

Implementation of Outcome Based Education in UNITEN-Closing the Loop (PEO)

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ABSTRACT: The shift toward outcome-based education (OBE) calls for a complete change in the way students are taught, graded and graduated. Universiti Tenaga Nasional (UNITEN) has been implementing OBE since 2006. It has been 4 years since the implementation of OBE and closing of the loop can be done since we have finished one cohort. To close the loop, three levels need to be completed, i.e. at the Course level, Programme level and Programme Educational Objective (PEO) level. These three levels are continuous and there are three stakeholders to be considered, namely from the alumni, Industrial Advisory Panel (IAP) and employer. The attainment for closing the loop is to obtain a minimum level of 3 from the performance criteria chart. From the survey conducted, all of the stakeholders obtained the minimum level of 3. Thus, the attainment was achieved. UNITEN needs to maintain the result of PEO level 3 and above while improving the graduates from time to time by implementing CQI (Continuous Quality Improvement).

Keywords: Outcome Based Education, Programme Education Objectives, Programme Outcomes, Course Outcomes, CQI

INTRODUCTION

1.1 Outcome-based Education at Universiti Tenaga Nasional (UNITEN)

In 2006, CE Department under College of Engineering (COE) started OBE initiative for its Bachelor of Civil Engineering (Honours) programme. OBE task force was formed and had formulated the PEO and PO which are to be used in all Bachelor Programmes under COE including Bachelor of Civil Engineering (Hons.)

OBE briefing, talks and awareness programme were conducted for the academic staff and students. OBE system was first implemented in Semester 2 of 2006/07. Course outcomes (CO) were developed for all BCE core courses and are fully implemented in Semester I 2008/2009.

Surveys were conducted to gauge the level of understanding of the lecturers and students with regards to the implementation of OBE in their courses and the achievements of Course Outcomes (CO).

At present, the survey is conducted periodically for all courses. The future plan is to prepare an online survey form which will solve the problems of paper handling and also to expedite the processing of data. The CE-OBE task force has promoted OBE to the students via talks, posters and also producing pocket books for the students. Apart from that every lecturers are required to give a 15 minutes talk in their class on OBE and its impact on the curriculum during the first week of every new semester.

LITERATURE REVIEW

In Malaysia, engineering graduates are evaluated to become not only technically competent but also need to be socially well interacted with others, creative and innovative, uphold professional attitudes and ethics and meet industrial expectations. Malaysian accreditations bodies have developed Malaysian Engineering Education Model to produce a well balance engineers.

2.1 Malaysian Engineering Education Model

Total adoption of global engineering philosophies and models studied due to the development of the Malaysian model has been proven unsuitable for the progress and sustainability of the nation even though it have shown their dynamic and farsighted approaches.

Many locally trained engineering graduates had strong technical knowledge but lacks in non-technical or transferable skills. This had been a very deep perception for many practitioners out in the real world. Non-technical skills are very important for top management or leadership positions. This skills are being introduced in the engineering education worldwide. Engineers also played a big role in developing economic growth of a country.

A greater focus in the knowledge of engineering science was needed for the engineers to adapt in the fast changing world of engineering. Before students become engineers, they need to be prepared with the knowledge to communicate effectively, manage or lead an organization and having critical analysis

skills.(Goonatilake, P.C.L ,1982)(Johari, M , 1999)Engineers must be prepared for rapidly expanding knowledge, globalization and the changing emphasis in scientific fields in the future. (O’Kane, M. ,1999)

The Malaysia Engineering Education Model identifies five criteria which are:

1. **Scientific strength**, which provides engineers who are innovative, able to work in research and development activities, and adaptable in different engineering fields.
2. **Professional competencies**, which provide engineers who are able to identify, formulate, and solve engineering problems, responsible professionally, and able to use techniques, skills, and modern engineering tools for engineering practice.
3. **Multi-skilled**, which provides engineer who is able to work in different engineering fields and function in multidisciplinary work/teams
4. **Well-respected and potential industry leader**, which provide engineers who are able to understand the impact of engineering solutions in a global/social context, knowledgeable of contemporary issues, able to communicate effectively and be involved in community or social projects.
5. **Morally and ethically sound** which provide engineers who understand ethical and moral responsibility.

