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Exploring a Green Element to Greening the Existing Curriculum in Polytechnic Malaysia

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ABSTRACT

Workers who have green skills can also be considered sustainable human capital. In fact, the process to produce sustainable human capital is closely linked to the curriculum implemented in institutions that offer training for occupations. Polytechnic Malaysia is one of the big institutions in Malaysia that offer Technical Vocational Education and Training (TVET). Focus area 1 (BT1), action plan 5 (PT5) of the Blueprint Polygreen document clearly refers to the lack of green elements in the Polytechnic Malaysia curriculum. Blueprint Polygreen also states the urgent need to implement green practices by incorporating green elements across the curriculum by up to 30%. In response to this, this study was conducted to explore green elements for greening the existing curriculum at Polytechnic Malaysia. The study was conducted using the Fuzzy Delphi Method (FDM). The FDM analysis shows elements of integrity get first ranking in the inventory of green elements in this study. These findings also indicate that the element of integrity is a very important element and should be incorporated in the Polytechnic Malaysia curriculum to enrich students' learning in order to produce sustainable human capital for the nation's needs.

Keywords: Fuzzy Delphi Method (FDM), green element, green skills

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INTRODUCTION

Green jobs can be found in various sectors of the economy from energy supply to recycling, agriculture and construction to transport. The global market for green jobs up to 2020 is estimated to be worth around USD2,740 billion (European Centre for the Development of Vocational Training, 2009,

p. 10). Green jobs also involve a diverse workforce and require workers with green skills. Workers who have green skills are known as sustainable human capital. The process of producing sustainable human capital is closely linked to the curriculum implemented in institutions that offer training for specific jobs. Polytechnic Malaysia is an institution that offers training for jobs. It is better known as an institution for Technical and Vocational Education and Training (TVET). Polytechnic Malaysia offers programmes in engineering, technology, commerce, tourism and hospitality, agro technology and bio industry, design and visual communication (Department of Polytechnic Education, 2016).

Statement of Problem

The curriculum of most of the programmes offered by Polytechnic Malaysia has reached a mature stage, and nearly all the programmes at the Polytechnic have received full accreditation from the Malaysian Qualification Agency (Malaysian Qualification Agency, 2016). However, the Blueprint Polygreen document clearly states that there is a lack of green elements in the Polytechnic Malaysia curriculum (Focus area 1 (BT1) and Action plan 5(PT5)).

The Polygreen Blueprint document also states the urgent need to implement green practices by incorporating green elements across the curriculum by up to 30% (Department of Polytechnic Education, 2015). Thus, the process of greening the existing curriculum at Polytechnic Malaysia is necessary to meet the demands of the global market in the future that emphasises jobs conditioned to greening the economy. Greening the curriculum also aims to improve the employability of Polytechnic Malaysia graduates. This study is limited to the three major areas of engineering taught at Polytechnic Malaysia i.e. mechanical, civil and electrical engineering.

METHODOLOGY

Process of Exploring Green Elements

A literature review yielded 33 elements that are considered green elements. After the literature review, interviews with experts were carried out to confirm whether the elements obtained from the literature review were important enough to incorporate in the curriculum of Polytechnic Malaysia as required green elements. During the interviews, the experts were asked for comments or suggestions on the appropriate green elements for inclusion based on their knowledge and experience. The experts used in this study, as required by the criteria for interviews with experts were practitioners of Technical and Vocational Education and Training (TVET) with experience teaching in TVET institutions for at least 5 years. They were also recognised by colleagues as practitioners or academics who excelled in their respective fields (Swanson & Falkman, 1997). A total of eight experts who had extensive experience in TVET were selected for the interview process in order to explore the required green elements (see Table 1). From the interviews, a list of green elements was prepared (see Table 2).

Table 1
List of experts interviewed

List of experts	Institution
Officer from the special unit of TVET	Department of Polytechnic Education
Officer from the policy division	Department of Polytechnic Education
Officer from the curriculum development division (Unit of Mechanical Engineering)	Department of Polytechnic Education
Officer from the curriculum development division (Unit of Civil Engineering)	Department of Polytechnic Education
Officer from the curriculum development division (Unit of Electrical Engineering)	Department of Polytechnic Education
Officer from Unit of Psychology	Polytechnic
Officer from Unit of Research and Innovation	Polytechnic
Lecturer from the Faculty of Technical and Vocational Education	UTHM

