

Using Rasch Model and Confirmatory Factor Analysis to Assess Instrument for Clothing Fashion Design Competency

K. Arasinah, Ab. R. Bakar, H. Ramlah, A. Soaib, and H. Zaliza

Abstract—The study aimed to determine the validity, reliability, polarity and fitness of the items, as well as to confirm the measurement model of Clothing Fashion Design Competency (CFaDC). Winsteps software was used to test the validity and reliability of the instrument, meanwhile AMOS was used to verify the measurement model. The results show the index of the items, the reliability of the individual (person) and high separation of the items and individual isolation. The results also show that the instrument is consistent, valid, stable and reliable if being administered into another sample with similar characteristics. Polarity items indicate that there were 4 knowledge items that measured other constructs and the items were dropped. A total of 31 knowledge items and 16 skills items were detected as misfit and were also dropped. Measurement model was fitted to the data and was accepted based on the suitability index (Fit Indices) that has been achieved, namely: CMIN $\chi^2 = 1306,979$, with degrees of freedom (df) 680, CMIN/df = 1.922 (< 5.0), CFI = 0.941 (> 0.90), IFI = .941 (> 0.90), TLI = 0.935 (> 0.90) and RMSEA = 0.053 (< 0.08). The instrument has been proven to be a good instrument and passed the psychometric standards.

Index Terms—Knowledge, Rasch model, structural equation modeling, skill.

I. INTRODUCTION

Competency plays an important role in every aspect of today's job. It is proven to have a positive impact on the workers, especially in educational institutions that have links related to the skills needed in the workplace [1]-[3]. The competency applied in Technical and Vocational Education (TVE) is designed to produce technical human capital that is not only technically qualified and skilled but also have high competency in technical field for their marketability [4]-[6]. Therefore, TVE educators should implement an effective teaching process and deliver the teaching in accordance to the academic standard, thus they need to master various level of competencies [7]-[9]. They also need to master certain levels of competency that has been certified by private institutions, government and training institutions involved in the job market [10].

Therefore, to acquire competent educators and have the

necessary competencies, the development of CFaDC instruments with high validity and reliability should be carried out. The development of CFaDC instruments must be suitable, stable, state-of-the-art and steady. CFaDC aspects are important in order to be used as a guide for educators to be able to deliver effective teaching and in line with the standard [8], [11]. Indirectly, skilled and semi-skilled worker can be produced to fulfill the industrial market needs. Meanwhile, there are various CFaDC instruments from abroad have been built, but there is no really legitimate instrument that has been built, and also all the instruments are too old and do not measure the competency comprehensively, for example the Clothing care on stain removal test instrument (1973), Hem construction test (1969), Wardrobe planning (1948), Basic clothing construction competencies test (1982), and Clothing placement test (1961). In addition, there is no available CFaDC instrument build in Malaysia to be used in STI. Therefore, the study of the development, instrument validation and CFaDC model should be carried out. The objectives of this study are to:

- 1) Determine the validity and reliability of CFaDC.
- 2) Test the reliability and respondents' item separation index.
- 3) Determine and detect the item polarity of CFaDC.
- 4) Detect the suitability of CFaDC item.
- 5) Validate the CFaDC measurement model.

II. METHODOLOGY

This study used a form of quantitative approach by survey method using questionnaires. The respondents consist of 330 instructors at STI in Malaysia that were selected by simple random sampling. The instrument consists of 157 items, which are 85 knowledge items (dichotomous), and 72 skill items (polytomous). The data were analyzed using the Rasch measurement model (Winsteps version 3.72.3) in the first stage and Structural Equation Modeling analysis using AMOS software (version 21) in the second stage.

III. RESULT AND DISCUSSION

In the first stage, the data was analyzed using the Rasch measurement model. Knowledge items consist of 5 subconstruct with 85 items of: 1) Design: 10 items, 2) Clothing construction: 40 items, 3) Clothing Selection: 9 items, 4) Clothing Care: 12 items, and 5) Textile Evaluation: 14 items. Knowledge items were in the dichotomous form, which are multiple choices, matching, right-wrong and filling

Manuscript received January 4, 2014; revised March 10, 2014.

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in the blank. Meanwhile, skill items were in polytomous form with the four score Likert scale designed based on category of: 1) not competent, 2) moderately competent, 3) competent, 4) very competent. Skill items consist of 6 constructs with 72 items of: 1) Designing (DS): 13 items, 2) Pattern drafting (PD): 14 items, 3) Sewing (SS): 8 items, 4) Computer (CS): 6 items, 5) Creative (CR): 10 items, and 6) Trade (TR): 21 items.

A. Analysis Using Rasch Measurement Model

The first stage was the process of analyzing data using Rasch measurement model to test the reliability of the instrument as shown in Table I. Table I shows the reliability index for the interpretation of knowledge competency items (85 items) of 0.99, while for the assessment of competency skills (72 items) was about 0.99. The reliability of the respondents for the assessment of knowledge competency was 0.84 and the skills competency assessment was 0.98. This indicates that these instruments are consistent and stable if administered in other samples that have the same and nearly similar features. The reliability index is parallel with CFaDC instruments as suggested by [12]-[15], which stated that the respondents and item reliability index > 0.8 is an acceptably good and high index.

