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The Psychometric Properties of Adversity Quotient (AQ) Items for TVET Education using Rasch Model

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Abstract: Technical and Vocational Education Training (TVET) require technical students as knowledge workers who have specific intelligence to face the challenges namely Adversity Quotient (AQ). AQ is a measure of how the individual respond and deal with everything, from everyday difficulties to the huge adversities. The linkages of AQ items assessment towards technical students are inadequate in order to prepare them for the real industry job environment. Previous research stated that it has very limited universal instrument to measure AQ for technical students. This paper investigated the psychometric items quality in measuring AQ and to see the pattern of AQ among technical students in polytechnic focusing on mechanical engineering students using Rasch model. The research used survey with quantitative approach and involved 369 respondents using proportionate stratified multistage of cluster sampling. AQ was measured using four constructs of Control, Ownership, Reach and Endurance. The results revealed that 36 from 66 items are fulfilling the reliability and validity with considerations of item fit, unidimensionality, local independence, polarity item, Gender Differential Item Functioning and Wright Map. The pattern of AQ level showed 10.03% of the respondents are at the very high, 15.18% at a high level, 28.18% at the moderate high, 24.39% at the moderate low, 13.28% at the low level and 8.94 % at the very low level. The pattern of AQ was at the moderate level. The study may influence the implementation of AQ for technical students as a future TVET graduates in order to identify them in handling adversities. This pattern will provide new ideas in helping stake holders to strategize the programme implementations of AQ. The novelty is that the item produced was proven empirically be applicable in the context of polytechnic which is notable for mechanical engineering students.

Keywords: Adversity Quotient (AQ), psychometric, technical, TVET, Rasch model

1. Introduction

Adversity Quotient (AQ) can be defining as the measures of a person ability to deal with adversities in his or her life. Stoltz (1997) reported that 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. The IQ and EQ are not sufficient to be learnt by the students. They need another factor of resilience that been called AQ. In the Fourth Industrial Revolution (IR4), many challenges should be taken by technical students to be surviving in the industrial world especially for the needs of various types of intelligences. Stoltz (1997) believed that AQ can be a potential type of intelligences that can help technical students to be more resilience to face the adversities. Furthermore, continuous demands of the industry that needs workers

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that not only knowledgeable but also able to face the challenges. Additionally, it has need items that can measure AQ for intervention and guidance. It is beneficial to check the items using measurement theory like Rasch model rather than using Classical Test Theory (CTT). This study introduces Rasch model as an alternative to assess the quality of the items as item fit, unidimensionality, local independence, item polarity, gender differential item functioning besides reliability and separation index. Nevertheless, based on previous studies, it reveals that many studies about AQ are focusing on correlating it with other variables and not into mechanical engineering students.

Therefore, the intention of this study are (a) to assess the psychometric items quality in measuring Adversity Quotient (AQ) and (b) to investigate the pattern of AQ among technical students in polytechnic using Rasch measurement model.

1.1 Adversity Quotient (AQ) in the TVET Context

Stoltz (1997) defined AQ as a new conceptual framework for understanding and enhancing all facets of success. Second, AQ is a measure of how persons respond to adversity. AQ also a scientifically-grounded set of tools for improving how someone responds to adversity. AQ can be measured into four constructs namely Control, Ownership, Reach and Endurance. In the context of TVET, the job pressure in technical ground especially in mechanical field sometimes are harsh. It is beneficial for them to increase the ability to cope with a variety of challenges in the future. Nowadays, it has variety of adversities in Industrial Revolution 4.0 (4IR). Transformation and challenges in the era of globalisation of 4IR around the world involves many companies put different work functions according to markets. Most of them also focus on key challenges such as proactive adjustment by corporations, Governments, communities and individuals. For a reconciliation of this challenge, many jobs will experience the transformation of fundamental nature (World Economic Forum, 2016). Liao et al. (2017) pointed out that production system will change 4IR traditional Industrial model to the internet of things which saw changes to the meaning for factory of the future. Malaysia also did not run away from confronting 4IR who witnessed the impending transformation of human capital. In Indonesia, Tjandrawinata (2016) explained that the world today is facing a challenge that combines the physical and digital world biology is fundamentally will change human forms 4IR. 4IR will also be watching the humans and machines will collaborate together using a cognitive technology in an industry (Zhong, Xu, Klotz, & Newman, 2017). This research will try to put AQ as a part of technical students in facing their challenges when working for the industry.

