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Construct Validity and Reliability in Content Knowledge of Design and Technology Subject: A Rasch Measurement Model Approaches for Pilot Study

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Abstract
Validity and reliability are the main important issues when developing a new instrument. This pilot study aims to test the validity and reliability of instruments in content knowledge for the Design and Technology subject in Malaysia. The content knowledge of RBT subject instruments that had been prepared consists of 94 dichotomous items and is distributed to 83 teachers. The purpose of the establishment of this instrument is to measure the five main constructs of this study, which is; (1) Introduction to Design and Technology; (2) Introduction to Design Project Management; (3) Product Making; (4) Introduction to Apply Technology; and (5) Introduction to Design and Technology in entrepreneurship. The approach used to examine the validity and reliability of the items and respondents in this study is emanate from the Rasch Measurement Model Approaches which is much more valid and well-grounded compared to just focus on the output produced by Cronbach's Alpha. The Winsteps software Version 3.73 has been used to check on the functionality of the items in the aspects such as the item reliability and the separation of item-respondent, polarity item, the suitability of the item to measure the construct, the item difficulty level, and the respondent's ability. It also allows the removal of items based on the statistics of polarity item and the suitability of the item. At the end of the analysis, it is found that there is a total of 10 items that were discarded because they did not meet the inspection criteria specified in accordance to the Rasch Model. The final instrument recorded a total of 84 items that can only be used to measure the five constructs of the study. Since this study was established as a pilot study, then the distribution made to the actual respondents can be carried out to measure the five main constructs of this study. This study shows that the Rasch Model can help researchers build a good instrument as the items constructed offset psychometric standards.
Keywords: Design and Technology, RBT, Validity, Reliability, Rasch Measurement Model Approach

Introduction

The Design and Technology Curriculum also emphasizes the skills required by RBT teachers in handling this subject. Teachers need to communicate knowledge in an integrated manner with activities to be carried out to students. In contrast to the delivery of teaching and learning (PdP) theoretical subjects, RBT requires teachers to improve their skills in real situations (Alwi, Kamis and Ismail, 2018). Therefore, according to Harun (2014) has stated that to ensure that students are able to master RBT subjects, teachers need to have teaching skills, subject knowledge, mastering materials and technology and using the Tools / Learning Aid Materials (ABBM) according to the needs of the subject. Design and Technology (RBT) are the subjects offered at all primary and secondary levels in Malaysia. RBT aims to provide students with a sense of value, aesthetics, practical skills and technology with creative, critical, innovative, inventive and entrepreneurial thinking for them to develop communication skills and generate ideas for creating new products and systems that meet human needs and improve the quality of life (KPM, 2015).

KSSM RBT focuses on four domains such as Appreciation of Design, Technology Application, Product Creation and Product Design Evaluation. Pupils will apply knowledge and skills through project design and production activities. It is supported by Moore, Johnson, Peters-Burton, and Guzey (2016) in details on the STEM core which has links in line with Design and Technology (RBT) subjects which challenge students' potential by using Engineering Design approaches, to develop critical and creative thinking through relevant technology-assisted design activities. Students can learn from failure in designing solutions in Engineering designs by improving existing designs.

Malaysia's Achievement in the Current Aggregated World Ranking Design report for 2010-2017, Malaysia ranked 51 out of 97 participating countries with 30 award-winning groups and total number 101 points compared to the first position by the United States with 584 and 2168 (World Bank Institute, 2017) points out that efforts need to be intensified to improve this poor performance. This transformation demonstrates that teachers as a policy implementer should have the knowledge, skills and values in implementing the planned policies (Appanna, Tajularipin & Wulandari, 2015).

Shulman (1986) says Content Content is an understanding of a subject as a discipline. According to him, content knowledge is a knowledge structure that includes the theory, concept and principles of a discipline of learning or subjects. Examples of Design and Technology (RBT) subjects offered at primary schools are different with their RBT offered at secondary schools. Therefore, to teach a subject, teachers need to have a good and up-to-date content knowledge (Koehler, Greenhalgh, Rosenberg & Keenan, 2017, Cherner & Smith, 2016; Nordin, 2014). The findings show that teachers teaching in schools need to have knowledge of the theories, concepts and principles contained in the learning standard.

