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Confirmatory Factor Analysis for Principal Transformational Leadership, Teachers Commitment and Classroom Assessment Teachers of Terengganu National Schools

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Abstract*:* There are two ways to conduct Confirmatory Factor Analysis (CFA) using individual confirmatory factor analysis or group confirmatory factor analysis based on the measurement model. The number of items depends on the construct used in the study and the measurement model analysis is conducted separately if the number of items in the construct is more than four. 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, Ismail and Mohd Noor (2024). A total of 384 study samples were involved in this research. Data were analyzed using the IBM-SPSS-AMOS (Structural Equation Modeling-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 Transformational Leadership (based on Cultivating Ideal Influence, Building Intellectual Stimulation, Inspiring Motivation, Individual Consideration), Teacher Commitment and Classroom Assessment have a value less than 0.85 (<0.85) teachers of Terengganu National Schools. 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.

Keywords: Principal Transformational Leadership, Inspiring Motivation, Classroom Assessment, Confirmatory Factor Analysis (CFA), Pooled CFA

Introduction

In Malaysia, studies on leadership and effective schools have been conducted, among others by Yaakob and Yahya (2019) who stated that a positive culture needs to be maintained and breathed new the school by highly charismatic school leadership such as transformational leadership.

The culture formed by the transformational leadership of the principal is related to the achievement of a school. The findings of their study show a positive relationship between school culture and transformational leadership and academic achievement towards developing the school. Hishamuddin, Mohd Rizal and Supian's (2019) study shows that transformational leaders have a strong influence on producing a quality and excellent school through the leadership orientation practiced. The study has proven that teachers can achieve a good level of job satisfaction and are impressed by the transformational leadership of headmasters and principals and subsequently produce effective schools. Siti Shahshina and Ahmad (2019) in their study on Transformational Leadership of Vocational College Directors and Self-Efficacy of Vocational College Lecturers stated that the level of transformational leadership of directors is at a moderate level. Therefore, the results of this study provide implications for college directors not only to be managers but also as leaders who are visionary, charismatic, capable of stimulating intellect, motivated, inspired and considerate individually (Jazmi, 2019). He is also a transformational leader at the vocational college level, thus he needs to set a good example and role model for lecturers. Hamidah and Kong (2019) also proved that the leadership style practiced by a principal in a school will influence the effectiveness of the school and all efforts towards improving the quality and effectiveness of the school must be made through improving the leadership quality of the school administrators and managers, namely the principal.

The results of a study conducted by Jeff, Aaron, Greg and James (2019) showed that principals in high-performing schools more often used all five (5) transformational leadership practices when compared to leaders in low-performing institutions. The study showed that the biggest difference in the leadership practices of low-performing principals was in the aspect of motivation, inspiration towards a shared vision and challenges towards the implementation process. This proves that high-performing schools are led by leaders who practice transformational leadership in their administration. The results of a study by Ahmad Yusri (2019) showed that transformational leadership style is more dominantly practiced by secondary school principals compared to transactional leadership style. Information from this study also shows that leaders in schools have been involved in implementing elements of transformational and transactional leadership in administration in schools either directly or indirectly. Administrators need to adjust the dimensions of transformational practices or appropriate leadership styles based on the situations and circumstances faced in the school so as not to disregard the needs and interests of themselves and subordinates.

Transformational leadership practices should be increased among school administrators in Malaysia because it has been proven to be effective in increasing job satisfaction in order to bring progress and excellence to a school (Kong & Mohd Izham, 2019). In the study by Ibrahim and Khairuddin (2019), several important implications were given to the management of educational organizations in an effort to increase and maintain the level of job satisfaction among teachers in the interior of Sabah. Principals' Transformational Leadership behavior, organizational commitment and teacher efficacy should be given serious attention by the responsible parties (Alam et al., 2025). The study shows that there is a positive relationship between transformational leadership and organizational commitment even at a very small level (Hossen, 2023). This shows that this positive relationship can have a great impact on teachers and the entire school organizational system.

