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An Exploratory Factor Analysis (EFA) of TVET Career Path Development Model

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Abstract

Technical and Vocational Education Training (TVET) has become important in Malaysian education system to produce skilled workforce for industrial need. Career planning are very crucial for TVET students to guide them for a better career in future. Career path development model has been develop to guide TVET student plan their career path. But, to understanding the structure underlying a set of measures in this model is not easy as to understand the data depicted because actual data will often show notable deviations from their pattern. These can make it difficult to gauge their correlation. Factor analysis is the answer to overcome the problems to determine the number of distinct constructs needed to account for the pattern of correlations among a set of measures. In this study factor analysis was used to determine career path model that could effectively bring TVET graduated for their future career in their sector. As to accessing these validity indicators, exploratory factor analysis (EFA), reliability and correlation analysis were used. The results of the analysis based on 151 local TVET graduated from various institution in Malaysia indicated that all extracted factors having good a values of factor loadings and communalities (i.e. above 0.55) and acceptable level of reliability value (i.e. Cronbach's alpha above 0.70). These extracted factors also have good discriminant and nomological validity, since the correlation analysis proof that, the directions of relationships among the extracted factors follow the expected theory (Super Theory) and the strength of the correlation is moderately strength. Therefore, the designed instruments were valid and reliable for accessing the targeted variables in the context of TVET career in Malaysia.

Keywords: Career Path, TVET, Career Demands, Factor, Graduated.

Introduction

Career Planning views with the ability of an individual to plan his future career. Individuals with career maturity will actively designing career, always looking for information about career choices, talk to the parties concerned (counselors, family and others) about planning his career, taking part in outdoor activities or working part-time that help identify career,

joined related courses and obtain additional exercises that can add value to the individual's future career (Amla et al., 2009). Career planning is crucial for TVET students to guide them in future career because most of the TVET students come from low and moderate achievement in their past academic schools. Career path development model has been developed to guide them based on experience of their successful alumni (Nor, 2016). But the model needs to be tested to confirm their constructs correlation.

Most of the studies like social sciences and others, often face a large set of data from observations or scores for a bunch of people. For example, a public opinion researcher might assess the attitudes of a sample of people on a wide range of social issues or health issues. A counsellor might measure a number of perceptions and emotions of people regarding a particular issue. Or a teacher might assess current behavior of their students by asking them to report the extent to which various behavior descriptors reflect their current attitudes. In these and similar contexts, one question that usually arises is whether this set of data can be more parsimoniously represented. Is it reflecting a single underlying construct or only a few distinct constructs. These problems were overcome by developing Factor analysis to determine the number of distinct constructs needed to account for the pattern of correlations among a set of measures (Fabrigar & Wegener, 2012). In this study, researchers used Factor Analysis to determine the number of career planning constructs presumed to account for the structure of correlations among measures are referred to as factors or more precisely as common factors. This Career Development Path for TVET Student was developed from several variables. These selected variables are the important variables for capturing the response of the experts such as Career Planning, Exploring, Information, Decision, Compromise and Spiritual Behaviors.

Literature Review

The obstacles of getting a job are also a big test for TVET graduates especially in post-covid 19 eras. Those who are unprepared and do not have good career information are always having trouble with their career development. However, their career potential needs to be explored to build their future careers (Sattar et al., 2015). A well-planned career development is proven to increase TVET's student career maturity. Even scholars in career counselling say that career development should be guided and can't grow on its own (Super, 1996; Holland, 1997; Creed & Hughes, 2012). Career planning is needed to be in line with their personalities. But, the diversity of personalities and personal profiles cause them a need for different forms of pathways to suit their personalities (Rasul et al., 2021). This is important for them to plan their future career planning for the sake of their future success especially when most of the TVET students come from low and moderate education backgrounds. The need for guidance to develop their career path in the future (Rasul et al., 2016)

Career planning can be defined as a process of systematically matching career goals and individual capabilities with opportunities for their fulfillment (Schermerborn et al., 2005), whereas career exploring is the conscious and unconscious activities conducted with an aim toward learning about the self and the work context and how the two fit together (Jordaan, 1968). Career Information is the information related to the world of work that can be useful in the process of career development, including educational, occupational and psycho-social information related to working (CERIC, 2022). Career decision is the process of choosing among career options (Kulcsárc et al., 2020). Compromise was proposed by Gottfredson (1981) when people are forced to compromise their career choices, they are more likely to compromise first on field of work, then on social level and lastly on sex-type as the amount

of compromise increases. Spiritual Behaviours according to Al-Ghazali is the true seat of knowledge in humans and is the substance of their real essence (Fatimah, 2010). Hence, with the development of the career path, this paper will examine the construct reliability and validity of the indicators that will effectively show Career Path Development for TVET students.