1.2 Rasch Measurement Model (RMM)

Rasch model has been broadly applied in many fields, especially in education and psychology assessment to measure the level of achievement and cognitive (Azrilah, Mohd Saidfudin, & Azami, 2013). This model arranged the persons based on abilities and the items by their difficulty (Bond & Fox, 2015) in constructing a scale based on a set of items (Azrilah, 2011). RMM involves, (1) item difficulty (observable trait), and (2) respondents' ability (unobservable trait). The rating-scale model is an extension of the dichotomous model to the case in which items have more than two response categories (e.g., Likert-type scales). In this research, each item has four response choices (1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree) it is modelled as having three thresholds. The model is represented in the Equation (1).

$$P_i = \frac{\exp[\beta_n - (\delta_i + \tau_k)]}{1 - \exp[\beta_n - (\delta_i + \tau_k)]}$$

Where,

P_i = probability of getting a correct answer for item i
β_n = ability parameter for respondent n
δ_i = difficulty parameter of an item i
τ_k = k_{th} threshold

Item difficulty parameter is defined as the proportion of the number of students who answer incorrectly. Respondent's ability parameter is calculated based on the ratio of the number of correct items. Modelling of both parameters is conducted through a procedure called calibration, where responses for each item is transformed into equal interval score call '*measure*' using natural log (*ln)*. The measure for both parameters is defined in *logits* unit. Many previous researchers are using Rasch for evaluating items for their instrument and also conducted other research based on Rasch model concept.

2. Methodology

The research approach was fully quantitative with a survey as a research design. The study involved 369 from 383 respondent of Mechanical Engineering students in five polytechnics according to zones (West, North, East, South, and Borneo). The clustered multistage stratified proportional sampling was applied and took ten per cent for each stratum as suggested by Gay and Mills (2018). The stratum are a variety of programme, year of study, and gender. A survey questionnaire was administered to measure AQ using IKBAR instrument developed by Mohd Effendi Ewan and Ahmad Zamri (2015). In this survey questionnaire, a four-point Likert scale was employed from strongly disagree "1" to strongly

agree "4". Part A of the instrument was designed to gather demographic information of respondents, while Part B of the instrument was meant to measure 66 items which were categorised under four constructs of AQ (i.e. Control – 12 items, Ownership – 19 items, Reach– 19 items and Endurance– 16 items). Face validity involved ten students as a test taker to explained that they were not required to answer the items, but just to check on the language (whether there were words that they could not understand), understanding (whether there were different meanings for the same sentence), and use of words only (whether there was a word of a higher level).

The content validity of the questionnaire was established through the appraisal of the academicians who were actively participating in the field of polytechnics. Thirty-seven experts were also involved in improving the existing questionnaires which nine professional experts from the university and 28 experts as a practitioner. The face and content validity were analysed by using Content Validity Ratio (CVR using Microsoft Excel. The respondents were given around one hour to complete the questionnaires, which were distributed by the researcher. Then, the data was analysed using descriptive and inferential statistics through Rasch analysis such as item fit, unidimensionality, local independence, item polarity, gender differential item functioning (GDIF) with the reliability and separation index.

