ORIGINAL ARTICLE

Outcome and Quality Assurance-Based Curriculum in Professional Accreditation of Engineering Courses: A Case Study of IIUM and UNIMAID

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ABSTRACT

The recent growth in engineering education has put pressure on the quality in order to produce competent global engineering professionals. Accreditation, being the most influential tool of quality assurance, can be used to enhance engineering education and engineering profession. Prior to year 2000, accreditation requirements for engineering courses in Malaysian and Nigerian Universities follow the age-long standard which enjoys Universities to demonstrate availability of physical and human resources (inputs) needed in training students in the respective disciplines offered by the faculty/department/programmes. Education sector is emerging as a new industry propelling economic growth as does the industrial and tourism sectors. Many countries including Malaysia are now experiencing fast growth in this sector with the increase in both local and foreign students in the tertiary institutions. Owing to the contribution of Engineering profession to human development in recent times and its centrality to all facets of development, a new paradigm in form of broader, and self-enhancing, and self-regulating assessment called outcome-based was adopted. This new assessment paradigm is by necessity quality assurance-based and outcome-based to reduce the cost of reaccreditation on both the University and accreditation bodies and simultaneously fulfils both technical and social needs of the society on the young engineers. This paper presents the experience of Faculty (Kulliyyah) of Engineering at the International Islamic University Malaysia (IIUM) in implementing a self-regulating, self-enhancing, ethical-laden, and outcome-based assessment, and juxtaposed this with the experience of the Faculty of Engineering, University of Maiduguri (NUIMAID) Nigeria where the pre year 2000 accreditation requirements of the National University Commission (NUC) is still in force as in other Nigerian Universities.

Key words: Accreditation, engineering education, outcome-based education.

Introduction

Academic accreditation of programmes is the permission given by an authorised body to teach and award degrees in Universities or related tertiary institution of a higher learning (EAC 2007), (NUC 2012). It is also a means of self-regulation and peer review adopted by the educational community. Programmes accreditation usually carried out in conjunction with professional bodies establishes the academic footing of the department/programme to award degree in the particular field of endeavour, or the ability of the programme concern to produce graduates with professional competence to practice (Augusti, G. 2007). Accreditation signifies that an institution has reviewed itself, was examined by educators from similar organizations, and was found to be meeting its own goals as well as standards set by the educational community. Accreditation standards operationalize values and principles, and put public policy into daily practice. Standards provide a tool for effective and efficient operations, a quality improvement strategy, and a management to continually evaluate and improve services. Accreditation is a long-term commitment, focused on continuous quality improvement initiatives, and accreditation standards contain many requirements that involve paperwork of evidence and documentations (EAC 2007).

An outcome-based accreditation is a practice in which the prime focus is on the graduates ‘fitness for purpose’ rather than technical competence alone (Lau Hieng Ho and Ahmad bin Tamby Kadir 2009), (Coates, H. 2007), (Andrew Nafalski et al 2001), it is also centered on students ability to perform a given task called outcome instead of input, it continuously adjusts the curriculum to suit dynamic and multifunctional market

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needs. Quality assurance-based accreditation ensures standard through rigorous monitoring and evaluation. The former is usually based on market situation represented by the industry and professional bodies, inputs from stake holders in the society, and the future direction of the state, country, or the global community; on the other hand, the latter is derived from the quest for standard outputs by both the University and the external accreditation bodies. The issue of ethical education is brought into the fore by the need for professional to be responsible to the society they serve from a moral point of view. As technological devices have become household material, engineers and scientist impacts are felt by the society and should there arise any unethical practice by these professionals, hence, the need to include moral training into the curriculum. Many cases are abound on the effect of unethical practices on the society, the use of atomic bomb in the second world war, and many other deadly weapons at war or peace times constitute unethical use of engineering products. The Fukushima Nuclear Plant disaster occasioned by the March 11 earthquake and tsunami in Japan, in which some information suggests that, the containment, had manufacturing defect discovered immediately after production but was covered-up owing to cost consideration of reproducing another one (Yahoo News, March 2011). Thus many authors like (Rosli Asmawi 2009), (Abdul R. Ambali 2009), (Roslan Jamaludin et al 2009), (Meftah Hrairi, and Othman O. Khalifa 2009), (Vidushi B. Sharma 2008) have all at one time or the other advocated ethical issues in Engineering discipline.

