Psychometric assessment on Adversity Quotient instrument (IKBAR) among polytechnic students using Rasch model

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***Abstract*—**The lack of psychometric testing empirical evidences among the Adversity Quotient (AQ) instrument became a major problem in the aspect of its application. AQ measurement instrument in the context of polytechnic students or IKBAR whom were tested using the Rasch model is believed to be able in increasing their validity and reliability of the items. The objective of this paper is to identify the potential items developed in measuring polytechnic students'AQ. Rasch model was used to study three main assumptions such as item fit, unidimensionality, and local independence. The results showed that the IKBAR items have met with all the main assumptions of Rasch model in measuring the AQ of polytechnic students in Malaysia.

***Keywords*—**Adversity quotient, IKBAR, Rasch model, instrument development.

I. Introduction

ONE of the 18 Critical Agenda Projects (CAP) in the National Higher Education Strategic Plan (2011-2015) is the Polytechnic Transformation [1]. This transformation aims to improve the highly skilled workforce from 23 to 37% by year 2015 [2]. This shift is in line with the current educational situation that is increasingly more challenging. It requires manpower to be more resilient and in competitive spirit [3]. Since more than 25 years ago, National Education Philosophy is seen only as emphasizing the dominant intelligence such as IQ, EQ, and SQ alone. Now, it is time for Malaysia to explore the potential intelligence in producing a student whom are able to handle challenges and that is the Adversity Quotient (AQ). AQ was introduced by Paul G. Stoltz in 1997 with four constructs, namely Control, Ownership, Reach, and Endurance [4]. The idea of AQ was generated when questions arise about how different individuals with the same IQ have responded in different ways to the challenges faced. As each individual has different AQ, the development of AQ instrument will help identify students whom are not able to meet the challenges so that they can be given guidance. The main question that arises is on the inconsistencies of AQ items in different contexts. Measurement instrument from the west and several of countries is not suitable for use in Malaysia. In fact, the challenges faced by each individual from various countries, institutions, and levels of schooling are not the same. Therefore, a total of 220 items are developed from the combined results of 55 challenges and AQ conceptualization which left the remaining 112 items after going through the first pilot test. This study will focus on the actual research or verification phase to identify the final items that best meet the needs of Rasch model. The literature shows many previous researchers questioning the psychometric issues due to the use of original instruments, new instruments, and adaptation of instruments in their studies [5]–[7]. Thus, the research gap can be addressed through psychometric feature testing on the development of IKBAR items through solid empirical analysis such as the Rasch model. The Rasch model has certainly gather the attention of many researchers within the country and abroad to validate the item on their instruments development [8]–[11]. This paper focuses on the validity and reliability of measuring IKBAR through three main assumptions of Rasch model, namely item fit, unidimensionality, and local independence. The main idea behind this research is to identify the weak students from the AQ aspect to be guided by counselors and educators in order to achieve excellent academic performance. Sometimes students with high intellectual intelligence, high emotional, and high spiritual do not guarantee their ability to face the challenges in life and the environment at the polytechnics. Thus, the endorsement of item for each AQ construct with Rasch model is believed to be capable of improving the quality measurement of items.

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II. Rasch Model

A model parameter or Rasch model is easier to apply as compared to other models in Item Response Theory (2 parameter logistics, 3 parameter logistics, and 4 parameter logistics) in addition to its WINSTEPS software that is user-friendly [12]. This model only has difficulty parameter. The difficulty parameter is b parameter and has θ value corresponding to the inflection point on the Item Characteristic Curve. b is the location of the inflection point on the θ scale which has a 0.5 probability of correct responses on a scale of abilities. Rasch model sees the response of a

person as a probability to make the right choice. Decision-making process begins with an equal chance (50:50) and their ability will help them get the final result. The individual will decide to accept or reject the item [13]. Rasch Model combines the algorithm that specifies the expected probability of an item as *i* and individual capacity as *n* in the form of mathematical equations. The mathematical formula for the Rasch model is as follows [14]. The mathematical expression for the Rasch model is as per equation (1).

$$P(\theta) = \frac{e^{(B_n - D_i)}}{1 + e^{(B_n - D_i)}} \quad (1)$$

Equation (1) shows the value of *e* is Euler's constant logarithmic numbers of 2.7183, B_n is the students ability to answer IKBAR item, D_i is the difficulty level of IKBAR item, and P *(θ)* is the adversity quotient score. Therefore, the probability of possibility of a success is B_n - D_i.

