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Confirmatory Factor Analysis for Servant Leadership, Headteacher Motivation and Innovative 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 Servant Leadership (based on Valuing Individuals, Developing Individuals, Building Communities, Showing Authenticity, Providing Leadership, Sharing Leadership), Headteacher Motivation and Innovative Teachers 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: Servant Leadership, Headteacher Motivation, Innovative Teachers, Confirmatory Factor Analysis (CFA), Pooled CFA

Introduction

Education plays an important role in the economic development and development of a country. The best education system is able to produce knowledgeable workers, able to think critically and creatively and able to communicate effectively at the global level (Ministry of Education Malaysia, 2012).

improve the quality of national education so that it is in line with the needs of global education, he government continues to make improvements in the national education system such as the implementation of the Education Development Master Plan (PIPP) 2006 - 2010 and the Malaysian Education Development Plan (PPPM) 2013-2025 (Ministry of Education Malaysia, 2012). As a major player in the field of education, the active involvement of teachers in additional work, in addition to their core duties, can improve the quality and performance of education, and make schools a better educational institution (Abu Nasra, 2019). Every organization needs change to improve its effectiveness and remain competitive in the challenges of globalization (Barsade & Gibson, 2017; Bass & Riggio, 2018). This change has occurred as a result of the rapid development of technology and socio-economics in the last few decades, including the development of information technology, the trend towards a service-based economy and a knowledge-based society (Khair, 2019). In this regard, organizational conflicts and issues that arise need to be resolved when organizations want to change. Among them are issues of strategy for the changes to be achieved, constraints to be faced, organizational leadership behavior, changes in organizational management and structure, planning to implement changes and goals to be achieved (Burnes, 2018). To achieve success in change management, every organization needs effective leadership with strong soft skills competencies to mobilize teachers who are the front line in efforts to improve educational excellence. Therefore, school organizations need to have an effective leader so that the changes implemented at the school level can be administered well.

Innovative teachers have the ability to equip students with new millennium skills, such as the ability to think wisely, solve problems and have high creativity. There are many challenges faced by the younger generation, especially in this era of globalization. Teachers should be able to prepare students so that they can navigate this globalization trend. According to Hamdan and Nasrudi (2020), the globalization trend that has hit will change almost the entire way of life, both in the political, economic, social and cultural fields, so that the world has become a small village called a global village and as a result we have become a world community. This shows that students need to be able to cross a platform that allows them to 'sit as low, stand as high' with the world community. There is no denying that there are advantages, especially for students in developed countries in particular. The purpose of this research is to identify the influence of Servant Leadership (based on Valuing Individuals, Developing Individuals, Building Communities, Showing Authenticity, Providing Leadership, Sharing Leadership) and Headteacher Motivation on Innovative Teachers at Terengganu National Schools.

Research Methodology

The research method used is quantitative and uses research instruments that have been adapted according to the suitability of factors Servant Leadership (based on Valuing Individuals, Developing Individuals, Building Communities, Showing Authenticity, Providing Leadership, Sharing Leadership), Headteacher Motivation and Innovative 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 (Hossen & Pauzi, 2025). 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 (Alam et al., 2025).

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. Construct Validity describes the extent to which a statement in the item used can measure the construct that the researcher wants to measure (Hossen, 2023). 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 Servant Leadership Based on Valuing Individuals Construct

The analysis of Fitness Indexes in Table 2 below shows that the Valuing Individuals 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 Valuing Individuals Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.000	Reach the set level
2. Incremental fit	CFI	1.000	Reach the set level
3. Parsimonious fit	ChiSq/df	0.419	Reach the set level

The Measurement Model for the Valuing Individuals 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).

