CFA for Principal Instructional, Technology Acceptation and Competency Teaching East Coast Boarding School in Malaysia

Mohd Zalmadi Razali, Abdullah Ibrahim, Zamri Chik
Faculty of Islamic Contemporary Studies, Universiti Sultan Zainal Abidin, Gong Badak Campus, 21300 Kuala Terengganu, Terengganu, Malaysia
Email: zalmadirazali76@gmail.com, zamrichik2015@gmail.com
Corresponding Author Email: abdullahibrahim@unisza.edu.my

Abstract
Confirmatory Factor Analysis (CFA) is conducted in the measurement model and there are two ways to conduct CFA through individual Confirmatory Factor Analysis or group Confirmatory Factor Analysis. It depends on how many items are in the construct and if the items in the construct have more than four, the measurement model analysis is conducted separately. Whereas, pooled CFA runs all measurement models at the same time. This Unidimensionality requirement can be met through the item deletion procedure that has a low factor loading value to reach the set level of fitness indexes. Items with a factor loading value of less than 0.6 are considered unimportant to the measurement of the construct and can be discarded (Chik & Abdullah, 2018). A total of 384 study samples were involved in this research, among East Cost Boarding School teachers in three (3) states on the East Coast of Peninsular Malaysia. Data were analyzed using the IBM-SPSS-AMOS (SEM) program version 21.0. Adjustment tests were conducted to ensure that the tested indicators truly represent the construct being measured and Confirmatory Factor Analysis was conducted in this study as a prerequisite that must be met. The findings of the study show that all the correlations between the constructs (Principal Instructional Leadership, the Acceptance of Technology Applications and Competency Teaching Teacher have a value less than 0.85 (<0.85) among East Coast Boarding school teachers in three (3) states (Kelantan, Pahang and Terengganu) on the East Coast of Peninsular Malaysia. The results of the Combined Confirmatory Factor Analysis of all measurement models (Pooled CFA), prove that all constructs have a strong relationship with each other to avoid the existence of multicollinearity problems.
Keywords: Instructional Principal Leadership, Acceptation of Technology Aplication and Competency Teaching Teacher in East Coast Boarding School in Malaysia

Introduction

The CFA method is able to assess the extent to which the observed factors are significant to the latent construct used. According to Byrne (2013), this assessment is done to examine the strength value of the regression structure path that starts from the factor to any variable used (ie the value of the weighting factor-factor-loading value) and not through any relationship between the factors. .During the CFA process, any item can be dropped in the model when it does not follow the values or fit the measurement model. This mismatch is due to the low value of the load factor. According to Chik and Abdullah (2018), it is necessary to carry out the CFA process on any construct used in the model, even if the model is created separately or even merged. There are two models that need to be analyzed to run a Structural Equation Modeling (SEM), namely the Measurement Model and the Structural Model. According to Awang (2012; 2015); Hoque et al (2017), two steps that need to be carried out when building a Structural Equation Model (SEM), among which is to verify the Measurement Model for all the constructs involved using the CFA method and build a model for all the constructs found in the Structural Model and perform the SEM procedure.

Measurement Fit Model with research data is important to verify a Structural Equation Model (SEM) (Chik & Abdullah, 2018). The constructed SEM becomes invalid when the Measurement Model does not match the data from the field. Therefore, when doing SEM analysis it is necessary to determine the appropriateness of the Measurement Model to the data from the field. Using CFA to conduct a Measurement Model fit analysis based on field data. Through the CFA approach, it is necessary to test statistically to verify the Measurement Model on the constructed construct.

