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INDUSTRIAL TRAINING AS AN INTEGRAL OF ENGINEERING AND TECHNOLOGY EDUCATION: ISSUES AND PROSPECTS

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ABSTRACT

In this paper, the philosophy of engineering and technology education curricula in Nigerian Universities is presented. The paper notes that in formulating the curricula, industrial training is incorporated into the programme to ensure that students are given the much needed on-job-experience during their course of study in the Universities, to make them better prepared for the challenges in the industry thus making them more relevant in the industry after graduation. An assessment is made of how well the curricula have been able to meet the needs of the industry taking cognisance of all the obstacles militating against the effective performance of Faculties of Engineering and Technology in the Universities and the problems in the industrial sector. It is suggested that to make progress technologically, there is need to provide an enabling environment that guarantees adequate facilities and funding of engineering and technology education in the universities and corresponding expansion in the industry.

1.0 INTRODUCTION

The general philosophy of engineering and technology education is to produce graduates with 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 (NUC, 1) 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 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 (vii) adequate knowledge in the area of engineering, management, economic and law

Candidates for admission into engineering and technology programmes are required to have passes at credit level in senior secondary school final year examination or GCE O' Level in five subjects including English, Mathematics, Physics and Chemistry. Candidates with passes in Mathematics, Physics and Chemistry at GCE A' Level or equivalent will qualify for direct admission into 200 Level of the programme. These requirements ensure that only candidates of good background suitable for the demand of engineering and technology problems are admitted into engineering programmes.

Kasuba and Vohra (2) reported that in today's global economy, all countries have either become competitors or members in competitive ventures. They noted that due to competitive pressures, the industries in the U.S.A. could no longer afford to invest substantial amount of the resources in training fresh engineering graduates before they become fully productive at the work place. The research by Di Bello and Glick (3) indicated that classroom instruction is an ineffective way to develop the required skill in some programme. They noted that people could manage to develop skills in work place through mastering the working process by solving problems encountered daily and acquiring expertise from each other or the equivalent of 'peer' tutoring. Ip and Kam (4) proposed a generic training programme for the engineers as well as management of students with the objective to enhance the understanding of the operation principles of manufacturing resources planning

In Nigeria, the universities are governed academically by the National Universities Commission, a Federal government parastatal entrusted with the responsibility of ensuring compliance of each university with its laid down minimum standards. Besides setting minimum standards, the National Universities Commission (NUC) is empowered to formulate policies on University Education. In the curriculum, industrial training in engineering and technology education is considered very crucial. The maximum stipulated duration of Industrial attachment is 40 weeks comprising the following modules: (i) students' work experience programme scheme I- 8 weeks (long vacation at the end of 200 level), (ii) students' industrial work experience - 8 weeks (long vacation after 300 level) and (iii) students' industrial work experience scheme II - 24 weeks (2nd semester of 400 level plus long vacation). The aims of these programmes are: (i) to provide the students with the needed on- the-job experience by applying the theories learnt in the classrooms to practical problems (ii) to motivate students and improve their academic performance by demonstrating the relevance of course content in industrial practice (iii) to promote the personal development of students by increasing their maturity through interacting with colleagues and mentors in industry and acceptance of professional responsibilities . The curriculum of subject with practical contents is generally organized into average of 67% for the theoretical classes and 33% for laboratory. Besides this 33%, students use the laboratory to develop case example on their own time (5).

An Industrial Training Fund (ITF) was established in 1971 with the aim of promoting acquisition of skills in industry and with a view to generating a pool of indigenous skilled manpower sufficient to meet the needs of the Nigerian economy. Each University has its own Industrial Liason Unit which ensures that: (i) students are appropriately placed for the industrial attachment (ii) students are adequately supervised by their lecturers. The unit also receives and grades reports submitted to it by students, collates the results and sends students grades to their respective departments and the students are accordingly credited.

The overall arrangement shows that to make progress in engineering and technology education there must be a close link between the university and industry. The faculties of Engineering and Technology are to engage in effective teaching, inventions and innovations in manufacturing and processing while industries are to absorb the graduates, sponsor

research and market the results of their sponsored investigations. This is sometimes undertaken through seminars, workshops and conferences.

In the recent time, there has been criticism that the standard of education has fallen particularly in engineering and technology and therefore the industrial sector is reluctant of taking students on industrial attachment even when the vacancies exist in their organisations. This is because of the assumption that the trainees would be unproductive. Teachers also complain of insufficient facilities to teach the students, both within and outside the university.