III. Methodology

The research involved a total of 1,845 students out of a total of 18,828 in five polytechnics according to zone grouping, namely Politeknik Premier Ungku Omar *(PUO)* (West Zone), Politeknik Sultan Abdul Halim Mu'adzam Shah *(POLIMAS)* (North Zone), Politeknik Sultan Haji Ahmad Shah *(POLISAS)* (East Zone), Politeknik Port Dickson *(PPD)* (South Zone), and Politeknik Kuching Sarawak *(PKS)* (Borneo Zone). The sampling techniques used are the clustered multistage stratified proportional sampling. The proportion value is 10% for each strata as proposed [15]. A total of three strata were involved, namely the type of study programme, year of study, and gender. It is important for researchers to estimate the suitability of the TRI model to the data being used [16]. There are a few assumptions that must be met prior to Item Response Theory (IRT) being used. Researchers need to analyze the reliability and consistency of data [17], [18]. The first step is to identify items that do not meet the requirement of Rasch model (item fit) with MNSQ value or Zstd statistics for each item. Analysis should also be carried out to determine whether items are questioning two or more questions at one time (one-dimensional). Next, other analysis can also be carried out. In the context of this study, the three main assumptions described are item fit, unidimensionality, and local independence.

IV. Finding and Discussion

A. Return Rate

The return rate was around 97.52% and above the proposed determined rate of 75% [19]. A total of 1,845 instruments were successfully collected and filled up entirely by students out of 1,892 instruments that were distributed.

B. Item Fit

The first assumption of Rasch model, which is item fit, will be using the Infit – Outfit Mean Square Analysis (MNSQ) and Outfit Z standard (Zstd) that are capable of detecting whether the research data will show discrepancies with the Rasch model [16]. Fit statistics will help instrument developers to decide the suitability of an item [20]. The findings demonstrate the MNSQ value having recorded from 0.83 logits to 1.28 logits for all 220 items. This MNSQ value fulfills the quality measurement by taking the setting range of item fit in the range of 0.77 logits to 1.30 logits [21]. Zstd also shows the importance of data. It is a statistical fit of infit mean squared *t* standardized that estimates the theoretical mean and variance distribution. Zstd value of between - 2.0 to +2.0 are acceptable values [14]. Nonetheless, if MNSQ is received, the Zstd may be neglected [22]. Table 1 shows several examples of IKBAR item measurement value according to AQ construct. The item polarity value which is early detection to construct validity is also found to be ranging from 0.33 logits to 0.51 logits. The polarity indicates values positive value and exceeding 0.3 [14], [22], [23]. These values also fulfill the bi-serial point ranging value from 0.30 logits to 0.60 logits for a good test and prove that all items work towards a single sub construct measurement [14]. In addition, the Standard Error (SE) is found to be in the range of 0.04 to 0.05 for all 66 items. The SE value is important in demonstrating the accuracy in calculation [24]. This is because most statistical textbooks elaborate on statistical standard error of the mean and not on the standard error of measurement [22]. This range of error is below 0.25 is deemed as excellent [21].

C. Unidimensionality

The second assumption is that of unidimensionality, which means items moving towards measuring only a single construct. This unidimensionality assumption can be met with Rasch Principal Components Analysis (PCA). If this assumption is met, then the Item Response Theory can be used to test the psychometric properties of an instrument. There are four aspects studied on unidimensionality and those are the variance explanation of a residual PCA by contrast, the level of interference on items being measured or unexplained variants in a contrast, the compliance rate for the minimum ratio of 3.1 between the variance measurement, and the fourth is the Eigen value. PCA findings showed that gross variance as explained by measurement is 21.3% and is found to be very close to the expected model of about 21.5%. This value meets the instrument requirements by at least 20%, which has been achieved in consideration of Rasch most minimal requirements [25]. The second aspect is the level of interference on items being measured or unexplained variants in a contrast. The research has set the level of interference to the value of 3 to 5% and is deemed to be very good [21]. The level of interference on items being measured or an unexplained variant in a contrast recorded a 3.2% and is categorized as very good within the range of 3 to 5% [21]. Values less than 10% is evidence to the compliance on unidimensionality [26], [27]. The third aspect is the ratio of variance explained by measurement (21.3%) with the variance of the first principal component (4.1%) is 5.19:1 and exceeds the minimum ratio of 3:1 [28]. The fourth aspect is the Eigen values, set at less than 3 to show that the second dimension does not exist clearly [29]. The eigenvalue of 2.7 proved that the second dimension does not exist clearly in IKBAR.

