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Fashion and clothing instrument for Malaysian fashion lecturers: An analysis of the instructors' competency scale

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Abstract

A latest fashion and clothing instrument that has high validity and reliability can serve as a predictor in measuring the competency of lecturers in the field of fashion. Indirectly, with this instrument, it is expected to improve the competency content that still needs to be explored and refined. Apart from that, this kind of exploration opens up new opportunities to enrich theories and models in the fashion and clothing field. This study aims to validate the knowledge competency scale of fashion and clothing among lecturers. The questionnaires consisted of 45 items, ranging from multiple choice questions to matching questions, right and wrong questions, and fill-in-blank questions. The validation of the constructs was carried out in two phases, firstly, using the Rasch Measurement Model (RMM), and secondly using the Confirmatory Factor Analysis (CFA). Results from the RMM analysis showed that there were 18 misfit items that needed to be removed. Additionally, through the CFA (convergent and discriminant validity), the instrument recorded a consistent internal validity scales of good, acceptable, and fit to the model. All four sub-constructs were also recorded as having high validity, since the overall model showed a good and acceptable fit. In the regard, the scale was deemed successful in fulfilling the psychometric standard and the instrument was adequately stable and could be used at any given time for samples that possessed the same or almost the same criteria.

Keywords: confirmatory factor analysis, fashion, psychometric, Rasch Measurement Model, reliability, unidimensionality

Introduction

The research to develop and validate fashion and clothing instrument should be carried out in order for the instructors to practice and increase their teaching competency based on the fixed standards. The standard fashion and clothing competencies should take into account the opinion of industrial experts, instructors and the current demand of the market (Arasinah et al., 2014). There are a few researches that have developed and validated competency instruments that measure the aspects of skills and knowledge of fashion and clothing relatively. Those instruments only measure the competency of students, not the instructors or teachers (Manire, 1948; Witt, 1961; Lochoof, 1969; Stufflebean, 1982 & Aderson, 1973). An instrument that is valid, reliable and strong can be used to measure the competency level of instructors and also to recruit new instructors.

For industry-related people, the findings of this research is expected to be made the as the guidelines of skills and knowledge that needs to be applied by the instructors of fashion design. Apart from that, it can also assist employers to develop various trainings to increase the level of skills in order to improve their work performance and competencies (Arasinah et al., 2014). The existing relationship that was built based on cooperation between the industry and educational institutions will be able to supply future

workforce that are more knowledgeable and skillful. When the skills and knowledge received by the students are parallel with the demands of the employers, it will cut down the cost incurred by the companies to train new employees.

The result of this study is also expected to be beneficial to new employees in the future that will be involved in this field. They will be able to compare and evaluate the competencies demanded by the employers. Moreover, it can also serve as a guide to individuals before they involve themselves in the field of designing. It is anticipated that the information given will be able to assist new graduates in obtaining jobs more easily and get worthy remuneration relevant to their competencies. The result of this study will also contribute towards generating new ideas, comprehension of concepts and improvement of knowledge field related to technical field that is needed now (Haziyah, Zawiyah, Aminuddin, & Aishah, 2012). That knowledge is not only local but also global. Thus, this research intends to validate the fashion and clothing knowledge competency instrument. The research questions are as follow:

1. What is the item and respondent reliability index?
2. What is the item and respondent separation index?
3. What is the level of item polarity for competency items?
4. What is the level of fit between the items and the measurement model?
5. Are the items one-dimensional?
6. Can fashion and clothing knowledge competency instrument be explained by the four sub-constructs?