The objective of this study is to highlight those factors that militate against effective training of engineering undergraduates and proffer some solutions that would assist in alleviating the problems, thus ensuring that engineering and technology education is directed towards national development and technological self-reliance. In this paper, all those factors that 'negatively' affect the training of engineering students are presented as problems and therefore issues that require urgent attention in order to make progress technologically.

2.0 PROBLEMS OF ENGINEERING AND TECHNOLOGY EDUCATION

Generally, both universities and industries are beset by problems, which hinder them from discharging their responsibilities towards the development of engineering and technology education. Some of these problems are:

2.1 In the University

The problems hindering effective training of engineering students are:

2.1.1 Students Enrolment

The enrolment of students significantly affects their training and this happens in the following ways.

2.1.1.1 Quantity vs. Quality

Over the years the students' enrolment has witnessed a steady growth. An excessive growth in students' enrolment has contributed to the decline in the quality of undergraduates. Joint Admission Matriculation Board conducts entrance examination for the prospective university candidates. The universities are mandated to admit the candidates so long as they meet the relevant cut-off marks for their choice –courses not minding whether they actually merit the marks they obtained or not. It has been suggested severally that each university be allowed to further examine its students to ascertain the correctness of the marks they scored but the suggestion was unacceptable to the Federal government. Year-in-year out, the first year undergraduate results in engineering have shown that a large number of freshers are ill prepared for the task of studying engineering. The results showed that many of them are either uninterested or of poor aptitude in mathematics and physical science and it is only natural that they do poorly in most of the engineering courses. It is common practice to see students in engineering faculty struggling to change to humanities after the first year in the faculty. The general reason is that they are unable to cope with mathematics and physics. In

addition, a widespread misconception that the university life promises four year or five smooth and easy sailing also contributes to their poor scholastic performances.

2.1.1.2 Students’ Population

Students’ population grows steadily on yearly basis in the universities. Table 1 (a) shows the growth of the population from 1967-1976 in university of Lagos. At the end of 1976, the students’ population was 3868. This gives an approximate campus area-student ratio of about 20 square metre per person.

Table 1: students’ population

(a) Year 1967-1976

Session	Total
1967/68	1365
1968/69	1548
1969/70	1805
1970/71	1941
1971/72	2326
1972/73	2400
1973/74	2741
1974/75	2993
1975/76	3868

(b) Year 1992-2001

Session	Total
1992/93	20,329
1993/94	cancelled
1994/95	32,230
1995/96	19,756
1996/97	22,232
1997/98	18,321

Source: Academic Planning Unit, University of Lagos

Table 1 (b) shows the students’ population between 1992 and year 2001. In 2001, the students’ population increased to 33,664 while its campus area has remained unchanged. With this population, congestion on campus is evident with the campus area-student ratio down from 20square metre/person to about 4 square metre per person in 2001.

2.1.1.2 Students’ Accommodation

In most universities particularly those located in urban centres, accommodation poses a serious problem, less that 30 percent of the students are accommodated. This shows that majority of the students will shuttle from their homes or rented accommodation both far and near to attend lectures every day in an environment where there is absence of good transportation system. In an attempt to proffer solution to the accommodation problem, students result to squatting their colleagues. A room that is meant for 10 students’ ends up playing host to between 20 and 25 students. Such a congested accommodation cannot provide a good environment for learning.

2.1.1.3 Students’ Industrial Attachment

Students are expected to participate in industrial attachment during their study period. This was vigorously pursued and achieved in the sixties, seventies and early part of eighties. But with increase in students’ enrolment without corresponding expansion in the industrial

sector, placement of students became more difficult with resultant that many of the students undertake their attachment in companies that have little or nothing to offer because they do not have projects that will provide necessary exposure to the students.

Table 2a shows that between 1981 and 1985 all the students that registered for industrial attachment were placed in good firms where they were adequately exposed to challenging tasks.

Table 2: Students' Industrial Work Experience Scheme

(a) 1981-1985

SIWES Year	Students	Chem. Engr.	Civil Engr.	Elect. Engr.	Mech. Engr.	Surv. Engr.
1981	A	13	47	23	27	29
	B	13	47	23	27	29
1982	A	12	47	25	37	26
	B	12	47	25	37	26
1983	A	28	60		43	23
	B	29	63		43	23
1984	A	26	72	54	50	26
	B	27	81	59	50	26
1985	A	37	79	47	44	36
	B*	37	79	50	44	36

(b) 1993-1997

SIWES Year	Students	Chem. Engr.	Civil Engr.	Elect. Engr.	Mech. Engr.	Met & Mat Engr	Surv. Engr.
1993	A	43	25	57	55	7	19
	B	43	59	90	58		19
1994	A	C	C	C	C	C	C
	B	"	"	"	"	"	"
1995	A	32	37	61	55	14	28
	B	34	45	80	63	24	34
1996	A	56	44	67	44	8	29
	B	72	76	75	56	8	34
1997	A	38	26	49	46	9	18
	B	43	37	51	59	12	35

A – No. of Students Placed

B – No. of Student that Registered for the Programme

Source: Industrial Liason Unit, University of Lagos.