Research Methodology

The research method used is quantitative and uses research instruments that have been adapted according to the suitability of factors Principal Transformational Leadership (based on Cultivating Ideal Influence, Building Intellectual Stimulation, Inspiring Motivation, Individual Consideration), Teacher Commitment and Classroom Assessment teachers of Terengganu National Schools. 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, Black, Babin, Anderson & Tatham, 2006; Schumacker & 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; Schumacker & 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, 2013). 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 $\chi 2$ 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 $\chi 2$ 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 et al. (2024) 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 et al., 2024; Hoque, Awang, Jusoff, Salleh & Muda, 2017; Kashif, Samsi, Awang & Mohamad., 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 measurement instrument used to measure the intended construct in the study (Hossen & Pauzi, 2025). 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 et al., 2024). 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
Incremental Fit Index	CFI	CFI > 0.90
Parsimonious Fit Index	Chisq/df	Chi-Square/ df < 5.0

Source: Chik et al. (2024)

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 et al. (2024) and 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 et al., 2024; 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 et al., 2024; Hoque et al., 2017).

CFA Analysis for the Measurement Model of Principal Transformational Leadership Based on Cultivating Ideal Influence Construct

The analysis of Fitness Indexes in Table 2 below shows that the Cultivating Ideal Influence 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 et al., 2024; Hoque et al., 2017).

Table 2 *Analysis To Determine Validity for Cultivating Ideal Influence Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.042	Reach the set level
2. Incremental fit	CFI	0.988	Reach the set level
3. Parsimonious fit	ChiSq/df	2.864	Reach the set level

The Measurement Model for the Cultivating Ideal Influence construct has reached the value of the Conformity Index level. This means that Construct Validity for this construct, has been achieved (Chik et al., 2024; Kashif et al., 2016).

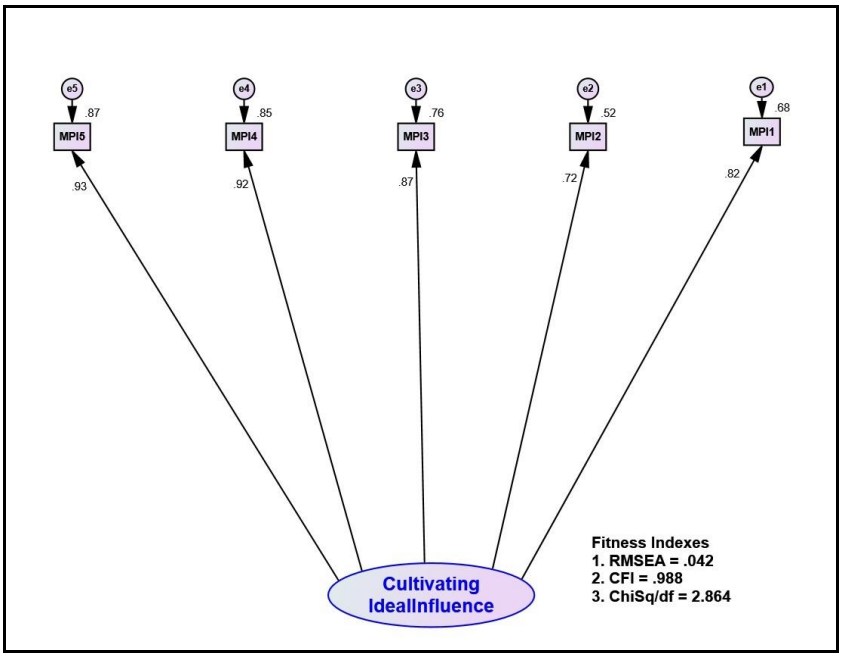

Figure 1. The Measurement Model of Cultivating Ideal Influence Construct

CFA Analysis for the Measurement Model of Principal Transformational Leadership Based on Building Intellectual Stimulation Construct

The analysis of Fitness Indexes in Table 3 below shows that the Building Intellectual Stimulation 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 et al., 2024).

Table 3 *Analysis To Determine Validity for Building Intellectual Stimulation Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.012	Reach the set level
2. Incremental fit	CFI	0.992	Reach the set level
3. Parsimonious fit	ChiSq/df	1.535	Reach the set level

The Measurement Model for the Building Intellectual Stimulation construct has reached the value of the Conformity Index level. This means that Construct Validity for this construct, has been achieved (Chik et al., 2024; Kashif et al., 2016).

