

The SEM SmartPLS Model Assessment: Mediating Influence of Technology Infrastructure Support on Human Capital Determinants in TVET Institutions

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To Link this Article: <http://dx.doi.org/10.6007/IJAROSS/v12-i11/15410> DOI:10.6007/IJAROSS/ v12-i11/15410

Published Date: 17 November 2022

Abstract

This study attempts to construct a model assessment of SEM SmartPLS application in assessing the contribution of technology infrastructure support on human capital determinants among TVET lecturers. The compatibility concept of person-organization among academicians is one of the strategic aims for the Ministry of Education as it was stated in Malaysia Education Blueprint 2015-2025 (higher Education). The Ministry believed a sustainable growth of this group is a crucial focus since they play an important role to accomplish the country's education objective. Therefore, their professional profile needs to be consolidated in parallel with the education ecology. Apart from that, technology infrastructure support is also seen as a significant tool in boosting the quality of public education institutions where the chalk and paper method is no longer relevant in current education environment. As the most practical solution information technology infrastructure was adapted by organization to assist the activity even with a non-face-to-face situation. The shifting allows the people to attend any virtual courses as the objective to improve their professionalism in academic sector. This study assesses the role of ability, education, experience, knowledge, skill and training as the determinants of human capital and its significant contribution towards the institution performance. Then technological infrastructure supports also been examine as the mediator to recognize its affect towards performance. A theoretical model was underpinned by the theory of Human Capital (HC), Resource Based View theory and Malcolm Baldrige Criteria for Performance Excellence, which consist of six independent constructs, one mediating construct and one dependent construct. Apart from that this study discuss some relevant issues which contributes to TVET lecturers HC investment such as shortage of qualified, skill gaps, lack of industrial exposure and pedagogical knowledge. To achieve the research objectives a quantitative study has been carried out to among lecturers from 9 polytechnic campuses in the East Coast, Malaysia. A

survey consisting of 63 items with 7 Likert scale was distributed to 1478 of TVET lecturers and 398 samples were successfully collected using the Stratified Sampling procedure. Next data were then analysed using the Structural Equation Modelling (SEM) approach on SmartPLS3 platform to test the hypotheses. The results confirmed the hypotheses in determining the direct and significant effect between the constructs. Skill was identified as the key driver of the significant relationship of HC towards the TVET institution performance ($t = 2.126$, $\beta = 0.143$, $p\text{-value} = 0.016$). The result revealed that skill, knowledge and training had significant and positive relationship towards the performance. Significantly, this study contributes a substantial finding to help the TVET institution in recognizing the role of HC determinants and technology infrastructure support in consolidating their human resources.

Keywords: Ability, Education, Experience, Knowledge, Skill, Training, IT Support and TVET

Introduction

In the current dynamic environment, the competition is getting stiffer and the human capital sustainability of the institution has become a crucial issue and the organizational performance had been a key focus in implementing measures to ensure competitiveness and sustainability (Muthuveloo et al., 2017). The sustainability of human capital quality force the organization to concentrate on enhancing every single element which provide a positive outcome towards performance. Now the education landscape is evolving and expanding as the alternative to the education institution in supporting the teaching and learning process by increasing access to the quality of higher education in Malaysia. The organisation must focus on increasing all factors that contribute to improved performance due to the sustainability of human capital quality. To promote the development of the nation, Malaysia needs professionals with the soft skills, such as problem-solving and opportunity-oriented thinking, entrepreneurialism, creativity, cooperation, and meta-abilities, to adapt to multidisciplinary work and information technology enhanced environments. In the same way one of the objective to strengthen the human capital is to ensure the institution will be flexible and efficient enough to adapt to new emerging trend (Miciak, 2019).

