QUALITY ASSURANCE AND ACCREDITATION OF ENGINEERING PROGRAMMES IN NIGERIAN UNIVERSITIES

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ABSTRACT

This paper presents different quality assurance strategies for engineering education in Nigeria. It notes the quality-demand for prospective engineering students from primary through secondary school to tertiary institution. The screening process for intending engineering students for admission into university is presented. The paper shows that the quality assurance for engineering programmes is carried out at three levels in the university. It further indicates that accreditation is guided by rules, regulations and accepted quality assurance indices that bothers on human and non-human elements available for the programmes.

The paper concludes that the accreditation status of any programme is usually based on the degree to which the resources on ground for the programme meet those minimum academic standards set by the National Universities Commission (NUC). At the end of an accreditation exercise, a programme may earn full accreditation, interim or denied accreditation.

1.0 INTRODUCTION

Engineering Education is the process of training engineers for the purposes of initiating, facilitating and implementing the technological development in the society. Engineers are to solve societal problems in a sustainable way using appropriate engineering tools to proffer required solutions. Prospective engineers and technologists are trained in the universities and polytechnics respectively. However, some products of polytechnics who have earned good grades in their final examinations can become engineers either by entering universities after the Ordinary or Higher National Diploma at the appropriate level or by undertaking professional development training organized by the professional body - Council for the Regulation of Engineering in Nigeria (COREN).

Academic programmes in the universities are regulated by the National Universities Commission (NUC), a Federal government agency set up to control education programmes in the universities. The programes in the polytechnics and colleges of technology are controlled by another government agency called National Board for Technical Education (NBTE). The Nigerian University system consists of 96 institutions. Comprising 27 Federal institutions, 35 State and 34 Privates universities.

A total of 37 Universities (Federal – 20, State – 12 and Private – 5) offer engineering programmes.

The general philosophy of engineering education in the university is to produce graduates of high academic standard with good practical background and of immediate value to the industry and the nation in general. In pursuance of the above philosophy, specific features have been included in the programmes, namely;

(i) common foundation years at 100 and 200 levels for all engineering disciplines
(ii) workshop practice, technology, laboratory work and tutorials
(iii) design project with bias towards local applications
(iv) broad-based engineering practice and interaction between students and professionals
(v) project in the final year on which the students work alone under supervision
(vi) special skills and indepth study in a particular area of the programme through optional courses or electives and
(vii) adequate knowledge in the area of engineering management, economics and law.

2.0 QUALITY ASSURANCE IN ENGINEERING EDUCATION

Quality can be defined as the extent to which all resources employed for engineering education delivery actually enable learners to acquire the desired knowledge, skills and attitudes at the end of their learning programmes (ADEA, 2002).

Quality assurance can also be described as a system which examines the aims, content, resources, levels and projected outcomes of modules, programmes courses or institutions proactively in order to, as far as possible, minimize errors and maintain quality. Quality assurance therefore plays not only the role of accountability but also that of standardization, evaluation and improvement of quality.

The quality of prospective graduates is controlled at two levels, namely pre-university programmes and University training

2.1 PRE-UNIVERSITY PROGRAMMES

Fig 1: Shows the processes of training technologists and engineers in Nigerian tertiary institutions. It also shows the possibility of migration of a student from polytechnic to university at the appropriate level.

