation, correlation, t-test and chi-square test was also used to determine the significant relationship between the variables. It has confirmed that the mean scores of 55, 50 and 48.3 were obtained for students in MTH 121, MEE 212 and CVE 211 respectively and there were significant differences in the level of academic performance of students between MTH 121 and MEE 212, and MTH 121 and CVE 211 respectively. The study concluded by recommending the teaching of drawing and strength of materials related courses at 100 level, so that the performance could be enhanced at the subsequent level.

Keywords: Academic Performance, Engineering Mathematics, Engineering Drawing, Strength of Materials, t-test, Chi-Square.

Introduction
In educational institutions, success is measured by academic performance. The academic achievement is commonly measured by examinations or continuous assessment (Academic performance index), but there is no general agreement on how it is best tested or which aspects are most important- Procedural knowledge, such as skills or Declarative knowledge, such as facts. Similarly, in their review, Bloom, Canning, and Chan (2005) concluded that education plays a crucial role in preparing and providing leadership to meet challenges and stimulate sustainable development.
Engineering is the most challenging profession in the world, because this world has revolved round an engineering piece. Teaching, laboratory/workshop experiments and entrepreneurial development are the components in which a balanced engineering training at undergraduate level is supposed to have. According to Oxford Advanced Learner’s Dictionary, engineering is the activity of applying scientific knowledge to the design, building, control of machines, roads, bridges, electrical equipment, etc. So, the need to appraise these foundation courses: Engineering Mathematics (MTH 121), Engineering Drawing (MEE 212) and Strength of Materials (CVE 211) by students is imperative to develop them in their carrier professions. Engineering mathematics is one of the crucial courses in engineering curriculum. It is regarded as the heart and queen of all sciences and engineering programme. According to Sazhin (1998), he stated that mathematics is a key element in engineering studies and serves as language of expressing physical, chemical and engineering laws. It is also a way of thinking and organizing a logical proof, it can be used to determine whether an idea is true or not, etc. Engineering drawing has become a mandatory course in engineering for both Polytechnics and Universities running engineering programme in the world, as it is not only necessary for academic achievement but also for everyday life. The role of engineering drawing in technological development cannot be overemphasized, as its importance is also a challenge to every student studying the course for it is mainly on technology that the prosperity of Nigeria depends. So also to Strength of materials, it is very important in the curriculum of any engineering programme at tertiary institutions, as it serves as basis for other engineering courses. It is a detailed study of forces and their effects, along with some suitable protective measures for the safe working condition. It also helps in determining the behaviour of all the materials used by engineers, to enable them in designing all types of structures and machines. The purpose of these courses is to enable the students acquire a basic general engineering knowledge, because they are required to understand the principle and fundamental of these courses, so as to assist in subsequent level courses and apply this knowledge to solve real world problem.

Modern nations show great concern for education, especially education in science, engineering and technology. This is because it enables rapid development of the social and economic infrastructure necessary for the growth of enterprise and reduces poverty by bridging the gap between nations in the knowledge emerging society (Gemade, 2009; Ajimotokan, Ajao, Adebisi, & Dainkeh, 2009). An engineering student cannot become a successful engineer without adequate and in-depth knowledge of these engineering courses, as it serve as a means of communication through which relevant information are given. According to Adebisi and Oladeji (2008), they defined engineering drawing as the non-oral language being employed to give precise technical information, which fully describe the shape, size, dimension, degree of finish, tolerances, assembly arrangement and other details about a component or assemblage. This could be in form of a structure (e.g. a bridge or a building); a machine element (e.g. a block making machine, a vice clamp or an aircraft engine); an electrical component (e.g. circuits for electronics); pipe networks and so on. According to Wikipedia (2013), academic performance is the outcome of education; the extent to which a student, teacher or institution has achieved their educational goals. Thus performance is characterized by performance tests in coursework and performance of students in examinations (Kyoshaba, 2009). Performance has been described by a number of psychologists and test, and measurement experts (Crowl, Kaminsky, & Podell, 1997; Adewolu, 1998; Popham, 2002). Therefore, students’ performance (academic achievement) plays an important role in producing the best quality graduates (Ali, Jusoff, Ali, Mokhtar, &
Salamat, 2009) and students’ academic performance measurement has also received considerable attention in various works (Mushtaq & Khan, 2012), and this performance is one of the tools used by both National Universities Commission (NUC) and the Council for the Regulation of Engineering in Nigeria (COREN) for accreditation of engineering programme in Nigerian Universities.

