*Journal of Asian Vocational Education and Training (2014) **6**, 1-9*

Verification of Employability Skills Inventory using Confirmatory Factor Analysis

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ABSTRACT

This study was carried out to validate an instrument used to measure employability skills of engineering students. A total of 535 respondents were involved in this study. Ten components were included to measure the employability skills namely: critical thinking and problem solving skills, lifelong learning and information management skills, communication skills, team work skills, technology utilizing skills, entrepreneurship, leadership, ethic and moral, social skills and spirituality. Confirmatory factor analysis (CFA) was conducted to obtain 10 factor solutions using AMOS software. The results showed that the value of Cronbach alpha is higher than 0.80. The results of the second order CFA confirm that the data was fit with the model. It is found that the instrument with 52 items based on 10 factor model can be used to measure the employability skills of engineering students.

Keywords Employability Skills; Confirmatory Factor Analysis; Instrument; AMOS, engineering students, technical institution

INTRODUCTION

Employability skill is one of the skills that will be valued by employers other than technical skills before being employed. Graduates mastering technical and employability skills have a better chance to fill the position offered by the employer. Mastering employability skills among graduates not only are getting attention in Malaysia but throughout the world. However, variety names were given to employability skills by countries such as 'essential skill' (New Zealand), 'generic skill' (Australia), 'necessary skill' (United States), 'transferable skills' (France) and 'key qualification' (Germany) (National Centre for Vocational Education Research, 2003).

The importance of mastering employability skills has gained attention and challenges by policy makers (Conford, 2005). Employers sometimes find employability skills other than academic to be important in the recruitment process (Yusoff et al., 2010). Therefore, Lankard (1995) identified seven categories of employability skills: (1) Demonstrate a positive image, (2) Demonstration of positive work behaviour, (3) Practice good work habits, (4) To be ethical, (5) Communicate effectively, (6) Accept responsibility, and (7) Being co-operative. Employability skills study was done by Husain et al. (2010), involving 180 employers from three categories of companies, namely the size of the company, type of company and the ownership status. The findings showed that personal quality, interpersonal skills, resources skills and basic employability skills are skills crucial to the employer. Rasul et al. (2013) conducted a study to investigate the level of employability skills among engineering and

technical institutions students from the employers' perspectives. Results showed that the employability skills level among engineering students is moderately high. According to Azami et al. (2009) engineering graduates should acquire employability skills such as communication skills, problem solving and interpersonal skills.

There are other studies on the attributes required by employers to address the changing work environment. Attributes studied include communication skills, self-confidence, sensitive to change and teamwork. Quek (2005) in his study found that interaction skills, skills to acquire knowledge and flexibility have a significant relationship with a successful career. The findings clearly focused on employability skills in demand among employees to survive in the era of globalization. Flexible workforce, skilled technical and employability skills such as creative thinking, problem solving and analytical skills will get a position in the industry to meet the challenges faced in businesses. Robinson (2006) and Godwin (2006) stated that employability skills are very important for the working environment. Employability skills requirements have been a catalyst of change in the education system (Bennett, 2006).

Study by Tahir (2010) in Malaysia, using attributes model by the Ministry of Higher Education Malaysia (2006) has seen the development of employability skills among final year students' from Community College Malaysia. Employability skills that are required have been studied by researcher in many sectors all over the world (Ballantine & Larres, 2007; Hiyang & Halim, 2010; Clark & Zukas, 2013; Boadman, 2008; Robinson, 2006; Burgaz, 2008; Kazilan et al., 2009; Ramli et al., 2010; Suleiman et al., 2006; Mitchell, 2008). This study shows the importance of employability skills in all areas of employment and should be given serious attention by all educational institutions.