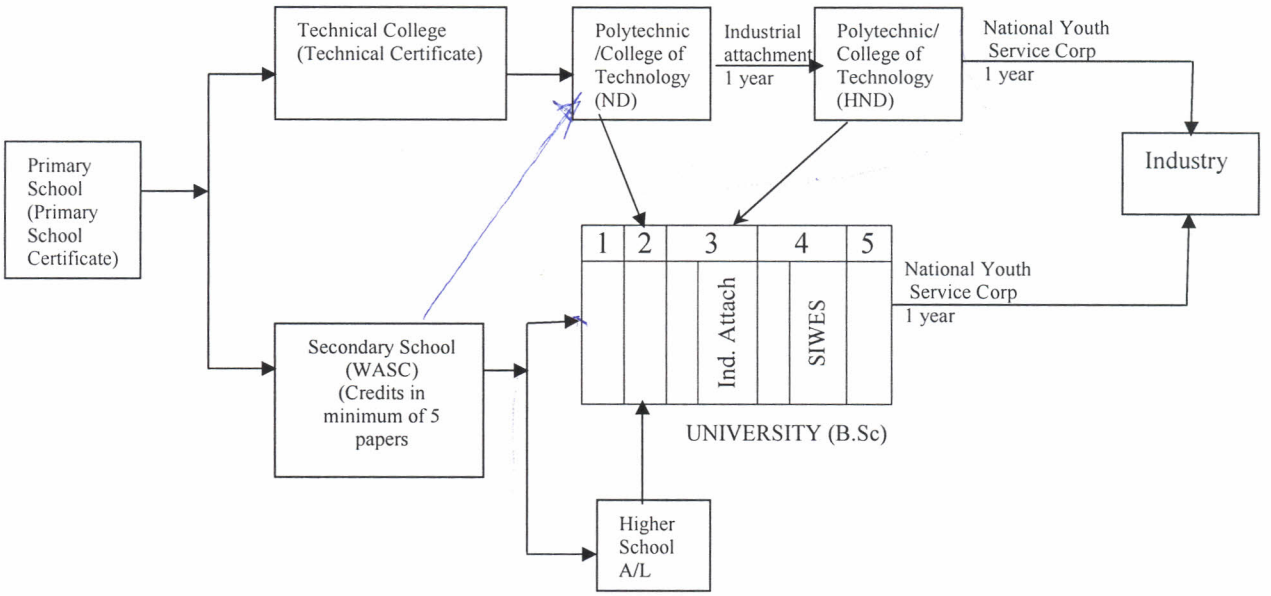

Fig 1: Knowledge Acquisition Processes for Prospective Engineers

A prospective technologist or engineer commences his training from primary school which is usually a 6-year programme. At primary school, a would-be engineer should show flare for mathematics. The quality of instruction is ensured by employing trained teachers to teach the pupils. After the completion of primary school, a pupil moves to secondary school after passing the qualifying examination. In the secondary school, he is introduced to the relevant science subjects (Physics, Chemistry and Mathematics/Further Mathematics). When he has earned his good grades in the subjects he is ready for admission into a university.

2.1.1 *Admission*

Admission processing plays a major role in determining the quality of engineering students as well as the quality of the engineers that are eventually produced. Admission into Nigerian engineering faculties may be gained through the Joint Admission Matriculation Examination process or direct entry route. In both cases the candidates need a minimum of six credit passes at two sitting or five credit passes at a sitting of the General Certificate Examination (GCE) Ordinary Level to qualify for registration.

When he has earned his good results with minimum of five (5) or six (6) credits in relevant subjects, he writes entrance examination that is centrally conducted by the Joint Admission and Matriculation Board (JAMB), a Federal Government agency established to:

- Ensure high quality matriculation examinations so that only those that are adequately prepared to benefit from university education do gain entrance to the institutions.
- Ensure high quality of administration of the examination process to minimize the exploits towards enhancing the quality of new entrants of the universities.

A good result in the examination qualifies a candidate for admission into university of his choice.

At the take off, JAMB was highly rated but as time passed-by, it was observed that some of the results published by the Joint admission and Matriculation Board (JAMB) did not represent the actual performance of the candidates. Students whose continuous assessments through the Senior Secondary Examination results have shown to be poor students often score ridiculously high marks and are offered admission at the expense of good students with moderate JAMB scores and excellent school certificate results. This informed the resolution at the National Summit on Education that admission to universities should no longer be based solely on the JAMB scores but that universities were free to apply other assessment criteria to make their selection. This resulted to the conduct of post-UME (2^{nd} test) by each university after a candidate has met the minimum cut-off in JAMB.