Research Methodology

The research method used is quantitative and uses research instruments that have been adapted according to the suitability of factors based on Principals Instructional Leadership, Teachers' Acceptance Of Technology Integration and Teacher Teaching Competency in education among SBP (Sekolah Berasrama Penuh) teachers in three (3) states on the East Coast of Peninsular Malaysia. Data were analyzed using Structural Equation Modeling (SEM) with the help of the IBM-SPSS-AMOS version 21.0 program. SEM is formed with two (2) main models namely Measurement Model and Structural Model. Before the SEM test is performed, an adaptation test should be conducted to ensure that the indicators tested truly represent the construct being measured. Confirmatory Factor Analysis (CFA) is a measurement model test to ensure that each construct meets procedures such as validity and reliability for each construct tested (Kline, 2016; Hair et al., 2006; Schumucker & Lomax, 2004). The fit of the measurement model is very important to ensure that each latent construct in this study has fit with the data studied before SEM can continue (Kline, 2016; Schumucker & Lomax, 2004). Using the CFA method can assess the extent to which the observed factors are significant to the latent construct used. This evaluation is done by examining the value of the strength of the regression structure path from the factor to the observed variable (ie Factor Loading value) instead of the relationship between the factors (Byrne, 2001). Through the use of CFA, any item that does not fit the measurement model is dropped from the model. This discrepancy is due to the low value of the load factor. Researchers need to perform the CFA process on all the constructs involved in the model, either separately or in a pooled CFA model (Alias & Hartini, 2017). The suitability of the tested hypothesis model was verified by using Fitness Indexes to see the value of Root Mean Square Error of Approximation (RMSEA<0.08), Comparative Fit Index (CFI>0.90) and Chi Square/Degrees of Freedom (chisq/df<5.0).

According to Hair et al (2006) if the $\chi2$ value is less than 2.00 but significant, then it is necessary to state whether the sample size is large or vice versa. A sample size that exceeds 200 can cause the $\chi2$ value to be significant. Because of that, Hair and his colleagues suggested two other indices namely CFI and RMSEA to ensure that the CFA analysis forms the unidimensionality of the study model. If the CFI value exceeds 0.90 and the RMSEA is less than 0.08, it is said that there is unidimensionality for the formation of each construct.

Findings
Confirmatory Factor Analysis (CFA)
There are two models that need to be analyzed in carrying out Structural Equation Modeling (SEM), namely the Measurement Model and the Structural Model. Chik and Abdullah (2018) suggest two steps that need to be carried out in a Structured Equation Modeling (SEM) namely: a) Confirming the Measurement Model of all the constructs involved through the Confirmatory Factor Analysis (CFA) method, and b) Modeling all the constructs into Structural Model as well as doing SEM procedures (Chik & Abdullah, 2018; Hoque et al., 2017; Kashif *et al.*, 2016). The fit of the Measurement Model with the study data is important to validate a SEM. If the Measurement Model does not match the data from the field, then the constructed SEM is invalid. Therefore, the first step in SEM analysis is to determine the appropriateness of the Measurement Model to the data from the field. Analysis of the fit of the Measurement Model with field data is done by using Confirmatory Factor Analysis (CFA) to confirm the proposed Measurement Model of the construct.

Testing the Validity and Reliability of the Measurement Model: Before evaluating the appropriateness of a constructed model, the evaluation of Unidimensionality, Validity and Reliability of the Measurement Model of the construct of this study needs to be carried out first. **Unidimensionality:** This requirement can be met through the items deletion procedure that has a low Factor Loading value until it reaches the set Fitness Indexes level. Items with a Factor Loading value of less than 0.6 are considered unimportant to the measurement of the construct and should be discarded.**Validity:** The three types of validity that must be achieved by a construct measurement model are Construct Validity, Convergent Validity and Discriminant Validity. **Construct Validity:** Refers to the accuracy of a measurementinstrument used to measure the intended construct in the study. Construct Validity describes the extent to which a statement in the item used can measure the construct that the researcher wants to measure. Construct Validity is achieved when all Fitness Indexes for the construct in question meet the specified level (Chik & Abdullah, 2018). Table 1 below shows the three categories of fit index that need to be achieved by a construct measurement model, namely Absolute Fit, Incremental Fit and Passionate Fit.

