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Development of Automotive Technology Competency Constructs By Modified Delphi Method

ArasinahKamis*, SariatiTalib**
**(Department of Family & Consumer Science, Faculty of Technical & Vocational Education, Sultan Idris Education University, Malaysia)*
*** (Department of Family & Consumer Science, Faculty of Technical & Vocational Education, Sultan Idris Education University, Malaysia)*
*Corresponding Author: SariatiTalib***

ABSTRACT
In a country heading into the 21st century, the field of skills is an important area to accommodate the needs of the workforce. Labor required in line with the latest technological developments. Institutions to produce graduates who have the skills competency in the skills and knowledge to be able to provide a quality workforce. Competence is the measurement level of knowledge and skills. Teaching competence in the skills taught will provide a beneficial effect on learning achievement in mastering the knowledge and skills. Paperwork aims to discuss the expert's views on the development of automotive technology competence constructs.Constructive competence of automotive technology is a measurement guide to the development of automotive technology instruments.Efficiency assessment instruments for automotive technology courses used to measure teacher competence. Previous studies have proven that authoritative educators can produce credible graduates in skills and contribute to quality workforce.The competence of existing instruments are not up to date and in line with technological advances.The seven industry experts consisting of car service trainers, academic training center managers, and workshop owners appointed as Delphi specialists. A total of seven constructs of automotive technology competency can be identified. The implication of the study is to build a robust, current and high reliability instrument to be used in the teaching competency measurement of instructional training institutions.
Keywords: Competency, Delphi, instrument, skills, knowledge, assesment

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I. INTRODUCTION

The Ministry of Education Malaysia has set up a course for technical and vocational skills to shape the students' interest in skills. During the Eleventh Malaysia Plan period (2016-2020), the TVET transformation was conducted for industrial demand and increased economic growth according to technological advances. TVET is a career path that helps youth gain skills and compete for jobs [1]. The country's economic productivity will increase with the availability of labour resources from competent graduates in the field of skills acquired from TVET institutions [2]. Competent TVET graduates with knowledge, skills and attitudes will have a comprehensive impact on economic growth and support the government's aspiration towards a high-income nation [3]. Quality education is able to meet the labour market demands and this can reduce the use of labour force from foreign countries [4].

Competency instruments that measure the competence of instructors' skills and knowledge should be relevant to industrial needs [5]. Collaboration between industry and education can result in a curriculum that includes the latest industry needs [6]. The provision of curriculum that is equivalent to industry competence needs can narrow the competitiveness gap between graduates and industries [7]. Unemployment is attributed to the

problem of competency in the competency of the education curriculum provided rather than industrial requirements [8]. Teachers who do not master the high level of competence will affect the quality of the students and consequently impact on human capital [9]. According to the 11th Malaysia Plan Report, there is a lack of competence in teaching staff skills. Skills institutions need to improve quality competency-based curricula and improve teaching skills to produce quality graduates [10]. The graduates' preparation to shifting the labour market to practical competence is low [11]. Employers put a very high standard in the selection of their employees and skills institutions need to provide competency-based curricula as well as competent students [12].

This paper examines the past study highlights that support the scale of automotive technology competency assessment need to be developed to measure the level of achievement of knowledge and skills instructors. This automotive technology competency assessment scale is derived from the analysis of NOSS documents, research highlights, competency models and expert assessment by method Delphi.This paper discusses previous studies related to thedevelopment of automotive technology programs at the Skills Training Institute in Malaysia, automotive technology competency instrumentand competency models. It is followed by obtaining automotive technology competency constructs by experts using the modified Delphi method. At the end of the paperwork, the conclusions and suggestions of research improvements for further study.

II. DEVELOPMENT OF AUTOMOTIVE TECHNOLOGY PROGRAMS AT THE SKILLS TRAINING INSTITUTE IN MALAYSIA

The Automotive Technology Program at the Institute of Skill Training is conducted using a modular system. Students are assessed the level of competence in a task-based skill module. The modules developed are based on the measure contained in the NOSS format developed by the Department of Skills Development (JPK)[13]. There are five levels of competence in the Automotive Technology program including Level 5 and 4 leading to the job post as manager and executive. The level 1, level 2 and level 3 are geared towards the scope of work in servicing, repairing and diagnosing gasoline and diesel engine vehicles[14].

III. AUTOMOTIVE TECHNOLOGY COMPETENCY INSTRUMENT

There are several instruments that have been developed by previous researchers who have been referred by the researcher. However, these instruments have long been in line with the latest technology and are not currently in use. Among the instruments are the Automotive Mechanics Program to Increase Efficiency and Task List [15], Automotive Technology Efficiency Assessment Service [16], Construction of the Framework Subject Competency-Based Automotive Technology [17], Profile Analysis to Train Undergraduate Students for Automotive Technology Courses [18].

The Automotive Mechanics Competency Instrument Program to Increase Efficiency and Task List developed by William and Ryerson (1976) [15] for the use of vocational instructors. This instrument contains 12 competency fields namely servicing steering and transmission system, drive train, mechanical engine, heating system and cooling system, air conditioning system, brake system, electric system, engine tuning, fuel system and emission, body rust, exhaust system and lubrication. The use of this instrument is to record the competence the student achieves. This limitation is only for measuring skill competence only.