In preparing engineering students to satisfy the five criteria mentioned above, there are six highly necessary skills and competencies. It was shown in the table 1 below. Table 1 also provides subjects associated with the six components.

Table 1 *Recommended Skill and Competencies in MEEM* (Malaysian Council of Engineering Deans/Institution of Engineers Malaysia, 2000)

Skills & Competencies	Characteristics	Typical Subjects (Civil)
Global & Strategic	These skills enable students to adapt easily within the borderless world that is experiencing rapid expanding knowledge.	Technical Communications, Malaysian Studies, Engineers in Society
Industrial	Skills that go beyond the scientific and professional and which are necessary in the advanced phase of the graduate's career.	Environment, Engineers in Society,
Humanistic	These skills help create a balanced engineer with high ethical and moral standards.	Islamic Studies, Moral Education
Practical	These enable students to be directly involved with hands-on activities or real-life situations, thus providing the basis for integrating the intra and inter engineering and non-engineering knowledge	Final Year Project, Industrial Project, Practical Training, Integrated Civil Engineering Design Project
Professional	Such skills cover technical competency aspects required to perform specific engineering tasks.	Professional Subjects in Civil Engineering e.g. Foundation Engineering, Water & Wastewater Engineering, Highway and Transportation Engineering, Reinforced Concrete Structures, Surveying
Scientific	They enable students to have a firm foundation in engineering science, thus enabling them to realign themselves with the changes in emphasis in the scientific field and to develop an interest in R&D and design.	Engineering Sciences e.g. Engineering Mathematics, Engineering Materials, Fluid Mechanics, Engineering Statistics, Engineering Mechanics, Programming

subject matter, especially when dealing with the scientific component. Without neglecting the average students to cater the loading from the engineering studies, it is also recommended to conduct the study within 4 years programme.

2.2 Paradigm shift in the curriculum development

Nowadays, there is another crossroads to be go through by Malaysian engineering institutions. They need to implement “outcome-based” learning in their curriculum development as encouraged by the cultural change in many institutions globally. However, the engineering field has its own champion i.e. the Engineering Accreditation Council (EAC) under the purview of the Board of Engineers, Malaysia. EAC is steering its way towards outcome-based education (OBE).

There is 11 generic attributes introduced by EAC for engineering graduates in 1999 towards OBE. However these attributes still was not clear and helpful in demonstrating the effectiveness of the learning process as desired by the OBE approach. During the accreditation only these attributes were discussed. Its rationale were not fully understood and practiced by the engineering education providers. Many problems were related such as staff-student ratio, number of graduation credits and duration of programmes. The only objective of curriculum is satisfying the minimum credits of completion.

Thus, EAC has to demonstrate that engineering schools in Malaysia are embracing OBE by revising its manual to clearly explain the OBE approach. As explained by Willis & Kissane (1997), an education program is outcome-based if it describes student outcomes “quite explicitly in terms of the actual learning students should exhibit as a result of planned learning experiences in school and developing accountability mechanisms which directly reflect student performance on those outcomes”.

Also by Enslin and Pendlebury (1998), remind us that an outcomes-based education is officially regarded as a key to improving quality at all levels of education and training: it “has been heralded in various national and provincial policy documents as the key to curriculum transformation”. This need to be understand first by the stakeholders in OBE. By then, the paradigm shift is not a problem.

2.3 CO Attainment Analysis

At the course level, the main method employed to analyze achievement of Course Outcomes (CO) is through the CO attainment analysis method which is a measurement tool to evaluate CO attainment dir-

It is recommended that this model were incorporated with tutorials to ensure greater understanding of the

ectly from students' final examination and continuous assessment marks.