An extensive review of studies related to the academic performance or achievement of students in schools, colleges and at the university level had presented by Ali (2012), Ali, Haider, Munir, Khan, & Ahmed (2013), Geiser & Stantellices (2007), and Farooq, Chaudry, Shafiq, & Berhanu (2011). They identified the various factors affecting students’ performance, these includes students’ efforts, previous or prior educational performance, self-motivation, parents’ social-economic status, students’ age, daily study hours, admission points, entry qualifications, tuition trend as well as the students’ area of residence (rural or urban), academic background of the students admitted into a programme of study, etc. Various research groups also focused on the measurement of students’ prior educational outcomes or performance as the most important indicators or determinants of students’ future academic performance, among which are Bratti and Staffolani (2006) and Yoho, Vardaxis, & Comstock (2010). 200 remedial students of Ahmadu Bello University Zaria, Nigeria were investigated, and found the significant relationship between their academic need achievement and study behaviour problems (Duruh, 2001). Wynarczyk and Hale (2009) have listed views of parents, teachers and society as one of the factors influence choice of careers in science. Aremu (2000) described poor performance as a performance that adjudged by the examinees and some significant as falling below an expected standard. The interpretation of this expected or desire standard is better appreciated from the perpetual cognitive ability of the evaluator of the performance. The evaluator or assessor can therefore give different interpretations depending on some factors. Also, Issa and Nwalo (2008) pointed out a clear disregard for vocational and career counseling among Nigerian youths leading them into careers due to ignorance, inexperience and peer pressure, advice from friends, parents and teachers or as a result of the prestige attached to certain jobs. Consequently, they constitute nuisance to themselves, their employers and ultimately become liability to the nation as they may lack the capacity and self-drive to contribute meaningfully to the society.

The purpose of this paper is to evaluate the academic performance of engineering students in the compulsory courses offering in tertiary institutions during their sophomore year. These courses focused on basic general engineering studies, and to determine whether the academic performance of these students in the listed courses offered together shall differ significantly. In the Faculty of Engineering, Kebbi State University of Science and Technology, Aliero (KSUSTA), the duration for all the programme is five years for those admitted through the UTME and four years for students admitted by Direct-Entry. There are basically four disciplines/departments, namely, Civil Engineering, Electrical/Electronics Engineering, Information and Communication Technology and Mechanical Engineering, and they are domiciled in the Faculty of Engineering.

**Research Hypotheses**

Ho 1: There is no significant difference in the academic performance of students between Engineering Mathematics (MTH 121) and Engineering Drawing (MEE 212).

Ho 2: There is no significant difference in the academic performance of students between Engineering Mathematics (MTH 121) and Strength of Materials (CVE 211).
Methodology
The study adopted ex-post-facto design (quasi-experimental design), to assess the relationship between dependent and independent variables. The research survey covered the entire population of engineering students in 200 level. The survey was descriptive and explanatory, and was conducted in the Faculty of Engineering, Kebbi State University of Science and Technology, Aliero (KSUSTA). KSUSTA is found in the North-West geopolitical zone of the country and ranked among the best state universities of science and technology in Nigeria. In order to achieve the aim and objectives of the study, the data was collected from the examination officers of concerned departments through the permission of their heads of departments. The data was subjected to statistical analysis of frequency tables and percentages, and the mean scores and standard deviation of the students’ performance were determined from this data. Pearson product moment correlation was also used to determine the relationship between the students’ performance and to test the hypotheses, and the correlation coefficient (r) obtained was further subjected to t-test analyses and Chi-square tests to determine whether it was indicative of the real relationship between the variables or it may be attributed to chance. The judgement of academic performance was based on the results of the students gathered. Each course was graded out of maximum of 100 marks and assigned appropriate grade point equivalent, the system of grading are presented in the table below.