Analysis Using Rasch Model

Rasch model with the application of WINSTEPS version 3.72 was used to analyze the data as well as to test the validity and reliability of the instrument. The Rasch model incorporates a method for ordering person according to their ability and ordering items according to their difficulty (Bond; Fox, 2015). According to Bond & Fox (2015), the criteria in Table 1.0 below used as benchmarks for determining the validity of the instrument. Knowledge items are dichotomous. Item compatibility starts with Mean Square (MNSQ) value not exceeding Mean Infit (MNSQ) with + / (-) S.D). Misfit and Outlier can be detected by seeing ZSTD values larger or out of limit t +/- 2logit (Azrilah et al., 2015). The MNSQ range should be at the range of 0.70 logits up to 1.30 logits (Bond & Fox 2015) for dichotomic or multiple-choice test items (knowledge items). The ZSTD value is the accepted value between -2.0 to 2.0 (Bond & Fox, 2015) and according to Fox and Jones (2005) the ZSTD value can be ignored if MNSQ has been accepted.

Table 1.0: Summary of item validity and reliability using Rasch Model.

Criteria Statistical Info Results Item Validity	Value	Reference
Item Fit Total Mean Square infit and outfit (Item Misfit)	0.70-1.30 logits	Bond & Fox 2015
Person Reliability Value	> 0.8	Bond & Fox 2015
Item Reliability Value	> 0.8	Bond & Fox 2015
Item Polarity PTMEA CORR	Positif, > 0	Bond & Fox 2015
Separation (SE) All items show	≥ 2.0	Linacre 2007
Unidimensionality - Value Principal Component Analysis of Residual (PCA)	Minimun 20%	Conrad, Dennis & Funk (2012)
Unidimensionality - Value of disturbance or variance level is not clear	Maximum 15%	Azrilah et al. (2015)

The Rasch model approach is used to look at the validity and reliability of the instrument more deeply through some diagnosis. Only four diagnoses were performed: checking to functional items in terms of (i) item reliability and separation; (ii) detect the polarity of items that measure the constructs based on the value of PTMEA CORR; (iii) the fit of constructing items; and (iv) determine the dependent items based on the standard residual correlation value; (v) determine the item difficulty level and the ability of the respondents. These four diagnoses complement the requirements required to verify the validity and reliability of the instrument due to the objective of the study only to produce a measurement model and a structural model. This is because if the researcher wants to produce a questionnaire instrument then all the diagnosis of Rasch's model should be followed as described earlier.

The pilot study was conducted to obtain construct validity and item reliability using Rasch model which produced 94 knowledge items of a tests instrument that had been developed by the researcher through the quantitative data collection.

Objective

This study aims to test the validity and reliability in content knowledge of Design and technology instruments for teacher at the secondary school using Rasch analysis. The objectives of this study are to: (1) Testing the reliability and separation index of the item and respondent; (2) Identify the polarity item that measures the constructs; (3) Examine the suitability of item (item fit) of the instrument; (4) Detect unidimensionality of construct; and (5) Determine the item difficulty level and the ability of the respondents.

Methodology

This pilot study was carried out by using a quantitative approach by distributing the test instrument regarding the content knowledge of design and technology subject to the selected respondents. The sample for this pilot study involved a total of 83 teachers which specifically teaching in design and technology subject for secondary school. According to Cooper and Schindler (2011), the number of respondents which is suitable and considered as adequate for the pilot study is between 25 and 100 people. The findings generated from this pilot study will then be analyzed using the Winsteps software Version 3.73 alongside the Rasch Measurement Model Approach. The content knowledge of design and technology subject instrument that had been constructed consists of 94 items which comprises the five main constructs, namely (1) Introduction to Design and Technology; (2) Introduction to Design Project Management; (3) Product Making; (4) Introduction to Apply Technology; and (5) Introduction to Design and Technology in entrepreneurship.

Table 1.1: Subcontruct Number of Items Competency of Knowledge Content

Subconstruct	Code Item	Total Item
Introduction to Design and Technology	P1B1-P1B17	17 item
Introduction to Design Project Management	P2B1-P2B14	14 item
Product Making	P3B1-P3B17	17 item
Introduction to Apply Technology	P4B1-P4B39	39 item
Introduction to Design and Technology in entrepreneurship	P5B1-P5B7	7 item

Results and Findings

In accordance with the Rasch Measurement Model Approach, the researcher had conducted a test on the functionality of the item in terms of (1) the reliability and separation index of the item and respondent; (2) the polarity item that measures the constructs of the study based on the value of PTMEA CORR; (3) the suitability of item (item fit) of the instrument; (4) the unidimensionality of construct; and (5)) the map of item difficulty level and the ability of the respondents. The description and explanation for each item tested on the functionality are as follows.