The CO Attainment System was implemented for the first time in Semester 2, 2008/2009 for the BCE programme. It is done by compiling final exam and continuous assessment marks for all student in all sections at the end of each semester.

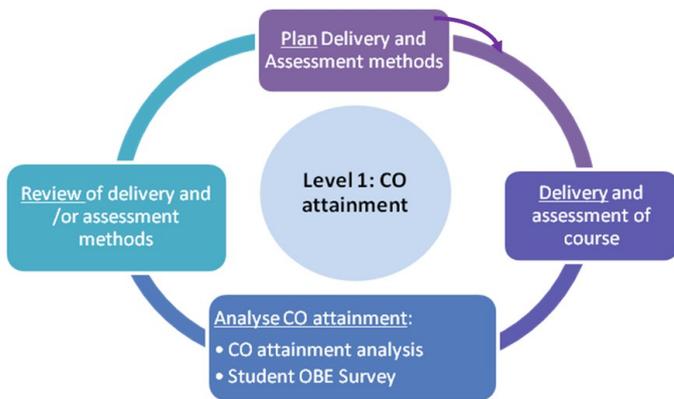


Figure 1 Course level CQI loop to evaluate Course Outcomes (CO) Attainment.

After individual CO attainment and PO attainment for associated POs addressed by the course is obtained, the CO attainment analysis is done by using the computerized CO attainment system (based on MS Excel) which was developed by the Department of Civil Engineering of COE.

This analysis will determine whether there is a need for improvement of the CO attainment process for the next semester. CO attainment analysis report inclusive of action plans for the next semester will be sent to Head of Department (HOD) for verification and placed in Course File.

2.4 PO Attainment Analysis

The programme level PO attainment process includes the inner course level attainment loop mentioned above. The newly implemented *CO Attainment System* will automatically calculate the PO attainment for associated POs addressed by the course at the end of each semester. This course level PO attainment is calculated based on a set criteria target. If the target is met, then the PO is achieved and is indicated by a 'Yes'. Information on PO attainment (i.e. 'Yes' or 'No') from all core courses will then be tabulated for the BCE programme and the achievement of PO at the programme level for that particular semester is calculated based on the formula:

$$\text{Attainment of PO (\%)\ at programme level} = \frac{\text{No. of YES (i.e. PO is attained by the subject)}}{\text{No. of subjects addressing this PO}}$$

If the percentage of PO attainment at programme level is 75% or more, the PO is considered achieved.

Results from the BCE programme PO attainment will then be discussed during the annual Programme Review to devise action plans for improvement which will be implemented in the next semester.

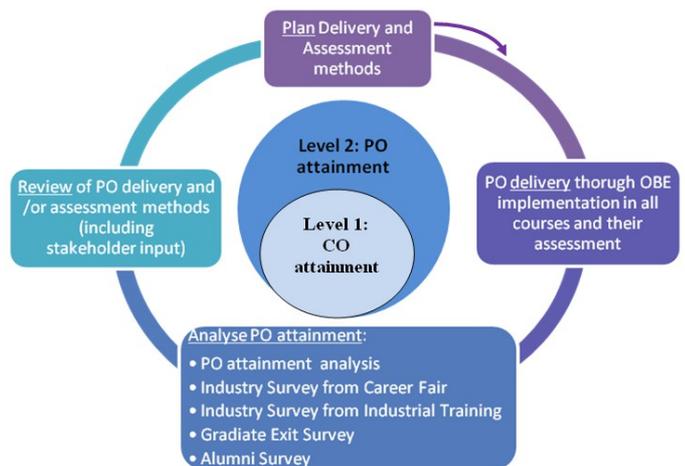


Figure 2 Programme level CQI loop to evaluate Programme Outcome (PO) Attainment.

