COMPETENCY ASSESSMENT OF CLOTHING FASHION DESIGN: RASCH MEASUREMENT MODEL FOR CONSTRUCT VALIDITY AND RELIABILITY

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ABSTRACT

The Clothing Fashion Design (CFaD) assessment instrument was used to measure the level of competence among instructors in Skills Training Institute (STI). This study was conducted to select items that are valid, fair, and of quality. The CFaD instrument consists of 97 Likert scale items with six constructs of designing, pattern drafting, computer, sewing, creative, and trade/entrepreneurship. The instrument was administered for the first stage of testing to 95 instructors in STI who teach in the field of fashion and clothing. The Rasch measurement model was used to obtain the reliability, validity, relevance of person items and unidimensionality of items. Therefore, Winsteps software version 3.72.3 was used to analyze the data. The findings showed that the items in the six constructs of skill competency have high reliability, from 0.63 to 0.96 for the Likert scale items. Meanwhile, the reliability of the respondents was estimated between 0.93-0.98. The analysis also indicate that 11 out of the 97 items were misfit while 32 items need to be repaired prior to the decision of dropping some of them due to lack of unidimensionality and differing levels of difficulty. Decisions to remove or repair were made so that the instrument is more fair and equitable to all respondents, and reliable.

Keywords: *Skill Competency, Clothing Design Fashion, Rasch measurement model*

1 INTRODUCTION

Quality instructors are important in ensuring the efficiency and effectiveness of delivery in the clothing fashion design (CFaD) program. Effective trainers with matching competence can help in perfecting the preparation and implementation of CFaD educational and training programs that are relevant to the needs of competent workforce for the growing fashion and clothing industry market (Pate, Trautmann, Torntore, & Walters, 2003; Hu, 2007; Hamzah, 2009).

Research indicates that competency is a contributor to work performance and productivity of an organization (Boyatzis, 1982; Palan, 2003; Gangani, McLean & Braden, 2006; Vanthanophas & Ngam, 2007; Mulder, & Collins 2007; Sachs, 2011). The developed competency models are important to ensure that a researcher or an organization can clearly reflect the behaviour of organizations in influencing the organizational effectiveness and performance (Spencer & Spencer, 1993; Klein, Spector, Grabowski & de la Teja, 2004). However, based on literature reviews, it was found that there are many different opinions featured on the competency model, which can be used as a standard because each competency models varies according to discipline (National Standards for Family and Consumer Sciences (NASAFC)ACS), 2008-2018); Kentucky occupational skill standards, 2011; FCS, 2010).

In the context of instructional delivery, the level of standardized competency practice is among the factors that affect the performance in the delivery of teaching, and in preparing the desired future teachers and students (Lee, 2002; Fox, Stewart & Erickson, 2008; Fox, 2009; Davis, 2010). Although there are various CFaD instruments that have been constructed such as *Wardrobe planning* (Manire, 1948), *Clothing placement test* (Witt, 1961), *Hem construction test* (Lochoof, 1969), *Basic clothing construction competencies test* (Stufflebean, 1982), and *Clothing care on stain removal test* (Aderson, 1973), these instruments have been used for too long and are only used to measure the competency level among students. A good CFaD competency instrument for assessing educators' competency is thus necessary as it can be a tool in enhancing the training and development of CFaD trainers. Furthermore, there is still no CFad competency instrument that has been built to measure the level of competency of educators in the Malaysia context.

The CFaD competency instrument on the components of skills and knowledge can still be explored. The development of the instrument can improve the scope of practice for competencies development; opens up an opportunity to enrich the CFaD competency theory and model in addition to the improvements of competencies development content which is broader in scope, and can be used to measure the level of competency of trainers. Therefore, the study on the development of CFaD instrument should be carried out to help Skills Training Institutes (STI) assess and improve the level of competency of their trainers in order to ensure the effective delivery of CFaD learning towards producing CFaD graduates that meets the needs of the industry.

1.1 Purpose of study

The purposes of this study are to explore the psychometric properties of CFaD instrument and to examine the validity and reliability of the newly developed CFaD competency instrument.

