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The Use of Rasch Measurement Model for The Validity and Reliability Teacher Leadership Instrument

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Abstract

A pilot study was conducted to validate and examine the reliability of the instrument for teacher leader evaluation. The instrument consisted of 109 items and was distributed to 50 teachers. This instrument was developed to measure three (3) constructs; i) teacher commitment in the concept of teacher leadership ii) competence of teachers in the concept of teacher leadership and iii) emotional intelligence of teachers in the concept of teacher leadership. Through this approach, respondent and item reliability been measured with more accurate than using Alpha Cronbachs' value. Rasch Measurement Model (using Winstep version 3.69.1.11) measured the reliability and separation item- respondent, Point Measure Correlation (PTMEA CORR), fitness of item to measure the construct (outfit Mean-Square or MNSQ) and Standardized Residual Correlation. This approach allows expelled of item that not follow the requirement based on the diagnosis. Final result of analysis, out of 109 item, 17 item need to be expelled and the rest of the item, which is 92 item are suitable to measure three (3) constructs in the concept of teacher leadership. A total of 50 teachers were selected as respondents. All respondents involved in this pilot study were not selected in the actual sample.

Keywords: Rasch Measurement Model, Instrument Validity, Item and Respondent Reliability, Pilot Study and Teacher Leadership.

Introduction

The education system in Malaysia is moving towards high quality education. This coincides with the compilation of the Malaysia Education Blueprint 2013-2025. To develop a world class education system and create better quality, this goal cannot be ignored by all citizens and society especially educators. In the Malaysia Education Blueprint, 11 shifts are placed to improve the education system. One such development is to transform the teaching profession into a profession of choice and a transformation to the abilities and capabilities of delivery in education (Darling-Hammond, 2017). The formulation of education policy in Malaysia has also implemented a mechanism that emphasizes the responsibilities that will be given to teachers outside and inside the classroom in the shift 4.

In fact, the Malaysia Education Blueprint (Wave 3) 2021-2025 also emphasizes the concept of teacher leadership to create a culture of peer-based professionalism excellence which will benefit teacher professionalism related to curriculum and teaching arrangements, timetables, pedagogical approaches and school-based assessment. As such, teachers in the world of education are expected to have qualifications that meet the quality standards set by the Minister of Education Malaysia who are able to shoulder this responsibility. Therefore, teachers need to be clear about their roles and responsibilities in achieving the planned standards of teacher leadership.

Yet there are some issues and problems in the concept of teacher leadership and the evaluation of teacher leaders. In the concept of teacher leadership, the general perception among teachers is that the duties or roles of leaders in schools fall only under the jurisdiction of school administrators (Norashikin et al., 2015). Moreover, the issue of there is only one leader in an organization and the idea that the status of the leader is the same as the head or administrator are among the main factors that cause teachers to be unwilling to be teacher leaders and more willing to be followers only (Katzenmeyer & Moller, 2009). Teachers also assume that their job is simply to teach their students according to the subject syllabus set by the ministry (Mohd et al., 2017).

The need for quality teachers is needed to produce highly competent students especially in schools. This is supported by Leithwood et al (2017) stated that there are a number of teachers who are less competent in the teaching process and become one of the causes of students' failure to achieve excellent academic achievement in school. According to van Lankveld et al (2017) it is already the responsibility of a teacher to form the characteristics of a skilled student, this is supported by Masry-Herzallah and Da'as (2020), who state that the quality of students is dependent on the quality of their instructors. This clearly shows that the level of teacher leadership influences the quality of the students produced

As such, an instrument needs to be develop to assess the characteristics of teacher leaders as a measure of effectiveness in meeting the criteria of teacher leaders. In fact, the development of the evaluation system is also growing nowadays. Not only in assessing student performance, but the evaluation of teachers based on certain criteria can also be measured based on the characteristics found in teachers in line with aspects of teacher leadership. The instrument development and assessment results using this instrument, can assess the characteristics of teacher leaders in the implementation of the concept of teacher leadership. This is also in line with the government's desire to improve the quality of teachers based on changes and developments in education in developed countries where the strengthening of teacher leadership among teachers is seen as an effort to improve teacher professionalism.

