Employers perspective on graduating student performance of mechanical engineering technology academic programme

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ABSTRACT – The purpose of this paper is to analyse employer's perspective on graduating student performance of mechanical engineering technology based academic programmes. A survey was conducted and represented 85 industrial respondents. The respondents are an industrial supervisor or employer of the graduating students who are undergoing 24 weeks internship program in the respective industry. The findings show that all determined program outcomes are aligned with engineering technologist requirement by the accreditation body. 12 program outcomes were measured as main parameters that can be categorized into three main program educational objectives: competency, creative and innovative; long live learning; ethics and leadership. The findings also proved that the outcome-based education (OBE) able to provide a better guidance for graduating students.

1. INTRODUCTION

Universiti Teknikal Malaysia Melaka is also known as UTeM is a leading institution of engineering technology academic programme in Malaysia. The university offers academic programmes at Diploma, Bachelor, Masters, and PhD levels with aims at producing professionals with greater knowledge, technical competency, personal values, and dynamic characters that fulfil the demands and requirements of the stakeholders. The academic programmes are therefore designed and conducted to meet these objectives. The establishment of UTeM was based primarily on the Government's decision to meet the demand on the requirement of the professional workforce, especially in the technical areas, where not only strong academic knowledge professionals but with high technical skill as well were to be made aplenty.

The duration for the Bachelor Engineering Technology programmes offered is 4 years and the entry requirements are Sijil Tinggi Pelajaran Malaysia (STPM) or Matriculation programme or other qualifications as approved by the Senate of UTeM. The programmes provide opportunities for students to undertake engineering courses, industrial training (internship program), final year project, applied sciences, mathematics, computer sciences, and non-engineering courses such as management, communication skills, and ethics. These courses are vital as a starting point to be qualified as an Engineering Technologist in the related fields who can give optimum contributions to the nation. The strong interest is supported by the positive trend in TVET and in industry that required more human resources and skilled workers in the engineering technology field.

This paper focuses on two engineering technology programmes: Mechanical and Manufacturing engineering technology. The syllabus of this program is designed such that students are strongly exposed to the working environment of mechanical or manufacturing engineering technologies. In addition to academic excellence, the program also focuses on the student's personal and professional development skills such as communication, leadership, teamwork, critical thinking, life-long learning, ethics, and multi-cultural. These are accomplished by implementing various approaches to teaching and learning experiences such as problem-based-learning (PBL), formal and informal cooperative learning. The current curriculum consists of the following components as Table 1:

Table 1 Summary of curriculum Structure

	No. of courses	Credit Hours	Example of courses
University Compulsory courses	10	18	English language, third language, entrepreneurship, co-curriculum, etc.
Faculty Core courses	6	14	Occupational safety and Health, Engineering Ethics, Engineering Mathematic, etc.
Programme Core courses	29	98	Automotive, HVAC, Product Design, Process and Technology, Maintenance Technology
Elective courses	4	11	IOT, Project Management, Marine Technology, Aerospace Manufacturing, etc.
Professional certification course	1	-	Catia V6, Auto CAD, Hypermesh, Solidwork, Flammable Refrigerant, etc.

As an accreditation main criterion [1], Program Educational Objectives (PEO) is the first pillar of Outcome-Based Education (OBE). PEO describe the expected accomplishments of the graduates in respect to their career and professional life three to five years after their graduation. The PEO are related to the University's Vision and Mission and stakeholder's requirement. In other words, the vision and mission of UTeM will be achieved if the faculty can produce competent engineers as emphasized in the PEO. PEO are established partly in reference to the Vision and Missions of the University and that of the faculty. Align with PEO, Program outcomes (PO) are established based on the inputs and recommendations of numerous stakeholders. These include inputs of the industrial advisory panel members, experts from other universities, government agencies, sponsors, COPPA, and the lecturers themselves. These inputs will ensure the establishment of the PO that is sustainable, achievable, and effectively reflect the desired characteristics of a competent mechanical or manufacturing engineering technologist.

Concerning the mapping of PEO and PO, other support activities are organized to help achieve the required PEO and PO. The faculty has been planning and implementing other support programmes to enhance the achievement of learning outcomes. Assessment materials to achieve POs are equipped with both academic and non-academic skills and competencies. The assessment materials evaluate the student knowledge, skills, and affective domains that directly measure the achievement of expected outcomes. These include quiz and test, presentation, assignment, capstone, case study, project, portfolio, and any other assessment task. Different LOs can be assessed concurrently in one assessment task but each outcome is evaluated separately. However, student knowledge (cognitive) is assessed through quizzes, mid-term test, and final exam. The student's skills (psychomotor) are assessed through laboratory practice assessment, report, and lab test. The affective domain is assessed through assignment and presentation. Rubrics for skills and affective domains are developed to standardize the measurement of performance.