Various national and regional accreditation authorities have also developed accreditation systems for the assessment of engineering education. In Malaysia, The Engineering Accreditation Council (EAC) is the accreditation body representing the Board of Engineers Malaysia (BEM), The Institution of Engineers (IEM), the National Accreditation Board Malaysia (Lembarg Akreditasi Negara LAN) and the Public Services Department, Malaysia (Japbatan Perkhidmatan Awan JPA). Likewise in Nigerian, the National University Commission (NUC) is vested with accreditation of degrees. In order to ensure quality, all stakeholders are duly represented on its accreditation panel. In addition to the NUC accreditation requirements, departments offering degree in engineering are also required to fulfill the conditions set by the Council for Regulation of Engineering in Nigeria (COREN) for the products to be qualified to register and practice as engineers in Nigeria. Thus apart from its representation in the NUC panel, the COREN sends its accreditation team (comprised of members of the Nigerian Society of Engineers (NSE)) separately.

In any accreditation process, the inspecting panel would report its findings to a national committee or NUC, who having gone through all necessary steps would accredit, provisionally accredit, or refuse to accredit the programme (Andrew Nafalski et al 2001). In any case, a time to revisit the programme would be stipulated. In Nigeria, a fully accredited engineering programme is revisited for reaccreditation every five years, while in Malaysia if a programme is accredited, it is for one or three year duration, while some also accredit for four years in exceptional circumstances. Accreditation of engineering education programs in any University including IIUM and UNIMAID is to ensure quality of education according to the criteria laid by accrediting body. The accreditation process is to verify the value-addition in transforming students admitted to the programme to become competent engineers, having sound fundamental knowledge and acceptable level of professional skills. They would then be employable in the engineering industry. An accredited engineering program requires satisfactory preparation of graduates eligible to be registered as graduate engineers and thereafter eligible to be developed and admitted as registered professional engineers after a few years of job experiences.

Previous Accreditation Practice:

Accreditation improves institutional prestige and academic standards in the global environment. In the past, the external monitoring process formulated by the accreditation bodies set performance standards for service quality, measure the merit and worth of an organization in relation to the standards, and keep the organization accountable to the public. The process is based on self-assessment and review, as teams of peers and/or professional surveyors assess the quality of an organization and provide assistance aimed at improvement. This practice is dubbed traditional education, because it primarily focuses on the age-long approach of measuring the resources that are available to the student, which are called inputs (Coates, H. 2007). Quality Assurance is not new to the new accreditation practice; it has always existed to guarantee quality of the inputs. On ethic, the previous practice assumes that if teachers could hold some form of ethical values, couple with no obvious students’ criminal or deviant character while studying, such a graduate would be morally okay. However, such position is found wanting by experience. Computer and Information Engineering programme of IIUM was first accredited by BEM in 1998 and re-accredited in 2002 up to the graduation of 2003 Intake, while the Computer Engineering department of UNIMAID being a new department was fully accredited in 2008 without any prior record of rejection.
Accreditation of Engineering Education in Malaysia:

The current accreditation requirement as against the former practice is aimed at achieving a self-assessment, self-regulation and peer review, performance-based by the educational community. It measuring system focuses on clear picture of what learners should ultimately be able to do successfully at the end of a significant educational experience (outcome) ((Andrew Nafalski et al 2001), (Shahrir Abdullah et al 2009). Secondly, the new requirement also ensures the old quality assurance system is modified to cope with monitoring, measuring, and evaluating the outcomes as against the inputs in the previous system. Thirdly it looks into the ethical courses embedded in the curriculum to determine the graduates’ readiness for the socially challenges of the society. Historically the development of accreditation process in Malaysia started in 1957 with the Public Services Department (PSD) being responsible for the admission to the Public Service and the quality of academic related matters for the purpose of admission into the Public Service. Then in 1959, Institution of Engineers Malaysia (IEM) initiated a model similar to UK and Australia. In 1967, the Board of Engineers Malaysia was established and formed joint accreditation with IEM. In 1996 LAN (National Accreditation Board) was established to ensure quality of private institution of higher learning. In 2000, Engineering Accreditation Council (EAC) was established comprising of Board of Engineers Malaysia (BEM), IEM, LAN and PSD. In 2007 Malaysia Qualification Agency (MQA) was established to replace LAN. In 2008, the membership of EAC includes BEM, IEM, MQA, PSD and industry representative. (Andrew Nafalski et al 2001), (Shahrir Abdullah et al 2009). In 2009 Malaysia represented by Board of Engineers Malaysia received full signatory status. Like Engineers in Australia, Malaysia through the Engineering Accreditation Council of Malaysia (EAC) has its own accreditation process and conduct of accreditation.

Engineering Education Accreditation in Nigeria

The National Universities Commission (NUC) is a parastatal under the Federal Ministry of Education (FME), established in 1962 as an advisory agency in the Cabinet Office and became a statutory body in 1974. In its over 47 years of existence, the Commission has transformed into important arm of government in the area of development and management of university education in Nigeria. The main functions of the Commission are outlined as are:

(a) Granting approval for all academic programmes run in Nigerian universities;
(b) Granting approval for the establishment of all higher educational institutions offering degree programmes in Nigerian universities;
(c) Ensure quality assurance of all academic programmes offered in Nigerian universities; and
(d) Channel for all external support to the Nigerian universities. (NUC 2012)

On the other hand, The Council for the Regulation of Engineering in Nigeria, COREN, formerly known as Council for Registered Engineers is a body set-up by the Decrees 55/70 and 27/92 (now Acts 110). The Decrees empowered the Council to regulate and control the training and practice of engineering in Nigeria and to ensure and enforce the registration of all engineering personnel (i.e. Engineers, Engineering Technologists, Engineering Technicians, and Engineering Craftsmen) and consulting firms wishing to practice or engage in the practice of engineering in Nigeria. (COREN 2012)

Continual Quality Improvement (CQI) & the Outcomes Approach at IIUM:

EAC requires in the accreditation Programme Objectives and Programme Outcomes. The first is defined as specific goals describing expected achievements of graduates in their career and professional life few years after graduation. The late is defined as statements that describes what students are expected to know and be able to perform or attain by the time of graduation, and shall be related to the knowledge, skills, and behaviour/attitude that student acquire through the programme (EAC 2007), (Andrew Nafalski et al 2001), (Shahrir Abdulllah et al 2009). The outcomes approach for continuous programme improvement is a significant element in the contents Manual of EAC. Outcome based Education is a method of curriculum design and teaching that focuses on what students can actually do after they are taught. While the curriculum designs backward by using the major outcomes as the focus and linking all planning, teaching and assessment decisions directly to these outcomes. The programmes at Kulliyyah (faculty) of Engineering, IIUM have implemented OBE for all batches. The Faculty has organized a number of workshops to explain the concept of OBE and motivate the faculty to the new teaching and learning process. An awareness of these significant benefits should provide a powerful motivating force for engineering faculties to be committed to the implementation of OBE. The department is closely monitoring the implementation process of the outcome based learning system. In addition, the programme has come up with learning outcome mapping form to ascertain the inclusion of direct assessment by the course instructor to achieve targeted learning outcomes in the respective courses and plans to determine the level of achievement of learning outcome. An important and integral component of the OBE approach is
Continuous Quality Improvement (CQI). Feedback from all stakeholders and the necessary follow-up actions must be implemented at all stages to complete the quality improvement loop. Conversely, since the accreditation requirement in Nigeria is still input based, the accreditation panel of the NUC and accreditation team of COREN looks into human and material resources such as qualified lecturers, library holdings, laboratories and workshops, offices, and classrooms and halls. Students’ University entry grade and previous level performances are also checked at random accreditation. In addition, the COREN team looks into the professional status of the lecturers and encourages students through NSE to register as student member to facilitate post graduation registration.

