

## **DEVELOPMENT OF TECHNICAL SKILLS MEASUREMENT MODEL AMONG ENGINEERING GRADUATES IN COMMUNITY COLLEGE USING DELPHI TECHNIQUE APPROACH AND CONFIRMATORY FACTOR ANALYSIS**

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### **Abstract**

Technical skill is one of the factors that determine a graduate to get a job. Hence, this study is conducted to identify the elements of the technical skills which important that should be mastered by the graduates by producing technical skills measurement model which important that should be mastered by the graduates, especially electrical engineering graduates from the Community College. This study is conducted using three rounds of modified Delphi Technique approach consist of seven experts panel and the survey involve 462 respondents which consisted of 162 Community College graduates, 197 Community College lecturers and 103 employers in the industry. Besides that, Confirmatory Factor Analysis (CFA) using AMOS software is conducted on the findings of the respondents' survey to verify the measurement model of the technical skills that should be mastered by the electrical graduates in Community College. The findings of the study show that the technical skills that important and should be mastered by the graduates consist of main five technical skills include 23 skill items and also to get the equivalence in the model obtained. The five main elements of technical skills are Basic Skills, Designing Skills, Installation Skills (Wiring), Testing Skills and Maintenance Skills (Repair). Indeed, mastering the elements of a strong and competent technical skills is crucial in ensuring that graduates get a place in job market and competitive.

Keywords: Technical skills, Electrical engineering graduates, Delphi technique.

## 1. Introduction

Malaysia is one of the countries in the world that allocates substantial investments of nearly 25% to advance the education system [1]. The field of education is the source of knowledge, training, potential, interest and all the elements of quality for people who ultimately make them the more dynamic and quality human capital to drive the nation's progress. Human capital development is an important investment as well as a core of productive innovation and high-income economy. Higher education qualifications to support the development of knowledge and innovation, high level of technical and professional skills, and high productivity levels are among the key characteristics of human capital and the country's workforce. Nevertheless, to produce a comprehensive and world-class workforce in Malaysia is not an easy matter and this is a challenge to Malaysia.

Community College is one of the TVET institutions under the Ministry of Higher Education Malaysia which offers technical and vocational and technical training and courses. The purpose of Establishing Community College is to provide skilled and semi-skilled workforce resources to help develop the country's economy. The Community College Studies Department is responsible for building a course curriculum at Community College which is built on two main components, namely technical skills and soft skills [2]. High tech technical skills and soft skills are important in producing graduates with job marketability. However, there are some employers who are still dissatisfied with the ability of graduates as they do not meet the desired skills requirement. Through the Graduate Detection Review Report in 2009 and 2010 shows that the statistics of graduates from unemployed Community College for 2009 and 2010 reached a higher percentage than the other Institute of Studies for the same period.

In addition, according to Ministry of Works Secretary-General Datuk Himmat Singh [2], the industrial sector in Malaysia is largely spearheaded by foreign laborers as local youths are less willing to venture into vocational fields. This is also acknowledged by Madar et al. [3] stating that based on a survey conducted by the Ministry of Human Resources in 2001 found that the proportion of workers with vocational skills entering the job market was low at around 3% to 12%. Indeed, the need for technical skills among graduates is an important criterion to enable them to gain a place in the job market. Hence, it is important to include elements of technical skills across the teaching and learning curriculum for each course or field of study offered at each Institution. Therefore, the TVET should be moving forward to plan strategies to improve the quality of graduates to produce a successful skilled and semi-skilled workforce.

Success in producing a highly competent source of workforce is important to prove the importance of this TVET in the country's economic growth and to eliminate the perceptions of people who consider this education as second-class education. Therefore, this research is executed to develop a technical skill measurement model among Electrical Engineering students especially in Community Colleges in Malaysia by using a modified Delphi Techniques approach and confirmatory factor analysis through computer software *Analysis Moment Structures* (AMOS).

## 2. The Importance of Technical Skills among Graduates

Technical skills can be defined in various contexts based on the views and opinions of individuals. Nair et al. [4] have listed the essential elements of technical skills in the global competencies that must be mastered in engineering as are basic skills related knowledge in engineering, proficient in each engineering subject, engineering design skills, engineering problem solving skills, project management skills and research and development related engineering skills.

Through the Malaysian Graduate Tracer Survey [5] there are graduates who state that the curriculum in Polytechnics is less helpful in their ability to master the language and the use of technology. They also argue that the content of the program being followed is moderately relevant to the skills required at the workplace. Md Ali et al. [6] also found that students in Polytechnics were even supplied with industrial training before graduation and went on to work, but in fact they were not able to help them in increasing their marketability in the industry today. This is because as long as they are doing industrial training there are less students being given the opportunity to participate in the repair, maintenance and implementation of work. Therefore, these students are less experienced with the actual work situation and unable to work efficiently. Polytechnics should ensure that every student undergoing industrial training should master the necessary technical skills before they go through the workplace. They should also be tested with various forms of testing and training related to the technical skills they learned to make them competent skilled workers [6].

