EXPLORING ENGINEERING EMPLOYABILITY COMPETENCY

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ABSTRACT

The objectives of this study are to assess whether the suggested lack of interpersonal and enterprise skills competencies cause unemployment amongst engineering graduates in Malaysia, critically appraise if engineering undergraduates have received a quality work placement (appropriate to their learning, knowledge and employability skills) and to enhance interpersonal and enterprise skills competencies awareness amongst engineering undergraduates in Malaysia. This study employed mix-method survey and open-ended questionnaire. The survey result was analysed using the SPSS software package. The open ended data was interpreted. The qualitative result revealed that the students industrial training was the most valuable session to help them to be employed and they had received the appropriate task during the training.

KEYWORDS: *exploring, engineering, employability, competency*

INTRODUCTION

Pressure on delivering quality transferable skills or generic skills to prospective engineering graduates has been a debate for some time. Employers expect and demand good quality engineering graduates from higher education institutions. Therefore, these institutions, within their constraints, try to fulfil the high requirements of employers.

There are many studies regarding the appropriate approach to delivering the skills needed by employers or at the workplace (Harvey, 2001; Quek, 2005; Dench, 1997; Andersen, 2004) to the undergraduate but those dealing with individual capability are non exhaustive. There are also arguments on how to balance the academic curriculum and generic skills (Quek, 2005; Holden, et.al., 2004; Morse, 2006). However, both employers and academics have different terms, definitions and perceptions of generic skills (Dench, 1997). With the contrasting opinions from both parties, the transfer of generic skills can be difficult.

It is suggested that both employers and universities have an important role in developing the skills needed in the workplace. The aim of this study is to demonstrate that the basic knowledge and skills provided by the university with an appropriate training package during industrial training will be useful to new graduate employees in the workplace.

Current situation

According to Skills Dialogues (2000), engineers today need a range of new and specific technical skills to meet the demands of technology and business (Andersen, 2004; Chojnacha et.al., 2000). It is important that employers place greater emphasis on personal and generic skills in all areas of work. The key role of managers and supervisors has become increasingly critical and requires a mixture of good quality technical and communication skills.

The engineering curriculum has been criticized (Skills Dialogue, 2000) for not developing personal and transferable skills sufficiently amongst graduates (National Employers Survey, 2003).

The importance of skills development

In addressing the importance of interpersonal and enterprise skills development, there are industry cases that demonstrate the need to improve the related skills. There is a high failure rate of new product development (NPD) reported by Balachandra and Friar (1997) who stated that almost 90 % of products introduced in 1991 did not reach their business objectives (Souder and Sherman, 1994; Schilling and Hill, 1998; Cooper, 2005; and Yahya et. al, 2007).

The engineer's work nature

Getting a new product into the market is more than just having a few parts made. It is done through a process called "Product Development". The process starts with the needs from customer, to having the bright idea, to having the desirable product in hand. Development of the bright idea into a final product is a process involving thinking through issues and adaptations, working out details and specifications, like how it can be made, the exact materials, possible failure modes, required regulations and more.

Coordination in engineering has been observed as an important and pervasive characteristic within a number of interpretations of approaches to engineering management; for example, models of the engineering design process (Ray, 1985 and Cross, 1994), concurrent engineering (Handfield, 1994; Duffy et.al., 1993, McCord and Eppinger, 1993, Prasad, 1996, Perrin, 1997, Coates et. al 1999a; Ainscough and Yazdine; 1999) and project management (Fayol, 1949; Oberlender, 1993, Bailetti et.al., 1994, Cleetus et.al 1996, Lock, 1996). Indeed, coordination has been identified as being significant in several other approaches such as workflow management (Alonso et.al, 1996, Yu, 1996, Piccinelli 1998 and Shan 1999), design integration (Hansen, 1995) and computer-supported cooperative work (Malone and Crowston, 1994, Schal, 1996). In any coordinated work, a lot of communication is needed. Therefore, interpersonal skill is important to maintain coordination and work flow amongst engineers (Coates, 2004).

In the modern manufacturing organization, it is axiomatic that serving manufacturing needs will also serve market needs due to the required responsiveness to customers. One danger of the traditional engineering approach, which is centered on product design for function only, is that the business organization encourages designers to indulge themselves in engineering design and less in communication and assessing the overall needs to be served (Abdul-Shukor, 2003).