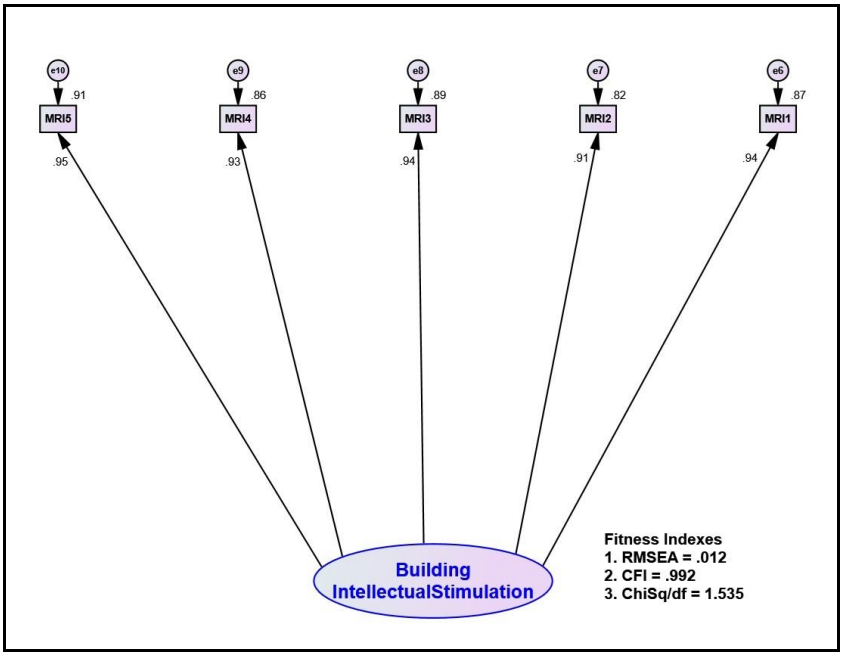

Figure 2. The Measurement Model of Building Intellectual Stimulation Construct

CFA Analysis for the Measurement Model of Principal Transformational Leadership Based on Inspiring Motivation Construct

The analysis of Fitness Indexes in Table 4 below shows that the Inspiring Motivation 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 et al., 2024; Hoque et al., 2017).

Table 4 *Analysis To Determine Validity for Inspiring Motivation Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.027	Reach the set level

2. Incremental fit	CFI	1.000	Reach the set level
3. Parsimonious fit	ChiSq/df	1.272	Reach the set level

The Measurement Model for the Inspiring Motivation construct has reached the value of the Conformity Index level. This means that Construct Validity for this construct, has been achieved (Chik et al., 2024; Kashif et al., 2016).

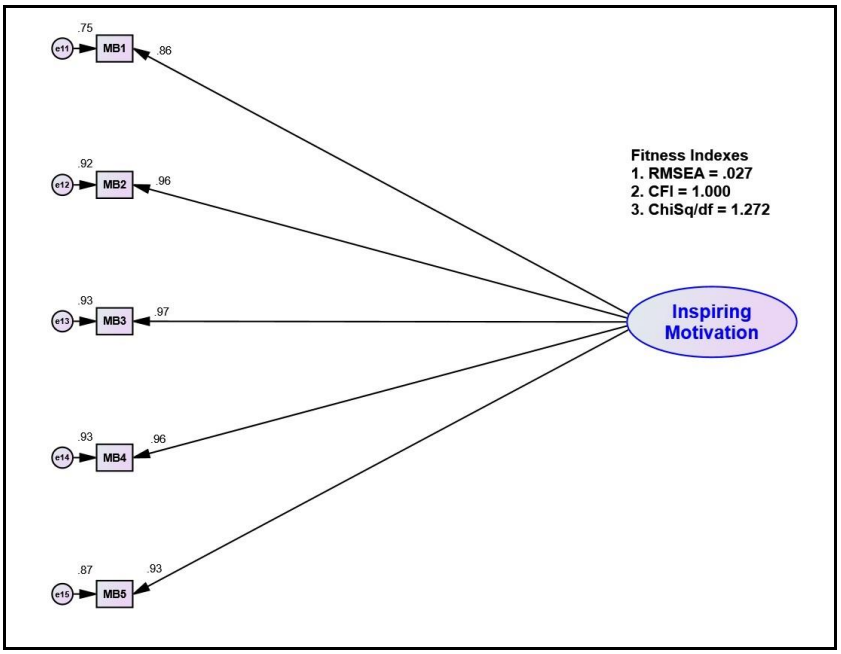

Figure 3. The Measurement Model of Inspiring Motivation Construct

CFA Analysis for the Measurement Model of Principal Transformational Leadership Based on Individual Consideration Construct

The analysis of Fitness Indexes in Table 5 below shows that the Individual Consideration 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 et al., 2024; Hoque et al., 2017).

