Employability Skills Model for Engineering Technology Students

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Abstract: The increasing unemployment rate among youth has affected Malaysian economic growth. This youth with tertiary education were the highest to be unemployed due to lack of experience, lack of labor market information and poor employability skills such as communication. Hence, TVET has become vital field in offering solution to the employability issue. This study aims to develop a prediction model in order to estimate the probability of obtaining high-level employability skills among engineering technology students in one of the technical institutes in Malaysia. A multinomial logistic regression analysis was implemented for this purpose. Through this prediction model, factors that contribute mostly to the high-level employability skills were identified. Using a random sampling technique, 204 engineering technology students from nine technical institutes were chosen to be the respondents of the study. A set of Students' Employability Skills Questionnaire of eleven items that include of Communication (3 items), Problem Solving (3 items), Teamwork (4 items), Planning and organizing (3 items), Creativity or Innovation (3 items), Working with others (3 items), Independent Study (3 items), Numeracy skills (2 items), ICT Skills (3 items), Self-Management (2 items) and Time management (3 items) was distributed. The collected data were analysed using SPSS version 22 in order to obtain multinomial logistic regression output. The result may be utilized by the technical institutes to predict the level of employability skills among engineering technology students for future employment in the job market. This implies a practical alternative for the similar issues among TVET graduates. The identification of lacking factors through the predictive model can be used in preparing the invention programs in order to reduce the unemployment rate among engineering technology graduates who become the job feeder in TVET area. Besides that, the contribution of this study is to fill the gap of the limitation study among TVET graduates as well.

Keywords: Employability skill, engineering technology, multinomial logistic regression

1. Introduction

Employability has been an alarming issue at the global level particularly when the world is moving towards the Fourth Industrial Revolution. Employability determines the economic growth rate of a state. Studies on employability have been done globally including India (Kashal, 2016), The United Kingdom (Creasy, 2013) and China (Su & Zhang, 2015). Similar issue of employability does occur in TVET (Ismail & Mohammed, 2015) which has been debated by Bhurtel (2015) on the importance skills that any TVET based program including engineering technology students should possess. As one of the TVET job feeders, engineering technology students are exposed to the similar employability issues which has been studied by Bakar, Putra, and Fitrisehara (2009) , Ismail and Hassan (2013).

The employability skill can be defined as the ability of an individual to be employed who have the required expertise, knowledge and understanding are in the related field (Lorraine & Sewell, 2007). The capabilities of one's to engage, reflect and articulate in opportunities also defines employability (Awang, Kadaruddin, Najid, & Omar, 2012). Consensus in defining employability is still arguable since some researchers defined the term explicitly and the rest defined implicitly yet one common understanding of employability is about getting a job.

In addition, a relationship exists between employability and economic factors, academic (Awang, et al., 2012) and knowledge (Eby, Butts & Lockwood, 2003) as well as gender (Ang, 2015). In Malaysian context, the unemployment trend seems similar with other countries in the world. However, this is rather prevalent to local universities graduates (Ang, 2015). Furthermore, Ang (2015) has shown findings on mismatch between the students' skills and the industry requirement. Another study by Krish, Mohd Meerah, Osman & Ikhsan (2012) discussed the challenges faced by the Malaysian local graduates in job market. The impact of communication to students' employability has been studied by Mohd Abd Wahab and Ismail (2014); Ahmad Fawzi and Yamat (2017) and another important factor of entrepreneurship skill has become the focus of a study by Tawil, Hassan, Ramlee & K-Batcha (2015) and current job demand (Omar, Abdul Manaf, Mohd, Che Kassim & Abd. Aziz, 2012).

Therefore, certain skills are required in ensuring students a placement in the job market. Several factors have been identified as predictors of students' employability which emphasized that students' family background and education play a vital role in relation to the employability.

Despite the rapid changes in the employment sector, then students have to develop their skills as early as possible particularly at the tertiary level. Some jobs in the past 20 years no longer exist (Fallows & Steven, 2000) which leads to obstacles in the current employment scenario. Besides that, new skills have yet to be discovered in order to be align with the demand of the future job market.

