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Research paper

Analyzing Validity and Reliability of Malaysian Building Surveyor Graduates Competency - Model Survey Instrument using the Rasch Measurement Model

Siti Hamidah Husain[1], Haryanti Mohd Affandi[2*], Adi Irfan Che-Ani[1], Nurfaradilla Mohamad Nasri[3]

[1]*Department of Architecture, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*

[2]*Department of Teaching and Learning Innovation, Faculty of Education, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*

[3]*Department of Education Leadership and Policy, Faculty of Education, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia*

**Corresponding author E-mail: haryantima@ukm.edu.my*

Abstract

The competency assessment instrument is a newly developed standard guideline for Malaysian building surveyor graduates in assessing their competency. In developing this competency assessment, researchers used a form of instrument survey in identifying the required competency domains for Malaysian building surveyor graduates. This study was conducted to examine the validity and reliability of the item contained in this competency assessment instrument. The instrument was designed using a 4 Likert scale was employed for data collection process which consists of 48 items with seven constructs representing non-technical competency domains. Meanwhile, 155 items with 14 constructs representing technical competency domains. A total of 56 building surveyor practitioners participated in this study. The results obtained were analyzed using the Rasch measurement model with a WinSteps version 3.73 to examine the item and person reliability. Additionally, the item measure quality was assessed by analyzing the PTMea Corr, infit and outfit MNSQ and ZSTD values to examine the construct validity. The results showed that the reliability of instrument items was 0.76 and the person reliability index was 0.93 which show that this instrument is reliable and acceptable with a high level of consistency for measuring the competence domains required from building surveyor graduates. While all the PTMEA Corr is in positive values which show that the item can differentiate the ability of the respondent. The final result relieved that out of 203 items, 13 items suggested being eliminated and revealed 190 items that are suitable to measure the 21 constructs in this competency assessment instrument.

Keywords: *Non-technical competence; technical competence; building surveyor graduates; Malaysian building surveyor; Rasch measurement model.*

1. Introduction

Building surveyors are the trained professionals who fulfil varied services for the built environment industry [1]. In Malaysia practice, this profession offered the comprehensive services to support the building control and compliance [2, 3], physical development and management, construction quality, the building physical condition [2], and maintenance, repair and restoration aspects for the new and existing buildings [4]. Therefore, in delivering the variety of services accordingly with the specific roles and tasks, the building surveyor professionals need to have appropriate competence elements. In addition, a competent building surveyor is expected to deliver input services in contributing to a better sustainable building quality and enhancing living standards. Therefore, the newly competency assessment was developed for Malaysian building surveyor graduates as a systematic guideline in assessing the graduate's competency.

Consequently, there are a few steps in testing the research instrument namely validity test and reliability test. In assessing the validity of the research instrument, three main approaches usually used namely face validity, content validity, and construct validity [5, 6, 7]. This testing is essential to establish the content validity of an instrument with aims to improve questions, format, and scales [8]. Besides, in assessing the reliability of research instruments, researchers can conduct a pilot test to pre-testing the research instrument to find out if the instrument fulfills all that is required [6]. Therefore, to ensure the quality of data and research instrument, this study was performed to produce the empirical evidence in measuring validity and reliability of items in competency assessment instrument for Malaysian building surveyor graduates using the Rasch measurement model.

The Rasch measurement model is a psychometric technique to improve the precision with which researchers construct instruments, monitor instrument quality, and compute respondents' performances [9]. It provides a technique for obtaining insight into how the data cooperate to construct measures [10] and for converting raw observational data into item difficulty and person ability estimates on an approximately linear measurement scale [11]. Thus, in measuring the quantitative data for this research, the Rasch measurement model which assists with the WinSteps computer program version 3.73 has been applied to examine the validity and reliability of the constructs and items developed in the competency assessment instrument for Malaysian building surveyor graduates.