3.1 Detecting Outliers and Normality

Finally, several analyses were conducted before conducting the analysis. Firstly, dealing with outliers. There should be no significant outliers**.** The problem with outliers is that they can have a negative effect on the statistical analysis and reducing the validity of the results. Outliers are often detected through graphical means which two of the most common graphical ways of detecting outliers are the boxplot and the scatterplot. This research used the logits person; the outliers were removed using boxplot analysis. The boxplot able in detecting one or multiple outliers by extending the range of maximum of 1.5 times the inter-quartile range, the box plot also carries outliers or ambiguous results. The data that fall outside of the range minimum and maximum values will be known as outliers. The total of 369 from 383 respondent were involved for further analysis which 14 of them had been dropped from this analysis The items removed are respondents numbered 50, 52, 58, 170, 227, 284, 299, 310, 368 (1st round), 356, 130, 148, 91 (2nd round), 321 (3rd round). Secondly, the normality analysis requirement. In addition, to considering the value of the skewness and kurtosis, normality is seen through the histogram and the Q-Q plot. By using statistical analysis to be more accurate, skewness and kurtosis was applied. For larger samples (more than 300), the calculation of dividing each value by its standard error (Std. Error), gives 1.97 for skewness (0.251/0.127) and -1.05 for kurtosis (-0.265/0.253), both results are well within ±2.58, that prove the normality is not too extreme and the data was normally distributed.

4. Results and Discussions

This section will discuss on item fit, unidimensionality, local independence, polarity item, reliability and separation index, gender differential item functioning, item person map and the pattern of AQ.

4.1 Item Fit

The first assumption of Rasch model, which is item fit, will be using the Mean Square Fit Statistic (MNSQ) and Z standard (Z std). Result revealed that 36 items within the range of 0.77 to 1.30 for MNSQ and ±2.0 for Z std as suggested for acceptance by (Fisher, 2007). Data are suit with Rasch and helps to decide on the suitability of an item (Wright & Masters, 1982). The present finding suggests that items for Control should be created more to make it balance with other constructs proposed that the items polarity should be indicated positive and exceeding 0.3. The item polarity is ranging from 0.30 to 0.55 logits. The standard error (SE) for each item is found in ranges from 0.08 to 0.10 and (less than 0.50) can be considered as very good (Fisher, 2007). This standard error information is significant in establishing the precision in estimation (Kumar et al., 2013). Table 1 shows 36 items of IKBAR that fit with Rasch requirement.

Table 1 - Item fit for the AQ measurement.

Entry number	Total Score	Count	Measure	Model S. E	Infit		Outfit		PTMEA	
					MNSQ	Zstd	MNSQ	Zstd	Corr.	Exp
27	1107	369	.58	0.08	1.01	0.1	1.09	1.2	0.36	0.44
43	1107	369	.58	0.08	1.01	0.2	1.02	0.3	0.43	0.44
41	1117	369	.51	0.08	0.97	-0.3	0.99	-0.1	0.36	0.44
12	1124	369	.46	0.08	0.98	-0.3	1.01	0.2	0.41	0.44
13	1134	369	.39	0.09	0.99	0	1.02	0.2	0.40	0.44
19	1152	369	.26	0.09	1.13	1.6	1.12	1.5	0.45	0.43
25	1156	369	.23	0.09	0.97	-0.4	0.96	-0.5	0.44	0.43
66	1157	369	.22	0.09	.99	.0	.99	-0.1	0.46	0.43
38	1159	369	.21	0.09	1.01	.2	1.03	0.4	0.39	0.43
20	1162	369	.18	0.09	.92	-1.0	.93	-0.8	0.36	0.43
30	1163	369	.18	0.09	1.03	0.4	1.00	0.1	0.44	0.43

Table 1 - (Continue)