The instrument development model of Miller et al (2013) has been adapted by researchers as a guiding platform in the instrument development process. In this study, new instruments are built to meet the needs analysis of the target group of respondents to be tested, test constructs that have the latest definitions, as well as increase researchers' understanding of a construct to be studied and encourage researchers to find new more effective methods to measure the construct. Therefore, new instruments are built (Retnawati, 2016).

This is related to the importance of the study that researchers need to know before starting a new study. In the initial phase of instrument development, concept identification and item construction among the important phases as the researcher needs to identify each

construct and item through the literature review. Literature review involves systematic analysis through the reading of documents related to the aspects studied. Through a review of the literature, the researcher who constructs the instrument is able to identify constructs that are frequently studied and will be used to define the constructs to be measured. In addition, the researcher constructing the instrument can also select previous studies to obtain input on the constructs that a particular item wants to represent.

In the context of this study as well, the researchers highlighted the literature related to the theories and models to be used are Teacher Commitment Firestone and Rosenblum (1988), Spencer and Spencer Competency Theory (1993) and Goleman Emotional Intelligence (1995) as sources of knowledge related to the three main constructs who want to be valued i.e. teacher commitment, teacher competency and teacher emotional intelligence. While Teacher Leadership Theory and Continuous Professional Development Model are used as guidelines in the details of the performance statement that should be achieved by a teacher.

This step aims to identify the attributes of the constructs and sub constructs of teacher leader characteristics among teachers in the implementation of the concept of teacher leadership through three main constructs namely teacher commitment, teacher competency and teacher emotional intelligence. Because these instruments measure attributes in the science of psychology that are abstract in nature, researchers also follow structuring steps that involve the process of conceptualization and operationalization of concepts. Based on the conceptualization and operationalization of the concepts, the researcher will compile the items to be measured in this instrument. Preliminary findings through this literature review form the basis in forming the initial conceptual framework of this study.

The completed instruments were distributed to 50 teachers selected as a respondent. All respondents involved in this pilot study were not selected in the actual study. The quantitative data obtained from this pilot study were analyzed using Winsteps Version 3.69.1.11 software which is a computer software used to analyze the data based on the Rasch Measurement Model. This system has facilitated the analysis of the data collected.

Data Analysis of Pilot Study Based on Rasch Measurement Model

Next, the results of the pilot study were analyzed using the Rasch Measurement Model approach, the researcher performed an examination of the item functionality from the aspects of (i) reliability and separation item- respondent (ii) Point Measure Correlation (PTMEA CORR.) (iii) fitness of item to measure the construct (outfit Mean-Square or MNSQ) and (iv) Standardized Residual Correlation. These four (4) diagnoses complete the requirements needed to check the reliability of the instrument.

The Rasch Measurement Model takes the ability or capability of each respondent who answered the instrument in addition to identifying the level of difficulty of the questionnaire items. In addition, this measurement model is able to calculate the score of each respondent in the form of interval data although the data is collected using a 5 -point Likert scale (Nurtanto et al., 2020).

Objective

The objective of this pilot study was to test the reliability of the instruments that have been developed. A pilot study was conducted before the actual study was conducted. A pilot study should be conducted to reduce errors in the actual study because the reliability and validity of the questionnaire used should be tested first, this is supported by Lowe (2019) that a pilot

study was conducted to measure the consistency of measurements of each item of questionnaire.

Through this pilot study, the researcher conducted functional testing of items by measured the reliability and separation item- respondent, Point Measure Correlation (PTMEA CORR), fitness of item to measure the construct (outfit Mean-Square or MNSQ) and Standardized Residual Correlation.

