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Technical Competency among Vocational Teachers in Malaysian Public Skills Training Institutions: Measurement Model Validation Using PLS-SEM

Ismail Khuzainey[1*], Mohd Nopiah Zulkifli[1], Sattar Rasul, Mohamad[2], Pang, Chau Leong[3]

[1]Centre of Engineering and Built Environment Education Research (PeKA),
Universiti Kebangsaan Malaysia, Bangi Selangor, 43600, MALAYSIA

[2]Faculty of Education, Universiti Kebangsaan Malaysia, Bangi, Selangor, 43600, MALAYSIA

[3] Universiti Tun Hussein Onn, 84600 Parit Raja, Batu Pahat, Johor, MALAYSIA

*Corresponding Author

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Abstract: It is important for vocational teachers in Malaysian Public Skills Training Institutions (MPSTI) based on the National Occupational Skills Standard (NOSS) modules to be technically competence. This study aimed to validate the measurement model for technical competency (knowledge and skills) consisting of eight constructs: material and application; work planning; handling, maintenance, and inventory of machines and hand tools; handling students at the workshop; practical instructional strategies; practical assessment; theoretical instructional strategies; specific knowledge; and general knowledge. This study is a quantitative research collected data through simple random sampling of vocational teachers from several technical programmes. A total of 1,186 respondents from 31 public skills training institutions were involved in this study. Measurement assessments were used to conduct a Partial Least Squares (PLS) analysis with SmartPLS 3.0 software to assess and validate the eight constructs of technical competency using a reflective model. The results revealed that 36 items on the eight constructs of technical competency had fulfilled the criteria for the validity assessment of the reflective measurement model through convergent validity and discriminant validity. For convergent validity, the value of loadings exceeded 0.708, the AVE values exceeded 0.5, and the CR values were between 0.7 to 0.9 (satisfactory). The discriminant validity of the model was assessed, and fulfilled the criteria of Fornell and Larcker (square root of AVE is larger than the correlations for all reflective constructs) by comparing the cross-loadings between the constructs, and using the HTMT0.9 technique. The finding of this study contributes to the knowledge on technical competency for vocational teachers in the Technical and Vocational Education and Training (TVET) programme. A proposed model, and newly developed technical competency items were employed in this study.

Keywords: Technical competency, reflective measurement model, Partial Least Square Analysis

1. Introduction

Vocational teachers should be capable of not only teaching theory in class but also educating and training students in the workshop so that they will be able to work in their specific field (Bakar, 2018). Thus, vocational teachers need to be equipped with technical competency. Technical competency refers to knowledge and skills in a specific subject (Colley, James, Diment, & Tedder, 2003; Zopiatis, 2010). One of the characteristics of a person with technical

*Corresponding author: khuzaineyismail@gmail.com

competence is the ability to perform activities in a job as well as use, apply, and create demonstrations as a result of the knowledge and skills in their work (Ayonmike, Chijioke, & Chukwumaijem, 2015). Zaharim, Omar, Basri, Muhamad, and Isa (2009) stated that technical competence means i) applying knowledge; ii) being competent in theory; iii) being competent in application and practice, and iv) being competent in a specific discipline. Thus, workers' competency has a significant influence on their performance (Ismail & Abidin, 2010). Competent vocational teachers must master the knowledge and skills because these features are in line with the requirements of teaching and learning according to Competency-Based Training (CBT). CBT observes the competence in learning and assesses the students based on practical and theoretical knowledge, and attitude of conducting learning activities. Hoepfner and Koch (2015) stated that employees who are knowledgeable and competent in technical areas would be able to use the correct working technique, equipment, and materials.

1.1 Knowledge and Skills

Technical competency is the combination of knowledge and skills (Abdullah, Yaman, Mohammad, & Hassan, 2018) and it is related to work performance (Wijaya & Irianto, 2018). (Young & Guile, 1997) stated knowledge and skills are an important element in TVET professions. Vocational teachers with a lack of knowledge and skills will produce incompetent students in the workplace (Dasmani, 2011). Thus, competent vocational teachers must have the knowledge and skills to teach in vocational education as well as competence in the modern practice of specific occupations (Fejes & Köpsén, 2014). It is known that knowledgeable teachers could affect students' learning achievement (van Uden, Ritzen, & Pieters, 2014). The teachers must have great fundamentals of knowledge and confidence (Ahmad et al., 2016; Muda et al., 2012). Ibrahim, Rahman and Yasin (2014) stated that vocational teachers are one of the student satisfaction factors for those who choose to study in public skills training institutions.

