MODEL OF ENGINEERING STUDENTS' GENERIC SKILLS: CONFIRMATORY FACTOR ANALYSIS

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ABSTRACT

This survey study was carried out to review the generic skills (GS) model for engineering students. A total of 527 respondents were involved in this research. The variables presented in this research were the skill of gathering and analyzing information, communication skill, team working skill, problem solving skill, life long learning skill, technology utilization skill, critis and creative thinking skill, entrepreunuership, leadership and personal qualities. Data were analyzed descriptively for reliability (Cronbach Alpha values) and confirmatory factor analysis (CFA) was used to obtain 10 factor solutions using AMOS software. The results showed that the Cronbach Alpha was on the classification of high and very high which was higher than 0.70. Result of second order CFA confirmed 10 factors solution with data collected was fit with model. The study also proposed a model of generic skills for engineering students.

KEYWORDS*: generic skills, engineering students, confirmatory factor analysis.*

1.0 INTRODUCTION

In Malaysia, human capital development will be a major boost in the Ninth Malaysia Plan period. Kamal Khir (2006) says that graduates possess less technical knowledge and generic skills. Kamal Khir (2006), lack of competence is causing new problems for the graduates which is unemployment. Economic Planning Unit (2006) showed that in 2005, there were about 3.5% of unemployed graduates and this continued to 2010.

Economic Planning Unit (EPU) described the economic growth of Malaysia in phases. The first phase began in 1957 to 1970. Economy at that time was very dependent on the production of rubber and tin. This revenue source contributed 70% of national income and 36% of the total workforce (EPU, 2005). The government at that time focused on agriculture. The second phase is known as the High Growth with Equity. EPU (2005) states that, at this stage the economy was showing some progress, but plagued by social problems and limited by the small domestic economy. Malaysia has three main ethnic groups namely Malays, Indians and Chinese. Thus, the government launched the New Economic Policy (NEP) to address the ethnic economy inequalities. During this period, the Gross Domestic Product (GDP) declined drastically. The third phase began in 1984 and lasted until 1990. However, in 1987 the economy began to recover. In the era of the eighties, in order to sustain economic growth, the government decided to make major changes in the economic system which was changing from agricultural to industrial economies.

The fourth phase began with the declaration of the vision 2020 and the economic development in the nineties showed positive growth. In addition, to become a developed nation by 2020, it is very important for the country to switch from Product-based economy (p-economy) to the Knowledge-based Economy (K-economy). Beginning with the Seventh Malaysia Plan (1996-2000), Eighth Malaysia Plan (2001-2005) and especially in the Ninth Malaysia Plan (2006-2010), the government placed emphasis on the importance of information technology. It has only one aim, which was to improve and facilitate the use of technology to create new technologies, new knowledge and new wealth (Halimah, 2004).

The shift to the k-economy is part of a broader plan to achieve the goals of Vision 2020. According to the plan within 30 years, Malaysia will be able to achieve continuous growth in GDP and a high level of productivity to be one of the developed countries. According to the Department of Economic Research (ERSD), it is expected that through information and knowledge-based economy, the GDP could increase four-fold within 20-23 years (ERSD, 2000). Besides k-workers, the k-economy is highly dependent on the use of information technology. Unfortunately, facilities and Internet usage is low (MSC, 2005). Overall, Malaysia needs to review and upgrade all the factors that will facilitate the development of knowledge-based economy. However, human capital is an important factor in the success of the k-economy (Siti Rohaida 2005).

In the transition to knowledge-based economy, Malaysia put the primary responsibility on human capital development (Halimah, 2004). Human capital is the backbone of the k-economy. They are versatile, autonomous, highly skilled and able to utilize and develop the knowledge to make decisions and actions using analytical skills. The success of the k-economy is very dependent on human capital; human capital demand to work in the field of information technology and high technology industry has drastically increased (Siti Rohaida 2005). According to Sanguinetti (2004),

> *"The emphasis on generic skills is part of the move towards developing 'human capital' to meet the demands of the 'new knowledge economy'. Economic output is becoming more information and knowledge- intensive and thus there needs to be a continual upgrading of the skills and competencies of the workforce".* (Sanguinetti 2004, pg 2).

Therefore it's crucial to develop generic skills model among student in order to help them prepare for globalization. This study aimed to develop generic skils model among engineering student.

2.0 METHODOLOGY

A total of 600 questionnaires were distributed to eight technical institutions in the country. The percentage of questionnaires that can be used is 527 (88%). Samples were adequate based on the recommendations of Hair, Anderson, Tathan, and Black (2006), in utilizing the CFA technique, the number of samples must exceed 500 if the number of constructs is more than six, some of constructs measured has less than three items and the communalities are low. Researchers are also suggested to increase the number of samples if they encounter any of these conditions (1) data displays abnormal characteristics, (2) using alternative estimation procedure, and (3) anticipating more than 10% of missing data.

The participants were 527 final semester diploma students (337 males, 190 females) from eight technical institutions in the country. All participants belonged to the same cohort and were all enrolled in engineering programme. They were selected randomly to complete the questionnaires and the measures were administered during regular class sessions coordinated with help from lecturers. Students were briefed on the nature of the questionnaires and confidentiality was confirmed. They were allowed as much time as they needed to complete the questionnaires, typically requiring 25 to 35 minutes. Further, Confirmatory Factor Analysis (CFA) are employed because these

analyses provide stronger tests of validity and allow for more options in the design of predefined multivariate models. The questionnaire used in this study was adapted from past study (Seri Bunian et.al., 2011; Saemah *et.al*., 2011a; Saemah *et.al*., 2011b) and has prove its reliability (The Cronbach's alpha values > 0.70) and preliminary evidence of its validity.