Table 1: Grading system for Nigerian Universities

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Range of Score</th>
<th>Grade Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>70 – 100 %</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>60 – 69 %</td>
<td>3</td>
</tr>
<tr>
<td>C</td>
<td>50 – 59 %</td>
<td>2</td>
</tr>
<tr>
<td>D</td>
<td>45 – 49 %</td>
<td>1</td>
</tr>
<tr>
<td>E</td>
<td>0 – 44 %</td>
<td>0</td>
</tr>
</tbody>
</table>


Results/Major Findings of the Study

Figure 1: Academic performance of Electrical/Electronics Engineering students
Figure 2: Academic performance of Civil Engineering students

Figure 3: Academic performance of Mechanical Engineering students

Figure 4: Academic performance of ICT students
The results from Figures 1 to 5 showed the performance of students in Electrical/Electronics, Civil, Mechanical, ICT and overall performance in the Faculty respectively. Findings from Figure 1 to 4 revealed that the Electrical/Electronics students performed better than their counterparts in MTH 121 with 67% of grade C and above. Students from Civil had better performance in MEE 212 with 57% scored grade C and above, while 53% of students in ICT scored grade C and above in CVE 211. Figure 5 which is overall performance of the entire students in the Faculty of Engineering revealed that the percentage of students scored 50 ‘C’ and above in MTH 121, MEE 212 and CVE 211 are 62.9%, 54.7% and 36.7% respectively. This implies that better performance of students in MTH 121 has no influence in CVE 211, because of poor performance in it.

Table 2: Relationship/Significant difference between academic performance of students in MTH 121 and MEE 212

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>$\bar{x}$</th>
<th>$\sigma$</th>
<th>$\sigma_X$</th>
<th>r</th>
<th>$r^2$</th>
<th>D.F</th>
<th>P</th>
<th>t-cal.</th>
<th>t-crit.</th>
<th>$X^2_{stat}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTH 121</td>
<td>108</td>
<td>55.00</td>
<td>17.95</td>
<td>1.73</td>
<td>-0.01</td>
<td>0.0001</td>
<td>256</td>
<td>0.05</td>
<td>2.73</td>
<td>1.96</td>
<td>44.61</td>
</tr>
<tr>
<td>MEE 212</td>
<td>150</td>
<td>49.97</td>
<td>11.59</td>
<td>0.95</td>
<td></td>
<td></td>
<td></td>
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</table>

The results from the average mean and standard deviation are shown in Table 2 and 3. Findings from Table 2 above shows a weak/negligible linear relationship between the students’ performance in MTH 121 and MEE 212 with correlation coefficient (r) and coefficient of determination ($r^2$) of –0.01 and 0.0001 respectively, which shows that MTH 121 has no effect on the performance of students in MEE 212.

The data were further subjected to t-test and chi-square test statistics table, the findings revealed that there is a little significant difference between the students’ performance in MTH 121 and MEE 212, because the calculated t-value of 2.73 is greater than the t-critical value of 1.96 at 95% confidence level and the higher value of chi-square ($X^2 = 44.61$). Hence the first hypothesis is rejected.
Table 3: Relationship/Significant difference between academic performance of students in MTH 121 and CVE 211