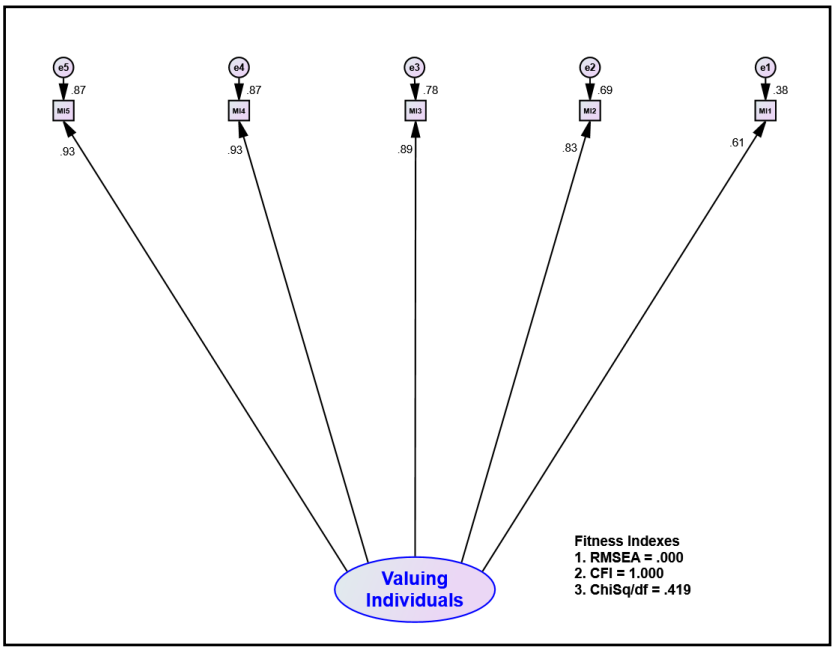

Figure 1. The Measurement Model of Valuing Individuals Construct

CFA Analysis for the Measurement Model of Servant Leadership Based on Developing Individuals Construct

The analysis of Fitness Indexes in Table 3 below shows that the Developing Individuals 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 Developing Individuals Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.042	Reach the set level
2. Incremental fit	CFI	0.999	Reach the set level
3. Parsimonious fit	ChiSq/df	1.661	Reach the set level

The Measurement Model for the Developing Individuals 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).

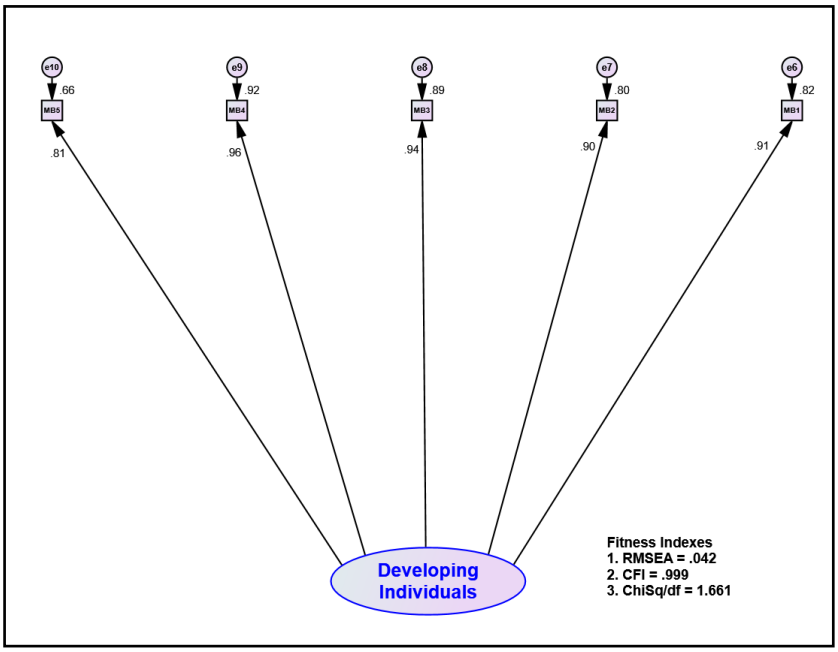

Figure 2. The Measurement Model of Developing Individuals Construct

CFA Analysis for the Measurement Model of Servant Leadership Based on Building Communities Construct

The analysis of Fitness Indexes in Table 4 below shows that the Building Communities 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 Building Communities Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.009	Reach the set level
2. Incremental fit	CFI	1.000	Reach the set level
3. Parsimonious fit	ChiSq/df	1.034	Reach the set level

The Measurement Model for the Building Communities 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).