Literature review

The researcher referred to various existing fashion and clothing design instruments which were mostly of foreign origin. However, those instruments were not suitable due to reasons such as very back-dated, only measures one part of the competency and not comprehensive. Literature reviews on skills and knowledge competencies showed that all the stated aspects are important and needed in the field and industry of fashion and clothing. The existing instruments were very old and each of the instruments only measured one construct and does not measure all the aspects of fashion and design as a whole (Manire, 1948; Witt, 1961; Lochoof, 1969; Aderson, 1973; Stufflebean, 1982; Workman, Caldwell & Kallal, 1999). The validity and reliability test of the instruments also only focused on the content validity by using the expert opinions, face validity and Kuder-Richardson 20 and Cronbach alpha reliability as shown in Table 1. Therefore, a strong, stable, valid and highly reliable instrument need to be developed so that it can be used for individuals and institutions related to this field.

Table 1. Comparison of clothing and fashion design

No	Autors/Year	Description	Type of Questions	Samples
1.	Manire (1948) *Wardrobe planning*	Instrument related to wardrobe planning, accessories selection, sewing machines and cloth-making processes. Alpha Cronbach 0.393.	205 multiple choices questions	Students of fashion field
2.	Witt (1961) *Clothing placement test*	Instrument of competency of cloth-care, cloth-design and cloth-selection. Item discrimination and difficulty index. *Kuder-Richardson* was .74	Multiple choices questions	112 Students of fashion field

No	Autors/Year	Description	Type of Questions	Samples
3.	Lochoof (1969) *Hem construction test*	Competency of hem-stitching skill.	Knowledge (10 items), comprehension (8 items), application (4 items), analysis(13 items) and evaluation (1 items)	56 Students of *Clothing and Textile*, experimental group (32 students) and control group (24 students)
4.	Anderson (1973) *Clothing care on stain removal test*	Experimental method to observe various teaching methods using tests, card games, charts, teaching using video tapes and slide presentations. Kuder-Richardson/KR20 was .83	Test developed to examine the understanding of students on the techniques of cloth-care	Pre-test (70 students) and post-test (56 studenst)
5.	Stufflebean (1982) *Basic clothing construction competencies test.*	Competency of clothing construction.	500 multiple choices questions	Students of fashion and clothing
6.	Workman, Caldwell & Kallal (1999) *Apparel Spatial Visualization Test*	Spatial visual ability to design clothing and ASVT fashion product development. Alpha cronbach 0.79-0.89	20 multiple choices questions	Students of fashion and clothing

Methodology

This research uses two methods to analyze data using the Winstep and Analysis of Moment Structure (AMOS). The researcher used the Winstep software to ensure that the items that are developed have the needed fit value, suitability of individual items to test the validity and reliability of the instrument. The instrument's validity issues can be managed using the Rasch Measurement Model (RMM). The model is used to evaluate items based on particular criteria. It is also a unidimensional model that is based on the assumptions that individuals with high capability has the probability of answering all the questions correctly. In the other hand, easier items will most probably be answered correctly by all the respondents (Wright & Stone, 1979; Wilson, 2005). The criteria of evaluation of RMM are shown in Table 2.

Table 2. Criteria of Rasch Measurement Model evaluation index

Fit Indices	References	Suggested value
Item's and respondents'reliability	DeVellis (2012); Pallant (2011); Pallant & Tennant (2007); Bond & Fox (2007)	> 0.80
Item's and respondents'separation index	Fisher (2007); Linarce, (2004)	> 2.00
Polariti item	Fisher (2007); Linarce (2004)	PTMEA Corr (positive values)
Item *fit*	Linacre (2002)	*"Local item fit"* 1.08-0.90 (infit MNSQ) 1.18-0.82 (outfit MNSQ)
Unidimensi	Fisher, 2007; Bon & Fox, 2007; Linacre, 2006; Smith, 2002; Reckase, 1979)	Rasch Principal Component Analysis (RPCA) *-Unexplained variance explained in 1st contrast* *- Standardized residual variance explained by measure*

Next, the researcher used AMOS to validate measurement model in CFA to identify suitability of model based on data. The researcher used different software to assist in making decisions that are more informational in validating items that has psychometric values. SEM has two models which are measurement model and structural model. The researcher used the measurement model only to determine the instrument's construct validity (Nurul Fadly, Suzaituladwini, Zuraidah, Wan Salmuni, Sharon, Yee Ong & Norlaile, 2015). The earlier part of the model needs CFA. The researcher used the combination of Rasch and CFA to increase the confidence related to suitability of items and construct dimensionality to answer the research questions as in the research of Christensen, Engelhard dan Salzberger (2012) dan Arasinah, Ab. Rahim, Ramlah, Soaib, Norhaily (2013). Table 3 below shows the criteria of fit indices.