Between 1993 and 1997, the number of students available for industrial attachment was more than those that were actually placed in all the departments in the faculty of engineering, University of Lagos. It is the same trend in other universities. The prevailing situation today is similar to what is found in Table 2.

2.1.2 Funding

It has been argued at different fora, that education in general is under-funded in Nigeria. The current 5.6% budget allocated to education by the Federal government fell short of the UNESCO benchmark of 26% of the budget. The problem of under-funding manifests in poorly equipped libraries. Poor motivation with its attendant low staff morale, unstable academic calendar arising from incessant strike by lecturers over improved conditions of service. The Federal government has stuck to its policy of non-payment of tuition fee in Federal universities without sufficient allocation of funds to the universities. We have a scenario where parents gave their wards qualitative education at secondary school level which they paid to obtain but at university level where they are supposed to pay more, the government says no payment of tuition fee and the parents fold their hands to watch the deteriorating state of the universities.

2.1.3 Staff Strength

There is consistent reduction in the number of staff in the Faculties. The student staff ratio has hovered between 35 and 24 in the last decade, higher than the generally recommended ratio of 15 by NUC. While the staff strength has reduced over the years, enrolment of student has increased.

Statistics showed that not more than 10,000 academic staff are available to do the required work of 36,000 academics required by the university system. This shortage can be partly attributed to exodus of staff from the university environment particularly during the military era. Lack of training and development programmes for academic staff further dampen staff development.

2.1.4 Training Facilities

It is common to have students either perform experiment in the laboratory or to hold classroom instruction in the laboratory setting to demonstrate important concepts. However, because of insufficient classroom, laboratory space, inadequate number of equipment and laboratory technologists, it is not always possible to have students enter research environments to demonstrate important concepts. At times, classroom instruction can be difficult when there is a need to demonstrate concept experimentally such as the various analysis tools used in some engineering programs. The existing training facilities have been stretched beyond limit. The lecture rooms that should normally accommodate about 50 students are now being used by over 250 students so also the laboratories which are inadequately equipped and with obsolete equipment, no re-agents in the laboratories. The non-availability of computers as working device of engineering students poses a major threat to the entire engineering programmes in our universities. The well conceived but ill designed and managed NUNet program of NUC is yet to have any significance impact on the way teachers do their work in our universities.

2.1.5 Engineering and Technology Curricula

It has been widely criticized that the existing engineering and technology curricula do not take cognizance of the challenges in the industrial sector. This is the reason that was given to justify why there is low demand of engineering graduates in some organisations. The industrial sector considers that the university courses have a scare practical training and do not provide a working knowledge. There is need to develop new curricula that integrate exchange program between the university and the industry and also between one country and another without extension of student' study period. Such curricula should have substantial contribution from the industry leaders. Industry expects engineers to be proficient in many non-technical, yet essential areas such as telecommunication skill, total quality management, teamwork skills etc. It is acknowledged that the new curricula may not be able to totally accommodate all these proposals but it must be seen to substantially address the basic needs of the industrial sector.

21.6 Commercial Activities

There are over commercialization of activities in some universities particularly those in urban centres by the authority in an attempt to generate income to complement government's allocation. This effort has brought into the university persons who ordinarily do not have value for learning, this causes a lot of distraction to students and creates unhealthy academic environment. Indeed some business outfits on campuses are owned and financed by students.

22 Industry

The problems in the industrial sector are somewhat different from those in the universities.

22.1 Raw Materials

Most of the industries in Nigeria rely on imported machinery, materials and chemicals for their operations. With age, some of the machines require replacement of parts or refurbishment but because spare parts are not manufactured locally, they are imported. The exchange rate is high and therefore expensive to bring them to the country. The same thing is true for materials and chemicals. When the facilities are imported at the cut throat prices the unit costs of the industrial products become too expensive for common people resulting in low demand for such consumer goods.

22.2 Corporate Downsizing

Due to lack of patronage, non-availability of raw materials and chemicals, some engineering and technological companies have folded up while others have considerably cut down the size of their employees. Under this condition, it is difficult to provide placement for engineering students on a short-term basis. Also most organization have no skilled personnel to put the students through the practical application of what they have learnt in the classrooms which is the basis of the industrial attachment. Lack of patronage of indigenous professionals and contractors in the construction industry in execution of projects has made it impossible for some Nigerian engineers to grow while some indigenous contractors have closed shops to construction activities, all these put together hinder necessary expansion in the industrial sector. The construction method of the foreign contractors is equipment-based which rely on the use of equipment supported by few labour. This approach can not generate the anticipated employment. Most local contractor use labour-intensive, this favours employment generation and should normally provide expansion in the sector.