2.1.2. *Registration Requirements*

The minimum requirements for registration in engineering degree programme in Nigeria are credit passes in five or six subjects including English Language, Physics, Chemistry and Mathematics; some universities require students to have credit pass in Further Mathematics.

A candidate may choose not to write JAMB examination but decides to go to high school for two years to acquire higher qualifications in three (3) relevant subjects and subsequently obtain Direct entry form from Joint Admission Matriculation Board to enter university at 200 level. Usually, science and engineering programmes are 5-year programme for UME candidates and four years for Direct Entry candidates. While a candidate with HND spends three years to complete the course.

2.1.2. *Graduation Requirements*

In order to satisfy the requirements for graduation, a student must take and pass the minimum units specified in the programme before he can qualify for the award of degree in

engineering. This includes passing all compulsory general courses and the Industrial Training courses.

2.2 University Training

In the universities, the training of engineers is in three fold: (i) training in basic science courses (mathematics, Physics and Chemistry) that are based in Faculty of Science and (ii) training in core engineering and elective courses which are either Departmental or Faculty based and (iii) practical training that is acquired in the industry (Falade, 2002).

Quality assurance for engineering disciplines is carried out at three different levels in the universities:

(i) On semester basis, quality assurance of programmes is carried out via (a) institutional culture of quality assurance and self analysis using in-house experienced senior academic staff for continuous evaluation of the performance of their academic programmes against predetermined academic standards and as moderation benchmarks and (b) external examiner system in which experienced academic staff are invited from another university to vet the question papers, the marking scheme and final year students projects. Atimes, the external examiners are enjoined to sit in during the final year students project defense. The examiners send their reports directly to the Vice-Chancellor for the consideration of their suggestions and recommendations for implementation.

(ii) The National Universities Commission (NUC) on regular basis conducts accreditation exercise for all engineering programmes in the universities using experienced senior academic staff. Under the scheme, programmes that fail to meet the minimum standards will not be accredited while those that meet the requirements at different levels may receive partial or full accreditation.

(iii) Apart from the NUC accreditation exercises, statutory professional bodies e.g. Council for the Regulation of Engineering in Nigeria (COREN) also ensure maintenance of standards in tertiary institutions through a system of visitation, accreditation and re-accreditation of programmes in various disciplines and inspection of human resources. The graduates of un-accredited programmes are usually not registered by COREN to practice engineering.

3.0 ACCREDITATION

Decree No. 16 of 1985 vests in the National Universities Commission (NUC) the powers to lay down minimum Academic Standards (MAS) for all academic programmes taught in

Nigerian Universities including engineering disciplines and also to accredit their degrees, certificates and other academic awards.

In line with the provision of the Decree, the Commission in collaboration with universities and their staff developed minimum academic standards for all undergraduate programmes taught in Nigerian Universities in 1989. The Commission in 2001 initiated a process to revise the documents. The major modification in the curriculum review was the placement of more emphasize on information and communication technologies and entrepreneurial studies in all programmes. The changes were viewed as essential new platforms that would guarantee all graduates from Nigerian universities the knowledge of appropriate skills competences and dispositions that would make them globally competitive and capable of contributing meaningfully to Nigeria's socio-economic development.

Accreditation may be defined as a process by which quality of a programme offered in an institution is judged against approved or established standards. Accreditation therefore has to be guided by rules, regulations and accepted quality assurance indices.

These indices normally include the content and structure of the syllabi; the number and quality of teachers and technologists; the quality of students admitted; the quality and quantity of equipment used for instruction; adequacy of classrooms, laboratories, workshops and studios; motivation of personnel involved in the process of teaching/learning and the relevance of the assessment and evaluation methods adopted.

3.1 OBJECTIVES OF ACCREDITATION

The objectives of accreditation in the universities are to:

- Promote and foster good quality post-secondary training for the production of high quality and skilled engineers;
- Ensure parity of standards in all programmes offered by universities;
- Certify to the Nigerian community that the programme offered by an institution has satisfied the minimum educational requirements as laid down by the National Universities Commission; and
- Provide counsel and assistance to the managers of institutions, where necessary.