The key aspect discuss on the importance contribution of human capital determinants towards the academic instructors quality. Generally employees are expected to stay current on global economics due to the dynamically shifting employment market and advancing technology advancements. Next, equally important education has been key to Malaysia's rapid development and Higher Education Ministry is strongly striving for improving the quality of education and instructor's development. To fulfill the strategy the government has established the Malaysia Education Blueprint 2015-2025 (Higher Education) to ensure. that the education sector will be able to maintain the sustainability of the current environmental needs. Therefore, in developing the most capable human capital, the government plays the main role in strengthening the education industry by empowering the Technical and Vocational Education and Training (TVET) program aspart of the Malaysia Education Blueprint 2015-2025 (Higher Education) and it can play a major role in providing a future workforce with high employability skills (Mahathir, 2019).

The Ministry of Education (MOE) also recognizes the importance of Technical and Vocational Education (TVE) in promoting the aspirations of the country in becoming a developed nation. The development of the TVET curriculum would be able to assist the economic and social well-being in the future (Minghat & Yasin, 2010). Bakar (2017) adds that the development of human resources through TVET is an investment in enhancing production capabilities, the use of those resources to produce higher output, and the consumption by those human resources of the benefits resulting from the increased output, leading to an improved quality of life. By fostering the development of human capital, particularly for industrialization and economic development, TVET is now acting as one of the most crucial keys to sustainable development.

As seen by the extraordinary growth in the number of higher education institutions over the past 15 years, the government has prioritised investments in the education sector, especially in higher education. Recognizing the significance of this endeavour, the government increased its budget to human capital development initiatives in the 10th Malaysia Plan from 21.8 percent in the 9th Malaysia Plan to 40% (or RM92 billion). Human Capital Development has been recognised as a major concern in the Economic Transformation Programme (ETP) across all National Key Economic Areas because it is a component of Malaysia's strategic development scope (NKEA). According to the Malaysia Investment Development Authority, Malaysia is listed at number 55 on the 2018 human capital index of the World Bank, behind number one Singapore. This human capital index looks at how nations use their human capital and train their workers to satisfy demand in a market that is competitive (Islam et al., 2016).

This study attempts to recognize the contribution of technological infrastructure support as the mediator on human capital determinants towards the Technical and Vocational Education Institutions (TVET). The research objectives were construct as below:

- i. To identify the influence of human capital determinants in Technical and Vocational Education and Training (TVET) Institutions in East Coast Malaysia
- ii. To examine the mediating (technology infrastructure support) effect and its contribution to the organizational performance of Technical and Vocational Education and Training (TVET) Institutions in East Coast Malaysia

Literature Review

Institutional Performance

By focusing on institution performance. The Malcom Baldrige measurement was implemented. The Excellence in Higher Education (EHE) model expands the Baldrige model to address the unique demands of higher education by taking into account the standards and vocabulary used in certifying, according to (De, 1991; Ruben, 2007). To evaluate the effectiveness of TVET institutions, the Malcolm Baldrige Criteria for Performance Excellence are modified. Leadership, Business Process Management, Human Resource Development and Management, and Quality and Performance make up the measurement.

Technical and Vocational Education and Training Institutions (TVET)

Many experts and researchers agree that TVET is an integral component of lifelong learning and that it has a crucial role in this new era as an effective tool to realize the objectives of an environmentally sound sustainable development. Therefore, TVET is becoming increasingly important as part of leading innovation and change in higher education. The Malaysian Budget for 2017 included approximately RM4.6 million to maintain the caliber of instruction at TVET institutions, demonstrating the government's earnest commitment. The primary job quality requirements for TVET lecturers must be the professional tasks and the knowledge, abilities, and attitudes necessary to complete them. Teachers must therefore have a thorough understanding of occupational duties and how they fit into the labour and business processes of the economic or industrial sector in order to effectively instruct their students. Therefore, the government is seriously focusing on improving the quality of the TVET system which includes the human capital development activity, task assistance and job environment improvement as several initiatives towards the development of the country. However, the need for strengthening and transforming this program is crucial in recent years due to the new and more challenging industrial environment, as the world begins to embrace the Fourth Industrial Revolution (IR4.0).