Table 1. Examples of IKBAR Item Measurement According to AQ Construct

Entry number	Total Score	Count	Measure	Model S.E	Infit		Outfit		Point Measure		Exact	Match	Items
					MNSQ	Zstd	MNSQ	Zstd	Corr.	Exp	OBS%	EXP%	
6	6092	1845	-0.15	0.04	1.03	1.0	1.02	0.4	0.44	0.42	60.8	61.9	Q6-C
11	6039	1845	-0.06	0.04	1.01	0.2	1.05	1.4	0.40	0.42	62.9	61.9	Q11-C
21	6098	1845	-0.16	0.04	0.99	-0.2	0.99	-0.3	0.48	0.42	63.4	61.9	Q21-C
23	6241	1845	-0.41	0.04	0.97	-0.8	0.95	-1.3	0.46	0.41	64.8	62.0	Q23-C
27	5884	1845	0.19	0.04	0.95	-1.4	0.96	-1.1	0.42	0.44	63.2	62.1	Q27-C
29	6041	1845	-0.07	0.04	0.96	-1.1	0.96	-1.2	0.48	0.42	62.9	61.9	Q29-O
31	6116	1845	-0.19	0.04	1.01	0.3	1.06	1.7	0.45	0.42	62.3	61.8	Q31-O
38	5878	1845	0.20	0.04	0.98	-0.6	1.00	0.1	0.40	0.44	65.9	62.1	Q38-O
39	5881	1845	0.19	0.04	0.99	-0.4	0.99	-0.2	0.41	0.44	65.4	62.1	Q39-O
48	6004	1845	0.00	0.04	0.97	-0.8	0.98	-0.5	0.43	0.43	64.7	61.9	Q48-O
61	5997	1845	0.01	0.04	0.97	-0.7	1.03	0.9	0.41	0.43	64.4	62.0	Q61-R
65	5893	1845	0.17	0.04	0.96	-1.0	0.98	-0.5	0.44	0.44	63.7	62.0	Q65-R
77	5821	1845	0.29	0.04	1.01	0.3	1.03	0.8	0.42	0.44	63.1	62.2	Q77-R
79	5941	1845	0.10	0.04	1.01	0.3	1.02	0.5	0.47	0.43	64.9	62.0	Q79-R
83	5837	1845	0.26	0.04	0.99	-0.4	0.98	-0.5	0.47	0.44	63.2	62.2	Q83-R
97	6132	1845	-0.22	0.04	1.07	2.1	1.06	1.8	0.45	0.42	62.4	61.9	Q97-E
100	6303	1845	-0.53	0.04	0.97	-1.0	0.94	-1.9	0.48	0.40	65.7	62.1	Q100-E
104	6150	1845	-0.25	0.04	0.96	-1.2	0.95	-1.4	0.46	0.42	66.6	62.0	Q104-E
108	6110	1845	-0.18	0.04	0.98	-0.5	1.00	-0.1	0.44	0.42	63.0	61.9	Q108-E
111	5829	1845	0.27	0.04	0.94	-1.8	0.93	-1.9	0.47	0.44	64.0	62.2	Q111-E

Table 2. Standardized Residual Variance (in Eigenvalue units)

		Empirical		Modeled
Total raw variance in observations	83.9	100.0%		100.0%
Raw variance explained by measures	17.9	21.3%		21.5%
Raw variance explained by persons	7.3	8.7%		8.8%
Raw variance explained by items	10.5	12.6%		12.7%
Raw unexplained variance (total)	66.0	78.7%	100.0%	78.5%
Unexplained variance in 1st contrast	2.7	3.2%	4.1%	
Unexplained variance in 2nd contrast	2.6	3.2%	4.0%	
Unexplained variance in 3rd contrast	2.3	2.7%	3.5%	
Unexplained variance in 4th contrast	1.9	2.2%	2.9%	
Unexplained variance in 5th contrast	1.7	2.0%	2.6%	

D. Local Independence

The third assumption of the Rasch model is local independence. An item is said to have local independence when there is no correlation between residual items for possible pairing items. Correlation between unequal measure theoretically should be low [30]. This range meets the requirements of local independence, which is correlation values less than 0.30 [31]. The findings in Table 3 show ten items that have the standard correlation of residual values from 0.20 to 0.29. This shows that the response ability of an individual towards any item is not associated with the response of other items in the same construct [8]. There are a few pairing items that need to be refined and the pairs are (Q41 - Q74) and (Q40 - Q72) which are relatively dependent on one another even though from different constructs. However, the low correlation does not give any implication on the item.

