ASSESSING CONSTRUCT VALIDITY AND RELIABILITY OF COMPETITIVENESS SCALE USING RASCH MODEL APPROACH

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Abstract

This paper aims to determine the construct validity and examine the reliability of a newly developed instrument namely Competitiveness Scale of Malaysian Higher Education Institutions. The instrument consists of 66 items with eight domains namely personal characteristics; goals; self-improvement; management communication; financial management; organizational management; competitiveness and workability and was administered to 1800 undergraduate students in Malaysian institutions of higher learning. The Rasch model was used to examine both validity and reliability of the items. From the analysis, item polarity indicates that the point measure correlation (PTMEA CORR) for the 66 items of competitiveness is between 0.58 to 0.88. The findings of the Summary Statistic indicated that item reliability and item separation for competitiveness is 0.99 and 12.58 respectively, while for person reliability and person separation is 0.97 and 5.57 respectively. In terms of items fit, results show that the 66 items of competitiveness range from 0.80 to 1.28.

Keywords: competitiveness; Rasch Model; construct validity; reliability; personal characteristics; goals; self-improvement; management communication; financial management; organizational management; workability

1 Introduction

Competitiveness has been defined as a psychological nature. As an individual character, competitiveness is an enjoyment of interpersonal competition and the desire to win and be better than others (Fletcher et al.2008). An alternative definition for competitiveness also states interpersonal emphasis as it refers to the social comparisons involving unequal distribution of rewards or limited resources derived from the relative performance of participants in an activity (Mudrack et al 2012). It is not only being a winner or a loser that defines the costs and benefits in a competitive situation. Irrespective of the outcome, competitive parties can experience positive stress, learning, improvement, good relationship, trust, communication and fairness among others (Fulop & Takacs 2013).

The instrument is developed based on The Revised Competitiveness Index by Houston et al. (2002) and The Art and Science of Competency Models by Lucia and Lepsinger (1999). The face and content validity of competitiveness instrument have been validated by 13 construct expert from various academic credentials. Wright & Stone (1979) suggested that in the construction of items which aim to measure person's behaviour, it is important for instrument developer to be aware of the crucial task of constructing high quality items. Items with high quality are related to the validity and reliability of the instrument. Therefore, Rasch analysis was used to determine the validity and relibility of items developed.

2 Research Objective

The objective of the study are as follows: (a) to identify the validity and reliablity of the competitiveness scale using Rasch Measurement Model, (2) to identify the point measure correlation in the construct of the competitiveness scale which are in the acceptable range, (3) to identify the adequacy of the separation index of the competitiveness scale and (4) to identify the fit items in the construction of the items competitiveness scale within the acceptable range.

3 Methodology

The Competitiveness Scale of Malaysian Higher Education Institutions consists of 66 self-assessment items that represent eight competitiveness construct. Respondents were requested to circle their agreement to the items using the five-point Likert type response categories namely 1 = strongly disagree to 5 = strongly agree. This study is a quantitative approach study which involves the collection of data using questionnaire.

The instrument were administered to a sample of 1800 undergraduate at higher education institutions in Malaysia. A stratified random sampling based on public and private higher education institutions was used in this study. A total of 1800 undergraduate comprising of 809 male, 991 female, out of which 604 are science students, 677 social science and 519 technical backgrounds were selected as a sample. The sample used was also representative of various races in Malaysia such as Malay, Chinese, Indian and others.

The Competitiveness Scale of Malaysian Higher Education Institutions was used to gauge 8 constructs with 66 items which comprises of (1) personal characteristics – PC (25 items), goals – G (3 items), self-improvement – SI (10 items), communication management – CM (5 items), financial management – FM (3 items), organizational management - OM (5 items), competitiveness – C (11 items) and workability – W (4 items). Items are quantitatively analyzed using WINSTEPS software 3.72.3 (Linarce 2007) based on the Rasch model to assess the suitability of items.

