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COMBINING DELPHI, AHP, AND DEMATEL TO IMPROVE STUDENTS' SATISFACTION ON NATIONAL YOUTH TRAINING CENTRES (IKBNS): AN INTRODUCTORY IDEA

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Abstract
Devising the finest possible strategies to enhance students' satisfaction towards the national youth training centres (IKBNs – Institut Kemahiran Belia Negara) is not a simple task as it entails the consideration of various attributes that carry different levels of priority. Also, in reality there exist some complex relationships between these attributes. Having clear information regarding the priorities and relationships held by these attributes may facilitate the key players of an institute to properly decide the strategies that could significantly boost the students' satisfaction. Sadly, there are not too many empirical studies relating to any Technical and Vocational Education and Training (TVET) institutes that have delivered such complete information to the decision makers. This paper introduces a new hybrid multi-attribute decision making (MADM) procedure as to scientifically develop the right strategies to improve the satisfaction of the students studying in East Malaysia IKBNs, especially by understanding the actual priorities and relationships held by the attributes. The proposed procedure uses DELPHI survey to finalize the list of attributes that could influence the students' satisfaction, factor analysis to extract the large set of attributes into fewer independent factors, a modified analytical hierarchy process (AHP) to prioritize the extracted independent factors, and decision-making trial and evaluation laboratory (DEMATEL) to uncover the causal-effect relationships between the attributes within each factor.

Keywords: *Analytical Hierarchy Process, DEMATEL, National Youth Training Centre, Students' Satisfaction*

Introduction

Having ample-skilled manpower has been identified as one important ingredient required by Malaysia in elevating its status as a developed nation by the year 2020. The government believes that this can gradually be attained by offering proper technical and vocational programmes to the potential youngsters in the nation. In fact, the government has never failed in showing its interest in improving the technical vocational education and training (TVET) sector of the nation (Kamarulzaman, 2014). This to some extent reflected through the increasing amount of funds that have been allocated by the government across every annual budgeting exclusively for the sake of spurring the growth of TVET sector (e.g. RM1.2 billion in 2015, while RM4.6 billion in 2017) ("2017 Budget", 2016).

To this date, the government has successfully established many TVET institutes which operate under the auspices of various ministries (Yunos et al., 2006). National youth training centre (IKBN) is one such institute, functioning under the Ministry of Youth and Sports. As of now, there are 20 IKBNs across the nation, offering a wide array of training programmes such as automotive, civil engineering, electrical engineering, food technology, and hospitality and tourism.

Today, in accordance to the missions of IKBN Transformation Programme introduced by the current Youth and Sports Minister, Khairy Jammaluddin Abu Bakar, the management of IKBNs together with the support from the ministry are now trying all the possible means to raise the quantity and quality of the students enrolled and produced by the institutes. One possible way to achieve these goals is to offer a satisfying service experience to the students. This can be further justified as follows: (1) satisfied students may spread positive words about the institutes, thus increases the number of new applicants across the semesters; (2) satisfying service may encourage the students to be more engaged with the learning environment and thus, help them to develop their skills with better level of enthusiasm throughout the training periods (Asnul Dahar & Siti Azizah, 2011).

However, evaluating the right strategies to improve the students' satisfaction towards IKBNs is actually a very challenging assignment as it involves the presence of multiple evaluation attributes (Maimunah et al., 2009) which are naturally intertwined by complex interrelationships and have different weightage or priority in determining the students' satisfaction. Discovering the priorities and relationships held by these attributes may enable the key actors of an institute to properly decide the optimal strategies that could significantly boost the students' satisfaction, with proportional or minimal use of resources. For instance, resources (e.g. budget or manpower) can simply be apportioned as to 'improve' those attributes that possess higher weightage in determining the overall students' satisfaction or those 'causal' attributes that have greater effect towards the 'performance' of other attributes (rather than treating and improving all these attributes equally). Unfortunately, to the best of our knowledge, none of the previous empirical studies pertaining to TVET institutes including IKBNs have synchronously produced such extra, crucial information to the decision makers.