Despite the issue the chalk-and-paper method is no longer appropriate in the traditional classroom, technology has now emerged as one of the key mediums supporting the quality of TVET education. Information technology can also improve a company's performance and that of its human resources. In order to conduct the learning session, TVET teachers must be able to use ICT tools like e-learning, video conferencing, social networking, and others. This teaching approach will emerge as one of the options for fostering a creative learning environment while also encouraging the idea of higher-order thinking (HOT) skills in the dissemination of knowledge and occupational skills (Churches, 2008). But Chua & Jamil (2017) forecast that 90% of teachers will be absent.

Human Capital Determinants

Human capital is one of the indicators to measure the sustainability of institutional success. Human capital is one of the important inputs relating to the performance, competitiveness, and sustainability of organizations. Meanwhile, 'capital' refers to wealth and the accumulation of value. The two fundamental parts of human capital are the individual and the organisation. Competitiveness is dependent on skills and human capital investment, as explained by Zahid, Sareeta, and Manisha in 2015. Initially, Schultz (1961) considers that human capital was formed by knowledge and employee skills and highlighted the role of education in shaping the individual. As stressed by Zlate & Enache, there is a growing body of research that acknowledges the significance of sustaining a person's quality in achieving an organization's performance (2015). This is referred to as the process of making a person and an organisation compatible, which evaluates how well a person matches the nature of the organisation. The ability to recruit and retain personnel who are generally sufficient and whose quality is important for maintaining the institution's success depends increasingly on a person's fit with their company. In addition, Pasban & Nojedah (2016) describe that human capital plays an important role in human development, improves life and income, increases knowledge, skill, and product capacities, and economic growth, and reduces poverty.

In general, the term "human capitals" refers to processes that involve TVET lecturers engaging in self-development activities through education, training, and other professional initiatives to increase an employee's levels of knowledge, skills, abilities, values, and social assets, which will ultimately lead to the employee's satisfaction and performance. TVET lecturers must equip themselves with reliable skills in order to succeed in today's high-performance workplace. The necessary skill traits for doing the activity are cognitive capacity, general knowledge, job expertise, and problem-solving abilities (Lenihan et al., 2019). The research considers the respondents' individual skills and characteristics that affect the success of TVET institutions while evaluating the respondents' abilities. As an alternative, Jamal & Saif (2011); Miiak (2019); Dolores et al (2017) define human capital as the sum of intangible features and qualities, including knowledge, skills, abilities, attitudes, intelligence, wisdom, and talent, and as such, they see it as a crucial resource for value creation.

In addition, Asiamah et al (2018) mention that employees' abilities not only help the employees in doing the job successfully but also lead to higher payment recognition and job security when used to accomplish the assigned job roles. While Yaakobi & Weisberg (2018) emphasise that a company must properly motivate its employees in order to maintain its financial standing as well as to match the employee's aptitude with the resources necessary to accomplish its objectives.

Experience has made a significant contribution to each person's potential for bettering their employment opportunities as part of the human capital dimension (Saffu et al., 2006). The TVET colleges typically select lecturers for education and training programmes based on their level of education, work experience, and capacity to carry out crucial tasks and job categories in today's competitive climate. The questionnaire therefore focuses on the role that work experience plays in developing institution excellence. The knowledge and skills of employees have grown in significance for organisational performance, competitiveness, and innovation, according to (Bashir & Long, 2015).

According to Khasawneh (2011), referenced in Becker (1993), human capital is defined as the expenditure made by firms on employees' knowledge, skills, and training in order to boost organisational productivity and outputs in the long run. Additionally, Ismail et al (2016) stress the need of TVET professors having the necessary teaching abilities and capabilities. In this study, employability and skill development opportunities were highlighted in order to get respondent response. To enhance their current abilities or learn new ones, TVET lecturers are typically needed to finish their training requirements, which are organised by TVET institutions, the government, and the teacher training institutes (Ahmad et al., 2017). Yunos (2016) discusses the significance of equipping vocational instructors with the appropriate abilities, knowledge, and attitudes as part of the excellence components for the TVET ecosystem through the teacher training and development programme, emphasising essential requirements for TVET educators.