4 Analysis using Rasch Model

Rasch model with the application of WINSTEPS version 3.72.3 was used to analyze the datas as well as to test the validity and reliability of the instrument. The Rasch model considers the ability of the respondents or the students who answered the questionnaires or instruments and the difficulty of each item (Rasch, 1980). Smith (1992) argues that the respondents should be ranked consistently by items measuring the same construct. He suggested by using item fit statistics to evaluate the extent to which items are tapped into the same construct and places in the same order to assess the items technical empirically in the Rasch analysis. Otherwise, the mistfit items that measure a different construct in the instrument should be revised or eliminated.

According to Wright and Stone (1979), the criteria in Table 1 below used as benchmarks for determining the validity of the instrument :

1. The use of valid items in the measurement process to determine the construct measurement.
2. The definition of the concepts and construct are clear and consistent with the supporting theory.
3. Testing item on appropriates individuals provides results that are consistent with the purpose of the measurement, and
4. The application of valid response patterns. Without a valid response pattern, the individuals cannot be defined precisely.

Table 1. Summary of item validity and reliability using Rasch Model.

Criteria	Statistical Info	Results
Item Validity	a. Item Polarity	PTMEA CORR > 0 (Bond & Fox 2007)
Item	b. Item Fit	Total Mean Square infit and outfit of 0.6 – 1.4 (Bond & Fox 2007)
Item Misfit	c. Separation (SE)	All items show ≥ 2.0 (Linacre 2007)
	d. Person Reliability	Value > 0.8 (Bond & Fox 2007)
	e. Item Reliability	Value > 0.8 (Bond & Fox 2007)

The respondents reliability index of 0.98 is a good value (Pallant, 2001) for the expected consistency on the logit scale for the answers on different sets of items that measure the same construct (Wright and Masters, 1982). Linarce (2007) stated that the reliablity of respondents of ≥ 0.8 and respondents separation index of ≥ 2.0 as good indices. The statistics generated by Rasch analysis estimate the degree of items suitability that measures latent variables, assuring the item-fit of the instrument are within an acceptable range. Thus, 8 items were removed because the mean square infit and outfit radius fall outside the range of 0.6 – 1.4 as proposed by Bond and Fox (2007).

Profile of Respondent

Table 2 shows the respondents' gender, race and stream. The total number of respondents is 1800. There were 991 respondents who were female (55.1%) and 809 of them were male (44.9%). The total number of Malay students is 1033 (57.4%) and non-Malay 767 (42.6%). There are 604 (33.6%) are pure science students, 677 (37.6%) social science and 519(28.8%) technical students. There were from 2 different types of university namely public university 887 (49.3%) and private university 913 (50.7%).

Table 2: Profile of Respondent

Demography factor	N	Factor	Frequency	Percentage
Gender	1800	Male	809	44.9
		Female	991	55.1
Race	1800	Malay	1033	57.4
		Non Malay	767	42.6
Streams	1800	Pure Science	604	33.6
		Social science	677	37.6
		Technical	519	28.8

Types of university	1800	Public University	887	49.3
		Private University	913	50.7

Reliability and Separation Index

The data was further analyzed using WINSTEPS version 3.72.3 to determine the validity and reliability of the competitiveness scale. Table 3 shows the statistics generated by Rasch analysis of item reliability and construct validity. The statistics shown indicate how Rasch model conform the item separation index and person separation index as well as the item reliability and person reliability. The item reliability index is between 0 and 1 whereby 0.8 and above is strongly acceptable (Fox & James 1998) while value less than 0.8 less acceptable. The item reliability of PC are .99, G 1.0, SI 1.0, CM .82, FM 1.00, OM .95, C .95, and W .99. The item reliability of eight construct is acceptable which ranges from 0.82 to 1.00.