Table 1
Three (3) Categories of Matching Indexes and Recognized Index Types

Name of Category	Name of Index	Level of Acceptance
Absolute Fit Index	RMSEA	RMSEA < 0.08
	GFI	GFI > 0.90
Incremental Fit Index	AGFI	AGFI > 0.90
	CFI	CFI > 0.90
	IFI	IFI > 0.90
	TLI	TLI > 0.90
	NFI	NFI > 0.90
Parsimonious Fit Index	Chisq/df	Chi-Square/ df < 3.0

Source: Chik & Abdullah (2018)

Convergent Validity: Refers to the relationship of a measurement model with other measurement models in theory. Convergent validity of a construct will be achieved if all Average Variance Extracted (AVE) values reach a minimum value of 0.50. **Discriminant Validity**: Explains the extent to which a construct does not have too strong a relationship with another construct in the same model so that it can be said that a construct is a shadow or repetition (redundant) of another construct. Discriminant Validity is assessed through the discriminant validity index summary. According to Chik & Abdullah (2018); Hoque et al (2017), discriminant validity for a construct can be achieved if all diagonal matrix values are greater than other values in row cells and also in column cells. The diagonal value of the matrix is the square root of the AVE, while the values in the matrix are the correlations between the constructs in the model. **Average Variance Extracted (AVE)**: The AVE value is calculated from the factor loading value for each item in a certain construct and needs to reach a minimum limit of 0.50 (AVE > 0.5) to prove the reliability of the Measurement Model of a latent construct in this study, which can be achieved (Chik & Abdullah, 2018; Hoque et al., 2017). **Reliability**: SEM uses the Composite Reliability (CR) value to verify the reliability of the Measurement Model according to the factor loading value of each item. Each construct that has a value of CR>0.6, has achieved Composite Reliability (Chik & Abdullah, 2018; Hoque et al., 2017).

CFA Analysis for the Measurement Model of Define School Mission Construct
The analysis of Fitness Indexes in Table 2 below shows that the Define School Mission Construct Measurement Model has reached the level of the Fitness Index level as stated in Table 1 above. This means that Construct Validity has been achieved (Chik & Abdullah, 2018; Hoque et al., 2017).

Table 2
Analysis To Determine Validity for Define School Mission Construct

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.064	Reach the set level
2. Incremental fit	CFI	0.990	Reach the set level
3. Parsimonious fit	ChiSq/df	2.559	Reach the set level

The Measurement Model for the Define School Mission construct has reached the value of the Conformity Index level. This means that Construct Validity for this construct, has been achieved (Chik & Abdullah, 2018; Kashif et al., 2016).
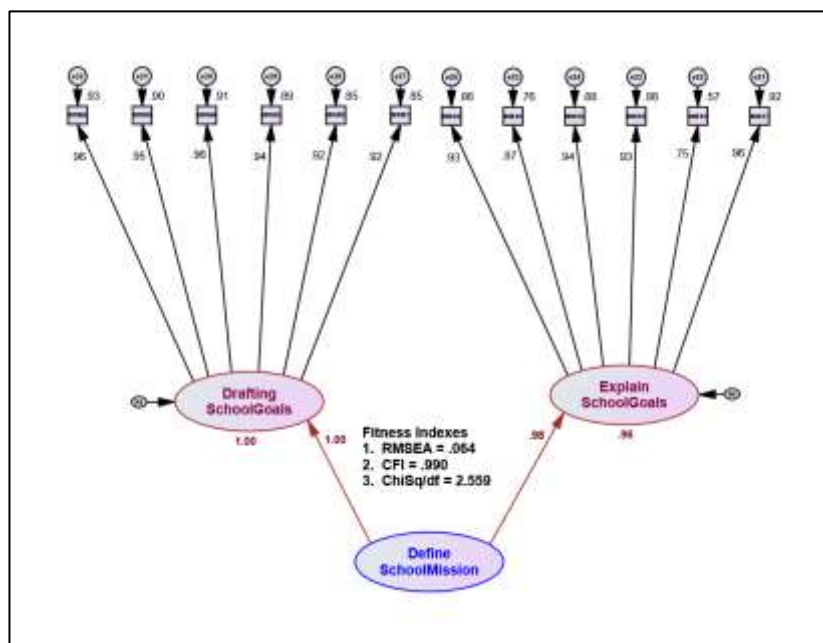