Information Technology Infrastructure Support

Two fundamental categories of technology used in TVET were identified by Mohamad et al (2017) as standard technology and unique technology. When we talk about "standard technology," we're talking about analogue tools like books, chalk, and chalkboards or digital tools like the Internet, computer hardware, and digital media to support educational activities

(Lux, 2010; Mishra & Koehler, 2006). Because of this, the measurements for this study were divided into five categories: hardware, software, people, database, and network.

Methodology

As for this research, the researcher applied a technique in probability sampling which is the simple stratified sampling. The advantage of this method is involved the division of TVET lecturer's population into smaller sub- groups called as strata. The stratification is formed according to the lecturer's characteristics such as job characteristic and the educational attainment. The east coast campuses were chosen as the study location because of the homogeneity of the TVET campuses, governed by the Department of Polytechnic Education and Community College Education, quality accreditation which applied to all campuses, and lecturer's job grade and qualification. The location also has the homogeneity in terms of geographical and the state economic performance. Supported by Council (2008), the east coast campuses are located in a location that is targeted to become a developed region by the year 2020. Lastly, the nine polytechnic campuses are chosen because they are sufficiently large to represent the study.

Result

Demographic profile

The number of research populations at nine polytechnics in East Coast Malaysia is 1,478 lecturers as recorded by the Department of Polytechnic Education and Community College Education Malaysia. To assess the research hypotheses, the analysis, begin with examining the measurement model to test the internal consistency of data, reliability, convergent validity and the discriminant validity. After that the procedure continues with testing the structural model to assess the collinearity, path coefficients, coefficient of determination (R^2), effect size of R^2 (f^2), predictive relevance (Q^2), PLS predict and effect size of Q^2 (q^2).

Table 31

Numbers of Population

State	Campus	No. of Lecturers(N)
Kelantan	Kota Bharu Polytechnic	480
	Jeli Polytechnic	40
Terengganu	Kuala Terengganu Polytechnic	88
	Sultan Mizan Polytechnic	268
	Besut Polytechnic	21
	Hulu Terengganu Polytechnic	43
Pahang	Sultan Hj Ahmad Shah Polytechnic	368
	Muadzam Shah Polytechnic	138
	Polytechnic of Metro Kuantan	32
	TOTAL	1478

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Table 2

Questionnaire Design

Section	Constructs	No. of items
A	Demographic	8
B	Job Information	6
C	Malcolm Baldrige Quality Principles	14
D	Training	8
E	Education	8
F	Knowledge Management	8
G	Skill Development	6
H	Experience	6
I	Ability	6
J	Information Technology Infrastructure	10
Total items		80

As shown in Table 2, the questionnaire was divided into ten different parts which are A, B, C, D, E, F, G, H, I, and J.