Table 3: Reliability Analysis and Separation of Competitiveness Index

Construct	Total item	Item Measure		Person Measure	
		Reliability	Separation	Reliability	Separation
Personal characteristics (PC)	25 items	.99	9.24	.95	4.17
Goals (G)	3 items	1.00	55.27	.78	1.89
Self-improvement (SI)	10 items	1.00	21.07	.87	2.54
Communication management (CM)	5 items	.82	2.17	.76	1.76
Financial management (FM)	3 items	1.00	52.51	.82	2.16
Organizational management (OM)	5 items	.95	4.54	.83	2.21
Competitiveness (C)	11 items	.95	4.52	.88	2.73
Workability (W)	4 items	.99	9.48	.73	1.65
Competitiveness Scale	66 items	.99	12.58	.97	5.57

The value of the item separation refers to the number of strata of item difficulties obtained in the questionnaire. As shown in Table 3 the value indicates that the items develop are well spread and the items are on the logits scale with high reliability. The value of the separation index for all respondents and the item constructs are in lined with the recommendations by Linarce (2005) which states that the separation value index of > 2.0 is good. The value of separation index >2.0 is grade measurement system caused by only one or two observartion, the value of between 1.5 to 2.0 is not productive for the development of measurement but not demeaning,values between 0.5 to 1.5 and the productivity measurement <0.5 is less productive for measurement, but do not lower the grade thus eliminates confusion and isolation of a high reliability coefficients Linarce (2005). Separation item measure index for the constructs are as folows; PC are 9.24, G 5.27, SI 2.07, CM 2.17, FM 2.51, OM 4.54, C 4.52, and W 9.48 are good. All the separation of items are good items and this in accordance with Linance (2005) who states that separation of > 2 is good.

Bond & Fox (2001) suggested where the value reliability which is more than 0.8 is acceptable and has strong value while less than 0.8 less acceptable. The reliability person measure for the constructs are PC : 0.95, G : 0.78, SI : 0.87, CM : 0.76, FM : 0.82, OM : 0.83, C : 0.88, and W : 0.73. Constructs G : 0.78, CM : 0.76 and W :0.73 have the reliability person measures < 0.8 which is less acceptable. However the reliability person measure the construct PC : 0.95, SI : 0.87, FM : 0.82, OM : 0.83, and C : 0.88 are the value of > 0.8 is acceptable and strong values. Reliability measure for the constructs are as follow ; PC : 0.99, G : 1.00, SI : 1.00, CM : 0.82, FM : 1.00, OM : 0.95,

C : 0.95, and W : 0.99. The values of reliability item measure of these constructs are acceptable and considered strong because they are > 0.8.

Item Polarity

Table 4 shows the value of PTMEA Corr in the competitiveness scale as generated by Rasch Analysis. According to Rasch Measurement Model, the validity of a questionnaire can be referring to the analysis of the output. The main output to be referred is the polarity item as a correlation coefficient of measurement point, which is known as point-measure correlation coefficient (PTMEA Corr).

Like any statistical value, the correlation coefficient is little importance unless it can be properly interpreted. Labelling systems exist to roughly categorize r values where correlation coefficients (in absolute value) which are ≤ 0.35 are generally considered to represent low or weak correlations, 0.36 to 0.67 modest or moderate correlations, and 0.68 to 1.0 strong or high correlations with r coefficients ≥ 0.90 very high correlations.

Table 4 : Analysis of Competitiveness Scale PTMEA Corr

Construct	PC	G	SI	CM	FM	OM	C	W	
Item 1	.60	.69	.69	.76	.82	.80	.74	.70	
Item 2	.61	.73	.70	.74	.86	.83	.69	.73	
Item 3	.61	.73	.73	.64	.88	.82	.77	.77	
Item 4	.67	.76	.74	.66		.83	.76	.68	
Item 5	.67		.75	.74		.80	.70	.74	
Item 6	.62		.79				.72		
Item 7	.73		.78				.74		
Item 8	.72		.77				.72		
Item 9	.75		.72				.74		
Item 10	.75						.74		
Item 11	.75								
Item 12	.77								
Item 13	.73								
Item 14	.76								
Item 15	.73								
Item 16	.73								
Item 17	.70								
Item 18	.68								
Item 19	.68								
Item 20	.69								
Item 21	.65								
Item 22	.67								
Item 23	.70								
Item 24	.58								
Item 25	.68								