2 RESEARCH METHODOLOGY

This research involves both the qualitative and the quantitative method. The qualitative method involved in-depth interviews and document analysis and the quantitative method involved data collection through the newly developed instrument. However, this paper intended to focus and explain the instrument development and validation process. The respondents were 95 trainers in STI in Malaysia. The politomus data (Likert) were collected and analyzed based on the Rasch Model with the aid of computer application software, WINSTEPS version 3.72.3.

The questionnaire consists of two parts, Part A contains 97 items covering six sub-components of CFaD skills and Section B contains eight itesm regarding demography. Part A requires the respondents to present their perception of the level of competence they have based on their honesty and integrity using 4 point Likert scale which are 1 (Not competent), 2 (Moderately competent), 3 (Competent) and 4 (Very competent). The skills competency constructs are: 1) Designing-DS: 16 items, 2) Pattern Drafting-PDS: 16 items, 3) Sewing-SS: 12 items, 4) Computer-CS: 10 items, 5) Creative-CRS: 11 items and 6) Trade / Entrepreneurship-TES: 32 items.

3 FINDINGS AND DISCUSSIONS

The findings discussed are based on the data of the pilot study for skills items that were constructed after the face and content validity verifications by relevant experts. The pilot study was conducted to ensure that the items constructions meet the Rasch measurement model procedure. The item functionality inspection covered aspects of reliability, items suitability/fit and items unidimensionality.

3.1 Items and Person reliability

Person and items reliability show the extent to which the items are compatible (conform to fit) with the Rasch Model and item and person separation index. Table 1 shows the summary of the item separation index and person separation index, the item reliability and person reliability. The findings show that the items for the six constructs have reliability ranging from 0.63 to 0.96, while respondents' reliability index is between 0.93-0.98. The indices indicate that the items are very good as the values are close to 1.0. The reliability values of more than 0.8 are acceptable values, while values between 0.6 - 0.8 are less acceptable and values less than 0.6 are not acceptable (Bond & Fox, 2007). Only one construct showed low item reliability index which is the Designing skill (0.63). Although this value does not conform to high reliability index, it is adequate and is of acceptable level (Pallant, 2011). The items reliability index can be further

enhanced if the misfit items are given special attention. Table 1 also shows the maximum Outfit MNSQ value of those four constructs where Pattern Drafting = 9.90; Sewing = 2.20; Creative = 1.79 and Trade / Entrepreneurship = 1.54 show that there are at least one or more misfit or inconsistent items with any of the constructs measured. Therefore, the summary of the reliability index in Table 1 is important in order to identify the misfit items for a construct based on the maximum Outfit MNSQ value. The misfit order inspection for each knowledge competency item in the six constructs should be done to identify those misfit items that do not fit with the Rasch measurement model.

Separation Index is the separation of items and person. The items and person separation value which is more than 2 is good (Fox & Jones, 1998; Linacre, 2005; Bond & Fox, 2007). Item separation index is the separation of item difficulty level, while person separation index is the estimated separation or person group differences by level of ability in the measured variables. The result showed the item separation index to be between the values of 1.31 to 5.00. Statistically speaking, these items can be divided into 1 to 5 strata or levels of agreement. This also shows that these items are 1 to 5 times more dispersed from the square root of the error. Table 1 also shows that the items of the competency construct of Designing as having the lowest value of items separation of 1.31. Separation item value which is less than 2 is less accepted. This suggests that the real difference related to the ability of respondents is hard to distinguish for the Designing construct. The items separation index for Pattern Drafting items is at the level of 4, Sewing skills construct is at 5, Computer skills construct is at 3, Creative skills constructs is at 3 and items of Trade/ entrepreneurial construct is at 2.

The higher the value of the separation index of the items, the better the measurement instrument because the items are separated by levels of varying difficulty. The separation index will increase if the reliability of items is increased and misfit items are detected and removed from the analysis. The study also found that the person separation index for the six competency skills constructs is between the values of 3.54 to 6.65. This indices show that the person difference or separation can measure the ability of persons with measuring variables (Wright & Master 1982; Bond & Fox, 2007).