Reliability and Item Separation

Based on the Rasch Measurement Model Approach, the value of Cronbach's Alpha (α) that its reliability can be accepted is between 0.71 – 0.99 where this value is at its best (71% - 99%) as described in Table 1.2 (Bond & Fox, 2007).

Table 1.2: The Interpretation of Cronbach's Alpha Score

The Score of Cronbach's Alpha	Reliability
0.9 – 1.0	Very good and effective with a high level of consistency
0.7 – 0.8	Good and is acceptable
0.6 – 0.7	Acceptable
<0.6	The item needs refinement
<0.5	The item needs to be discarded

Source: (Bond & Fox, 2007)

To determine the reliability of the respective items, the statistical analysis by using the Rasch Measurement Model Approach was used with reference to the reliability value and the value of the item separation. The result of the analysis found that the reliability value obtained based on Cronbach's Alpha (α) value was 0.97 as shown in Table 1.3 below. The value obtained clearly shows that the instruments used are in very good condition and is acceptable, thus it can be used in real research.

Table 1.3: The Reliability Score (Cronbach's Alpha) for Pilot Study

PERSON RAW SCORE-TO-MEASURE CORRELATION = 0.96
CRONBACH's ALPHA (KR-20) PERSON RAW SCORE "TEST" RELIABILITY = 0.97

The analysis for the entire instrument was also performed by looking at the reliability value and the separation values of the items and respondents. Based on Table 1.4 as shown below, the reliability value of the item is 0.83, which indicates that it is in good condition and is acceptable (Bond & Fox, 2007). Meanwhile, the value of item separation is 2.20, this value can be used because the items are new items. As suggested by Fox and Jones (2005), the value that shows a good index separation is a value that is greater or more than the value of 2.0.

Table 1.4: Reliability and Item Separation Value for the Entire Construct Instruments: Pilot Study

	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	143.8	83.0	.00	.31	1.00	-.1	1.00	.0
S.D.	8.7	.3	.78	.05	.22	1.4	.46	1.2
MAX.	161.0	83.0	1.82	.52	1.48	3.1	3.15	3.2
MIN.	119.0	80.0	-2.23	.25	.46	-3.2	.24	-2.2

```
REAL RMSE    .32 TRUE SD    .71  SEPARATION  2.20  ITEM   RELIABILITY  .83
MODEL RMSE   .31 TRUE SD    .72  SEPARATION  2.31  ITEM   RELIABILITY  .84
S.E. OF ITEM MEAN = .08
```

Whilst, based on Table 1.5 below, the reliability value of the respondents is 0.94 and the respondent's separation value is 3.91. This shows that the reliability of the respondents is very good and effective with a high level of consistency. The value of the item and respondent separation which is more than 2.0 is considered as good (Fox & Jones, 2005; Bond & Fox, 2007).

Table 1.5: Reliability and Respondent Separation Value for the Entire Construct Instruments: Pilot Study