Although previous researches have shown interests in employability yet the scopes varies. However, Kalbande and Handa (2015) produced a predictive model of employability among students in IT sector using logistic regression. Meanwhile (Chandrakumara, 2015) used the same method of logistic regression in order to unveil the unemployment issue among students in Sri Lanka.

Another related issue is the type of analysis has become one of the limitations of the study. Although most studies are conducted using quantitative (Ismail, 2011; Chandrakumara, 2015; Kalbande & Handa, 2015; Yusof, Mustapha, Mohamad & Bunian, 2012; Xu & Zhang, 2015 & Dania, Bakar & Mohamed, 2014) but qualitative method has become an interest among researchers (Lorraine & Sewell, 2007; Ismail & Mohammed, 2015; Su & Zhang, 2015). The quantitative aspect focuses on multiple linear regressions that are widely used in predicting the said variable (Dania et. al., 2014). Besides multiple linear regressions, logistics regression is also considered the analysis in the predictive model (Ismail, 2011). Past research which by Chua, Chuatoco, Mariz, Pena & Jimenez (2017), Pan & Lee (2011) and Sujaat (2011) employed logistic regression in the similar context. The predictive model (logistic regression) is commonly used in predicting the probability of being employed or unemployed. Due to limited related studies in TVET then this method offers alternative, in terms of providing the industry and students on significant factors that contribute to the employability skill particularly to the engineering technology students. Any deficiencies in making TVET as one of the main agenda in nation, the predictive model could be refined so that TVET graduates are highly employed. Any mismatch between industry and TVET institution could be rectified using the proposed model.

2. Methodology

Using a random sampling technique, 204 engineering technology graduates of Universiti Kuala Lumpur (UniKL) were chosen to be respondents of the study. A total of 300 questionnaires were distributed to the graduates during the academic robes collection session in the 13th UniKL Convocation Ceremony. All 300 questionnaires were collected and only 204 questionnaires valid. The 204 selected samples belonged to the same cohort and were all enrolled in engineering technology program.

A set of questionnaire on Students Employability Skill (SES) Questionnaire consisting 32 items using 5 point Likert scale ranging from '1' as 'Strongly Disagree' to '5' as 'Strongly Agree' was used in this study. It was adapted from Yusof et al. (2012) of which eleven factors of Communication (3 items), Problem Solving (3 items), Teamwork (4 items), Planning and organizing (3 items), Creativity or Innovation (3 items), Working with others (3 items), Independent Study (3 items), Numeracy skills (2 items), ICT Skills (3 items), Self-Management (2 items) and Time management (3 items) are included to measure Students Employability Skill (SES). The reliability of SES was at a good level of 0.960 which is consistent as suggested by Hair et al. (2010).

Hence, multinomial logistic regression (MLR) was used to estimate the probability of obtaining high level of SES among graduates and thus identify the predictor variables that contributes mostly to the employability skills. Multinomial linear regression is the extension of classical binomial logistic regression where it allows the dependent variable to be more than two categories. In this study, the level SES can be measured by categorizing the sum responses from Students Employability Skill Questionnaire into three categories including low, moderate and high. Darmawang, Syafrudie, Tuwosa & Muhamad Yahya (2016) categorized the level of employability skills into four categories: very high, high, low and very low. In this study the categorization can be developed based on the following Table 1

Table 1 –SES Categories.

Sum of responses	Interpretation
32 - 85	Low
86 - 138	Moderate
139 - 160	High

Six assumptions before performing the MLR has been fulfilled. Firstly, the dependent variable measured at the nominal level; type of independent variables are varies which include continuous, ordinal and nominal (including dichotomous variables); all observations are independent (each participant is only counted as one observation); no multicollinearity between independent variables (variance inflation factors, VIF values lies between 1-10); linear relationship between continuous independent variables (through scatterplot) and the logit transformation of the dependent variable (logarithm of the odds $p/(1 - p)$ where p is the probability); and lastly no outliers or highly influential points (Statistics.laerd.com, 2018). The goodness-of-fit test, the likelihood ratio Chi-square test, Cox & Snell R^2 and Nagelkerke R^2 measures was utilized to assess the model adequacy and the fit of the final multinomial logistic regression model (Li, Roessler, Rumrill, & Li, 2018).