2.5 Improved PEO attainment process

The improved programme level PEO attainment process now includes the improved inner programme level PO attainment loop, inner course level CO attainment loop and stakeholder feedback from Industry, Alumni and Staff. Its process flow is same like PO attainment analysis.

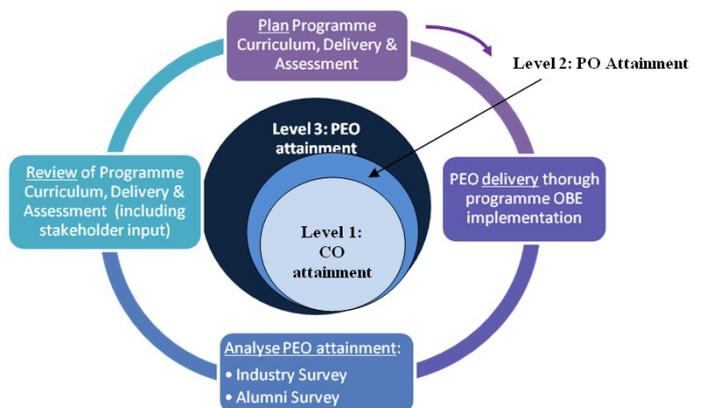


Figure 3 Programme level CQI loop to evaluate Programme Educational Objectives (PEO) Attainment.

3 METHODOLOGY

1.2 Background

Continuous Quality Improvement (CQI) loop consists of three level which is course level, programme level and PEO level. These three levels are arranged accordingly.

At first, course level need to be completed. At this level, the analysis was done by teaching, learning and assessment by the lecturers to their students. The

students were required to do the OBE survey. From this OBE survey, the cognitive and bloom analysis will be done to provide the distribution of weighting of course outcome for every subject that has been taught from the department whether it meet the course objective for the particular subject or not. After finishing the CQI loop for the course level, then only can the CQI loop for programme level can be initiated. In this level, surveys were done to the alumni, employer and the Industrial Advisory Panel (IAP) to obtain their feedback.

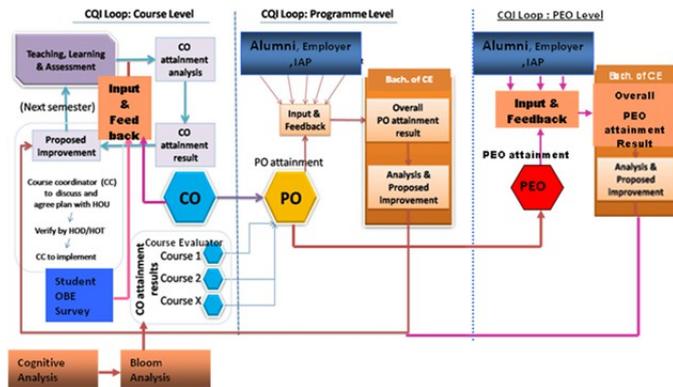


Figure 4: Overview of the CQI Loops at Course, Programme and Programme Educational Objectives Level

Lastly is the PEO analysis, there will be 3 input and feedback which is same like in the programme level, to be analyzed for closing the loop. The only differences are this level was done after 5 years the students had graduated from UNITEN.

1.3 Input from Alumni UNITEN

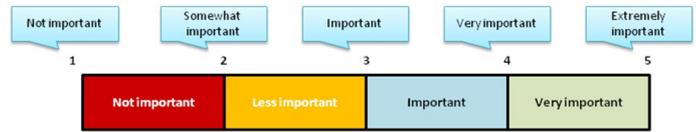
Alumni survey has been carried out by Civil Engineering Department to analyze Programme Outcome and Programme Educational Objectives of the Civil Engineering graduates after 5 years of graduations. Alumni surveys were filled by Alumni which as one of the stakeholders and graduated more than 5 years. The purposes of the survey are to update their current working status and to rate their selves' qualities in order to evaluate POs and PEOs of Civil Engineering course.