3.2. PROGRAMME APPROVAL

All Nigerian Universities require prior approval of NUC before establishing new programmes. NUC has developed guidelines and application formats for this purpose. Adequacy of preparedness is assured through resource assessment then granting of approval

follows. The curriculum of the programme will normally pass through relevant university organs. After the approval of the programme NUC then commences periodic monitoring of the established programme.

3.3 ACCREDITATION PROCESS

Usually, the programmes to be accredited are classified into fresh programmes and programmes to be re-accredited. Fresh programmes are the newly matured for accreditation whereas re-accreditation is for:

- Programmes that earned full accredited status (5 years) whose accreditation will soon lapse
- Programme that earned interim status (2 years) in earlier exercise that are due for a revisit usually at the end of the second year.
- Programmes that earned denied accreditation status (1 year) in earlier exercises and for which the Commission has received formal letters of a revisit from the offering universities.

3.4 SELECTION OF PANEL MEMBERS

The Commission selects senior academic experts from different universities. Usually two persons are selected to assess each programme to ensure peer review of the each discipline.

3.5 INSTRUMENTS TO BE USED IN THE NUC ACCREDITATION EXERCISE

The Minimum Academic Standards (MAS) have been used for several rounds of accreditation of academic programmes in Nigerian universities since their approval in 1989. The documents stipulate minimum requirements for both physical facilities and human resources.

The MAS documents constitute the basis for assessment.

The formats for undergraduate accreditation are:

- Self Study Forms (SSF)
- Programme Evaluation Form (PEF)
- Accreditation Panel Report Form (APRF)
- Accreditation Revisitation Form (ARVF)
- Manual on Accreditation Procedure (MAP)

3.5.1 *The Self Study Form (SSF)*

This is divided into two parts: Section 'A' and Section 'B'

(i) Section A – This is a general information section on the university as a whole, to be completed by the Chief Executive of the university. This section serves as a guide to the accreditation panel members and all necessary information on the university is contained therein.

(ii) Section B – This section deals specifically with the programme to be accredited by the panel. The section is completed by the Head of Department of the programme to be accredited including the history of its inception and development; general administration, academic content; as well as student staff work load, facilities available for the programme etc.

3.5.1.1 *Academic content*

This covers the philosophy and objective of the programme, the curriculum, compliance with the guidelines on quality of admissions, academic regulations, standard of test and examinations, interview with the students, interaction with staff – both academic and non-academic, practical/project work, external examination system, engineering drawing practice and adequacy of lecturers.

3.5.1.2 *Staffing*

This comprises teaching staff, technical and administrative staff.

The minimum academic standards provide a ratio of 1:15 (staff: students). The documents further provide the proportion of each category of staff to ensure quality. It also includes staff development programme and staff contribution to the engineering industry. Table 1 show the academic staff structure.

Table 1: Academic Staff Structure

Rank	Percentage of total (%)
Professors/Associate Professors	20
Senior Lecturers	35
Lecturer 1 and below	45

3.5.1.3 *Physical facilities*

These include classrooms/lecture threatres, office accommodation, library facilities, funding and feedback from employer. The documents provide for minimum floor space for laboratory, library and other facilities per student and teacher. Table 2 provides NUC minimum standards for space requirements for different purposes for effective teaching and learning

Table 2: Space Requirements

Professor's Office	18.50m^2
Head of Department's Office	18.50m^2
Tutorial Teaching Staff Space	13.50m^2
Other Teaching Staff Space	7.00m^2
Technical Staff Space	7.00m^2
Secretarial Space	7.00m^2
Science Staff Research Laboratory	16.50m^2
Engineering Staff Research Laboratory	14.00m^2
Drawing Office Space (A. O. Board)	1.85m^2
(Per Student)	4.60m^2
Drawing Office Space (Per Student)	3.70m^2
Laboratory Space	7.50m^2

Source: NUC, 1989

3.5.1.4 *Funding*

Source of funding is usually provided, the panelists assess the adequacy or otherwise of the allocation.

