ASSESSMENT OF THE MECHANICAL ENGINEERING PROGRAMS BY EXIT SURVEYS AT UNIVERSITY MALAYSIA PAHANG

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ABSTRACT
This paper focused on the assessment and continuous program improvement of mechanical engineering programs at Universiti Malaysia Pahang. Continuous program improvement is an important factor in ensuring the high quality of the graduates of the engineering programs. Rapid changes in the job market demands have made it vital for the engineering educators to adopt a strategy of continuous quality improvement (CQI) of their academic programs. The faculty of Mechanical Engineering, Universiti Malaysia Pahang is using exit surveys as a tool to explore the assessment of the graduating students of the engineering education. The survey covers the program outcomes (PO's) elements which have been developed for mechanical engineering program. The objective of this paper to present the outcomes of this assessment processes and discusses how it can be help to improve the mechanical engineering program. The survey was conducted during last academic semester (first semester of the year 2007/2008).

INTRODUCTION
The Engineering Accreditation Council (EAC) of Malaysia has directed that Outcome-Based Education (OBE) learning approach is to be adopted in engineering academic programs in Malaysia. OBE is a method of curriculum design and teaching that focuses on what students can actually do after they are taught [1]. The underlying belief that drives OBE is the conviction that all students can learn, regardless of ability, race, ethnicity, socioeconomic status, and gender [2]. OBE also urges schools to generate "exit outcomes" based on the challenges and opportunities that students will face after graduation, and then to "design down" from the outcomes for all other aspects of educational delivery [3]. Transformation and developing engineering programs has been taken is a major concern that has been dealt by many universities. There have been rapid changes in the technologies and consequently the needs and expectations of the industrial sectors of graduates from engineering university. Assessment of the engineering programs by the various parties is an essential activity in the process of continuous program development [4,5]. The assessment of the programs by senior students immediately prior to their graduation, by means of senior exit surveys, is one of the key tools for the development process [6]. Basically the exit survey questions are based on the mechanical engineering eleven program outcomes. The survey is particularly useful for valuing the graduating students input on the quality education, determining that the areas that need improvement in mechanical engineering programs. This paper present the results of a final year student exit survey conducted for mechanical engineering programs towards the end of first semester of the year 2007/2008, before the students do the industrial training at the final semester.

METHODOLOGY
The methodology used for determining the students' assessment of the engineering programs was to request final year students fill-up the survey. A sample of exit survey questions is shown in Appendix 1. For this survey, a total of 111 students were received from graduating students in academic year 2004-2008. The questions were evaluating based on the three categories as follows:

a) Quantity - The amount of time in this program spent on activities to support these program outcomes has been measured.
b) Quality - The quality of the activities in this program to support these program outcomes has been measured.
c) Improvement - As a result of this program, students have improved their skills to support these program outcomes.

All the data gathered from the survey is analyzed using Statistical Package for Social Science (SPSS) for Windows statistical software.

RESULTS AND DISCUSSION

For the purpose of analysis, the respond from the final year students was analyzed based on five criteria:

a) Responds on the Amount of Time Spent on Activities to Support PO's
b) Responds on the Quality of the Activities to Support PO's
c) Responds on the Improvement of Skills to Support PO's
d) Correlation between Quantity Spent on Activities and Skills Improvement to Support PO's
e) Correlation between Quality of Activities and Skills Improvement to Support PO's

Responds on the Amount of Time Spent on Activities to Support PO's

The results based on responds on the mount of time spent on activities to support Program Outcomes (PO's) are summarized in Table 1. The results indicate that the highest portion belongs to scale number 3 for all PO's which means that most of the respondents feel that the amount of time spent on activities to support the PO has been just right. This is parallel with requirement not to overload the students with activities such as exercise, assignments, projects, experiments, quizzes, and tests. However, some subjects need more activities compared to the other subjects to ensure knowledge and skill improvement as well as to maintain good performance. Perhaps because of this quite a large portion of respondents was tended to choose scale 4 which is the second highest portion after scale 3.