2. Methodology

This study is conducted using a quantitative research approach by using a survey technique with a set of questionnaire adapted from the six graduates' attributes under the Student Aspirations in the Malaysia Education Blueprint (MEB) 2015–2025 (Higher Education) [12] and the eight domains of learning outcomes listed in the Malaysia Qualifications Frameworks (MQF) [13] for the non-technical competency domains. While, the technical competency domains was developed with adaptation from the unpublished document from Royal Institute Surveyor Malaysia (RISM) [14, 15, 16], the Royal Institution of Chartered Surveyors Assessment of Professional Competence (RICS APC) document [17] and RISM rules and guide document [18]. In ensure the quality of items for this research instrument is valid and reliable, the constructs and items developed were validated by seven expert panels in building surveying for face and content validity, two panels for language validity and two panels for measurement validity. The input from that procedure was used to revise and refine the items. The final constructs and items retained and used for this competency assessment instrument after experts verified as shown in Table 1.

The question structure chooses for this study is closed-ended questions with applied the four-point Likert scales format which required respondents to circle an agreement to the items ranging from 1 (very unimportant), 2 (unimportant), 3 (important) and 4 (very important). The four-point Likert scales format to be applied for this study because researchers believe that the use of the Likert scale that with or without midpoints are acceptable and it may not affect the reliability [19]. Similarly, the Likert scale six-points (no midpoints) tend to give the discriminating and reliability values which are higher than scale five-points with midpoints [20]. In additional, as referred to the [21] and [22] studies which previously examines the comparison on response style regarding the use of rating scales among East Asian and North American, and Asians and Asian Americans respectively, it relieves that Asian respondents were more likely to choose the midpoint of a Likert scale item than Americans respondents [21, 22].

Furthermore, a total of 56 building surveyor practitioners participated as a sample for this study, which selected based on the random/probability selected among building surveyors professional who are registered with the Building Surveying Division, RISM. The selection of 56 respondent as a minimum sample size for pilot test in this research is based on the suggestion from the previous studies with mention that the sample size for pre-test is normally ranging from 15 to 30 respondents [23], 12 is satisfactory [24], whereas [25] and [26] suggested a range of 10 to 30 participants for pilots in survey research is adequate. Again, in processing the information data for this research, the statistical analysis procedure was applied with the assistance of the Rasch measurement model using a Winstep software version 3.73.

Table. 1: Finalization of construct and items in competency assessment instrument after face and content validity

Construct	Item Before Validity	Item Retained After Validity
Non-Technical Competency Domains		
1. Communication Skills (CS)	10	10
2. Information Management and Lifelong Learning Skills (IMLLS)	7	7
3. Managerial and Entrepreneurial Skills (MES)	4	4
4. Teamwork Skills (TwS)	8	8
5. Thinking Skills (TS)	9	9
6. Value, Ethics and Professionalism (VEP)	5	5
7. Leadership Skills (LS)	5	5
Sub Total	48	48
Technical Competency Domains		
1. Building Inspection (BI)	12	10
2. Building Maintenance and Management (BMM)	15	12
3. Conservation and Restoration (CR)	15	15
4. Building Control Administration (BCA)	15	11
5. Risk Management and Building Audit (RMB)	12	10
6. Building Works and Quality Management (BWQM)	13	11
7. Development and Construction Management (DCM)	18	14
8. Building Insurance (BuI)	17	15
9. Building Information Modelling (BIM) Management	12	12
10. Health and Safety (HS)	8	7
11. Building Pathology (BP)	8	8
12. Conflict Avoidance, Management and Dispute Resolution Procedures (CAMD)	7	6
13. Fire Safety (FS)	13	12
14. Sustainability (SuS)	12	12
Sub Total	177	155
Total Items	**225**	**203**

3. Results and Discussion

Through Rasch measurement model approach, the discussion of finding will be divided into two parts which are reliability and separation index, and item measure quality by analyzing the PTMea Corr, and infit and outfit MNSQ and ZSTD values in order to examine the construct validity.

