IIUM Engineering Education A Model

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ABSTRACT

Several reports and papers of the past decade suggesting paradigm shifts in engineering education are shown to reveal a common theme, engineering is an integrative process and thus engineering education, particularly at the baccalaureate level, should be designed toward that end. A change in intellectual culture, the roots of contemporary collegiate education currently are traced to their origin and attention is given to discussing the current emphasis on turning a course-focused education compared to a more holistic approach in which process and knowledge are woven throughout the curriculum. A system for baccalaureate engineering education is presented in terms of taxonomy of intellectual components connected holistically with a core focus on developing human potential, as opposed to the present system in which students are passed serially through course filters.

Key words: engineering education, engineering curriculum, outcome based education, Islamic Education Philosophy

Introduction

Engineering work has been done for thousands of years, and however documented records shows only for some 150 years of them has it had any formal connection with universities (Wei 2005). For several centuries the universities of Europe and the engineers of Europe had no connection with each other. With advancement in engineering education in the university today current only few practical men who look with considerable suspicion on a university graduate as he come to an engineering job. The suspicion generally stem from engineering itself has two aspects and two tradition. One is the tradition of the master craftsmen, which were builders and doers of civilization. The craftsmen form a guild which has strong sense of professional responsibility and mistakes often not tolerated. The art was handed down from master to apprentice and the road to mastery involved hard work. The other tradition is a scientific and mathematical one. It is represented in ancient times by Plato Academy. At the time of renaissance it comes to light in the faculties of philosophy in the universities, mathematicians and artists attached to various courts. The men of this tradition were often dismissed as merely theoretical or impractical. However, from this group have come most of the strikingly new ideas in engineering. The uneasy union of the two traditions is the basis of modern engineering education that of today. The changes in curriculum and training for engineers which started in earnest early 1900 has been put in place in the years after world War II, due mainly to the need of close collaboration between researchers and practitioners experience during the war.

Currently there is almost universal agreement that an effective engineer must possess a broad range of knowledge and skills, extending far beyond the technical expertise of his or her discipline. An engineer must command not only understanding of theory, but also the skill necessary for the successful elevation of theory to practice. Engineers who possess all these traits in abundance are able to apply them not only in engineering but also in research, management and numerous other fields (Parnaby, 1998).

Various approaches for engineering education has been proposed and implemented over the years varying degree of success. However, with the decision made by Engineering Accreditation Council in 2002 for Malaysia to be signatory for Washington accord the approaches is then narrowed down to one that is compatible with Outcome Based Education (OBE) (Aziz et al., 2005).
Outcome Based Education:

The concept of OBE is simple and straightforward. The curriculum designers should start with a definition of what learners should ultimately be able to do successfully at the end of the educational programme (i.e. outcome). Then the curriculum, methods of instruction and assessment (i.e. the education) are strategized to ensure that the learners are able to meet the outcome [Besterfield-Sacre et al. 2003].

The emphasis in an OBE education system is on measured outcomes rather than ‘inputs’, such as how many hours student spend in class, or what textbook are provided (Khairiyah et al., 2004). Outcomes varies according to programmes but generally will encompass the technical, managerial and soft skills as well as knowledge. A complete system of outcomes for a subject area normally includes everything from mere recitation of facts, to complex analysis and interpretation.

An important by product of this approach is that students are assessed against external, absolute objectives instead of reporting the student relative achievements against his or her peers. The traditional model of grading on a curve (top student gets the best grade, worst student always fails) is never accepted in OBE. Instead a student’s performance is assessed against the outcome in absolute term.

The adoption of measurable standards is seen as a means of ensuring that the content and skills covered by the standards will be a high priority in the education of students. While recognizing that some students will learn certain material faster than others the OBE rejects the idea that there will be a disparity between graduates.

Islamic Education Concept:

Seeking knowledge has been an integral part of the Islamic tradition. The early years of Koranic revelations to the Prophet were embedded in the oral tradition and subsequently written down and compiled to the various chapters, which become the book of Islam, the Koran. The methods implemented by the Prophet in educating the companion have been the basis of Islamic education.

The essential components in the system implemented by the Prophet is in the emphasis on the form (surah) and meaning (ma’ana) in the acquisition of knowledge. Modern deliberation of the system also includes the arrival, a process of perception that requires active mental and spiritual preparation in the part of the seeker and the pleasure and grace of god as the Giver (Aminuddin Hassan et al., 2010).