Technical competency in this study refers to the theory of work process knowledge (Boreham, 2002). The theory states that, in the concept of work process knowledge, knowledge is the basis for the employees' needs, and knowledgeable workers work better in the field. Integrating knowledge and skills enables vocational teachers to use their knowledge as the basis for practical implementation based on principles. If they only focus on the practical without the knowledge, they will not have an in-depth understanding. Such understanding can only be obtained when they understand the concepts or theories in the subject. When presenting the subjects, the teachers can help students visualise the practical works in the field, which can ultimately impact student learning outcomes (Timperley, 2008). The work process knowledge theory states that a knowledgeable person in the work process has both practical and theoretical knowledge (Rauner, 2007). The theory also involves the understanding of the work which integrates knowledge and skills (Fischer, Boreham, & Nyhan, 2004), including technical knowledge, and knowledge on the use of the equipment and work processes including preparation, action, control, and evaluation. Ahmad (2011) stated that the theory of work process knowledge combines the theoretical and practical elements in the curriculum. This theory also focuses on the social interactions among workers in the workplace and is applied in a practical context. The following are the epistemological assumptions of the theoretical approach: (a) the worker is a major source of activity that builds knowledge from experience, stores knowledge in his or her brain, and uses knowledge for practical work; and (b) the memory of each work activity produced by the worker is the result of external stimuli that trigger the act and action.

Knowledgeable, skilled, and competent vocational teachers can transfer basic knowledge, principles and skills, and written materials to real-life and experiences (Kilbrink & Bjurulf, 2013). Firstly, knowledge is defined as the assimilation of information in the form of facts, principles, theories, and practices related to working or learning (Bohlinger, 2008). Winterton (2009) defined knowledge as the concrete manifestation for the abstract intelligence of a person as a result of interaction between intelligence (capacity for learning) and conditions (opportunity to learn). Therefore, knowledge involves intellectual interaction with the theories that become the basis and concept and makes a person more holistic in his or her field. In job orientations, knowledge is imperative as they involve a mental process where every employee needs to apply knowledge to carry out his or her duties (Winterton, Delamare-Le Deist, & Stringfellow, 2006). Specific knowledge is the knowledge required according to the working group includes knowledge of work procedures, or steps in performing the work (Rauner, 2007). Nur Kamariah Rubani, Selvan Subramaniam, Ariffin, Hamzah, & Bidin (2018) stated vocational teachers must be able to master practical knowledge such as handling machines and hand tools. Metzler & Woessmann (2012) stated that knowledgeable teachers can influence the achievement of students' learning and knowledgeable teachers important in the teaching process (Araghieh, Farahani, Ardakani, & Zadeh, 2011). In this study, knowledge is divided into general knowledge and specific knowledge.

Secondly, skills are defined as the ability of a person to perform and demonstrate a job or task (Winterton, Delamare-Le Deist, & Stringfellow, 2006). Since skills are the ability to carry out assigned tasks, skilled workers have the knowledge, movement (psychomotor), and positive interaction and attitude towards work (Romiszowski, 2009). Practical teaching applied psycomotor domain by selecting proper teaching strategies (Ahmad, Kamin, & Md Nasir, 2018). A skilled person also possesses technical skills since the latter refers to the ability of a person to complete specific tasks and assessments based on his or her knowledge and skills in the field (Fosa, Peinemann, & Schröder, 2015). Rauner, Heinemann, Maurer and Haasler (2013) stated that a practitioner should have the skills for the following: (i) the use of technology, tools, and methodologies in his or her work; (ii) in-job skills; and (iii) social relationships within the organisation.Therefore, a competent teacher should have the ability to perform and think for his or her work, and be able to practice and evaluate his or her teaching. This is important as the weightage for learning in MPSTIs based on the National Occupational Skills Standard (NOSS) module is 70% practical and 30% theoretical. This present study categorises skills as the following: material and application, work planning, handling machines, hand tools, maintenance, and inventory; handling students at the workshop; practical instructional strategies, theoretical instructional strategies, and practical assessment (Lindberg, 2003).

1.2 Partial Least Square Structural Equation Modeling (PLS-SEM) and Reflective Model

Structural Equation Modelling (SEM) applies the concept of path modelling, where one of its applications include being able to depict the relationships among the observed variables. There are two types of SEM, namely Covariance-Based SEM (CB-SEM), and Partial Least Squares SEM (PLS-SEM). PLS-SEM is a causal modelling approach that maximises the explained variance of the dependent latent constructs (Hair, Ringle, & Sarstedt, 2011). This study used PLS-SEM to predict the latent variables (constructs) and observed variables (indicators of the latent variables) that used reflective constructs and second-order factor analysis (a variation of factor analysis in which the correlation matrix of the common factors is analysed to provide second-order factors). The reflective measurement model hypothesised that the variation in an observed variable could be entirely explained by an underlying latent variable and random measurement error (Henseler, 2016). The criteria for reflective measurement are as follows: the constructs have a relationship with the indicators, and they have high correlations; the scale score does not adequately represent the construct, and it takes measurement error into account at the item level; dropping an indicator does not alter the meaning of the construct; and indicators have the same antecedents and consequences (Henseler, 2017). Fig. 1 shows the reflective-reflective model with a total of 47 items on the technical competency of vocational teachers.