Table 3. Standard Correlation of Residual Values

Correlation	Item Number	Constructs	Item Number	Constructs
0.29	Q90	Endurance	Q91	Endurance
0.25	Q41	Ownership	Q74	Reach
0.24	Q15	Control	Q18	Control
0.23	Q40	Ownership	Q72	Reach
0.23	Q34	Ownership	Q35	Ownership
0.22	Q97	Endurance	Q98	Endurance
0.21	Q72	Reach	Q73	Reach
0.21	Q28	Ownership	Q35	Ownership
0.20	Q6	Control	Q8	Control
0.20	Q41	Ownership	Q42	Ownership

E. Item – Person Map

Figure 1 shows the hierarchy of individual ability and item difficulty on a straight line where item Q34 (I am able to explain the reason as to why I am afraid to face the future) and

Q40 (I always try to increase the total hours of study time) are the most difficult item for respondents to agree whereas the easiest item for respondents to agree upon is item Q15 (I am certain there will be job opportunities anywhere). The logits value between +0.67 to -0.90 spread fulfilling the range of +3.00 to -3.00 is deemed good and sufficient (Andrich & Styles, 2004; Hill & Koekemoer, 2013; Linacre, 1994). IKBAR shows that there is no item that is able to test respondents with high AQ. The items developed can only measure the capabilities of students with moderate and weak AQ. The additional items on logits 0.67 until 6.38 can help so that the items can measure students with high AQ (high capability). Based on the Rasch model assumptions, a total of 66 IKBAR items satisfied all the main assumptions such as item fit, unidimensionality and local independence.