Table 1: The reliability of CFaD skills constructs

No	Construct	Total items	Item reliability	
			Item	Separation
1.	Designing	16	0.63	1.31
2.	Pattern Drafting	16	0.93	3.61
3.	Sewing	12	0.96	5.00
4.	Computer	10	0.91	3.15
5.	Creative	11	0.92	3.45
6.	Trade/ Entrepreneurship	32	0.72	1.59

3.2 Polarity of items that measure the constructs

With regard to the polarity of items, all items must move in a similar direction in interpreting the measured constructs by the positive PTMEA value. If the point-measure correlation (PTMEA Corr) value is high, it shows that the items are able to distinguish between respondents' ability (Bond & Fox, 2007). If the value of PTMEA Corr is lower than 0.30, it means that the items do not fulfil the criteria set. Table 2 shows that the items in the CFaD skills constructs are more than 0.30 indicating that all items are measuring the corresponding constructs. This analysis is a fundamental step to measure the validity of the constructs used to build and validate the CFaD skills instrument.

Table 2: PTMEA value of items

Construct	DS	PDS	SS	CS	CRS	TES
Item 11	.82	.71	.91		.75	.84
Item 12	.83	.83	.89			.89
Item 13	.89	.75				.89
Item 14	.87	.76				.88
Item 15	.88	.68				.81
Item 16	.86	.76				.73
Item 17						.79
Item 18						.80
Item 19						.84
Item 20						.85
Item 21						.86
Item 22						.78
Item 23						.85
Item 24						.87
Item 25						.85
Item 26						.78
Item 27						.79
Item 28						.81
Item 29						.87
Item 30						.82
Item 31						.81
Item 32						.89

DS = Designing Skill, PDS = Pattern Drafting Skill, SS = Sewing Skill, CS = Computer Skill, CRS = Creative Skill, TES = Trade / Entrepreneurship Skill.

3.3 Difficulty of items and respondents

Figure 1 below represents item difficulty locations and distribution of examinees along the logit scale. Item difficulty measures from +3.08 to -2.30 logit. Meanwhile, the respondents' ability estimates from +4.51 to -4.82, which is slightly higher than the item difficulty measurement. The mean for both measurements are 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.