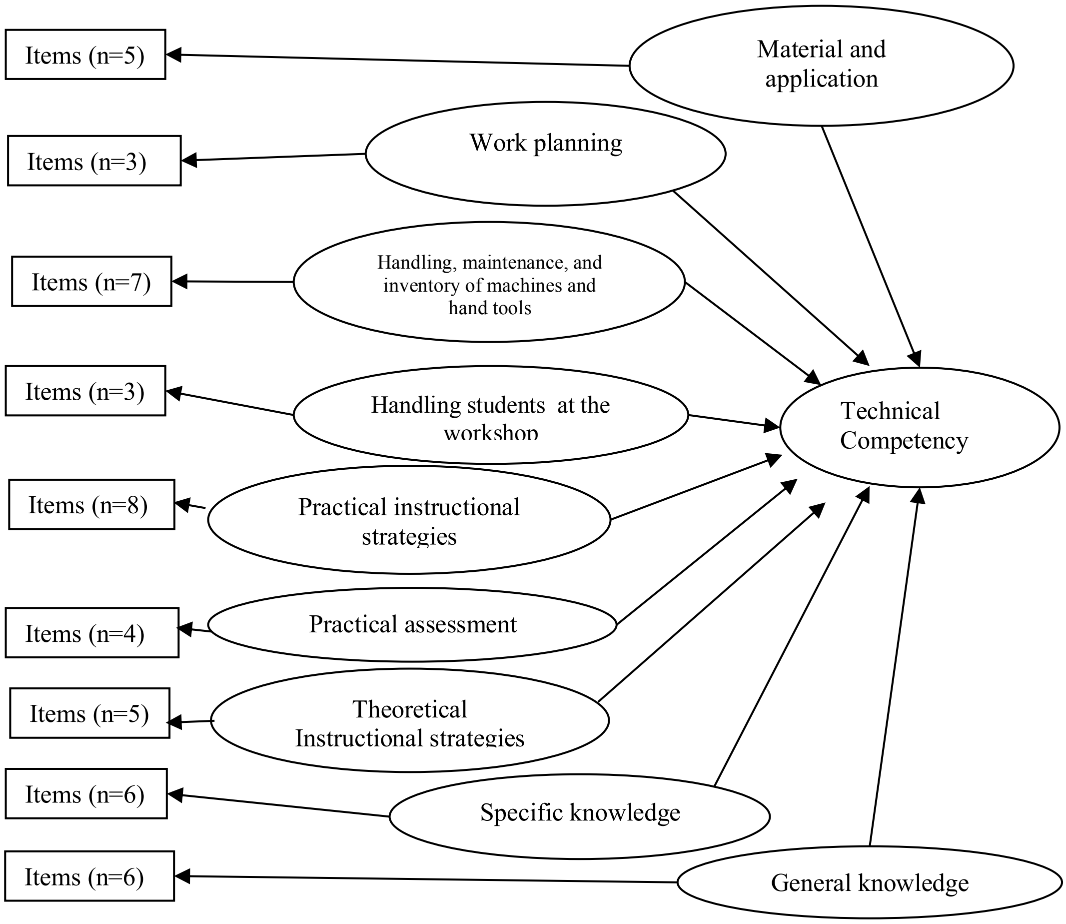

Fig. 1 - Reflective Model for Technical Competency

Measurement assessments were used to conduct Partial Least Squares (PLS) analysis with SmartPLS 3.0 software. The measurement model evaluation aimed to show how well the selected sets of indicators measured the latent or emergent constructs (Ingenhoff & Buhmann, 2016). The validity assessment of the reflective measurement model covered both convergent validity and discriminant validity. The convergent validity consisted of the following: (i) internal consistency reliability/composite reliability (CR), (ii) indicator reliability/factor loadings, and (iii) convergent validity/average variance extracted (AVE). The discriminant validity consisted of the following: (i) cross-loadings, (ii) Fornell and Larcker's criteria, and (iii) the heterotrait-monotrait ratio of correlations (HTMT) criteria. Sarstedt, Ringle, Smith, Reams, and Hair (2014) stated that indicator reliability loadings of above 0.70 indicate that the construct explained over 50% of the indicator's variance. Internal consistency reliability with higher values has high reliability (but values of more than 0.95 indicate item redundancy). Convergent validity measures the extent to which a construct converges on its indicators by explaining the items' variance through the average variance extracted (AVE). On the other hand, discriminant validity determines the extent to which a construct is empirically different from other constructs in the path model in terms of how much it correlates with other constructs, and how differently the indicators are represented in a single construct (Sarstedt et al., 2014). Fornell and Larcker's criteria and HTMT criteria were used to determine discriminant validity for the reflective measurement model through cross-loading. This study aimed to analyse the measurement model for technical competence, consisting of eight constructs using SmartPLS 3.0 software.