The philosophical objective of education from the Islamic perspective is to create a good man. Good here means a man possessing adab in the inclusive sense where he since rely conscious of his responsibilities toward the true God, who understands and fulfill his obligation to himself and others in his society with justice and who constantly strives to improve every aspect of himself towards perfection as a man of adab (Wan Daud, 1998).

Education thus is the process of instilling and inculcation of adab in man (ta’dib). The concept of ta’dib includes within its conceptual structure the elements of knowledge (’ilm), instruction (ta’lim) and upbringing (tarbiyah). Adab is the discipline of body, mind and soul; the discipline that assures the recognition is recognition and acknowledgement of the reality that knowledge and being are ordered hierarchically according to their various grades and degrees of rank, and of one’s proper place in relation to that reality and to ones’ physical, intellectual and spiritual capacities and potentials.

Engineering Curriculum in IIUM:

Engineering curriculum in IIUM is designed to support the vision of the kulliyah which is ‘to be a world class centre of engineering education and research with values and ethics’. The emphasize on the statement is to provide quality engineering education with sufficient scope to include fundamental and specialized knowledge and practice in engineering, management and humanities so that the graduate are prepared to serve the current need and emerging needs of the society.

The concept of engineering curriculum in IIUM has benefited from the current trend of implementing OBE in engineering education. The balanced curriculum developed at IIUM principally satisfies the integrated nature of the engineering programmes offered in IIUM namely:

1. B.Eng(Hons) Mechatronics Engineering
2. B.Eng(Hons) Mechanical – Automotive
3. B.Eng(Hons) Mechanical – Aerospace
4. B.Eng(Hons) Electronics – Computer and Information Engineering
5. B.Eng(Hons) Communication Engineering
6. B.Eng(Hons) Manufacturing Engineering
7. B.Eng(Hons) Material Engineering
8. B.Eng(Hons) Biochemical-Biotechnology Engineering
The aspiration for the programmes designed are that they will be able to produce graduates with broad based knowledge and fundamentals of engineering to solve problems, generate new ideas and develop products for the need of the society. Graduates from the kulliyyah also should have competencies in engineering design and analysis.

The engineers graduated from kulliyyah of engineering should also have skills in communication, management, team work and leadership. They also should have a good understanding of moral values professional ethics and responsibility towards society and environment. To keep pace with the advancement in engineering the graduates should also continuously embrace lifelong learning.

In order to achieve the (PLO) aspiration of the curriculum a program learning outcome has been designed so that at the point where the student graduate from kulliyyah of engineering the student should have the ability to:

1. acquire and apply knowledge of mathematics, computers, science, and engineering. (T)
2. have in-depth understanding and technical competency in relevant engineering discipline. (T)
3. identify, formulate and provide solutions to engineering problems. (T)
4. design and conduct experiments, as well as to analyze and interpret data. (D)
5. analyze and design a system, component, or process to achieve the required objectives. (A)
6. apply design principles for sustainable development. (D)
7. communicate effectively. (S)
8. function effectively as an individual and in group with the capacity to be a leader or manager as well as an effective team member. (S)
9. recognize the need for lifelong learning and to pursue independent learning for professional development. (S)
10. understand the responsibility of a professional engineer in the context of contemporary social, cultural, global and environmental issues. (ESSE)
11. demonstrate understanding and commitment to professional and ethical responsibilities. (ESSE)
12. understand the impact of engineering solutions in a global and societal context through broad-based education. (ESSE)

The curriculum requires the engineering student to take basic engineering courses in the first and second semester prior to the fields of specialization. This approach will give students the right guidance and enough knowledge to select their core specialties as well as broaden their knowledge in engineering as a whole.

Courses for engineering students are selected to accommodate the needs of the particular field of specialization as well as to satisfy the university and faculty graduation requirements. The general courses are taken in the first year. These courses are common for all engineering students. In the second year the engineering students will take courses that are common for areas of specialization with the area of the major. Starting from the third year onwards the students will be required to take courses in the area of specialization (Salami et al., 2003).

The engineering components address the first three competency groups of the PLO namely the Technical (T), Analysis (A) and Design (D) which is the essential capabilities related to scientific and engineering knowledge. The other competency group which is addressed indirectly through activities undertaken to explore the first competency group are Ethics, Safety, Society and Environment (ESSE) and Work Skills (S) which gives appropriate consideration to matters pertaining to professionalism and ethics.