Besides continuous assessments, the final examinations also carry marks for the LO for the courses. The final examination only evaluates the students' knowledge (cognitive). Considering that holistic graduates should also be equipped with non-academic skills and competencies, assessment materials that contributed to the POs attainment such as records of various activities (clubs, sports, uniform bodies, and others) should be included. Students are encouraged to take part in any level activities organized by the university or outside, whereas may help them raise their self-esteem, develop the spirit, and connect with the adults in the community in a positive manner creating a good situation for all.

The evaluation of the achievement of our program outcomes is based on the results of both the assessment of learning outcomes achievement of each subject undertaken by the students and the exit survey. The following two sections describe in detail the two assessment methods as Table 2. This purpose of this study is to conform the developed program outcomes among graduating students and to identify the relationship of all POs based on these valuable inputs. The organization of this paper is as follows. Section 2 explains the research methods, Section 3 discusses the results and finally a conclusion and suggestion for future research in Section 4.

2. RESEARCH METHOD

This study involved a survey that seeks the employer input on the quality of education and program outcome upon graduation. 85 respondents have participated in the survey, which included the representative of graduating student from mechanical and manufacturing engineering technology academic programme. The data were analysed using SPSS software. Analyses included in this research are descriptive analysis, calculation of percentage and Spearman rho correlation test.

Table 2 Assessment Methods

Direct Assessment Tools	In-Direct Assessment Tools
Tests/Final Exam Questions • PO and LO assessment by the lecturer based on student performance on tests or exam questions.	Industrial Evaluation • POs and LOs assessment by industrial supervisors based on student performance during industrial training.
Assignment/Laboratory Reports/Lab Test/Quizzes • PO and LO assessment by the lecturer based on student performance during subject assignment/laboratory activity.	Exit Survey • PO assessment by outgoing seniors at/near the end of their last semester
Bachelor Degree Project (BDP) • PO assessment conducted by the project supervisor and examiners based on student performance in conducting/completing their FYP. • Presentation – PO assessment by appointing academic Faculty, staff based on student performance during BDP seminars.	

3. RESULTS AND DISCUSSION

Table 3 indicates that the Crosstab for student gender, academic program and company status. According to the Table, the analysis found that more than a half (58.8%) of respondent size of the survey were referring male students. Meanwhile, 41.3% of total respondents related to female students. On the other hands, 55.3%, representing mechanical engineering technology student, and the rest 44.7% has specialized in manufacturing engineering technology. The findings also show that most students were preferable to undergo multinational companies (MNC) as their internship program. Almost third quarter of respondents represent MNC that covered 69.4%. The second highest are small medium enterprise (SME) that covered 23.5%. The lowest is government linked companies (GLC) that covered 7.1%% of the industry involved.

Table 3 Crosstab for student gender, academic program and company status

	MNC	SME	GLC	Total
STUDENT GENDER				
Male	37.6%	16.5%	4.7%	58.8%
Female	31.8%	7.1%	2.4%	41.3%
ACADEMIC PROGRAMMES				
Mechanical Engineering Technology Based	35.3%	15.3%	4.7%	55.3%
Manufacturing Engineering Technology Based	34.1%	8.2%	2.4%	44.7%
Total	69.4%	23.5%	7.1%	100.0%

From Table 4, there are 10 types of industries were involved in this study. Electric & electronic product and technology got the highest percentage of type of industry that takes 27.1% equal to 23 respondents from the overall data collected. Meanwhile, the second highest is a mechanical part fabrication & machining that takes 15.3% of total of respondents. The third- highest was Consultation, Maintenance & Services that takes 11.8% equal to 10 respondents.

Table 4 Industry representative

Types Of Industry	Percent (%)	TYPES OF INDUSTRY	Percent (%)
Electric & Electronic Product and Technology	27.1	Food & Beverages	3.5
Mechanical Part Fabrication & Machining	15.3	Logistic & Supply Chain Management	3.5
Consultation, Maintenance & Services	11.8	Mill & Plantation	2.4
Automotive	10.6	Oil & Gas	2.4
HVAC product & Technology	9.4	Glass Product & Technology	1.2
Plastic Product & Technology	7.1		
Medical Product & Technology	5.9	Total	100.0

Table 5 below shown competency, creative and innovative of program educational objectives that can be broken down into five program outcomes (B1 – B5) and aslo determined as an industrial training intervention [2]. Almost of the employers agreed (over 97%) that the engineering technology student are competent in mechanical or manufacturing relates theories and find information to identify, analyse the problem and propose possible solutions using principles of sciences, technology, engineering and mathematics (STEM) tools (B1, B2). Furthermore, 94.1% of the students were identified by their employee able to conduct an investigation of a problem by using modern tool; search and select relevant data from databases, internet, journals, design and conduct experiment to validate root cause and solution (B4). Besides, 93% of the graduating student are creative and innovative in determining appropriate techniques, resources, and tools to predict, evaluate or model an engineering problem and understand of the limitation of each technique and tools used (B5). However, only 89.4% agreed that student able to design solutions for engineering technology problems that meet specification with consideration for safety and health, cultural, societal, and environment (B3).