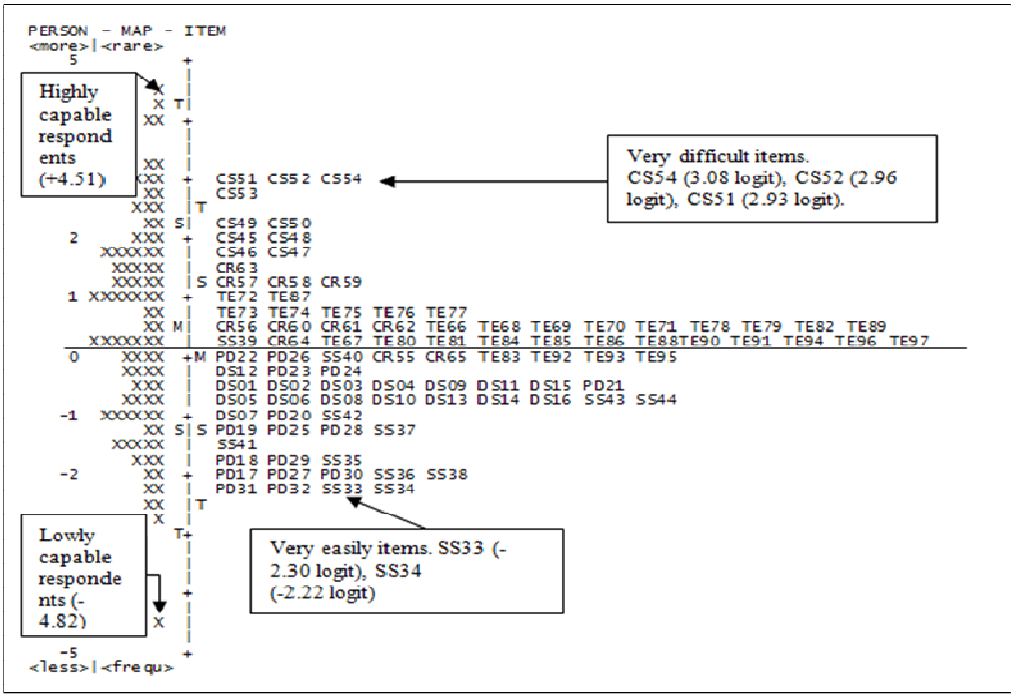

Figure 1: Items map of competency skills constructs

The Figure 1 shows the number of respondent 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 competency are above the scale, while the respondents that have low competency are below the scale. The most difficult items are Computer Skill: CS54 (3.08 logit), Computer Skill: CS52 (2.96 logit), Computer Skill: CS51 (2.93 logit) that are on the upper scale. While the easiest items are Sewing Skill: CS33 (-2.30 logit) and Sewing Skill: SS34 (-2.22 logit). This shows that the difficult items can be answered by the highly capable respondents, while easy items can easily be answered by respondents of high ability and low ability (Linacre, 2007). Figure 1 also shows that there are four respondents who have high competence and one respondent have very low competence.

3.4 Suitability / Fit of Items in Measuring Constructs

The appropriateness of items in measuring the constructs can be seen in the total mean square Infit and mean square Outfit of each item and the respondent. For politomus data (Likert scale) the acceptable range of fit items for Likert scale is between 0.6 logits to 1.4 logits (Bond & Fox, 2007). If the items are out of the range, it must be separated in order to make modifications or rephrase (Linacre, 2005). This is due to the matter that suitability of an item will affect and influence the reliability and validity of the instrument. Table 4 shows the measurement of misfit items or items that do not fit the Rasch measurement model for the six CFaD competency skills constructs. A value that are higher than 1.4 indicate that the items are not homogeneous with other items in a measurement scale and value that is lower than 0.6 indicates redundancy with other items. Table 4 shows a total of 11 misfit items out of 97 items of competency skills based on Outfit/Infit MNSQ index. The constructs and the total items are Designing Skill (DS) = 1 item, Sewing Skill (SS) = 1 item, Computer Skill (CS) = 4 items, Creative Skill (CRS) = 1 item and Trade / Entrepreneurship Skill (TES)= 4 items. Therefore, the 11 competency skills items of the first pilot study were isolated for analysis procedure of Rasch measurement model.

Table 4: Misfit items of competency skills

Construct	Measure	MODEL S.E	INFIT	OUTFIT	PTMEA CORR	ITEM
			MNSQ	ZSTD	MNSQ	ZSTD
DS	.55	.28	1.51	2.5	1.47	1.7
SS	2.44	.23	2.22	6.3	2.20	5.1
CS	.87	.27	.68	-2.0	.59	-1.9
CS	-1.78	.42	.48	-.20	.29	-.40
CS	1.01	.27	.60	-2.7	.49	-2.5
CS	1.30	.27	.56	-3.0	.53	-2.1
CRS	-.98	.23	1.61	3.5	1.79	3.8
TES	-.36	.24	1.37	2.1	1.40	1.8
TES	.66	.24	.64	-2.5	.57	-2.4
TES	.18	.25	.68	-2.2	.55	-2.5
TES	-.24	.24	.67	-2.2	.58	-2.4
DS	.55	.28	1.51	2.5	1.47	1.7

DS = Designing Skill, PDS = Pattern Drafting Skill, SS = Sewing Skill, CS = Computer Skill,
CRS = Creative Skill, TES = Trade / Entrepreneurship Skill

Table 5 shows a summary of the items that need to be improved because there are some items found to be redundant in the measured scale and items that were deemed appropriate for these constructs but has Infit/Outfit MNSQ value beyond 0.6 to 1.4. The overlapping items of the constructs are DS(DS03,DS04,DS05,DS10,DS13,DS15), PDS (PD031,PD032,PD023,PD28), CS

(CS46,CS49,CS50,CS52,CS53), CRS (CR061) and TES (TE66, TE75, TE84, TE86, TE94, TE95, TE96).The other items have Infit / Outfit MNSQ value beyond 0.6 to 1.4. After referring to experts, the researchers decided that these items can be repaired for further analysis and should not be dropped. Linacre (2005) also stated that if a less-fitting item is indeed measuring a construct, the item should be improved.