Mac Quarrie (2005) [16] builds an Automotive Technology Efficiency Assessment Service (ASTISP) instrument for employers to evaluate the skills and skills of employees. This instrument includes skills in using hand tools, power tools, the use of mechanical tools, equipment and equipment usage safely and correctly.

Sudsomboon(2007) [17] has fostered a Construction of the Framework Subject Competency-Based Automotive Technology aimed at a framework of automotive technology competence analysis for mechanical technology education program. The instrument encompasses 14 critical work functions, it controls the periodic implementation, controls the exhaust system, controls the cooling system of the engine, controls the system, controls the body component system, controls the steering and

delivery system, controls the electrical system, controls the accessory system, controls the air safety system, controlling the mechanical engineering system, controlling the release system, firing material, controlling the manual drive train system, and controlling the automatic drive system and 135 key framework competencies. This instrument only covers the competence of proficiency and using technology in the past year.

Sudsomboon (2008) [18] builds the Instrument Construction Competency Profile Analysis to Train Undergraduate Students for Automotive Technology Courses to analysing the competence of students in the electrical system on the vehicle's vehicle. This instrument is produced by observing, deep-seated, DACUM document analysis with 17 training instructors. This instrument does not measure in-vehicle systems thoroughly and is based on technology during the year.

IV. COMPETENCY MODEL

In this paper, the competency models referred to are the Lancaster Competency Model (1976) [19], Memorable Model of Boyatriz (1982) [20], Competency Model Iceberg (1993) [21], and Green Competency Model (2010) [22].

Burgoyne and Stuart (1976) [19] have developed the Lancaster Competency Model. This model has eleven competencies below three levels. There are three levels of level one, level 2 and level 3. One level consists of a basic fact order and professional knowledge. The second level consists of first being a sensitive continuity to events, social skills and abilities, emotional endurance and a tendency to respond. The third level is creativity, mental agility, learning habits and skills and the fourth is self-knowledge.

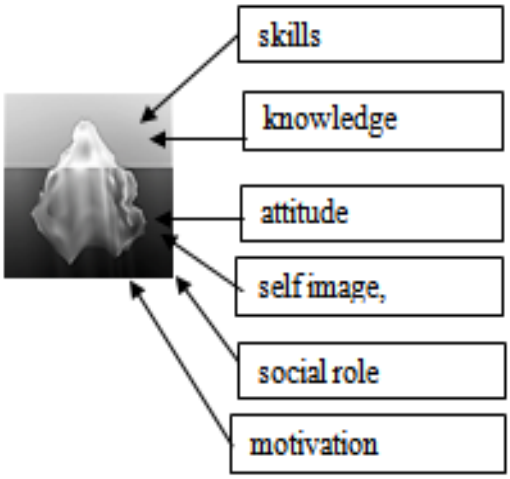
Table 1 is the Model of Competency Lancaster (1976) by level.

Level	**Competency**
Level 1	1. Basic fact order. 2. Professional related knowledge
Level 2	1. Continuity of sensitivity to events. 2. Social skills and abilities 3. Emotional stability 4. The tendency to respond
Level 3	1. Creativity 2. Mental dexterity
	3. Balance of learning habits and skills. 4. Own Knowledge

Boyatriz's Performance Model (1982) [20] states that the definition of competence is the ability of a person to do something regardless of the circumstances and ambiance. Boyatzis (1983)states that individual capabilities are known by understanding one's behavior and difficult to predict, interpret or interpret one's capabilities if they do not know their ability.

Lyle M. Spencer and Signe M. Spencer introduced the Iceberg Competency Model(1993) [21]. This competency model uses iceberg as an object to explain the concept of competence. By using the state of the incident iceberg, that is at the top is the ice which represents the components that can be seen as knowledge and skill. Below the surface of the ice is the water that represents a behaviour component that not be seen such as attitude, self-image, social role and motivation. The Iceberg model has two parts; the first part is the competence that it sees to be easily observable and measured. The second part is hidden competence that is difficult to see and measure. The first part consists of competence of knowledge and skill competence. The second part consists of social roles, self-image, nature and motivation. According to Spencer and Spencer (1993), competencies in the second part may influence knowledge and skill to produce memorable work. Second-section competencies are more necessary for complex work. To awaken two stages of competence also take different paths. The competence of knowledge and skills may be polish through practice, when the competence of social role, self-image, nature and motivation may be enhanced by counselling guidance, motivation and spiritual workshop. Competence in the first and second parts plays an important role. In the world of work, the competence of social roles, self-image, traits and motivations is a boost to the competence of skills and knowledge to carry out the work with more brilliance.

Figure 1, show Competitive Model of Iceberg



Green manufacturing competence model (2010) [22] developed by Department of Economic Development by U.S. Department of Labour's Employment and Training Administration. Green manufacturing is the research, development and production of sophisticated green technology products. It is the most basic driver in the creation of green jobs in Missouri. The Model of Green Competence Model is a competence model that has 10 competency ratings.In the first stage until the ninth stage of competence of personal effectiveness, academic competence, workplace competence, technical competency in industry, technical competency of the industrial sector, job satisfaction scope, job specification competence, occupational specification and management competence. Green manufacturing competence models can be used in the manufacturing industry to improve industry progress.