Methodology

The pilot study conducted was a survey study involving quantitative methods using questionnaires and using the Rasch Measurement Model approach. Quantitative data were collected through questionnaires. Researchers distributed a set of questionnaires to 50 respondents who were teachers involved with teaching and learning in schools. According to Malmqvist et al (2019) a minimum number of respondents of 30 people was sufficient to analyze the validity and reliability in the preliminary study. However, in this pilot study, a total of 50 teachers were selected as study respondents. All respondents involved in this pilot study were not selected in the actual study.

The questionnaire that will be prepared is divided into four parts. Part A, Part B, Part C and Part D. Part A is related to teacher demographics, Part B is a statement related to teacher commitment in the concept of teacher leadership. Part C statements related to teacher competency in the concept of teacher leadership and Part D statements related to teacher emotional intelligence in the concept of teacher leadership. The part of the questionnaire form can be seen as Table 1.

Table 1
Contents of Questionnaire and Number of Items Before the Pilot Study

Part	**Construct**	**Sub construct**	**Number of Item**	**Total**
Part B	Teacher Commitment	Teachers Commitment to the Profession	1-10	10
		Teacher Commitment to School	11-20	10
		Teacher Commitment to Teaching and Learning	21- 29	9
		Teacher Commitment to Students	30-39	9
Part C	Teacher Competency	Teacher Competence towards Knowledge	1-8	8
		Teacher Competence towards Skills	9-17	9
		Teacher Competence on Personal Values	18-25	8
Part D	Teacher Emotion Intelligence	Self-Awareness	1-9	9
		Self-Control	10-18	9
		Self-Motivation	19-27	9
		Empathy	28-36	9
		Social skills	37-46	10
Total				**109**

Findings of The Study

The results of the pilot study were analyzed using Winsteps software with Rasch Measurement Model approach, the researcher conducted an inspection of the functionality of the items from the aspects of (i) reliability and separation item- respondent (ii) Point Measure Correlation (PTMEA CORR) (iii) fitness of item to measure the construct (outfit Mean-Square or MNSQ) and (iv) Standardized Residual Correlation. The explanation for each item functional diagnosis is as follows.

The Reliability and Separation Item- Respondent

The level of reliability of the study can be determined by using the interpretation of Cronbach's Alpha values which have a range between 0.00 to 1.0. If the range value approaches 1.0, it indicates the level of reliability is at a good, high, and effective level. Meanwhile, the range is close to 0.00, it reflects a low level of reliability. Table 2 shows the guidelines in analyzing the pilot study (Bond & Fox, 2015)

The findings of the pilot study analysis found that the reliability value referring to the Cronbach's Alpha value is 0.94 as shown in Table 2. This shows that the instrument is in very good condition and effective with a high level of consistency and can be used in real research. Based on the Rasch measurement model, the acceptable Cronbach's Alpha value score is 0.71–0.99

Table 2
Cronbach's Alpha Score Interpretation Table (Bond & Fox, 2015)

Cronbach's Alpha Score	**Level of Reliability**
0.9 to 1.0	Very good and effective with a high degree of consistency
0.7 to 0.8	Good and acceptable
0.6 to 0.7	Acceptable
<0.6	The item needs to be repaired
<0.5	Items need to be dropped

Based on Table 3 also shows a summary of the statistics of the person reliability value that can be accepted which is 0.94. The value of the separation index obtained also shows a good value of the separation index that exceeds the value of 2.0 which is 3.83. According to Linacre (2010), states a good isolation index is above the value of 2.0.

Table 3
Separation Index, Person Reliability and Cronbach's Alpha Reliability for Overall Construct of Instrument

Separation Index	Person Reliability
3.83	0.94
Cronbach's Alpha Reliability = 0.94	

Table 4 shows a summary of the statistics of the reliability value and item reliability. Where, the item reliability value is 0.81, based on the item reliability value, the value of 0.80 is in good condition and acceptable (Bond & Fox, 2015). While the value of item separation (item separation) is 2.05 and this value indicates that it is in good condition, according to Linacre

(2010), the value of good index separation is more than the value of 2.0.