Method

Study Design

This study applied a survey cross-sectional design with the applications of quantitative methods. Part of the method involved validating and exploring the relationships between the conceptual and operationally defined variables namely, planning activities, exploring career information, career decisions, compromise and spiritual factors. In this study, target population are graduates who are related to a Malaysian TVET local providers. Specifically, the target population shall consist of people who currently graduated from local TVET provided and wanted to have jobs, namely fresh graduated. Judgmental sampling technique is used and deemed suitable since there is no sampling frame criteria for choosing the targeted respondent (Lohr, 2010).

A total of 151 respondents who are graduates from local TVET provider such as Community College, Polytechnics, IKBN, IKM, ADTEC and ILP have participated in this study. This sample size is considered adequate, as the minimum sample size required to cover a 95% confidence interval with 15 % effect size power is 90 respondents. This is based on the calculation of the G-Power (Hair et al., 2017). Data was collected using a self-administered internet survey via Google form. This is to ensure a moderate to high response rates are achieved.

Survey Instruments

In measuring Career Planning, Exploring, Information, Decision, Compromise and Spiritual for TVET students career path, 125 indicators were constructed based on literature and expert opinions. These 125 indicators were assigned a 5-point Likert scale where one (1) refers to strongly disagree and five (5) refers to strongly agree and were randomly located in the instruments. In measuring Career Planning, five dimensions were constructed which are Focus, Objective, Self-efficacy, Catalyst Factor and Planning Method. Four dimensions for Career Exploration were constructed which are Duration, Self-Initiatives, Sources and Approach. Three dimensions for Career Information which are Experiences, self-information and Career Information. Three dimensions for Career Decisions which are Psychology, Social and Economic. All these constructs are based on Career Development Inventory by (Super et al., 1984). Four dimension was constructed for Compromise are based on Gotfredson's Theory of Career Aspiration which are Factor, External Compromise, Internal Compromise and Process. Six dimensions was constructed for Spiritual Behaviours based on Islamic Theology which are Intention, Resolve, Patient, Consistency, Dua' and Relationship.

Statistical Analysis

Data entry and data analysis process were conducted using the IBM SPSS Statistics for Windows, Version 27. Since the primary objective in this study is to analyse the construct reliability and validity of the instrument, therefore exploratory factor analysis (i.e. EFA) and correlation analysis were selected. This process allows the researchers to validate and clear the indicators used in this study (Ong and Puteh, 2017; Hair et al., 2010). Two regimes of EFA analysis were compared in order to obtain a valid structure for the instruments. The first

regime is about a combination of principal axis factoring (i.e. PAF) extraction method with direct oblique rotation (Hair et al., 2010; William et al., 2010) while the second regime of EFA analysis used the combination of principal component analysis (PCA) extraction method with a varimax rotation analysis (Pallant, 2010; William et al., 2010).

In securing that the covariance matrix among the items is sufficient and not an identity matrix, Kaiser-Meyer-Olkin (i.e. KMO) index must be greater than 0.60 and the Bartlett's Test of Sphericity must be significant (Pallant, 2010), in consequence, the EFA analysis can be accepted. Thompson and Daniel (1996) proposed to use multiple criteria approached for resolved the number of factors or variables that should be extracted in order to confirming and validating the number of variables extracted from the analysis. In this process, only factors with eigenvalue greater than 1.00 are retained (Hair et al., 2010; Tabachnick & Fidell, 2007) and the percentage of the variance that is more than 60% can be used to determine the number of factors or variables that should be extracted (Hair et al., 2010; Thompson & Daniel, 1996). As for measuring items that do fit well with the factor solution, factor loading and communalities values should be more than 0.55 (Hair et al., 2010) for a considerable sample size (n = 151). This is to confirm a highly confident and adequate level of factors extracted is distinct, meaningful and practically significant. Finally, internal test of consistency items grouped from the EFA were analysed using Cronbach's alpha reliability test. Nunnally and Bernstein (1994) suggested that, the cut-off 0.70 and above can be used to indicate the grouped items were reliable.

Furthermore, the validity of the extracted factors from the EFA analysis, discriminant and nomological validity was executed. It is a logical and relevance relationship exists among the variables that follows the expected relationship direction, which is either it is a positive or negative relationship (Creswell, 2014; Hair et al., 2010; Saunders et al., 2009; Kaptein, 2008). In this process, correlation analysis was used since this analysis allow us to measure the direction of the relationship among the extracted variables (Creswell, 2014; Field, 2009).

