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Sustainable TVET Teacher Education Program Instrument: Instrument Validation

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Abstract. The purpose of this article is to construct-validate an instrument of sustainable TVET Teacher Education program. The sustainable domains and elements measured were derived from previous study of instrument development. Fifty questionnaires were distributed to TVET-TE lecturers from Institute of Technical Teacher Training, which lasted for a week and 31 questionnaires had returned within the timeframe. The Rasch Measurement Model through Winstep version 3.69.1.11 was used for analysis to get the construct validation. There were three parameters referred to namely reliability and separation index item-person; statistical fit; and standardised residual correlation for item dependent. This parameter were used to measure the item fit and redundancy. The Cronbach's alpha of the instrument was highly reliable at 0.99 make it highly reliable to be used. All items indicate a positive value for item polarity. The analysis indicates 24 items can be dropped from the instrument for being misfit, and nine pairs of items has been identified to be redundant. Overall, 24 items were drop and five items were kept with revision, making the final instrument consisted of 93 items in total. In conclusion, the instrument is valid an applicable for the real study. It is in a hope that this study can contribute towards the development and improvement on the sustainability of TVET Teacher Education program.

Keywords: Sustainable Education, Rasch Measurement Model, TVET Teacher Education

1. Introduction

The definition of sustainable from the online dictionaries mostly referred to the ability to upheld and continuing good practices over a period of time (Cambridge Dictionaries Online, 2015; Dewan Bahasa dan Pustaka, 2015; Oxford Dictionaries, 2015). The Australian Research Institute (The Australian Research Institute in Education for Sustainability, 2009) simplified the meaning of sustainability as an ongoing learning-by-doing process that actively involves stakeholders in undertaking change. In short this term can be used to resemble the meaning of 'long-term', 'durable', 'sound' or 'systematic' (Filho et al., 2009). From the aspect of a program, sustainability can be referred to the ability to maintain the life of the program as well as its benefits over time (Center for Public Health Systems Science, 2012). A program that is able to survive the challenges of time by being relevant and answer to the current needs is important as this will affect the quality of the graduates produced.

The sustainable concept in most educational program often refers to the sustainable development such as 'education for sustainable development' or ' education for sustainability' rather than education that last

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over time. The concept of sustainable education requires deeper discussion that involves many aspects and several stakeholders as mention by (Sterling, 2001). It requires deeper and systematic learning response that involves three areas including personal, organisational and the community (Sterling, 2008). Thus, a sustainable program cannot only revolves one main domains or elements. It has to be the correlation among all these important areas that work together with the same objectives towards sustainability.

The sustainability of the technical skills and qualifications requires TVET teachers to have a different preparations and medium in doing so. This is the reason why most of the TVET TE programme sustainability requires the partnership with industries and collaboration internationally (Gunadi et al., 2020; Obwoge, 2016). It is important for the TVET Teacher Education program to train the future TVET teachers with sustainable development knowledge and skills applicable to particular specialization (Kang & Pavlova, 2019). The knowledge and skills will assist the teachers in producing TVET graduates whom are highly creative with the ability to think creative and competent to serve the industry (Ir et al., 2020). In order to prepare student to face the industry, (Tapani & Salonen, 2019) had proposed the use of authentic learning and development process which involve various learning environment and offer quick entry into working environment. To do this, lecturers must posses competencies that are related to this learning approach including (i) Pedagogical competency, (ii) Guidance and counselling competency (iii) Interaction competency (iv) Competency of pedagogical leadership (v) Partnership competency (vi) Innovator competency and (vii) Assessment competency (Tapani & Salonen, 2019). These are some example of elements needed for a teacher including TVET teacher for them to be part of the sustainable system in TVET environment.

This study is a part of a larger research regarding the sustainable TVET Teacher Education program. The instrument was developed beforehand in previous phase involving experts through semi-structured interview process. During this phase, there were eight domains identified to be the main criteria in the sustainable framework for TVET Teacher Education program. From these domains, several elements were then identified and converted to be the items for the instrument. These domains were translated into section in the instrument. Above all, an instrument with 117 items was developed. The developed instrument was then validated using Rasch Measurement Model, which will be discussed in this paper.