Table 5: Items that need improvement in CFaD skills competency constructs

No	Construct	Item	Measure	InfitMNSQ	OutfitMNSQ	PTMEA Corr
1.	Designing Skill (DS)	DS03	.47	1.31	1.40	.86
		DS04	.31	.57	.41	.92
		DS05	-.53	.69	.51	.91
		DS10	-.53	1.07	.84	.86
		DS13	-.30	.74	.51	.89
		DS15	.24	.86	.80	.88
2.	Pattern Drafting Skill (PDS)	PD17	-.91	.37	.86	.75
		PD21	.06	9.90	9.90	.45
		PD23	1.21	1.05	1.05	.79
		PD27	-.91	.46	1.04	.71
		PD28	.06	.81	.77	.83
		PD30	-.95	.24	1.04	.76
		PD31	-.98	.20	1.12	.68
		PD32	-.99	.15	.82	.76
3.	Sewing Skill (SS)	SS34	-1.49	.59	.51	.83
		SS43	.62	.54	.50	.91
4.	Computer Skill (CS)	CS46	-.97	1.18	1.19	.86
		CS49	-.24	1.05	.94	.89
		CS50	-.44	1.09	.98	.87
		CS52	1.08	.63	.63	.91
		CS53	.87	.68	.59	.90
5.	Creative Skill (CRS)	CR61	-.44	.72	.66	.90
6.	Trade / Entrepreneurship Skill (TES)	TE66	.24	1.26	1.13	.78
		TE72	1.01	1.37	1.33	.78
		TE75	.72	.70	.62	.87
		TE79	.36	.74	.66	.88
		TE81	-.12	1.52	1.54	.73
		TE84	-.30	.90	.80	.84
		TE86	-.42	.88	.92	.86
		TE94	-.42	.74	.64	.87
		TE95	-.54	.94	.80	.82
		TE96	-.42	1.02	.86	.81

Table 6 shows a summary of the items that need to be repaired or removed and the number of items that remain. A total of 11 items of competency skills constructs have been dropped, 32 items need to be improved and the numbers of maintained items are 86 items.

Table 6: Summary of functionality examination of CFaD skills competency items

No	Construct	Item	Total item	Analysis of Rasch measurement model / expert.					
				Dropped item	Total dropped Item	Improved item	Total improved item	Maintained item	Total maintained item
1.	Designing Skill (DS)	DS01-DS16	16	4 1 1	1	3,4,5,10, 13,15	6	1,2,3,4,5,6,7, 8,9,10,12, 13,14,15,16	15
2.	Pattern drafting Skill (PDR)	PD17-PD33	16	-	-	17,21, 23, 27, 28, 30, 31,32	8	17,18	16
3.	Sewing Skill (SS)	SS33-SS44	12	39	1	34,43	2	33,34,35,36, 37,38,40,41, 42,43, 44	11
4.	Computer Skill (CS)	CS45-CS54	10	47,48, 51,54	4	46,49, 50,52, 53	5	45,46,49,50, 52,53	6
5.	Creative Skill (CRS)	CR55-CR65	11	65	1	61	1	55,56,57,58, 59,60,61,62, 63,64	10
6.	Trade / Entrepreneurship Skill (TES)	TE66-TE97	32	67,77, 78, 97	4	66, 72, 75, 79, 81,84, 86, 94, 95, 96	10	66,68,69,70, 71,72,73,74, 75,76,79,80, 81,82,83,84, 85,86,87,88, 89,90,91,92, 93,94,95,96	28
	TOTAL		97		11		32		86

