

Implementation of Outcome Based Education in the Faculty of Mechanical Engineering, Universiti Malaysia Pahang: An Experience

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ABSTRACT

This paper was discussed about an experience of Outcome Based Education (OBE) implementation in the Faculty of Mechanical Engineering (FKM), Universiti Malaysia Pahang (UMP) since 2006. The faculty had derived and formulated its own strategy on OBE as well as teaching and learning to aid the implementation. The process of implementation involved of training the representative, planning the implementation process and formulating the outcomes. The teaching approaches which is teacher centered were modified to mix with student centered ensure that graduates attain our planned outcomes.

1.0 Introduction

Engineer's ability is the most important toward new modern engineering. In this era of globalization, the mobility of engineers to be able to work around the world is important. However, engineers being professionals, require recognition in the country that they are working. A group of developed nations sat together and came up with the Washington Accord where every signatory member recognized engineering graduates from the other member nations [1,2].

Malaysia as a developing country is trying to move towards the direction of being a signatory of Washington Accord (WA). This would be an international recognition that the quality of engineers we produce is at par to that of developed nations. In the modern world where the supply of graduates seems to outpace the demand of the industry, the industry has more choices [3,4]. This is probably one of the reasons why the Outcome Based Education (OBE) was formulated. The successful implementation of OBE is the main criterion to be a new member of WA.

The Universiti Malaysia Pahang, which has always stressed on producing quality graduates (as can be seen in Vision and Mission of UMP) to fulfil the needs of this developing country, embraced the OBE with open arms. The Faculty of Mechanical Engineering, UMP had to plan and implement OBE as quickly as possible in order to seek accreditation for its first graduates in 2007 for Bachelor of Mechanical Engineering (BMM) programme. This is due to major changes in the program to fulfil the requirements of Ministry of Higher Education and the evaluation criteria of Engineering Accreditation Council (EAC) [5]. Now it is beginning to focus on OBE. A few representatives of FKM were attended seminars on OBE and shared the knowledge they learned from the expert with the other faculty members. Then, Dean was instructed them to learn, plan and implement the OBE in the FKM. This paper discusses our philosophy on OBE, the accreditation process that we went through and the challenges we faced along the way.

2.0 The Faculty's Philosophy on OBE

The main concern of OBE is about defining the proper outcomes based on the needs of the stakeholders and taking whatever actions necessary to achieve it. There are no hard and fast rules on what must be done. Although there are references on what should be done [6]. They served only as very general guidelines.

OBE focuses on our outcomes and in this case, the graduates we produced. Thus the main question is, “What type of graduates do we want to produces?” After that, we must work towards it using all available resources that we have creatively. Then we have to measure how successful we are at achieving our outcomes. Finally, we have to identify the remedial actions to be taken on those aspects we are lacking and to make necessary adjustments to our target outcomes or implementation procedures.

There are many ways to implement OBE. However, our philosophy in whatever implementation we do is based on the factors stated, which are it fulfils the outcomes and does not burden the students and staffs. Abiding by these philosophies is important because certain implementation done by another university may look great but, due to resources constrain or the difference in the university’s policy, it may not be possible to duplicate it. Other methods may fulfil the outcomes of the university concern but not ours. The sure way to fail the implementation of OBE is to create resistance among the people directly involved in the OBE, which are the students and staffs. Their support to make OBE a success is of utmost importance. Thus, do not create a situation where they feel that it is too much of work to them. Extra work is fine if it brings about benefits but not too much to extend it creates a burden to the students and lecturers.

3.0 The FKM UMP Experience

The experiences of implementing OBE that the FKM went through over the past three years will be shared in this section. This section discusses the matter from the planning to the implementation stage.