Table 3. Criteria of fit indices

Fit Indices	References	Sugested value
CMIN	Tabachnik & Fidell (2007)	If sample >100-200
CMIN/DF (*degrees of freedom)*	Marsh & Hocevar (1985) Bentler (1990)	≤ 5.0 ≤ 5.0 Of sample > 200
AGFI (*adjusted goodness of fit*)	Chau & Hu (2001)	≥ .80
GFI (*goodness of fit index*)	Chau (1997) Segars & Grover (1993)	≥ .90 ≥ .90
CFI (*comparative of Fit Index*	Bentler (1990) Hatcher (1994) Schumacker & Lomax (2010)	≥ .90 ≥ .90 ≥.90
NFI (*normed fit index*)	Bentler & Bonett (1980)	≥ .90
RMSEA (*the root mean square error of approximation*)	Byrne (2010) Hu & Bentler (1999)	≤ .08 ≤ .095

Research instrument and participants

Knowledge items were of multiple choice questions, matching, true or false and fill in the blanks. The knowledge items consisted of 4 sub-constructs with a total of 45 items. Sample selection to test validity and reliability of instrument using the Rasch measurement model and CFA was different. Linacre (1994) stated that the sample selection using the Rasch measurement model should identify the number of sample needed to obtain item calibration or stable individual. How big is the needed sample to determine items that are useful and stable or how long the testing is needed to obtain estimation of useful and stable individuals?

Table 4. Number of samples according to Rasch Measurement Model

Determination of item stability	Level of Confidence	Minimum value of sample size (strongest to weakest)	Suitable sample size
+ 1 logit	95%	16-36	30
+ 1 logit	99%	27-61	50
+ ½ logit	95%	64-144	100
+ ½ logit	99%	108-243	150

Source: Linacre, 1994; pg. 328.

To determine a set of items on different samples using the same examination, the researcher need to expect a result that is a little different. Table 4 shows the number of samples based on the Rasch measurement model. The researcher also analyzed data using the SEM to measure CFA model and to

validate items that measure a certain construct in the instrument. The determination of sample size for CFA was based on suggestions of Bryne (2010) and Hair, Black, Babin dan Anderson (2010). The suggestion was it should be more than 100 to 150 (Hair et al., 2010). The determination of sample size used the formula of Cochran (1977). Overall, the total number of samples were 330.

Results

During the first level, Rasch measurement model was used to identify validity and reliability of the instrument. The final analysis to evaluate content validity was done using the SEM to ensure the findings are precise and consistent.

Rasch Measurement Model (RMM)

Table 5 shows the summary of statistic that measured 45 knowledge items. The item reliability index is 0.99 and categorized as a value that is high, good and acceptable. This means that the items are stable and consistent when measured using respondents who has the same or almost similar criteria. The respondents' reliability index is 0.84 and categorized as a value that is high and acceptable. This means that the respondents are stable and consistent when tested using the different items that measures the same constructs. The item separation index is 8.38. there are 8 levels of agreeableness for these items. The higher the value of separation the better the instrument because the items are separated by different levels of difficulties. The respondents separation index is 2.25 and this explains that the respondents can be categorized into two groups of abilities. The item and respondent separation index showed that the values are acceptable because it is more than 2.0.