3.1 Reliability and Separation Index

In assessing the instrument reliability and separation index for this instrument, the rating scale instrument quality criteria [27] as shown in Table 2 is referred. Similarly, [28] and [29] mention that for the Cronbach's Alpha value indicator, the reliability coefficient must range from 0.0 to 1.0, which indicates that the closer to 1, the more reliable the scale of the variable and research instrument [29, 30]. In addition, the person separation value in summary statistics indicates how well the test is successful in identifying differences in each person's ability, while, item separation values indicate how well the items are consistent and would be reproduced with another sample of test takers in terms of the relative order of item difficulty [31].

Table. 2: The summary of rating scale instrument quality criteria

Criterion	Poor	Fair	Good	Very Good	Excellent
Person and Item Measurement Reliability	<.67	.67-.80	.81-.90	.91-.94	> .94
Person and Item Strata Separated	2 or less	2-3	3-4	4-5	> 5

The summary statistics result as shown in Table 3 revealed that the Cronbach Alpha (α) value is 0.99, which is reliable and acceptable with a high level of consistency for the instrument in measuring the competence domains required from building surveyor graduates. This higher Cronbach Alpha value shows instrument used is in excellent condition and effectively with the high level of consistency and is accepted to be used for the real

study. Table 3 showed "Very Good" reliability for person reliability and "Fair" reliability for item reliability.

The person reliability is considerably very good at 0.93 which means that the respondents are very high reliability and stronger acceptable, and the instrument can differentiate the person's ability in identifying the competencies required from building surveyor graduates. Meanwhile, the item reliability is considerably fair at 0.76 which shows that the instrument has fair reliability in measuring what it needs to measure. Thus, the competency assessment instrument outlined is appropriate and effective in measuring the competencies required from building surveyor graduates.

As suggested by [27, 32], the accepted strata separation value for item and person should exceed 2.0, with higher values of separation, indicated the greater spread of items and person along with a continuum. Based on Table 3, the number of person strata separation is 3.75 when rounded off is equal to 4.0, which means that the person separation value is considerably good. This result indicates that the sample of 56 building surveyor practitioners can be separated into four requirement group. Meanwhile, the number of item strata separation is 1.78 when rounded off is equal to 2.0 which indicates that the competence items can be separated into two important levels.

Table. 3: Reliability and separation index for item and person

SUMMARY OF 56 MEASURED (EXTREME AND NON-EXTREME) PERSON

	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	716.9	203.0	4.02	.38				
S.D.	68.8	.0	2.63	.56				
MAX.	812.0	203.0	9.79	1.82				
MIN.	550.0	203.0	.13	.12	.11	-9.9	.10	-9.9
REAL RMSE	.68	TRUE SD	2.54	SEPARATION	3.75	PERSON RELIABILITY		.93
MODEL RMSE	.68	TRUE SD	2.54	SEPARATION	3.76	PERSON RELIABILITY		.93
S.E. OF PERSON MEAN = .35								

PERSON RAW SCORE-TO-MEASURE CORRELATION = .89

CRONBACH ALPHA (KR-20) PERSON RAW SCORE "TEST" RELIABILITY = .99

SUMMARY OF 203 MEASURED (NON-EXTREME) ITEM

	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	197.8	56.0	.00	.31	1.00	.0	1.01	.1
S.D.	6.9	.0	.66	.02	.21	1.0	.44	.9
MAX.	213.0	56.0	1.36	.38	1.63	2.8	5.63	6.3
MIN.	182.0	56.0	-1.66	.28	.48	-3.0	.46	-2.3
REAL RMSE	.32	TRUE SD	.57	SEPARATION	1.78	ITEM	RELIABILITY	.76
MODEL RMSE	.31	TRUE SD	.58	SEPARATION	1.87	ITEM	RELIABILITY	.78
S.E. OF ITEM MEAN = .05								

3.2 Item Measure Quality

In order to examine the construct validity, the Point Measure Correlation (PtMea Corr), infit and outfit mean square fit (MNSQ) and Z-standard (ZSTD) statistics can be referred to examine the validity of the instrument. Therefore, in assessing the item measure quality and construct validity for this instrument, the misfit pattern consideration as shown in Table 4 were referred as a benchmark to check for any outliers or misfits items. In assessing the polarity item table, the positive value of PtMea Corr will be the indicator for the construct to be valid. [32] mentions that researchers need to check all items are aligned in the same direction on the latent variable, and all item should appear in the positive correlation. Additionally, the negative value indicates that the relationships for response item or person are contradicted with the developed constructs [32], and thus not developed to measure any construct [10] and that item was only weakly correlated with an increasing person's ability estimate [31].