In addition, most of the studies pertaining to the services of TVET institutes in Malaysia including IKBNs have only considered the feedbacks from the students or staff that are attached to the institutes in West Malaysia. However, the actual needs of students in East Malaysia may somewhat vary due to distinct geographical, infrastructure, cultural, and demographic factors. Therefore, it is not really sensible to generalize the strategies for improvement identified in previous studies to the institutes in East Malaysia.

In a nutshell, there is a need for a specific study that uses an alternate quantitative approach which delivers some extra, useful information (i.e. priority scores and relationships of the attributes) as to make better decisions regarding the potential course of actions that can be implemented in order to improve the satisfaction of students studying and residing in IKBNs located across East Malaysia.

Literature review

This section mainly surveys some pertinent past scholarly studies as to understand the significance of providing satisfying educational service to the students in tertiary educational institutes. Also, the attributes that could define the students' satisfaction over the institutes are explored. The usage of two different non-parametric MADM techniques which are believed to have the potential in dealing with the matter elucidated in section 1.0 are reviewed as well.

Students' Satisfaction

Student's satisfaction can actually be defined as a student's short-term attitude that resulted from his/her evaluation on their educational experience (Athiyaman, 1997). It is a broadly-accepted fact that students may express their dissatisfaction towards the educational institutes if and only if their experience with the institutes failed to surpass their initial expectations. Mahapatra and Khan (2007) believe that producing satisfied customers (i.e. students) should be the ultimate goal of any tertiary educational institutes including TVET institutes. In fact, it was clearly reported in many scholarly works that guaranteeing students' satisfaction may then result into various benefits, both to the students and institutes concerned. It is proven that students with higher level of satisfaction towards their institutes exhibit better academic performances throughout their study periods. Besides, they appear to gradually develop stronger loyalty and sense of attachment over their institutes, and engage better in positive word-of-mouth marketing (Boulding et al., 1993), which may then lead to a meaningful increase in the number of new applicants for the subsequent semesters.

Gruber et al. (2010) claimed that there are few factors that can predict students' satisfaction, namely service quality, personal or situational factor, and price (i.e. fees). However, this study will solely be concentrating on understanding the influence of service attributes over the students' satisfaction. In fact, in many cases, service quality attributes have been used as the only or main base for measuring the students' satisfaction towards an educational institute. Besides, as this study aims at providing some direct solutions to the management of IKBNs, then it is definitely more sensible to simply propose the solutions that are developed based on the service aspects because apparently, the management has better 'control' over the service quality attributes, unlike the price or personal or situational factor. Such solutions can actually be implemented by the management without seeking the consent of too many parties. Note that the prices (i.e. fees of IKBN) are mainly decided by Ministry of Youth and Sports Malaysia, whilst personal or situational factor may vary from one individual to another.

Identifying and implementing the proper strategies to enhance students' satisfaction over the service offered by an educational institute is certainly easily said than done as the construct of service is composed by multiple interactive attributes. There are plenty of past studies which have used various service dimensions and attributes in order to evaluate students' satisfaction, but as expected, the choice service dimensions or attributes in such studies appear to be varying significantly from one to another. It is then very important for us to review all pertinent

dimensions or attributes mentioned in past literature, so none of the key evaluation traits are overlooked prior to conducting the real analysis.

SERVQUAL model, which have been extensively used in various service-based industries, has also never failed in making its pathway into studies involving the services of higher educational institutes (e.g. Arambewela & Hall, 2006; Hasan et al., 2009). There exist many academic works which have used the five dimensions of SERVQUAL, namely "reliability", "assurance", "tangibility", "empathy", and "responsiveness" as the yardstick to assess the students' satisfaction over the educational institutes. However, it is learnt that the dimensionality of SERVQUAL is not really consistent where the presumed dimensions may vary from one context to another; items (attributes) do not always load on to the priori. Besides, many scholars regard SERVQUAL as not comprehensively capturing the all the important attributes of service quality, since it merely focuses only on process quality attributes, not on outcome quality attributes (Buttle, 1996).