Status of unemployment amongst Malaysian engineering graduates

An online survey done by the National Economic Action Council (MTEN) in 2006 reported that out of 7,370 graduates in the engineering field who responded to an online survey only 4,035 were working and 3,335 were unemployed. It is important to note that in Malaysia access to the internet is very limited particularly in poor, rural and isolated regions. Internet installation in their homes can be very expensive for many Malaysians. Cyber cafes normally provide relatively cheap but restrictive access. Therefore, the number of engineering graduates responses is not representative of the whole population of engineering graduates educated in the Malaysian higher education institutions (HEI).

This study focuses on the engineering graduates with degrees as they are qualified to take up employment in supervisory, managerial and generally higher positions.

In Malaysia, it is generally assumed and through the researcher observation it is made known that an engineering graduate can easily gain employment in industry because of their professional status as compared to graduates from the arts. It is suggested that they should not have any difficulty to be employed in comparison to the non-engineering graduates. The survey indicated otherwise, where 67.1% of engineering graduates have a waiting period of less than 3 months to be employed, 14.3 % wait for about 6 months in a period of unemployment and in some cases more than 6 months.

Aims and scope of research

The aim of this study is to explore whether the suggested lack of interpersonal and enterprise skills competencies cause unemployment amongst engineering graduates in Malaysia. The study intends to gain information and appraise whether engineering undergraduates receive a quality work placement (appropriate to their learning, knowledge and employability skills) and to the needs of the workplace. The researchers' interest is to examine the extent of the engineering programme, industrial training and university life and co-curriculum activities offered to engineering students. Do these schemes help to promote interpersonal skills and entrepreneurial skills towards employability?. A questionnaire survey is employed to explore the situation under study..

Methodology

These study employed Generic Transfer Questionnaire (GTQ) adopted from the framework of Course Experience Questionnaire (CEQ) (Ramsden, 1999) Australia and justification of interpersonal and enterprise skills characteristic used in the GTQ questionnaire established by Harvey (2001) employability framework. The GTQ measured whether the engineering degree programmes, industrial training, co-curriculum activity and university life has increased the engineering students' interpersonal skills and enterprise skills. Exploratory factor analysis was used to test the validity and reliability of the proposed methodology and measurement tool.

Two government public universities and two private universities were chosen for the study purpose through stratified random sampling. Stratified random sampling is a method for obtaining a sample with a greater degree of representativeness. The homogeneous categories of this sample are the final year engineering undergraduates (civil engineering, electrical engineering, and mechanical engineering) who have been identified from the higher education institutions.

Data presentation and discussion

360 questionnaires were distributed, and 269 questionnaires returned to the researcher. That means there was a response rate of 74.72% from the engineering undergraduates.

According to Mangione (1995) response rates in the 70% to 80% range are viewed as very good. Participants gave their ratings on a six-point Likert scale ranging from 1 who strongly disagree to scale 6 who strongly agree, with the frequency mean being mostly 4.5 and towards 5. The standard deviation scores of programme evaluation, industrial training and university life and co-curriculum evaluation are in between 0.87 to 1.0. Therefore, according to Tabachnick, (2001) the high scores are indicators of a good result.

It is reported that out of 269 respondents, 154 or 57.2% are male. This illustrates that there is only a small difference in the number of male and female engineering undergraduates. In the United Kingdom the distribution is significantly different.

Bartlett's test of sphericity (see Table 1) tests the adequacy of the correlation matrix and yielded a value of 7795.238 and an associated level of significance smaller than 0.001. This procedure determines whether the data deviates significantly from a random matrix (Weiss, 1970). Thus, the correlation matrix has significant correlation amongst at least some of the variables.

Table 1 : KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.932
Bartlett's Test of Sphericity	Approx. Chi-Square	7795.238
	df	528
	Sig.	.000

Factor analysis output

The Total Variance Explained presents the number of common factors extracted, the eigenvalues associated with these factors, the percentage of total variance accounted for by each factor and the cumulative percentage of total variance accounted for by the factors. Using the criterion of retaining only factors with eigenvalues of 1, five factors were retained for rotation. These five factors accounted for 40.96%, 16.26%, 9.13%, 3.3% and 3.1% of the total variance, respectively, and a total of 72.66%.

The Rotated Component Matrix presents the five factors after a varimax rotation. The Rotated Component Matrix shows that there are items that are loaded or overlap in meaning between factor 3, factor 4 and factor 5. The words 'effect, written and oral' used in the question overlaps in meaning. The communality in meaning of some of these factors suggests that a number of factors can be combined or deleted for a better result. Therefore, the researcher decided to delete the overlap or cross loading items and rerun the analysis.