Table 1 Responds on the Amount of Time Spent on Activities to Support PO's

No.	Program Outcome	Percentage distribution (%)				
		The amount of time in this program spent on activities to support the PO has been measured				
		1	2	3	4	5
		way too little	too little	just right	too much	way too much
1	an ability to apply knowledge of mathematics, science, and engineering		3.6	66.7	20.7	9.0
2	an ability to design and conduct experiments, as well as to analyze and interpret data		9.0	58.6	27.0	5.4
3	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		18.0	58.6	16.2	7.2
4	an ability to function on multi-disciplinary teams		3.6	49.5	37.8	9.0
5	an ability to identify, formulate, and solve engineering problems		4.5	57.7	29.7	8.1
6	an understanding of professional and ethical responsibility		4.5	50.5	32.4	12.6
7	an ability to communicate effectively		6.3	46.8	35.1	11.7
8	the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	1.8	12.6	54.1	31.5	

9	a recognition of the need for, and an ability to engage in life-long learning	0.9	9.9	53.2	27.9	8.1
10	a knowledge of contemporary issues		19.8	45.0	32.4	2.7
11	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	0.9	11.7	48.6	29.7	9.0
	Overall Percentage (%)	0.3	9.4	53.6	29.2	7.5

Responds on the Quality of the Activities to Support PO's

Based on the results obtained from Table 2, the highest portion of the responds (60%) on the quality of the activities to support PO's is scale 4 (very satisfactory). This is indicate that majority of the activities shows the quality in order to support PO's. Beside of that this result shows the course outcomes in mechanical subject covered with quality towards PO's assessment.

Table 2 Responds on the Quality of the Activities to Support PO's

No.	Program Outcome	Percentage distribution (%)				
		The quality of the activities in this program to support the PO has been measured				
		1	2	3	4	5
		very poor	poor	fair	vary satisfactory	exceptional
1	an ability to apply knowledge of mathematics, science, and engineering			36.9	54.1	9.0
2	an ability to design and conduct experiments, as well as to analyze and interpret data		2.7	36.9	52.3	8.1
3	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		7.2	45.9	41.4	5.4
4	an ability to function on multi-disciplinary teams		2.7	27.0	55.9	14.4
5	an ability to identify, formulate, and solve engineering problems		2.7	34.2	50.5	12.6
6	an understanding of professional and ethical responsibility		1.8	36.9	44.1	17.1
7	an ability to communicate effectively		3.6	31.5	49.5	15.3
8	the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context	1.8	7.2	43.2	42.3	5.4
9	a recognition of the need for, and an ability to engage in life-long learning		2.7	42.3	48.6	6.3

10	a knowledge of contemporary issues	0.9	15.3	36.9	40.5	6.3
11	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	1.8	5.4	31.5	49.5	11.7
	Overall Percentage (%)	0.4	4.7	36.7	48	10.2

Responds on the Improvement of Skills to Support PO's

Even though respondents feel that the quantity of activities given is just a fair number of activities, they don't deny that they have improved their skills to support the PO's. This is proved by results obtained as shown in Table 3. Note that more than 77% of the respondents agree and strongly agree that the program has improved their skills to support the PO's for all eleven PO's. In addition, only a very small percentage of respondents disagree.

Table 3 Responds on the Improvement of Skills to Support PO's

No.	Program Outcome	Percentage distribution (%)				
		As a result of this program, students have improved their skills to support the PO				
		1	2	3	4	5
		strongly disagree	disagree	neither agree nor disagree	agree	strongly agree
1	an ability to apply knowledge of mathematics, science, and engineering		0.9	9.0	71.2	18.9
2	an ability to design and conduct experiments, as well as to analyze and interpret data			16.2	64.0	19.8
3	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		0.9	34.2	48.6	16.2
4	an ability to function on multi-disciplinary teams		4.5	14.4	61.3	19.8
5	an ability to identify, formulate, and solve engineering problems		0.9	20.7	64.0	14.4
6	an understanding of professional and ethical responsibility		3.6	14.4	60.4	21.6
7	an ability to communicate effectively		1.8	10.8	67.6	19.8
8	the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context		6.3	30.6	43.2	19.8
9	a recognition of the need for, and an ability to engage in life-long learning		2.7	21.6	64.9	10.8
10	a knowledge of contemporary issues	0.9	5.4	28.8	53.2	11.7

11	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice		3.6	16.2	60.4	19.8
	Overall Percentage (%)	0.1	2.8	19.7	59.9	17.5