3.1 The Representative

Since the OBE is part of requirement for the accreditation of engineering program by EAC, it is natural that the person handling EAC is chosen as the representative of the FKM to spearhead the challenges in the implementation of OBE. The representative should be able to understanding deeply what is OBE, state the common methods utilized by other universities, plan the implementation process, explain to all parties involved in the implementation, execute the process and monitor continuously for continual improvement. Table 1 shows the representatives were sent for courses on OBE to enhance their knowledge in OBE and its implementation. After every each training, the representative would present to the FKM staffs during meeting, what had been learned. Seminars are also organized to remind and give a complete overview on OBE to all faculty members.

Table 1: Courses attended by the OBE representative

No.	Course	Date	Venue	Representative
1.	OBE & CQI – Part 1 – Organized by BEM	14-16 Feb 2005	Pan Pacific Hotel, KLIA	1. Prof. Madya Dr. Wan Mansor b. Wan Muhamad 2. Muhamad Arifpin b. Mansor
2.	OBE & CQI – Part 2 – Organized by BEM	13-14 Apr 2005	Equatorial Hotel, Bangi	1. Mohd Shahrir b. Mohd Sani 2. Mahadzir b. Ishak @ Muhammad
3.	Designing Courses for Outcomes Based Education & Effective College Teaching – Prof. Richard Felder & Rebecca Brent	13-15 Dec 2005	UTM Skudai	1. Mohd Shahrir b. Mohd Sani 2. Dr. Wan Azhar b. Wan Yusoff 3. Mohd Ruzaimi b. Mat Rejab 4. Mohd Zuki b. Salleh

No.	Course	Date	Venue	Representative
4.	KUKTEM OBE Workshop	7-8 Aug 2006	Astana Golf Club, Kuantan	1. Prof. Madya Dr. Rosli b. Abu Bakar 2. Dr. Wan Azhar b. Wan Yusoff 3. Mohd Shahrir b. Mohd Sani 4. Ahmad Razlan b. Yusoff 5. Mahadzir b. Ishak @ Muhammad 6. Mohd Zaidi b. Sidek 7. Saiful Bahri b. Ahmad Bakarim
5.	EAC Training Workshop 2007 (OBE)	28-30 Jan 2007	Seri Pacific Hotel, KL	1. Prof Madya. Dr. Rosli b. Abu Bakar 2. Mohd Shahrir b. Mohd Sani

3.2 The Planning Stage

The representative would also have to plan the implementation in the FKM. The timeline and task to be done were written down and were then discussed with all FKM's staffs. Basically, the task involved were formulating the outcomes, planning the implementation, measuring the success and continual improvement.

3.3 Formulating the Outcomes

The outcomes for the program must be stated before any implementation of the OBE. The outcomes must take into account the needs of all the stakeholders. The first draft was started based on the Programme Outcomes (PO) as stated in the ABET requirement and EAC manual [5.6]. Then, the academic staffs have a workshop to touch up on the PO and come up with Programme Educational Objectives (PEO). Once the first draft was completed, surveys were carried out among the industry, academician and parent in order to gauge whether the outcomes fulfil the needs of the stakeholders. Based on the feedbacks, the FKM would revise the PO and PEO, taking the feedbacks into account. Then the industry, the alumni, the academician and the parent were invited for a stakeholder meeting (was held from 18-19 April 2007) with FKM management on the PO and PEO. This discussion gave opportunity to the FKM to explain clearly the motivation for proposing the outcomes as well as getting feedbacks from the stakeholders. As a conclusion from the meeting, the stakeholder agreed with PEO, PO and academic curriculum of our programmes. The list of our outcomes can be seen from Table 2.

It is extremely important to make known to all the stakeholders especially the FKM students, the PEO and PO of the faculty. Various ways and techniques were used to disseminate the PEO and PO to everyone. They were posted in FKM website for any outsider who wanted to get information about FKM UMP. Posters were prominently displayed at the FKM office and Laboratory to show our outcomes to all our students, staffs and visitors. Brochures on FKM programmes also stated the outcomes. In order to clear any doubts on the outcomes as well as to give a clear picture to all the students, a seminar to explain the outcomes had been conducted and made obligatory to all the students to attend. Any queries by the students would be answered immediately.