Entry number	Total Score	Count	Measure	Model S. E	Infit		Outfit		PTMEA	
					MNSQ	Zstd	MNSQ	Zstd	Corr.	Exp
29	1168	369	.14	0.09	1.06	0.8	1.07	0.9	0.41	0.43
50	1172	369	.11	0.09	.93	-0.9	.93	-1.0	0.47	0.43
9	1181	369	.04	0.09	.96	-0.5	.95	-0.6	0.52	0.42
15	1182	369	.03	0.09	.96	-0.5	.96	-0.5	0.55	0.42
21	1186	369	.00	0.09	1.01	0.2	1.04	0.5	0.30	0.42
44	1186	369	.00	0.09	.94	-0.8	.95	-0.7	0.49	0.42
14	1190	369	-.03	0.09	.97	-0.4	.97	-0.4	.38	0.42
63	1190	369	-.03	0.09	1.13	1.5	1.11	1.5	.41	0.42
52	1192	369	-.05	0.09	.95	-0.6	.98	-0.6	.38	0.42
32	1193	369	-.06	0.09	.93	-0.9	.94	-0.9	.38	0.42
46	1195	369	-.07	0.09	1.14	1.7	1.12	1.7	.41	0.42
62	1196	369	-.08	0.09	1.06	0.7	1.04	0.7	.45	0.42
36	1208	369	-.18	0.09	1.08	1.0	1.09	1.0	.41	0.42
57	1208	369	-.18	0.09	.96	-0.4	.96	-0.4	.40	0.42
60	1208	369	-.18	0.09	.89	-1.4	.90	-1.4	.42	0.42
59	1210	369	-.20	0.09	.92	-1.1	.92	-1.1	.44	0.42
54	1212	369	-.21	0.09	1.01	0.2	1.00	0.2	.40	0.41
65	1213	369	-.22	0.09	.88	-1.6	.88	-1.7	.51	0.41
31	1218	369	-.26	0.09	1.12	1.6	1.09	1.3	.43	0.41
53	1221	369	-.29	0.09	1.11	1.4	1.09	1.3	.28	0.41
42	1222	369	-.30	0.09	1.08	1.1	1.07	0.9	.43	0.41
11	1227	369	-.34	0.09	1.03	0.4	1.02	0.3	.41	0.41
28	1233	369	-.39	0.09	.97	-0.4	.96	-0.6	.46	0.41
23	1238	369	-.43	0.09	.92	-1.0	.91	-1.3	.46	0.41
61	1257	369	-.60	0.10	.99	-0.1	.96	-0.5	.53	0.40

4.2 Unidimensionality

The PCA presented that variance as explained by measures is 19.9% and looked very close to the expected model of 20.0%. The result meets the requirements of at least 20% (Reckase, 1979). The level of interference on items being measured or an unexplained variant in a contrast recorded a 5.7% and is categorised as good within the range of 5 to 10% (Fisher, 2007). Values less than 10% is evidence of the compliance on unidimensional (Eakman, 2012; Linacre, 2007). The third aspect is the ratio of raw variance explained by items must be at least three times the variance explained by the first contrast (ratio 3:1). The result was 2.12:1 and nearly achieved the minimum ratio of 3:1 (Linacre, 2012). The Eigen value was 2.6 (meet the requirement of less than three) (Linacre, 2009). The results from Table 2 revealed that all items are meeting the minor requirement of unidimensional.

Table 2 - Standardised residual variance (in eigenvalue units).

		Empirical		Modelled
Total raw variance in observations	44.9	100.0%		100.0%
Raw variance explained by measures	8.9	19.9%		20.0%
Raw variance explained by persons	3.5	7.8%		7.8%
Raw variance explained by items	5.4	12.1%		12.2%
Raw unexplained variance (total)	36.0	80.1%	100.0%	80.0%
Unexplained variance in 1st contrast	2.6	5.7%	7.1%	

4.3 Local Independence

Ten items reached the standard correlation of residual values within 0.44 to – 0.28. This range fulfilled the requirements of local independence, which need the correlation should be less than 0.7 (Eakman, 2012). The result portrays the ability of an individual to any item is not linked with the response of other items in the same construct (Balsamo et al., 2014). The low correlation doesn't provide implication towards item and correlation that should be low (Ornum et al., 2008). The largest standardised residual correlations revealed that the pair was item number 53 and number 54 (both from Endurance construct) (r = 0.44). Improvement can be done to these pair of items of different constructs (a) item number 12 (Endurance construct) and number 13 (Reach construct) (r = 0.22); (b) item number 9 (Control construct) and number 29 (Ownership construct) (r = 0.44); (c) item number 29 (Ownership construct) and number 43 (Reach construct) (r = -

0.28); (e) item number 41 (Reach construct) and number 61 (Endurance construct) (r = -0.27); (f) item number 9 (Control construct) and number 21 (Ownership construct) (r = -0.23); (g) item number 28 (Ownership construct) and number 43 (Reach construct) (r = -0.23); (h) item number 9 (Control construct) and number 54 (Endurance construct) (r = -0.23). Each pair of items requires improvement because these findings need an explanation of how the different items constructs have a correlation. However, this correlation remains in the acceptance range.