Thus, this research paper discuss on the validation of an instrument that can be used to measure the sustainability of mention program, which is the TVET Teacher Education program. The purpose of the study was to ensure data gathering instruments used were measuring what it was supposed to measure consistently. This need to be confirmed by examining the definitions for and methods of establishing the validity and reliability of a research instrument (Etebarian et al., 2013).

2. Validity and Reliability

Validity in quantitative study refers to the ability of the instrument to measure what they are intended to measure and the means of measurement are accurate (Golafshani, 2003). In discussing this validity, Ihantola and Kihn (2011) had focused mainly on internal validity and external validity. Internal validity as describe by Zohrabi (2013) is concerned with the similarity of the research findings with the reality. It also concerned with the ability of the researcher to observe and measures what is supposed to be measured. Zohrabi (2013) listed six methods proposed by Merriam (1998) to boost the internal validity namely triangulation, member checks, and long-term observation at the research site, peer examination, participatory /collaboration modes of research and researcher's bias. Meanwhile, external validity as

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describe by Ihantola and Kihn (2011) refers to the ability to draw a more general conclusion based on the model used and data collected to other sample, periods and settings. External validity is crucial for a quantitative study. As been described, Ihantola and Kihn (2011) divided external validity into three main validity namely population validity, time validity, and ecological validity. Population validity deal with whether inference can be made towards the larger population. It concerns whether the relationship between two variables that exist in a sample can be found in the population. The existence of bias in population will affect the population validity. Time validity refers to either the outcome can be generalized to another period of time while environmental validity refers to the generalization of the outcome in a different setting such as in the case of international generalization.

Other than this two validity, Golafshani (2003) emphasized another important validity for quantitative study which is constructed validity. This validity focused on the correlation between the construct. One way to test the construct validity is through a test and by referring to the value of the correlation coefficient where the high value indicated validated construct.

Golafshani (2003) explain reliability in quantitative research as the idea of replicability or repeatability of results or observations. Furthermore, as for instrument, the reliability is referred to the stability of the instrument whereas a stable instrument will produce a similar result when test repeatedly. to increase the reliability, Hoyle, Harris, and Judd (2002) had come out with a listing of few influences on reliability. According to them, longer measures are more reliable than shorter ones and by having a various measured construct among the sample will lead to higher reliability. Overall, a thorough explanation of the instructions and optimal testing situation will contribute to decreasing the tendency of random errors by the sample.

3. Research methodology

The sustainable TVET Teacher Education program instrument was developed beforehand through a qualitative method. A semi structured interview was done individually with nine experts from three main stakeholders. By using a thematic analysis, the input for the instrument including the items and sections were developed. The developed instrument consist of four main sections including the criteria for sustainable TVET teacher education program and the role of the stakeholders. The stakeholder involved in this study comes from the government, the TVET Teacher Education institution and the industry. 91 items for the criteria of sustainable TVET Teacher Education program were identified and 56 items were for the role of the stakeholders. The details of the instrument is shown in table 1.

Table 1. Instrument Structure

Section	Construct	Sub-construct	Item
One	Criteria For Sustainable TVET Teacher Education Program	Sustainable Curriculum	15
		Sustainable Leadership	6
		Sustainable Management System	15
		Sustainable TVET Teacher Education Lecturer	20
Two	Role of TVET Teacher Education Institution	TVET Teacher Education Faculty	16
		TVET Teacher Education Lecturer	17
Three	Role of Government		16
Four	Role of Industry		12
Total			117

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The instrument used a seven-point Likert scale that instructs respondents to indicate the extent to which they agree with various statements regarding the domains and elements in sustainable TVET-TE Program. The scale started with '1' as 'Entirely Disagree' and '7' as ' Entirely Agree'. The uses of seven-point Likert Scale is appropriate to use in this study as (Dawes, 2008) had stated that reliability and validity are improved by using 5- to 7-point scales rather than coarser ones (those with fewer scale points). It is also stated that the finer scale may result to the greater spread of data.