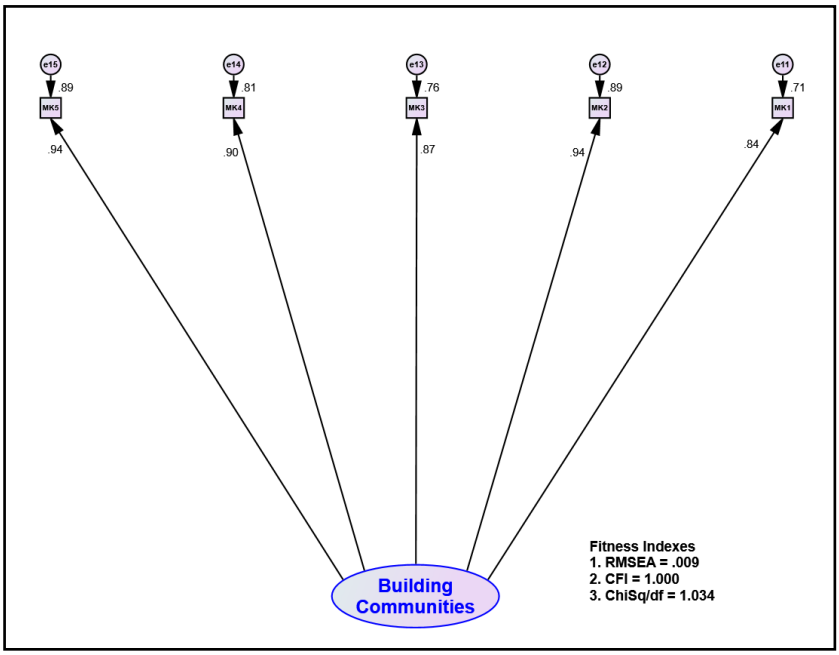

Figure 3. The Measurement Model of Building Communities Construct

CFA Analysis for the Measurement Model of Servant Leadership Based on Showing Authenticity Construct

The analysis of Fitness Indexes in Table 5 below shows that the Showing Authenticity 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 Showing Authenticity Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.068	Reach the set level
2. Incremental fit	CFI	0.998	Reach the set level
3. Parsimonious fit	ChiSq/df	2.748	Reach the set level

The Measurement Model for the Showing Authenticity 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).

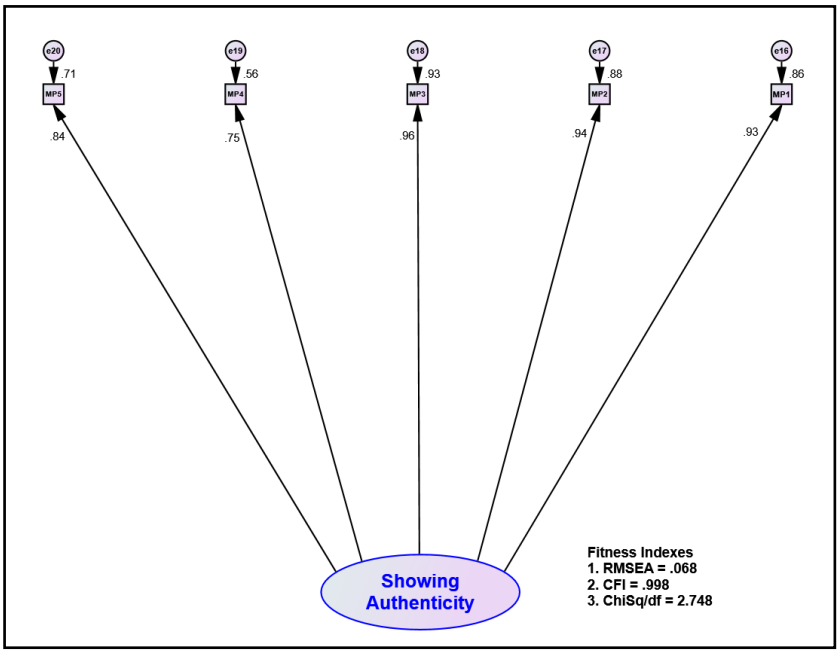

Figure 4. The Measurement Model of Showing Authenticity Construct

CFA Analysis for the Measurement Model of Servant Leadership Based on Providing Leadership Construct

The analysis of Fitness Indexes in Table 6 below shows that the Providing Leadership 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 Providing Leadership Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.000	Reach the set level
2. Incremental fit	CFI	1.000	Reach the set level
3. Parsimonious fit	ChiSq/df	0.961	Reach the set level

The Measurement Model for the Providing Leadership 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).