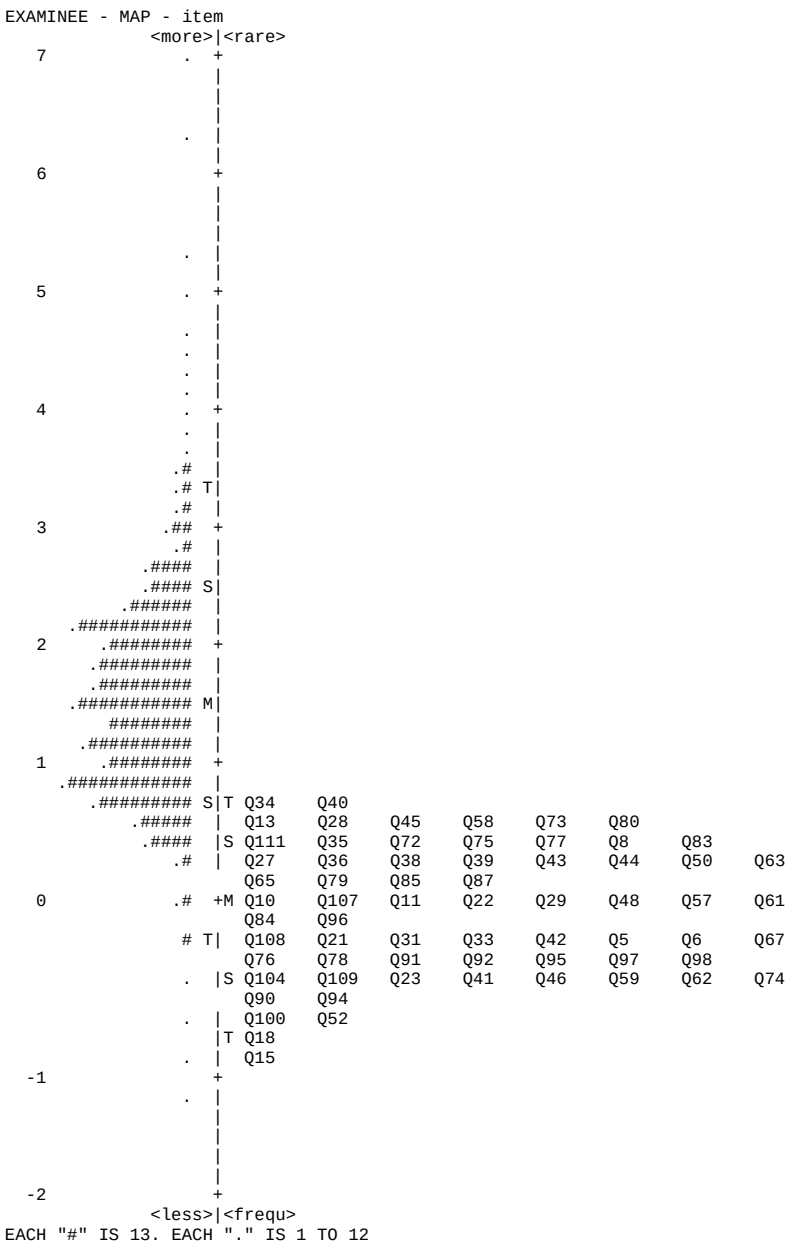

Figure 1. Item – Person Mapping

A total of 112 items were studied in this validation phase with 27 items (Control construct), 29 items (Ownership construct), 28 items (Reach construct), and 28 items (Endurance construct). In total, 46 items were dropped through item fit consideration, item polarity, and Differential Functionality Item across gender. This paper analyses a total of 66 IKBAR items of which are the best and meet the Rasch assumptions.

F. Reliability and Separation Index

Table 4 shows the statistics summary for persons (respondents). The reliability value of an persons is 0.92 and is within the range of values of 0.91 to 0.94, and is categorized as very good. The Cronbach's alpha value of 0.94 is deemed excellent [21]. The individual separation index is recorded at the value of 3.50 and is deemed as good it is over

the value of 2 [35], [36]. Table 5 shows the statistics summary for the items. The findings show that the items reliability which is recorded at 0.98 is deemed to be excellent, being more than 0.94 [21]. The item separation index recorded the value of 7.62 and is deemed good. Item separation index having been more than 3 as well received [36]. Overall, the reliability index value of individuals exceeding 0.8 with the reliability of the item exceeding 0.9 proves that the sample taken is adequate [36]. The reliability value is also found to be better than the recorded original AQ instruments with the value of 0.91 [37]. The study also refers to the quality of measurements stating that the separation index between 3 and 4 as good and more than 5 as excellent [21]. In this study, individual separation index is good and the item separation index as excellent.

Table 4. Statistics summary for individuals (respondents)

	Raw Score	Count	Measure	Model Error	*Infit*		*Outfit*	
					MNSQ	ZSTD	MNSQ	ZSTD
Mean	214.3	66.0	1.56	0.22	1.01	-0.30	1.01	-0.3
Standard Deviation	18.6	0.0	0.88	0.04	0.55	0.55	0.54	3.0
Max	263.0	66.0	6.38	1.01	4.48	4.48	4.46	9.8
Min	132.0	66.0	-1.12	0.16	0.04	0.04	0.04	-9.9
Real RMSE	0.24	Adj. SD	0.85	Separation	3.50	Person Reliability		0.92
Model RMSE	0.24	Adj. SD	0.86	Separation	3.86	Person Reliability		0.94

Person Raw Score-To-Measure Correlation = .97
Cronbach Alpha (KR-20) Person Raw Score Reliability = .94

Table 5. Statistics summary for items

	Raw Score	Count	Measure	Model Error	*Infit*		*Outfit*	
					MNSQ	ZSTD	MNSQ	ZSTD
Mean	5993.8	1845.0	0.00	0.04	1.00	-0.1	1.01	0.2
Standard Deviation	193.6	0.0	0.32	0.00	0.10	2.7	0.10	2.9
Max	6496.0	1845.0	0.67	0.05	1.27	7.1	1.28	7.2
Min	5560.0	1845.0	-0.90	0.04	0.83	-5.0	0.84	-4.9
Real RMSE	0.4	Adj. SD	0.31	Separation	7.62	Person Reliability		0.98
Model RMSE	0.4	Adj. SD	0.31	Separation	7.76	Person Reliability		0.98

UMean = 0.000 UScale = 1.000
Item Raw Score-To-Measure Correlation = -1.000

CONCLUSION

This study showed that the IKBAR items are appropriate in the context of polytechnics and do not contradict with the main assumptions of Rasch model. The improvements proposed for this study is by conducting research through the analysis on Differential Item Functioning in order to examine whether there exist the possibility of biased, unfairness and bias, namely items in favor of only one group of individuals [38]. The psychometric feature testing has proven that the high validity and reliability of IKBAR were capable of achieving the goal in identifying polytechnic students who are weak in their AQ for the purpose of guidance and catalyzing the improvement of academic performance.