STATEMENT OF THE PROBLEM

From literatures, Malaysia should have an education system that is capable of leading the industry requirements as well as producing first-class human capital. Human capital requires technical and employability skills in order to adapt to the social, economic and environmental. Graduates employability becomes major critical issue whereby flaws occur in embedding employability skills among graduates. Yunus et al. (2007) believe this is the weakness of adult graduates in both two skills; technical and employability skills. Workforce with employability skills can be facing changes to social and economic conditions which are constantly changing (Clark, 2011). The education system and skilled workforce are the key weapons for a country in facing global competition (Mustapha, 2011). The Malaysian education system (technical and vocational) need to devise strategies in shaping measures to improve the quality of graduates being produced. According to Idris (2010) and Mokhtar (2012), emphasized from a number of studies in Malaysia that a suitable valid measurement tool is still lacking for measuring the skills and employability. Measuring the level of employability skills among graduates need to be addressed by educational institutions to meet the needs of employers that emphasizes mastery of employability skills among graduates. Therefore, this study should be conducted to construct an instrument that is valid and reliable for measuring the development of employability skills in the learning environment of engineering students.

CONCEPTUAL FRAMEWORK

Figure 1 showed the conceptual framework of this study. Analytical model and instrument employability have been done from SCANS (1991), The Conference Board (1996), Mayer

(1992) Kearns (2001), Malaysia Qualification Framework (2006), Ministry of Higher Education Malaysia (2006), Abdullah & Kamaludin (2007), Kaur & Sharma (2008), Idris (2010), Najmuddin (2011), Tahir (2010) and Rasul et al. (2008).

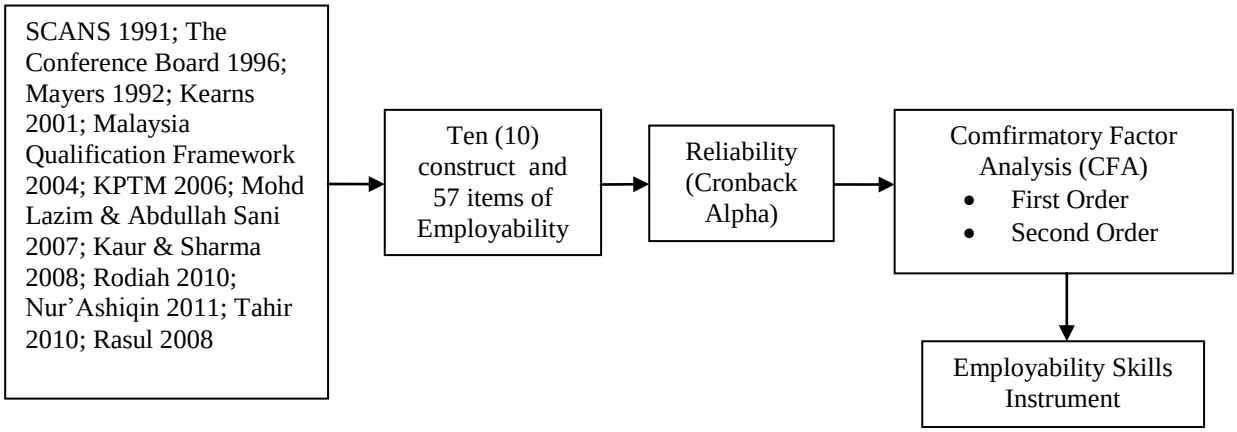

Figure 1: Conceptual Framework

METHODOLOGY

The sample consists of randomly selected students based on systematic sampling by Krejcie and Morgan (1970), which has a population of 10501 students and the number of sample size is 373. A total of 600 questionnaires were distributed to students in their final semester and a total of 535 questionnaires are usable. This study using a survey instrument consists of 2 parts, Part A and Part B. Part A contains demographic information. Part B contains 55 employability skills items (ES), which measures students' perception on employability skills development through attended programs based on by ten constructs.