Figure 1: The Measurement Model of Define School Mission Construct

CFA Analysis for the Measurement Model on Programs Management Instructional Construct

The analysis of Fitness Indexes in Table 3 below shows that the Construct Programs Management Instructional Measurement Model has reached the level of the Fitness Index level as stated in Table 1 above. This means that Construct Validity has been achieved (Chik & Abdullah, 2018; Hoque et al., 2017).

Table 3
Analysis To Determine Validity for Management Instructional Programs Construct

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.067	Reach the set level
2. Incremental fit	CFI	0.976	Reach the set level
3. Parsimonious fit	ChiSq/df	2.713	Reach the set level

The Measurement Model for the Management Instructional Programs construct has reached the value of the Conformity Index level. This means that Construct Validity for this construct, has been achieved (Chik & Abdullah, 2018; Kashif et al., 2016).
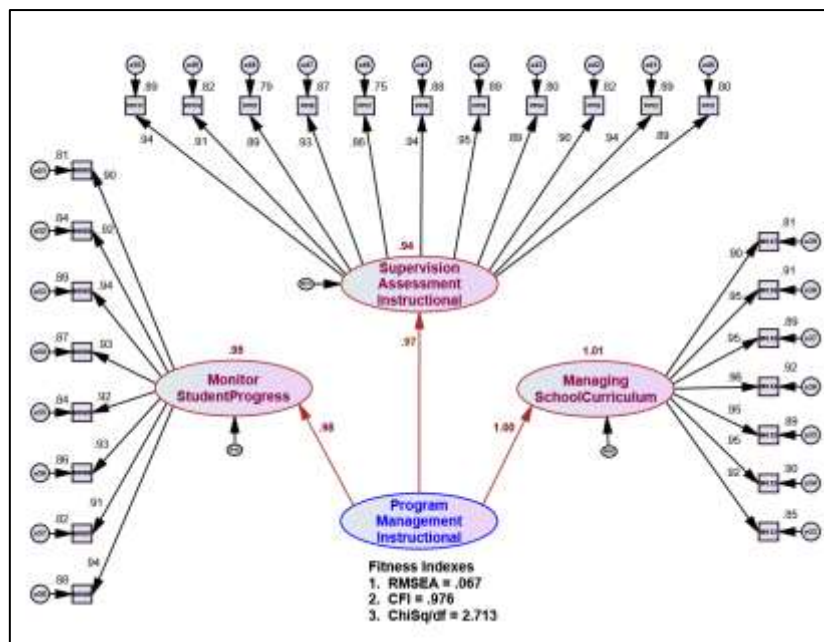
Figure 2: The Measurement Model of Management Instructional Programs-construct

CFA Analysis for the Measurement Model of Creating Climate Positive School Construct
The analysis of Fitness Indexes in Table 4 below shows that the Creating Climate Positive School Construct. Measurement Model has reached the level of the Fitness Index level as stated in Table 1 above. This means that Construct Validity has been achieved (Chik & Abdullah, 2018; Hoque et al., 2017).