2. Methodology

2.1 Items Validity and Reliability

This study is quantitative research and for validity purposes, the items were through a content validity index (CVI) process to validate the suitability of each item as an instrument for each construct. The CVI process by calculating the item-level CVI (I-CVI), the value I-CVI is the summation of agreement divided by the total number of experts and the content validity index for S-CVI to recognize the proportion of agreement within the instrument (Polit & Beck 2006). The determinate criterion (cut-off point) of I-CVI is 0.78 (78%) and 0.90 (90%) for the S-CVI/Ave (Polit & Beck 2006). A total of seven content experts are involved in the I-CVI and they are asked to rate 61 competency items with scale, 1= not relevant, 2=somewhat relevant, 3=quite relevant and 4= highly relevant (Polit, Beck, & Owen, 2008). The result of the I-CVIs is valued is 0.85, the total agreement for 61 items with the sum of S-CVI / Average is 0.96. It shows the I-CVI is 85% and 96% for S-SCI/Ave is considered good content validity (Polit & Beck 2006). For the pilot test, the questionnaire used a 5 Likert scale (strongly disagree (1) to strongly agree (5)) were submitted to seven public skills training institutions in Selangor, Negeri Sembilan and Kuala Lumpur. 222 vocational teachers (purposive sampling) for the technical programme in mechanical, electrical, computer and civil programme were involved in the pilot test. The data were analysed using Rasch Measurement Model. The items are discarded if the values of PT-Measure Correlation, MNSQ Outfit, and Z-Std are not within the range as follows: 0.4 to 0.85 for PT-Mea Corr value; 0.6 to 1.4 for Outfit MNSQ; and +-2 for Outfit Z-Std value (Azrilah 2010; Bond & Fox 2007). Then the items were examined for item redundancy or possible multi-collinearity through item pairs. The results of the pilot test revealed 14 items were discarded and the total of 47 items for technical competency is accepted with the Cronbach Alpha value is 0.91.

2.2 Research Instrument

This quantitative study used a set of questionnaires that contained 47 technical competency questions, with the response scale for the survey being strongly disagree (1), disagree (2), neither disagree nor agree (3), agree (4), and strongly agree (5). After receiving permission to conduct the research from the General Director of the Manpower Department, Ministry of Human Resources, and the Director of the Youth Skills Development Division, Ministry of Youth and Sports, the questionnaires were distributed to 36 public skills training institutes in Peninsular Malaysia, out of which only 31 responded. The completed questionnaires were mailed and returned to the researcher using stamped envelopes. The questionnaires were divided into two sections: 1) the first part consisted of the respondents' information (gender, age, vocational positions, education background and grade, programme field, and teaching technique course); while 2) the second part contained the 47 items. The questionnaire also had a description of how to fill in the form, and information about the research.

2.3 Population and Sample

This study selected the population comprising vocational teachers in the DV scheme who teach and manage Technical and Vocational Education and Training (TVET) programmes based on the National Occupational Skills Standards (NOSS) in Malaysian Public Skills Training Institutions (MPSTI) under the Ministry of Human Resources, and the Ministry of Youth and Sports. For the simple random sampling, vocational teachers who taught in various technical fields in public skills training institutions in Peninsular Malaysia.

2.4 Data Analysis Technique for Reflective Measurement Model Evaluation

The internal consistency reliability was assessed using Cronbach's alpha values as a measure for the homogeneity of a construct, where the value of 0.7 was considered acceptable (Ingenhoff & Buhmann, 2016). The composite reliability (CR) should be higher than 0.70 in exploratory research, but a value of 0.60 to 0.70 was also considered acceptable (Hair, Ringle, & Sarstedt, 2011). Ramayah et al. (2018) stated that the values for composite reliability are CR ≥ 0.9 (not desirable), CR ≥ 0.7-0.9 (satisfactory), and CR ≥ 0.6 (exploratory research). Hair et al. (2018) stated that the minimum value is 0.70 (or 0.60 in exploratory research).

(i) Composite Reliability (CR)

The composite reliability (CR) was assessed using Cronbach's alpha values as a measure for the homogeneity of a construct, where the value of 0.7 was considered acceptable (Ingenhoff & Buhmann, 2016). The CR should be higher than 0.70 in exploratory research, but a value of 0.60 to 0.70 was also considered acceptable (Hair, Ringle, & Sarstedt, 2011). Hair et al. (2018) stated that the minimum value is 0.70 (or 0.60 in exploratory research).

(ii) Indicator Reliability/ Outer Loadings

The indicator reliability should be higher than 0.70 (Hair, Ringle, & Sarstedt, 2011; Hair et al., 2018). Ramayah et al. (2018) stated that the loading of 0.708 or higher is recommended; the loadings which are equal to or more than 0.7, 0.6, 0.5, or 0.4 are adequate if other items have high scores of loadings to complement AVE and CR values.

(iii) Average Variance Extracted (AVE)

Average variance extracted (AVE) is the grand mean value of the squared loadings of all indicators associated with the construct (Ramayah et al., 2018). The AVE value should be higher than 0.50 (Hair, Ringle, & Sarstedt, 2011; Hair et al., 2018).

(iv) Discriminant Validity

Discriminant validity was assessed through cross-loading, Fornell and Larcker's criteria, and HTMT criteria (Hair et al., 2018). Cross-loading is the highest loading of each indicator for the designated construct. For Fornell and Larcker's criteria, the square root of AVE of a construct should have larger correlations between it and another construct in the model, while the HTMT criteria is HTMT0.9 (Gold, Malhotra, & Segars, 2001).