Analytical models of employability skills have been done to determine the essential skills for graduates in order to construct inclusive employability skills in these instruments. List by analyzing the models were examined and a set of employability skills were produced. Although there are differences in terms which are not consistent, but there is agreement between the models studied that all graduates need to develop skills in the list below. As a result, there were 10 employability skills development constructs. (1) Critical thinking and problem solving skills, (2) Lifelong learning and information management skills, (3) Communication skills, (4) Team work skills, (5) Technology utilizing skills, (6) Entrepreneurship, (7) Leadership, (8) Ethics and moral, (9) Social skills and (10)Spirituality

With the above mentioned list, researchers produce a combination of a questionnaire to measure employability skills adapted from previous studies (Rasul et al., 2008; Tahir, 2010; Human Capital Skills, 2006; Idris, 2010; Najmuddin, 2011; SCAN, 1999). Employability skills questionnaires adapted modified to evaluate the role of the program attended by students can develop their employability skills. Designed questionnaires were referred to a specialist in the field and have been modified accordingly.

Reliability test (Cronbach Alpha) and conformity factor analysis (CFA) was performed to determine the validity and conformity of constructs. Conformity Factor Analysis (CFA) is conducted on the measurement model based on hypotheses factors used by Analysis Moment of Structure - AMOS version 18. To check the congruity of the measurement model that has 57 items thus congruity index such as: (i) the minimum value of the differences between the observed data and the hypotheses model is divided by degrees of freedom (CMIN

/ df), (ii) Comparative of Fit Index (CFI), (iii) Tucker Lewis Index (TLI), (iv) Incremental-Fit-Index (IFI) and (v) The Root Mean Square Error of Approximation (RMSEA) were checked. Arbuckle (1997), Hair et al. (2006), Arbuckle and Wothke (1999) set out a model corresponds when congruity index showed: (i) CMIN/df with a value between 1 and 5 is considered acceptable or acceptable fit between the model and data, (ii) index CFI, IFI and TLI approaching 1.00 shows a good match, and (iii) index RMSEA .08 or less indicates a reasonable error estimation and it can be accepted.

Next to strengthen the position of the hypothesized constructs, construct validity is done. Construct validity involves the validity of the Convergent Validity and discriminant validity. Convergent Validity were evaluated based on the coefficient of each item loaded significantly ($p < 0.05$) and composite reliability of a latent variables (Anderson & Gerbing, 1988; Fornell & Larcker, 1981). The value of composite reliability more than 0.70 indicate convergent validity is in a good position (Fornell & Larcker, 1981; Hair et al., 2006). Meanwhile, discriminant validity was evaluated by average variance extracted for all 10 constructs which must be less than 0.9. If the value is less than 0.9 constructs, then discriminant validity is achieved (Hair et al, 2006).

RESULTS AND DISCUSSION

Reliability

To get the internal variable consistency, reliability test scale (Cronbach Alpha) was conducted. In this study, all values of Cronbach Alpha internal variable consistency for all variables exceed 0.7. According to Babbie (1992), Cronbach Alpha value is classified into four categories: very high values are from 0.90-1.00, 0.70-0.89 is high, 0.30-0.69 is moderate and 0.00-0.30 is low. Therefore, the analysis results in this study have shown Cronbach Alpha for all variables in high classification. The analysis results of Cronbach Alpha value (Table 1) are in the classification of high and very high, whereby all are higher than 0.70.

Table 1: Alpha Cronbach values for the variables

Variable	Number of item	Number of item deleted	Cronbach Alpha Value
Lifelong learning and information management skills	6	-	0.84
Critical thinking and problem solving skills	5	-	0.81
Spirituality	6	-	0.90
Communication skills	6	-	0.86
Team work skills	5	-	0.90
Leadership	6	-	0.87
Entrepreneurship	6	-	0.90
Ethic and moral	6	-	0.90
Technology utilizing skills	5	-	0.90
Social skills	6	-	0.88

Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis (CFA) was performed to confirm the *employability* skills instruments based on ten hypothetical factors using the Analysis Moment of Structure - AMOS version 18. To check the congruity of the measurement model which has 55 items, thus, matching index as: (i) the minimum value of the differences between the observed data and the hypothesis model is divided by degrees of freedom (CMIN / df), (ii) Comparative of Fit Index (CFI), (iii) Tucker Lewis Index (TLI), (iv) Incremental-Fit-Index (FI) and (v) The Root Mean Square Error of Approximation (RMSEA) were checked.