Result after deletion of overloading items

The analysis of the second Correlation Matrix (Table 2) analysis shows that the KMO adequacy of the correlation matrix is .928. Bartlett's test of sphericity tests the adequacy of the correlation matrix and yields a value of 7050.833 and an associated level of significance smaller than 0.001. Even though the scores are lower from the previous test it remains high.

Table 2: KMO and Bartlett's Test (second run)

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.928
Bartlett's Test of Sphericity	Approx. Chi-Square	7050.833
	df	435
	Sig.	.000

The result of the second run of factor analysis output Table 3 shows the Total Variance explained using the criterion of retaining only factors with eigenvalues of 1, four factors were retained for rotation. These four factors accounted for 41.396%, 17.818%, 8.340%, and 3.394% of the Total Variance, respectively, and for a total of 70.948%.

Table 3 : Total Variance Explained

Factor	Eigenvalue	Percentage of variance	Cumulative percentage
1	12.419	41.396	41.396
2	5.345	17.818	59.214
3	2.502	8.340	67.554
4	1.018	3.394	70.948

According to Lewis (1984), "reasonable comprehensiveness" (p.68) is maintained when extracted factors explain at least 60% of variance. The total variance explained by all four factors is somewhat higher, at around 71%. Table 4 shows the abbreviated results of the factor analysis of determinant attributes. For a sample size of 269, and in accordance with the recommendations of Tabachnik and Fidell (2001), correlations of less than 0.45 were deemed to be unexceptional. Therefore, Table 4 only presents coefficients greater than this. The grouping of variables with high factor loadings should suggest what the underlying dimension is for that factor. The rotated component matrix presents the four factors after varimax rotation.

The clustering of the items in each factor and their wording offers the best clue as to the meaning of that factor. For example, eleven items loaded on Factor 1. An inspection of these items shows an evaluation of university life and co-curriculum activities (e.g. university life and co-curriculum developed my knowledge and intellectual capability, university life and co-curriculum increased my creativity ability, university life and co-curriculum improved my skills in formal and informal oral communication, etc.) and was thus labelled UNIVERSITY/CO-CURRICULUM. Factor 2 contains eleven items that clearly reflect evaluation of industrial training (e.g. the industrial training helped me to develop the ability to work effectively with different groups, the industrial training developed the ability to identify problems, analyse and solve them, the industrial training developed my commercial consciousness etc.) and was labelled INDUSTRIAL TRAINING. Factor 3 contains 6 items that reflect programme evaluation (e.g. the programme increased my self- control and motivation, the programme increased my self- confidence in tackling unfamiliar problems, the programme helped me to develop the ability to socialize at all levels and maintain relationships etc.) and was labelled PROGRAMME. Factor 4 contains 2 items that reflect the enterprise skills (the programme helped me to develop the ability to plan and complete any project given and the programme developed the ability to identify problems, analyze and solve them) and was labelled ENTERPRISE. This four-factor model represents the combination of the five original factors and appears to reflect adequately the underlying factor structure of the 41-item generic transfer inventory.

Table 4 : Rotated Component Matrix

Items	Factors 1	2	3	4
d- Increased intellectual capability	.806			
d- Increased creativity ability	.803			
d- Developed commercial consciousness	.710			
d- Increased myself control & motivation	.852			
d- Increased myself confidence tackling problem	.870			
d- Improved formal/informal oral communication	.831			
d- Improved formal/informal written communication	.746			
d- Developed the ability to socialize at all levels and maintain the relationship	.817			
d- Ability to work effective with different groups	.832			
d- Developed the ability to plan and complete any project given	.824			
d- Ability to identify problems, analyze and solve them	.845			
c- Increased intellectual capability		.752		
c- Increased creativity ability		.778		
c- Developed commercial consciousness		.757		
c- Increased myself control & motivation		.854		
c- Increased myself confidence tackling problem		.873		
c- Improved formal/informal oral communication		.812		
c- Improved formal/informal written communication		.768		
c- Developed the ability to socialize at all levels and maintain the relationship		.802		
c- Ability to work effective with different groups		.821		
c- Developed the ability to plan and complete any project given		.858		
c- Ability to identify problems, analyze and solve them		.831		
b- Increased intellectual capability			.738	
b- Increased creativity ability			.768	
b- Developed commercial consciousness			.751	
b- Increased myself control & motivation			.774	
b- Increased myself confidence tackling problem			.657	
b- Developed the ability to socialize at all levels and maintain the relationship			.651	
b- Ability to work effective with different groups				
b- Developed the ability to plan and complete any project given				.709
b- Ability to identify problems, analyze and solve them				.756

Note: b represent for programme evaluation
c represent for industrial training evaluation
d represent for university life and co-curriculum evaluation

Engineering student reliability output

Total samples of 269 cases were processed in this analysis. There are no missing values. The Cronbach's Alpha score is 0.955, which indicates high overall internal consistency. As recommended by Cronbach(1949) the alpha value of .60 is considered reliable among the items representing programme evaluation factor, industrial .training factor and university life and co-curriculum activity factor. The corrected item-total correction shows the correlation (consistency) between each item and the sum of the remaining items.