Table 1
Variables and indicators description

Variable	Code	Indicator Description
Planning	PLN1	Focus on career planning
	PLN2	Objective career planning
	PLN3	Self -efficacy in career planning
	PLN4	Catalytic Factors in Career Planning
	PLN5	Career Planning Methods
Exploring	EXP1	Career Exploration Period
	EXP2	Self -Initiative in Exploration
	EXP3	Career Information Sources
	EXP4	Approaches in career exploration
Career Information	INF1	Work experience in career development
	INF2	Self pre -employment information
	INF3	Career pre -employment information
Career Decision Decisions	DEC1	Factor of Psychology in making Career Decisions
	DEC2	Factor of Social Determinants in Making Career Decisions

	DEC3	Factor of Economic Determinants in Making Career Decisions
Career Compromise	COM1	Factors that cause compromises to be made
	COM2	External Compromise in the process of compromise
	COM3	Internal Compromise in compromising
	COM4	The process of compromise in job selection
Spiritual Behaviour	SPR1	Good intention
	SPR2	High resolve
	SPR3	Strong patient
	SPR4	Consistency in job planning
	SPR5	Pray and trust in God
	SPR6	Manage a good relationship with God, human and nature

Analysis and Results

Validity and Reliability for Exploratory Factor analysis

General rules for sample size in EFA according to Hair et al (2018) is 100 sample and this study used 150 sample which exceed the minimum numbers. In terms of correlation among variables or item, according to Hair et al (2018); Tabachnik & Fidell (2013) most correlation coefficient is greater than 0.3 and correlation coefficient is less than 0.8 (No multicollinearity problem). Anti-image correlation should diagonal value greater than 0.5 and off-diagonal less than 0.7. Table 2 show the correlation matrix has fix the value needed.

