Evaluations of Interns' Performances after Intervention Program using Hierarchical Fuzzy Conjoint Analysis Model

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***Abstract*— The intervention program is a special program that was carried out prior to the students embarked their internship program. At the end of their internship, the questionnaires were given to their respective companies' employers to rate the interns' performance. The evaluation of the performance is based on seven attributes and twenty nine sub-attributes. Likert scales are employed in extracting the level of satisfactions (ratings) of the respective employers' towards the interns. As human preferences are rather fuzzy and uncertain in nature, the fuzzy set based analysis model is seen as an appropriate model to be used in handling and investigating human preferences. Thus, for this purpose, a hierarchical fuzzy conjoint analysis model is proposed and employed in analyzing the employers' preference levels on the interns' performance with respect to the employability attributes. The findings show that the employers were "satisfied" with the interns' performance with a degree of satisfaction 0.804.**

Keywords—conjoint analysis, employability skills, intervention program, performance, internship

I. INTRODUCTION

In today's highly competitive job market, managers are looking for individuals that have proper scholarly proficiencies and are exceptionally talented to fill positions in their organizations. Malaysian managers are searching for a more adaptable and versatile workforce as they themselves try to change their organizations into a more adaptable and versatile one [1]. However, graduates today face appalling challenges in meeting the market demand in terms of skills, quality and also qualifications. Therefore, only graduates with better competencies will be able to meet these tough challenges and to be accepted in the job market. Graduates whose skills and attitudes are highly valued by employers would definitely succeed in paving their way into the labour market.

A. Employability Skills

Ref. [2] suggests that "In simple terms, employability is about being capable of getting and keeping fulfilling work. More comprehensively employability is the capability to move self-sufficiently within the labor market to realize the potential through sustainable employment". Many studies indicate that graduates having trouble in finding a proper job because lacking of employability skills, such as work ethics, self confidence, communication skills, leadership skills and attitude problems [3,4]. Some of the predictors of employability are English language proficiency, ethnicity, and the types of degree obtained [5]. Conversely, Ref. [6] found that Malaysia graduates did not lack the skills and talent or competency to be employed. But it was just that some of them lacked proper direction and inputs to nurture their natural talent, interpersonal skills and abilities as stated by The National Education Blueprint 2015-2025: Higher Education [7].

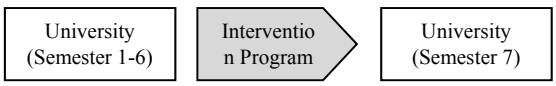
B. Industry Perspective on Graduate Employability

Graduates must have the evidence to prove to the employers that they have the ability to deal with uncertainty, the ability to work under pressure, show action-planning skills, communication skills, information technology skill, team work, a readiness to explore and create opportunities, self-confidence, self-management skills and the enthusiasm to learn something new to gain their employer's interest [8]. In addition to that, graduates who have the traits to work within a team also can lead to team success and they will be hired by the employer. Employers are searching for graduates that can converse fluent English and good interpersonal skills since they have the ability to express ideas, explain about issues and resolve problems [9]. At the same time, the internship programs also provide relevant hands-on or practical experiences for undergraduates within a specific period [1].

In 2012, Ministry of Higher Education Malaysia (MOHE) launched the Graduate Employability Blueprint [8] for 2012-2017 with the aim to increase the graduate employability as well as to fulfil the need for skilled and professional manpower towards nation building. Many of the programs suggested involved collaboration of industry with universities [8] and universities are encouraged to implement programs through Graduate Employability Grant from MOHE.

C. The Intervention Program

To embed employability skills into students' activities, the Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA (UiTM) Malaysia proposed a model for graduate employability [11] through Graduate Employability Grant. The aim is to prepare the students prior to their internship as shown in Figure 1.



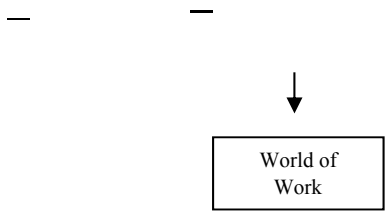


Fig. 1. An intervention program before internship.