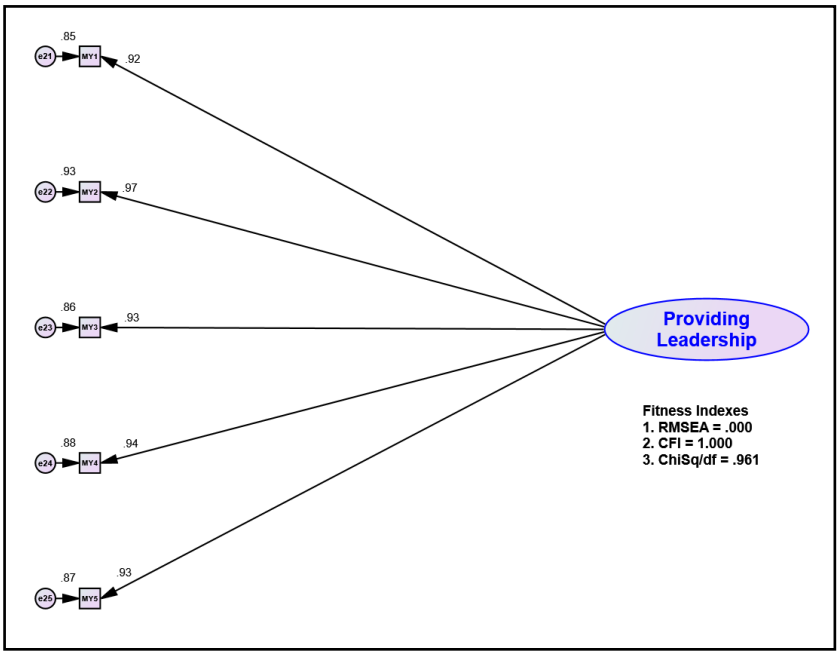

Figure 5. The Measurement Model of Providing Leadership Construct

CFA Analysis for the Measurement Model of Servant Leadership Based on Sharing Leadership Construct

The analysis of Fitness Indexes in Table 7 below shows that the Sharing Leadership 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 Sharing Leadership Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.000	Reach the set level
2. Incremental fit	CFI	1.000	Reach the set level
3. Parsimonious fit	ChiSq/df	0.950	Reach the set level

The Measurement Model for the Sharing Leadership 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).

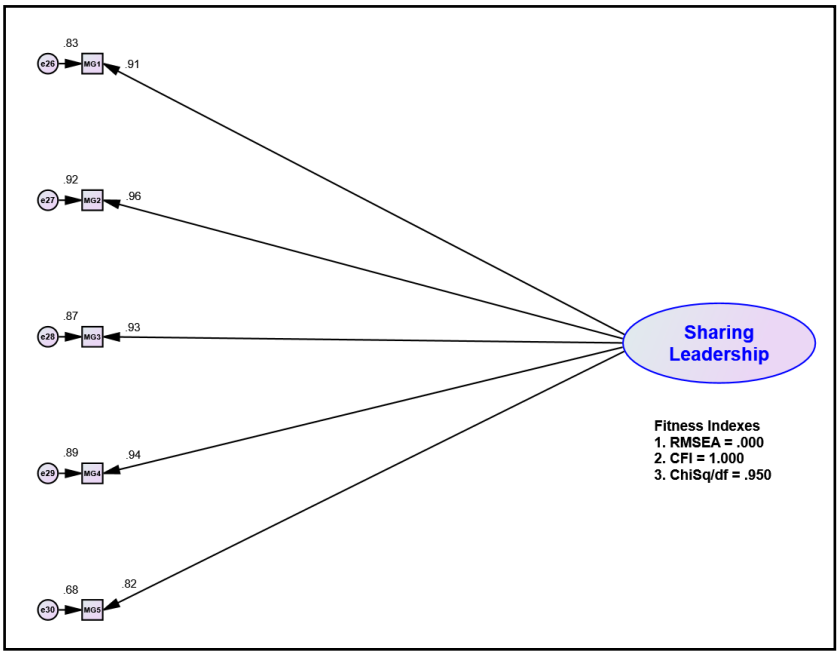

Figure 6. The Measurement Model of Sharing Leadership Construct

CFA Analysis for the Measurement Model of Headteacher Motivation Construct

The analysis of Fitness Indexes in Table 8 below shows that the Headteacher 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 8 *Analysis To Determine Validity for Headteacher Motivation Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.064	Reach the set level
2. Incremental fit	CFI	0.944	Reach the set level
3. Parsimonious fit	ChiSq/df	1.356	Reach the set level

The Measurement Model for the Headteacher 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).