Table 5 also shows the findings of *point measure correlation* (PTMEA CORR) or the point of correlation measurement for 45 items of knowledge competency (4 sub-constructs) to determine the item polarity. The minimum value of *point* PTMEA CORR is 0.20 and maximum is 0.51. The findings showed that there are 4 items that has negative PTMEA CORR value. This means that the items are not parallel and should be eliminated. Positive value shows that the items are moving together in measuring a construct. The item polarity explains to which level the development of knowledge competency items fulfils its aim and identify to which extent the relationship between the items and the respondents. This research needs positive PTMEA CORR value to prove that this instrument is free from item polarity issues. The PTMEA CORR analysis is a basic procedure that is very important in order to produce items that are truly in line with other items to measure the intended construct. In conclusion, the other items in this construct are parallel with the construct it intended to measure and contribute towards the measure construct.

Table 5. Summary of the validity and reliability of the items using RMM

No	Objectives	Results (45 items)	Acceptance Level
	Reliability		
1.	What is the item and respondent reliability index?		
	-Item's reliability	0.99 (KR20)	> 0.80 (DeVellis, 2012; Pallant , 2011; Pallant & Tennant, 2007; Bond & Fox, 2007)
	-Respondents' reliability	0.84	
2.	What is the item and respondent separation index?		

No	Objectives	Results (45 items)	Acceptance Level
	-Item separation index	8.38	> 2.00 (Fisher, 2007; Linarce, 2004)
	-Respondents' separation index	2.25	> 2.00
3.	What is the level of item polarity for competency items?	0.2-0.51 (4 negative items omitted) 18 out of 45 items measured construct	-PTMEA Corr (positive values) (Fisher, 2007; Linarce, 2004)
4.	What is the level of fit between the items and the measurement model?	14 items *misfit*	*"Local tem fit"* 1.08-0.90 (infit MNSQ) 1.18-0.82 (outfit MNSQ) (Linacre, 2002)
5.	Are the items one-dimensional?	*Unexplained variance explained in 1st contrast* (saiz) adalah 4.5% (3.1) *Standardized residual variance explained by measure 35.8%*	Rasch Principal Componen Analysis (RPCA) (Fisher, 2007; Bond & Fox, 2007; Linacre, 2006; Smith, 2002; Reckase, 1979)

Table 5 shows the *misfit* items that does not fit the Rasch measurement model for the 4 sub-constructs of knowledge. Basically, the guideline to evaluate *"local item fit"* is by ensuring that the *infit* value is greater than SD and min *infit*. Based on the Table 5, the guideline showed that the overall index of 85 knowledge items, ReFP is Mean (0.99) +/- S.D (0.09) = 1.08/0.90 (*infit* MNSQ) and Mean (1.00) +/- S.D (0.18) = 1.18/0.82 (*outfit* MNSQ). The higher value shows that the items are not homogenous with other items in one measurement scale. A lower value shows construct redundancy with other items. Therefore, it was found that 14 out of 45 items are *misfit* and not suitable with Rasch measurement model based on the *outfit/infit* MNSQ and thus eliminated.

The findings of Rasch Principal Component Analysis (RPCA) showed that the knowledge items which showed the biggest factor that was separated the residual is 3.1 unit. It has the strength of 3 items and less than 5 items. This is good. Thus, the findings showed that the existence of a second dimension is not evident. The unexplained variance explained in 1st contrast size is 4.5% compared to the varians and this is considered very good because it is less than 15%. This vaguely showed that there are no side factors to measure knowledge competency. This data also showed that the Rasch dimension only explains 35.8% of the varian in the data. The s*t*andardized residual variance explained by measure for the data and expectation model are similar, which was 35.7%. Therefore, it cab be concluded that this sub-construct showed that the measurement dimension to be moderate and acceptable.