Meanwhile, the significance of the parameters in the model was tested by using Wald statistic. The Wald statistic represents the significance of each variable in its ability to contribute the model. Since several sources indicate that the Wald statistic is quite conservative, the p-value was also reported in the summary table with a 0.05 level of significance adopted for all statistical tests. Data were analysed using SPSS v22.0. Data were first screened and cleaned for missing data and outliers. Normality testing was performed using Kolmogorov Smirnov test that indicate $p>0.05$ for the outcome measure and thus the outcome measure is normally distributed.

2.1 Demographic Profile

Table 2 shows the cross tabulation of the independent variables and the SES level. The category of SES based on gender indicates that 126 male students have moderate level of employability skills as compared to 28 females. However, only 23 males have high category of SES out of 24 students in total. SES category based on education level reflects that 78 bachelor and 74 diploma level students scored at moderate level respectively. A total of 18 bachelor students and 5 diploma students out of 24 have high level of SES. The SES category based on extracurricular activities shows that similar number of inactive and moderately active students are categorized to moderate level for SES. Only 5 from active category students have high SES level.

Table 2 –Cross tabulation of independent variables and SES levels.

		SES Category			
		Low	Moderate	High	Total
Gender	Male	22	126	23	171
	Female	4	28	1	33
		26	154	24	204
Marital status	Single	26	147	23	196
	Married	0	7	1	8
		26	154	24	204
Employment status	Employed	12	59	5	76
	Unemployed	5	47	13	65
	Student	9	48	6	63
		26	154	24	204
Residential area	Urban	14	82	13	109
	Rural	12	72	11	95
		26	154	24	204
Fathers' occupation	Employed	21	94	14	129
	Self-employed	5	60	10	75
		26	154	24	204
Mothers' occupation	Employed	12	49	11	72
	Self-employed	2	6	3	11
	Housewife	12	99	10	121
		26	154	24	204

Table 2 (continued) –Cross tabulation of independent variables and SES levels.

		SES Category			
		Low	Moderate	High	Total
Financial assistance	Study loan	26	147	24	197
	Scholarship	0	2	0	2
	Self-sponsored	0	5	0	5
		26	154	24	204
Parents' income	Less than RM2,000	5	46	5	56
	RM2,001-RM4,000	10	44	11	65
	RM4,001-RM6,000	4	31	2	37
	RM6,001-RM8,000	2	10	2	14
	RM8,001-RM10,000	3	13	3	19
	More than RM10,000	2	10	1	13
		26	154	24	204
Previous institute	UniKL MFI	8	44	12	64
	UniKL BMI	6	13	2	21
	UniKL MIIT	3	13	3	19
	UniKL IPROM	1	3	0	4
	UniKLMIAT	1	22	4	27
	UniKL MICET	1	15	0	16
	UniKL MIMET	6	26	1	33
	UniKL MITEC	0	2	2	4
	UniKL MSI	0	16	0	16
		26	154	24	204
CGPA	3.50 - 4.00	2	42	7	51
	3.00 - 3.49	12	58	10	80
	2.50 - 2.99	10	53	6	69
	2.00 - 2.49	2	1	1	4
		26	154	24	204
Education level	PhD/ Master	0	2	1	3
	Bachelor	12	78	18	108
	Diploma	14	74	5	93
		26	154	24	204
Extracurricular activities	Inactive	5	47	13	65
	Moderately active	9	47	6	62
	Active	12	60	5	77
		26	154	24	204
Career development	Inactive	5	47	13	65
	Moderately active	9	47	6	62
	Active	12	60	5	77
		26	154	24	204
Entrepreneurial activities	Inactive	7	27	7	41
	Moderately active	14	100	15	129
	Active	5	27	2	34
		26	154	24	204