A high PTMEA Corr means that an item is able to distinguish between the ability of the respondents. A zero value or negative indicates that the link for the item response or respondent is in conflict with the variable or construct (Linacre 2003). Table 4 shows a summary of PTMEA Corr for 66 items in competitiveness scale. All items shows positive value with the index >.30. Minimum PTMEA Corr is .58 for PC37 (personal characteristics) and maximum index is 0.88 for FM52 (finance management). According to Bond & Fox (2001) the positive value of PTMEA Corr proves measuring items that are to be measured need to be carefully constructed. Therefore, it can be concluded that the items will contribute to the measurement of competitiveness scale. This can discriminate or differentiate between different types of competitiveness held by the respondents.

Item Fit and Item Misfit

Statistical analysis for suitability of items were carried out to identify items that have should be greater than 0.6 and less than 1.4 (Bond & Fox 2007). First, the fit statistic was performed on the outfit MNSQ then to the infit MNSQ statistics (Bond & Fox 2007). Table 5 shows the number of items based on the infit MNSQ and outfit MNSQ statistics. The analysis shows that Infit MNSQ and outfit MNSQ value of all items and respondents that were measured.

The Infit MNSQ and outfit MNSQ value of each item and the respondents should be in the range of 0.60 to 1.40 for Likert scale (Bond & Fox 2007) while according to Wright & Linance (1992), the total mean square infit and outfit mean square of each item and respondent must be located within 0.6 to 1.5. For the purpose of this research, the researcher used the total mean square infit and outfit mean square in the range proposed by Bond & Fox (2007). If the individual item does not fulfill the requirements, then the item will be considered to eliminate. The analysis showed that mean square infit is 0.80 to 1.28 and outfit mean square value of the item is 0.81 to 1.41 for all constructs. As seen ini Table 5, it can be concluded that there is one item, CM47 should to improve or dropped because has exceeded the range suggested of 1.41.