Table 4
Analysis To Determine Validity for Creating Climate Positive School Construct

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.070	Reach the set level
2. Incremental fit	CFI	0.970	Reach the set level
3. Parsimonious fit	ChiSq/df	2.873	Reach the set level

The Measurement Model for the Creating Climate Positive School construct has reached the value of the Conformity Index level. This means that Construct Validity for this construct, has been achieved (Chik & Abdullah, 2018; Kashif et al., 2016).
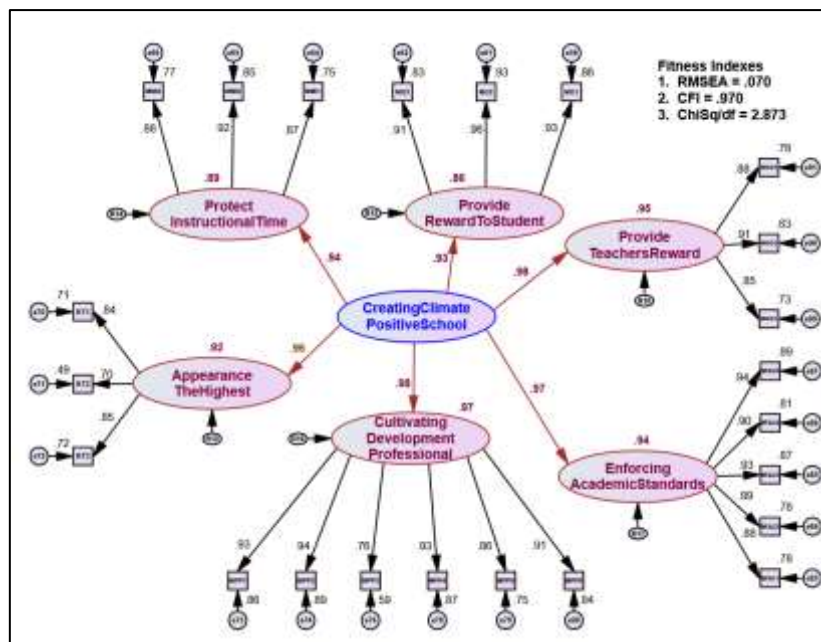
Figure 3: The Measurement Model on Creating Climate Positive School Construct

CFA Analysis for the Measurement Model on Acceptance Of Technology Applications Construct

The analysis of Fitness Indexes in Table 5 below shows that the Acceptance of Technology Applications Construct Measurement Model has reached the level of the Fitness Index level as stated in Table 1 above. This means that Construct Validity has been achieved (Chik & Abdullah, 2018; Hoque et al., 2017).

Table 5
Analysis To Determine Validity for Acceptance of Technology Applications Construct

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.051	Reach the set level
2. Incremental fit	CFI	0.990	Reach the set level
3. Parsimonious fit	ChiSq/df	2.001	Reach the set level

The Measurement Model for the Acceptance of Technology Applications construct has reached the value of the Conformity Index level. This means that Construct Validity for this construct, has been achieved (Chik & Abdullah, 2018; Kashif et al., 2016).
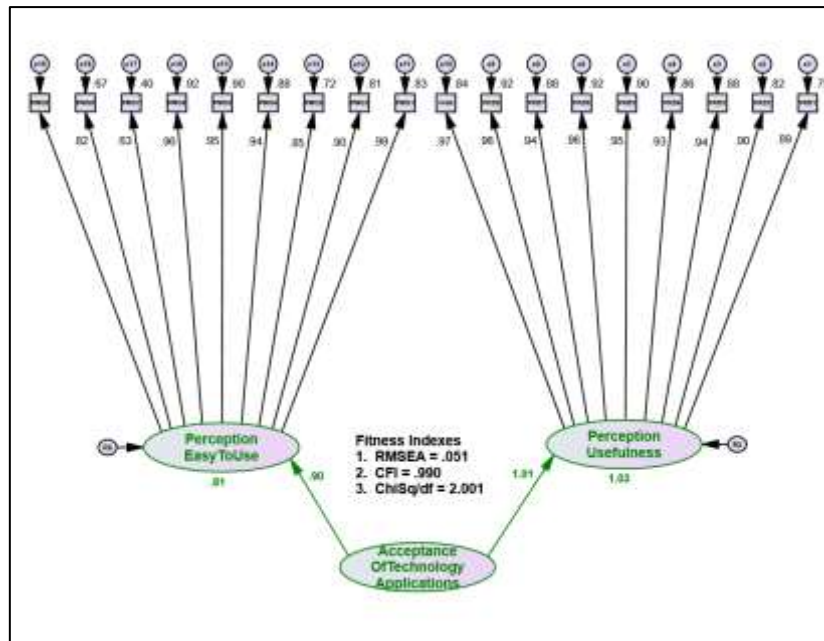
Figure 4: The Measurement Model of Acceptance of Technology Applications Construct