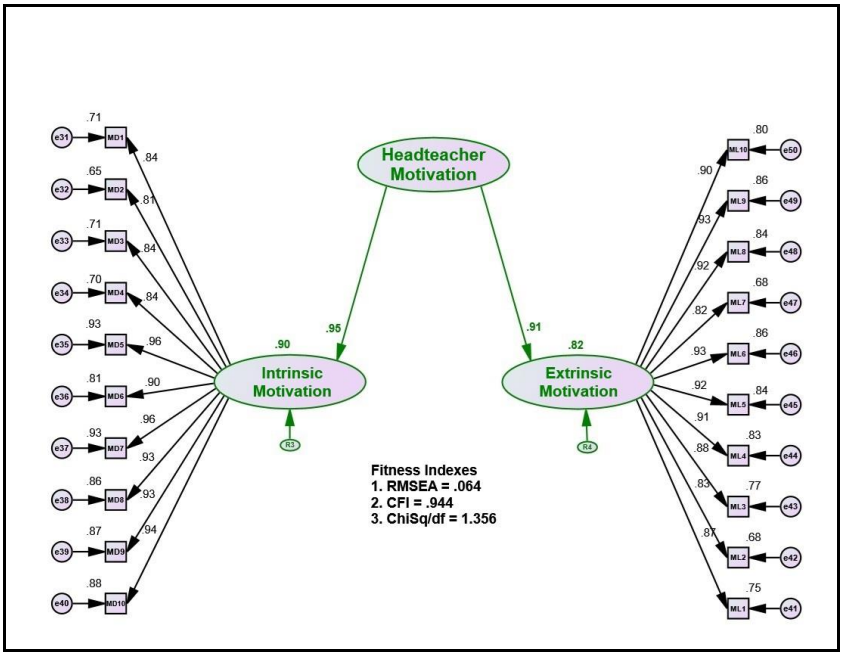

Figure 7. The Measurement Model of Headteacher Motivation Construct

CFA Analysis for the Measurement Model of Innovative Teachers Construct

The analysis of Fitness Indexes in Table 9 below shows that the Innovative Teachers 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 9 *Analysis To Determine Validity for Innovative Teachers Construct*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.070	Reach the set level
2. Incremental fit	CFI	0.995	Reach the set level
3. Parsimonious fit	ChiSq/df	2.895	Reach the set level

The Measurement Model for the Innovative Teachers 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).

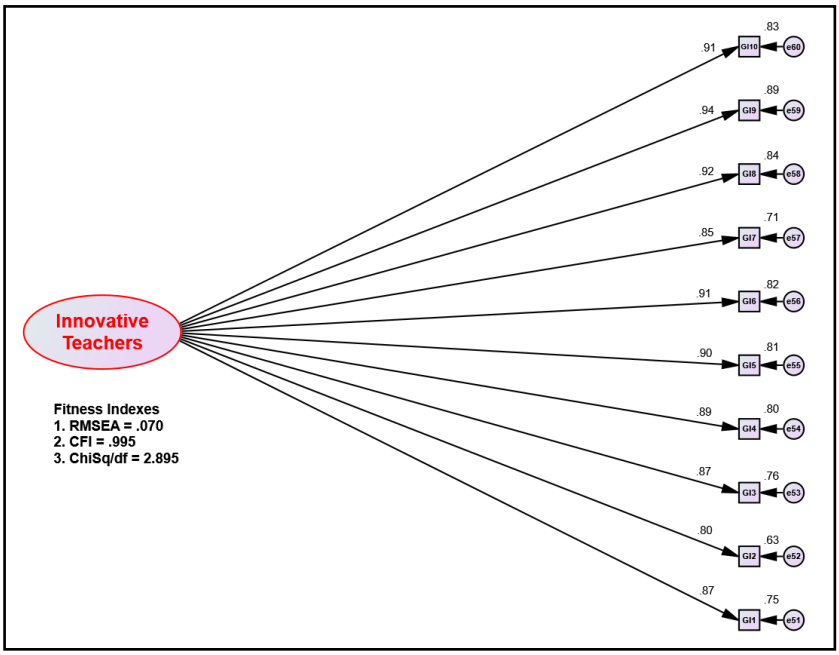

Figure 8. The Measurement Model of Innovative Teachers Construct

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 9 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 10 below shows that all three categories of model fit index for the construct measurement model have been achieved.