Meanwhile, the index of item separation was 8.38 for items of knowledge and skills items was 9.64, which statistically means that CFaDC items are distinguished based on the 8 and 9 levels of different measurement. Respondents separation index (person separation) for knowledge items was 2.2 and skill items was 6.51, which shows the ability of the respondents can be divided into 2 and 6 levels of ability to answer the competency item. The findings are in line with the recommendations by [13], [16] whom stated that the value of individual and item separation exceeds the value of 2 is considered good. Meanwhile, [12] also recommends the value of individual and items separation between 2 to 3 is moderately good and more than 5 is excellent. The higher the level of item separation, thus the measurement instrument is better as they are separated with varying difficulty.

Meanwhile, the polarity of the items shown by the PTMEA Corr value as mentioned by [17] that PTMEA CORR negative value indicates the item is not moving in line with other items to measure the constructs. Therefore, out of the 85 knowledge items, 4 items have negative PTMEA CORR value and were omitted because these items measured other constructs. A total of 81 moving items measured 5 knowledge subconstruct, where the PTMEA CORR values were between -0.02 to 0.54. Meanwhile, all 72 skill items have strong positive PTMEA CORR values between 0.47 to 0.73. This means that all skill items moved in line or to the same direction with other items in measuring the skills construct more meaningfully. Thus, 81 knowledge items and 72 skill item statistically indicated that the items moved in a desired direction. These items were not in conflict with the intended CFaDC constructs to be measured.

The suitability of the item (item fit) was based on the Outfit / Infit MNSQ index. The acceptable range for the item fit to the Likert scale (polytomous) is between 0.6 logits to 1.4 logits and for dichotomous data is between 0.7 to 1.3 logits as proposed by [13] and [18]. The higher value

indicates the item is not homogeneous with other items in a scale of measurement. The low value indicates redundancy constructs with other items. The results in Table I explained out of 85 knowledge items, 31 items were detected as misfit, while from 72 skill items, 16 items were detected as misfit. Hence, only 54 knowledge items and 56 skill items contributed to the construction of CFaDC competency subconstruct.

TABLE I: SUMMARY OF THE VALIDITY AND RELIABILITY OF THE ITEMS USING RASCH MODEL

No	Objective	Results		Acceptance Level
		Knowledge (85 items)	Skill (72 items)	
<u>Reliability</u>				
2a	Reliability test and item separation index of respondents.			
	-Item's reliability	0.99 (KR20)	0.99	>.70 [12]- [15]
	-Respondents' reliability	0.84	0.98	
	-Item separation index	8.38	9.64	>2.0 [13], [16]
	-Respondents' separation index	2.25	6.51	>2.0 [12]
<u>Fit item validity</u>				
2b	To determine and detect the polarity of CFaDC competency item.			
	-To what extent do the items moved in one direction to interpret the constructs?	-0.02-0.54 (4 negative items omitted)	0.47-0.73 (72 positive index items)	-PTMEA Corr (positive values) [17]
	-To what extent do the items contribute towards the constructs measured?	54 out of 85 items measured construct	-56 out of 72 items measured construct	
2c	Detect the suitability/fit of CFaDC competency items.			
	To what extent do the items fit with the measurement model?	31 items <i>misfit</i>	16 items <i>misfit</i>	<i>Infit /outfit</i> MNSQ -0.7 -1.3 (dichotomous) [13] -0.6 - 1.4 (polytomous) [13], [18]

B. Analysis Using Structural Equation Modeling (SEM)

Further analysis used Structural Equation Modeling (SEM) to ensure the findings meet the accuracy and consistency. Confirmatory Factor Analysis (CFA) was used to test the construct validity of the skill competency items with Likert scale. The skill items acquired were consistent and have good internal validity, which is through the convergent and discriminant validity. The findings of the CFA determined that out of the 56 items, only 34 skill items have good and acceptable convergent validity and discriminant validity.

The final analysis to confirm the measurement model CFaDC was by using AMOS. As [19] suggested to check the suitability (fit) measurement model, the analysis is dependent on the suitability index (fitness index). At least 3 or 4 fitness indices criteria must be met as shown in Table II. The

individual measurement values (person measure) were entered into SPSS and then the data were analyzed using AMOS. As [19] suggested reporting Chi Square / df (Parsimonious fit), CFI or TLI (Incremental Fit) and RMSEA (Absolute fit) is sufficient to evaluate the measurement model.

CFaDC measurement model obtained 41 degree of freedom and Chi square goodness-of-fit statistics, ($N = 330$, $df = 680$) = 1306.979, $p = < 0.00$. The results show that this model obtained Chi square value of 1306.979, degree of freedom is 680, and the level of probability (probability level) was .000. Fig. 1 shows a model of CFaDC competency measurement containing 5 subconstructs of knowledge competency and 6 subconstructs of skill competency. The knowledge items contained 54 items of Design (8 items), Tailoring (27 items), Cloth Selection (5 items), Clothing Care (8 items), and Textile Evaluation (6 items). Meanwhile, the skill items consisted of 33 items of Designing (8 items), Pattern Drawing (4 items), Sewing (6 items), Creative (4 items), Trade (9 items), and Computer (4 items).