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-------------------------------------------------------------------------------
|          TOTAL                         MODEL         INFIT         OUTFIT    |
|          SCORE     COUNT     MEASURE   ERROR      MNSQ   ZSTD   MNSQ   ZSTD |
|-----------------------------------------------------------------------------|
| MEAN     162.8      94.0        1.42     .32      1.00     .0   1.00     .0 |
| S.D.      20.4        .2        1.44     .14       .09     .9    .24    1.0 |
| MAX.     187.0      94.0        4.82    1.01      1.23    2.9   1.97    3.2 |
| MIN.     102.0      93.0       -2.62     .22       .82   -2.3    .53   -2.0 |
|-----------------------------------------------------------------------------|
| REAL RMSE    .36 TRUE SD    1.39  SEPARATION  3.91  PERSON RELIABILITY  .94 |
|MODEL RMSE    .35 TRUE SD    1.40  SEPARATION  3.97  PERSON RELIABILITY  .94 |
| S.E. OF PERSON MEAN = .16                                                   |
-------------------------------------------------------------------------------
```

Polarity Item by PTMEA CORR Value

The Point Measure Correlation or PTMEA CORR value examination was made to identify the polarity items in the study, which is intended to test the extent of which the established constructs can achieve its goals. If the value found in the PTMEA CORR section is positive (+), then it indicates the respective item can achieve its goals of measuring the construct that needs to be measured (Bond & Fox, 2007).

In contrast, if the value is negative (-), then the established item does not measure the construct that needs to be measured. So, the item needs to be revised or discarded because it does not address the question, or it is too difficult for the respondents to answer it. Based on Table 1.6 below, there are no items show negatif value and near to value 0. Based on the findings, it shows that the items are positively moving in one direction to measure the constructs. And it does not contradict with the constructs that need to be measured.

Table 1.6: Point Measure Correlation (PMEA CORR) Value

Entry Number	Point Measure Corr.	Item	Entry Number	Point Measure Corr.	Item	Entry Number	Point Measure Corr.	Item
20	.18	P2B3	37	.45	P3B6	7	.56	P1B7
19	.19	P2B2	71	.46	P4B23	6	.56	P1B6
88	.20	P5B1	54	.46	P4B6	16	.56	P1B16
32	.23	P3B1	77	.46	P4B29	34	.56	P3B3
14	.25	P1B14	31	.46	P2B14	72	.57	P4B24
18	.26	P2B1	9	.46	P1B9	41	.57	P3B10
78	.26	P4B30	27	.46	P2B10	67	.58	P4B19
89	.26	P5B2	53	.47	P4B5	13	.58	P1B13
94	.28	P5B7	42	.48	P3B11	60	.58	P4B12
90	.30	P5B3	38	.48	P3B7	17	.58	P1B17
23	.31	P2B6	84	.48	P4B36	58	.59	P4B10
91	.31	P5B5	52	.48	P4B4	59	.59	P4B11
92	.31	P5B4	1	.50	P1B1	64	.59	P4B16

79	.33	P4B31	15	.50	P1B15	12	.60	P1B12
8	.34	P1B8	76	.50	P4B28	85	.61	P4B37
93	.36	P5B6	35	.50	P3B4	66	.62	P4B18
63	.36	P4B15	73	.51	P4B25	40	.62	P3B9
28	.38	P2B11	82	.51	P3B34	48	.63	P3B17
30	.38	P2B13	74	.51	P4B26	3	.64	P1B3
80	.39	P4B32	33	.51	P3B2	62	.65	P4B14
29	.39	P2B12	2	.52	P1B2	70	.65	P4B22
5	.41	P1B5	24	.52	P2B7	69	.65	P4B21
87	.42	P4B39	55	.53	P4B7	4	.66	P1B4
75	.42	P4B27	81	.53	P4B33	56	.66	P4B8
49	.43	P4B1	46	.53	P3B15	68	.66	P4B20
83	.43	P4B35	21	.54	P2B4	47	.66	P3B16
43	.44	P3B12	11	.54	P1B11	61	.67	P4B13
86	.44	P4B38	26	.55	P2B9	57	.69	P4B9
22	.44	P2B5	50	.55	P4B2	36	.71	P3B5
51	.45	P4B3	65	.55	P4B17	10	.77	P1B10