Confirmatory factor analysis of the ten *employability* skills factors of the hypothesized model were found less compatible with data from a sample of students (n = 535). Thus, modifications to the model were done based Hair et al. (2006) with some of the information being examined. Proposed modifications are as following: (i) Load factor review of each item must exceed 0.50. Fewer items less than 0.50 were removed. (ii) Review the standard residual values between 2.58 and 4.00 be considered to be maintained or dropped while values above 4.00 should be removed, (iii) Review the modification indices to improve the model.

Two (2) items were removed after a review. Minimum requirement is three items per construct as recommended by Hair et al. (2006) and it had been fulfilled. Figure 2 shows the 10 factors measurement model used to measure the *employability* skills which consists of lifelong learning skills and information management, critical thinking and problem solving skills, spirituality, communication, teamwork, leadership, entrepreneurship, ethics and morality, social skills and technology usage, whereby data collected from a sample of students (n = 535) with the 55 number of items. Items from each factors considered in measuring only the latent variables, respectively. Analysis results of the ten factor model *of employability* skills are modified to match and can be accepted based on the indicators recommended by Arbuckle (1997), Arbuckle and Wothke (1999) and (Hair et al., 2006). Congruity index; CMIN / df = 2.006, CFI = .922, TLI = .916, IFI = 0.923 and RMSEA = 0.043 indicates that the data of the sample (n = 535) corresponds to measurement model hypotheses. (Figure 2).