Confirmatory Factor Analysis (CFA)

The final analysis was to evaluate the content validity of the instrument using the SEM to ensure the findings are precise and consistent. The items were checked through convergent and discriminant validity.

a. Convergent validity

The first step was to determine the convergent validity of sub-constructs. The convergent validity was determined by referring to the weighing factors that are more than 0.50 and even better if it is 0.70, *Average Variance Extracted* > 0.5 and construct/composite reliability >.70. The knowledge competency has 4 sub constructs which are (i) Design, (ii) Clothing selection, (iii) Clothing care, dan (iv) Textile evaluation. Table 6 shows the measurement statistic of AVE and CR for each item of all the sub-constructs. The values are within the range of 0.579 to 0.900. This shows that all the factors fulfils the

point of 0.50 and even better if it is 0.70 and acceptable. The AVE value of 4 sub-constructs fits the criteria and its more than 0.50. The lowest AVE value of knowledge competency was for Clothing selection (0.550) and highest for Textile evaluation (0.687). this proves that the complete measurement model of knowledge competency has a good convergent validity.

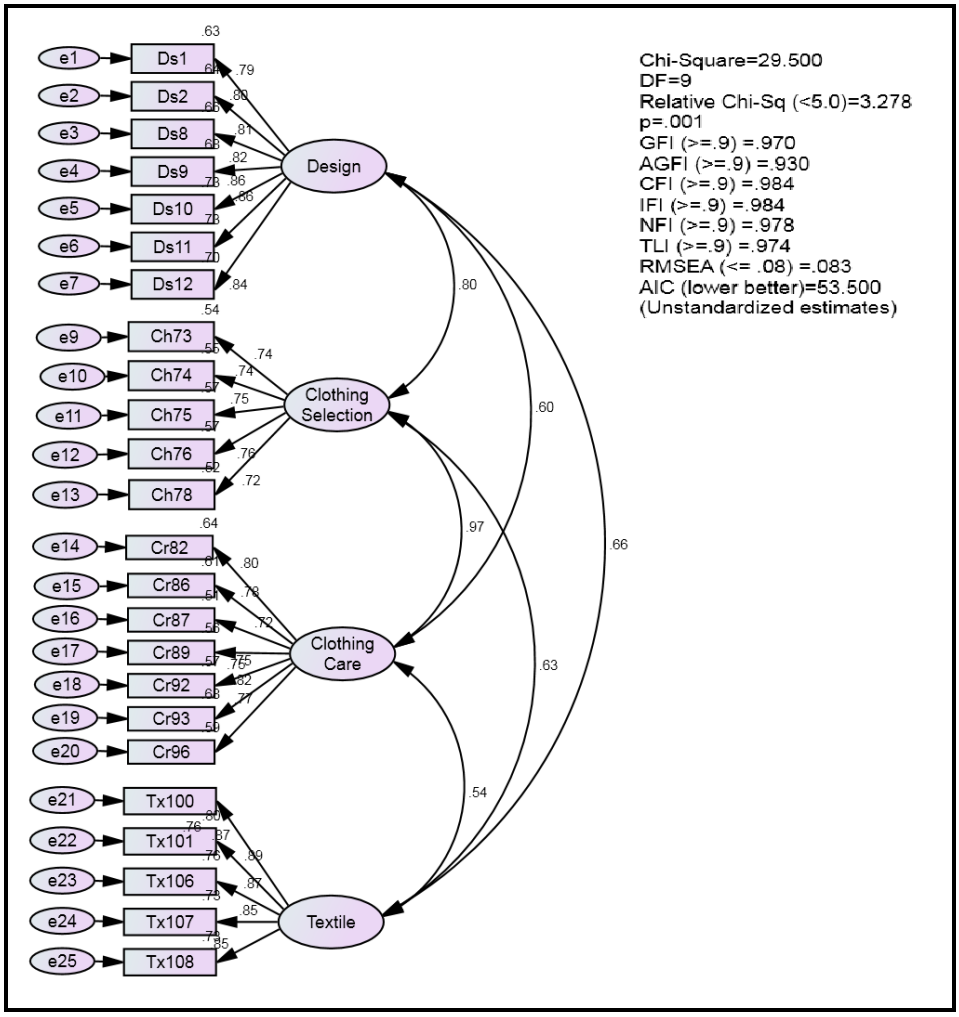
Table 6. Factor loading, AVE and CR

Construct	Items	Cronbach alpha	Factor loading (>0.05)	CR [1] (>0.70)	AVE [2] (>0.50)
Design	Ds1	0.980	0.798	0.933	0.637
	Ds2		0.793		
	Ds8		0.809		
	Ds9		0.828		
	Ds10		0.865		
	Ds11		0.723		
	Ds12		0.829		
	Ds13		0.730		
Selection	Ch73	0.857	0.764	0.858	0.550
	Ch74		0.744		
	Ch75		0.810		
	Ch76		0.798		
	Ch78		0.579		
Care	Cr82	0.910	0.849	0.912	0.597
	Cr86		0.828		
	Cr87		0.748		
	Cr89		0.766		
	Cr92		0.714		
	Cr93		0.748		
	Cr96		0.745		
Textile	Tx100	0.927	0.870	0.928	0.687
	Tx101		0.900		
	Tx106		0.875		
	Tx107		0.850		
	Tx108		0.846		
	Tx110		0.594		

b. Discriminant validity

Following the convergent validity, the discriminant validity was determined. The discriminant validity was determined by comparing the AVE values of two factors with r^2 (square of correlation between two factor*s*), which was determined if AVE > r^2. the discriminnat validity test also found that the AVE value was greater than r^2 (square of correlation between two factors) bfor all the sub-constructs of knowledge competency and thus fulfils the fixed requisite. This findings also prove that the measurement model of this research is free of discriminant problems.

