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Validity and Reliability of Index of Learning Styles for Vocational Students Using the Rasch Measurement Model

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Abstract--- *The purpose of this paper is to generate empirical evidence on the validity and reliability of modified items in the Index of Learning Styles instrument by applying the Electrical Technology vocational elements. Instrument has been distributed to a sample of 60 Electrical Technology students at a Vocational College. The Rasch measurement model was used to examine the functional items and detect the item and respondent reliability and index separation, the polarity of item, measuring the fit of item in measuring the construct and standardised residual correlation values. The final findings showed that only four items did not meet the criteria and 31 items remained suitable to measure the four constructs. There were two implications. First, this analysis helped the educators to investigate their students learning styles in order to select a suitable teaching strategy or approach that focused on the students' learning style. Second, the data obtained will develop a vocational learning style framework that could assist the BPTV and curriculum planning division in designing and organizing activities in line with the students' learning styles. This study is the first effort to established valid constructs for the development of instrument for accessing vocational learning styles.*

Keywords--- *Learning Styles, Vocational College, Rasch Measurement Model, Validity, Reliability.*

I. INTRODUCTION

Technical and vocational education and training (TVET) is recognized globally as a key role in fostering economic and socio-economic growth, increasing productivity, motivating people and reduce poverty. Thus far, the standard of TVET nevertheless differs in terms of learner achievement and teaching inputs. In some nations, this aimless discrepancy is resolved in some countries through the use of accountability systems to verify the standard of provision, while in others standard is enhanced by increasing TVET workforce professionalization and training education.

As a developing country with a rapidly increasing population, providing the citizens with extensive and updated knowledge is crucial for the country, particularly in vocational education. For that, a number of vocational and technical training institutions have been developed in Malaysia (Hassan, Foong, & Ismail, 2019). However, the success of vocational education relies on the capability of instructors, teachers, and trainers of applying a suitable

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vocational pedagogy to achieve the goals of establishing a successful and sustainable vocational education in this country (Md Yunos et al., 2017). According to Holt, Chasek, Shaurette, & Cox (2018), an appropriate teaching approach has a significant positive impact on learning. Therefore, it is important for educators to create and adopt appropriate teaching approaches or strategies that take into consideration their students' learning styles to accomplish better learning outcomes.

The advancement that we have today is part of the string of changes in education. Transition in education often evolve through time, and it is important to learn new knowledge in order to deal with this transition and to be adaptable to changing situations (Smith, Krass, Erica, & Grenville, 2010). Learning is a productive process that influences how learners approach studying, and it is diverse from one person to another person. (John, Shahzadi, & Khan, 2016; Li, Yu, Liu, Shieh, & Yang, 2014). It is clear that each individual has his or her own learning style. For that reason, to understand a specific learning style that fits student's needs, teachers need to identify the best learning style that can succeed in the classroom.

Learning styles have been defined as "being characteristics of the cognitive, affective, and physiological behaviours that serve as relatively stable indicators of how learners perceive, interact with and respond to a learning environment" (pg.4) (J. W. Keefe, 1979). Besides that, learning styles are evaluated in multiple respects based on numerous theoretical learning models. Each theory such as the theories proposed by Dunn and Dunn, Kolb, Myers-Briggs and Felder-Silverman reflects the most prevalent educational framework.

In the Dunn and Dunn model, it is believed that factors such as environment, the possibility of moving around the school, working at distinct times of the day, participating in distinct activities could affect the students' learning (Coffield, Moseley, Hall, & Ecclestone, 2004). Kolb (1984) argued that learning is best conceived as a process where gaining knowledge is a combination of grasping experience and transforming it, while the Myers-Briggs model has been strongly linked to personality as explained in the "big five" personality factors.