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REFERENCES

[1] Kementerian Pengajian Tinggi, "Pelan tindakan pengajian tinggi negara fasa 2 (2011 - 2015) mencetus transformasi pengajian tinggi," 2011.

[2] Jabatan Pengajian Politeknik, "Hala tuju transformasi politeknik ke arah kelestarian penghasilan modal insan negara," Putrajaya, 2009. Available: http://www.polinilai.edu.my/v2/pdf_content/penerbitan/halatujutransformasipoliteknik.pdf

[3] Z. Saleh, M. S. Nordin, and M. S. Saud, "Penerapan nilai minjaroes dan formula '3H' dalam kurikulum PTV," *J. Tech. Vocat. Eng. Educ.*, vol. 5, no. 1, pp. 41–55, 2012.

[4] P. G. Stoltz, *Adversity quotient: turning obstacles into opportunities*. Canada: John Wiley & Sons, 1997.

[5] P. A. Angelopoulos, S. J. R. J. Houde, M. M. Thompson, D. R. McCreary, A.-R. Blais, and L. Pasto, "Canadian Forces training and mental preparation for adversity: Empirical review of Stoltz 'Adversity Quotient (AQ) training for optimal response to adversity', a review of the AQ literature and supporting studies," Toronto, 2002. Available: http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA408478

[6] Z. HuiJuan, "The adversity quotient and academic performance among college students at St. Joseph's College, Quezon City," Bachelor Thesis. St. Joseph's College, 2009. Available: http://www.peaklearning.com/documents/PEAK_GRI_huijuan.pdf

[7] E. Le Thi, "Adversity quotient in predicting job performance viewed through the perspective of the big five," Masters Thesis. University of Oslo, 2007. Available: https://www.duo.uio.no/handle/10852/18313

[8] M. Balsamo, G. Giampaglia, and A. Saggino, "Building a new Rasch-based self-report inventory of depression.," *Neuropsychiatr. Dis. Treat.*, vol. 10, pp. 153–65, Jan. 2014.