4.4 Polarity Item

The positive value of polarity item is a necessity (Bond & Fox, 2015; Wu & Adams, 2007) and it must be more than 0.30 (Nunnally & Bernstein, 1994). The values are located in the range of 0.38 and 0.54. The point biserial within 0.30 to 0.60 proves that items functions towards a single construct (Bond & Fox, 2015). This analysis proves that items are move in one direction for a construct (Abu Bakar & Bhasah, 2008). It was proven that all items have a good discrimination index.

4.5 Reliability and Separation Index

The person reliability index is 0.85 and considered high which proven that the items can discriminate between one individual to another (Bond & Fox, 2015; Wright & Masters, 1982). The Cronbach Alpha is 0.87 and acceptable by Hair, Celsi, Oritinau, and Bush (2017) who suggested the value more than 0.70 for internal consistency. The items reliability index is 0.90 and acceptable by Linacre (2012). The items' reliability indicated the possibility to obtain those items at similar locations throughout the scale, even though the same items are given to samples with the equal level of abilities (Bond & Fox, 2015). The person separation index is 2.38 and the items separation index is 2.99. The results must be more than two to be considered as acceptable (Bond & Fox, 2015). The items distribution along the scale are able to separate the individuals based on their abilities and item difficulty (Wright & Masters, 1982). It means that all items are able to dispersed individuals according to their abilities and also the items based on their difficulty (Wright & Masters, 1982).

4.6 Gender Differential Item Functioning

The total of 36 items in Table 3 shows the GDIF results that listed items which are not favored to both of the genders. GDIF can identify the items that indicated the early signs of biases when students group are vary in the same gender of competency (Bond & Fox, 2015). Results show that DIF contrast within + 0.5 logits up to - 0.5 logits are significant for item assessment (Lai & Eton, 2002; Wang, 2008). Bond dan Fox (2007) suggested three DIF requirements such as t value must be within - 2 to + 2, DIF contrast within - 0.5 to + 0.5 logits and p value must be more than 0.05. The GDIF size that less than 0.5 are considered unimportant and can be neglected (Wright & Panchapakesan, 1969). The results shown 36 selected items are fulfill all the criteria's for free from GDIF.

Table 3 - Gender differential item functioning for 36 items accepted.

Group	DIF measure	Group	DIF measure	GDIF Contrast	t	Probability	Item number
1	.04	2	-.05	.08	.32	.7499	9
1	-.40	2	.01	-.41	-1.56	.1226	11
1	.43	2	.68	-.25	-1.02	.3087	12
1	.39	2	.47	-.08	-.30	.7624	13
1	.00	2	-.29	.30	1.10	.2741	14
1	.03	2	-.05	.08	.29	.7726	15
1	.26	2	.19	.07	.28	.7839	19
1	.14	2	.47	-.33	-1.31	.1918	20
1	.00	2	.07	-.07	-.28	.7766	21
1	-.41	2	-.62	.22	.77	.4434	23
1	.23	2	.19	.04	.16	.8743	25
1	.58	2	.47	.11	.46	.6459	27
1	-.39	2	-.42	.03	.12	.9047	28
1	.14	2	.07	.07	.25	.8005	29
1	.22	2	-.17	.39	1.48	.1418	30
1	-.24	2	-.42	.18	.66	.5085	31
1	-.06	2	-.11	.05	.19	.8516	32
1	-.24	2	.19	-.43	-1.66	.1005	36
1	.21	2	.07	.13	.52	.6063	38
1	.53	2	.36	.18	.70	.4864	41
1	-.30	2	-.36	.06	.23	.8206	42
1	.60	2	.41	.19	.77	.4433	43

Table 3 - (Continue)