According to [10], an accepted correlation value (PtMea Corr value) is between 0.20 and 0.79 and any item with a negative (-) value and below 0.20 must be rejected because the item is not developed to measure any construct.

Table. 4: Misfit pattern consideration

Criterion	Acceptable Rating Scale	Literature Support
PtMea Corr	0.2 < PtMea Corr value < 0.79	[10]
	0.4 < PtMea Corr value < 0.85	[33]
Outfit MNSQ	0.5 < MNSQ value < 1.5	[33]
	0.6 < MNSQ value < 1.4	[34]
Outfit ZSTD	-2.0 < ZSTD value < +2.0	[33]

Furthermore, in order to examine the misfits items, researchers can report the mean-square statistics (MNSQ) and Z-standard (ZSTD) statistics value. It means, the MNSQ analyses the fit of response sets, while outfit ZSTD tests the significance of a particular MNSQ value [21]. Item misfit normally caused by the human carelessness that occurs when items are too difficult to be answered and when a high ability respondent fails to answer an easy item respectively [28] or might occur when respondents see the items measure the same construct [35]. According to [33], this three indicators, (the PTMea Corr column, MNSQ column, and ZSTD column) must be fulfilled when considering outliers or misfits data. Similarly, if the outfit and infit MNSQ be accepted, the ZSTD value index can be ignored [32]. Therefore, for the purpose of this research, the researcher focused on the outfit columns and any misfits items that not met the condition of outfit 0.5 < MNSQ value < 1.5 [33] and/or outfit -2.0 < ZSTD value < +2.0 [33] can be considered to be eliminated from the instrument list or having purified.

Table 5 shows the value of PtMea Corr, MNSQ and ZSTD values in the competency assessment instrument generated by Rasch analysis. The result from Table 5 shows every item have positive (+) PtMea Corr and no negative (-) correlation was found. It shows that each PtMea Corr value for this research instrument is in the range of 0.32 to 0.75, which consider as accepted correlation value because all items meet the range of PT-Measure, which are between 0.2 < PtMea Corr value < 0.79 [10] or 0.4 < PtMea Corr value < 0.85 [33]. Therefore, it can be concluded that the entire entry items in this competency instrument meet all the criteria as the quality instrument and thus no revision is required.

Table 6 shows the list of misfit items that need to be addressed in the competency assessment instrument as generated by Rasch analysis. The data consists in Table 6 was generated from Table 5 which refer to the outfit MNSQ value and outfit ZSTD value of each item and respondents. The analysis in Table 6 showed that the outfit MNSQ item is 0.46 to 5.63 and outfit ZSTD item is -2.3 to 6.3 for all constructs. Therefore, it can be concluded that there are at least 13 items (8 items from non-technical domains and 5 items from technical domains) not in the specific range of value and it should be purified or consider to be removed as showed in Table 6.

There are three items removed from the construct Value, ethics and professionalism (VEP03, VEP04 and VEP05), two items removed from the Communication skills (CS07 and CS09), while one item from Managerial and entrepreneurial skills (MES04), Thinking skill (TS04), Leadership skills (LS01), Building inspection (BI05), Building maintenance and management (BMM11), Building control administration (BCA10), Development and construction management (DCM05), and Building information modelling (BIM12). Meanwhile, for the IMLLS, TwS, CR, RMB, BWQM, BuI, HS, BP, CAMD, FS, and SuS constructs, no items that needs to be removed as the outfit MNSQ value and outfit ZSTD value is in the range of 0.5 to 1.5 and -2.0 to +2.0 respectively as proposed by [33].