Table 4
Separation Index and Item Reliability for Overall Construct of Instrument

Separation Index	Item Reliability
2.05	0.81

Point Measure Correlation (PTMEA CORR)

Checking the Point Measure correlation value (PTMEA CORR.) is to detect the polarity of the item in order to test the extent to which the construction of the construct achieves its goal. If the PTMEA CORR. value is a positive value (+), it indicates the item measures the construct to be measured (Bond & Fox, 2015). If the value obtained is otherwise, negative (-) it means that the developed item does not measure the construct to be measured. Then it needs to be repaired or dropped because the item does not lead to a question or is difficult to answer by the respondent.

Referring to the values of PT Measure Corr. found in Table 5, there is no negative value (-) in the effect in that value. Nevertheless, there is a PTMEA CORR value. the lowest i.e. on item D23 which yields a value of 0.02 where this item should be noted. However, based on the findings show that all the items provided move in one direction with the construct and are able to measure the construct and do not conflict with the construct to be measured. If the PTMEA CORR. value is high, then the item is able to distinguish abilities between respondents.

Table 5
Point Measure Correlation for Items

Entry Number	Point Measure Corr.	Item	Entry Number	Point Measure Corr.	Item	Entry Number	Point Measure Corr.	Item
86	0.02	D23	64	0.24	D01	48	0.44	C10
8	0.08	B08	89	0.24	D26	71	0.44	D08
31	0.08	B31	19	0.26	B19	96	0.44	D33
46	0.08	C08	57	0.26	C19	14	0.46	B14
69	0.08	D06	80	0.26	D17	37	0.46	B37
94	0.08	D31	105	0.26	D42	52	0.46	C14
23	0.16	B23	2	0.27	B02	75	0.46	D12
61	0.16	C23	25	0.27	B25	100	0.46	D37
84	0.16	D21	40	0.27	C02	6	0.49	B06
109	0.16	D46	63	0.27	C25	29	0.49	B29
1	0.17	B01	88	0.27	D25	44	0.49	C06
24	0.17	B24	16	0.30	B16	67	0.49	D04
39	0.17	C01	54	0.30	C16	92	0.49	D29
62	0.17	C24	77	0.30	D14	20	0.50	B20
87	0.17	D24	102	0.30	D39	58	0.50	C20
22	0.19	B22	9	0.31	B09	81	0.50	D18
60	0.19	C22	32	0.31	B32	106	0.50	D43
83	0.19	D20	47	0.31	C09	12	0.53	B12
108	0.19	D45	70	0.31	D07	35	0.53	B35
17	0.19	B17	95	0.31	D32	50	0.53	C12
55	0.19	C17	13	0.32	B13	73	0.53	D10
78	0.19	D15	36	0.32	B36	98	0.53	D35
103	0.19	D40	51	0.32	C13	7	0.53	B07
21	0.20	B21	74	0.32	D11	30	0.53	B30
59	0.20	C21	99	0.32	D36	45	0.53	C07
82	0.20	D19	18	0.41	B18	68	0.53	D05
107	0.20	D44	56	0.41	C18	93	0.53	D30
85	0.21	D22	79	0.41	D16	15	0.60	B15
5	0.23	B05	104	0.41	D41	38	0.60	B38
28	0.23	B28	4	0.41	B04	53	0.60	C15
43	0.23	C05	27	0.41	B27	76	0.60	D13
66	0.23	D03	42	0.41	C04	101	0.60	D38
91	0.23	D28	65	0.41	D02	11	0.60	B11
3	0.24	B03	90	0.41	D27	34	0.60	B34
26	0.24	B26	10	0.44	B10	49	0.60	C11
41	0.24	C03	33	0.44	B33	72	0.60	D09
						97	0.60	D34

Fitness of Item to Measure the Construct (outfit Mean-Square or MNSQ)