Table 5 . Infit and Outfit MNSQ

TOTAL		MODEL	INFIT		OUTFIT		PT-MEASURE		EXACT MATCH			
SCORE	COUNT	MEASURE	S.E.	MNSQ	ZSTD	MNSQ	ZSTD	CORR.	EXP.	OBS%	EXP%	ITEM	G
29	5228	1797	.90	.03	1.12	3.9	1.15	4.5	.60	.65	39.3	40.8	PC31	0
20	5363	1797	.80	.03	.99	-.2	.99	-.5	.65	.64	43.9	41.7	PC22	0
19	5376	1799	.78	.03	1.00	.1	.99	-.3	.65	.65	41.5	40.9	PC21	0
21	5659	1798	.63	.03	.83	-5.6	.82	-5.9	.70	.62	50.3	44.1	PC23	0
44	5648	1799	.59	.03	1.22	6.6	1.26	7.5	.53	.63	42.2	43.6	FM51	0
27	5697	1796	.58	.03	1.00	.0	1.02	.6	.62	.62	48.1	44.8	PC29	0
23	5703	1799	.56	.03	.81	-6.4	.81	-6.4	.71	.62	50.5	43.5	PC25	0
1	5859	1800	.47	.03	1.17	5.2	1.18	5.4	.55	.63	43.2	43.0	PC3	0
33	5811	1799	.46	.03	1.23	6.8	1.28	7.9	.51	.62	43.4	44.5	PC37	0
22	5863	1799	.46	.03	.80	-6.6	.81	-6.4	.70	.61	51.5	45.6	PC24	0
32	5921	1799	.40	.03	.96	-1.2	.97	-1.0	.64	.62	47.7	43.8	PC36	0
12	6027	1798	.36	.03	.94	-2.0	.95	-1.6	.63	.61	48.2	45.3	PC14	0
45	5982	1800	.35	.03	1.06	1.8	1.08	2.3	.59	.61	46.3	45.6	FM52	0
28	5996	1798	.34	.03	.86	-4.3	.87	-4.2	.66	.60	51.5	47.6	PC30	0
13	6039	1798	.34	.03	.92	-2.6	.92	-2.5	.65	.62	47.2	43.9	PC15	0
18	6002	1798	.34	.03	.83	-5.6	.83	-5.6	.69	.62	48.8	44.1	PC20	0
2	6028	1796	.34	.03	1.12	3.7	1.12	3.7	.55	.61	45.8	45.5	PC4	0
62	6011	1799	.34	.03	.88	-3.9	.88	-3.8	.67	.62	48.2	44.1	PC70	0
31	6104	1799	.29	.03	1.01	.4	1.03	1.0	.61	.62	47.7	43.7	PC35	0
17	6143	1797	.26	.03	.86	-4.4	.86	-4.4	.66	.60	50.5	46.0	PC19	0
16	6119	1798	.26	.03	.84	-5.3	.84	-5.0	.68	.61	51.4	45.6	PC18	0
43	6102	1798	.23	.03	1.24	6.8	1.24	6.9	.50	.60	44.1	46.2	FM50	0
25	6195	1798	.22	.03	.84	-5.3	.84	-5.1	.68	.61	52.0	45.1	PC27	0
24	6206	1800	.20	.03	.84	-5.1	.85	-4.9	.68	.61	52.1	44.5	PC26	0
26	6297	1789	.11	.03	.83	-5.3	.83	-5.2	.66	.59	55.0	48.1	PC28	0
64	6254	1795	.09	.03	.97	-.9	.98	-.7	.60	.59	52.5	48.6	W72	0
30	6318	1800	.09	.03	.91	-2.9	.90	-3.0	.63	.60	50.7	46.7	PC32	0
58	6407	1797	.04	.03	.88	-3.7	.88	-3.7	.65	.59	52.8	47.9	CO66	0
56	6286	1799	.02	.03	.93	-2.0	.91	-2.7	.61	.57	53.3	51.1	CO63	0
63	6478	1796	.00	.03	1.11	3.2	1.12	3.4	.55	.60	46.9	45.9	W71	0
10	6479	1797	.00	.03	.87	-4.1	.87	-3.8	.64	.59	50.5	47.6	SI12	0