Steps in Achieving OBE Objectives at Programme Level:

The following steps and strategies were used by the faculty in order to achieve the programme outcomes which should lead to the accomplishments of the programme objectives few years after graduation.
1. Each course which is linked and contributes to the programme outcomes, contributes to the programme objectives.
2. Course contents are designed to meet the programme outcomes and objectives.
3. Faculty knows how his/her course is linked to the programme outcomes and objectives and what contributions are made by his/her course.
4. Faculty evaluates the student achievements in a course through continuous assessment.
5. Faculty ensures that students are tested on various contributing elements through exams, home works, assignments, presentation and/or reports.
6. The programme uses a grade of ‘C’ (2.0/4.0) as the datum to specify the graduation requirements. A student’s performance in a class is measured by the class grade, although a student can receive a grade of ‘C’ (2.0/4.0) or better, but not achieving a program outcome. Similarly, a student can achieve a program outcome, but not meeting the degree requirement of ‘C’ or better. However, students are required to achieve a grade of at least ‘C’ in order to meet the overall course outcomes and objectives.
7. Students are required to have a grade of ‘C’ or better in all pre-requisite courses. That is, if a particular course is a pre-requisite to another course, then students are assumed to have achieved 100% of the course objectives.
8. Overall, students must have an accumulative GPA of 2.0/4.0 or better in all ECE courses. This requirement will ensure that all students graduating from the program will be expected to attain a certain minimum level of achievement toward meeting the overall program outcomes and be prepared in achieving the program objectives after graduation.

Curriculum Review:

Comprehensive review of programmes has been conducted during the year 2003 to accommodate the comments made by the board of Engineers Malaysia, and also the representative of the Australian Institute of Engineers. In this process both the contents of the courses and the assessment schemes have been modified. Assessment schemes for all theoretical courses, lab based courses, final year projects and Seminars have been improved and rubrics for mark distribution have been developed. In Nigeria, the NUC sets the minimum curricula for all courses and allow individual Universities/ departments to make additions to it according the quality they intended. The curriculum being implemented in the Computer Engineering department, UNIMAID is a hybrid of NUC minimum requirements and other ones from within and outside the country.

Mini Project Hands on Design:

Mini project hands on design has been introduced to levels two and three and incorporated in the curricula where students are have their hands on skills and practical implementation of the knowledge they obtained in the theory classes. It is an “open” or design type experiments as part of undergraduate assignments or laboratory projects. This is to address one of the issues highlighted in the report “The Future of Engineering Education in Malaysia” by Malaysian Council of Engineering Deans (MCED). The objectives of Mini Project are:

a) To enhance student creativity and problem solving skills
b) To build the spirit of team works in design process.
c) To enhance students communication skills
Because of the relationship between project (mini/main) and management, economics and ethics, it was realized that courses are of vital importance to Computer Engineers, these courses were restructured and offered by other Kulliyyah. However, in Nigeria no mini project is administered to students and while management course(s) are taught to engineering students, it is expected that through a course titled ‘Engineers in Society’ students will imbibe the required ethical values.

Appointment of Industrial Advisory Panel:

A senior Professional Engineer was appointed as member of an Industrial Advisor board of the programme. The advisor is a liaison between the industry and the programme where he can advise on the industrial relevance of the following:
1. Final year projects (through examining the topics and quality of work as well as the student's discussion / presentations)
2. Seminar courses (through examining list of topics and speakers)
3. Industrial Training (IT) (examining the IT annual report prepared by the coordinator)
4. Advising on the relevant component of the programme curriculum.
5. Proposing Industrial related projects
6. Proposing Fellowship visits
7. Proposing Research related to Postgraduate Students
8. Writing a formal report about the programme.

In Nigeria, no departmental industrial board, but we do have SIWES (Students Industrial Work Experience Scheme) coordinator who is an academic staff of the department concerned.