The respondent for this study involved TVET-TE lecturers from Institute of Technical Teacher Training, which lasted for a week whereby 50 questionnaires were distributed and 31 questionnaires had returned within the timeframe. The number of samples is enough even though it is minimum since according to Bryman and Bell (2003) it still can produce an accurate outcome if the data were analyses efficiently. The analysis of the data was done using the Rasch Model with the software of Winsteps Version 3.69.1.11. There were three parameter referred when using Rasch Measurement Model namely reliability and separation index item-person; statistical fit; and standardized residual correlation for item dependent. Each analysis was discussed in the following section.

3.1 Rasch Measurement Model

In order to test the reliability of an instrument using Rasch Measurement Model, three parameter was used as the indicator. The parameter are reliability and separation index item-person; statistical fit and standardised residual correlation for item dependent. The reliability and separation index item-person is used to identify the ability of the item and person in answering the questions based on the difficulty level. The statistical fit indicates whether the items are behaving as expected and fit with three parameters, which are the point measure correlation, the outfit mean square (OUT.MNSQ) and the outfit z-standard (OUT.ZSTD) (Azrilah et al., 2014). The following subsection further discussed on the three criteria respectively.

3.2 Reliability and Separation index item-person

The value of Cronbach's alpha normally referred to indicate the instrument's reliability. The value of Cronbach's alpha has to be more than 0.70 to indicate high reliability of the instrument. Hoyle *et al.*, (2002) explained the range of this coefficient alpha begins from zero to one where zero indicates complete unreliability and one indicate perfect reliability. According to Bond and Fox (2007), the value for Cronbach's alpha to be excellent is between 0.71-0.99. Table 2 shows interpretation of Cronbach's alpha score according to Bond and Fox (2007). Meanwhile, item separation index need to be more than 2.0 to be considered as good value (Linacre, 2005).

Table 2 The interpretation of Cronbach's Alpha score

Cronbach's alpha	Criteria
<0.5	Drop Item
<0.6	Revised Item
0.6-0.7	Acceptable
0.7-0.8	Good and acceptable
0.8-1.0	Very good and effective with high consistency

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3.3 Statistical Fit

A fit statistic in Rasch measurement model is an analysis that provides internal mechanisms to identify inappropriate responses to the items and allowed for exclusion or re-assessment of the responses that do not fit (Green & Frantom, 2002). For this analysis, three parameter were used to measure the fitness of the item namely point measure correlation (PTMEA CORR), Mean square (Outfit MNSQ) and outfit ZSTD. The PTMEA CORR analysis was done to determine whether all items are moving in one direction with the construct. An item with the positive value indicated that the item is measuring the domain intended to be measured while negative value indicated the vice versa thus this item needs to be drop or revised (Bond & Fox, 2007). The item fit was measured based on the values of the Mean-Square (MNSQ) fit. The value of outfit MNSQ must be between the range of 0.6 – 1.4 as according to Bond and Fox (2007). The value that is lower than 0.6 indicates the item is too easy and expected by the respondent while value that is higher than 1.4 indicates that the item is too difficult or confusing. As for the outfit ZSTD value, the item must be within the range of -2.0 to +2.0 to be fit. Item that is misfit need to be drop from the instrument or revised. This is because, a misfit item is considered to be too complex, confusing or measuring different construct (Green & Frantom, 2002).

3.4 Standardised residual correlation for item dependent

To identify whether the item is redundant or not, the value of standardized residual correlation was referred to in the analysis. To get the item residual correlation value, the Item Dimensionality was referred. High residual correlation value which is more than 0.7 (Linacre, 2005) indicated that the two items were dependent. This is because the items might have same criteria or sharing several dimensions. Nevertheless, only one item needs to be drop between the two items (Linacre, 2005). Item that has outfit MNSQ value close to 1.0 were kept in the analysis.