Table. 5: Item measure quality by analyzing the point-measure PTMea Corr, outfit MNSQ and outfit ZSTD values

ENTRY NUMBER	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD	PT-MEASURE CORR.	PT-MEASURE EXP.	ITEM
44	1.32	1.6	5.63	6.3	A .45	.55	LS01
53	1.10	.5	2.56	2.4	B .32	.40	BI05
42	1.19	1.0	2.43	2.6	C .45	.52	VEP04
43	1.11	.6	2.03	2.0	D .51	.52	VEP05
41	1.04	.3	1.92	2.0	E .51	.55	VEP03
122	1.61	2.6	1.66	1.9	F .49	.60	DCM05
95	1.63	2.8	1.56	1.4	G .48	.54	BCA10
9	1.43	1.8	1.60	1.9	H .51	.63	CS09

33	1.28	1.4	1.59	1.3	I .42	.51	TS04
21	1.33	1.6	1.56	1.5	J .46	.57	MES04
34	1.51	2.3	1.31	.8	K .43	.51	TS05
69	1.06	.4	1.51	1.2	L .49	.53	BMM11
7	1.14	.8	1.51	1.3	M .48	.55	CS07
30	1.51	2.2	1.18	.5	N .41	.47	TS01
23	1.16	.9	1.49	1.1	O .45	.51	TwS02
10	1.46	2.1	1.49	1.2	P .39	.48	CS10
82	1.49	2.2	1.39	1.2	Q .54	.59	CR12
94	1.46	2.1	1.33	.9	R .49	.53	BCA09
125	1.42	1.8	1.43	1.4	S .55	.63	DCM08
56	1.38	1.6	1.40	.9	T .35	.43	BI08
20	1.19	1.0	1.40	1.2	U .55	.60	MES03
1	1.39	1.7	1.26	.7	V .32	.43	CS01
63	1.19	1.0	1.36	1.1	W .54	.58	BMM05
64	1.18	.9	1.35	.9	X .44	.50	BMM06
78	1.32	1.5	1.23	.8	Y .56	.59	CR08
25	1.13	.7	1.31	.8	Z .48	.53	TwS04
50	1.20	1.0	1.31	.8	.39	.47	BI02
89	1.30	1.4	1.16	.5	.45	.47	BCA04
123	1.29	1.3	1.25	.9	.58	.62	DCM06
126	1.28	1.3	1.22	.8	.60	.62	DCM09
93	1.27	1.3	1.12	.4	.44	.45	BCA08
16	1.13	.7	1.27	.8	.48	.53	IMLLS06
80	1.25	1.3	1.17	.6	.54	.57	CR10
167	1.24	1.2	1.16	.5	.38	.46	BP02
19	1.06	.4	1.24	.8	.58	.59	MES02
110	1.24	1.1	1.20	.7	.58	.61	BWQM04
81	1.24	1.2	1.16	.5	.53	.56	CR11
77	1.22	1.1	1.18	.6	.52	.56	CR07
72	1.22	1.1	1.09	.3	.44	.50	CR02
135	1.21	1.1	1.10	.4	.49	.53	BuI04
48	1.12	.7	1.21	.6	.51	.54	LS05
139	1.21	1.0	1.17	.7	.58	.63	BuI08
160	1.20	1.0	1.10	.4	.54	.55	HS02
BETTER FITTING OMITTED							
98	.95	-.2	.77	-.4	.46	.45	RMB02
176	.80	-1.0	.94	.0	.59	.56	CAMD03
116	.90	-.4	.77	-.4	.48	.46	BWQM10
190	.90	-.5	.79	-.4	.56	.52	FS11
186	.89	-.5	.79	-.4	.55	.50	FS07
91	.86	-.6	.77	-.4	.50	.47	BCA06
159	.86	-.7	.78	-.4	.51	.49	HS01
115	.86	-.7	.79	-.5	.60	.56	BWQM09
194	.85	-.7	.77	-.5	.57	.54	SuS03
70	.85	-.8	.73	-.6	.58	.53	BMM12
185	.85	-.7	.77	-.4	.56	.50	FS06
180	.84	-.7	.73	-.6	.52	.47	FS01
87	.83	-.8	.74	-.5	.48	.45	BCA02
3	.83	-.8	.77	-.4	.53	.50	CS03
189	.83	-.9	.73	-.5	.58	.52	FS10
112	.82	-.9	.77	-.5	.57	.54	BWQM06
138	.82	-.9	.79	-.6	.62	.60	BuI07
184	.82	-.9	.74	-.5	.54	.49	FS05
201	.82	-1.0	.76	-.5	.58	.54	SuS10
143	.81	-1.0	.73	-.6	.59	.55	BuI12
195	.81	-1.0	.75	-.7	.60	.57	SuS04
31	.81	-1.0	.67	-.7	.57	.52	TS02
97	.80	-1.0	.70	-.7	.61	.53	RMB01
83	.80	-1.0	.77	-.4	.54	.51	CR13
26	.80	-1.1	.74	-.6	.59	.54	TwS05
141	.80	-1.0	.75	-.7	.62	.59	BuI10
99	.78	-1.1	.67	-.7	.56	.50	RMB03
129	.78	-1.1	.77	-.8	.65	.61	DCM12
202	.77	-1.2	.72	-.6	z .57	.52	SuS11
200	.77	-1.2	.70	-.8	y .61	.56	SuS09
120	.75	-1.3	.70	-.8	x .59	.55	DCM03
58	.75	-1.3	.70	-.7	w .59	.55	BI10
193	.75	-1.3	.65	-.8	v .56	.51	SuS02
17	.74	-1.4	.67	-.7	u .57	.52	IMLLS07
183	.74	-1.4	.64	-.8	t .55	.49	FS04
102	.73	-1.4	.70	-1.0	s .67	.61	RMB06
136	.73	-1.4	.67	-1.2	r .67	.62	BuI05
151	.72	-1.3	.72	-1.1	q .72	.65	BIM05
15	.71	-1.6	.65	-.9	p .60	.54	IMLLS05
192	.71	-1.6	.62	-.9	o .57	.50	SuS01
156	.70	-1.4	.71	-1.1	n .71	.65	BIM10
182	.70	-1.7	.65	-.8	m .59	.52	FS03
146	.68	-1.8	.63	-1.2	l .64	.58	BuI15
149	.68	-1.7	.66	-1.2	k .69	.62	BIM03
8	.68	-1.8	.62	-1.0	j .62	.54	CS08
22	.68	-1.7	.57	-1.1	i .54	.46	TwS01
150	.67	-1.7	.66	-1.3	h .70	.63	BIM04
203	.62	-2.2	.56	-1.1	g .61	.52	SuS12
154	.61	-2.1	.60	-1.5	f .71	.63	BIM08
153	.61	-2.1	.61	-1.5	e .71	.63	BIM07
137	.60	-2.2	.57	-1.7	d .71	.62	BuI06
152	.58	-2.3	.56	-1.7	c .72	.63	BIM06
157	.56	-2.3	.55	-1.9	b .74	.65	BIM11
158	.48	-3.0	.46	-2.3	a .75	.64	BIM12