<table>
<thead>
<tr>
<th>Variables</th>
<th>N</th>
<th>$\bar{x}$</th>
<th>$\sigma$</th>
<th>$\sigma_\bar{x}$</th>
<th>r</th>
<th>$r^2$</th>
<th>D.F</th>
<th>P</th>
<th>t-cal.</th>
<th>t-crit.</th>
<th>$X^2_{stat}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>MTH 121</td>
<td>108</td>
<td>55.00</td>
<td>17.95</td>
<td>1.73</td>
<td>0.04</td>
<td>0.0020</td>
<td>245</td>
<td>0.05</td>
<td>3.52</td>
<td>1.96</td>
<td>47.50</td>
</tr>
<tr>
<td>CVE 211</td>
<td>139</td>
<td>48.27</td>
<td>11.96</td>
<td>1.01</td>
<td></td>
<td></td>
<td></td>
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The result of the correlation coefficient in Table 3 showed neither relationship in students’ performance in MTH 121 nor relationship in students’ performance in CVE 211. This implies that the findings showed no relationship in academic performance of students between MTH 121 and CVE 211 with correlation coefficient value of 0.04. Also, the calculated t-value of 3.52 is found to be significant when compared with the critical value of 1.96 at 95% confidence level. The MTH 121 mean of 55.00 higher than that of CVE 211, which is 48.27, and chi-square statistics value of 47.50. Therefore, the second hypothesis (Ho 2) is rejected as well; meaning that the finding shows that the difference exists in students’ performance between MTH 121 and CVE 211.

Discussion of Findings
From the above findings, it showed that the Electrical/Electronics engineering students performed better than their counterparts in other disciplines in MTH 121, Civil engineering students had better performance in MEE 212, while students from ICT department performed better than their counterpart in CVE 211. From the overall performance, more than half of the students scored 50 % and above in MTH 121 and MEE 212, but in CVE 211, students that scored 50 % and above were not up to half of the whole class. The findings also showed no correlation in the students’ performance between MTH 121 and MEE 212, and MTH 121 and CVE 211 respectively, because there was no conclusive linear relationship between them, and the correlation coefficients are almost equal zero (0). Also from the findings, the two hypotheses were rejected. This means there were significant differences in the academic performance of students between MTH 121 and MEE 212, and MTH 121 and CVE 211 respectively, because the mean value of MTH 121 greater than that of MEE 212 and CVE 211, the calculated values of t are greater than 1.96 t-critical value, and there was higher values of chi-square statistics. This study agreed with the findings of Amsuomo (2015), where he concluded that there was significant difference in the academic performance of students in School of Technical Education, Federal College of Education (Technical), Omoku, Rivers State, Nigeria, and Ehiozuwa (2003); which studied majorly focused on low academic performing students of FCE Zaria. This study also in agreement with the findings of Adeyemi (2006) and Oluigbo (2005) that the graphical communication skill such as drawing and a variety of other skills associated with model making, printing, photography and graphic arts is needed to effectively communicate his ideas to his clients and other members of construction team. Several factors also may have influenced the academic performance of students, as discussed by various researchers, among which are types of secondary school the students attended (Considine & Zappala, 2002), environmental influenced (Kyoshaba, 2009), poor communication skills/language challenges between lecturers and students (Iliyas, 2011) etc.
Conclusion
The study presented educational assessment of engineering students on foundation courses in tertiary institutions, it is hereby concluded that the students performed better in MTH 121 with 62.9 % when compared with other courses selected in this research. It has established that there is no/low correlation between the academic performance of students in MTH 121 and MEE 212, and MTH 121 and CVE 211 with – 0.01 and 0.04 respectively. Also, research hypotheses 1 and 2 are rejected because the calculated t-values are higher compared with the critical value of 1.96 at 95 % confidence level, the greater values of chi-square statistics also constitute to the rejection of two hypotheses.

Recommendations
Based on the findings of this investigation, it is recommended that the courses offer by students at 100 level should be reviewed to include technical drawing and strength of materials related courses, and as the pre-requisite to 200 level courses. Coordinator should be assigned to each level for proper guidance of these students, morally and academically. Also, engineering library should be provided with modern textbooks on these compulsory courses.

References


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