The Alumni inputs are needed in terms of the PO 1 - PO 10 and PEO 1 - PEO 4. Each data is collected and analyzed in 3 parts.

- i. Part A: Employability
- ii. Part B: PO attainment result

iii. Part C: PEO attainment result

The results are based on the performance criteria shown in figure 5 below.



1.4 Input from employer

Employer survey has been carried out by Civil Engineering Department to analyze the Programme Educational Objectives of the Civil Engineering graduates after 5 years of graduations. The employer as one of the stakeholders has filled in the Employer Survey form to rate the importance of the PEO of Civil Engineers graduates who worked with them.

The employer input is needed in terms of the PEO 1, PEO 2, PEO 3 and PEO 4. A rating from 0 until 5 is used to rate the students. 0 = not relevant, 1 = not important, 2 = somewhat important, 3 = important, 4 = very important, 5 = extremely important. An analysis of bar graph for each PEO is made and conclusion can be made about Civil Engineering PEO.

1.5 Input from Industrial Advisory Panel (IAP)

Industrial Advisory Panel (IAP) survey has been carried out by Civil Engineering Department to analyze relevancy of Programme Outcome and Programme Educational Objectives of Civil Engineering. Industrial Advisory Panel as one of the stakeholders have filled the IAP Survey form to rate the relevancy of the PEO and PO of Civil Engineering. IAP indicated how important the statements that describe the features which should be achieved by our graduates after few years of graduation and upon graduation.

The survey will be done by separate it to two-part survey – PEO & PO importance/relevancy. Opportunity for “open suggestion” and general feedback is also given. Sample of survey are shown in Appendix 1a and 1b. The data is collated and analyzed.

RESULT AND DISCUSSION

1.6 Analysis of surveys from Alumni UNITEN

First part of the survey is regarding personal information including the details of their employment. From the survey, we can see that 86% of the Alumni found their first employment less than 3 months after graduation and 14% in between 3 to 6 months

(Figure 3). 86% of Alumni worked with less than 3 companies before the present company and 14% served more than 3 companies before the current company (Figure 4). 100% of the Alumni have been working in the current company for 2-5 years (Figure 5).

Another survey was conducted by Student Affairs Centre during convocation day, 19th -22nd August 2008 and 11th – 14th August 2009. From the survey done by Student Affairs Centre in 2008, we can see that the employability of Civil Engineering Department is 85%. Total respondents were 97%. In 2009, total respondents were 75% and employability rate was 85%. Refer to reference section. According to Table 8 of the presentation (Appendix 5), Employment Status of First Degree Graduates of 2008 for Civil Engineering in Malaysia is 69.9%.

By referring to survey done by Student Affairs Centre during convocation on 19th -22nd August 2008, it shows that employability for Civil Engineering Department in UNITEN considered having a higher employability rate which is 85% compared to employability rate for Civil Engineering First Degree Graduates in Malaysia for 2008 which is 69.9%.

1.7 Analysis of surveys from employer

There are 20 correspondents to this employer survey. The details of the employer's background that hired UNITEN alumni are as follows: 5% education sector, 10% non-engineering sector, 20% government bodies, 65% from engineering related sector.

From that, Figure 6 will summarize the result of the employer survey. It can be conclude that the 25% employer decide the PEO 1 until PEO 4 as very important and 75% of employer decide the PEO 1 until PEO 4 as extremely important.