Table 2
Green elements listed from interviews with the experts

Green element		Green element	
1.	Sustainability practices	18.	Interpersonal skills
2.	Material resources	19.	Integrity
3.	Safety, health and environment	20.	Professionalism and ethics
4.	Social responsibility	21.	Initiative
5.	Knowledge about carbon emission, global warming, climate change, rise in ocean level and environmental degradation	22.	Adaptability and flexibility
		23.	Dependability and reliability
		24.	Lifelong learning
6.	Business fundamentals	25.	Willingness to learn
7.	Working with tools & technology	26.	Teamwork
8.	Checking, examining & recording	27.	Creative thinking
9.	Reading & writing	28.	Communication: Visual, listening and verbal
10.	Mathematics	29.	Following directions
11.	Science	30.	Planning, organisation and scheduling
12.	Engineering and technology	31.	Problem solving, prevention and decision
13.	Basic computer skills	32.	Seeking and developing opportunities
14.	System thinking	33.	Critical and analytical thinking
15.	Sense of belonging	32.	Seeking and developing opportunities
16.	Naturalist ability making	33.	Critical and analytical thinking
17.	Existential/spiritual ability	33.	Critical and analytical thinking

Expert Consensus on Using FDM

According to Jamil, Siraj, Hussin, Noh and Sapar (2014, p. 38) the first step in conducting the Fuzzy Delphi Model (FDM) testing is to determine the experts involved in the study. The number of expert should be between 10 and 50 experts. A questionnaire based on the FDM was prepared and distributed to 12 TVET experts in the fields of mechanical, civil and electrical engineering. Three of the experts were from Universiti Tun Hussein Onn Malaysia (UTHM), while nine were from Polytechnic Malaysia. The questionnaire is an instrument used for the purpose of obtaining a consensus among experts on a matter. In this study, it was used to determine the required green elements.

Table 3
Experts involved in the study (FDM)

Number of experts	Experts who answered the questionnaire for the FDM	Institution	Years of experience in the field
1	Lecturer in Mechanical Engineering	UTHM	Over 10 years
1	Lecturer in Civil Engineering	UTHM	Over 10 years
1	Lecturer in Electrical Engineering	UTHM	Over 10 years
4	Lecturer in Mechanical Engineering	Polytechnic	Over 10 years
3	Lecturer in Civil Engineering	Polytechnic	Over 10 years
2	Lecturer in Electrical Engineering	Polytechnic	Over 10 years

The second step was to determine the scale of the study. This study used a 7-point Likert scale because, according to Ramlie et al. (2014), the higher the scale used, the more accurate the data obtained.

Table 4
Fuzzy scale

Level of important	
Extremely not important	(0.0, 0.0, 0.1)
Very not important	(0.0, 0.1, 0.3)
Not important	(0.1, 0.3, 0.5)
Not sure	(0.3, 0.5, 0.7)
Important	(0.5, 0.7, 0.9)
Very important	(0.7, 0.9, 1.0)
Extremely important	(0.9, 1.0, 1.0)

The third step was to process the data collected to obtain an average value (m1, m2, m3). Step four was to determine the distance between two fuzzy numbers to determine the value (d) provided if $d \leq 0.2$. There was consensus among the experts, and this meant that a second round of interviews or removal of items could be avoided. To get the value (d), the distance between two fuzzy numbers was determined using the following formula:

$$d(\tilde{m}, \tilde{n}) = \sqrt{\frac{1}{3}[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]}$$

The fifth step was to determine the group consensus; group consensus had to exceed