3. Results and Discussion

3.1 Respondents Information

A total of 1,186 vocational teachers from 31 public skills training institutions were involved in this study as respondents. The respondents were both male (N = 915) and female (N = 271). The respondents' age was divided into four groups: less than 30 years (N = 47), 31 to 40 years (N = 638), 41 to 50 years (N = 406), and 51 to 60 years (N = 95). Their vocational positions were divided into two groups: 1) executives who have certificates and diplomas (N = 902), with their grades as follows: DV17/19 (n = 9), DV22 (n = 8), DV29/30 (n = 629), DV36 (n = 151), and DV38 (n = 107); and the 2) professional and management group who have bachelor's, master's, and PhD degrees (N = 284), and their grades: DV41 (n = 91), DV42 (n = 48) DV48 (n = 13), DV52 (n = 2), and DV54 (n = 1). Most of the vocational teachers had completed the compulsory instructional course. Purposive sampling was done with vocational teachers from various technical programmes as follows: ICT (n = 60), mechanical (n = 421), electronics (n = 103), mechatronics (n = 31), electrical (n = 287), welding (n = 35), video publishing (n = 2), civil (n = 67), manufacturing (n = 16), plastic technology (n = 12), composite (n = 2), quality assurance (n = 6), and ceramic technology (n = 8).

3.2 The Measurement Model Results

The indicator reliability, AVE, CR, and Cronbach's alpha of the reflective constructs are shown in Table 1. All the items with loadings exceeding 0.708 were retained, and those below were not (PU9, KBP3, KPATM1, KPATM3, KPATM6, KPATM8, KPT3, KPT4, KPPP1, KPPP3, and KPPP6) as indicator reliability should be higher than 0.7 (Hair, Ringle, & Sarstedt, 2011). In this study, items PS12 and PS13 with loading exceeding below 0.708 is remaining because of the importance of the items. Ramayah et al. (2018) stated that the values for indicator reliability 0.708 or higher are recommended but loadings values more than 0.6, 0.5 or 0.4 is adequate if other items have high scores of loadings to complement AVE and CR. The Cronbach's alpha values for all factors were higher than 0.7, and thus, considered acceptable (Ingenhoff & Buhmann, 2016; Hair, Ringle, & Sarstedt, 2011; Hair et al., 2018). The AVE value was above 0.5 for each factor and was accepted in this study. All eight constructs achieved the thresholds of AVE greater than 0.5, and CR greater than 0.7. All the constructs fulfilled the requirements for reliability and convergent validity. Tavakol and Dennick (2011) stated that the Cronbach's alpha value should not be more than 0.90 because it may suggest redundancies. The Cronbach's alpha values for this study were above 0.7 and less than 0.9, which indicates good values.

Table 1 - Measurement Model Result and Item for Technical Competency of Vocational Teachers

Latent variables	Items		Loadings	AVE	Composite Reliability	Cronbach Alpha
Material and application	KBP1	I am able to identify suitable materials for practical teaching.	0.834	0.715	0.9	0.867
	KBP2	I am able to ensure adequate materials for practical teaching.	0.838			
	KBP4	I am able to keep the materials in the right place.	0.868			
	KBP5	I am able to save on material use.	0.841			
Work planning	KP2	I am able to plan proper teaching methods.	0.881	0.766	0.890	0.847
	KP3	I am able to carry out the process of teaching and learning as planned in the teaching schedule.	0.886			
	KP4	I am able to plan the use of appropriate teaching aids during practical teaching.	0.858			
Handling, maintenance, & inventory of machines and hand tools	KPATM2	I am able to handling and explain the function of each element (hand tools, tools, and machines).	0.831	0.719	0.885	0.805
	KPATM4	I am able to work on a maintenance schedule.	0.876			
	KPATM5	I am able to work on inventories and records for hand tools/machines.	0.835			
Handling students at the workshop	KPP1	I am able to attract students during their study in the workshop.	0.83	0.724	0.887	0.809
	KPP2	I am able to control the learning activities during practical teaching.	0.886			
	KPP3	I am able to instruct students to perform housekeeping after practical session.	0.835			
Practical instructional strategies	KPPP2	I am able to make adjustments to the machines and equipment.	0.773	0.653	0.880	0.867
	KPPP4	I am able to demonstrate practical work to the students.	0.815			
	KPPP5	I am able to provide student-centred learning assignments, such as problem based learning.	0.81			
	KPPP7	I am able to monitor student learning activities.	0.817			
	KPPP8	I am able to listen to the explanations for the steps of work and important points from students.	0.824			
Practical assessment	KPPrak1	I am able to assess the students' practical work (exact requirements, criteria, procedures and techniques for finishing, accuracy, and installation at the designated time).	0.825	0.693	0.9	0.852
	KPPrak2	I am able to evaluate student attitudes when assessing safety practices.	0.844			
	KPPrak3	I am able to assess students' attitude in handling hand tools, machines, and equipment.	0.841			
	KPPrak4	I am able to evaluate students' application skills while doing practical work.	0.819			
Theoretical instructional strategies	KPT1	I am able to explain theoretical teaching clearly with the objectives.	0.875	0.726	0.888	0.811
	KPT2	I am able to repeat the main points to strengthen the students' understanding.	0.868			
	KPT5	I am able to correct students' misconceptions by motivating them.	0.813			
Specific knowledge	PS5	I am able to design and interpret drawings/diagrams (designs and specifications).	0.788	0.596	0.898	0.862
	PS6	I am able to explain how to take measurements correctly.	0.82			
	PS7	I am able to explain the practical process step by step.	0.845			
	PS11	I am able to explain the steps during troubleshooting.	0.797			
	PS12	I am able to explain rules/safety practices in the workshop.	0.682			
	PS13	I am able to describe the latest technology in the field (systems/equipment/machines/hand tools/manuals).	0.682			