3. Results

Multinomial logistic regression was used to predict students' employability skills based on predictors like gender, marital status, fathers' occupation, mothers' occupation, parents' income, residential area, previous institute, education level, CGPA, financial assistance, employment status, extracurricular activities, career development activities and entrepreneurial activities. All statistical assumption on multinomial logistic regression have been checked. Low level of

multicollinearity was present at accepted level (VIF = 1.07 for gender, 1.15 for marital status, 1.32 for father occupation, 1.42 for mother occupation, 1.64 for parents income, 1.08 for location, 1.12 for institute, 1.30 for education level, 1.06 for CGPA, 1.18 for financial assistance, 1.78 for employment status, 1.81 for extracurricular activities, 3.72 for career development activities and 3.64 for entrepreneurial activities). By using scatterplot statistical tool, linearity relationship was proven and outliers was filtered during data screening and cleaning process. The omnibus model for the multinomial logistic regression was statistically significant, Chi-Square (df=66, N=204) =101.82, p<0.005, Cox and Snell R^2 =.39, Nigelkerke R^2=.51. Table 3 indicates the significance of the independent variables. This table is mostly useful for nominal independent variables because it is the only table that considers the overall effect of a nominal variable. From the table, mothers' occupation, education level, career development and entrepreneurial activities are statistically significant (p-value<=0.05). It means that these independent variables make a significant contribution to the accuracy of the employability skills model.

Table 3 –Likelihood ratio test.

Effect	Likelihood Ratio Tests		
	Chi-Square	df	Sig.
Intercept	0.000	0	
Gender	2.867	2	0.239
Marital status	2.526	2	0.283
Fathers' occupation	3.153	2	0.207
Mothers' occupation	8.913	4	0.053
Parents' income	11.170	10	0.344
Residential area	0.208	2	0.901
Institute	0.208	2	0.127
Education level	9.107	4	0.048
CGPA	9.510	6	0.147
Financial assistance	1.833	4	0.766
Employment status	1.980	2	0.372
Extracurricular act.	2.011	2	0.366
Career development act.	9.341	4	0.053
Entrepreneurial act.	13.204	4	0.011

Table 4 presents the parameter estimates (also known as the coefficients of the model). As there were three categories of the dependent variable, we can see that there are two sets of logistic regression coefficients (sometimes called two logits). The first set of coefficients is found in the "Low" row (representing the comparison of the "Low" level of SES category to the reference category, "High" level of SES). The second set of coefficients is found in the "Moderate" row (this time representing the comparison of the "Moderate" level of SES category to the reference category, "High" level of SES).

Table 4 -Parameter estimate associated with high level of SES.

Variable	Coef.	Wald	Sig.	Exp(B)	95% CI for Exp(B)	
					Lower Bound	Upper Bound
Low level of SES						
Education level (Bachelor)	-2.592	7.322	0.007	0.075	0.011	0.489
Intercept	-19.528	0.000	0.996			
Moderate level of SES						
Mother's occupation (Employed)	-1.571	4.074	0.044	0.208	0.045	0.956
Mother's occupation (Self-employed)	-2.145	3.820	0.051	0.117	0.014	1.006
Education level (Bachelor)	-1.778	5.394	0.020	0.169	0.038	0.758
Employment status (Employed)	-13.152	188.839	0.000	1.941E-6	2.974E-7	1.267E-5
Employment status (Self-employed)	-14.322	283.664	0.000	6.024e-7	1.138E-7	3.190E-6
Intercept	46.284	0.001	0.970			

The only coefficient that is statistically significant for the first set of coefficients is education level [bachelor degree] (p-value = 0.007), which represents the comparison between "diploma" holder and "bachelor degree" holder. Therefore the coefficient value of -2.592 can be interpreted as the bachelor graduates are less likely to score low level rather than high level in the SES compared to diploma graduates. So the multinomial logistic regression probability equation for low level of SES relative to high level of SES is

$$\ln\left[\frac{P_{\text{low}}}{P_{\text{high}}}\right] = -19.528 - 2.592x_1 \tag{1}$$

where x_1 = education level (bachelor-1; others-0).