Elliott and Healy (2001) investigated the effects of the three primary dimensions, "student-centredness", "campus climate", and "instructional effectiveness" of service quality on several constructs including satisfaction. The dimension of ''student-centredness'' was composed of six attributes which relate to a university's effort to convey to students that they are important. ''Campus climate'' was comprised of seventeen attributes which relate to the extent a university provides and promotes a sense of campus pride and feeling of belonging. ''Instructional effectiveness'' was made up by fourteen attributes which assess a student's academic experience, to include curriculum, academic excellence, and effectiveness of faculty. The study identified "student-centredness" as most significant determinant of students' satisfaction followed by "campus climate", and "instructional effectiveness".

Meanwhile, Mai (2005) has compared the satisfaction between the postgraduate business school students in UK and US based on a set of 19 service quality attributes. Surprisingly, he discovered that "the quality and accessibility of IT facilities" attribute does not play a significant role in determining the students' satisfaction. One may find this claim as no longer in line with the current trend where the teaching and learning system strongly relies on the use of IT facilities. At the same time, the list of attributes used in the analysis was largely concentrated on academic service aspects. Some important non-academic service aspects (e.g. sport facilities and cafeteria) which may also have meaningful association with students' satisfaction were completely absent.

Zineldin (2011) used another version of questionnaire developed based on five service quality dimensions, namely technical, functional, infrastructure, interaction and atmosphere, as to evaluate the satisfaction of the students studying in higher education institutes in Istanbul, Turkey. On the other hand, recently, Ibrahim et al. (2014) had developed a questionnaire comprising nine service dimensions (i.e. "campus environment", "physical facilities", "training equipment", "instructor", "curriculum", "training delivery", "support service", "library", and "management of institute") that span a total of 42 attributes in order measure the students' satisfaction of Malaysian Skills Training Institutes in Klang Valley, Malaysia. The empirical results of the study indicated "campus environment", "management of institutes", and "support services" as the key dimensions that determine the students' satisfaction. Unexpectedly, "physical facilities" and "training delivery" were found to be insignificant in predicting the students' satisfaction.

In a nutshell, this study has decided to use the service dimensions together with the attributes proposed by Ibrahim et al. (2014) as the main skeleton of this particular evaluation study based on the following two reasons: (a) the similarity of both studies in context of research setting and (b) the comprehensiveness of the suggested list of attributes which enclose almost all the important academic and non-academic service aspects of a IKBN.

Multi-attribute Decision Making

Management of any organizations rarely makes decisions by considering a single criterion or attribute. They usually take into account all the possible attributes that are pertinent to the existing decision problems as omitting any influential attribute may then result into faulty decisions. A series of meetings or brainstorming sessions involving the members of the organizations are typically held as to seek the solutions for such decision problems. Nevertheless, it is a fact that the complexity involved in the process of making the final decisions usually grows tremendously as the number of attributes considered in the decision problem increases, thus proper decisions may not be achieved easily (Krishnan, 2017). Even developing the right strategies for enhancing students' satisfaction towards IKBNs is complex as it involves contemplation.

This scenario hinting that there is always a demand for systematic techniques that could furnish some useful numerical information to the decision makers as to enable them to identify and implement the optimal decisions with better confidence. As a result, multi-attribute decision making (MADM) has recently emerged as one important branch of study in decision sciences (Triantaphyllou, 2000). Scholars in the area of MCDM have never failed in offering new techniques or improving the existing techniques as to help the decision makers to analytically deal with the decision problems that usually entails a wide-range of conflicting attributes (Hwang & Yoon, 1981).

Although there are many types of MADM techniques, in the following section, we merely review two important MADM techniques, namely analytical hierarchy process (AHP) and DEMATEL.

AHP

Ever since its introduction by Thomas L. Saaty in the 1970s (Saaty, 1980), the application of AHP has found to be making inroads into many disciplines such as education, healthcare, defence, business, environmental management and engineering, thanks to its ability in decomposing and organizing all the elements (e.g. options or attributes) involved in a complex decision problem into a simpler hierarchical structure. Not to mention its ability in quantifying the weight of every element that characterizes a decision problem or goal, be it a tangible or an intangible element. A review on past literature reveals that AHP has broadly and successfully been employed as a tool for identifying the finest possible courses of action in achieving a decision goal based on the weight computed on the decision attributes.