The research conducted by Md Ali et al. [6] has similarities with the study conducted by Awang [7] which states that students in Polytechnics are not given the opportunity to work and are not given the opportunity to apply the skills they have learned throughout the polytechnics when undergoing industrial training. This causes them not to feel the real world of work. They should be given the opportunity to take part in the execution of any work related to their field. This is important because one of the conditions laid down by a company in the selection of employees is the mastery of technical skills and work experience in related fields. Zaharim [8] states that most employers agree that elements such as the ability to apply engineering-related knowledge, have a high degree of competence in applying engineering-oriented practical skills and problem-solving skills in engineering are elements of essential and necessary technical skills mastered by engineering graduates.

The results of Weligamage and Siengthai [9] study on graduate students at Sri Lanka University found that the curriculum provided at this university did not meet the market and the latest job requirements and this caused the graduates not to have the appropriate knowledge and skills as well as to add to the factors unemployment occurs. In addition, the training provided in the vocational education system itself is irrelevant and does not conform to the needs of the job market. This incompatibility causes graduates to be difficult to get the job they want because they are not knowledgeable and skilled in the will of the employer. Lack of high skills, especially technical skills and space skills contribute to the concept of marketability and contributors to unemployment factors among graduates.

### **3. Methodology of Research**

This study uses a three-round modified Delphi technique approach and a survey method aimed at producing an important technical skills measurement model mastered by electrical engineering graduates at Community College. In particular, the study involving modified Delphi technique was divided into three stages:

#### **3.1. First stage**

At this stage, the researcher will construct a structured question for an interview instrument. This interview method was conducted on Delphi's panel of experts in the first round. The panel of experts involved in this study consists of 7 experts comprising lecturers and engineers in the field of electrical. Linstone and Turoff [10] suggested that the number of Delphi panels ranging from 5 to 10 people alone was sufficient because if there were many experts panel it would be difficult to implement the study.

#### **3.2. Second stage**

In the second stage, a study using modified Delphi technique for three rounds. The study that uses Delphi's technique is aimed at reaching a consensus view among the panel of experts involved. In the first round of this study, a bridging method was conducted to identify and verify important technical skills and must be mastered by graduates, especially graduates in electrical engineering. The findings of the Delphi technique were based on the formulation of questionnaire instrument items that were used in the second round of Delphi's technical study. Through the findings from Delphi's technical study on the first round and the analysis of reference-related documents from previous research sources, researchers have developed items for questionnaire instruments.

#### **3.3. Third stage**

In the third stage it involves pilot studies and surveys conducted. For this study, pilot studies and surveys involve the industry, lecturers and graduates of the Community College in the field of electrical as a respondent study aimed at verifying the technical skills measurement model that should be mastered by the electrical graduates at Community College. To verify the technical skills measurement model that must be mastered by the electrical graduates at Community College, the Confirmatory Factor Analysis (CFA) analysis using AMOS software was conducted on the survey findings. Through the analysis of this confirmatory factor it aims to determine the number of items included in the construct and in parallel with what is stated in the theory used as the basis in this study. For the confirmatory factor analysis, all items contained in the measurement model should achieve convergent validity based on the weighting factor value which should be greater than  $> 0.60$ , the average value of the transformed variance for each element or construct  $\geq 0.50$  and the constructability value of the construct  $> 0.60$  [11].

Discrimination validity assessment analysis is also conducted to ensure that each item does not have cross-loading with other items. In addition, the precision match between the element and the study data for the CFA

measurement model is determined based on a combination of Combinations Index or at least one Absolute Fit Indices and one Incremental Fit Indices [11].

## **4. Findings**

### **4.1. Respondent delphi engineering review**

A total of seven Delphi panels of experts were selected to be involved in this study. This study uses Delphi's technique for 3 rounds. The panel of experts involved as Delphi experts is selected based on a number of criteria set by the researchers themselves. The panel of experts involved consists of two women and five men. They consist of an employer in the industry, three lecturers teaching at the University and three lecturers who teach at the Public Skills Training Institute. Additionally, Delphi's panel of experts involved consists of seven experts who have experience in teaching and working more than 15 years in fields related to field of electric studies.

### **4.2. Survey respondents**

For the conduct of the survey, it involved 462 respondents consisting of 162 Community College graduates, 197 community college lecturers and 103 employers in the industry.

### **4.3. The key elements of technical skills that are important and need to be mastered by electrical graduates in Community College**

Overall, through the interviews conducted on Delphi's expert panel in the first round, five key skills elements for technical skills have been identified, namely basic skills, design skills, assembly skills, testing skills and maintenance skills.