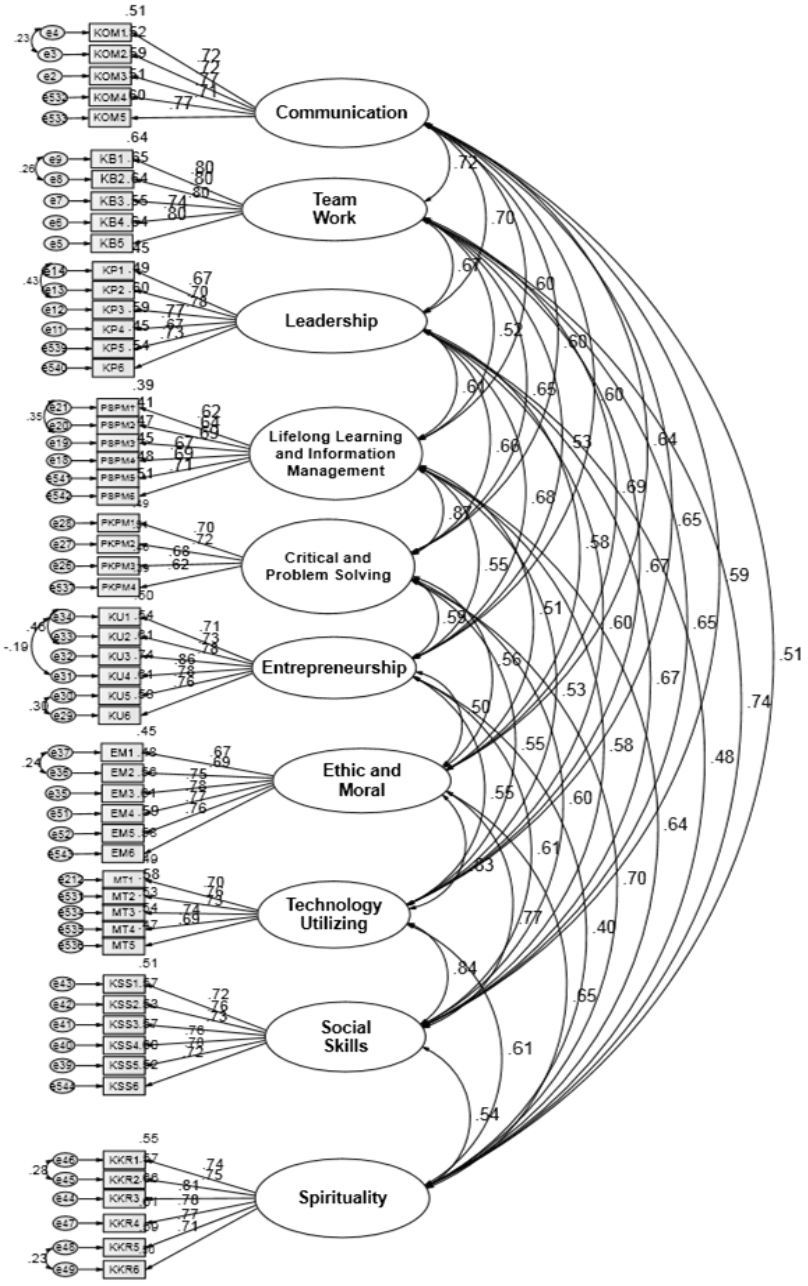

Figure 2: Employability Skills Measurement Model

Table 2 shows the CFA results to measurement model for all 55 items of the developed from review model to measure 10 *employability* skills constructs. All values were obtained from the modified measurement model which was more than the recommended value.

Table 2: Correspondence Index for E*mployability* skills Measurement Model

Fit Index	Hypothesized measurement model (n = 535)	The modified measurement model (n = 535)	The recommended value	Source
χ^2 / df	2315	2006	≤ 5:00	Hair et al. (2006)
CFI	0896	0922	≥ 0.90	Bagozzi & Yi (1988), Hair et al. (2006)
RMSEA	0.050	0.043	≤ 0:08	Browne and Cudeck (1993), Hair et al. (2006)
TLI	0889	0916	≥ 0.90	Bagozzi & Yi (1988), Hair et al. (2006)
IFI	0896	0923	≥ 0.90	Bagozzi & Yi (1988), Hair et al. (2006)

According to Hair et al. (2006), the sample size exceeds 250 respondents require a loading factor of at least 0.35 to determine significant at the .05 level, which determines the strength of an item or indicator relates or measure to a construct or latent variables in a CFA analysis. Based on Table 3, the loading factor for all items shown were all above 0.50. This shows all of the 55 items measuring formed 10 constructs.

While strengthening the position of the constructs in theory, validity test of Convergent Validity and discriminant validity were done. The analysis shows that the lowest Composite reliability was 0.75 surpassed the 0.70 and the Average variance extracted was more than 0.45 with each item loaded significantly exceed the critical ratio + / - 1.96. Meanwhile, the Average variance extracted for all 10 constructs is less than 0.9 (Table 4). Results of this analysis show the Convergent Validity and discriminant validity is achieved.

Table 3: Measurement model CFA results

			Convergent validity	
Construct	Item	Factor loading	Composite reliability[a]	Average variance extracted[b]
Communication skills	KOM1	.715	.857	.546
	KOM2	.721		
	KOM3	.770		
	KOM4	.713		
	KOM5	.772		
Team work skills	KB1	.799	.891	.622
	KB2	.804		
	KB3	.799		
	KB4	.740		
	KB5	.799		