CFA Analysis for the Measurement Model on Competency Teaching Teacher Construct
The analysis of Fitness Indexes in Table 6 below shows that the Competency Teaching Teacher Construct. Measurement Model has reached the level of the Fitness Index level as stated in Table 1 above. This means that Construct Validity has been achieved (Chik & Abdullah, 2018; Hoque et al., 2017).

Table 6
Analysis To Determine Validity for Competency Teaching TeacherConstruct

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.075	Reach the set level
2. Incremental fit	CFI	0.964	Reach the set level
3. Parsimonious fit	ChiSq/df	3.149	Reach the set level

The Measurement Model for the Teacher Teaching Competency construct has reached the value of the Conformity Index level. This means that Construct Validity for this construct, has been achieved (Chik & Abdullah, 2018; Kashif et al., 2016).
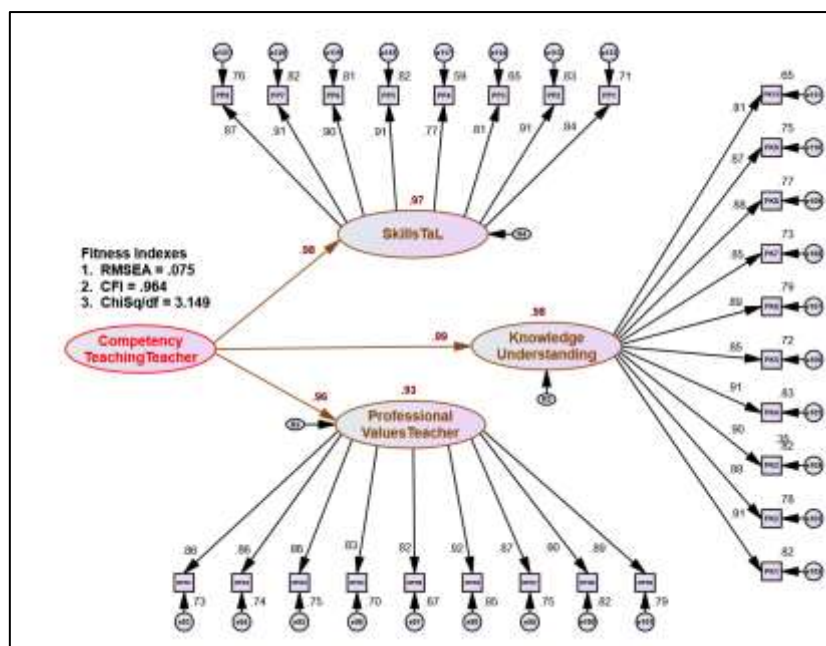
Figure 5: The Measurement Model of Competency Teaching Teacher Construct