Group	DIF measure	Group	DIF measure	GDIF Contrast	t	Probability	Item number
1	-.03	2	.13	-.16	-.60	.5501	44
1	-.07	2	-.11	.03	.13	.8992	46
1	.11	2	.07	.04	.14	.8928	50
1	.00	2	-.42	.42	1.56	.1226	52
1	-.25	2	-.56	.30	1.10	.2752	53
1	-.25	2	.01	-.26	-1.00	.3186	54
1	-.20	2	-.05	-.16	-.59	.5567	57
1	-.23	2	.01	-.24	-.93	.3549	59
1	-.18	2	-.23	.05	.19	.8481	60
1	-.62	2	-.49	-.13	-.48	.6303	61
1	-.08	2	.01	-.09	-.36	.7186	62
1	-.10	2	.36	-.46	-1.79	.0760	63
1	-.25	2	-.05	-.20	-.77	.4427	65
1	.25	2	.01	.24	.91	.3653	66

From this study, the total of 36 from 66 items show a significant contribution statistically in measuring AQ among Mechanical Engineering students in polytechnic. The items according to constructs are Control (Q9, Q11 and Q12), Ownership (Q13-Q15, Q19-Q21, Q23, Q25, and Q27-Q31), Reach (Q32, Q36, Q38, Q41-Q44, Q46, and Q50) and Endurance (Q52-Q54, Q57, Q59-Q63, and Q65-Q66). The newly found results would encourage further studies on exploring new effort in adding new items.

4.7 Item Person Map (Wright Map)

The item person map showed the distribution of the person and items on the logits measurement ruler, which makes it effective to visualise the distribution of person's ability and items difficulty (Azrilah Abdul Aziz et al., 2014). Figure 1 shows that the most difficult item to be endorsed is Q27 and Q43 (+0.58 logit) and the easiest item is Q61 (-0.60 logit). The logit range within +0.58 logit to -0.60 logit that fulfilled the acceptance range of +3.00 to -3.00 logits that considered as acceptable (Andrich & Styles, 2004; Hill & Koekemoer, 2013; Linacre, 1994). Results also reported the items need to be generated more than Q27 and Q43 (+0.58 logit), and Q11 (measure = -0.34 logits) to Q61 (measure = -0.60 logits), so as to ensure the instrument may have adequate items of AQ to be verified among mechanical engineering students with the variety and different of abilities.