Suppose $C = c_1, c_2, \dots, c_n$ represents the n number of attributes that independently contribute to a decision goal. The basic steps involved in deriving the weights of attributes using AHP with respect to the decision goal can then be summarized as follows. Firstly, the relative importance between the attributes are compared pair-wisely where the preferences can be expressed by adhering to Saaty's 1 – 9 linear scale as summarized in Table 1 (Ishizaka & Labib, 2011).

At the end of the evaluation, a pair-wise comparison matrix as shown in equation (1) is obtained. According to matrix *A*, a_{12} represents the quantified judgment when c_1 compared to c_2. The similar interpretation applies to other values in the matrix. One important feature in AHP pair-wise comparison is that since c_1 compared to c_2 is a_{12}, then value of c_2 compared to c_1 should be the reciprocal of a_{12} (i.e. $a_{21} = 1/a_{12}$).

Table 1: Saaty's AHP Scale

Rating	Description
1	Two elements, *i* and *j* contribute equally
3	*i* is slightly favoured over *j*
5	*i* is strongly favoured over *j*
7	*i* is very strongly favoured over *j*
9	*i* is most favoured over *j*
2, 4, 6, 8	Used to compromise between two judgments
Reciprocal values $(\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \frac{1}{5}, \frac{1}{6}, \frac{1}{7}, \frac{1}{8}, \frac{1}{9})$	If *i* has one of the above ratings when compared to *j*, then *j* has the reciprocal value when compared to *i*

$$A = [a_{ij}] = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ a_{21} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & 1 \end{bmatrix} \quad (1)$$

Then, the priorities of the attributes in matrix *A* in terms of their contribution to the overall goal can be identified through the commonly used eigenvalue method (Dong, Zhang, Hong & Xu, 2010). The computational process involved in the eigenvalue method can further be explained as follows. First, the values in each column of the pair-wise comparison matrix are summed. Second, each value in the pair-wise comparison matrix is divided by its column total as to derive the normalized pair-wise comparison matrix. Third, the average of the values in each row of the normalized pair-wise comparison matrix is computed. These averages represent the priorities of the attributes.

One important merit of AHP analysis is that it is packaged with a scheme to measure the degree of consistency in the pair-wise evaluations performed by the respondents. The consistency ratio (CR) of each pair-wise comparison matrix in the analysis can actually be computed based on a specific formula, and those matrices with the CR exceeding the threshold, 0.1 can be considered as highly inconsistent. The inconsistent matrices may then be excluded from the analysis or a re-evaluation may be performed if the respondents involved can really be reached again (Ho, 2008).

However, recently, Engku et al. (2016) has introduced a revised AHP approach which is able to assure the priorities of the elements are always being derived from a consistent pair-wise matrix. All the steps involved in the usage of this version of AHP similar to the original one, but it differs in terms of the process involved in obtaining the pair-wise comparison matrix. In this revised AHP analysis, the respondent merely needs to rate the importance of each element towards the decision goal based on a 9-point Likert scale, instead of pair-wisely comparing them based on the usual 1/9 to 9 scales. These ratings are then converted accordingly into a pair-wise comparison matrix using certain formulas.

In detail, suppose that there are n attributes that determine the achievement of a decision goal. A respondent then needs to rate the importance of these attributes with respect to the goal based on the 9-point Likert scale, where 1 and 9 indicate "least important" and "most important", respectively. Now, assume that the respondent has rated attribute i as r_i and attribute j as r_j, the pair-wise comparison value of attribute i over j (i.e. c_{ij}) can then be determined using the following equations:

$$\begin{aligned} &\text{Let } b = r_i - r_j \\ &\text{If } b > 0, \text{ then } c_{ij} = b + 1 \\ &\text{If } b = 0, \text{ then } c_{ij} = 1 \\ &\text{If } b < 0, \text{ then } c_{ij} = 1/(1 - b) \end{aligned} \tag{2}$$

Through a simple experiment, Engku et al. (2016) have proved that the CR of the pair-wise comparison matrix obtained by converting the importance ratings using equations in (2) can always be maintained below 0.1.