Summary of Outcome Orientation of Kulliyyah of Engineering, IIUM

A graduate of Kulliyyah of Engineering IIUM should be able to:

**Demonstrate Knowledge in**
- His chosen field of sufficient depth to satisfied industrial needs of his service,
- Other field adequate to function well in his immediate society and the global market,

**Act Ethically**
- In any situation be it as a professional or a member of society,

**Solve Problem**
- In his field of specialization using creative and problem solving skill acquired,

**Work independently and in a team**
- In collaboration with other professional of either the same field or different field,

**Communicate Effectively**
- In the local language and International language especially English at both the professional and community levels,

**Respond to Market Dynamics**
- In terms of acquisition of more knowledge in his field to be continuously relevant in his job,

**Manage resources**
- Either as a professional working in an engineering field or
- As a manager of an organization

**Quality Assurance At IIUM And UNIMAID:**

Quality assurance is important to institutions of higher education as it relates to an institution’s operational effectiveness in teaching and learning, research and publication, consultancy and services. Quality assurance and recognition play important roles in securing the market confidence to the education providers. Accreditation is also an important tool for global recognition within the global education industry that will facilitate mobility of students and professionals internationally especially in professional degree such as engineering education. The establishment of a new entity which merges the National Accreditation Board (LAN) and the Quality Assurance Division, Ministry of Higher Education (QAD) was approved by the Government on 21 December 2005. The new entity, the Malaysian Qualifications Agency (MQA), was established on 1 November 2007 with the coming in force of the Malaysian Qualifications Agency Act 2007. The MQA is responsible for monitoring and overseeing the quality assurance practices and accreditation of national higher education. As a quality assurance body, the functions of MQA are:

1. To implement MQF as a reference point for Malaysian qualifications;
2. To develop standards and credits and all other relevant instruments as national references for the conferment of awards with the cooperation of stakeholders;
3. To quality assure higher education institutions and programmes;
4. To accredit courses that fulfill the set criteria and standards;
5. To facilitate the recognition and articulation of qualifications; and
6. To maintain the Malaysian Qualifications Register (MQR).

The Academic Quality Assurance Framework (AQAF) of IIUM was endorsed in the 287th Senate on 14 November 2003. The framework is essentially a structured manifestation of good academic practice that comprises the core quality assurance and control procedures which promote quality enhancement and the maintenance of academic standards. It requires that each kulliyyah/centre/institute has effective, accessible and auditable procedures for assuring and enhancing the quality and academic standards of the programmes offered. In line with the implementation of AQAF, the University has established the Board of Academic Review which is responsible for the overview of quality assurance procedures, communications with the University’s Senate, and the identification and dissemination of good practice. The members comprise the Deputy (Academic Affairs) of the Kulliyyahs/ Centers.

Since the accreditation requirement itself in Nigeria is quality assurance loaded, what is needed is a ubiquitous monitoring system. At UNIMAID a multilevel and hierarchical monitoring system was devised to ensure quality assurance. The head of department (HOD) who is under the supervision of the dean and deputy vice-chancellor DVC academic is expressly expected to monitor compliance by both the staff and students. He may however delegate some of these responsibilities to other competent lecturers. Such responsibilities as laboratory supervision, Examination and time-table coordination, SIWES coordination, level coordination, and final year project coordination are usually assigned to other academics and then supervised by the HOD for compliance and effectiveness. Apart from these, dissatisfied parties may directly report to the Federal Government established Service Delivery Committee (SERVICOM) who reports directly to the Vice-Chancellor (VC) or the national office in the presidency.

Methods Employed to Monitor Programme Objectives:

The IIUM Plan for undergraduate education is characterized by student responsibility for his/her learning, an outcomes-orientation based on ethical as well as the technical and professional components of the Bachelor of Engineering degree. The curriculum was created to be in concert with IIUM’s Mission (Integration, Islamisation, internationalization, and Comprehensive Excellence) and educational philosophy which were in place prior to the formalization of Programme Objectives. The formal process of establishing Objectives for the undergraduate programmes began with the departmental Strategic Planning process in 1994. The curriculum review was undertaken and modified in 2004. The faculty of engineering stays in touch with its constituencies by several means:
• Direct, two-way contact with individual constituents such as students, industrial advisor, faculties etc
• Indirect, via industry surveys Alumni Tracer Study.