An important research that characterises engineering students' learning preferences was proposed by Felder & Silverman, (1988). Felder & Silverman, (1988) regarded learning style as a characteristic strength and preferences in the way one obtains an information and process it. Several studies used this model and it has been shown that engineering students are primarily inclined to the learning styles which are active, sensing, visual and sequential (Felder & Silverman, 1988; Holt et al., 2018; Kourakos, Karaoglanoglou, Koullas, & Koukios, 2017; Mohamad, Heong, & Kiong, 2014; Omar, Mohamad, & Nazura, 2015; Tulsi, Poonia, & Anupriya, 2016; Zywno, 2003). Yet, there is a lack of studies investigating the vocational students.

II. RASCH MEASUREMENT MODEL

Rasch measurement model has shown to be true that the learning style with vocational element has a level of validity and reliability and is then used to form a learning style framework for the vocational field. In view of the fact that, the use of Rasch measurement model is a solution to the validity matter, since Rasch measurement model produce practical data and provide a great opportunity to test the validity (T. G. Bond & Fox, 2015). Additionally, implementing the Rasch measurement model in a study could assist and process more effective, accurate and valid measurement while strengthening user satisfaction (Azrilah et al., 2008). To maintain the accuracy of the instrument, it is very important to identify the validity and reliability of the instrument. This is essential to define the measurements of the instrument that need to be measured regularly and precisely.

The clue to the Rasch's model efficacy as a surrogate method of measuring the instruments to modify ratings into probabilities. This modification adequately modify the rating scale of the latent trait of learning style from ordinal (rank order) into interval (continuous) level measurement (Tennant & Conaghan, 2007; Wright & Masters, 1982). Rasch modelling allows separate but integrated analyses of both person and item effects. Person ability is generally characterize as the relative standing of a person on the latent trait of interest, the probability that a particular item will be approve by respondent (T. G. Bond & Fox, 2015).

The person's interrelation with the item gives an appraise of the difficulty of the item. Item difficulty appraisal allow researchers to analyse whether an instrument hold an items that are too difficult or too easy to be endorse by respondents at a certain level of ability (Hendriks, Fyfe, Styles, Skinner, & Merriman, 2012). Comparing the person ability and item difficulty distributions recorded by an instrument may expose measurement differences that possibly flatten effect sizes, reliability estimates, and correlation coefficients (Engelhard, 2013).

In spite of the fact that there is an enormous amount of research investigating the Felder-Silverman learning style validity, there is a few structural validity studies of the learning style with vocational elements have been conducted. Thus, researchers have modified the Felder-Silverman instrument, refining it with the vocational elements and making it a vocational students' learning style instrument. To achieve this, the researchers need to investigates the vocational learning style constructs' validity whether the instrument was a practical instrument for measuring learning styles among vocational students.

2.1 Research Purpose

The objective of the study is to determine the validity, and reliability of the items in the constructs of vocational learning style in accordance with the Rasch measurement model's procedures of the reliability analysis of an item.

2.2 Research Objectives

This study is specifically driven by the following research objectives:

1. To identify the items and person reliability and separation index in the instrument.
2. To identify the polarity of item adequacy in the instrument.
3. To identify the item's fit in the definition of learning style of the instrument.
4. To identify dependant items based on standardized residual correlation values.

III. METHODOLOGY

3.1 Population and Sample

This is a pilot study research. According to J.M. Linacre, (1994), 30 respondents are sufficient for the pilot study stage, whereas (Wolf, 1997) suggests that the pilot study requires 30 to 50 respondents for the pilot study. However, a sample of 60 students was chosen for this study to ensure that the instrument could be returned to at least the minimum sample requires for the pilot study research. Instrument has been distributed to the Electrical Technology

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students in classes after obtaining the approval from the Education Planning and Research Division (EPRD), Department of Technical and Vocational Education (BPTV), College Director and lecturer's permission. Of the 60 instruments distributed, 57 instruments were returned.