Table 2: The FKM UMP outcomes

FKM UMP Graduates	1. Global Engineers
	2. High Level of Knowledge
	3. Integrity
	4. Competency and Learning Capability

Programme Educational Objectives (PEO)	1. Become competent mechanical engineers that view engineering as a profession with extensive global interactions
	2. Able to apply engineering principles with an ability to adapt the changes in latest tools in the design, analysis and synthesis of engineering system
	3. Aware and practice professionalism and responsible in conducting their careers
	4. Competence in communication skill, able to work in team, demonstrate high moral values with the ability to continue and expand learning necessary
Programme Outcomes (PO)	a) an ability to apply knowledge of mathematics, science, and engineering
	b) an ability to design and conduct experiments, as well as to analyze and interpret data
	c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
	d) an ability to function on multi-disciplinary teams
	e) an ability to identify, formulate, and solve engineering problems
	f) an understanding of professional and ethical responsibility
	g) an ability to communicate effectively
	h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
	i) a recognition of the need for, and an ability to engage in life-long learning
	j) a knowledge of contemporary issues
	k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

4.0 Implementing the Outcomes

Basically, the outcomes spell out the types of graduates that we are going to produce. To achieve the outcomes, suitable teaching and learning techniques have to be used. Since each and every lecturer has his/her own style, the faculty laid down only the fundamental philosophies of teaching and learning.

There are three main things that must be done for a complete learning process which are teach, practice and evaluate. In order for a student to learn anything, the student should first be taught on it. This will give the student a general idea of what it is but it does not mean that he/she can apply it. Thus, opportunities must be given to the student to practice it or 'practice makes perfect'. For a more complete learning experience, there should be a relevant assessment method that not only encourages the student to learn, it will also point out the weaknesses of the student in the subject matter. Based on the weaknesses found from the assessment, the student can work to rectify the weaknesses and to be better at what has been learned.

We also have set-up a guideline for teaching philosophy. Any students can be taught almost anything [7]. However, a few things must be kept in mind. First, whatever that is to be taught must be well thought of and planned properly. The faculty made up Teaching Plan based on OBE concept; there were emphasized more on element of course outcome (CO) and lesson outcome (LO) to guide the lecturer to deliver the input and assessing the outcome from students. Next, a lecturer must explain clearly to the students the task involved, as well as its outcomes to the student, in each and every of lecture topic. Then, the lecturer must closely monitor the progress of the students. He/She should get constant feedback from the students on whatever problems they faced and guide them to achieve the outcome for that particular outcome.

5.0 Techniques in Implementation

In this section, we shall discuss how the POs are achieved by the different methods of delivery in the FKM programs. Common methods of delivery such as Lectures, Tutorial and Laboratory Experiments are discussed.

5.1 Lectures

Each subject's content and syllabus are mainly delivered through a series of lectures attend by the students over an academic year. Normally the lectures are delivered by a lecturer for up to sixty students per session. The lectures are held in lecture halls equipped with audio-video facilities. This is where the students first learn the about the subject and learn to hone their soft skills attributes such as effective learning. We implemented student-centred learning (SCL) during the lectures where we give some short problems to ask the students to discuss and come out with a solution. This enhances their ability to communicate and interact with one another. Furthermore, the students are asked to give anonymous feedback on outcomes that should have been achieved during that lecture. Based on the feedback the lecturers can take corrective actions during the following lectures.

5.2 Tutorials

Each subject's content and syllabus are further emphasized onto the students by tutorials. This is where a smaller group of students numbering up to thirty students able to interact directly with lecturers, tutors and each other. The tutorials are normally held in lecture rooms. The seats and tables are moveable therefore allowing groups to be formed. Besides learning about a specific academic subject, students are able to practice their soft skills such as group interactions, team working and oral communication.