3.0 RESULTS AND DISCUSSION

3.1 Reliability

Internal consistency reliability to test unidimensionality was assessed by Cronbach's alpha. The resulting alpha values ranged from 0.78 to 0.90, which were above the acceptable threshold 0.70 suggested by Babbie (1992). According to Babbie (1992), the value of Cronbach Alpha is classified based on the reliability index classification where 0.90-1.00 is very high, 0.70-0.89 is high, 0.30-0.69 is moderate, and 0.00 to 0.30 is low. The analysis showed the Cronbach Alpha value, higher than 0.70, falls into the classification of high and very high.

Table 2: Cronbach alpha reliability values for the variables

Variables	Items	Rejected Items	Alpha Cronbach Value
Information Management Skills	5	-	0.83
Basic Skills	6	-	0.83
Team Working Skills	5	-	0.89
Problem Solving Skills	5	-	0.85
Life Long Learning Skills	5	-	0.77
Technology Utilizing Skill	6	-	0.80
Entrepreneurship	6	-	0.88
Critical and Creative Thinking Skill	5	-	0.87
Leadership	6	-	0.87
Personal Qualities	6	-	0.87

3.2 Confiramatory Factor Analysis

The research instrument used confirmatory factor analysis (CFA) to examine the reliability and validity. The analysis was done as proposed by Byrne (2010), where if the hypothesized model was modified; a new sample from the same population should be used for cross validation model. However, according to Byrne (2010), due to constraints in time and finance, sample splitting can be done. Data from the sample (n = 527) obtained was split into two parts, the sample A and sample B. In this study, the sample was randomly split using the SPSS 17 software into two groups; where the first group or sample A (n = 264) and the second group or sample B (n = 263).

The confirmatory factor analysis (CFA) was conducted on sample A as the hypothesized model and sample B (n = 263) as the cross validation model. If the cross validation model could confirm the modifications done in the hypothesized model, the cross validation model will be used as the hypothesized model in the Structural Equation Model representing all the samples (n = 527). After that, the normality tests were carried out for both sample using skewness and kurtosis values. Skewness and kurtosis values ranging from +3 to - 3 shows the data is normal scattered and parametric tests can be carried out (Kline, 2005). Descriptive analysis results found that all items are in the range from +3 to - 3. Thus it can be concluded that the data for both sample is normal.

Therefore, Confirmatory factor analysis (CFA) was conducted on the first order measurement model for generic skills instrument based on 10 hypothesized factors using Analysis Moment of Structure - AMOS version 18. CFA models are tested by examining the goodness of fit of the model against the data collected to measure the variables included in the model. Assessment of model fit was based on multiple criteria including both absolute misfit and relative fit indexes. The absolute misfit indexes included the Root Mean Square Error of Approximation (RMSEA; Hair *et.al* 2006) and the relative goodness-of-fit index used in the study were the Comparative Fit Index, Tucker Lewis Index and Incremental-Fit-Index (CFI, TLI, IFI; Hair *et.al* 2006). Arbuckle (1997; Arbuckle and Wothke (1999) state that a model is fit when the index showed: (i) the value of CMIN / df between 1 and 5, considered acceptable or acceptable fit between model and data, (ii), indices of CFI and TLI approaching 1.00 shows a suitable fit, and (iii) the RMSEA index of 0.08 or less indicates a reasonable error and can be accepted.

Confirmatory Factor Analysis on the ten factors of generic skills showed the model do not fit the data of sample A (n = 264). Therefore, modifications were done to the model according to the guide provided by Hair *et.al* (2006) where some of the information was checked. Modification steps are as follows;

a. Review of the factor loading of each item where it must exceed 0.50, and remove the items that do not meet this criterion.
b. Review of the standardized residual where the items with value of more than 2.58 will be dropped.
c. Review of the modification index to improve the model.

Modified model was tested again from sample A (n = 264) and the results of CFA indicated a better fit. Thus, the modified model becomes the hypothesized model for the sample B (n = 263). Then, CFA was conducted on sample B (n = 263) for cross-validation of the previous model. The overall fit of the ten factors generic skills cross validation model shows it is fit and can be accepted based on the indicators recommended by Arbuckle (1997), Arbuckle and Wothke (1999), Hair *et.al* (2006). Degrees of freedom indices, CMIN / df = 1.706, CFI =0.907, TLI =0.900, IFI= 0.909, and RMSEA = 0.052, indicates that the data from sample B (n = 263) were fit with the cross validation model. Second order measurement model also been conducted to ten factor generic skills model in order to convert latent variables to become indicators in measuring generic skills. Result showed that that second order measurement model was fit with data collected from 527 samples. Degrees of freedom indices, CMIN/df = 2.012, CFI=.929, TLI=.924, IFI= 0.929 and RMSEA=.044, indicates that the data from sample (n = 527) were fit.

4.0 CONCLUSION

The results showed that the Cronbach Alpha value classification is high and very high, which was more than 0.70. This instrument had high reliability in accordance with the classification of Babbie (1992). The final model indicated ten factors measurement model of generic skills which are;

i.) Information Management Skills
ii.) Basic Skills
iii.) Team Working Skills
iv.) Problem Solving Skills
v.) Life Long Learning Skills
vi.) Technology Utilizing Skill
vii.) Entrepreneurship
viii.) Critical and Creative Thinking Skill
ix.) Leadership
x.) Personal Qualities

Each item shows a satisfactory loading of more than 0.5 (Hair *et.al.,*) and the model showed goodness-of-fit. Thus, the model developed is suitable to be used to study the generic skills acquire by engineering students in the context of education in Malaysia.

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