The suitability of the items for measuring the developed constructs can be seen through the values found on the Outfit Mean-Square (MNSQ). According to Bond & Fox (2015), the MNSQ

outfit value should be in the range between 0.6 to 1.4 to ensure the item developed is suitable for measuring constructs. If the value obtained exceeds 1.4, it indicates that the item is misleading. Whereas if the value is less than 0.6, it indicates the item is too easy to be expected by the respondent. In addition, ZSTD outfit values need to be in the range of -2 to +2 (Bond & Fox, 2015). However, if the MNSQ outfit value is accepted, the ZSTD index can be ignored (Linacre, 2010). Therefore, if this condition is not met, then the item can be considered for removal or purification.

Table 6 shows there are 10 items that are not in the range of 0.6 to 1.4 and they need to be purified or dropped. Values that exceed the value of 1.40 are in the outfit column which is 1.48 for B08, B31, C08, D06, and D31. The value of 1.41 is items B03, B26, C03, D01 and D26. While a value less than 0.6 in the outfit column is not available. Through this diagnosis, it was found that there were 10 items that needed to be dropped or repaired out of the 109 items provided.

Table 6
Item Fit

ENTRY NUMBER	MEASURE	INFIT		OUTFIT		PT-MEASURE	ITEM
		MNSQ	ZSTD	MNSQ	ZSTD		
8	0.22	1.14	0.70	1.48	2.0	A.08	B08
31	0.22	1.14	0.70	1.48	2.0	B.08	B31
46	0.22	1.14	0.70	1.48	2.0	C.08	C08
69	0.22	1.14	0.70	1.48	2.0	D.08	D06
94	0.22	1.14	0.70	1.48	2.0	E.08	D31
3	-0.50	1.45	1.8	1.41	1.6	F.24	B03
26	-0.50	1.45	1.8	1.41	1.6	G.24	B26
41	-0.50	1.45	1.8	1.41	1.6	H.24	C03
64	-0.50	1.45	1.8	1.41	1.6	I.24	D01
89	-0.50	1.45	1.8	1.41	1.6	J.24	D26
BETTER FITTING OMITTED +----------+----------+							
10	0.64	0.70	-1.6	0.71	-1.5	j.44	B10
33	0.64	0.70	-1.6	0.71	-1.5	i.44	B33
48	0.64	0.70	-1.6	0.71	-1.5	h.44	C10
71	0.64	0.70	-1.6	0.71	-1.5	g.44	D08
96	0.64	0.70	-1.6	0.71	-1.5	f.44	D33
13	-0.50	0.62	-1.8	0.66	-1.5	e.32	B13
36	-0.50	0.62	-1.8	0.66	-1.5	d.32	B36
51	-0.50	0.62	-1.8	0.66	-1.5	c.32	C13
74	-0.50	0.62	-1.8	0.66	-1.5	b.32	D11
99	-0.50	0.62	-1.8	0.66	-1.5	a.32	D36

Standardized Residual Correlation

Measurement of standardized residual correlation values aims to determine whether there are items that overlap each other and are not singular in nature. Referring to Table 7, the high residual correlation value of more than 0.7 for the two items indicates that the items are dependent and not singular. This is because the items have similar characteristics to each other or both combine several shared dimensions. If the correlation value of the two (2) items

exceeds 0.7, then only one item is required and retained for each pair of items involved. Item selection also refers to the MNSQ value, where a value close to 1.00 will be maintained (Linacre, 2010).