5.3 Laboratory Experiments

Laboratory experiment is part and parcel of any engineering course. The students would be able to understand the engineering principles better after conducting experiments. The laboratory experiments are planned in such a manner that the students are closely guided in their first year to a situation where they achieve complete independence in final year, especially during Final Year Project (PSM). Since the UMP is different from other universities as our equipments are more advanced and the first year student are completely unfamiliar with them, then the lecturers and with help form vocational training officer (JP) will demonstrate to the students, step by step, on how and every experiment is to be done. The importance of safety and ethics during laboratory experiments are stressed in the first year. In the second year, the students would have to start reading the laboratory sheet on their own and then discuss with the lecturers on what needs to be done. The lecturer no longer spoon feed the students. Any student who has yet to realize the importance of ethics and safety will be reprimanded. In the third year, the students start to learn how to design experiments on their own. The laboratory sheet just contains brief guidelines on the experiments. The students must be aware of the other important steps for better data requisition as well as safety while conducting the experiment. They also have to produce a report like a technical report format. The final year students take PSM for 2 semesters. They will have to design their own experiments based on the problem statement given by the lecturer. Furthermore, they have to learn how to use the necessary equipment on their own and fixed the suitable time of experiment. Once they have finished writing their reports, there will be a seminar session where the lecturer questioned the student on how much they understand the experiment. Thus, the PSM provides opportunities for the students to acquire almost all of the 11 POs.

6.0 Issues and Challenges

Implementing the OBE is not an easy matter. Initial difficulties can be faced due to the weakness on the part of people, process or paperwork. In order to achieve the outcomes as stated, all the parties involved

must work together. The students must strive towards the outcomes with the guidance from the lecturer and also help from industries. Furthermore, the burden of implementing OBE would be reduced if the appropriate facilities are there to support this endeavour.

The faculty members were initially reluctant to implement OBE as they were not well informed of it. Their general perception is that OBE equates to more meaningless paperwork. This negative perception can be countered by having a seminar to explain the main ideas about OBE to all the academic staff. Furthermore, the OBE is being implemented in stages and any changes in their teaching style are to be done gradually. This can be seen via the modified way of delivering lectures, tutorials and lab experiments as discussed earlier. As time goes on, some lecturers like OBE a lot since it makes their lecturing so much easier. They only need to look at the CO, LO and teach according to it. The assessments (tests, final examination and projects) are based on course outcomes.

The students originally complained that OBE is very demanding on to them as they do not just have to acquire technical skills (cognitive and psychomotor domains) from engineering courses, but they also have to improved soft skills elements (affective domain) before they graduate. Thus, a seminar was conducted and knew what to expect from it. There was a general agreement between the students and the lecturers to work together to make OBE a success.

7.0 Conclusion

The FKM UMP has change tremendously with OBE's system and has moved a long way since being involved in the Outcome Based Education (OBE) system. However, the journey has just begun as OBE is a system of continual quality improvement (CQI) to meet the ever changing needs of the stakeholder and EAC requirements.

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9.0 References

- [1] Adam Blust (1995), The Debate Over Outcome Based Education, News & Views.
- [2] Malan, SPT (2000), "The 'new paradigm' of outcome-based education in perspective", *Tydskrif vir Gesinsekologie en Verbruikerswetenskappe*, 28, 22-28.
- [3] Acharya, C. (2003), "Outcome-based Education (OBE): A New Paradigm for Learning", Centre for Development of Teaching and Learning (Singapore), Vol. 7, No. 3
- [4] McNeir, G. (1993), "Outcome-Based Education", ERIC Digest 85, University of Oregon
- [5] Engineering Programme Accreditation Manual (2007), Engineering Accreditation Council (EAC).
- [6] Felder, R.M. and Brent, R. (2003), "Designing and Teaching Courses to Satisfy the ABET Engineering Criteria", *Journal of Engineering Education*, 92 (1), pp. 7 – 25.
- [7] Felder, R.M. and Brent, R. (2006), "How to Teach (Almost) Anybody (Almost) Anything", *Chem. Engr. Education*, 40(3), pp.173 - 174.
- [8] EAC Submission Report for BMM program to BEM (2007), Faculty of Mechanical Engineering, Universiti Malaysia Pahang.