3.2 Analysis and Measurement

The instrument consists constructs involving four learning styles which are active, sensing, visual and sequential. Before the instrument was distributed, the questionnaire had undergone a process of face-to-face and content evaluation with an appointed expert to establish the validity of the construct. Validity is an important concept of measuring a construct. According to Darusalam & Hussin (2018), the validity of a measurement depends on how well it measures what it aims to measure. Therefore, a panel of experts is asked to review and provide suggestions on the format, content of the questionnaire and the style of the language.

A total of 3 specialists with doctorate degrees in Philosophy in the field of Psychology and Technical and Vocational Education with over five years of experience were appointed as the panel experts to evaluate the validity of the instrument. To determine the reliability of the experts' evaluation, the k^* value was calculated according to the modified kappa estimation. At this stage, 5 items were removed. However, this paper will focus on the validation stage of the remaining research instrument development.

The data was analysed using Winsteps version 3.72.3 on the basis of a Rasch measurement model, it is assumed that the students and items were on a latent continuum of the character investigated (learning style in this study). The likelihood of agreeing with an item response category depends on the student's location compared to the complexity of that item (Rasch, 1960). For example, students with a greater level of active learning style would be more expected to consider a "strongly agree" category as easier to favour than "agree", while a response of "agree" category are easier to favour than "neither agree or disagree," and so on. On the other hand, it is expected that students with low levels of active learning style will consider "strongly disagree" easier to endorse than "disagree" and so on.

The Rasch measurement model is capable of performing a thorough and detailed examination of each item as opposed to just the Alpha Cronbach's values. Under the Rasch Model, some of the in-depth analysis that involves examining the functionality of the item can be performed. According to Yusoff, Hamzah, & Surat (2018), the Rasch model offers several diagnostics that can be used to test and determine the validity and reliability of an instrument which include:

i. Testing the reliability and the separation index for item/respondent.
ii. Detecting the polarity of an item in measuring the construct.
iii. Testing the item fit in measuring the construct.
iv. Determining the dependant items based on the standardised residual correlation values.
v. Determining the difficulty level of an item.
vi. Detecting the existence of differential item functioning (dif)
vii. Determining the functionality of the scale measurement structure.
viii. Identifying the unidimensional of the construct.

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For this study, the Rasch model approach was used to examine the validity and reliability of the vocational learning styles' instrument. For that purpose, the researchers conducted only four diagnoses to perform the item functional inspection, namely item reliability and separation index, detecting the polarity of an item to measure the construct based on PTMEA CORR, testing the suitability of an item by measuring the construct and lastly to determine the dependant item based on the standardised residual correlation values.

IV. RESULTS AND FINDINGS

4.1 Reliability and Separation Index Items and Person

Based on the Rasch measurement model approach, item reliability is reflected in Cronbach's alpha's (α) values. According to Bond & Fox (2007), the acceptable reliability of Cronbach's alpha is between 0.71-0.99. The range and justifications are as shown in Table 1.

Table 1: Interpretation of Cronbach's Alpha Range

Cronbach's alpha (α)	*Reliability*
0.9 – 1.00	Very good and effective with a high degree of consistency
0.71 – 0.89	Good and acceptable
0.6 – 0.70	Acceptable
< 0.60	Items need to fix/repair
< 0.50	Items need to be dropped

To determine the reliability of the items in the instrument, statistical analysis with the Rasch measurement model approach was used. The pilot study's findings found that the reliability obtained based on the Cronbach's alpha (α) was 0.89 as shown in Table 2. Thus, this value indicates that the instrument used is good and acceptable; hence, it could be used in the actual research.

Table 2: Reliability Value for Pilot Test

Person Raw Score-To-Measure Correlation	1.00
Cronbach Alpha (KR-20) Person Raw Score "Test" Reliability	.89

Moreover, this analysis of the instrument was performed as a whole by looking at the reliability and separation index values of the items and respondents. According to Fisher, (2007) and Linacre, (2012), the separation index value which is greater than 2 is considered good and acceptable. The separation of a person is used to classify individuals. Low person separation with a sample of the relevant person means that the instrument may not be sufficient enough to differentiate between high and low performers. To overcome this matter, more items need to be added to the instrument. Low item separation signifies that the sample of the person is not large enough to verify the item's difficulty hierarchy of the instrument.