Table 7
Largest Standardized Residual Correlation on Items

Correlation	Entry Number	Item	MNSQ	Result	Entry Number	Item	MNSQ	Result
1.00	74	D11	0.66	Retained	99	D36	0.66	Retained
1.00	75	D12	1.03	Dropped	100	D37	1.03	Retained
1.00	76	D13	0.71	Retained	101	D38	0.71	Retained
1.00	77	D14	1.10	Retained	102	D39	1.10	Dropped
1.00	79	D16	1.07	Dropped	104	D41	1.07	Retained
1.00	80	D17	1.15	Dropped	105	D42	1.15	Dropped
1.00	81	D18	0.79	Retained	106	D43	0.79	Retained
1.00	82	D19	0.96	Retained	107	D44	0.96	Retained
1.00	83	D20	1.11	Dropped	108	D45	1.11	Retained
1.00	84	D21	1.17	Retained	109	D46	1.17	Dropped

Referring to table 7, shows that there are 10 pairs of items that have a high correlation value that is at a correlation value of 1.00 between items D11, D12, D13, D14, D16, D17, D18, D19, D20, D211, D36, D37, D38, D39, D41, D42, D43, D44, D45 and D46. This means that these items have the same measurement meaning or combine several other dimensions that are shared together.

Thus, this item needs to be given attention and the sentence structure needs to be dropped or corrected for one of the items involved between the two. However, the selection of items to be dropped should be referred to the MNSQ value of the items involved, which is above the MNSQ value of 1.00. Nonetheless, the researchers have repaired and reviewed the overlapping items whether these items have similar meanings or vice versa and can be tested in actual studies. Therefore, the items issued are only D12, D16, D17, D20, D39, D42 and D46. Then items less than the MNSQ value with a value of 1.00 were retained.

Discussion and Conclusion

Once the data were analyzed, item review was performed on each item based on the standard index as well as the conditions that need to be followed to achieve the standard of validity and reliability of the instrument based on the Rasch Measurement Model. The removal and refinement of items is done with reference to and taking into account the views and evaluations of experts. Based on the pilot study that has been done, there are 17 items that do not meet the requirements of the analysis that has been set and should be eliminated it also by looking at the needs of the study and the views of experts. Based on the findings of the analysis. The overall summary of the relevant question items is as shown in Table 8 below.

Table 8
Summary of Items dropped and retained

Number	Construct	Item Retained	Total Item Retained	Item Dropped	Total Item Dropped
1	Teacher Commitment	B01 B02 B04 B05 B06 B07 B09 B10 B11 B12 B13 B14 B15 B16 B17 B18 B19 B20 B21 B22 B23 B24 B25 B27 B28 B29 B30 B32 B33 B34 B35 B36 B37 B38	34	B03 B08 B26 B31	4
2	Teacher Competency	C01 C02 C04 C05 C06 C07 C09 C10 C11 C12 C13 C14 C15 C16 C17 C18 C19 C20 C21 C22 C23 C24 C25	23	C03 C08	2
3	Teacher Emotional Intelligent	D02 D03 D04 D05 D07 D08 D09 D10 D11 D13 D14 D15 D18 D19 D21 D22 D23 D24 D25 D27 D28 D29 D30 D32 D33 D34 D35 D36 D37 D38 D40 D41 D43 D44 D45	35	D01 D06 D12 D16 D17 D20 D26 D31 D39 D42 D46	11
TOTAL			**92**		**17**

Based on the findings of the analysis conducted on 109 items, item analysis with Rasch measurement model approach was performed by performing four diagnoses for the purpose of item functionality inspection. The results of the analysis found that there were items that had been proposed to be segregated and discarded. The items that need to be dropped are, 4 items from the Teacher Commitment construct, namely items B03, B08, B26, B31; 2 items from the Teacher Competency construct, namely items C03 and C08; and 11 items from the Emotional Intelligence construct namely D01, D06, D12, D16, D17, D20, D26, D31, D39, D42 and D46. Based on Table 8 shows that only 92 items were retained for use in the actual study.

The conclusion is based on the item functionality examination to identify the validity and reliability of this instrument, indicating that this instrument has a desirable quality for use

by the researcher. This pilot study is an initial step in helping researchers in assessing the characteristics of teacher leaders in terms of teacher commitment, teacher competence and emotional intelligence of teachers in the implementation of the concept of teacher leadership and then help all parties involved in producing teachers a perfect teacher and be the best model for all students, colleagues and the community.

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