Correlation between Quantity Spent on Activities and Skills Improvement to Support PO's

In this section, the relationship between quantity spent on activities (amount of time) and skills improvement to support the PO's is examined. Since the data is in ordinal form, Spearman's correlation coefficient analysis is used. Spearman**'**s Rank Correlation Coefficient is a technique which can be used to summarize the strength and direction **(**negative or positive) of a relationship between two variables. Formula for computing the Spearman Rank Correlation Coefficient [7];

$$r_s = 1 - \frac{6\sum d^2}{n(n^2-1)} \qquad \text{.....(1)}$$

r_s= *Spearman Rank Correlation Coefficient*
d = *difference in ranks*
n = *number of data pairs*

Table 4 shows that there exist significant correlations between the two variables for all PO's. This indicates that the amount of time spent on activities does affect the skills improvement of the students to support the PO's. However, only PO3, PO5, and PO6 show strong relationships between the two variables.

Table 4 Correlation between Quantity Spent on Activities and Skills Improvement to Support PO's

Program Outcome	Correlation coefficient	Sig.(2-tailed)
PO1	**0.391****	0.000
PO2	**0.289****	0.002
PO3	**0.535****	0.000
PO4	**0.305****	0.001
PO5	**0.554****	0.000
PO6	**0.505****	0.000
PO7	**0.411****	0.000
PO8	**0.413****	0.000
PO9	**0.426****	0.000
PO10	**0.442****	0.000
PO11	**0.418****	0.000

**. Correlation is significant at $\alpha = 0.01$

Correlation between Quality of Activities and Skills Improvement to Support PO's

Next, the analysis is continued to see the relationship between quality of activities and skills improvement to support the PO's. Again, the Spearman's correlation analysis is used. The results are summarized in Table 5. From Table 5, it can be concluded that there exist significant correlations between the two variables for each PO. It can be seen from the results that the relationships are strong for PO2 to PO11 especially for PO8, PO10, and PO11.

Comparing the values of correlation coefficient obtained in Table 5 and Table 6, it can be said that in general the quality of activities has stronger relationships than the quantity of activities with skills

improvement to support the PO's. Thus, this shows that the quality of activities is more important than the quantity of activities to support the program outcome in order to have better results of skills improvement for the students.

Table 5 Correlation between Quality of Activities and Skills Improvement to Support PO

Program Outcome	Correlation coefficient	Sig.(2-tailed)
PO1	**0.476****	0.000
PO2	**0.540****	0.000
PO3	**0.670****	0.000
PO4	**0.581****	0.000
PO5	**0.548****	0.000
PO6	**0.505****	0.000
PO7	**0.596****	0.000
PO8	**0.649****	0.000
PO9	**0.576****	0.000
PO10	**0.607****	0.000
PO11	**0.660****	0.000

**. Correlation is significant at $\alpha = 0.01$

CONCLUSIONS

As a conclusion from this assessment, it is discovered that quality of education and the level of preparation of Mechanical Engineering Faculty is appropriate and at good level. Majority of the PO's shows the strong relationship and positive trends between quantity, quality and improvement. Based on quantity, 90% student agreed at least level 3 with program outcomes exit survey. On quality side, 58% student agreed at least level 4 with program outcomes exit survey. Furthermore, on the improvement category, 77% student agreed at least level 4 with program outcomes exit survey. However, survey questionnaires need to review, details and improve in a various aspects included of facilities, laboratory equipment, faculty service and structure curriculum. As whole, survey was found to be an essential tool which can be for continuous quality improvement.

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Appendix 1

Universiti Malaysia PAHANG

Fakulti Kejuruteraan Mekanikal

Student Evaluation of Exit Survey (BMA and BMF)

Programme outcome		Quantity: The amount of time in this programme spent on activities to support this programme outcome has been							Quality: The quality of the activities in this programme to support this programme outcome has been							Improvement: As a result of this programme, I have improved my skills to support these programme outcomes.						
		1	2	3	4	5			1	2	3	4	5			1	2	3	4	5		
		way too little	too little	just right	too much	way too much	NA	No ans.	Very poor	Poor	Fair	Very satisfactory	Exceptional	NA	No ans.	Strongly disagree	Disagree	Neither agree nor disagree	agree	strongly agree	NA	No ans.
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																					