Combined Confirmatory Factor Analysis of All Measurement Models (*Pooled* CFA)
This Pooled CFA analysis is necessary to evaluate the correlation value between the constructs in the Discriminant Validity procedure. If the correlation value between two constructs exceeds 0.85, then there is redundancy between the two constructs (Chik & Abdullah, 2018; Hoque et al., 2017). A model involving a second order construct is a construct that has dimensions or sub-constructs where each dimension or sub-construct has a certain number of items. Researchers will have difficulty combining all the second-level constructs in one model to conduct Pooled Confirmatory Factor Analysis (Pooled CFA). The solution, all second order constructs need to be summarized into a first order construct model by taking the mean item of each sub-construct or dimension (Chik & Abdullah, 2018; Hoque et al., 2017). The results of the Pooled CFA procedure are shown in Figure 7 below. The single headed arrow value is the factor loading values of each item and the double headed arrow value is the correlation between constructs. Through the Pooled CFA method, only one model fit index that represents all the constructs is released. Table 7 below shows that all three categories of model fit index for the construct measurement model have been achieved.

Table 7
Analysis To Determine Validity for All Constructs and Sub-Constructs

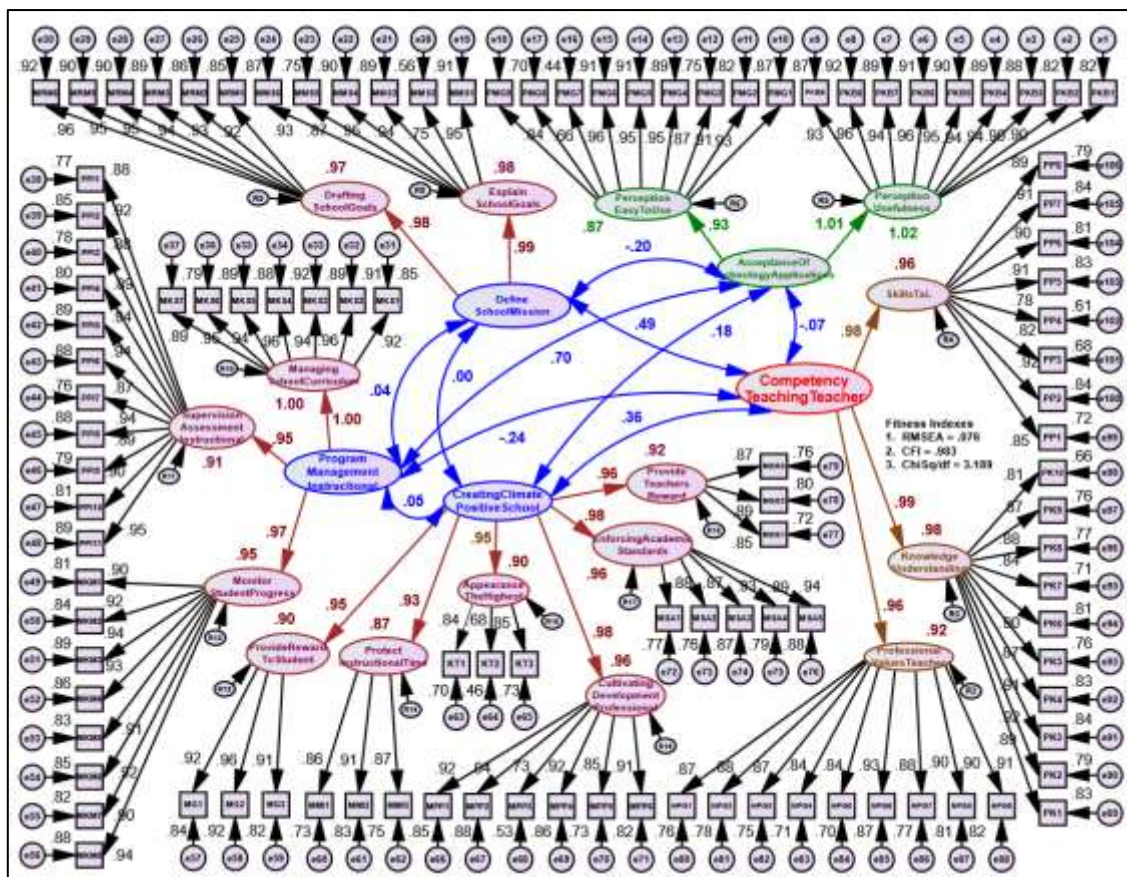| Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.076	Reach the set level
2. Incremental fit	CFI	0.983	Reach the set level
3. Parsimonious fit	ChiSq/df	3.189	Reach the set level