Latent Variabel		Items	Loadings	AVE	Composite reliability	Cronbach Alpha
General knowledge	PU6	I am able to promote the programme to the public.	0.76	0.616	0.889	0.844
	PU7	I am able to explain articulation of learning to the students.	0.793			
	PU8	I am able to explain the areas of work that are relevant to the field.	0.780			
	PU10	I am able to explain new ideas using appropriate methods/techniques/instruments.	0.789			
	PU11	I am able to explain my ideas for solving a work-related problem.	0.8			

Table 2 shows all the constructs that exhibited satisfactory discriminant validity, whereby the bold values show the square root of AVE, which are higher than the estimated correlation values. According to Fornell and Larcker (1981), an AVE value of 0.50 and higher indicates a sufficient degree of convergent validity. The AVE of a latent variable should be higher than the squared correlation between the latent variable and all the other variables (Ramayah et al., 2018). These results satisfy all requirements for establishing the validity and reliability of reflective measurement models.

Table 2 - The Results of Fornell and Larcker

	Material and application	Theoretical instructional strategies	Specific knowledge	General knowledge	Handling students at the workshop	Practical assessment	Handling, maintenance, and inventory of machines and hand tools	Work planning	Practical instructional strategies
Material and application	**0.846**								
Theoretical instructional	0.742	**0.852**							
Specific knowledge	0.576	0.649	**0.772**						
General knowledge	0.549	0.617	0.684	**0.785**					
Handling students at the workshop	0.687	0.635	0.579	0.543	**0.851**				
Practical assessment	0.701	0.678	0.58	0.536	0.63	**0.832**			
Handling, maintenance, & inventory of machines and hand tools	0.601	0.624	0.615	0.59	0.574	0.605	**0.848**		
Work planning	0.635	0.686	0.603	0.555	0.602	0.707	0.595	**0.875**	
Practical instructional strategies	0.737	0.758	0.657	0.597	0.646	0.771	0.665	0.687	**0.808**

Table 3 and Fig. 2 show the results of cross-loadings for the technical competency items. All indicators loaded high on their constructs, but low on other constructs. All items in the measurement models achieved discriminant validity as the constructs were distinctly different from one another.

Table 3 - The Results of Cross–Loadings

	Material and application	Work planning	Handling, maintenance, and inventory of machines and hand tools	Handling students at the workshop	Practical instructional strategies	Practical assessment	Theoretical instructional strategies	Specific knowledge	General knowledge
KBP1	**0.834**	0.558	0.551	0.664	0.641	0.612	0.616	0.521	0.483
KBP2	**0.838**	0.532	0.482	0.542	0.623	0.565	0.596	0.466	0.455
KBP4	**0.868**	0.548	0.514	0.583	0.626	0.618	0.641	0.493	0.455
KBP5	**0.841**	0.507	0.485	0.528	0.601	0.575	0.657	0.465	0.462
KP2	0.558	**0.881**	0.536	0.544	0.602	0.638	0.616	0.556	0.502
KP3	0.547	**0.886**	0.506	0.518	0.593	0.595	0.57	0.511	0.462
KP4	0.56	**0.858**	0.519	0.517	0.607	0.623	0.613	0.516	0.494
KPATM2	0.552	0.536	**0.831**	0.525	0.598	0.566	0.558	0.571	0.536
KPATM4	0.495	0.48	**0.876**	0.455	0.555	0.488	0.517	0.504	0.48
KPATM5	0.477	0.493	**0.835**	0.474	0.533	0.477	0.508	0.484	0.479
KPP1	0.509	0.492	0.483	**0.83**	0.538	0.497	0.553	0.497	0.475
KPP2	0.612	0.526	0.523	**0.886**	0.595	0.548	0.555	0.512	0.496
KPP3	0.63	0.517	0.457	**0.835**	0.515	0.563	0.514	0.471	0.415
KPPP2	0.573	0.506	0.545	0.48	**0.773**	0.546	0.6	0.548	0.491
KPPP4	0.609	0.549	0.544	0.531	**0.815**	0.612	0.642	0.544	0.479
KPPP5	0.558	0.559	0.549	0.5	**0.81**	0.575	0.605	0.542	0.508
KPPP7	0.609	0.579	0.522	0.557	**0.817**	0.684	0.61	0.511	0.461
KPPP8	0.626	0.579	0.527	0.541	**0.824**	0.692	0.606	0.508	0.476
KPPrak1	0.6	0.566	0.528	0.52	0.716	**0.825**	0.598	0.514	0.476
KPPrak2	0.59	0.556	0.499	0.525	0.679	**0.844**	0.589	0.485	0.454
KPPrak3	0.562	0.598	0.488	0.51	0.591	**0.841**	0.536	0.469	0.424
KPPrak4	0.582	0.638	0.496	0.544	0.575	**0.819**	0.531	0.461	0.428
KPT1	0.704	0.594	0.556	0.567	0.649	0.587	**0.875**	0.576	0.537
KPT2	0.631	0.597	0.53	0.542	0.665	0.602	**0.868**	0.549	0.516
KPT5	0.558	0.561	0.509	0.514	0.624	0.543	**0.813**	0.533	0.524
PS11	0.499	0.481	0.501	0.449	0.593	0.48	0.538	**0.797**	0.563
PS12	0.413	0.442	0.422	0.464	0.437	0.457	0.438	**0.684**	0.428
PS13	0.399	0.419	0.476	0.403	0.474	0.399	0.483	**0.681**	0.577
PS5	0.404	0.461	0.451	0.411	0.469	0.386	0.476	**0.788**	0.522
PS6	0.441	0.481	0.479	0.46	0.489	0.446	0.502	**0.82**	0.517
PS7	0.498	0.503	0.513	0.493	0.562	0.509	0.555	**0.845**	0.556
PU10	0.4	0.405	0.473	0.427	0.462	0.385	0.466	0.507	**0.789**
PU11	0.457	0.443	0.495	0.43	0.508	0.409	0.52	0.547	**0.8**
PU6	0.416	0.394	0.421	0.395	0.422	0.419	0.461	0.516	**0.76**
PU7	0.405	0.458	0.481	0.415	0.466	0.413	0.476	0.545	**0.793**
PU8	0.471	0.475	0.444	0.46	0.481	0.474	0.494	0.566	**0.782**