On the other note, it has to be mentioned herein that AHP can also be applied in group decision making environment that involves the participation of more than one expert or respondent. The group-based AHP methods can be classified into two categories namely aggregation of individual judgments (AIJ) and aggregation of individual weights (AIW) (Forman & Peniwati, 1998). AIJ is normally performed using the geometric mean, whereas AIW is usually performed via arithmetic mean (Angiz et al., 2012).

DEMATEL

DEMATEL was originally developed by Science and Human Affairs Program of the Battele Memorial Institute of Geneva with the intention to understand and solve complex or intertwined systems (Fontela & Gabus, 1976). Lately, the use of DEMATEL has been expanding into various areas due to its ability in visualizing the structure of complicated causal relationships via matrices or digraphs (Wu & Lee, 2007). These matrices or digraphs portray the interdependence relationships and the strength of influence among the elements in the systems (Tseng, 2009). The method, which is developed based on graph theory, splits the involved elements or the evaluation attributes into cause and effect group (Falatoonitoosi, Ahmed & Sorooshian, 2014; Hsu, Chen & Tseng, 2007). The main four steps for implementing DEMATEL can be summarized as follow (Tzeng, Chiang & Li, 2007):

i. In step 1, each respondent is requested to specify the direct influence between any two attributes based on a 0 – 4 where 0, 1, 2, 3, and 4 represent "no influence", "low influence", "medium influence", "high influence", and "very high influence", respectively. The $n \times n$ non-negative matrix resulted from each respondent can be denoted as $Z^k = [z_{ij}^k]$ where n is the number of attributes, k represents the the kth DM with $1 \leqslant k \leqslant H$, and z_{ij} is the degree to which the respondent believes attribute i affects attribute j. For $i = j$, the diagonal elements in the matrix are set to zero, indicating no influence. All the matrices obtained from H respondents, $Z^1, Z^2, \cdots, Z^H$ are then aggregated using equation (5) in order to derive the average matrix, $A = [aij]$:

$$[a_{ij}] = \frac{1}{H}\sum_{k=1}^{H} z_{ij}^k \tag{5}$$

ii. In step 2, the normalized initial direct-relation matrix, D is computed by finding the product between A and S where:

$$S = \frac{1}{\max\limits_{1 \le i \le n} \sum_{j=1}^{n} a_{ij}} \quad (6)$$

iii. In step 3, the total relation matrix, T is identified using equation (7):

$$T = D(I - D)^{-1} \quad (7)$$

where I is the identity matrix. Presume r_i be the sum of ith row in matrix T, then r_i reflects both direct and indirect effects given by attribute i to the other attributes. If c_j denotes the sum of jth column in matrix T, then c_j shows both direct and indirect effects by attribute j from the other factors. When $j = i$, the sum $(r_i + c_j)$ shows the total effects given and received by attribute i or in other words, it indicates the degree of importance that attribute i plays in the entire system. Meanwhile, the difference $(r_i - c_j)$ implies the net effect that attribute i contributes to the system. In general, if $(r_i - c_j)$ is positive, the attribute can be labelled as a net cause, whereas negative $(r_i - c_j)$ implies that the attribute is a net receiver.

iv. In step 4, since matrix T provides information on how one attribute affects another, it is essential for the DMs to determine a threshold value to disregard some trivial effects and only depict the effects that are really significant in the yet-to-be-developed digraph. The threshold value can be determined by the DMs based on their experience or by computing the average of the elements in matrix T. After setting up the threshold value, the digraph can then be constructed by mapping the dataset of $(r + c, r - c)$.