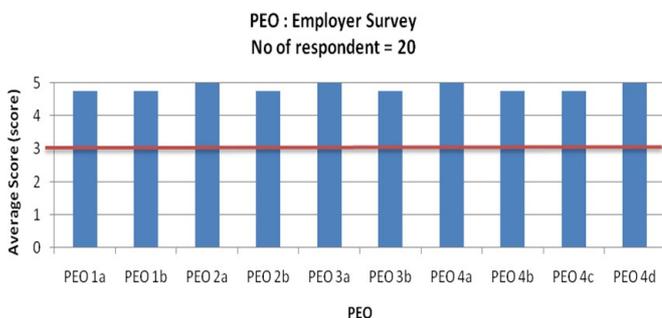


Figure 6 Employer survey

Table 2 : PEO Score (Ranking)

No	Score	PO	
1	4.35	1a	Able to acquire knowledge
2	4.3	1b	Able to apply and solve problems
3	4.25	1c	Able to use statistical methods
4	4.25	2a	Posses in depth technical knowledge
5	4.2	2b	Able to apply and acquire technical knowledge
6	4.2	3a	Ability to identify and appreciate eng problems
7	4.75	3b	Able to formulate plans
8	4.75	3c	Able to obtain appropriate solutions
9	5	4a	Ability to undertake design project
10	4.2	4b	Ability evaluate performance
11	4.25	4c	Ability to carry out capstone design
12	4.25	5a	Ability to recognize and explain the importance of practicing ethical behaviour
13	4.2	5b	Ability to recognize and explain the importance of abiding code of practice
14	4.3	6a	Able to conduct good oral presentation
15	4.25	6b	Able to produce report
16	4.3	6c	Able to produce drawings
17	4.15	7a	Able to function well in team
18	4.15	7b	Has capability to lead a tem
19	4.35	8a	Ability to explain impact of eng to society
20	4.35	8b	Ability to explain environmental responsibilities
21	4.0	9a	Ability to acquire related media to update current issues
22	4.0	9b	Able to seek information
23	4.05	9c	Able to self learn
24	4.0	10a	Able to use engineering tools for design
25	4.15	10b	Posses in depth knowledge and skills
26	4.2	10c	Ability to use ICT effectively
27	4.25	10d	Able to interpret data
28	4.25	10e	Able to manage project
29	4.2	10f	Able to practice OSHA

Based on the result, the score is above 3.00 which is achieved the target. None of the result shows Not Important or Not Relevant.

1.8 Analysis of surveys from IAP

The overall scores are shown in Table 3. Figure 7 shows the results in form of chart. All PEO meet attainment criteria which is 3.0. The highest score are PEO 1 followed by PEO 4, PEO 2 and PEO 3. Rating of relevancy in terms of percentage for every PEO is shown in Figure 7.

Table 3: Summary of PEO feedback score and average result

Respondent	PEO (Relevancy)											
	PEO1A	PEO1B	PEO2A	PEO2B	PEO3A	PEO3B	PEO4A	PEO4B	PEO4C	PEO4D		
1	5	4	3	4	3	3	4	3	3	4		
2	4	4	4	4	3	3	4	4	4	4		
3	4	4	3	3	4	3	5	4	4	3		
4	5	5	4	5	3	4	3	3	3	4		
5	4	4	4	3	5	5	5	4	5	5		
6	4	5	5	4	4	5	5	5	4	4		
Average Score	4		4		4		4					
Attainment Criteria	3		3		3		3					
Target Met	YES		YES		YES		YES					
Action Plan	To maintain or improve the performance in the future semester											

The PO is mapped to the PEO as shown in Table 4. The PO is shown to be closely related to the PEO. Hence achievement of the PO in Civil Engineering should also ensure that the PEO are achieved. Table located marks based upon 3 different levels of adoption which are Substantively, Moderately and Slightly.

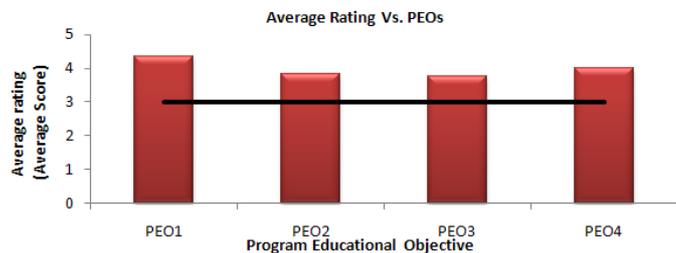


Figure 7 Average Score on the Relevancy of PEO 1 – PEO 4.