V. METHOD

Delphi technique was developed by two researchers at RAND Corporation, Hemer and Dalkey in 1950. According to Linstone and Turoff (2002)[23], this technique is used to forecast positions, organizational relationships, business agencies, and government agencies. Linstone and Turoff (2002)[23],point out that Delphi's technique combines qualitative and quantitative methods for expert opinion and judgment to the level of consensus [24]. This technique is also an alternative to separate group communication with distance [25].

Delphi techniques that produce consensus assessments from this expert panel are considered valid and useful information for analyzing data and formulation. Assessment of an expert may create inclination or bias while group assessments can cause disagreements as there may be experts who not accept the opinions of others [26]. According to Linstone and Turoff (2002)[23], this problem can be overcome by creating difficult discussions for consensus.According to Linstone and Turoff (2002)[23], there are three main features of the first procedure are the confidentiality of panel feedback, the number of rounds of questionnaires and panel feedback statistics. Statistics in the form of median and partial deviation of quartiles are given to the panel. The standard deviation is an indication of the level of panel approval of the panel against the median.

VI. SELECTION OF PANEL

In Elmendorf and Song (2015) [24] study, there are five processes in the selection of panel experts. The first step, Elmendorf and Song (2015) determine the relevance of skills, disciplines, and organizations by characterizing each element with expert panel features to look for. The second step, after determining the features of the desired expert panel, the researcher has listed the appropriate individual names. Step three, they contacted the specialist. Step four, ask the expert about the expert contact who is eligible to be nominated as a respondent. This step facilitates the expert search process. The last step after getting the expert's feedback, Elmendorf and Song (2015) [24] have categorized experts according to the elements (skills, disciplines and organizations) and sent a letter of appointment. They stop the search process after the number of experts has been sufficient.

In this study, a total of 7 Delphi experts actively involved. They were involved in the interview to gain insights on the development of automotive technology competence.As of the Delphi specialists involved were two car service centre instructors, two service centre entrepreneurs and three workshop entrepreneurs.

VII. SIZE OF PANEL

The panel size affects the quality of the results obtained. There is no solid source for reference on the number that is most suitable for

the actual number of experts. Spotlight studies show that the number of experts is between 3 and 1500. According to Boonan (1979), the number of experts is able to determine the group's reliability and error on consensus. Table 2 shows the relationship between error reductions and panel size.

Size of Panel	Error Reduction	Error on Consensus
1-5	1.20 to 0.70	0.50
5-9	0.70 to 0.58	0.12
9-13	0.58 to 0.54	0.04
13-17	0.54 to 0.50	0.04
17-21	0.50 to 0.48	0.02
21-25	0.48 to 0.46	0.02
25-29	0.46 to 0.44	0.02

Source : Boonan 1979

In this study, the researcher set the target of a specialist panel of 7 expects.

VIII. DATA ANALYSIS THROUGH MODIFIED DELPHI METHODS

In the first round, semi-structured interview methods are implemented. Researchers will produce interview transcripts to facilitate the process of coding and analysing the data[26]. The findings of from analysing Delphi experts resultis of the part to development of automotive technology competence. The researcher will build five likert questionnaires to obtain expert approval in the distribute of constructs and substructures. Researchers will retrieve questionnaires from Delphi experts and analysing data using IBM Statistics.

The questionnaire was constructed from the constructs that were selected through interview analysis in the first round of Delphi. In the second round of Delphi, each expert will be provided with a questionnaire to get subcontract and item approval. The process of Delphi technique is repeated so that subconstructs and items have reached consensus.

According to Gravetter and Wallnau (1996) [28], variability is a quantitative computation of whether the score scores or clustered scores. If the value of variability is small, this means that the degree of pile score is grouped. Variability can be obtained with quartile and interquartile deviation values. The consensus value of each construct and subconstructs chosen by the panel of experts refers to the degree of agreement and agreement by the expert panel. The degree of agreement is obtained from the value quartile deviation and partial deviation of quartiles.

The classification of the consensus value is divided into three parts, the partial deviation value of quartile is less than or equal to 0.5 (high consensus value), partial deviation of partial deviation is greater than 0.5 to 1.0 (moderate consensus value) and partial deviation value of quartile is more than 1.0 (low consensus value.

IX. CONCLUSION

The findings of the modifiedDelphi method are that there are seven contracts that are identified as a guideline for measurement in the construction of competence instruments. The findings of construct of automotive technology competency is fitting, overhaulling, service, diagnosis, management, administration and marketing.

A study on the development of automotive technology competency constructs is a guideline for measuring the construction of automotive technology competence instruments. This competence instrument is used to measure the level of achievement and mastery in terms of skills and knowledge. Previous studies by other researchers on the measurement of the skills, knowledge, attitudes and behaviors of the teaching staff of the skills training institute are generally not specific to the more specifics of the skills.

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