25	.45	P2B8	39	.56	P3B8			
44	0.45	P3B13	45	.56	P3B14			

Item Fit in Measuring the Constructs

Item fit measured the constructs through the infit and outfit Mean Square (MNSQ). According to Bond and Fox (2015), the outfit and infit MNSQ should be in the range of 0.70 to 1.33 to ensure that the items are suitable for measuring the constructs. But the outfit index MNSQ noteworthy in advance compared infit MNSQ for determining congruity of items that measure a construct or latent variable (Sumintono, 2017). If the infit or outfit MNSQ value more than 1.33 logit, then it gives the meaning of confusing item. If the MNSQ value is less than 0.70 logit, it shows that the item is too easily anticipated by the respondents (Linacre, 2007). Beside that the outfit and infit ZSTD value should also be within -2.00 to +2.00 (Bond & Fox, 2015). But if the outfit and infit MNSQ be accepted, then the ZSTD index can be ignored (Linacre, 2007).

Therefore, if this condition is not met, then the item should be either removed or refined. The Table 1.7 below shows the misfit order featuring items having the largest MNSQ and the smallest MNSQ analysis statistics: misfit order. Based on Table 1.7 below, found that 14 items from introduction to design and technology, 7 items from introduction to design project management, 9 items from product making, 20 items from apply technology and 1 item from introduction to design and technology in entrepreneurship that are not in the specified range and it should be revised or refined.

Table 1.7: Item Fit Based on MNSQ Value

Subconstruk	Measure	Model	Infit		0utfit		PTMEA	Item
		SE	MNSQ	ZSTD	MNSQ	ZSTD	CORR	
Introduction to Design and Technology	-2.71	0.66	1.03	0.2	2.38	1.2	0.49	P1B1
	-1.98	0.55	1.58	1.6	2.36	1.3	0.40	P1B8
	-0.01	0.37	0.82	-0.8	2.04	2.1	0.63	P1B6
	-0.81	0.43	1.95	2.7	1.82	1.3	0.41	P1B14
	0.82	0.33	1.03	0.3	1.56	1.7	0.61	P1B9
	-0.30	0.39	1.33	1.3	1.29	0.7	0.55	P1B5
	-0.15	0.38	0.72	-1.3	0.99	0.1	0.67	P1B13
	-0.81	0.43	0.96	0.0	0.65	-0.4	0.62	P1B2
	-1.44	0.49	0.95	-0.1	0.54	-0.4	0.59	P1B4
	-0.30	0.39	0.83	-0.7	0.60	-0.8	0.66	P1B10
	2.90	0.33	0.75	-1.7	0.67	-0.5	0.74	P1B16
	-0.01	0.37	0.75	-1.2	0.72	-0.6	0.68	P1B3
	-0.30	0.39	0.69	-1.4	0.50	-1.2	0.69	P1B7
	-0.46	0.40	0.64	-1.5	0.43	-1.3	0.69	P1B12
Introduction to Design Project Management	-1.28	0.45	2.15	2.8	2.875	2.4	0.72	P2B1
	-0.06	0.35	0.85	-0.8	0.60	-1.4	0.69	P2B4
	0.59	0.31	0.80	-1.4	0.74	-1.0	0.67	P2B11
	-0.44	0.37	0.79	-0.9	0.50	-1.5	0.70	P2B9
	0.17	0.33	0.75	-1.6	0.69	-1.2	0.68	P2B10
	-1.28	0.45	0.71	-0.9	0.74	-0.3	0.72	P2B2
	0.06	0.34	0.74	-1.6	0.57	-1.6	0.69	P2B8
Product Making	-1.00	0.36	1.32	1.5	2.32	2.0	0.46	P3B2
	-0.28	0.33	1.94	4.2	2.16	2.5	0.35	P3B1
	0.64	0.31	1.21	1.3	1.70	2.1	0.59	P3B12
	-1.00	0.36	1.02	0.2	1.38	0.8	0.58	P3B6
	0.83	0.31	0.81	-1.3	0.61	-1.4	0.74	P3B9
	-1.42	0.39	0.68	-1.5	0.58	-0.5	0.64	P3B3
	-1.42	0.39	0.65	-1.6	0.43	-0.9	0.66	P3B5
	0.54	0.31	0.58	-3.0	0.44	-2.3	0.79	P3B17
	0.73	0.31	0.56	-3.4	0.49	-2.0	0.80	P3B16
Introduction to Apply Technology	-0.74	0.37	1.45	1.8	2.67	2.5	0.35	P4B31
	0.08	0.32	1.48	2.3	2.10	2.6	0.37	P4B15
	-0.03	0.32	1.60	2.7	1.71	1.8	0.36	P4B30
	-0.13	0.33	1.18	0.9	1.71	1.7	0.49	P4B38
	-1.20	0.41	1.19	0.8	1.59	1.0	0.45	P4B32
	-0.74	0.37	1.20	0.9	1.47	1.0	0.46	P4B1
	-0.03	0.32	0.97	-0.1	1.43	1.2	0.56	P4B7
	0.46	0.30	0.74	-1.7	1.02	0.2	0.64	P4B11