22.3 Impact of Computer Softwares

The advent of different computer softwares being used in design offices is a technological advancement but not without its negative effect of displacing personnel. Most design work that would ordinary take weeks to complete with several people on board working can now be done in a matter of hours by using computer softwares. Some of the elementary design work which routinely would be given to students on industrial attachment to do are no longer there, the use of the softwares has taken over all such assignments.

3.0 PROSPECTS IN ENGINEERING AND TECHNOLOGY EDUCATION

The primary key to progress is in the quality of technical education that aims at not only excellence but adds wealth to the creation of knowledge on the global scale as the academically relevance will help to tackle the basic problems of the nation.

As the needs of the society are changing with time, the period for revision of requirements programs and curricula of the engineering and technology education become an intrinsic part of a continuous improvement process to cope with the global trends.

All the major stakeholders in the engineering and technology education have accepted the fact that there is need to move forward and to achieve this, each sector has started to identify various areas in which improvements are required.

3.1 University

Each university has been putting together its strategic plan for a 5-year period. The plan with inputs from all the units including faculty of engineering and technology in each university addresses all the basic problems hindering good academic performance of the universities namely; funding, updating of curricula, accommodation etc. The document is also to contain appropriate solutions to all the teething problems.

3.2 Industry

The recent interests being showed by foreign investors to invest in Nigeria indicate the likelihood of expansion in the industrial sector. The on-going privatisation of federal government parastatals and agencies if judiciously pursued will bring about efficiency and growth in the sector.

3.3 Government

Government has submitted a bill on full autonomy of university which if approved with the suggestion of Academic Staff Union of Universities will solve some of the problems of admission, funding, inadequate facilities etc. currently being experienced in most universities.

An effective triangular relationship between academia, industry and government establishments will facilitate pragmatic approach to transforming classroom theories to practical application for the improvement and expansion of industry and enhance national development. Under such a conducive environment, the required on-job-experience of students during their training will be achieved.

4.0 CONCLUSION

1. Qualitative placement of students during industrial attachment has been impossible because of problems in the industrial sector
2. Corporate downsizing creates reduction in available skill personnel to train the students
3. Over-population of students hinder good lecture delivery.

5.0 RECOMMENDATIONS

In order that students can acquire necessary theoretical and practical training during their course of study, the following recommendations are made;

1. There is need to review the modalities for using both the Senior Secondary Certificate Examination (SSCE) and the university matriculation examination (UME) for admission to universities.
2. The admission to faculties of engineering and technology must be based on the available facilities
3. Adequate infrastructure facilities and teaching facilities are essential to retain the quality standard of engineering and technology education.
4. The curriculum of engineering and technology education should reflect the needs of industry for national development with inputs from industry leaders
5. The problem of over-population of students in the classrooms which has hindered good lecture delivery method can be alleviated by using wire-less communication technology, a personal computer and the use of data communication software.
6. The atmosphere on university campus plays an important role in influencing the students' life-style. The administration and faculty should make concerted effort in promoting on-campus academic activities such as international, regional and national conferences on various studies.
7. The government and/or university should provide enabling environment conducive to study e.g. availability of well stocked library, well equipped laboratories, hostels and other infrastructure facilities that offer scope to creative thinking and innovative experimentation to students.
8. The management of hostel accommodation should be transferred from the university authority to private individuals.
9. University in general has suffered from paucity of funds, government should provide adequate funds for the universities and also each university should identify various ways by which it can source funds to further complement allocation from government. Such method should not be at the expense of conducive academic environment.
10. Universities should engage in cooperative ventures with industries in both training and research and such agencies can act as placement agencies for students' in local industry.
11. Government should give challenging assignments to the indigenous professionals and contractors to enable the development of local capacity and necessary expansion in the industrial sector
12. Government should as a matter of policy patronize indigenous entrepreneurs to provide for expansion in the industrial sector to allow for quality placement of students on industrial attachment so that they can apply what they have learnt in the classrooms to practical problems
13. Faculty-in-industry programmes which will provide opportunity and support for faculty members to work at industrial sites should be established. This will help the participating faculty members to understand the latest industrial practices and the industrial hosts to benefit from the technical experience of the faculty members. In this interface, the faculty members will be able to bring new experience to curricula reform and innovations.

14. Technical education employment policies must be matched at all times to avoid frustration among the students.

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