Figure 1 shows the complete measurement model of fashion and clothing design knowledge competency that consisted of 4 sub-constructs. The knowledge items has 24 items as follow: Design (7 items), Clothing selection (5 items), Clothing care (7 items) dan Textile evaluation (5 items). The inter-factor correlations were r= 0.80, 0.97, 0.54, 0.60, 0.63 and 0.66, substantiated the hypothesis that the four factors were distinct. The loadings range was between 0.72 to 0.89. Dapatan menunjukkan model adalah *fit* dengan data berdasarkan indeks kesesuaian (*fit*): Chisq/df= 3.278 (< 5.0), CFI=0.984 (>0.90), TLI=0.974 (>0.90), IFI=0.984 (>0.90), dan RMSEA=0.08 (<0.08). As a final results, only 24 items fit the model and fulfill the psychometric standard.



Rajah 1. *CFaDC Competency Measurement Model*

Discussion

Rasch Measurement Model

The reliability index of knowledge instrument is parallel with the suggestions made by Bond and Fox (2007); Pallant dan Tennant (2007); DeVellis (2012) that stated reliability index of respondents and items of > 0.8 is considered high and can be accepted. Fisher (2007) identified that reliability value of respondents and items of more than 094 is excellent. However, Pallant (2011) opinioned that reliability value of .60 is still acceptable for new instruments or the ones that are still under development. The Cronbach's alpha and KR20 for both competency construct in this research has value higher than the findings of other researchers that developed and validated instrument. Among those researchers were Witt (1961) where KR20 was only 0.74, Anderson (1973) with KR20 was 0.83, Stufflebean (1982) where alpha value was within the range of 0.59 and 0.91, Kaughlin and Kean (1995) with Spearman-Brown reliability value between 0.77 and 0.93, and Yang (2010) with alpha value between 0.53 and 0.91. Rasch measurement model prepared indices that assist researchers to check whether the developed items are distributed sufficiently along the continuum and distributed based on the ability of the respondents. The respondent reliability index of this instrument is high and good.