Table 4 shows the results of the heterotrait-monotrait ratio of correlations (HTMT), and it was found that there was no correlation within the constructs and none between the constructs. The values were lower than the required threshold value of HTMT0.9 (Gold, Malhotra, & Segars, 2001) indicating that discriminant validity was established for the constructs of this study. Since all HTMT values were well below the threshold level of 0.9, there was no issue with discriminant validity.

Technical competency consists of knowledge and skills (Mohammad et al., 2018). Knowledge and skills are important for the vocational teachers of TVET programme which is in line with the work process knowledge theory. Vocational teachers need to do demonstrations during practical teaching; able to handle tools, equipment and machines; and able to do the practical and theoretical evaluation. Classroom management is a pedagogy activity (Villegas-reimers, 2003) and one of the measurements of the effectiveness and performance of a teacher (Hamid et al., 2012). The vocational teachers deliver the theoretical subject based on the NOSS module. Thus, the knowledge and understanding of the theoretical subjects as well as the strategies ineffective theoretical teaching can attract students learning in the classroom. This study found that the measurement model via PLS-SEM analysis was relevant to the technical competence of vocational teachers for the eight constructs. Vocational teachers with the knowledge and skills in the field could deliver instruction effectively, identify equipment, hand tools, and machines correctly, perform work planning, perform maintenance and inventory on equipment, hand tools, and machines, identify material and save on material use, and have specific knowledge in the field and general knowledge.