Table. 6: List of misfit items that need to be addressed based on the PtMea Corr, outfit of MNSQ and ZSTD value for the item of the instrument

Constructs	Item Misfit	Removed the items proposed			Total Item	Item Omit	Permanent Items
		PtMea Corr	Outfit				
			MNSQ	ZSTD			
Non-technical			0.5 < x < 1.5	-2.0 < x < +2.0			
CS	CS07	0.48	1.51	-	10	2	8
	CS09	0.51	1.60	-			
IMLLS	-	-	-	-	7	-	7
MES	MES04	0.46	1.56	-	4	1	3
TwS	-	-	-	-	8	-	8
TS	TS04	0.42	1.59	-	9	1	8
VEP	VEP03	0.51	1.92	-	5	3	2
	VEP04	0.45	2.43	2.6			
	VEP05	0.51	2.03	-			
LS	LS01	0.45	5.63	6.3	5	1	4
Technical							
BI	BI05	0.32	2.56	2.4	10	1	9
BMM	BMM11	0.49	1.51	-	12	1	11
CR	-	-	-	-	15	-	15
BCA	BCA10	0.48	1.56	-	11	1	10
RMB	-	-	-	-	10	-	10
BWQM	-	-	-	-	11	-	11
DCM	DCM05	0.49	1.66	-	14	1	13
BuI	-	-	-	-	15	-	15
BIM	BIM12	0.75	0.46	-2.3	12	1	11
HS	-	-	-	-	7	-	7
BP	-	-	-	-	8	-	8
CAMD	-	-	-	-	6	-	6
FS	-	-	-	-	12	-	12
SuS	-	-	-	-	12	-	12
				Total Items	**203**	**13**	**190**