This intervention program named as "Born to Be a Diamond" involved industry participation. Only twenty three (23) students participated in this program since their participation is on a voluntary basis. The program which was held for 22 days focuses on effective employability skills such as Interpersonal Communication, Business Professional Communication, Public Communication, and Executive Skills Development. Also sessions such as visioning, personal development, interpersonal communication, personal finance, personal grooming, etiquette and protocol are embedded in the program. Apart from that, some other modules such as business acumen, entrepreneurship skills to empower self or create a startup, design thinking and Business Model Canvas for a new economy and Internet of Things (IoT) skills, e-commerce is also being introduced to prepare them for the new world of work. Some of the modules were conducted by captains of industries.

At the end of their internship, the questionnaires were given to their respective companies' employers to rate their performance. Some of the reputable companies (Multinational Companies and Government Linked Companies) were the American Insurance Association (AIA), Tune Protect Malaysia, Petronas, AmBank Group Malaysia, Bank Muamalat Malaysia Berhad, Commerce International Merchant Bankers Berhad (CIMB), Telekom Malaysia Berhad (TM) and Bank Islam Malaysia Berhad Securities (BIMB Securities).

II. METHOD

In general, the measurement of interns' performance is done based on human interpretations and preferences which are vague and uncertain in nature. Therefore, an application of fuzzy set based conjoint model would provide a more adequate basis to generate a model for the evaluation process. Thus, for the purpose of analyzing the employers' preference levels on the interns' performance with respect to the employability attributes, a hierarchical fuzzy conjoint analysis method is proposed and employed.

A. Instruments

The questionnaires are designed based on [3,12] with slight modification to suit with the intervention program. Seven attributes and twenty nine sub-attributes are considered in this study as listed in Table I.

TABLE I. ATTRIBUTES AND SUB-ATTRIBUTES

Attribute	Sub-attributes
Communication Skills (X_1)	Understand and follow instructions correctly (x_{11}) Communicates and expresses ideas effectively (x_{12}) Speaking clearly and effectively (x_{13}) Communicates ideas in writing effectively (x_{14})
Problem Solving (X_2)	Applies problem solving technique effectively (x_{21}) Applies creative thinking producing ideas (x_{22}) Applies critical thinking in decision making (x_{23}) Able to provide an explanation of the problem clearly and accurately (x_{24}) Able to create new ideas (x_{25})
Practical Skills (X_3)	Able to work in a team (x_{31}) Demonstrates good analytical skills (x_{32}) Willingness to learn in accommodating change (x_{33}) Able to lead a work in a team (x_{34}) Entrepreneurial skills (x_{35})
Ethics and Values (X_4)	Punctuality (x_{41}) Dress appropriately to work place (x_{42}) Take full responsibility on the task given (x_{43}) Able to distinguish between personal and workplace matters (x_{44})
Social Skills (X_5)	Carry out a task from start to finish based on quality standards (x_{51}) Ability to finish a task in a given time (x_{52}) Ability to cope with work pressure (x_{53}) Ability to work without supervision (x_{54})
Technological Skills (X_6)	Use computing and information technology effectively (x_{61}) Willing to learn new IT skills (x_{62}) Have adequate IT skills to apply in a given task (x_{63})
Information Management (X_7)	Able to retrieve information from maximum references (x_{71}) Highly engages in independent learning (x_{72}) Excellent use of references (x_{73})

B. Hierarchical Fuzzy Conjoint Analysis Method (HFCAM)

Fuzzy conjoint method (FCM) which is based on the fuzzy set preference model [13] is widely used in social science and educational researches, particularly in analyzing the human level of satisfactions, perceptions and evaluations. Amongst the areas of interests are on the market products [13,14], the quality of services [15,16], job satisfaction [17-19], academic or teaching and learning practices [20-23]. The level of preferences is expressed in terms of linguistic terms which are represented in the form of fuzzy sets. Fuzzy

sets have the advantage in handling the subjective elements in human valuation [24]. The membership degrees characterizing fuzzy sets indicate the degree of satisfaction or preference of a particular individual or group of individuals in evaluating the attributes or factors associated with a specific problem under study. Basic theories and operations on fuzzy sets can be found in [25].