Meanwhile the coefficients that are statistically significant for the second set of coefficients is mothers' occupation [employed] (p-value = 0.044); mothers' occupation [self-employed] (p-value = 0.051); education level [bachelor degree] (p-value = 0.020); employability status [employed] (p-value = 0.000) and employability status [unemployed] (p-value = 0.000). As an example the coefficient value of employability status [employed] -13.152 can be interpreted as the graduates who have been employed are less likely to score moderate level rather than high level in the SES compared to other students. So the logistic regression probability equation for moderate level of SES relative to high level of SES is given by the following equation;

$$\ln\left[\frac{P_{\text{moderate}}}{P_{\text{high}}}\right] = 46.284 - 1.571x_2 - 2.145x_3 - 1.778x_4 - 13.152x_5 - 14.322x_6 \tag{2}$$

where x_2 = mothers' occupation (employed-1; others-0)

x_3 = mothers' occupation (self-employed-1; others-0)

x_4 = education level (bachelor degree-1; others-0)

x_5 = employability status (employed-1; others-0)

x_6 = employability status (self-employed-1; others-0)

By applying the exponent into both sides of the equations (1) and (2) and combine them together, the probability of obtaining high level of Students Employability Skills (SES) once the students complete their study can be estimated as:

$$P_{\text{high}} = \frac{1}{1 + e^{-19.528 - 2.592x_{11}} + e^{46.284 - 1.571x_2 - 2.145x_3 - 1.778x_4 - 13.152x_5 - 14.322x_6}} \tag{3}$$

where

x_1 = education level (bachelor-1; others-0).

x_2 = mothers' occupation (employed-1; others-0)

x_3 = mothers' occupation (self-employed-1; others-0)

x_4 = education level (bachelor degree-1; others-0)

x_5 = employability status (employed-1; others-0)

x_6 = employability status (self-employed-1; others-0)

4. Discussion

Findings from this study indicate that multiple factors play a role in predicting the level of employability skills. Based on the model developed, the probability of obtaining high level of Students Employability Skills (SES) once the students complete their study is influenced by education level. As such, education level is one of the vital factors in students' employability which is consistent with the findings by Asonitou (2015). The importance of employability skills among higher education students are most concern among researchers. Such method like adapting the curricula to include specific skills courses, using information technology in innovative ways, service learning, career planning, extra-curricular activities and work-based education were discussed in promoting employability skills among higher education students.

Another factor that has an effect towards the high-level employability skills is parents' occupation particularly on the mothers' side, which is consistent with the finding of Parikh and Sadoulet (2005). The justification of this finding is based on the parents' employment could relate with their children job skill development (Ermisch & Francesconi, 2000).

An analysis conducted by the British Household Panel in order to compare the difference in parents' employment pattern revealed that the effects of fathers' employment on the outcomes studied were generally less important than mothers' employment.

From the result, gender is not considered as a significant factor for this study which could be explained by the domination of male students in this study; 171 out of 204 respondents were males as compared to 33 females. It is consistent with the finding from Li, Roessler, Rumrill and Li (2018) that gender is not a predictor of employment status. In addition, some factors such as extracurricular activities are supposedly to be acknowledged by students as it can leads to another added value when applying for a job placement (Chua et al., 2017). Meanwhile, the entrepreneurial intention has become a student's interest as an alternative which requires more improvement in motivating the students (Barba-Sánchez & Atienza-Sahuquillo, 2018). Although multinomial logistic regression has been used widely in making prediction particularly among engineering students ((Xu & Zhang, 2015), yet another contribution is given by the finding of the research. Future works should consider other factors that play significant role in students' employability particularly towards entrepreneurial based job.

5. Conclusion

The aim of this study was to develop a prediction model in order to estimate the probability of obtaining high-level employability skills among engineering technology students. Through this prediction model, significant factors that contribute mostly to the high-level employability skills were identified. The multinomial logistic regression model was the appropriate method to predict the level of employability skills as it allows the dependent variable to be more than two categories. In general, TVET has to ensure that the employability plays the role as the main issue in supporting the national agenda in producing high skill workers. Factors that influence the employability rate in TVET must be rectified when framing the roadmap for TVET graduates. All related parties should have the common direction in uplifting TVET at the next level.

Furthermore, the technical institute precisely can use this model to predict the level of employability skills of their students for the purpose of future placement in the job market. They need to change their traditional focus and help the students to develop the skills through intervention programs. Employers may use this approach to identify the quality of the graduates that they are hiring in ensuring that the graduates are fully equipped with the required skills and knowledge in TVET.

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