The reliability and separation index of the item is shown in Table 3. The reliability of the items is 0.82, while the separation index of item is 2.10. Based on Bond & Fox (2007), the reliability value of 0.82 is good and acceptable. The separation index indicates that the value that is accepted by Linacre (2012) and Bond & Fox (2007) is more than 2.0. The index separation will increase if the reliability increases and item mismatch is detected and removed from the analysis.

The person reliability and separation index are shown in Table 3. The reliability of the person is 0.87, while the separation index of person is 2.64. It is evident that the reliability of this item is enhanced by the reliability of the

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person which is good and acceptable. While the person's separation index shows a decent separation of the item's difficulty level is appropriate as stated in Linacre (2012) and Bond & Fox (2007) which is more than 2.0.

Table 3: Reliability and Separation Index of Item and Person for the Whole Construct

	Item	***Person***
Separation	2.10	2.64
Reliability	.82	.87

4.2 Polarity Item by PTMEA CORR Value

The polarity of item is analysed using the Point Measure Correlation (PTMEA CORR) values. The polarity inspection aims to determine the extent to which the construction of constructs achieves its goals through positive values (+ve) or negative values (-ve). Based on Bond & Fox (2007), if the value in the PTMEA CORR section is positive, it indicates that the item is measuring the construct. Likewise, if the value shown is negative, it indicates that the developed item does not measure the measuring constructs. Those negative value item needs to be repaired or removed as the item does not address the question or is hard to answer by the respondent.

Based on Table 4, all the PTMEA CORR values indicate positive values, and these verify that the items developed by the researcher actually measure the construct. If the value of the PTMEA CORR is high, it indicates that the item is able to differentiate between the respondent's capability (Yasin, Yunus, Rus, Ahmad, & Rahim, 2015). On the other hand, if the positive value of the PTMEA CORR is low, the item is considered as difficult to answer by the respondents. Nevertheless, it indicates that positive items shift in one direction with constructs and capable to measure constructs and it does not interfere with the measure constructs. Therefore, all the items are retained.

Table 4: Point Measure Correlation Value of Instrument

Entry Number	Point Measure Corr	Item	Entry Number	Point Measure Corr	Item	Entry Number	Point Measure Corr	Item
17	.24	S17	33	.39	Q33	12	.50	S12
31	.28	Q31	16	.41	S16	13	.50	S13
6	.31	A6	27	.41	Q27	14	.50	S14
8	.32	A8	30	.42	Q30	34	.51	Q34
20	.32	V20	24	.42	V24	15	.52	S15
9	.33	A9	2	.42	A2	21	.54	V21
29	.33	Q29	35	.43	Q35	10	.57	S10
25	.35	V25	5	.44	A5	7	.58	A7
3	.35	A3	18	.44	V18	4	.58	A4
1	.38	A1	28	.45	Q28	19	.65	V19
22	.39	V22	32	.47	Q32	23	.68	V23
11	.39	S11	26	.48	V26			

4.3 Measure Item Fit Construct

The appropriateness of the items can be seen in the total mean square (MNSQ) infit and outfit of each item and respondent. According to Linacre (1999), all the items are considered productive for measurement when the value of Infit-MNSQ and Outfit-MNSQ are in the range of 0.5 – 1.50. if the value of MNSQ is greater than 1.5 logit, it indicates that the item is misleading, while if the value is less than 0.5 logit, it indicates that the item is too easy to expect (John M. Linacre, 2012). Furthermore, Bond & Fox (2007) claim that the value infit and outfit ZSTD should

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be in the range of -2 to +2. However, if the infit and outfit MNSQ values are accepted, the ZSTD values can be ignored (Linacre, 2012).