Table 5 Competency, creative and innovative

Competency, Creative And Innovative		Agree/ Strongly Agree (%)	Disagree/ Strongly Disagree (%)	Not sure (%)
B1	Knowledge of STEM	97.6	-	2.4
B2	Problem analysis	97.7	1.2	1.2
B3	Design solutions for engineering technology problems	89.4	-	10.6
B4	Modern tool usage	94.1	1.2	4.7
B5	Predict, evaluate or model an engineering problem	93.0	1.2	5.9

Table 6 below indicates potential impact on the lifelong learning. 94.1% of employers agreed that the student understand the impact of engineering technology solutions that pollutes the environment, produce waste of materials and energy that compromise the needs of future generations (B7). Besides, 94.1% of the respondents agreed that student aware of the need for independence, continuous, lifelong learning improving the knowledge and skills in the professional development and life (B12) while only 1.2% disagreed with the opinion.

Table 6 Lifelong learning

Lifelong Learning		Agree/ Strongly Agree (%)	Disagree/ Strongly Disagree (%)	Not sure (%)
B7	Environment and sustainability awareness	94.1	-	5.9
B12	Lifelong learning for professional development	94.1	1.2	4.7

Table 7 below indicates the ethics and leadership skill among students during industrial training in different types of industry. These factors are crucial in enhancing the employability rate [3]. 95.3% of employers agreed that the student is aware that his/her engineering technology practice and solutions will not cause health, safety, legal and cultural issue to the society (B6). Then, 94.1% of the respondents agreed that students applying the knowledge, integrity, accountability and abiding the law when providing a product / service to the company or public (B8). There is about 92.9 of employers approved that student able to work independently and in team with individual from diverse backgrounds (B9) and able to understand and communicate clearly with engineers and public on engineering activities, write reports and documentations, and make effective presentations (B10). However, only 89.4% of the employers accepted that students applying the engineering management principles to each project, as a member and a leader in a cross-functional team while managing the finance with respect to cost, time and quality (B11).

Table 7 Ethics and leadership

Ethics And Leadership		Agree/ Strongly Agree (%)	Disagree/ Strongly Disagree (%)	Not sure (%)
B6	The engineer and society	95.3	-	4.7
B8	Professional ethic and Responsibilities	94.1	1.2	4.7
B9	Individual and teamwork	92.9	1.2	5.9
B10	Communication skill	92.9	2.4	4.7
B11	Project management and business practices	89.4	2.4	8.2

Table 8 shows the Spearman correlation analysis. In the analysis, all 12 program outcomes were tested using SPSS software. The most interesting aspect of this table is a clear finding to conclude that all the outcomes have significant positive correlation. In Table 8, there is shown, that several outcomes had a strong correlation companion. B1 has strong correlation with B2 and B3. In other words, the problem analysis and the design solution for engineering technology problem strongly related to student knowledge of math, science, engineering, and technology. Meanwhile, B3 have a potential impact for B10 or vice versa, which determine that the problem-solving skill is significant with communication skill.

Table 8 Spearman correlation coefficient

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11
B2	.735(**)										
B3	.707(**)	.560(**)									
B4	.603(**)	.664(**)	.611(**)								
B5	.608(**)	.648(**)	.533(**)	.646(**)							
B6	.582(**)	.484(**)	.569(**)	.507(**)	.570(**)						
B7	.528(**)	.557(**)	.511(**)	.482(**)	.613(**)	.771(**)					
B8	.564(**)	.548(**)	.473(**)	.550(**)	.537(**)	.772(**)	.787(**)				
B9	.593(**)	.609(**)	.503(**)	.576(**)	.563(**)	.678(**)	.741(**)	.749(**)			
B10	.503(**)	.547(**)	.712(**)	.684(**)	.544(**)	.524(**)	.558(**)	.553(**)	.641(**)		
B11	.607(**)	.625(**)	.661(**)	.660(**)	.632(**)	.593(**)	.689(**)	.627(**)	.540(**)	.688(**)	
B12	.504(**)	.660(**)	.576(**)	.648(**)	.572(**)	.607(**)	.633(**)	.595(**)	.724(**)	.726(**)	.649(**)

Note: ** Significant at level of 0.05

4. CONCLUSIONS

As a conclusion, the participation of the employer in the assessment of program outcomes among graduating student is very crucial. This is because, as one of the critical stakeholders the employer knows what is the best for them in preparing the future engineer or technologist. With 24 weeks duration of industrial training able to conform the developed program outcomes among graduating students. This paper pursues the employer input on the quality of education and program outcome upon graduation. Besides, the paper reveals how to assess the quality of the academic program and plan for future improvements based on these valuable inputs. However, these findings may vary due to specific study on industry or different graduating student. For future study, the authors will be analysis the trend of achievement, including before and post COVID 19 pandemic as reviewed by Hussain and Spady [4] and the best approach in internship management towards program outcomes.

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