Table 5 *Analysis To Determine Validity for Individual Consideration Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.064	Reach the set level
2. Incremental fit	CFI	0.998	Reach the set level
3. Parsimonious fit	ChiSq/df	2.571	Reach the set level

The Measurement Model for the Individual Consideration construct has reached the value of the Conformity Index level. This means that Construct Validity for this construct, has been achieved (Chik et al., 2024; Kashif et al., 2016).

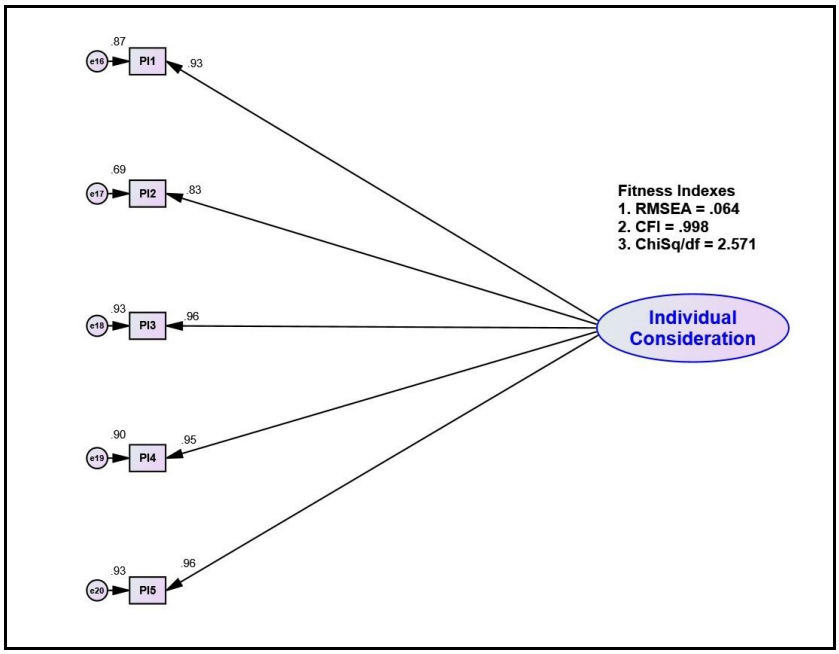

Figure 4. The Measurement Model of Individual Consideration Construct

CFA Analysis for the Measurement Model of Teacher Commitment Construct

The analysis of Fitness Indexes in Table 6 below shows that the Teacher Commitment 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 et al., 2024; Hoque et al., 2017).

Table 6 *Analysis To Determine Validity for Teacher Commitment Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.069	Reach the set level
2. Incremental fit	CFI	0.980	Reach the set level
3. Parsimonious fit	ChiSq/df	2.825	Reach the set level

The Measurement Model for the Teacher Commitment construct has reached the value of the Conformity Index level. This means that Construct Validity for this construct, has been achieved (Chik et al., 2024; Kashif et al., 2016).