Thus, if the condition is not fulfilled, the item may be deleted or revised. Table 5 below shows the item statistics, misfit order of 35 items. Based on Table 5, there are four items which exceeds the value of 0.5 - 1.50 in the outfit MNSQ which are item V22, S17, Q31, and A9. The value of ZSTD for this item likewise, exceeds the range (-2 to +2). Item Q30 has ZSTD values of 2.1 which is above 2.0 logit but the researchers accept the item because of the MNSQ outfit's logit value for item Q30 is within the accepted range which is 1.43. As stated by Linacre, (2012), if the MNSQ outfit and infit values were accepted, the ZSTD index could be ignored. Based on this inspection and expert referral results, the researcher decides to remove the four items (V22, S17, Q31, and A9) and refined item Q30.

Table 5: Item Fits

Entry Number	*Infit*		*Outfit*		*Ptmea Corr*	*Item*
	MNSQ	*ZSTD*	*MNSQ*	*ZSTD*		
22	1.80	3.6	1.81	3.7	.39	V22
17	1.83	3.5	1.79	3.4	.24	S17
31	1.62	2.3	1.75	2.8	.28	Q31
9	1.57	3.5	1.60	3.7	.33	A9
30	1.42	2.1	1.43	2.1	.42	Q30
26	1.30	1.6	1.25	1.4	.48	V26
12	1.26	1.3	1.26	1.3	.50	S12
35	1.13	.7	1.13	.7	.43	Q35
32	1.07	.5	1.07	.4	.47	Q32
24	1.06	.4	1.06	.4	.42	V24
28	1.03	.2	1.06	.4	.45	Q28
6	1.05	.3	1.04	.3	.31	A6
8	1.04	.3	1.04	.3	.32	A8
16	1.00	.1	1.02	.2	.41	S16
20	.99	.0	1.01	.1	.32	V20
1	1.00	.1	.99	.0	.38	A1
25	.99	.0	1.00	.1	.35	S25
21	.97	-.1	.99	.0	.54	V21
10	.97	-.1	.99	.0	.57	S10
34	.98	.0	.98	.0	.51	Q34
27	.97	-.1	.98	.0	.41	Q27
3	.97	-.1	.97	-.1	.25	A3
19	.95	-.2	.95	.2	.65	V19
11	.93	-.3	.94	-.3	.39	S11
23	.94	-.3	.92	-.4	.68	V23
7	.93	-.3	.93	-.3	.58	A7
5	.91	-.5	.90	-.5	.44	A5
13	.87	-.7	.88	-.7	.50	S13
4	.84	-.8	.86	-.7	.58	A4
33	.83	-.9	.85	-.8	.39	Q33
15	.81	-1.0	.83	-.9	.52	S15
29	.79	-1.2	.80	-1.2	.33	Q29
2	.73	-1.6	.75	-1.5	.42	A2
14	.68	-1.9	.70	-1.9	.50	S14
18	.66	-2.0	.69	-1.9	.44	V18

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4.4 Determining Standardized Residual Correlations Values

Measuring the standardised residual correlation will allow it to detect local dependence on whether the items depend on other items or not. If there are high positive correlation values, local dependence may occur. If the residual correlation values for two items are more than 0.7, they indicate that the items are interdependent and not singular (Azrilah et al., 2008; John M. Linacre, 2012). In such cases, Linacre (2012) recommended that only one item be selected to be used in the measurement. Other than that, in order to produce a high-quality instrument, one of these items needs to be dropped. However, item selection needs to refer the MNSQ value, where items with the value which is close to 1.00 should remain (John M. Linacre, 2012).