14	6496	1792	-.01	.03	.86	-4.4	.86	-4.3	.64	.58	52.4	49.1	SI16 0
61	6509	1798	-.05	.03	.83	-5.3	.84	-4.9	.65	.57	53.6	49.7	CO69 0
51	6443	1798	-.06	.03	.87	-3.9	.86	-4.3	.64	.57	54.7	51.0	CO58 0
55	6472	1799	-.06	.03	1.03	1.0	1.03	.8	.57	.58	47.4	48.4	CO62 0
5	6566	1800	-.08	.03	.87	-3.8	.88	-3.6	.63	.57	51.8	49.6	SI7 0
7	6529	1795	-.08	.03	.99	-.3	1.00	.0	.59	.59	48.7	47.4	PC9 0
15	6584	1797	-.09	.03	1.01	.3	1.10	2.8	.58	.59	46.7	46.5	PC17 0
57	6561	1798	-.15	.03	.83	-5.5	.84	-5.0	.66	.58	52.9	48.5	CO65 0
46	6435	1800	-.18	.03	1.02	.8	1.00	.2	.56	.57	53.4	51.1	OM53 0
38	6386	1796	-.19	.03	1.02	.8	1.01	.4	.56	.57	51.9	49.9	CM45 0
52	6589	1799	-.20	.03	1.04	1.0	1.03	1.0	.53	.55	53.6	52.6	CO59 0
54	6567	1793	-.20	.03	.95	-1.5	.94	-1.8	.59	.56	52.9	51.4	CO61 0
53	6596	1795	-.21	.03	.90	-2.8	.90	-3.1	.62	.56	53.8	51.6	CO60 0
11	6756	1796	-.21	.03	.90	-2.8	.91	-2.7	.60	.56	52.1	50.4	SI13 0
42	6498	1799	-.24	.03	1.11	3.3	1.10	3.0	.50	.56	49.6	51.3	CM49 0
8	6745	1787	-.26	.03	.93	-2.1	.92	-2.2	.58	.56	52.1	51.4	SI10 0
66	6627	1797	-.26	.03	1.03	1.0	1.03	.9	.54	.56	53.4	51.1	W74 0
41	6528	1794	-.26	.03	1.37	9.9	1.37	9.7	.38	.57	46.7	50.1	CM48 0
47	6402	1799	-.29	.03	1.01	.3	1.00	.0	.56	.56	51.9	51.6	OM54 0
6	6806	1797	-.29	.03	.99	-.2	.98	-.6	.54	.56	51.0	51.8	SI8 0
60	6668	1792	-.29	.03	.84	-4.8	.86	-4.2	.64	.56	57.5	51.7	CO68 0
59	6681	1798	-.30	.03	.85	-4.4	.86	-4.2	.63	.56	55.7	51.6	CO67 0
50	6487	1799	-.35	.03	1.05	1.6	1.04	1.3	.52	.55	52.9	53.2	OM57 0
9	6905	1798	-.35	.03	.92	-2.3	.90	-2.7	.59	.55	53.7	51.7	SI11 0
3	6942	1795	-.37	.03	1.11	3.0	1.13	3.3	.49	.56	49.7	50.4	SI5 0
49	6452	1798	-.39	.03	1.05	1.5	1.04	1.1	.53	.55	52.4	52.7	OM56 0
4	7060	1798	-.43	.03	1.15	3.9	1.16	4.1	.46	.55	47.5	51.0	SI6 0
40	6991	1799	-.46	.03	1.28	7.5	1.41	9.9	.42	.56	45.6	49.3	CM47 0
36	6918	1798	-.54	.03	1.19	5.3	1.19	5.2	.46	.56	47.4	50.6	G43 0
65	6904	1797	-.58	.03	1.09	2.7	1.09	2.6	.49	.55	49.6	53.0	W73 0
48	6591	1800	-.60	.03	1.04	1.3	1.04	1.1	.52	.54	54.9	53.7	OM55 0
39	6775	1799	-.61	.03	1.09	2.6	1.08	2.4	.51	.56	49.8	51.1	CM46 0
35	7188	1800	-.65	.03	1.22	5.8	1.22	5.5	.44	.54	46.8	51.5	G42 0
34	7128	1799	-.67	.03	1.13	3.6	1.14	3.7	.46	.54	48.6	52.4	G41 0
37	7253	1800	-.87	.03	1.12	3.4	1.12	3.3	.47	.54	48.1	52.0	G44 0

Conclusion

By using the Rasch measurement model, researchers have obtained high reliability value to the reliability test. Reliability test and respondents also indicates that the set of the questionairre is valid and reliable to measure competitiveness. The findings have answered the posibilities designed to examine the suitability of the items in the competitiveness instrument. The item reliability is high and this means the item is stable. Separation index for the level difficulty exceed the value of 2 and is strongly accepted. Separation index indicates all constructs range between 2 and 55 and exceeded 2 which is the acceptable value. All PTMEA shows positive value. This shows that all the items used are parallel to the measurement of competitiveness scale and correlation between constructs to be tested. In examining the fit statistics, the outfit and infit MNSQ statistics used the range of 0.80 to 1.41 for quality control purposes. A total of 65 item are found to be fit and one item should be improve. This indicates that intervention must be done to check on the problems or weaknesses of the item. Item CM47 need to revised before developing the new version of competitiveness scale. Whereas there are no mismatch of items and all items fit respondents found during the process of data analysis.

Biography of the authors

Norasmah binti Othman is an Associate Professor at the Department of Leadership and Educational Policy in the Faculty of Education, Universiti Kebangsaan Malaysia, Malaysia. She had published 30 journals, 29 proceeding and edited two books namely Entrepreneurship- Catalyst of an Excellent Nation and Life's Sustainability; and Entrepreneurship and People with Disabilities. Her research interests include entrepreneurship education; evaluation and management of human resources; and evaluation of training programs.

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