Figure 6: Pooled CFA Analysis Findings

Discriminant Validity is necessary to prove that all the constructs in the model do not have a strong relationship with each other leading to the problem of multicollinearity (Chik & Abdullah, 2018; Hoque et al., 2017; Kashif et al., 2016). Table 8 below shows the Discriminant Validity Index Summary between all the constructs in the model.

Table 8
Discriminant Validity Index Summary

Konstruk-Konstruk	(a)	(b)	(c)	(d)	(e)
Define School Mission (a)	**0.985**				
Management Instructional Programs (b)	0.040	**0.974**			
Creating Climate Positive School(c)	0.000	0.050	**0.950**		
Acceptance Of Technology Applications (d)	-0.200	0.700	0.180	**0.971**	
Competency Teaching Teacher (e)	0.490	-0.240	0.360	-0.070	**0.977**

Table 8 above presents the square root value of AVE for each construct on the diagonal matrix. The other values in the table are correlations between the two constructs. According to Chik and Abdullah (2018), Discriminant Validity will be achieved if all the values of the square root of AVE (Diagonal) are greater than other values whether the values are in rows or columns. Findings from Table 8 show that Discriminant Validity for all constructs in the model has been achieved.

Conclusion

Overall, the CFA analysis conducted on the measurement model for Principle Instructional Leadership , Acception Of Technology Aplication and Competency Teaching Teacher In Education construct, has reached the level of fitness indexes. The results of the combined confirmatory factor analysis of all measurement models (Pooled CFA), prove that all constructs do not have a strong relationship with each other to avoid the existence of multicollinearity problems.

Acknowledgement

References

Alias, H., & Husain, H. (2017). *Structural Equation Modelling (SEM) & Manual Amos Graphic (edisi Bahasa Melayu) Modul 1.*

Awang, Z. (2012). *Research Methodology And Data Analysis*. Penerbit Universiti Teknologi MARA Press (UiTM Press).

Awang, Z. (2015). *SEM Made Simple: A Gentle Approach to Learning Structural Equation Modeling.* Bandar Baru Bangi, MPWS Rich Resources.

Byrne, B. M. (2001). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. Mahwah, NJ: Lawrence Eribaum Associates.

Byrne, B. M. (2013). *Structural Equation Modeling With Amos: Basic Concepts, Applications, And Programming (2nd Ed.).* New York: Routledge.

Chik, Z., & Abdullah, A.H. (2018). Developing And Validating Instruments For Measurement Of Motivation, Learning Styles And Learning Disciplines For Academic Achievement. *International Journal of Academic Research in Business and Social Sciences, 8*(4), 594-605.

Hoque, A. S. M. M., Awang, Z., Jusoff, K., Salleh, F., and Muda, H (2017). Social Business Efficiency: Instrument Development and Validation Procedure using Structural Equation Modelling. *International Business Management, 11*(1), 222-231.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivatiate Data Analysis (6th ed.).* New Jersey: Pearson Education International.

Kashif, M., Samsi, S. Z. M., Awang, Z., & Mohamad, M. (2016). EXQ: Measurement Of Healthcare Experience Quality In Malaysian Settings: A Contextualist Perspective. *International Journal Of Pharmaceutical And Healthcare Marketing*, *10*(1), 27-47

Kline, R. B. (2016). *Principles and practice of structural equation modeling* (4th ed.). New York: The Guilford Press.

Schumucker, R. E., & Lomax, R. (2004). *A Beginner's Guide To Structural Equation Modeling (2nd Edition).* Mahwah, New Jersey: Lawrence Erlbaun Associates Publishers.