In this paper, an extension of the FCM [12] called the Hierarchical Fuzzy Conjoint Analysis Method (HFCAM) is presented. Basically, in HFCAM, the attributes of the problem under study are organized hierarchically, that is, they can be further broken down into sub-attributes, and so on. The hierarchical structure allows a comprehensive understanding of the individuals preferences or opinions towards a problem, product or an issue, ranging from specific attributes (sub-attributes) to a more general attributes (main attributes). In the context of evaluating the interns' performance after intervention program, the application of HFCM enables the performance of the interns' to be studied by specific attribute as well as by the overall achievement across attributes as laid out in Table I. The general procedure of the HFCM is presented as follows:

Step 1: Identify the set of attributes, $X=\{X_i\}$, and the corresponding sub-attributes, $X_i=\{x_{ij}\}$ with $i=1,2,...,m$, $j=1,2,...,|X_i|$, where $|X_i|$ is the cardinality of the set X_i.

Step 2: Set the predefined linguistic rating defined by discrete fuzzy sets, $L_k=\left\{\frac{\mu_{Lkp}}{p}: p=1,2,...,t\right\}$, $k=1,2,...,t$.

Step 3: Obtain the number of respondents, r_{ijk}, for each linguistic rating, L_k, $k=\{1,2,...,t\}$ with respect to x_{ij}.

Step 4: Obtain the fuzzy sets representing:

- The aggregated linguistic ratings $\tilde{x}_{ij}$ with respect to the sub-attributes x_{ij} where

$$\tilde{x}_{ij}=\sum_{k=1}^{t}\left(\frac{r_{ijk}}{\sum_{k=1}^{t} r_{ijk}}L_k\right)=\left\{\frac{\mu_{ijp}}{p}, p=1,2,...,t\right\} \quad (1)$$

- The aggregated linguistic ratings $\tilde{X}_i$ for the *i*-th attributes $X_i, i=1,2,...,m$ such that

$$\tilde{X}_i=\sum_{j=1}^{|X_i|} w_{ij}\tilde{x}_{ij}=\left\{\frac{\mu_{ip}}{p}, p=1,2,...,t\right\} \quad (2)$$

where $w_{ij}\in[0,1]$ represent the weight of x_{ij}.

- The overall rating $\tilde{X}$ across attributes such that

$$\tilde{X}=\sum_{i=1}^{m}\omega_i\tilde{X}_i=\left\{\frac{\mu_p}{p}, p=1,2,...,t\right\} \quad (3)$$

where $\omega_i\in[0,1]$ is the weight of X_i.

Note that the sub-attribute weights w_{ij} and the attribute weights ω_i can be generated using any appropriate attribute weight determination methods available in the literature.

Step 5: Calculate the degree of similarities of the following pairs of fuzzy sets representing:

- The aggregated linguistic ratings for sub-attributes $\tilde{x}_{ij}$ and the linguistic ratings L_k where

$$S_{ijk}(\tilde{x}_{ij},L_k)=\frac{1}{1+\sqrt{\sum_{p=1}^{t}(\mu_{ijp}-\mu_{Lkp})^2}} \quad (4)$$

$i=1,2,...,m$, $j=1,2,...,|X_i|$, $k=1,2,...,t$

- The aggregated linguistic ratings $\tilde{X}_i$ for the *i*-th attributes and the linguistic ratings L_k, such that

$$S_{ik}(\tilde{X}_i,L_k)=\frac{1}{1+\sqrt{\sum_{p=1}^{t}(\mu_{ip}-\mu_{Lkp})^2}} \quad (5)$$

$i=1,2,...,m$ $k=1,2,...,t$

- The overall rating $\tilde{X}$ across attributes and L_k where

$$S_k(\tilde{X},L_k)=\frac{1}{1+\sqrt{\sum_{p=1}^{t}(\mu_p-\mu_{Lkp})^2}} \quad (6)$$

$k=1,2,...,t$.