4. Result and Analysis

This study used the Rasch Measurement Model approach in analysing the data. The Winstep version 3.69.1.11 was used as the analysis tool. The analysis aim to validate the instrument developed by validating the construct in the instrument. Construct validation is done to ensure the data is measuring the given construct effectively and accurately with provided empirical evidence (Hamid et al., 2013).

4.1 Reliability and Separation index item-person

Reliability of the instrument was determined by referring to the value of Cronbach's alpha. The output data shows that the score of Cronbach's alpha for the questionnaire was 0.99, which indicate an excellent value and can be used for real study. Meanwhile, the item reliability for the questionnaire was 0.65 and item separation index was 1.37. According to Bond and Fox (2007), 0.65 is still an acceptable value for item reliability while according to Linacre (2005) good item separation index is more than 2.0. As for the person reliability, the analysis indicated that the value for person reliability was 0.98 indicates very good with high consistency value and person separation index was 7.36 indicates that item can be categorized into seven groups of item ability. Both values show that the construct is highly acceptable (Bond & Fox, 2007; Linacre, 2005). Table 3 shows the statistical summary for reliability and separation index item-person. In order to see the overall picture of the distribution of ability for item and person, the Wright Map was referred. Based on the map, there is no items that is below the ability of the person to answer since all items are above and equal to the lowest person's ability logit at above -1. This indicates that the ability of the respondent to answer the question is appropriate to the difficulty level of the items. Figure 1 shows the Wright Map referred in this study.

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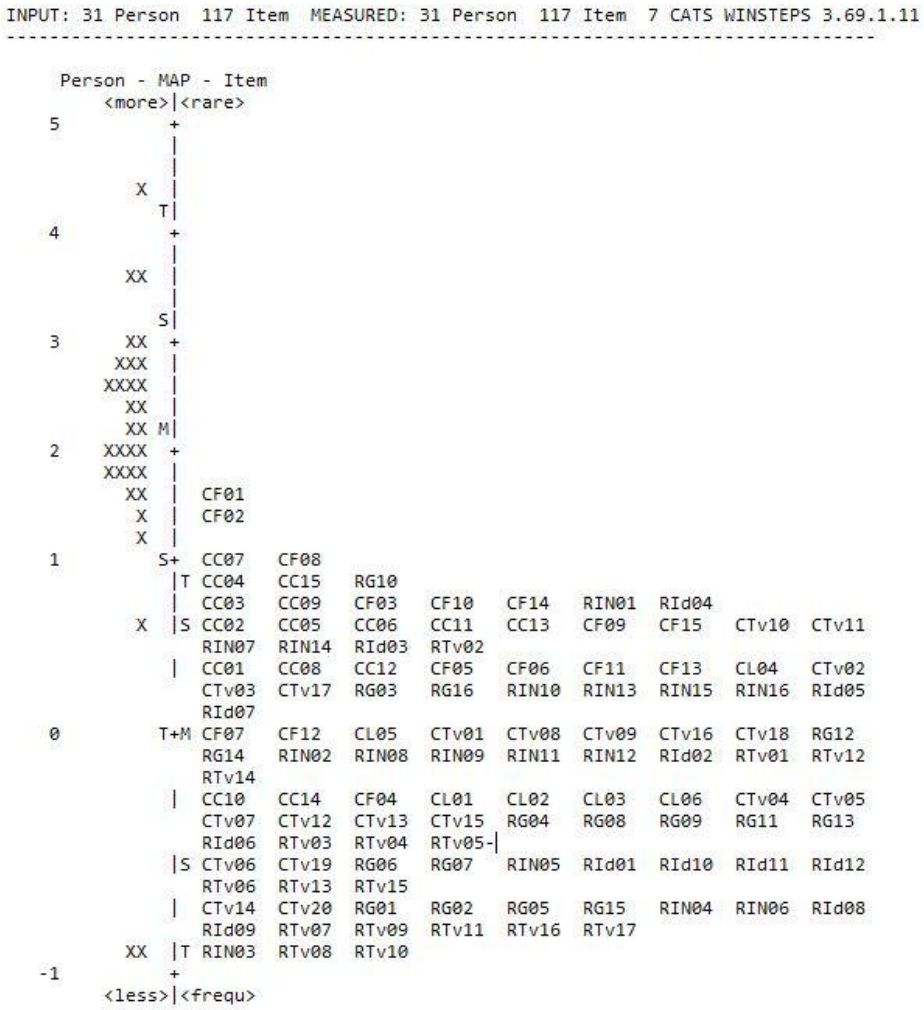