The separation index of the knowledge items can be differentiated into 8 levels of measurements. The respondent separation index shows the ability of the respondents and it can be divided into 2 levels of capability to answer the items. The findings of this research is corresponding with the suggestions of Linarce (2004) that explained that the value of individual and item separation of more than 2 can deemed good. Fisher (2007) stated that the value of individual and item separation of 2 to 3 are moderate and more than 5 is excellent. This showed that the items in this instrument are 8 to 9 times more distributed than r^2 or has 8 levels of agreeableness or level of difficulties. The respondents of the research are twice more distributed than r^2 or 2 and 6 levels of different capabilities.

The item polarity was determined by observing the PTMEA CORR value. The final analysis found that 4 out of 45 items has negative PTMEA CORR value and must be eliminated based on the suggestions of Linacre (2010) and Bond and Fox (2007). (2007) because it measures unintended constructs. Only 27 items move to measure the 4 sub-constructs of knowledge based on the PTMEA CORR value. Linacre (2010) stated that the negative PTMEA CORR value showed that the items are not moving together in measuring the intended construct. Fisher (2007) suggested that if the PTMEA CORR value is lesser than 0.40, the items do not fulfil the criteria, thus the items can be eliminated. therefore, the researcher follows the suggestion of Linacre (2002) that negative items can be eliminated and items with value of less than 0.3 are repaired and maintained.

The final analysis found that only 18 items are misfit and not suitable with Rasch measurement model. It has to be eliminated based on the range suggested by Bond and Fox (2007), and based on the *"local item fit"* Linacre (2002). The misfit items bring negative effects towards the validity of the instrument. The knowledge items are unidimensional because it measures only one dimension at a time as suggested by Bond and Fox (2007) and Smith, (2002). The unexplained variance explained by 1st contrast index knowledge items is very good which was 4.5% as suggested by Fisher (2007) dan Linacre (2006). They opinioned that index lower than 5% and lower 15% can still be accepted. Overall, only 27 items were maintained in the instrument.

Confirmatory Factor Analysis

The strenght of thi sinstrument lies its ability to show that each construct used contributes twards measurement. All the 4 sub-constructs show high construct validity when the model shows a good fit with all the criteria value are acceptable to determine construct validity. This shows that this instrument has sufficient stability to be used continuously on sample groups of same or similar characters. This is in line with the suggestion of Byrne (2010) that there are a few types of fix indices that are used to measure model fit whis is Chisq/DF $\leq$ 5.0 (Marsh & Hocevar, 1985; Bantler, 1990), GFI $\geq$ 0.90 (Chau, 1997; Segars & Gover, 1993), CFI $\geq$ 0.90 (Bentler, 1990; Hatcher, 1994; Schumacker, & Lomax, 2010), NFI $\geq$ 0.90 (Bentler & Bonett, 1980) dan RMSEA $\leq$ 0.08 (Byrne, 2010; Hu & Bentler, 1999). This findings show that the 4 sub-constructs which has 24 items (design knowledge, clothing selection, clothing care and textile evaluation) has good, consistent internal validity that passed the psychometric standard and thus can be used to measure the level of instructors competency in skills training institute.

Conclusion

This research explored the psychometric criterion of fashion and clothing knowledge competency instrument and validated it as an instrument that can measure the competency level of instructors. This research also showed important proofs about the usability of procedure by using Rasch measurement model and CFA analysis through SEM to validate the instrument. The validation of an instrument that has good psychometric value enable the validation procedures to be smooth. The CFA result prove that this instrument has high construct validity with fit indices value that fulfils all the criteria successfully tested. The fashion and clothing competency instrument has two constructs which are knowledge competency

and performance competency. Knowledge competency can be used by related parties to measure the levels of competency in fashion and clothing filed. Performance competency for lecturers that relevant and effective can help to complete the preparation and implementation of related educational programs and trainings which are relevant to the needs of the competent work force in the development of fashion industry.

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