			Convergent validity	
Construct	Item	Factor loading	Composite reliability[a]	Average variance extracted[b]
Leadership	KP1	.671	.867	.521
	KP2	.698		
	KP3	.776		
	KP4	.769		
	KP5	.674		
	KP6	.734		
Lifelong learning and information management skills	PSPM1	.623	.832	.452
	PSPM2	.640		
	PSPM3	.688		
	PSPM4	.672		
	PSPM5	.695		
	PSPM6	.713		
Critical thinking and problem solving skills	PKPM1	.697	.774	.461
	PKPM2	.717		
	PKPM3	.678		
	PKPM4	.621		
Entrepreneurship	KU1	.707	.898	.595
	KU2	.735		
	KU3	.778		
	KU4	.860		
	KU5	.782		
	KU6	.759		
Ethic and moral	EM1	.672	.877	.544
	EM2	.689		
	EM3	.749		
	EM4	.778		
	EM5	.770		
	EM6	.759		
Technology utilizing skills	MT1	.702	.846	.523
	MT2	.760		
	MT3	.727		
	MT4	.737		
	MT5	.689		
Social skills	KSS1	.717	.881	.554
	KSS2	.756		
	KSS3	.730		
	KSS4	.758		
	KSS5	.777		
	KSS6	.722		
Spirituality	KKR1	.739	.892	.580
	KKR2	.753		

			Convergent validity	
Construct	Item	Factor loading	Composite reliability[a]	Average variance extracted[b]
	KKR3	.815		
	KKR4	.783		
	KKR5	.766		
	KKR6	.708		

Table 4: Discriminant validity of the constructs

Constructs	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1)Communication	0.9									
(2)Team work	0.72	0.9								
(3) Leadership	0.70	0.67	0.9							
(4) Lifelong learning and information management	0.60	0.52	0.62	0.9						
(5) Critical thinking and problem solving	0.60	0.65	0.66	0.87	0.9					
(6) Entrepreneurship	0.60	0.53	0.68	0.55	0.60	0.9				
(7) Ethic and moral	0.64	0.69	0.58	0.51	0.56	0.50	0.9			
(8) Technology utilizing	0.66	0.67	0.60	0.53	0.55	0.55	0.83	0.9		
(9) Social skills	0.59	0.65	0.67	0.58	0.60	0.61	0.78	0.84	0.9	
(10) Spirituality	0.51	0.74	0.48	0.64	0.70	0.40	0.65	0.61	0.54	0.9

Next, second order measurement model was conducted on a sample (n = 535) as the hypothesized model on the developed employability skills model. After checking is done, there are three items were removed. Figure 3 shows the model is commensurate with data from a sample based on congruity index CMIN / df = 2.267, CFI = 0.906, TLI = 0.900, IFI = 0.906 and RMSEA = 0.049. Figure 2 shows the measurement model of 10 factors were used to measure the employability skills of lifelong learning skills and information management, critical thinking and problem solving skills, spirituality, communication, teamwork, leadership, entrepreneurship, ethics and morality, social skills and technology usage and data collected from a sample of students (n = 535) with the number of 52 items. The findings showed that the loading factor for all constructs of employability skills is higher, from 0.69 to 0.85. This shows that all 10 constructs that are designed to measure employability skills.