4. Conclusion

Through the findings of this study, by using the Rasch measurement model, researchers have obtained empirical evidence of the validity and reliability of the developed items for this competency assessment instrument. This means high reliability and validity value indicate that this developed set of the assessment instrument is valid and reliable to measure the competence required by Malaysian building surveyor graduates. Based on this study, this instrument is fit and acceptable to be used for real data collection and real study, which needs some improvement as referred to the result of the study. Additionally, the findings of this study support previous research that building surveying students need to be trained and educated in a broad range of skills which are adaptable and flexible with the industry requirement, and thus bridging a gap in the mismatch in supply and demand of the graduates' skills. Therefore, it would be fruitful to pursue further research in establishing and developing the competency model for Malaysian building surveyor graduates, thus helping the entry-level building surveyors in developing and maintaining a proper level of their competence and professionalism as required by the industry. Researchers hope this study at least can establish early consciousness among graduates, building surveying community, and Higher Learning Institutions (HLIs) about the needs of the competency model for the building surveying professional practices.

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References

[1] Royal Institution of Chartered Surveyors (RICS), "The Chartered Building Surveyor's portfolio." Royal Institution of Chartered Surveyors, United Kingdom, pp. 1–2, 2008.

[2] A. S. Ali and C. J. Woon, "Training and Development of Building Surveyors in Malaysia," *RICS COBRA*, pp. 777–785, 2012.

[3] A. I. Che-Ani, "The roles and involvement of building surveyors in the Malaysian building industry." Royal Institution of Surveyors Malaysia (RISM), Malaysia, pp. 1–23, 2013.

[4] N. Ahzahar, N. A. Kayat, I. B. Zakaria, and S. Z. Hashim, "Women in Building Survey," *Int. Acad. Res. J. Soc. Sci.*, vol. 1, no. 2, pp. 95–100, 2015.

[5] R. Heale and A. Twycross, "Validity and reliability in quantitative studies," *Evid Based Nurs*, vol. 18, no. 3, pp. 66–67, 2015.

[6] B. Taylor, G. Sinha, and T. Ghoshal, *Research methodology: A guide for researchers in management & social sciences*. New Delhi: PHI Learning Private Limited, 2009.

[7] D. Muijs, *Doing Quantitative Research in Education with SPSS*, 2nd ed. SAGE, 2011.

[8] J. W. Creswell, *Research Design: Qualitative, Quantitative and Mixed Approaches (3rd Edition)*. 2009.

[9] W. J. Boone, "Rasch Analysis for Instrument Development: Why, When, and How?," *Cell Biol. Educ.*, vol. 15, no. 4, p. rm4-rm4, 2016.

[10] J. M. Linacre, "Optimizing Rating Scale Category Effectiveness," *J. Appl. Meas.*, vol. 3, no. 1, pp. 85–106, 2002.

[11] T. Pelton, "Where Are the Limits To the Rasch Advantage?," 2002.

[12] Ministry of Education Malaysia (MoE), "Malaysia Education Blueprint 2015-2025 (Higher Education)," Malaysia, 2015.

[13] Malaysian Qualifications Agency (MQA), "Malaysian Qualifications Framework: Point of reference and joint understanding of higher education qualifications in Malaysia," Malaysia, 2009.