TABLE II: CRITERIA FOR SUITABILITY INDEX (FIX INDICES)

Suitability index	Measurement	Referenc e	Suggested value	Comment
CMIN/DF	1.922	[20]	≤ 5.0	The value must be ≤ 5.0
		[21]	≤ 5.0	
IFI	.941	[22]	$\geq .90$	IFI $\geq .941$ is a good fit
		[23]	$\geq .90$	
CFI	.941	[21]	$\geq .90$	CFI $\geq .941$ is a good fit
		[24]	$\geq .90$	
TLI	.935	[25]	$\geq .90$	TLI $\geq .935$ is a good fit
RMSEA	.053	[26]	$\leq .08$	RMSEA $\leq .08$ accepted and is a good fit
		[27]	$\leq .05$	

DF (degree of freedom), CFI (Comparative of Fit Index), TLI (Tucker-Lewis Index), RMSEA (Root mean square error of approximation)

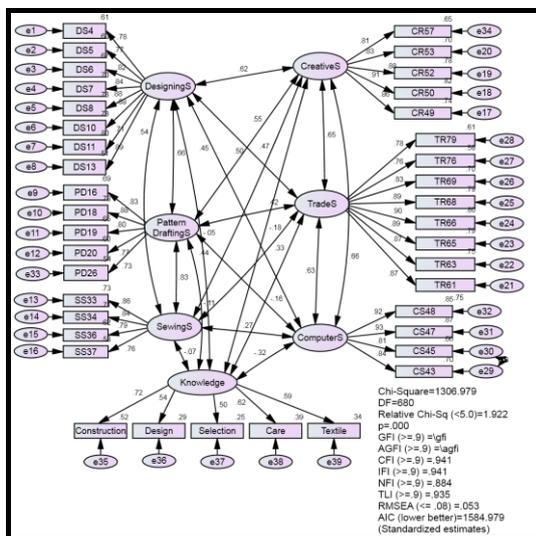


Fig. 1. CFaDC competency measurement model.

Fig. 1 also shows the model is fit with the data and

accepted based on the suitability index (fit), which is: CMIN $\chi^2 = 1306.979$ with the degree of freedom of (df) 680, CMIN/df=1.922 (≤ 5.0), CFI=0.941 (≥ 0.90), TLI=0.935 (≥ 0.90), IFI=0.941 (≥ 0.90), and RMSEA=0.035 (≤ 0.08). Furthermore, the weighting factor was between 0.502 to 0.935. The CFaDC instrument consists of 11 subconstructs with 88 items, 54 knowledge competency items, and 34 skill competency items.

IV. CONCLUSION

The validity and reliability of each item in the instrument is very important. The psychometric properties are proofs of high validity and reliability. The results of analysis using the Rasch measurement model achieved an index of the items reliability, the reliability of an individual (person), the item separation and the relatively high individual separation of knowledge and skill items. This shows CFaDC instrument is reliable and valid. Meanwhile, although most of the items moved in a similar direction, there are also a few items that do not contribute meaningfully to the measurement for the desired construct.

The researcher also ensures that each items is unidimensional naturally, have different levels of difficulty, fair to all individuals who answered the built instrument. In addition, the reliability of the items and the respondent is to be taken seriously to ensure that the built instrument and respondents are consistent. The instrument can also produce a more meaningful measurement. Analysis result using the Rasch model found the CFaDC instrument have good construct validity and are acceptable. Further analysis of the CFA on 56 skill items with Likert scale found that only 34 items obtained good internal consistency and validity through convergent and discriminant validity. Furthermore, CFaDC measurement model consists of 5 subconstructs of knowledge competency (56 items) and 6 subconstruct of skill competency (34 items). The model was fit to the data and was based on the suitability index (fit) achieved, namely: χ^2 CMIN, CMIN / df, CFI, IFI, TLI, and RMSEA.

The findings of this study would provide new leads to the robustness of the competency standard for CFaDC program so that it is always updated and in sync with the needs of industry, Institute of Teacher Education, the profession of fashion in STI and the schools in Malaysia. The findings are also expected to contribute to the preparation of fashion program for teachers, educators and trainers in schools and in the STI by modifying the existing competencies in the curriculum. Thus, the robust CFaDC instrument, legitimate and fair can be practiced at STI, which emphasizes the skills and knowledge components that can still be explored. Therefore, the development of CFaDC instrument can improve the content scope of the practice competency constructions, which can still be refined and explored. This exploration provides opportunities to enrich the theory or CFaDC model alongside the enhancement to the construction content competencies with more broader scope besides assessing the level of competency of instructors in STI.

ACKNOWLEDGMENT

Arasinah, K. Author thanks to all the individuals involved

in helping to obtain all the needed information and the supervisor of this research. The author(s) received no financial support for the research and/or authorship of this article.

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