Relationship of the students programme findings

The engineering students' frequency tables of the GTQ on programme evaluation illustrate that the highest score is in the agree column. The second highest score (Likert scale=4) in the satisfied column shows a similar amount of respondents (33.5%) in the satisfied and the agree column (Likert scale= 5).This shows that the programme has improved their skills in formal and informal written communication.This also gives a perspective that the students agree that the programme they had undergone had provided them with some generic skills that they require for their future employment. The data reflects that the engineering programme or curriculum has transferred the interpersonal and enterprise skills to the engineering students in class. This finding is supported by Kagaari, 2007 who states that survey instruments will end-up with positive response (similar to Hawthorn.effect). As it is clear from the literature, respondents to quantitative questions can sometimes respond as the feel they should respond, rather than always being fully honest. The respondents are showing 'what you want to see, rather than the real situation'. This can cause other problems especially during data analysis. Thus, the researcher decided to look into this study using another method. The researcher tried to use another instrument (in another research paper, not highlighted in this paper) to compliment the weaknesses in the first research instrument. As to the open-ended data,it has shown positive correlation with the Likert scale findings. As a result, this confirms that the method chosen can be trusted and valid.

Relationship of the students' industrial training findings

The overall evaluation in the GTQ of the industrial training illustrates that most students agree (Likert scale = 5) that employers transfer generic skills and knowledge to the engineering student whilst they are doing their industrial training. This is supported by the highest scores being in the agree columns (Likert scale = 5). Most engineering students agree that they were given an appropriate task during industrial training. 100% of respondents agree that the industrial training has helped to build employability skills (Zakaria, et.al.2006). Thus, the engineering students agree with the importance of interpersonal and enterprise skills development in the workplace (McCounnell, 2004; Van Slyke, Kittner and Cheney, 1998; Doke and Williams, 1999; Bailey and Stefaniak, 2000). The survey, and opened-ended data support each other. This shows a positive remark. The employers have transferred the interpersonal and enterprise skills to the engineering graduates.

Relationship of students' university life and co-curricular activities

The engineering students' GTQ on university life and co-curriculum activity demonstrates that the highest scores are in the agree column. Whilst, the next highest response is in the satisfied column (Likert scale = 4). Therefore, the students generally agree that the university life and co-curricular activities have developed and transferred the generic skills that they require for future employment.

The survey illustrated a positive response and was supported by an open-ended question response that the co-curricular activity has increased the engineering students' communication skills. The engineering students acquire benefits from seminars conducted during their university life.

The contradictory component with regards to the co-curricular activity is that the engineering students found that the budget for this activity is limited. Therefore, the students have less and limited activity in co-curriculum. The engineering students gave a positive response and suggest converting the co-curriculum activity into a module and ensuring that all students participate.

In the open-ended section, the students gave positive comments as to how to improve the personal development outcome for engineering students. They suggested having grooming classes, more university and industry collaboration, a specialized engineering programme, extending the industrial training, replacing exam-oriented systems with more practical skills and a chance to explore society. In this section, even though the contradiction was there the percentage was insignificant against a positive response.

Conclusion

Clearly, what can be seen here is that the GTQ measurement tool is important for Higher Education Institution (HEI) and the educators as an interpersonal skills and enterprise skills pre and post training assessment. The result could signal both parties by giving feedback on the process taken, the necessary actions to be taken and the students' strengths and weaknesses.

This mixed-method study with the strength of the triangulation in methodologies provide an in-depth study and ensures richness of data. The present study may encourage future research into interpersonal skills and enterprise skills to adapt similar methods and to be thorough in qualitative and quantitative data. The open-ended questions and survey questionnaire that has been done proved to be informative in their own ways. The present study could also guide any future researcher to monitor continuing changes in interpersonal skills and enterprise skills in Malaysia as HEI engineering educators integrate the benefits of more interactive teaching with the traditional cultural practices embedded in the engineering curriculum.

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