Figure1. Wright Map for the distribution of the ability for item and person

Table 3. Statistical summary for reliability and separation index item-person

Item	Cronbach's Alpha	Item Reliability	Item Separation	Person Reliability	Person Separation
117	0.99	0.65	1.37	0.98	7.36

4.2 Statistical fit

Three parameter was referred to measure the fitness of an item namely the point measure correlation, outfit MNSQ and outfit ZFTD. Upon analysis, the point measure correlation (PTMEA CORR) value for this questionnaire shows all positive values indicated all items were measuring the intended domains. Thus, no item needed revised or dropped. As for the outfit MNSQ value, 24 items were being out of the

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accepted range of 0.6-1.4. Based on Table 3, items that has oufit MNSQ value larger than 1.4 were CC03 (2.47); RID12 (2.45); CC15 (2.31); RG10 (2.15); CM06 (2.13); CC07 (1.98); RG16 (1.94); CC09 (1.64); CM05 (1.61); CTv17 (1.57): and CC08 (1.48). Item that had value lower than 0.6 for outfit MNSQ were RIN11 (.56); RTv16 (.56); RTv09 (.56); RID05 (.54); CTv04 (.54); CTv09 (.53); RG03 (.50); RTv14 (.47); RIN08 (.47); RG09 (.45); RID04 (.43); CS05 (.36); and CS06 (.35). Overall, these items were drop from the questionnaire for having outfit MNSQ value that is outside of the acceptable range, which is 0.6-1.4 (Bond & Fox, 2007). Overall, 11 items are not fit with value higher than 1.4 indicating to be too difficult or misleading and 13 items has lower outfit MNSQ acceptable range of 0.6 indicating the item to be too easy and expected by the respondent (Bond & Fox, 2007). Table 4 shows statistical fit value for the instrument.

Table 4 Statistical Fit Value For The Instrument

Entry Number	**Outfit**		**Item**
	MNSQ	ZFTD	
3	2.47	4.1	CC03
117	2.45	3.9	RID12
15	2.31	3.8	CC15
99	2.15	3.5	RG10
34	2.13	3.3	CM06
7	1.98	3.2	CC07
105	1.94	2.9	RG16
9	1.64	2.2	CC09
33	1.61	2.0	CM05
53	1.57	1.9	CTv17
8	1.48	1.7	CC08
67	.56	-1.8	RIN11
88	.56	-1.8	RTv16
81	.56	-1.9	RTv09
110	.54	-2.0	RID05
40	.54	-2.0	CTv04
45	.53	-2.0	CTv09
92	.50	-2.2	RG03
86	.47	-2.4	RTv14
64	.47	-2.3	RIN08
98	.45	-2.5	RG09
109	.43	-2.7	RID04
26	.36	-3.1	CS05
27	.35	-3.2	CS06

4.3 Standardized residual correlation for item dependent

Based on the analysis, there were nine pairs of item with high residual correlation value that is more than 0.7. Overall, four items were dropped, which were RIN03; RID01; RID12; and RG11. Other items that did not fulfil the criteria were revised and kept in the questionnaire based on the needs of the research. Table 5 shows the item standardized residue value for this study.