Based on Table 6, there are 10 pairs of items that have a correlation, namely item Q27 and Q28, item V19 and V23, item S10 and S12, item A1 and Q28, item A7 and S15 item S16 and V26, item Q30 and Q31, item A1 and V23, item A7 and Q30 and item A8 and Q34. Although these pairs of items have a correlation, the correlation value does not exceed 0.7, and this indicates that no item should be removed (Azrilah et al., 2008; John M. Linacre, 2012).

Table 6: Standardized Residual Correlation

Correlation	Entry Number	Item	Entry Number	Item
.58	27	Q27	28	Q28
.49	19	V19	23	V23
.47	10	S10	12	S12
.43	1	A1	28	Q28
.39	7	A7	15	S15
.38	16	S16	26	V26
-36	30	Q30	31	Q31
-.41	1	A1	23	V23
-.40	7	A7	30	Q30
-,40	8	A8	34	Q34

V. DISCUSSION

This analysis set forth at validating the constructs for a new drafted vocational learning style instrument. The analysis of items used the Rasch measurement model to assess the suitability of items correlated with identified dimensions. This is to ensure that all of the items meet the requirement of the instrument's validity and reliability measurement. It allowed the researchers to decide whether the response to items is consistent with conceptual expectations resulting in items that are consistent with the measurement intent through the use of analysis item reliability and person reliability. Item reliability and separation index was the first inspection in this analysis. The reliability values for item and person in the study were good and acceptable, while the separation index for both be greater than the value of 2 which point out good accepting items.

The second inspection was the polarity of item. All the PTMEA CORR values were positive values indicates that items developed were measuring the construct. However, for the third inspection which measuring the item fit construct has found four items (V22, S17, Q31 and A9) that does not exceed the acceptable value for the outfit MNSQ and the measured reading is above 1.50 logit. The value of ZSTD for these items (V22, S17, Q31, A9, and Q30) exceeds the range (-2 to +2). Item Q30 value for MNSQ outfit's logit was within the accepted range. For that, item Q30 was accepted, nevertheless the researchers continued the purification for item Q30 accomplished by

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reference and consideration of expert reviews relevant to the context of the study. Therefore, only item Q30 is retained in the instrument, while four items (V22, S17, Q31 and Q30) has been removed from the instrument. Lastly, the fourth inspection was regarding the standard and residual correlation and it found that none of the pairs of items have a correlation exceed 0.7. This state clearly the item was not depending on the other item. The complete summary of these items is shown in Table 7.

Table 7: Summary of Functionality Item

Construct	Maintained Item	Improve Item	Item Dropped	Total Remain Item
Active	A1, A2, A3, A4, A5, A6, A7, A8	-	A9	8
Sensing	S10, S11, S12, S13, S14, S15, S16,	-	S17	7
Visual	V18, V19, V20, V21, V23, V24, V25,V26	-	V22	8
Sequential	Q27, Q28, Q29, Q39, Q32, Q33, Q34, Q35	Q30	Q31	8
	TOTAL	1	4	31

Based on a pilot study, validity and reliability are among the most important aspects that need to be undertaken before developing a new instrument. A valid instrument should be created to enable the measurement is accurate. Removal and purification of items are need to be done by reference and consideration of expert opinions and assessment.

VI. CONCLUSION

To conclude, based on the validity and reliability of the instrument, it is shown that the instrument has the right quality to be used by teachers, lecturers, instructors and all educators in the vocational field. There are two implications of this analysis. First, this analysis helps the educators to investigate their students' learning styles and help the educators to prepare suitable teaching strategies or approaches that focused on the students' learning style. Second, the data obtained from the established instrument could also be used to develop a vocational learning style framework that could help the BPTV and curriculum planner to plan better in terms of the course development, course delivery, learning activities and assessment as these are the most impactful modifications required in the curriculum. In the line with the development of TVET, future research should extend the validation efforts to include technical or engineering students from higher learning institutions from universities in Malaysia as this could enhance the utility of the new instrument in the vocational education.

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