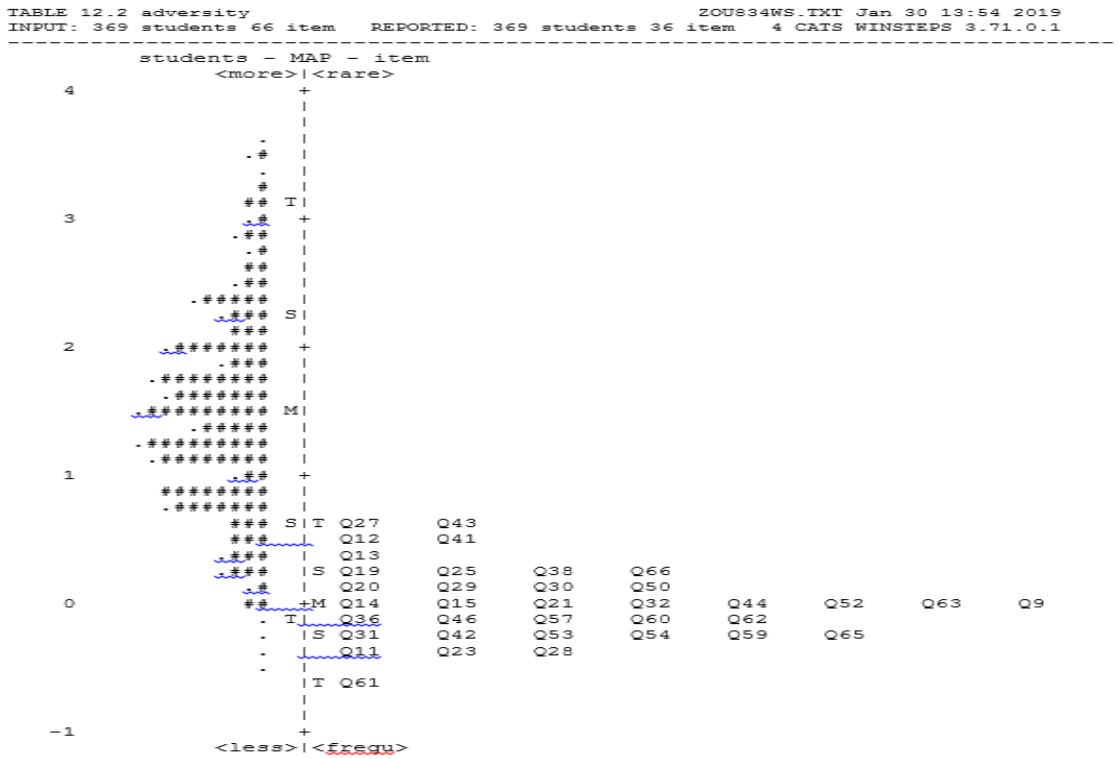

Fig. 1 - Item person map.

4.8 The Pattern of AQ

The AQ level shows the percentile norms for overall score. Quartile analysis is the point of being divided into four frequency part which is the 25th percentile, to 50 (median or interquartile) and to 75 (Kaplan & Saccuzzo, 2013). Based on a weighted average, this study uses a percentile and quartile for determining each stage as shown in Table 4.

Table 4 - The norms level of AQ among polytechnic students.

Group	Percentiles						
	5	10	25	50	75	90	95
Weighted Average (Definition 1)	.2850	.4400	.8600	1.4900	2.0800	2.6500	2.9800
Tukey's Hinges			.8600	1.4900	2.0800		

Table 5 - The pattern AQ among polytechnic students.

AQ Level	Indicator Quartile	Indicator	Respondents	AQ Level
Very high	AQ Score > 2.650	Min + 3SP	37 / 369	10.03%
High	2.080 < AQ Score ≤ 2.650	Min + 2SP	56 / 369	15.18%
Moderate high	1.490 < AQ Score ≤ 2.080	Min + 1SP	104 / 369	28.18%
Moderate low	0.860 < AQ Score ≤ 1.490	Min - 1SP	90 / 369	24.39%
Low	0.440 < AQ Score ≤ 0.860	Min - 2SP	49 / 369	13.28%
Very low	AQ Score ≤ 0.440	Min - 3SP	33 / 369	8.94%

The AQ level of mechanical engineering students in Malaysia are determined based on an indicator. The Table 5 shown that 10.03% (37/369) of the respondents are at the very high AQ, 15.18% (56/369) at a high level, 28.18% (104/369) at the moderate high, 24.39% (90/369) at the moderate low, 13.28% (49/369) at the low level and 8.94 % (33/369) at the very low level. The respondents mostly are at a moderate level of AQ.

5. Discussion

Some previous studies have recorded inconsistent findings for the AQ level in various field, including the education context. The moderate level findings of this research are consistent with previous studies (Tian & Fan, 2014; Canivel, 2010; Patdo, 2010; Ferrer, 2009; Villaver, 2005; Lazaro-Capones, 2004; Williams, 2003). However, it is contrary to some studies with high AQ level findings (Ratri, 2014; Bantang et al., 2013; Gulan & Caballero, 2013; Praditsang & Zahyah, 2013; Legaspi, 2012; Patdo, 2010; Lazaro-Capones, 2004; Markman, 2000). Besides, the past findings also stated about the low AQ level from various context (Bantang et al., 2013; Gulan & Caballero, 2013; Macasaet, 2013; Napire, 2013; Legaspi, 2012; Olila, 2012; Cura & Gozum, 2011; HuiJuan, 2009;). The majority of previous studies show a tendency towards a low AQ level.