Step 6: Identify the linguistic term (ratings) that are associated with the highest membership degrees obtained in Step 5. These linguistic terms will be respectively chosen to represent the performance of the candidates with respect to the sub-attributes, attributes and overall evaluation (across attributes).

III. Results and Discussions

The employers' ratings of interns' performances in the internship program under their supervisions are obtained from the distributed questionnaires. The five linguistic ratings, namely, L_k, $k=\{1,2,...,5\}$ i.e. *Not Satisfied* (L_1), *Less Satisfied* (L_2), *Quite Satisfied* (L_3), *Satisfied* (L_4) and *Very Satisfied* (L_5) are pre-defined by the following fuzzy sets:

$$L_1=\left\{\frac{1}{1},\frac{0.7}{2},\frac{0.3}{3},\frac{0}{4},\frac{0}{5}\right\},\quad L_2=\left\{\frac{0.7}{1},\frac{1}{2},\frac{0.7}{3},\frac{0.3}{4},\frac{0}{5}\right\},$$

$$L_3=\left\{\frac{0.3}{1},\frac{0.7}{2},\frac{1}{3},\frac{0.7}{4},\frac{0.3}{5}\right\},\quad L_4=\left\{\frac{0}{1},\frac{0.3}{2},\frac{0.7}{3},\frac{1}{4},\frac{0.7}{5}\right\},$$

and $L_5=\left\{\frac{0}{1},\frac{0}{2},\frac{0.3}{3},\frac{0.7}{4},\frac{1}{5}\right\}$.

The number of responses that corresponds to each of the five linguistic ratings with respect to the sub-attributes are displayed in Table II.

TABLE II. RATINGS ON ATTRIBUTES AND SUB-ATTRIBUTES

Attribute		Linguistic Rating				
		Not Satisfied (L_1)	*Not Satisfied* (L_2)	*Quite Satisfied* (L_3)	*Satisfied* (L_4)	*Very Satisfied* (L_5)
X_1	x_{11}	0	0	2	7	14
	x_{12}	0	0	4	8	11
	x_{13}	0	0	2	9	12
	x_{14}	0	0	4	13	6
	x_{15}	0	0	6	13	4
X_2	x_{21}	0	0	3	5	11
	x_{22}	0	0	6	7	10
	x_{23}	0	1	4	10	8
	x_{24}	0	1	3	13	6
	x_{25}	0	0	8	13	2
X_3	x_{31}	0	0	1	6	16
	x_{32}	0	0	3	6	14
	x_{33}	0	0	1	10	12
	x_{34}	0	1	7	9	6
	x_{35}	1	1	15	4	2
X_4	x_{41}	0	1	0	7	15
	x_{42}	0	0	1	6	16
	x_{43}	0	0	0	6	17
	x_{44}	0	0	1	6	16
X_5	x_{51}	0	0	3	11	9
	x_{52}	0	1	2	6	14
	x_{53}	0	0	4	6	13
	x_{54}	0	1	2	12	8
X_7	x_{61}	0	0	1	12	10
	x_{62}	0	0	0	16	7
	x_{63}	0	0	4	14	5
X_7	x_{71}	0	0	4	11	8
	x_{72}	0	1	2	14	6
	x_{73}	0	0	7	13	3

Based on Table II, the fuzzy sets representing the aggregated linguistic ratings for each sub-attributes, $\tilde{x}_{ij}$, main attributes, $\tilde{X}_i$, and the overall performance, $\tilde{X}$, are derived using equations (1), (2) and (3), respectively. For illustrative purposes, based on (1) the fuzzy set for x_{11} i.e $\tilde{x}_{ij}$ is obtained as

$$\tilde{x}_{ij} = \frac{0}{23}L_1 + \frac{0}{23}L_2 + \frac{2}{23}L_3 + \frac{7}{23}L_4 + \frac{14}{23}L_5$$
$$= \left\{\frac{0.026}{1}, \frac{0.152}{2}, \frac{0.483}{3}, \frac{0.791}{4}, \frac{0.848}{5}\right\}.$$