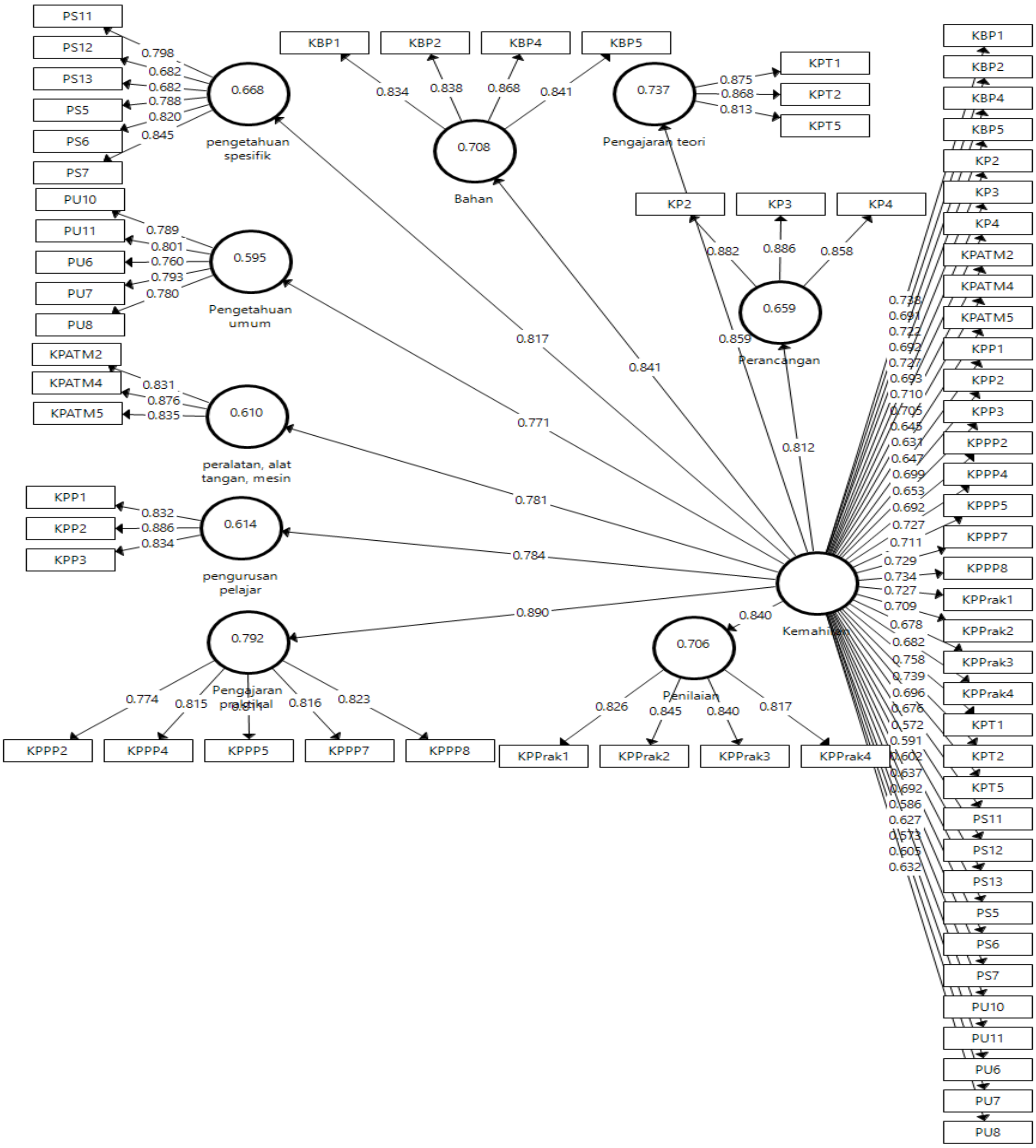

Fig. 2 - Competency Technical Measurement Model for Vocational Teachers

4. Conclusion

Technical competence is a reflective measurement model and it had fulfilled the validity requirements of convergent validity and discriminant validity. In this study, the convergent validity of the technical competency model had the loadings that exceeded 0.708, the AVE value exceeded 0.5, and the CR value exceeded 0.7 to 0.9 (satisfactory). The discriminant validity of the model was assessed and it fulfilled the Fornell and Lacker criterion (square root of AVE is larger than the correlations for all reflective constructs) by comparing the cross-loadings between constructs and HTMT.90 technique. The 35 items in technical competence for vocational teachers were measured via the measurement model criterion by PLS-SEM and they fulfilled the requirements for convergent validity and discriminant validity. A newly developed technical competency items were employed and the items for technical competence can be used as a reference for other researchers. For future research, researchers would like to propose a competency model consist of technical competency, pedagogy competency and personal competency for the vocational teachers in Malaysian public accredited centres.

Table 4 - The Results of HTMT

	Material and application	Theoretical instructional strategies	Specific knowledge	General knowledge	Handling students at the workshop	Practical assessment	Handling maintenance & inventory of machines and hand tools	Work planning	Practical instructional strategies
Material and application	****								
Theoretical instructional strategies	0.883 (0.847, 0.915)	****							
Specific knowledge	0.664 (0.611, 0.71)	0.775 (0.737, 0.814)	****						
General knowledge	0.64 (0.57, 0.695)	0.745 (0.698, 0.785)	0.802 (0.76, 0.841)	****					
Handling students at the workshop	0.817 (0.733, 0.869)	0.784 (0.739, 0.827)	0.695 (0.643, 0.741)	0.656 (0.604, 0.702)	****				
Practical assessment	0.815 (0.772, 0.852)	0.814 (0.772, 0.855)	0.676 (0.623, 0.72)	0.63 (0.564, 0.679)	0.759 (0.681, 0.807)	****			
Handling, maintenance & inventory of machines and hand tools	0.716 (0.669, 0.762)	0.77 (0.725, 0.816)	0.736 (0.686, 0.779)	0.713 (0.665, 0.756)	0.708 (0.649, 0.758)	0.726 (0.682, 0.78)	****		
Work planning	0.74 (0.682, 0.78)	0.827 (0.784, 0.865)	0.706 (0.661, 0.748)	0.655 (0.604, 0.699)	0.727 (0.676, 0.769)	0.833 (0.788, 0.868)	0.718 (0.788, 0.868)	****	
Practical instructional strategies	0.849 (0.813, 0.884)	0.89 (0.871, 0.920)	0.758 (0.71, 0.798)	0.697 (0.633, 0.751)	0.771 (0.69, 0.823)	0.894 (0.864, 0.92)	0.794 (0.752, 0.827)	0.801 (0.749,0.84)	****

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