The study highlighted that respondents have moderate levels because the institution like polytechnics were not really emphasised on problem handling and management. They are organising more on self-development programme. Self-development was a bit different from the adversity's management skills. Students may be aware of the adversities they faced, but they will not be able to handle the challenges properly. The challenges in the technical field are tough. Technology is constantly moving fast and the competition was completely aggressive. The ability of technical students is very important as TVET is moving forward in Malaysia. Hence, the creation of this AQ item contributes to the empowerment efforts and further enhances the quality of TVET technical graduates in Malaysia. The AQ level of technical students is at low moderate level due to the different types of challenges experienced, the differences of institutions and the context of the country. Challenges involving this context are more on internal challenges (Stoltz, 1997). The moderate levels showed that respondents were not very capable of controlling and managing academic challenges well in their lives. The student's experience in controlling the challenges in secondary school does not help them to have high AQ in polytechnics. It is in line with the findings that many of the students failed to pursue their studies due to failure in the course or quit because they were unable to adapt to the tertiary education system which was very different from the secondary school (Macasaet, 2013). Challenges in polytechnics environment are certainly were not the same as the larger institutions such that require higher AQ skills by students.

The recent findings among vocational high school students from the study by Darmawan, Budiyono and Pratiwi (2019) revealed that adversity quotient of type campers (moderate) is more than the other two types (climbers and quitters). However, the difference is not very significant. This finding also in line with Hanum (2018) among UPI (Universitas Pendidikan Indonesia or Indonesia University of Education) in Bandung, West Java, Indonesia, undergraduate students that also in moderate or Campers category. The research findings also showed that adversity intelligence of undergraduate students statistically did not differ significantly in terms of gender. The study by Ahmad

(2017) that involved 217 junior high school students from eight schools in eight different districts in Indonesia also categorised as moderate. The study by Yazon and Ang-manaig (2019) in the Philippines mentioned about the majority of the 30 respondents student-parents possess an average level of AQ for all the constructs. This research was contributed by empirical evidence for technical students in polytechnic that seen taking time to adapt to the challenges. They should be more intelligent in responding to and controlling the challenge.

This respondent response is like one of the reactions expressed by Stoltz (2000), namely Delayed Response Control. This reaction is common to all individuals. It was explained that an individual would be aware of their mistakes and responded better to the challenge afterwards. Students should have the second type of reaction that is Spontaneous Response Control. These responses make the individual more spontaneous and ready to face the unexpected challenges at any time. Polytechnic students with moderate AQ levels can change to the lower levels if they do not change the way they react to challenges. As a result, the students are likely to give up, depression, helplessness, pain, and avoid challenging tasks (Stoltz, 2001). The AQ level also illustrated that the polytechnic students have a Campers type of personality. They will be easily satisfied after reaching a certain level, having only a few initiatives, enthusiasm and effort, refraining from change and disliking the big changes because they are in a comfortable zone.

6. Conclusions

The pattern of AQ at the moderate level indicated the highly needs to improve the durability handling elements of the problems faced by TVET technical workers. These improvements will help students learn to handle the job and personal challenges in a better way. Items with high validity and reliability are expected to be able to measure AQ more accurately for guidance purposes. TVET in the future not only requires workers who are knowledgeable, strong spiritual and emotional power but need to be identified to have a high AQ. So, the adversities will make them more successful. Adversities will not be a barrier for them to develop the country. This research proven that the total of 36 items in measuring AQ was found to have good psychometric characteristics with Rasch model analysis. This study has provided empirical information on the items. This also contributes to overcoming the lacking in previous research that was focusing more on classical test theory especially involves the consideration of the congruity between the item difficulty with the ability of the person. Through the findings, it was suggested that new items should be generating more for testing among students with low ability. Improvements can be carried out not only to test the unidimensionality but also to test the strength of the constructs through Confirmatory Factor Analysis (CFA). Practically, future researchers can take the initiative to test the items among technical students from the other institutions. This study only involves mechanical students. The improvement can be done by broadening the context to show the usability of these items. Future research can be made not only focusing the DIF to gender, but also through aspects such as location and specialisations variations. The novelty of this research is the discussions are more on covering the gap of past research in selecting the items with the complementing between modern and classical theories.

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