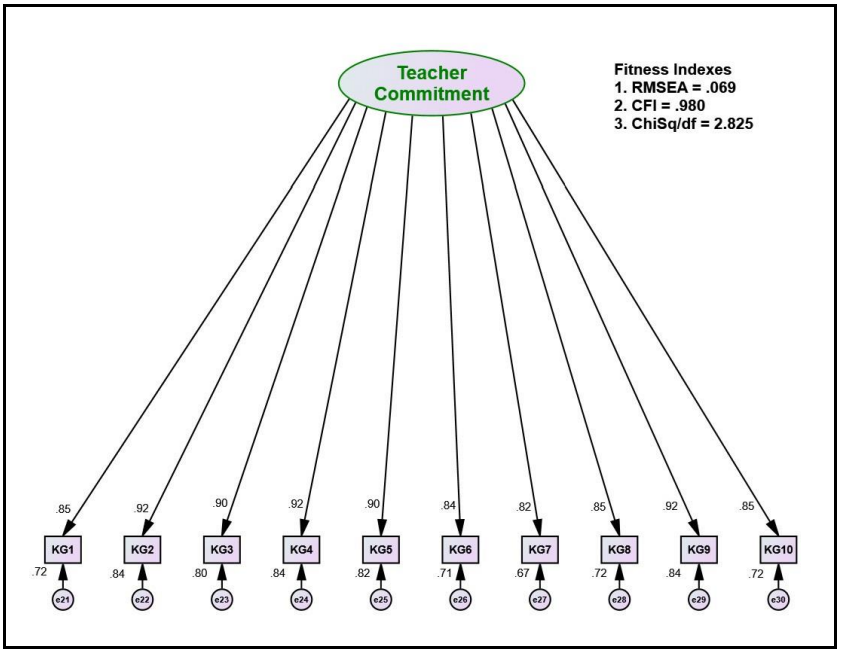

Figure 5. The Measurement Model of Teacher Commitment Construct

CFA Analysis for the Measurement Model of Classroom Assessment Construct

The analysis of Fitness Indexes in Table 7 below shows that the Classroom Assessment 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 et al., 2024; Hoque et al., 2017).

Table 7 *Analysis To Determine Validity for Classroom Assessment Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.065	Reach the set level
2. Incremental fit	CFI	0.986	Reach the set level
3. Parsimonious fit	ChiSq/df	2.618	Reach the set level

The Measurement Model for the Classroom Assessment construct has reached the value of the Conformity Index level. This means that Construct Validity for this construct, has been achieved (Chik et al., 2024; Kashif et al., 2016).

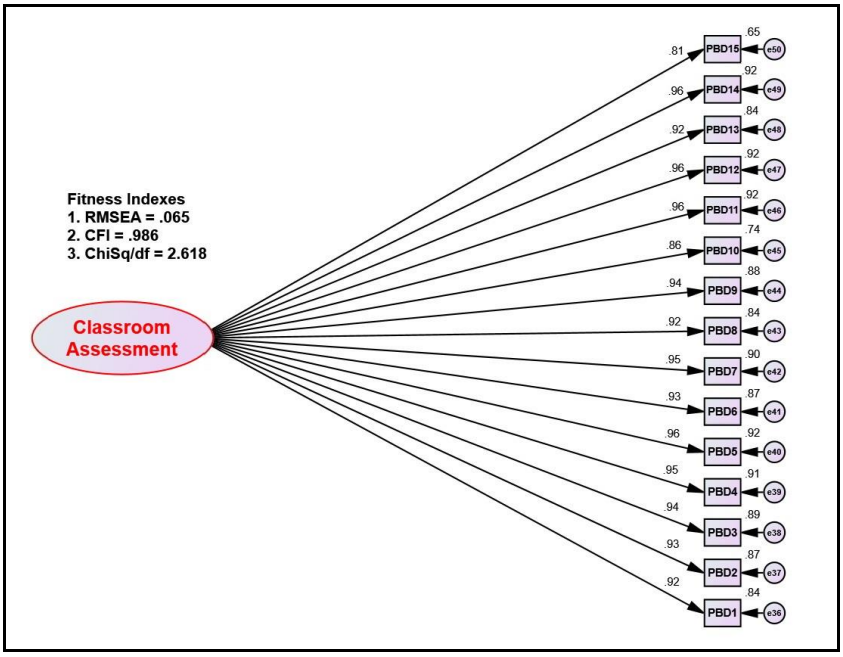

Figure 6. The Measurement Model of Classroom Assessment Construct

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 et al., 2024; 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 et al., 2024; 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 8 below shows that all three categories of model fit index for the construct measurement model have been achieved.