[9] N. Othman, S. Mohd Salleh, H. Hussein, and H. Ab. Wahid, "Assessing construct validity and reliability of competitiveness scale using Rasch model approach," in *The 2014 WEI International Academic Conference Proceedings*, 2014, pp. 113–120.
[10] T. A. Sondergeld and C. C. Johnson, "Using Rasch Measurement for the Development and Use of Affective Assessments in Science Education Research," *Sci. Educ.*, vol. 98, no. 4, pp. 581– 613, Jun. 2014.
[11] S. M. K. S.A. Bakar, A. Esa, and S. M. D. Syed Abdullah, "Instrumen penilaian kemahiran generik dalam kursus pendidikan jasmani dan kesihatan (PJK): metode kajian," in *Prosiding Persidangan Antarabangsa Kelestarian Insan 2014 (INSAN2014)*, 2014, pp. 225–236.
[12] R. K. Hambleton and R. W. Jones, "Comparison of Classical Test Theory and Item Response Theory and Their Applications to Test Development," *Educ. Meas. Issues Pract.*, vol. 12, no. 3, pp. 38–47, 1993.
[13] A. Abdul Aziz, *Rasch Model fundamentals: scale construct and measurement structure*. Kuala Lumpur: Integrated Advance Planning Sdn Bhd, 2011.
[14] T. G. Bond and C. M. Fox, *Applying the Rasch Model: fundamental measurement in the human sciences*. New Jersey: Routledge, 2007.
[15] L. R. Gay, G. E. Mills, and P. Airasian, *Educational research: competencies for analysis and applications*, 10th ed. Upper Saddle River, New Jersey: Merrill Prentice Hall, 2012.
[16] S. R. Ariffin, *Inovasi dalam pengukuran dan penilaian pendidikan*. Bangi: Universiti Kebangsaan Malaysia, 2008.
[17] J. W. P. Fisher, "Survey design recommendations," *Rasch Meas. Trans.*, vol. 20, no. 3, pp. 1072–1074, 2006.
[18] M. Apple, "Using Rasch Analysis to Create and Evaluate a Measurement Instrument for Foreign Language Classroom Speaking Anxiety," *JALT J.*, vol. 35, no. 1, pp. 5–28, 2013.
[19] L. B. Christensen, R. B. Johnson, and L. A. Turner, *Research Methods, Design and Analysis*, 11th ed. Boston: Pearson Education, 2011.
[20] B. D. Wright and G. N. Masters, *Rating scale analysis Rasch measurement*. Chicago: MESA Press, 1982.
[21] J. W. P. Fisher, "Rating scale instrument quality criteria," *Rasch Meas. Trans.*, vol. 21, no. 1, p. 1095, 2007.
[22] J. M. Linacre, *A user's guide to Winsteps: Rasch Model Computer Programs*, no. 312. Chicago: MESA Press, 2005.
[23] J. C. Nunnally and I. H. Bernstein, *Psychometric Theory*, 3rd ed. New York: McGraw Hill, 1994.
[24] M. Kumar, S. Abdul Talib, and T. Ramayah, *Business Research Methods*. Shah Alam: Oxford University Press, 2013.
[25] K. M. Conrad, K. J. Conrad, M. L. Dennis, and R. Funk, "Validation of the Self Help Improvement Scale to the Rasch Measurement Model GAIN Methods Report 1.0," Chicago, 2012. Available: http://gaincc.org/_data/files/Psychometrics_and_Publications/Working_Papers/Conrad_et_al_2011_SPS_Report.pdf
[26] A. M. Eakman, "Measurement Characteristics of the Engagement in Meaningful Activities Survey in an Age-Diverse Sample," *Am. J. Occup. Ther.*, vol. 66, no. 2, pp. 20–29, 2012.
[27] J. M. Linacre, *A User's Guide to WINSTEPS: Ministep Rasch Model Computer Programs*. Chicago: MESA Press, 2007.
[28] S. E. Embretson and S. P. Reise, *Item Response Theory for Psychologists*. Mahwah, New Jersey: Lawrence Erlbaum Associates, 2000.
[29] J. M. Linacre, *A user's guide to WINSTEPS: Rasch Model Computer Programs*. Chicago, IL: MESA Press, 2009.
[30] W. Van Ornum, L. L. Dunlap, and M. F. Shore, *Psychological testing across the life span*. Upper Saddle River, New Jersey: Pearson Education, 2008.
[31] R. J. Siegert, D. M. Jackson, A. Tennant, and L. Turner-Stokes, "Factor analysis and Rasch analysis of the Zarit Burden Interview for acquired brain injury carer research.," *J. Rehabil. Med.*, vol. 42, no. 4, pp. 302–9, Apr. 2010.
[32] D. Andrich and I. Styles, "Final report on the psychometric analysis of the Early Development Instrument (EDI) using the Rasch Model: A technical paper commissioned for the development of the Australian Early Development Instrument (AEDI)," Perth, Australia, 2004. Available: http://ww2.rch.org.au/emplibrary/australianedi/Final_Rasch_report.pdf
[33] C. Hill and E. Koekemoer, "The development of the MACE work-family enrichment instrument," *SA J. Ind. Psychol.*, vol. 39, no. 2, pp. 1–16, 2013.
[34] J. M. Linacre, "Sample size and item Calibration (or person measure) stability," *Rasch Meas. Trans.*, vol. 7, no. 4, p. 328, 1994.
[35] J. A. Jones and C. M. Fox, "Uses of rasch modeling in counseling psychology research," *J. Couns. Psychol.*, vol. 45, no. 1, pp. 30–45, 1998.
[36] J. M. Linacre, *A user's guide to WINSTEPS: Rasch Model Computer Programs*. Chicago: MESA Press, 2012.
[37] J. Grandy, "Psychometric Properties and Analysis of the AQ PROFILE ®," 2009. Available: http://www.tccta.org/links/Committees/exc-archive/resilience/AQProfile.pdf
[38] S. R. Ariffin, *Ke Arah Kesaksamaan Penilaian Pendidikan: Amalan dan Cabaran*. Bangi: Universiti Kebangsaan Malaysia, 2013.

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