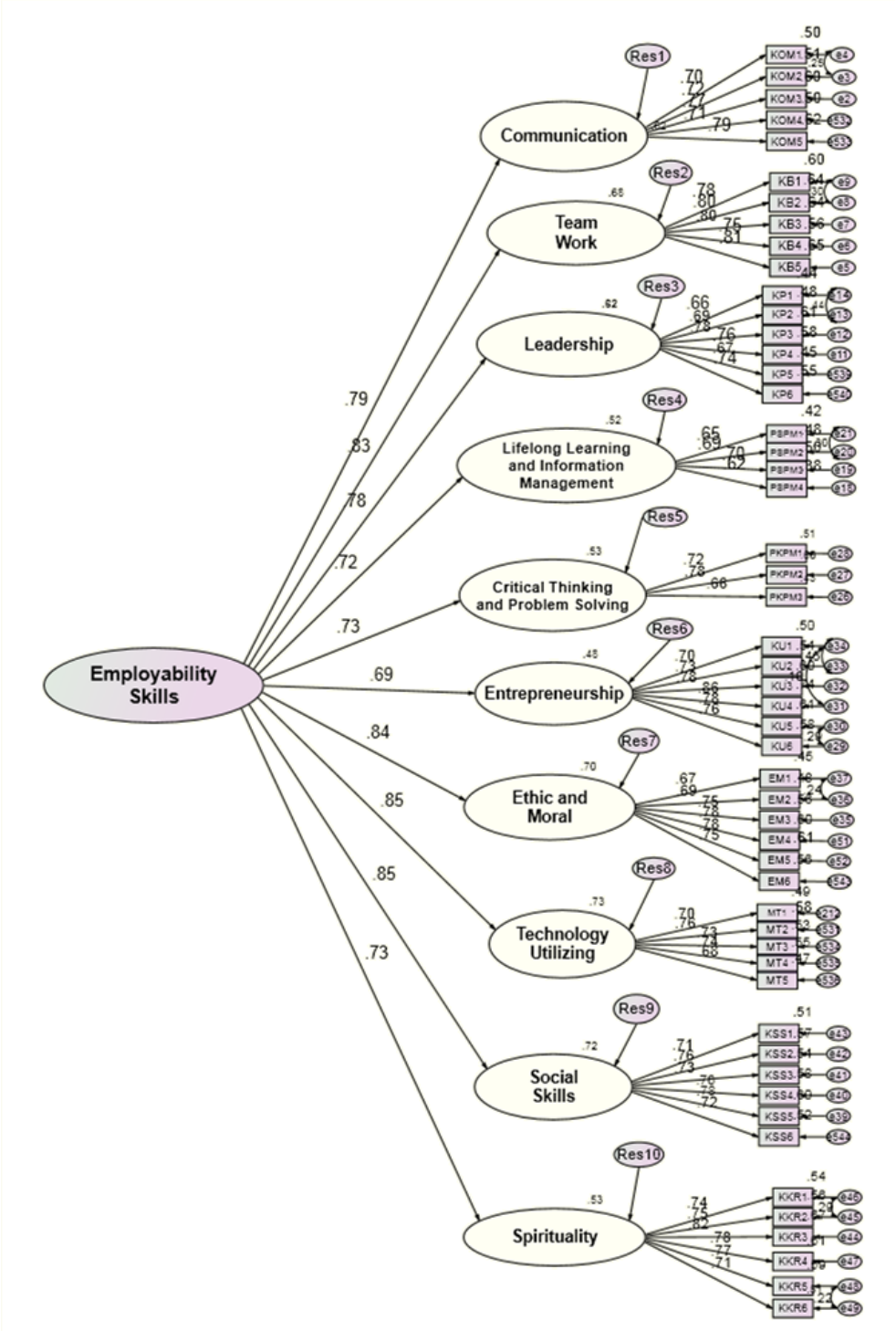

Figure 3: The second order measurement model

Analysis also showed the reliability of the constructs (Table 5) was 0.94 which exceeded 0.70 above the variance extracted value of 0.88, more than 0.50 with each item loaded significantly exceeding the critical ratio + / - 1.96. Results of this analysis showed the convergent validity was achieved.

Table 5: Standardized Loadings and Squared Multiple Correlations (SMC): Second order measurement model - employability skills

Constructs	Standardized Loadings	Squared Multiple Correlations (SMC)	Composite reliability[a]	Average variance extracted[b]
(1)Communication	.788	.621	0.94	0.88
(2)Team work	.827	.684		
(3)Leadership	.784	.615		
(4)Lifelong learning and information management	.723	.523		
(5)Critical thinking and problem solving	.727	.529		
(6)Entrepreneurship	.693	.480		
(7)Ethic and moral	.837	.700		
(8)Technology utilizing	.853	.728		
(9)Social skills	.848	.719		
(10)Spirituality	.729	.532		