Proposed Procedure

In this section, we introduce the procedure that has been developed as to achieve the ultimate objective of this investigation (i.e. to quantitatively identify the optimal strategies to improve the students' satisfaction towards the IKBNs operating across East Malaysia). The procedure is developed by integrating the following key techniques: DELPHI survey, factor analysis, and not to mention the two MADM techniques discussed in the previous section, namely modified AHP and DEMATEL. On the whole, the implementation of the procedure entails eight crucial phases as presented in Figure 1. The complete information regarding the processes and purposes involved in each phase can be found in the following sections.

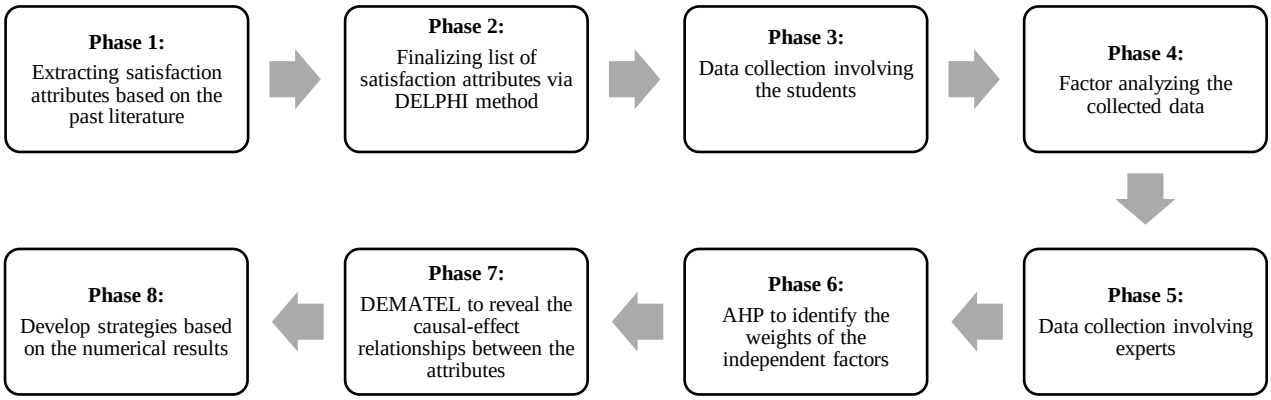

Figure 1: Proposed procedure

Phase 1

In Phase 1, the important attributes that have been used in past studies to define students' satisfaction towards TVET intuitions are explored and listed. As studies on IKBNs are too limited, the attributes used in studies involving any TVETs will be considered as the proxies of this analysis. However, as decided in section 2.1, it has to be reminded herein that this study will use the service attributes proposed by Ibrahim et al. (2014) as the foundation to initiate this specific analysis.

Phase 2

In Phase 2, a modified DELPHI survey as what has been proposed by Wang et al. (2016) will be utilized as to finalize the list of satisfaction attributes that will be used for this study. A minimum of 10 experts will be identified for this survey purpose among whom will consists of executive staff serving in the involved IKBNs as well as the scholars with ample expertise in TVET field. Overall, the survey will involve two rounds.

In round 1, the experts will be provided with an initial list of attributes developed based on the findings from Phase 1, and requested to rate the significance of the attributes in influencing a student's satisfaction towards an IKBN based on a 5-point Likert scale. The experts will also be given with an opportunity to provide suggestions if there are any missing attributes that should be added to the given list, certainly with some reasonable justifications. A new list of attributes will then be formed by eliminating the attributes with the average rating below than a predetermined threshold rating. The suggestions provided by the experts will also be considered in the process of forming the new set of attributes.

In round 2, a reassessment will be conducted based on the new list of attributes, involving the same panel of experts. The finalized list of attributes that should be maintained to the next stage of analysis will then be determined by adhering to the similar approach described in the preceding round (i.e. by computing and comparing the average rating of each attribute with the pre-determined threshold rating).

Phase 3

In Phase 3, a questionnaire will be developed based on the attributes finalized in Phase 2. It will be used as an instrument to collect the data required from the respondents before performing factor analysis. The sample of respondents at this stage will comprise students from the all the IKBNs situated in East Malaysia. The sample size will be determined by adhering to the rule of '10 observations per attribute' as to ensure a meaningful factor analysis result. The respondents (students) for the data collection purpose will be selected through systematic random stratified sampling approach as students residing in IKBN hostels are 'naturally' grouped by block and gender.