Table 2
Correlation Matrix

	PLN1	PLN2	PLN3	PLN4	PLN5	EXP1	EXP2	EXP3	EXP4	INF1	INF2	INF3	DEC1	DEC2	DEC3	COM1	COM2	COM3	COM4	SPR1	SPR2	SPR3	SPR4	SPR5	SPR6
Correlation	1.000	0.800	0.699	0.633	0.558	0.648	0.560	0.707	0.765	0.422	0.621	0.615	0.616	0.609	0.576	0.223	0.186	0.191	0.251	0.458	0.490	0.477	0.512	0.445	0.463
PLN2	0.800	1.000	0.828	0.666	0.653	0.594	0.613	0.700	0.715	0.495	0.667	0.683	0.696	0.665	0.638	0.243	0.219	0.206	0.316	0.581	0.606	0.570	0.602	0.566	0.564
PLN3	0.699	0.828	1.000	0.742	0.662	0.559	0.625	0.690	0.676	0.450	0.627	0.667	0.690	0.662	0.655	0.285	0.181	0.246	0.253	0.499	0.511	0.497	0.516	0.509	0.527
PLN4	0.633	0.666	0.742	1.000	0.727	0.623	0.686	0.749	0.734	0.497	0.617	0.643	0.665	0.657	0.668	0.258	0.219	0.248	0.286	0.447	0.416	0.411	0.425	0.453	0.468
PLN5	0.558	0.653	0.662	0.727	1.000	0.574	0.695	0.762	0.703	0.585	0.528	0.519	0.564	0.539	0.568	0.273	0.217	0.215	0.242	0.379	0.367	0.293	0.354	0.305	0.324
EXP1	0.648	0.594	0.559	0.623	0.574	1.000	0.608	0.750	0.678	0.363	0.581	0.652	0.565	0.583	0.570	0.222	0.210	0.256	0.277	0.390	0.387	0.390	0.393	0.350	0.342
EXP2	0.560	0.613	0.625	0.686	0.695	0.608	1.000	0.768	0.636	0.568	0.452	0.511	0.504	0.515	0.581	0.234	0.315	0.229	0.304	0.258	0.270	0.278	0.292	0.322	0.303
EXP3	0.707	0.700	0.690	0.749	0.762	0.750	0.768	1.000	0.826	0.467	0.658	0.690	0.675	0.674	0.677	0.244	0.274	0.293	0.282	0.512	0.497	0.470	0.465	0.445	0.478
EXP4	0.765	0.715	0.676	0.734	0.703	0.678	0.636	0.826	1.000	0.492	0.727	0.732	0.726	0.714	0.683	0.282	0.289	0.301	0.357	0.542	0.546	0.515	0.548	0.534	0.542
INF1	0.422	0.495	0.450	0.497	0.585	0.363	0.568	0.467	0.492	1.000	0.507	0.511	0.542	0.538	0.542	0.230	0.254	0.181	0.294	0.338	0.337	0.337	0.342	0.345	0.353
INF2	0.621	0.667	0.627	0.617	0.528	0.581	0.452	0.658	0.727	0.507	1.000	0.909	0.874	0.870	0.771	0.263	0.224	0.296	0.283	0.680	0.704	0.703	0.722	0.678	0.689
INF3	0.615	0.683	0.667	0.643	0.519	0.652	0.511	0.690	0.732	0.511	0.909	1.000	0.863	0.902	0.833	0.226	0.207	0.289	0.311	0.680	0.697	0.706	0.701	0.635	0.663
DEC1	0.616	0.696	0.690	0.665	0.564	0.565	0.504	0.675	0.726	0.542	0.874	0.863	1.000	0.896	0.772	0.275	0.169	0.258	0.303	0.663	0.698	0.706	0.720	0.687	0.698
DEC2	0.609	0.665	0.662	0.657	0.539	0.583	0.515	0.674	0.714	0.538	0.870	0.902	0.896	1.000	0.819	0.283	0.234	0.293	0.315	0.662	0.679	0.687	0.665	0.614	0.652
DEC3	0.576	0.638	0.655	0.668	0.568	0.570	0.581	0.677	0.683	0.542	0.771	0.833	0.772	0.819	1.000	0.245	0.299	0.243	0.361	0.565	0.535	0.543	0.544	0.516	0.548
COM1	0.223	0.243	0.285	0.258	0.273	0.222	0.234	0.244	0.282	0.230	0.263	0.226	0.275	0.283	0.245	1.000	0.543	0.813	0.549	0.110	0.104	0.079	0.171	0.101	0.121
COM2	0.186	0.219	0.181	0.219	0.217	0.210	0.315	0.274	0.289	0.254	0.224	0.207	0.169	0.234	0.299	0.543	1.000	0.589	0.754	0.122	0.097	0.101	0.147	0.114	0.143
COM3	0.191	0.206	0.246	0.248	0.215	0.256	0.229	0.293	0.301	0.181	0.296	0.289	0.258	0.293	0.243	0.813	0.589	1.000	0.663	0.154	0.167	0.159	0.190	0.182	0.190
COM4	0.251	0.316	0.253	0.286	0.242	0.277	0.304	0.282	0.357	0.294	0.283	0.311	0.303	0.315	0.361	0.549	0.754	0.663	1.000	0.231	0.221	0.237	0.243	0.246	0.244
SPR1	0.458	0.581	0.499	0.447	0.379	0.390	0.258	0.512	0.542	0.338	0.680	0.680	0.663	0.662	0.565	0.110	0.122	0.154	0.231	1.000	0.905	0.799	0.775	0.735	0.772
SPR2	0.490	0.606	0.511	0.416	0.367	0.387	0.270	0.497	0.546	0.337	0.704	0.697	0.698	0.679	0.535	0.104	0.097	0.167	0.221	0.905	1.000	0.879	0.860	0.802	0.826
SPR3	0.477	0.570	0.497	0.411	0.293	0.390	0.278	0.470	0.515	0.337	0.703	0.706	0.706	0.687	0.543	0.079	0.101	0.159	0.237	0.799	0.879	1.000	0.842	0.830	0.824
SPR4	0.512	0.602	0.516	0.425	0.354	0.393	0.292	0.465	0.548	0.342	0.722	0.701	0.720	0.665	0.544	0.171	0.147	0.190	0.243	0.775	0.860	0.842	1.000	0.778	0.792
SPR5	0.445	0.566	0.509	0.453	0.305	0.350	0.322	0.445	0.534	0.345	0.678	0.635	0.687	0.614	0.516	0.101	0.114	0.182	0.246	0.735	0.802	0.830	0.778	1.000	0.898
SPR6	0.463	0.564	0.527	0.468	0.324	0.342	0.303	0.478	0.542	0.353	0.689	0.663	0.698	0.652	0.548	0.121	0.143	0.190	0.244	0.772	0.826	0.824	0.792	0.898	1.000

Table 3 show the KMO index for each analysis was 0.844 and the Bartlett's test for sphericity for the indicators in both regimes were largely significant ($\chi^2 = 651.906$, p-value < 0.01).

Therefore, it can be concluded that, the covariance matrices for these 25 indicators were not identity matrices and the items can be used for EFA analysis.