	0.18	0.31	0.85	-0.8	0.73	-0.8	0.62	P4B16
	-1.78	0.48	0.83	-0.4	0.52	-0.4	0.67	P4B34

	0.88	0.28	0.83	-1.3	0.73	-1.0	0.63	P4B21
	-0.13	0.33	0.81	-1.0	0.56	-1.3	0.65	P4B28
	1.04	0.28	0.79	-1.7	0.67	-1.2	0.65	P4B22
	0.37	0.30	0.79	-1.3	0.72	-1.9	0.64	P4B10
	0.72	0.29	0.76	-1.7	0.70	-1.1	0.65	P4B20
	-2.03	0.51	0.73	-0.7	0.23	-1.0	0.60	P4B33
	0.27	0.31	0.66	-2.2	0.70	-1.0	0.68	P4B8
	-0.13	0.33	0.70	-1.7	0.55	-1.3	0.67	P4B37
	0.27	0.31	0.66	-2.2	0.58	-1.5	0.69	P4B13
	0.27	0.31	0.55	-3.0	0.51	-1.8	0.72	P4B9
Introduction to Design and Technology in entrepreneurship	-1.84	0.45	1.62	1.8	2.61	2.2	0.39	P5B1

Unidimensionality

Residual Principal Component Analysis (PCA) is used in Rasch's analysis to ensure the consistency of the dimensions of the instrument, the technique used is the Residual Variant Standard (Azrilah et al., 2015). Researcher refers to two criteria intesting the unidimensionality of an instrument namely the value of Principal Component Analysis of Residual (PCA) and (ii) the level of distortion of items or unexplained variance 1st contrast (Azrilah et al. 2015). According to Runnels (2012) the good PCA value is at least 20% and more than 40% and the unexplained variance 1st contrast is 15% maximum (Azrilah et al., 2015). Local independance is a value referring to the individual abilities of an item is not related to another item in the same construct. Values that meet local independance requirements are less than 0.7 (Linacre, 2007).

Table 1.8 below represents the findings of Principal Component Analysis (PCA) based on variance explained by measure for content knowledge. The PCA value for content knowledge 30.9% is accepted as it exceeds 20%. The value of unxplained variance by 1st contrast (size) to be in the desired specification is the content knowledge is 5.8%.

Table 1.8 Unidimensionality: Standardized Residual Variance for each Knowledge Sub-Construct: Pilot Study

Subcontruct	Varian explained by measure (%)	Unexplained variance by 1st contrast (size)
Introduction to Design and Technology	49.1	3.0(9.0%)
Introduction to Design Project Management	33.6	2.7(12.8%)
Product Making	44.6	2.5(8.1%)
Introduction to Apply Technology	35.5	5.7(9.4%)
Introduction to Design and Technology in entrepreneurship	28.6	1.6(16.1%)

Table 1.9 shows an item having a residual value correlation that exceeds 0.7 logits, P4B33, P4B34, P4B25, P4B39, P3B16, P3B17, P1B15 and P1B16 items. All these items go through the filter

process by looking at the value of seeing MNSQ values approaching the value of 1.00 and ZSTD approaching the value of 0.00. After the filtering process, P3B16 and P3B17 items have been dropped.

Table 1.9: Largest Standardized Residual Correlations Used to Identify Dependent Item

CORREL-ATION	ENTRY NUMBER	ITEM	ENTRY NUMBER	ITEM
.79	81	P4B33	82	P4B34
.74	73	P4B25	87	P4B39
.74	47	P3B16	48	P3B17
.71	15	P1B15	16	P1B16
.68	58	P4B10	59	P4B11
.66	57	P4B9	59	P4B11
.66	71	P4B23	72	P4B24
.65	75	P4B27	76	P4B28
.64	5	P1B5	11	P1B11
.60	51	P4B3	76	P4B28

Item Difficulty and Respondent's Ability

Figure 1.10 below represents item difficulty locations and distribution of examinees along the logit scale. Item difficulty measures from +1.21 to -1.43 logit. Meanwhile, the respondents' ability estimates from +1.53 to 0.16, which is slightly higher than the item difficulty measurement. The mean for both measurements is approximately around the same location, thus indicating that the items for this sample are well targeted. The map has greatly assisted the researcher in locating the area where most items are located particularly to see whether this is parallel with the spread of the respondents.