Applying (4), the similarity degree between $\tilde{x}_{11}$ and the pre-defined linguistic terms $L_1 = \left\{\frac{1}{1}, \frac{0.7}{2}, \frac{0.3}{3}, \frac{0}{4}, \frac{0}{5}\right\}$ can be calculated as

$$S_{11}(\tilde{x}_{11}, L_1) = \frac{1}{1 + \sqrt{\sum_{p=1}^{5}(\mu_{11p} - \mu_{L_1})^2}}$$
$$= \frac{1}{1 + \sqrt{(0.026-1)^2 + \ldots + (0.848-0)^2}}$$
$$= 0.382$$

The respective degrees of similarity for the rest of the sub-attributes, main attributes and the overall performance with the predefined linguistic terms i.e. $S_{ijk}(\tilde{x}_{ij}, L_k)$, $S_{ik}(\tilde{X}_i, L_k)$ and $S_k(\tilde{X}, L_k)$ are obtained in the same manner. The corresponding calculated similarity degrees are displayed in Table III, IV and V.

TABLE III. SIMILARITY DEGREES $S_{ijk}(\tilde{x}_{ij}, L_k)$ BETWEEN SUB-ATTRIBUTE RATINGS $\tilde{x}_{ij}$ AND LINGUISTIC RATINGS L_k

Sub-Attribute Rating $\tilde{x}_{ij}$	Predefined Linguistic Rating L_k					Linguistic Rating
	L_1	L_2	L_3	L_4	L_5	
$\tilde{x}_{11}$	0.38	0.40	0.51	0.73	<u>0.77</u>	Very Satisfied
$\tilde{x}_{12}$	0.39	0.42	0.54	<u>0.79</u>	0.70	Satisfied
$\tilde{x}_{13}$	0.38	0.41	0.52	<u>0.76</u>	0.74	Satisfied
$\tilde{x}_{14}$	0.39	0.43	0.58	<u>0.87</u>	0.64	Satisfied
$\tilde{x}_{15}$	0.40	0.44	0.61	<u>0.86</u>	0.60	Satisfied
$\tilde{x}_{21}$	0.41	0.43	0.52	0.68	<u>0.72</u>	Very Satisfied
$\tilde{x}_{22}$	0.40	0.43	0.57	<u>0.80</u>	0.66	Satisfied

Sub-Attribute Rating $\tilde{x}_{ij}$	Predefined Linguistic Rating L_k					Linguistic Rating
	L_1	L_2	L_3	L_4	L_5	
$\tilde{x}_{23}$	0.40	0.44	0.58	0.82	0.65	Satisfied
$\tilde{x}_{24}$	0.40	0.44	0.58	0.85	0.64	Satisfied
$\tilde{x}_{25}$	0.40	0.46	0.65	0.81	0.56	Satisfied
$\tilde{x}_{31}$	0.38	0.39	0.49	0.70	0.82	Very Satisfied
$\tilde{x}_{32}$	0.39	0.41	0.51	0.74	0.76	Very Satisfied
$\tilde{x}_{33}$	0.38	0.40	0.51	0.76	0.75	Satisfied
$\tilde{x}_{34}$	0.41	0.46	0.63	0.80	0.60	Satisfied
$\tilde{x}_{35}$	0.45	0.54	0.82	0.63	0.49	Quite Satisfied
$\tilde{x}_{41}$	0.38	0.40	0.50	0.71	0.80	Very Satisfied
$\tilde{x}_{42}$	0.38	0.39	0.49	0.70	0.82	Very Satisfied
$\tilde{x}_{43}$	0.37	0.39	0.48	0.67	0.85	Very Satisfied
$\tilde{x}_{44}$	0.38	0.39	0.48	0.67	0.85	Very Satisfied
$\tilde{x}_{51}$	0.39	0.42	0.54	0.82	0.69	Satisfied
$\tilde{x}_{52}$	0.39	0.41	0.52	0.73	0.75	Very Satisfied
$\tilde{x}_{53}$	0.39	0.42	0.53	0.76	0.73	Satisfied
$\tilde{x}_{54}$	0.39	0.43	0.56	0.83	0.67	Satisfied
$\tilde{x}_{61}$	0.38	0.41	0.52	0.79	0.72	Satisfied
$\tilde{x}_{62}$	0.38	0.41	0.53	0.83	0.69	Satisfied
$\tilde{x}_{63}$	0.39	0.43	0.58	0.88	0.63	Satisfied
$\tilde{x}_{71}$	0.39	0.43	0.56	0.84	0.66	Satisfied
$\tilde{x}_{72}$	0.39	0.43	0.57	0.86	0.63	Satisfied
$\tilde{x}_{73}$	0.40	0.45	0.63	0.83	0.58	Satisfied