Table 3
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.844
Bartlett's Test of Sphericity	Approx. Chi-Square	651.906
	df	10
	Sig.	.000

Factor Extraction

The summary of multiple criteria was shown in Table 4 and used to determine the number of factors that could be extracted. It shows that, the EFA analysis for both methods could extract six components from a group of 25 indicators since the first seven eigenvalues under the Kaiser's criteria (i.e. between 13.579 and 1.661) exceeded the value of 1.00. The extracted factors are 84.172%, which exceed 60% of the cumulative percentage of variance explained. Hence, this confirms the extraction of six components or factors from the 25 indicators.

Table 4
Multiple criterion for factors to be extracted

Component Number	Initial Eigenvalue Variance Explained	Cumulative %	Decision
1	13.579	54.318	Accept to Extract
2	2.973	66.210	Accept to Extract
3	2.209	75.045	Accept to Extract
4	1.839	78.401	Accept to Extract
5	1.782	81.527	Accept to Extract
6	1.661	84.172	Accept to Extract
7	0.529		Reject to Extract
8	0.461		Reject to Extract

Note: Only the first 8 out of 25 components were reported

Communalities and Factor Rotation

Table 5 shows that all the communalities values are greater than 0.40. All loadings (i.e. range 0.55 to 0.82) and communalities (i.e. range 0.607 to 0.905) values were above the minimum cut-off point value of 0.55. Therefore, it can be concluded that, all 25 indicators were fit well with factor solution and can be used as indicators for measuring the targeted variables in this study.

Table 5

Communalities Value

	Initial	Extraction
PLN1	1	0.65
PLN2	1	0.73
PLN3	1	0.70
PLN4	1	0.74
PLN5	1	0.72
EXP1	1	0.61
EXP2	1	0.72
EXP3	1	0.81
EXP4	1	0.78
INF1	1	0.55
INF2	1	0.80
INF3	1	0.81
DEC1	1	0.82
DEC2	1	0.79
DEC3	1	0.70
COM1	1	0.72
COM2	1	0.70
COM3	1	0.80
COM4	1	0.75
SPR1	1	0.79
SPR2	1	0.88
SPR3	1	0.87
SPR4	1	0.82
SPR5	1	0.80
SPR6	1	0.83

Extraction Method: Principal Component Analysis.

Reliability: Cronbach 's Alpha

Table 5 show the internal consistency reliability test based on Cronbach's alpha value also proved that for each group of indicators, it has an acceptable and satisfactory internal consistency, since the minimum value of Cronbach's alpha was 0.772. Pearson's correlation analysis also confirmed that all bivariate relationship among the variables were positive and statistically significant (i.e. p -value < 0.05) and the strength of the relationship can be categorized as below than moderate strength (i.e. r < 0.70).

Table 5

Cronbach's Alpha Value

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.946	0.949	6

Discussion

This paper has demonstrated the process of developing the career planning instruments based on two methods of EFA and correlation analysis for the Malaysian TVET students as for

to examining the instrument validity and reliability. Exploratory factor analysis (EFA) is a multivariate statistical method that has become a fundamental tool in the development and validation of psychological theories and measurements (Watkins, 2018). Based on the two EFA methods, the selected indicators for measuring the variables showed a valid and acceptable result. This is emphasized either through the first or second method of extraction and rotation techniques where a similar pattern of indicators grouping was identified. Furthermore, each indicator has also met the minimum requirement loading and communalities of more than 0.55. Overall, there are six constructs have been proved and correlate each other's. The constructs are Planning, Exploration, Career Information, Decision, Compromise and Spirituality. According to Super et al (1984), all these constructs are crucial to develop their career path and prepare them to compete in career world in endemic Covid 19 era. Thus, this result proves that Career Path for TVET students can be measured using several dimensions or components and each of which is represented by several related items. These constructs were developed base on experience of TVET graduated which in line with Bandura Social Theory which suggest that all behaviors are learned through conditioning, and cognitive theories, which take into account psychological influences such as attention and memory (Bandura, 1977).

Conclusion

Based on these findings, all items are practically significant and fit to measure to measures the targeted variables based on EFA and correlation analysis. This research work is very importance since it can be an alternative useful tool for measuring overall career path development for TVET student. In addition, this develop instrument can be as a stepping stone work for redesigning and creating a good instrument for measuring these interesting phenomena that meet the Industrial Revelation 4.0 era. On the other hand, this research work also emphasized the useful of EFA analysis for the initial development stage of instrument validation procedure. Hence, this study has demonstrated that all indicators in this instrument were fit and reliable for assessing the career development variables in the Malaysian TVET. Following this analysis, this study has confirmed the constructs for TVET career path to follow and supported Super theory in career planning. In addition, this instrument can be used outside from the TVET field such as social sciences and also heavy religious education, provided that it has a good career plan based on IR 4.0 platform as for achieving the overall global fit indexes for this instrument.

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