DISCUSSION AND IMPLICATIONS

Instruments for measuring the *employability* skills developed in this study are derived from engineering students' data. The instrument was developed through testing reliability scale and confirmatory factor analysis (CFA). Reliability refers to the extent to which the measured instrument can produce a consistent measure (Nitko, 2001). Sekaran (2003), expressing the reliability indices ≥ 0.8 is an acceptable and good index for the expected consistency in the compilation of the logit scale for answers on different sets of items while measuring the same construct. Ary (1985), states that the instrument reliability can be determined by reliability testing where the alpha is 0.8 or close which means the instrument has a high degree of reliability. This is further stressed by Mohd Najib (2003), reliability index is high when the value is above 0.8 and less if it is below 0.8, which meant the item need to be modified. Reliability test scale found Cronbach Alpha value is high and no items were removed. Reliability index of 0.81 till 0.90, indicating that this instrument is consistent and stable if it is administered in other samples that have the same or almost equal characteristics.

Measurement instrument *of employability* skills were conducted for further confirmation. According to Hair et al. (2006), appropriate confirmatory factor analysis performed for the total sample of 200 or more. Thus, the sample in this study met the recommendations of Hair et al. (2006). Prior to confirmatory factor analysis is done, the

normality tests were performed for the sample data using *skewness* and *kurtosis values. Skewness* and *kurtosis* values in the range of +3 to / - 3 shows the data are normally distributed and parametric tests can be carried out (Kline, 2005). Descriptive analysis result found that all the items are in the range of +3 to / - 3. Thus it can be concluded that data for the sample of students, lecturers and employers are normal.

Confirmatory factor analysis was performed, two (2) items that were removed as a result of *the first order* analysis and three (3) items that were removed from the analysis of the *second order* analysis. *Loading* factors shown for all 10 employability skills constructs were high, from 0.693 (Entrepreneurship) to 0.853 (technology usage). This shows that all 10 constructs developed are measuring *employability* skills. These findings are in line with Hulland, Chow and Lam (1996), Rakov and Marcoulides (2000), Di Stefano and Hess (2005), Idris (2010), Najmuddin (2011) stating the value of 0.6 (very good) and 0.70 (Excellent) and above are well received because of the amount of information possessed by the latent constructs which is greater than the variance error. This finding is also in line with Hair et al. (2006) which state that samples size of more than 350 a loading factor of at least 0.30 is needed to determine significance at the 0.05 level, which determines the strength of the items or indicators relating to or measuring a construct or *latent variable* in the CFA analysis. Thus, the loading factor was shown for all 52 items in this study is higher, from 0.693 to 0.853. This shows that all the 52 items measuring 10 *employability* skills constructs were formed.

Employability skills instruments' strength indicates that each item contributed measurement of each construct. All 10 constructs have high construct validity when viewed on the RMSEA which is ≤ 0.08, is acceptable to determine the validity of the constructs. CFI, IFI and TLI values are approaching 1 or ≥ 0.9. This shows instruments can to be used at other times on an ongoing basis for characteristics of the same or almost equal sample group. Results of this analysis show the convergent and discriminant validity of the instrument were achieved.

The implications of this study are based on development of an authentic and reliable instrument to measure the employability skills of engineering students based on the substantial CFA measurement model. Thus, the instrument containing 52 items that measure the model produces a valid and reliable result and can be used in carrying out the assessment of employability skills. The findings of an assessment can be used by respective party or teaching staff in an institution to implement programs that can enhance students' employability skills.

CONCLUSION

The findings of this study demonstrated employability skills measurement instrument consists of 10 constructs of communication skills, teamwork, leadership, lifelong learning and information management, spirituality, critical thinking and problem solving, entrepreneurship, ethics and morality, using technology and social skills are valid and reliable for measuring the employability skills of engineering students. Measurement model first order and second order have the recommended compatibility index of the RMSEA value of ≤ 0.08 and CFI, TLI, IFI value approaching 1 or ≥ 0.9. Loading factor for all 52 items was high. Therefore, it is proposed employability skills measurement instrument can be used to measure employability skills levels among engineering students.

ACKNOWLEDGEMENTS

We extend our sincere appreciation to the engineering students and technical institutes for providing cooperation for the success of this study.

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