The content validity of the instrument can be presumed to be adequate as it will be developed based on the feedbacks provided by experts in Phase 2. However, as a cautious measure, prior to the actual data collection process, the questionnaire will still be pre-tested as to detect and alter any complex or confusing terms or phrases therein. The pre-testing may involve a small group of students from any nearest TVET institute.

In general, the questionnaire will be structured into two main sections. Section 1 is mainly designed as to gather some basic yet important information about the respondents (e.g. country of origin and type of treatments undergone), whilst in section 2 the respondents will be

requested to express their personal opinion on the importance of each healthcare service quality attribute based on a 5-point Likert scale.

Phase 4

In Phase 4, the data collected in Phase 3 will be used as to perform factor analysis. As the result, the large, complex set of satisfaction attributes will then be simplified into fewer independent factors. Note that although the extracted factors are independent from each other, the attributes describing each factor may still have some degree of interactions.

Phase 5

In Phase 5, the inputs that will require the same group of experts involved in Phase 2 will be approached again as to request them to pair-wisely compare the relative importance of the extracted dimensions, based on a predetermined fuzzy AHP scale. The questionnaire that will be used will consist two major sections. In section 1, they will be requested to rate the importance of the attributes against their respective factors based on a 9-point Likert scale. Meanwhile, in section 2, the experts will need to indicate the direct influence that they believe each attribute exerts on each of the others based on a 0 – 4 integer scale.

Phase 6

In Phase 6, the importance ratings given by each expert at Section 1 will be utilized as to compute the individual priority score of each independent factor using the modified AHP method (refer section 2.1). The final priority of each factor will then be identified by aggregating the individual priorities derived through all the experts involved.

Phase 7

In Phase 7, the information on the 'direct influence' provided at Section 2 of the questionnaire will then be utilized as to mathematically expose the actual causal-effect relationships between the attributes within each factor using DEMATEL.

Phase 8

In Phase 8, the strategies for improving the students' satisfaction are developed mainly by adhering to the priorities of extracted factors as well as the mapped causal-effect diagraphs.

Conclusion

This paper begins by emphasizing the necessity for a research that applies an alternate quantitative approach as to enable the management to make better-informed decisions regarding the strategies for improving the satisfaction of students studying and residing in IKBNs located across East Malaysia. Subsequently, a hybrid MADM procedure which integrates four quantitative decision techniques, namely DELPHI, factor analysis, modified AHP, and DEMATEL was introduced. The complete step-by-step elucidation on the usage of the procedure, right from the stage of determining the evaluation attributes up to interpreting the results, was provided herein. Post of actual implementation, this research is expected to deliver some important values that can be described based on the following three different perspectives.

Firstly, in the context of decision science, this study will introduce a new, feasible hybrid quantitative procedure to the field of MADM. The proposed procedure will be suitable to be applied for achieving any decision goals that involve the presence of multiple qualitative

factors or attributes that are naturally difficult to measure, and at the same time possess some degree of interactions. The overall merits of the procedure can actually be summarized as follows: (a) it extracts the actual dimensions explaining the attributes involved in the analysis, (b) it measures the priority or influence of each extracted dimension towards the decision goal, and (c) it systematically uncovers the causal-effect relations between the attributes describing each dimension.

Secondly, from a managerial perspective, it is expected that the hybrid MADM procedure will comfort the key players of East Malaysia IKBNs to make better-informed, precise decisions in developing the ideal strategies for enhancing the students' satisfaction, especially by understanding the priorities of the dimensions and causal relationships between the attributes.

Lastly, from TVET literature viewpoint, this study can be regarded as one petty endeavour to further diversify the discussion on choice of techniques used in developing strategies to improve satisfaction or service quality which appear to be limited thus far. This study may analyze the students' satisfaction towards the IKBNs with a different yet comprehensive set of satisfaction attributes, not to mention the use of different empirical approach (i.e. non-parametric MADM techniques).

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