Table 5
Results of the analysis of the data using FDM

Expert	Green Elements															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0.3	0.0	0.3	0.2	0.2	0.1	0.2	0.0	0.0	0.1	0.2	0.3	0.0	0.2	0.0	0.2
2	0.1	0.2	0.1	0.2	0.1	0.1	0.2	0.0	0.2	0.4	0.5	0.0	0.2	0.0	0.0	0.0
3	0.1	0.2	0.1	0.0	0.2	0.2	0.2	0.0	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.0
4	0.1	0.0	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.0	0.0	0.0
5	0.1	0.0	0.1	0.0	0.2	0.3	0.2	0.2	0.2	0.1	0.2	0.0	0.2	0.2	0.0	0.0
6	0.1	0.0	0.1	0.2	0.2	0.3	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.2	0.2
7	0.1	0.0	0.1	0.0	0.2	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
8	0.1	0.0	0.1	0.0	0.1	0.2	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.2	0.0	0.2
9	0.1	0.0	0.1	0.0	0.1	0.3	0.2	0.2	0.2	0.1	0.1	0.0	0.2	0.2	0.0	0.2
10	0.1	0.0	0.1	0.0	0.1	0.2	0.2	0.2	0.0	0.1	0.2	0.0	0.2	0.0	0.0	0.0
11	0.1	0.2	0.1	0.2	0.1	0.2	0.2	0.0	0.2	0.1	0.1	0.1	0.2	0.2	0.2	0.2
12	0.1	0.2	0.1	0.0	0.2	0.6	0.2	0.2	0.2	0.1	0.1	0.0	0.0	0.2	0.2	0.0
d value of each item	0.098	0.082	0.097	0.091	0.138	0.241	0.155	0.091	0.125	0.172	0.162	0.070	0.125	0.125	0.082	0.109
Percentage of each item d ≤ 0.2	92%	100%	92%	100%	100%	67%	100%	100%	100%	92%	92%	92%	100%	100%	100%	100%
Fuzzy evaluation	10.933	10.267	10.833	10.367	10.033	8.700	10.233	10.367	10.300	9.567	9.733	10.533	10.300	10.300	10.267	10.100
Average of fuzzy number	0.911	0.856	0.903	0.864	0.836	0.725	0.853	0.864	0.858	0.797	0.811	0.878	0.858	0.858	0.856	0.842
Score	5	25	7	16	30	33	27	17	20	32	31	15	21	22	26	29

Table 5 *(continue)*

Expert	Green Elements																
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
1	0.0	0.2	0.1	0.1	0.1	0.2	0.1	0.0	0.1	0.3	0.2	0.0	0.0	0.3	0.3	0.3	0.3
2	0.0	0.2	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0
3	0.2	0.2	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1
4	0.0	0.2	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.0	0.0
5	0.0	0.2	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.2	0.3	0.2	0.3	0.0	0.0	0.3
6	0.2	0.2	0.0	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.0	0.1	0.1	0.2	0.1	0.0	0.1	0.1	0.0	0.0
8	0.2	0.0	0.0	0.1	0.1	0.2	0.1	0.0	0.1	0.1	0.2	0.0	0.0	0.3	0.3	0.3	0.0
9	0.2	0.0	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.0	0.1	0.1	0.1	0.1
10	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.1	0.2	0.1	0.1	0.1	0.1
11	0.2	0.2	0.0	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.0	0.1	0.1
12	0.0	0.2	0.1	0.1	0.1	0.2	0.1	0.0	0.1	0.3	0.0	0.3	0.2	0.0	0.1	0.1	0.1
d value of each item	0.091	0.147	0.057	0.074	0.076	0.125	0.076	0.057	0.074	0.122	0.125	0.112	0.091	0.147	0.119	0.112	0.112
Percentage of each item d ≤ 0.2	100%	100%	100%	100%	100%	100%	100%	100%	100%	83%	100%	83%	100%	75%	83%	83%	83%
Fuzzy evaluation	10.367	10.133	11.300	11.100	11.000	10.300	11.000	10.700	10.900	10.767	10.300	10.567	10.367	10.600	10.667	10.567	10.567
Average of fuzzy number	0.864	0.844	0.942	0.925	0.917	0.858	0.917	0.892	0.908	0.897	0.858	0.881	0.864	0.883	0.889	0.881	0.881
Score	18	28	1	2	3	23	4	9	6	8	24	14	19	11	10	12	13

75% to avoid a second round of interviews. Step six was to determine the aggregates based on the fuzzy evaluation and the seventh was to do a defuzzification process. The defuzzification process was carried out through the process of analysing the data collected using the Fuzzy Delphi technique. This process determines the ranking or priority of each item or the position of each variable or sub-variable (Jamil et al., 2014, p. 37).

RESULTS AND ANALYSIS

DISCUSSION AND CONCLUSION

Based on the results of analysis, two elements (Element 6 & Element 30) did not get the consensus of the experts. These elements scored a percentage value (d) of 67% and 75%, respectively. Based on the FDM percentage for group consensus, each element must receive a score exceeding 75% to avoid a second round of data collection or the element should be removed. In this study, the researcher removed these two elements from the inventory of green elements. Analysis of the defuzzification process showed that the element of integrity received the topmost ranking, while business fundamentals received the lowest. These findings indicated that integrity is a very important element to should be incorporated in the curriculum of Polytechnic Malaysia students in order to produce sustainable human capital.

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