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Table 5 Item standardized residual value

Correlation	Item	MNSQ Outfit	Result	Item	MNSQ Outfit	Result
.85	CL01	1.16	Keep	CL02	1.31	Keep
.83	RIN03	0.83	Drop	RIN04	1.00	Keep
.81	RID01	2.71	Drop	RID12	2.45	Drop
.80	CM07	1.26	Keep	CM08	1.23	Keep
.78	RG06	0.80	Keep	RG11	0.79	Drop
.75	CM02	1.42	Keep	CM03	1.19	Keep
.74	CS01	1.28	Keep	CS02	1.02	Keep
.74	CM01	0.80	Keep	RID07	0.70	Keep
.73	CTv01	1.03	Keep	RTV08	1.07	Keep

Overall, there were 24 items dropped from overall 117 items. This was based on the Rasch Model analysis that consists of three criteria. The total item that did not meet the criteria was 29 items. 24 items were dropped from the questionnaire whereas five items were revised and kept in the instrument. Table 6 shows the summary of statistical analysis.

Table 6. Summary for statistical analysis

Domain	Item		Total
	Kept	Drop	
Criteria for Sustainable Curriculum	10	5	15
Criteria for Sustainable Leadership	6	0	6
Criteria for sustainable functioning system	11	4	15
Criteria for sustainable TVET-TE lecturer	17	3	20
Role of sustainable TVET-TE lecturer	14	2	16
Role of sustainable TVET-TE faculty	15	2	17
Role of government	11	5	16
Role of industry	9	3	12
Total	93	24	117

5. Discussion, Limitation and Future Research

Sustainable education calls for discussion that is deeper that the concept of sustainability itself. The criteria that contributes toward this sustainable differ based on the requirement of the education itself. It test the ability of the program to last over the time and survive the changes and challenges introduced by the development of the surrounding. However, the main agenda in sustainable education still in line with the purpose of education itself whereby to ensure the inclusive and quality education for all and promote lifelong learning for all including ensuring all learners acquiring the knowledge and skills needed to promote sustainable development (UNESCO, 2016).

TVET Teacher Education program is not a new program in education system worldwide. Like any other program, this program also need to be revamp in order to stay relevant across the time. An instrument that able to measure these changes is crucial to ensure correct assessment is used. The instrument however need to be reliable and valid in measuring the intended criteria. For this, Rasch Measurement

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Model was used for a convenient and systematic approach of evaluation on the instrument's reliability and validity (Azrilah et al., 2014).

The contributions to the academia is, a validated instrument that measure the sustainability of TVET TE program in Malaysia. This instrument and its variant can be used to measure the perception of the stakeholders on the sustainability of the program, thus test the theoretical impact of the sustainability development on the 21st century education implementation. Moreover, this instrument provide an insight of the readiness of the TVET education system in the country in facing changes and challenges brought by the 21st century education. therefore, the concept and and instrument of sustainability program can be applied to broader sustainability concept.

Since this instrument was built with input from experts from TVET background, the sustainability of other education sector cannot be measured using this instrument. Thus, this open up for future research whereby the same concept and approach can be used with different content focus in educational field. This will contribute towards improving the quality of education system in the nation holistically.

6. Conclusion

This study shows that the instrument is reliable with Cronbach's alpha at 0.99, which indicate an excellent value and can be used for real study. Meanwhile, the item reliability for the questionnaire was 0.65 and item separation index was 1.37. As for the ability of the TVET Teacher Education lecturer in answering the question, it is shows that the lecturer's ability is much higher than the mean difficulty of the item. The Wright map shows this distribution to visualise it in a simpler way based on the logit measurement ruler. Overall, 24 items has been dropped from this instrument making a final instrument to have total of 93 items. With this validated instrument, TVET Teacher Education stakeholders can cross check their existing program either sustainable or not based on the sustainable criteria that has been developed through a research in the instrument. With this, it is hope the TVET Teacher Education program will be sustained and continuously contribute towards the better performance of TVET in general.

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