TABLE IV. SIMILARITY DEGREES $S_{ik}(\tilde{X}_i, L_k)$ BETWEEN ATTRIBUTE RATINGS $\tilde{X}_i$ AND LINGUISTIC RATINGS L_k

Attribute Rating, $\tilde{X}_i$	Pre-defined Linguistic Rating L_k					Linguistic Rating
	L_1	L_2	L_3	L_4	L_5	
$\tilde{X}_1$	0.39	0.42	0.55	0.82	0.68	Satisfied
$\tilde{X}_2$	0.40	0.44	0.58	0.81	0.65	Satisfied
$\tilde{X}_3$	0.40	0.44	0.57	0.79	0.66	Satisfied
$\tilde{X}_4$	0.38	0.39	0.48	0.69	0.83	Very Satisfied
$\tilde{X}_5$	0.39	0.42	0.54	0.78	0.71	Satisfied
$\tilde{X}_6$	0.38	0.42	0.54	0.84	0.68	Satisfied
$\tilde{X}_7$	0.39	0.44	0.59	0.86	0.63	Satisfied

TABLE V. SIMILARITY DEGREES $S(\tilde{X}, L_k)$ BETWEEN OVERALL PERFORMANCE $\tilde{X}$ AND LINGUISTIC RATINGS L_k

Overall Performance	Pre-defined Linguistic Ratings L_k					Linguistic Ratings
	L_1	L_2	L_3	L_4	L_5	
$\tilde{X}$	0.39	0.42	0.55	0.80	0.69	Satisfied

The underlined values indicate the maximum similarity degrees and these values are associated with linguistic terms (linguistic ratings) that represent the final ratings for x_{ij}, X_i, and X. As an example, based on Table III, comparison between $\tilde{x}_{11}$ and L_5 produces the highest similarity degree i.e. 0.77. Hence, the term 'Very Satisfied' is assigned to x_{11}. In other words, the employers are very satisfied with the ability of the interns in understanding and following instructions correctly. By similar interpretation, the sub-attribute Entrepreneurial skills (x_{35}) received the lowest linguistic preference rating by the employers i.e. 'Quite Satisfied' as compared to the rest of the sub-attributes.

Table IV shows that the interns' "Ethics and Values" skills are very satisfying to the employers. The employers are satisfied with the rest of the attributes, namely "Communication Skills", "Problem Solving", "Technological Skills" and "Information Management". Note that, in terms of ranking, the attribute "Social Skills" is placed the lowest with similarity degree 0.782.

Overall, the respective employers are "Satisfied" with the interns' performance in the internship program of their company.

IV. CONCLUSIONS

This study focuses on the implementation of Hierarchical Fuzzy Conjoint Analysis Method (HFCAM) which is the

extension of the Fuzzy Conjoint Method (FCM). It provides a more adequate basis to generate a model for the evaluation process whereby the attributes are organized hiearchically. Employers have stated their opinions about each element of attributes and these opinions were used for the evaluation process. The result showed that HFCAM approach has successfully evaluated the fuzzy values found in the Likert scale approach. Since the employers were satisfied with the overall interns' performances, it can be concluded that the intervention program before the students enter the world of work can be served as an effective model for the future employability program.

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