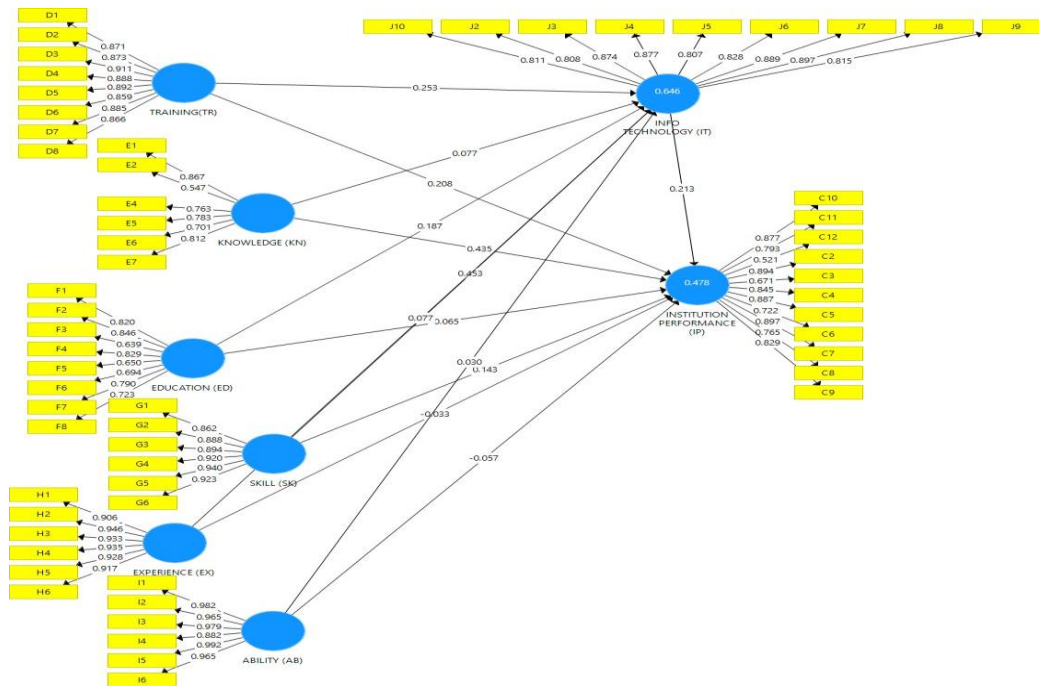
Respondent's Demographic Analysis

Table 3 shows the frequency and percentage of demographic profile. The research respondents were 345 lecturers from nine (9) polytechnic campuses in East Coast Malaysia (Kelantan, Pahang and Terengganu). The demographic concentrated on analysing information such as the campus, gender, age, race, marital status and job grade.

Demographic	Frequency	%
Campus		
i. Kelantan- Kota Bharu Polytechnic	92	26.7
ii. Kelantan- Jeli Polytechnic	17	4.9
iii. Pahang – Sultan Haji Ahmad Shah Polytechnic	85	24.6
iv. Pahang- Polytechnic of Metro Kuantan	11	3.2
v. Pahang- Muadzam Shah Polytechnic	39	11.3
vi. Terengganu- Sultan Mizan Polytechnic	59	17.2
vii. Terengganu-Besut Polytechnic	7	2.0
viii. Terengganu- Hulu Terengganu Polytechnic	16	4.6
ix. Terengganu- Kuala Terengganu Polytechnic	19	5.5
TOTAL	345	100.00
Gender		
Male	123	35.7
Female	222	64.3
TOTAL	345	100.00
Age		
Below than 30 years old	21	6.1
31-40	191	55.4
41-50	89	25.8
51-60 TOTAL	44	12.8
	345	100.00

Evaluation of Measurement Model

This study used the Smart PLS, version 3.0 (Ringle et al., 2005). Based on Valerie (2012), PLS model are analysed and interpreted in two stages. Firstly, the measurement model (outer model) is tested to ensure its validity and reliability which includes convergent validity, and discriminant validity and reliability that were observed by conducting confirmatory factor analysis (CFA). Secondly, the structural model investigated hypotheses, R square (R^2) effect size (f^2) and predictive relevance (q^2) of the model. Then bootstrapping was employed to test the hypotheses. Figure 4.8 illustrates the original model of measurement model which consist of the independent constructs, mediating construct and dependent construct.



((TR)-Training, (KN)-Knowledge, (ED)-Education, (SK)-Skill, (EX)-Experience, (AB)-Ability, (TS) Technology Support, (IP)-Institution Performance)

Figure 1 PLS Algorithm Model

The PLS algorithm is a sequence of regressions in terms of weight vectors. The weight vectors obtained at convergence satisfy fixed point equations. It shows the r^2 value for institution performance is 0.478 while the r^2 value for technology infrastructure is 0.646.

Convergent Validity

For this stage, the convergent validity was examined therefore the Average Variance Extracted (AVE) is used to estimate the value. The AVE must exceed than 0.5 to gain an acceptable convergent validity. The Composite reliability (CR) value must be 0.7 or above is deemed to be acceptable and main loading should be 0.7 (Hair et al., 2014).