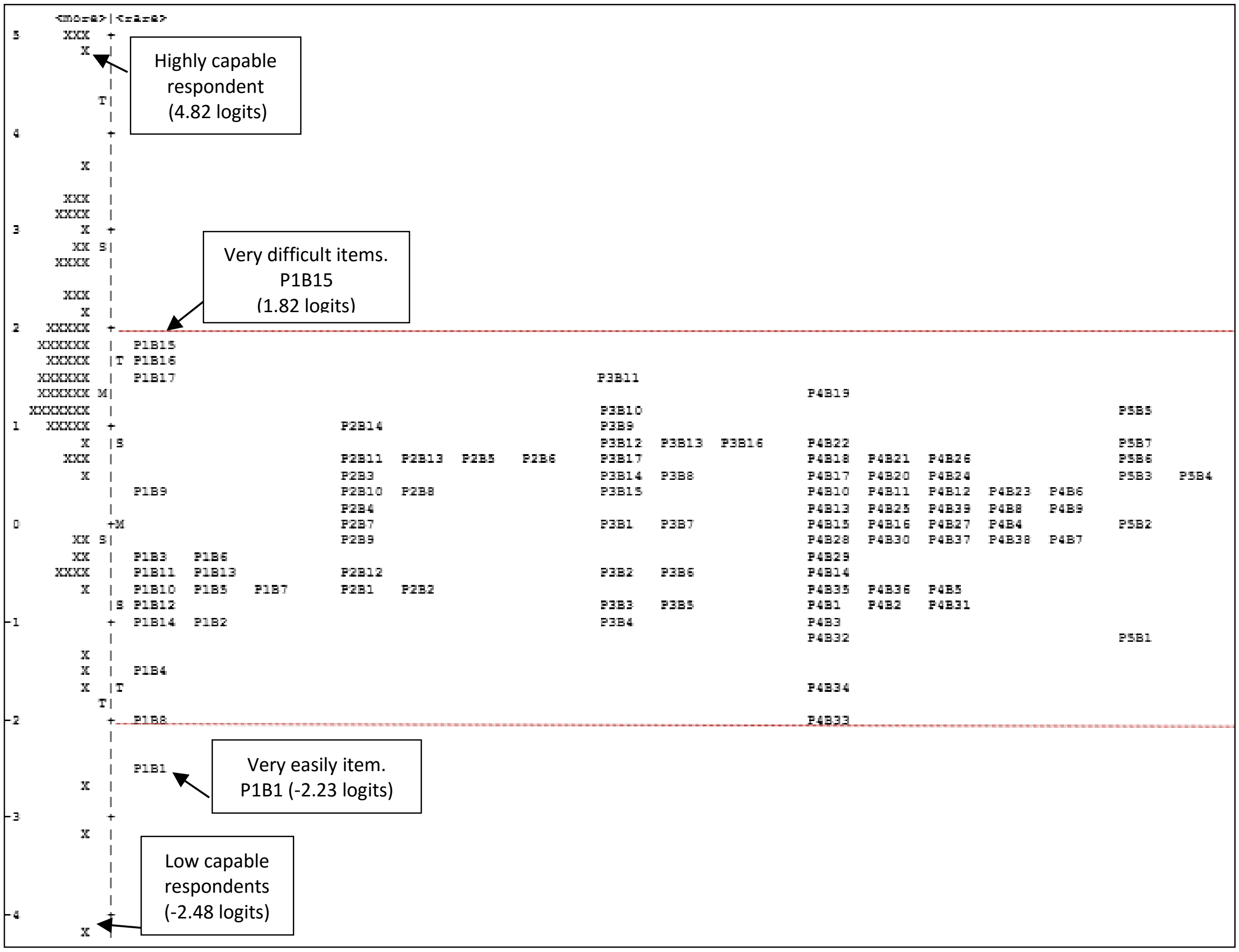

Figure 1.10: Items map of content knowledge of Design and Technology Subject Instrument

Figure 1.10 shows the number of respondent's ability and item difficulty on the logit scale. All the items are scattered and point towards the ability of respondents' diversity. Respondents that have high satisfaction located at the above on the scale, while the respondents that have low satisfaction are located below on the scale. The most difficult items are introduction to design and technology: P1B15 (1.82 logit) which located on the near upper scale. While the easiest item is introduction to design and technology: P1B1 (-2.23 logit). This shows that the difficult items can be answered by the highly capable respondents, while the easier item can be easily answered by the respondents of high ability and low ability (Linacre, 2007).

DISCUSSIONS AND CONCLUSION

After data analysis, each item is being revised following the standard index and the conditions that must be followed to achieve the standards of validity and reliability of the instrument based on the Rasch measurement model. The item removal refines, and purification were conducted by referring and considering the views and expert evaluation.

Based on the results obtained, there are 11 items that do not meet the requirements analysis and should be discarded. Whereas 40 items are appropriately refined in accordance with the context and significance of the study. 43 items were retaining from 94 items. Overall summary of the related items in the questionnaire is shown in Table 1.11 below.

Table 1.11: The Summary of Items Drop, Refine and Retained

Sub-Construct	Item	Total item	Item Drop	Total Item Drop	Item Refine	Total Item Refine	Item Retain	Total Item Retain
Introduction to Design and Technology	P1B1-P1B17	17	P1B8 P1B14	2	P1B1 P1B2 P1B3 P1B4 P1B5 P1B6 P1B7 P1B9 P1B10 P1B12 P1B13 P1B16	12	P1B11 P1B15 P1B17	3
Introduction to Design Project Management	P2B1-P2B14	14	P2B1	1	P2B2 P2B4 P2B8 P2B9 P2B10 P2B11	6	P2B3 P2B5 P2B6 P2B7 P2B12 P2B13 P2B14	7
Product Making	P3B1-P3B17	17	P3B1 P3B16 P3B17	3	P3B2 P3B3 P3B5 P3B6 P3B9 P3B12	6	P3B4 P3B7 P3B8 P3B10 P3B11 P3B13 P3B14 P3B15	8
Introduction to Apply Technology	P4B1-P4B39	39	P4B9 P4B15 P4B30 P4B31	4	P4B1 P4B7 P4B8 P4B10 P4B11 P4B16 P4B20	15	P4B2 P4B3 P4B4 P4B5 P4B6 P4B12 P4B13	20

					P4B21 P4B22 P4B28 P4B32 P4B33 P4B34 P4B37 P3B38		P4B14 P4B17 P4B18 P4B10 P4B23 P4B24 P4B25 P4B26 P4B27 P4B29 P4B35 P4B36 P4B39	
Introduction to Design and Technology in entrepreneurship	P5B1-P5B7	7	P5B3	1	P5B1	1	P5B2 P5B4 P5B5 P5B6 P5B7	5

Based on this research, it can be concluded that the validity and reliability of an instrument are a very important aspect to consider in developing a new instrument for a study. Overall from this analysis, it is found that a total of 11 items that were dropped are questionable items on validity and reliability. Thus, based on the validity and reliability test made on this instrument, it indicates that this instrument is fits to be used by school or other researchers for future study. The implications of this analysis help researchers in developing a good instrument for the school subject.