Curriculum Review As Part Of QA:

There has been continuous review of programmes since its comprehensive review during the year 2003 to bring it in-line with the principle of outcome based objectives. In this process both the contents of the courses and the assessment schemes have been constantly modified to suit market and society demands. This is in line with the general QA system, and IIUM AQAF.

Implementation of Stakeholders Feedback:

Engineering education is quickly expanding in Malaysia to meet the country’s demand for engineers. The challenge arising from this phenomenon is quality assurance. Feedback from stakeholders is very important and reflects the ability of graduates in job market. It is a common practice to use alumni, employer surveys and interview, competitions, and seeking feedback from faculty, student, and industry for monitoring program quality (Jack R. Lohmann (1999). The feedback has been implemented at the Kulliyyah and the University levels. Alumni Tracer Study, Industry and exit Survey. Survey results are analyzed to derive important conclusions on the effectiveness of the curriculum interim of achieving the programme objectives/ learning outcome on programme level as well as on course level and actions are being taken to achieve Continuous Quality Improvement (CQI).
Monitoring the performance of the individual programmes

- By direct contact with the constituents
- Surveys Alumni

Continuous curriculum review

- To ensure graduates ‘fit for purpose’ at all times,
- To satisfy conditions for reaccreditation,

Analysis of Feedback from Stakeholders

- To carry the stakeholders along in the improvement strategy of the programme,
- To achieve Continuous Quality Improvement (CQI),

Implementation of Student-Lecturer Communication through LMS

- Enables low cost distribution of course materials
- Allows quicker feedback for quality improvement

On her part, based on the input based accreditation requirement of the NUC, the Faculty of Engineering of the University of Maiduguri have been striving hard to guarantee quality assurance. The efforts of the Computer Engineering Department are summarized below:

Staffing and Staff Development

- By employing a number of staff within a short span of time
- By supporting staff to obtain higher degrees within and outside Nigeria
- By employing senior academics within the country as visiting fellows

Acquisition of Educational Resources

- Opening and Equipping Laboratories
- Direct purchase of books not available in the country from outside
- Planned database for free electronics books and periodicals

Multilevel and Hierarchical Monitoring

- Appointment of supervisors and coordinators
- Monitoring by the HOD
- Monitoring by the Dean
- Monitoring by the Deputy Vice-Chancellor
- Establishment of SERVICOM

Learned Lessons:

The accreditation exercise at the Kulliyyah of Engineering, International Islamic University Malaysia was very good experience and leads to more excitation since the programmes visions and mission fulfill the criteria of internationalization and Integrations. The EAC requirements are almost identical with University mission and vision. It was a smooth and easy process. It will also provide a solid platform for self assessment of performance and planning for future improvements. All learning outcomes were assessed using suitable performance indicators. Programme objectives address the graduates’ attainment within 3-5 years after their graduation. Programme outcomes, which consist of abilities to be attained by students before they graduate, are formulated based on the programme objectives and encompass the outcome requirement by accreditation bodies. Another lesson is the evidence documentation, where the learner has to login all the output assessment for programme objectives, programme outcome for each and single course (Khalifa et al 2011).

The accreditation experience of the staffers of the Computer Engineering department of the University of Maiduguri (UNIMAID) in 2008 was more than intriguing. This is explained by the fact that that was the first time the department was subjected to accreditation rigors being a new department and it scaled through with full accreditation in an era when older departments in older universities failed reaccreditation. The department fulfillment of all NUC requirements within a short time of its existence was mostly responsible for the feat.

Conclusions:

Accreditation is a useful tool towards the achievement of best practices in engineering education and to ensure the minimum standard is maintained in the delivery of engineering programmes. The experience of faculty of Engineering at IIUM and UNIMAID could provide an excellent platform for closer cooperation and consultation between all the stakeholders for the continual quality improvement in the engineering education. It thus will further strengthen the determination of IIUM and UNIMAID at contributing towards the economic growth of their respective countries and the development of the education industry around the globe.
References