[14] B. S. D. RISM, "Draft Cadangan Pindaan Akta Pendaftaran Jurutera 1967," no. 6. pp. 2012–2013, 2013.

[15] B. S. D. RISM, "Permohonan Rang Undang-Undang/Akta Juruukur Bangunan (BS)." unpublished, Malaysia, 2011.

[16] B. S. D. RISM, "Perkembangan Dan Pengiktirafan Jawatan Juruukur Bangunan Di JKR Dan Kepentingan Peranan Juruukur Bangunan." unpublished, Malaysia, pp. 1–8, 2016.

[17] Royal Institution of Chartered Surveyors RICS, "Assessment of Professional Competence: Building Surveying," United Kingdom, 2015.

[18] Royal Institution of Surveyor Malaysia RISM, "Rules and guide to the test of professional competence for building surveyors." Royal Institution of Surveyor Malaysia, Malaysia, p. 28, 1995.

[19] K. K. Tsang, "The use of midpoint on Likert Scale: The implications for educational research," *Hong Kong Teach. Cent. J.*, vol. 11, pp. 121–130, 2012.

[20] R. Garland, "The Mid-Point on a Rating Scale: Is it desirable?," *Mark. Bull.*, vol. 2, no. 3, pp. 66–70, 1991.

[21] C. Chen, S. Y. Lee, and H. W. Stevenson, "Response style and cross-cultural comparisons of rating scales among East Asian and North American students," *Psychol. Sci.*, vol. 6, no. 3, pp. 170–175, 1995.

[22] J. W. Lee, P. S. Jones, Y. Mineyama, and X. E. Zhang, "Cultural Differences in Responses to a Likert Scale," pp. 295–306, 2002.

[23] N. K. Malhotra, J. Hall, M. Shaw, and P. Oppenheim, *Essentials of Marketing Research: An Applied Orientation*, 2nd ed. Pearson Education Australia, 2008.

[24] R. Ferber and P. J. Verdoorn, *Research Methods in Economics and Business*, 1st ed. Collier Macmillan Ltd, 1962.

[25] S. Isaac and W. B. Michael, *Handbook in Research and Evaluation: A Collection of Principles, Methods, and Strategies Useful in the Planning, Design, and Evaluation of Studies in Education and the Behavioral Sciences*, 3rd ed. EdITS, 1995.

[26] R. Hill, "What sample size is 'enough' in internet survey research?," *An Electron. J. 21st Century*, vol. 6, no. 3–4, pp. 1–10, 1998.

[27] W. P. J. Fisher, "Rating Scale Instrument Quality Criteria," *Trans. Rasch Meas. SIG Am. Educ. Res. Assoc.*, vol. 21, no. 1, p. 1095, 2007.

[28] B. D. Wright and M. H. Stone, *Measurement Essentials*, 2nd ed. Wide Range Inc, 1999.

[29] G. LoBiondo-Wood and J. Haber, *Nursing Research - E-Book: Methods and Critical Appraisal for Evidence-Based Practice*, 9th ed. Elsevier Health Sciences, 2017.

[30] Mohd Rafi Yaacob, *PASW (SPSS) Statistics 18: For Business and Social Science Students*, 1st ed. Malaysia: Eduserve Resources, 2011.

[31] M. Miyata, "A Rasch analysis of the ELI listening placement test.," 2007.

[32] J. M. Linacre, *A User's Guide to WINSTEPS/MINISTEP Rasch-Model Computer Programs (3.91.0)*. 2006.

[33] A. A. Aziz, *Rasch Model Fundamentals: Scale Construct and Measurement Structure*, 1st ed. Advance Planning Sdn Bhd, 2010.

[34] T. G. Bond and C. M. Fox, *Applying the Rasch Model: Fundamental Measurement in the Human Sciences*. New Jersey, London: Lawrence Erlbaum Associates, 2007.

[35] A. A. Aziz, M. S. Masodi, and A. Zaharim, *Asas Model Pengukuran Rasch: Pembentukan Skala & Struktur Pengukuran*, Cetakan Pe. Malaysia: Universiti Kebangsaan Malaysia, 2013.