Table 4 Matrix of PEO vs. PO (Table 3.4 page 3-6 of EAC Assessment Report)

PEO No.	PEO	PO									
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PEO1	UNITEN produces engineering graduates who: Have strong fundamental engineering knowledge and technically competent in their respective fields.	3	3	3	3				1	1	3
PEO2	Uphold professional attitudes and ethics necessary in fulfilling their responsibilities towards the Almighty, clients and the society.					3		2	3		1
PEO3	Are innovative and creative in conceiving, designing and executing broad range of engineering tasks locally and globally.	2	2	3	3		2	2	3		1
PEO4	Meet industry expectations with excellent communication and leadership skills and committed to life-long learning.	1	1	1	1	1	3	3		3	3

3 Substantively
2 Moderately
1 Slightly

Based on the relation in Table 4, we analyse average score by IAP for POs shown in Figure 8. As we know that achievement of the POs should also ensure the achievement of PEOs, average score of

POs that is substantively related to each PEO are calculated. It shows that all PEOs meet the Attainment Criteria 3.

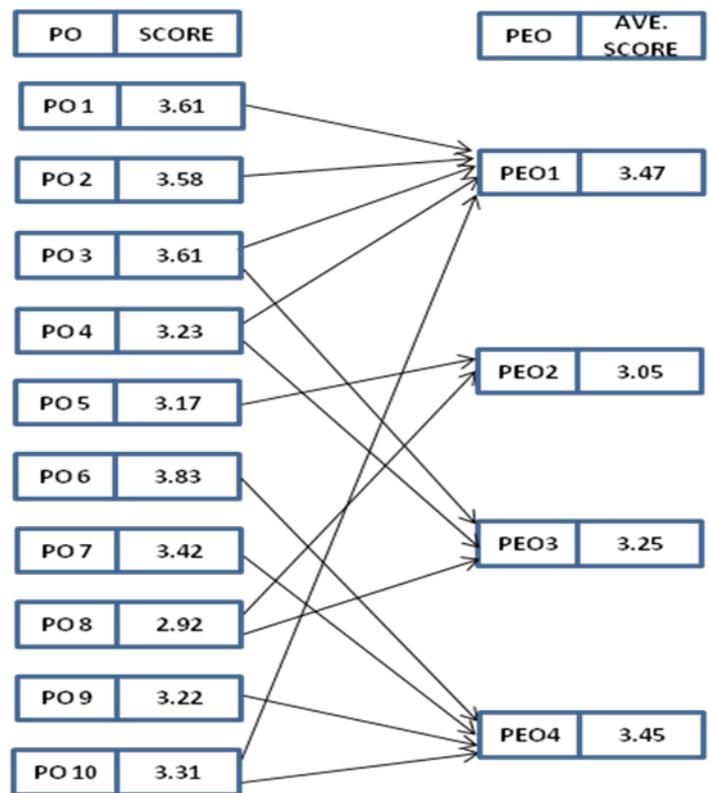


Figure 8 Average Score on the Relevancy of POs.

CONCLUSION

Overall PEO attainment was shown in the table below. It shows that all surveys meet the attainment criteria 3.

Type of survey	Attainment criteria	Achieved or Not Achieved	CQI
Employer Survey	Must be level of 3.00 which is important	Yes	Need to maintain the result of PEO level 3 and above and improved the graduates from time to time.
Alumni Survey		Yes	
IAP Survey		Yes	

Table 5 Concluding the PEO

From the survey and analysis, we know that our graduates have the knowledge, skills, behaviors and abilities, which should be acquired by graduates on the day of graduation (PO). By having all these qualities upon graduation, it leads to the achievements of features which should be achieved by graduates after few years of graduation (PEO).

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