Table 8 *Analysis To Determine Validity for All Constructs and Sub-Constructs*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.066	Reach the set level
2. Incremental fit	CFI	0.945	Reach the set level
3. Parsimonious fit	ChiSq/df	2.692	Reach the set level

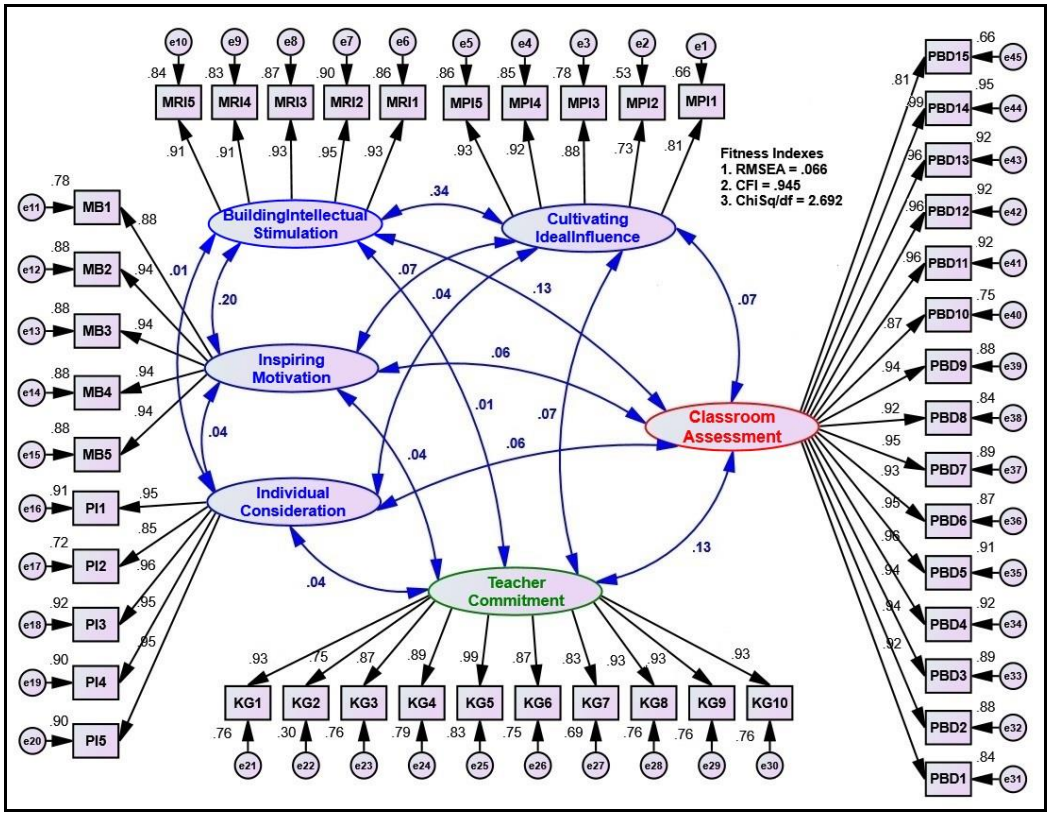

Figure 7. Pooled CFA Analysis Findings

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 et al., 2024). Table 9 below shows the Discriminant Validity Index Summary between all the constructs in the model.

Table 9 *Discriminant Validity Index Summary*

Constructs	(a)	(b)	(c)	(d)	(e)	(f)
Cultivating Ideal Influence (a)	**0.857**					
Building Intellectual Stimulation (b)	0.340	**0.926**				
Inspiring Motivation (c)	0.070	0.200	**0.928**			
Individual Consideration (d)	0.040	0.010	0.040	**0.933**		
Teacher Commitment (e)	0.070	0.010	0.040	0.040	**0.894**	
Classroom Assessment (f)	0.070	0.130	0.060	0.060	0.130	**0.934**

Table 9 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 et al. (2024), 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 9 show that Discriminant Validity for all constructs in the model has been achieved.

Conclusion

Overall, the CFA analysis conducted on the measurement model for Principal Transformational Leadership (based on Cultivating Ideal Influence, Building Intellectual Stimulation, Inspiring Motivation, Individual Consideration), Teacher Commitment and Classroom Assessment 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.

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Declarations: This manuscript has not been published to any other journal or online sources.

Data Availability: The author has all the data employed in this research and is open to sharing it upon reasonable request.

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