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References

Appanna, S., & Tajularipin, S., & Wulandari, Y. (2018). The Effectiveness of Teachers Higher Order Thinking Skills Questions on Science Test Achievement. 10.2991/icems-17.2018.41.

Aziz, A. A., Masodi, M. S., & Zaharim, A. (2013). Asas Model Pengukuran Rasch: Pembentukan Skala dan Struktur Pengukuran. Bangi: Penerbit UKM.

Bond, T. G., & Fox, C. M. (2007). *Applying the Rasch model: Fundamental measurement in the human sciences* (2nd ed.). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Bond, T. G., & Fox, C. M. (2015). *Applying the Rasch model: Fundamental measurement in the human sciences* (3rd ed.). Mahwah, New Jersey: Lawrence Erlbaum Associates.

Cooper, D. R., & Schindler, P. S. (2011). *Business research methods* (11th edition). New York: McGraw-Hill.

Cherner, T., & Smith, D. (2016). Reconceptualizing TPACK to meet the needs of twenty-firstcentury education. The New Educator. Advance online publication. doi:10.1080/1547688x.2015.1063744.

Conrad, K. J., Conrad K. M., Mazza, J., Riley, B. B., Funk, R., Stein, M. A., & Dennis, M. L. (2012). Dimensionality, hierarchical structure, age generalizability, and criterion validity of the GAIN's Behaviioral Complexity Scale. Psychological Assessment, *24*(4), 913-924, doi:10.1037/a0028196

Cooper, D. R., & Schindler, P. S. (2011). *Business research methods* (11th edition). New York: McGraw-Hill.

Fox, C. M., & Jones, J. A. (2005). Uses of Rasch modeling in counseling psychology research. Journal of Counselling Psychology, 45(1), 30-45.

Harun, Z., N. (2014). Kompetensi Guru dalam Pengajaran Amali Reka Bentuk dan Teknologi di Sekolah Rendah Daerah Batu Pahat.

Kementerian Pendidikan Malaysia. (2015). *Dokumen Standard Kurikulum dan Pentaksiran. Reka Bentuk dan Teknologi Tingkatan Satu*. Putrajaya: Bahagian Pembangunan Kurikulum.

Koehler, M., Greenhalgh, S., Rosenberg, J., & Keenan, S. (2017). What the tech is going on with teachers? Digital teaching portfolios? Using the TPACK framework to analyze teacher? Technological understanding. *Journal of Technology and Teacher Education, 25*(1), 31- 59.

Linacre, J. M. (2007). *A user's guide to WINSTEPS Rasch-model computer programs.* Chicago, Illinois: MESA Press

Moore, T. J., Johnson, C. C., Peters-Burton, E. E., & Guzey, S. S. (2016). *The need for a STEM road map*. In C. C. Johnson, E. E. Peters-Burton, & T. J. Moore (Eds.), STEM Road map: A framework for integrated STEM education (3-12). NY: Routledge Taylor & Francis Group.

Runnels, J. (2012). Using the Rasch model to validate a multiple choice English achievement test. International Journal of Language Studies, 6(4), 141-153.

Alwi, A., Kamis, A., & Ismail, B. L. H. (2018). Effects of Green Skills Module in Design and Technology Subjects on The Student's Knowledge in Primary School. *International Journal of Academic Research in Business and Social Sciences, 8*(11), 1701–1712.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching, *Educational Researcher, 5*(2), 4-14.

Sumintono, B. (2017). Rasch Model Measurement as Tools in Assessment for Learning. 10.2991/icei-17.2018.11.

World Design Rankings. (2017). Latest World Design Rankings. Retrieve From http://www.designerrankings.com