3.5.1.5 *Feedback from employer.*

The Employers' rating is considered very important in order to appraise the performance of the products of the engineering programmes. The Head of the Department to be accredited is expected to provide written document from the employers of the graduates of the programme. The document is to provide an appraisal of the performance of the graduate on the job.

3.6 THE PROGRAMME EVALUATION FORM (PEF)

This form is usually completed by the relevant panel member. The information contained in this form provides the basis for the scoring of the programme to be accredited. It is used for the preparation of statement of fact about the programme.

3.7 ACCREDITATION PANEL REPORT FORM (APRF)

This form is usually completed for each programme that is being accredited. The accreditation status awarded to the programme and the summary of scores will be entered into the appropriate space in the form.

The panel is to submit APRF to the university officials at the end-of-visit meeting with the Vice-Chancellor for his/her comment(s) which will be submitted along with the panel report to the commission. The copy of the APRF to be made available to the university shall exclude the last page on which the numerical computations are made. The summary of the scoring system is contained in Table 3.

Table 3: Summary of scores in APRF

	Maximum	Actual
1.0 ACADEMIC CONTENT		
1.1 Philosophy and objectives	2	
1.2 Curriculum	3	
1.3 Admissions	3	
1.4 Academic Regulations	2	
1.5 Tests and examination	3	
1.6 Evaluation of students' work	3	
1.7 Practical/project work	3	
1.8 Student course evaluation	2	
1.9 External examination system	2	
	23	
2.0 STAFFING		
2.1 Teaching Staff		
2.1.1 Staff/student ratio	10	
2.1.2 Staff mix by rank	6	
2.1.3 Qualifications	3	
2.1.4 Competence	3	
2.2 Administration	5	
2.3 Non-Teaching Staff	3	
2.4 Staff development	2	
	32	
3.0 PHYSICAL FACILITIES		
3.1 Laboratories etc		
3.1.1 Space	5	
3.1.2 Equipment	5	
3.2 Classrooms		
3.2.1 Space	4	
3.2.2 Equipment	3	
3.3 Office Accommodation	5	
3.4 Safety and Environment	3	
	25	
4.0 FUNDING	5	
5.0 LIBRARY		
5.1 Holdings	8	
5.2 Currency	4	
6.0 EMPLOYER'S RATING	3	
TOTAL SCORE	100	

The overall distribution of the scores is along six major criteria weighted (in percentage) as indicated in Table 4:

Table 4: Distribution of the scores

Item	Percentage
Academic content	23%
Staffing	32%
Physical Facilities	25%
Library	12%
Funding	5%
Employers' rating of graduates	3%
Total	**100**

3.8 ACCREDITATION STATUS

The accreditation status of any programme or discipline will be based on the degree to which the resources on ground meet these minimum academic standards. At the end of an accreditation exercise, a programme can earn full, interim or denied accreditation. To qualify for full accreditation a programme must score above 70% in each of four major areas; that is academic content, staffing, physical facilities and library facilities. For interim accreditation 69.9% while denied accreditation the score is 59.9% and below.

3.9 COREN ACCREDITATION

The COREN accreditation exercise follows the same principle as NUC with minor changes in the membership of the panels and in the overall distribution of the scores. The basis of COREN accreditation is the NUC Minimum Academic Standards.

Apart from experts from the university, COREN invites experts from industry as panel members. The distribution of the overall scores is along seven (7) criteria weighted (percentage) as indicated below in Table 5.

Table 5: Distribution of the overall scores

Item	Percentage
Academic content	**27%**
Staffing	**26%**
Physical Facilities	**27%**
Library	**8%**
Funding	**5%**
Employers' rating	**2%**
Overall management	**5**
Total	**100**

The accreditation status is similar to that of NUC.

REFERENCE

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