4.5 Unidimensionality of items

Unidimensionality refers to characteristics of test items that measure a single ability. Linacre (2005) suggests that a construct requires 5 items or more to allow it to have the weight upon a factor before the factor or construct is treated as a different dimension. As Linacre (2007) suggests the value of *unexplained variance explained by 1st contrast* (size) <3.0 units is good, and the value of *unexplained variance explained by 1st contrast* (size) <5% is well accepted. While Fisher (2007) also suggests the *variance value explained by 1st contrast* (size) <3% is excellent, 3-5% is very good, 5-10% is good, 10-15% is moderate and 15% is poor. Based on Table 7 that shows the principal component analysis (PCA) found the *unexplained variance explained by 1st contrast* (size) for 2 competency skills constructs are showing <3.0 units, which is good, as proposed by Linacre (2007). The constructs are Computer = 3.1 (9.2%) and Creative = 2.3 (5.5%). However, the other 4 sub constructs have the *unexplained variance value explained by 1st contrast* (size) > 3.0 units, which are the skills of Designing = 4.1 (7.3%), Pattern drafting = 4.0 (10.2%), Sewing = 3.6 (9.9%), and Trade/Entrepreneurship = 6.8 (6.6%). This clearly indicates the existence of a second or third dimension for these 4 subs constructs and they need to be analyzed again.

Rasch analysis also requires at least a minimum of 40% Raw *variance explained by measures* as proposed by Fisher (2007) and Linacre (2007) also suggests that is better to exceed 60%. Results showed that Raw *variance explained by measures* (%) above 60% is good for sub constructs skills of Designing = 71.7%, Pattern drafting = 64.8% Sewing = 67.3%, Computer = 70.2, Creative = 72.9, and Trade/ Entrepreneurship = 68.6%. This is very crucial as it clearly indicates that 4 construct being multidimensional which therefore violate the unidimensionality requirement of Rasch Model.

Table 7: Unidimensionality: Standardized Residual Variance for six constructs of skills competency

No.	Construct	Varian Explained by Measures (%) (eigen)	Unexplained Variance Explained by 1st Contrast (size)
1.	Designing Skill (DS)	71.7	4.1 (7.3%)
2.	Pattern Drafting Skill (PDS)	64.8	4.0 (10.2%)
3.	Sewing Skill (SS)	67.3	3.6 (9.9%)
4.	Computer Skill (CS)	70.2	3.1 (9.2%)
5.	Creative Skill (CRS)	72.9	2.3 (5.5%)
6.	Trade / Entrepreneurship Skill (TES)	68.6	6.8 (6.6%)

5 CONCLUSION

The Rasch model was used to identify quality items for an assessment instrument used to measure the level of competence among CFaD instructors. The results of the Winstep analysis indicate that the item reliability index and respondent reliability index were quite good except for the designing sub construct. Thus, the items that measure this construct need to be given more attention in order to achieve a better item reliability. Removal of items that are not compatible with the model should be considered to improve the validity and reliability of the CFaD instrument. Thus, although most of the items are moving in a similar direction, there are also a few items that do not contribute meaningfully to the measurement of the desired constructs. From this study, a review of the reliability and validity of the content of the instrument indicate that 11 items need to be dropped from the 97 items, while 32 items need to be improved before considering to be dropped due to the lack of unidimensionality and varying levels of difficulty.

Meanwhile, based on the analysis results, special attention should be given to four sub constructs (Designing, Pattern drafting, Sewing and Trade/Entrepreneurship) as there are at least one or more misfit items that causes the value of unexplained variance inferred from the 1st contrast that is high. This clearly indicates the existence of a second or third dimension for the four constructs which need to be re-examined. Researchers also need to ensure that all the items are unidimensional, have different levels of difficulty, fair to all persons who answer the built instrument. The reliability of the items and the respondents should be given serious attention so as to ensure that the instrument is consistent with the ability of the respondents. Consequently, the instrument can produce a more meaningful measurement.

The findings are expected to contribute to the preparation of teachers, educators and instructors of CFaD program in schools and in the STI by modifying the existing competencies in the curriculum. Additionally, it is also expected to contribute to the Division of Teacher Education and the relevant public education institutions in designing appropriate training programs that meet the needs of trainers and teachers for the CFaD program. The findings acn also be used to inform the relevant agencies in establishing national standards of CFaD competence in the profession of fashion in STI, Institute of Teacher Education (ITE) and schools in Malaysia. The information obtained can provide guidance for CFaD trainers to equip themselves with competencies to facilitate the delivery of knowledge to CFaD students that will prepare students to pursue a career in the garment industry after graduating. The use of the appropriate assessment tool will support instructors and students in preparing for the ever changing demands of the CFaD industry.

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