The second group of competency is directly addressed in the ten week of industrial training which can be taken after the student completed 90 credit hours of courses. The industrial training provides another venue for the student to gain exposure to industrial environment. This complement the training provided for the soft-skill via a structured co-curricular approach in IIUM.

The aims of the curriculum designed for the engineering programmes offered as a whole are to balance the strength of graduates in moral/ethics, social responsibilities and specific job skills. The resultant graduate should meet the expectation of the industry.

Discussion and Analysis:

A traditional Islamic education develops an Islamic outlook to life but does not prepare the student to assimilate developments over the past three or four centuries, in particular in the domain of current knowledge. A modern secular educations inevitably entails absorption of a secular worldview built into the framework of western sciences. For muslims, the current need is to develop an Islamic approach to understanding recent history and developments in secular physical and social sciences.

However, the goal of Islamic education in general agrees with the adopted Malaysian Engineering Education Model (MEEM) (Abang et al., 2002) which is to produce graduates with these attributes:

1. Scientific strength, which enables engineers to conduct innovative research and development in traditional and new areas such as biotechnology, nanotechnology, and information technology.
2. Professional competencies, which enable engineers to be technically proficient in performing specific engineering tasks in a world driven by rapid technological advancement.

3. Multi-skilled, which enables engineers to perform a variety of engineering tasks and adapt to different engineering disciplines, and committed to life-long learning.

4. Well-respected and leadership quality, which prepares engineers to lead in business and public service, able to communicate effectively, understand other cultures, and contribute to the wider world.

5. Morally and ethically sound, which prepares engineers to be responsible and ethical citizens.

The desired attributes specified in MEEM has been translated into programme learning outcomes which specify the skills and objectives that students should obtain in the educational process. In Kulliyyah of Engineering, IIUM the components have been grouped into Technical, Analysis and Design, Work Skills and Ethics, Safety, Society and Environment with corresponding programme learning outcome.

Each of the programme learning outcomes is then mapped into a group of inter-related course that support the programme learning outcomes. Each of the courses in the groups differs according to which skill group it offers. The engineering education process that transforms the inputs (students) into output (engineers) differ in the methods of:

1. acquisition of new information
2. transformation and manipulation of knowledge through learning activities
3. application of engineering theory, knowledge and skills
4. evaluation of the course learning outcome.

The nature of engineering education adopted is future-oriented, encourages creative activities to stimulate innovative thinking, and fosters independent and active learning. It is multidisciplinary to solve real-life problems in a multi-ethnic, multi-cultural and multi-religious community. Similar to traits of engineers described by Jeff and Smith, (2005) and O’Kane, (1999), Kulliyyah of Engineering adopted a scheme for engineering education which aims to produce engineers with high moral and ethical values such as respect, equality, responsibility, integrity and trustworthiness. Formal education needs settings with conducive infrastructure, facilities and environment for teaching and learning.

In line with the current national development in achieving the industrialized nation status in its Vision 2020 and supporting the Economic Transform Programme (ETP), there are continuous demands for engineers to fulfill the vacancies in the electronics, automotive and aerospace manufacturing, Research & Development (R&D), and the construction sectors. Engineering programmes mainly offered by higher education institutions in Malaysia are from the following traditional engineering fields: Electrical & Electronics, Mechanical and Civil engineering. However, with the current global developments, engineering courses offered by the universities have also varied to include biomedical, biotechnology, biochemical, information, communication and computer, manufacturing and materials, mechatronics, and environmental engineering programmes.

Challenges for the Future:

The challenges that kuliyyah will face in the coming decades will be wide-ranging and varies accordingly (Hirsh and Weber, 1999). The pace of technological advancement is accelerating and new technologies are being developed, and subsequently being made obsolete, at an increasing rate. Globalization, technology, governance, changing missions and expectations, the emergence of competitors, the utility of maintaining tenure, and securing new revenues, increase product and reducing costs are a few of the recurring challenges facing by higher education at the millennium.

The kuliyyah of engineering plans to play a vital role in changing the society. To produce engineers who can keep pace with global technological development, there must be:

i. Corresponding innovation in how engineers are educated. Faculty and students must be prepared to learn and to acquire new knowledge and technology.

ii. Awareness that the technology has become increasingly integrated with all aspects of our lives. The skills that an engineer will need to acquire may differ from what he already knows.

The ultimate challenges mentioned by Wankat et al., (2002) is that the growing number of engineering schools that need to regard teaching in a meaningful way. Multidisciplinary collaboration between engineers and non-engineers is essential to attain suitable level of professionalism.

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References