Table 4

Convergent Validity

Const	(CA)	(CR)	(AVE)
AB	0.985	0.987	0.925
ED	0.901	0.912	0.567
EX	0.968	0.974	0.861
IT	0.950	0.958	0.715
IP	0.941	0.950	0.638
KN	0.844	0.885	0.566
SK	0.955	0.964	0.818
TR	0.959	0.965	0.776

All the loadings which exceed the recommended value of 0.708 (Hair et. al., 2004) are retained. In addition, all 7 constructs meet the threshold values/minimum cut-off values for CR and AVE, where all CRs are greater than 0.7 and all AVEs are greater than 0.5.

Discriminant Validity Result- Fornel Lacker and Heterotrait Monotrait Ratio (HTMT)

The result indicates that there is discriminant validity between all the constructs. The squared roots of AVEs on the diagonal are higher than the values of the inter-construct on the same column and rows (bolded value > not bolded value). The finding presents that the square root of AVEs is greater in all cases than the off-diagonal elements in their corresponding row and column, so that the required discriminant validity by Fornell-locker has been achieved.

Assessment of Collinearity

Table 5

Assessing the Inner Variance Inflating Factor (VIF) Values

AB	AB	ED	EX	IT	IP	KN	SK	TR
ED				1.009	1.011			
EX				1.168	1.267			
IT				1.529	1.546			
IP					2.825			
KN								
SK				1.035	1.052			
TR				2.297	2.878			
AB				1.783	1.964			

Table 6

Direct and indirect effect of technology performance on TVET Institution Performance

Construct	Direct Effect Model			Indirect Effect Model			Total Effect β (direct +indirect)	Types of Mediation
	β	t-stat	p-value	β	t-stat	p-value		
Ability	-0.057	1.324	0.093	0.030	0.777	0.219	-0.027	No mediation
Education	-0.065	1.414	0.079	0.187	6.067	0.000	0.122	Full mediation
Experience	-0.033	0.677	0.249	0.077	1.704	0.045	0.044	Full mediation
Knowledge	0.435	8.322	0.000	0.077	2.409	0.008	0.512	Complementary
Skill	0.143	2.146	0.016	0.453	8.088	0.000	0.596	Complementary
Training	0.208	3.509	0.000	0.253	4.426	0.000	0.461	Complementary

Table 6 represent the result of mediation testing on the research framework. The result shows that ability (total effect = -0.027) indicate no mediation result (Zhao et.al., 2010). This result shows that information technology significantly mediates the relationship between education, experience, knowledge, training and TVET institution performance.

Conclusion

The purpose of this study was to evaluate how six human capital determinants includes the ability, education, experience, knowledge, skill, and training affect the performance of TVET institutions. The direct relationship assessment shows only knowledge, skill and training significantly influence the TVET institutions' performance. Meanwhile, mediation assessment demonstrates information technology infrastructure significantly mediates the relationship between education, experience, knowledge, skill and training and the TVET institutions' performance. Lastly, skill is indicated as the most critical driver which influence the TVET institutions' performance in East Coast Malaysia. The result shows $\beta=0.143$, $t=2.146$, p -value=0.016

The performance of TVET institutions was examined in respect to the indirect interaction between human capital determinants and information technology infrastructure. In order to strategically plan the performance of the nation, higher education institutions are crucial. Investment in human capital is necessary to enhance the teaching abilities of instructors in order to provide high-quality education. Since TVET directly improves the competitive edge of the nation, it is no longer considered to be secondary education. As a result, the TVET institutions should actively encourage the lecturers to improve their capabilities with the full support of the TVET institutions in order to create a competitive environment. Additionally, technology enables the learning and development process to be hastened in order to meet institutional performance goals. TVET lecturers are encourage to improved their teaching delivery by utilizing test technology such as online learning, experience-based learning, collaborative learning, virtual reality, simulation, and the use of Technology-Enabled Classroom (TECC), also known as TECCGOGY. TVET education program demanded the lecturers be competitive in facing the 21st-century education learning delivery approaches such as 'immersive centered learning' that require the TVET institutions to expand the access to knowledge and skills enhancement through teaching quality enhancement.

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