### **4.4. Verify the technical skills model that must be mastered by electrical graduates in Community College**

There are five main elements of technical skills that must be mastered by electrical graduates at Community College namely Basic Skills, Design Skills, Installation Skills (Wiring), Testing Skills and Maintenance Skills (Repair). Table 1 shows the value of the compatibility indicators for the overall elements of technical skills. While Table 2 shows the confirmatory factor analysis for construct validity and Table 3 shows the confirmatory factor analysis for discriminant validity. The results of the analysis show that the average value of the Extracted Variance (AVE) for each element of technical skills reached the value of  $\geq 0.50$  [11] between 0.527 and 0.852. Construct reliability (CR) analysis also shows that all technical skill elements have a good reliability value that exceeds the value of 0.60 [11] between 0.886 and 0.958. Therefore, the three indicators show that all items of technical skills contained in this model have valid convergence (valid) and all the skills elements in this technical skill measurement model have no discrimination validity problem. Meanwhile, the *cronbach alpha* reliability value for each element of technical skill is also higher than 0.8.

**Table 1. Compatibility indicators for all elements of technical skills.**

No.	Compatibility Value Received/Technical Skills Element	Chisq/df	RMSEA	TLI	CFI	NFI
		< 5.0	< 0.08	> 0.9	> 0.9	> 0.9
1	Basic Skills	2.50	0.068	0.969	0.979	0.966
2	Design Skills	1.642	0.045	0.996	0.998	0.995
3	Installation Skills (Wiring)	0.105	0.000	1.003	1.000	1.000
4	Testing Skills	1.939	0.054	0.996	0.999	0.997
5	Maintenance Skills (Repair)				1.000	1.000

**Table 2. Confirmatory factor analysis (Construct reliability).**

Item	Cronbach Alpha (> 0.7)	Construct Reliability (CR) (> 0.6)	Average Variance of Extract (AVE > 0.5)
<b>Basic Skills</b>			
Ability to manage a project			
Ability in quality systems, laws and regulations			
Ability to draw engineering drawings manually			
Ability to draw computer-assisted drawings such as Autocad	0.879	0.886	0.527
Ability to read work drawings such as schematic drawings			
Ability to provide estimated work and operating cost			
Ability to make technical reports of the work done			
<b>Design Skills</b>			
Ability to produce light circuit diagrams for single phase surface wiring			
Ability to produce lighting circuit, power and general power of single phase surface wiring			
Ability to produce power circuit and general power diagrams for single-channel and single-channel wiring	0.932	0.952	0.800
Ability to produce light, power and general circuit diagrams for single phase mains and wiring			
Ability to produce light circuit diagrams and power circuits for single phase mains hidden wiring			
<b>Installation Skills</b>			
Ability to control the lamp circuit for wiring and three-phase wiring			
Ability to control the lamp circuit and power circuit for three-phase wiring and mains wiring	0.922	0.946	0.818
Ability to handle light, power and			

general circuit for three-phase  
wiring and mains wiring  
Ability to extend the cable for  
cable tray installation

<b>Testing Skills</b>			
Ability to test the power and general power circuits for single phase surface wiring			
Ability to test the light circuit for single-channel wiring and wiring			
Ability to test the power and general power circuits for wiring and single-phase mains wiring	0.934	0.958	0.852
Ability to test lighting, power and general circuit for single-channel wiring and mains wiring			
<b>Maintenance Skills</b>			
Ability to detect damage to the lamp, power and general circuit faults for three-phase wiring and mains wiring			
Ability to detect damage to the project circuit for wiring and three-phase wiring	0.924	0.941	0.843
Ability to detect damage to power circuits and general power for three-phase mains hidden wiring			

**Table 3. Confirmatory factor analysis (Discrimination validity).**

<b>Element Technical Skills</b>	<b>Basic Skills</b>	<b>Design Skills</b>	<b>Installation Skills</b>	<b>Testing Skills</b>	<b>Maintenance Skills</b>
Basic Skills	0.726				
Design Skills	0.651	0.894			
Installation Skills	0.616	0.795	0.904		
Testing Skills	0.613	0.832	0.875	0.923	
Maintenance Skills	0.585	0.743	0.888	0.876	0.918

## 5. Discussions and Conclusions

The present world development in the technology era is of great importance to the technical skills that every graduate needs to master. This is reinforced by the views of Awang [7] states that the technical factor is one of the factors that determine a graduate to get a job. Nevertheless, through a report from a study conducted by Bank Negara found that graduates from Malaysia have very low technical skills compared to foreign graduates. According to and Weligamage and Siengthai [9] states that the lack of high skills especially technical skills will contribute to the concept of marketability and contributors to unemployment factors among graduates.

According to Zaharim [8], most employers state that the elements of technical skills that are important and must be mastered by engineering graduates are like the ability to apply engineering-related knowledge, have high competence in applying practical engineering-oriented skills and problem-solving skills related to engineering. This was also agreed by Awang [7], which states one of the conditions laid down by a company in the selection of employees is the mastery of technical skills and work experience in related fields. Hence, this demonstrates that the mastery of the elements of high technical skills plays an important role in helping graduates gain a place in the workplace. Therefore, through the modeling of technical skills compatibility measurements can be used as a guide to graduates in the field of electrical engineering in identifying the essential elements of competence and must be mastered so that they can prepare accordingly before entering the world of work.

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