Table 10 *Analysis To Determine Validity for All Constructs and Sub-Constructs*

Category Name	Index Name	Index Value	Findings
1. Absolute fit	RMSEA	0.012	Reach the set level
2. Incremental fit	CFI	0.976	Reach the set level
3. Parsimonious fit	ChiSq/df	1.825	Reach the set level

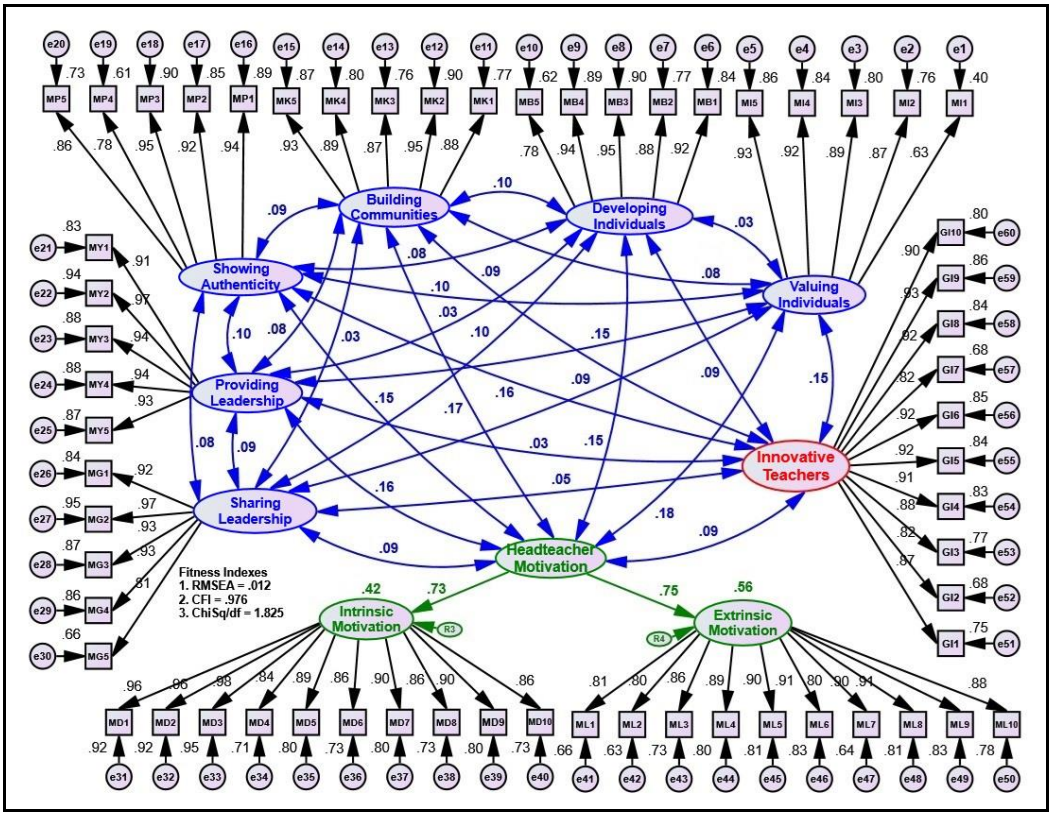

Figure 9. Pooled CFA Analysis Findings

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 11 below shows the Discriminant Validity Index Summary between all the constructs in the model.

Table 11 *Discriminant Validity Index Summary*

Constructs	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Valuing Individuals (a)	**0.855**							
Developing Individuals (b)	0.030	**0.896**						
Building Communities (c)	0.080	0.100	**0.904**					
Showing Authenticity (d)	0.100	0.080	0.090	**0.892**				
Providing Leadership (e)	0.150	0.030	0.080	0.100	**0.938**			
Sharing Leadership (f)	0.090	0.100	0.030	0.080	0.090	**0.932**		
Headteacher Motivation (g)	0.180	0.150	0.170	0.080	0.160	0.090	**0.805**	
Innovative Teachers (h)	0.150	0.090	0.090	0.160	0.030	0.050	0.090	**0.890**

Table 11 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 11 show that Discriminant Validity for all constructs in the model has been achieved.

Conclusion

Overall, the CFA analysis conducted on the measurement model for Servant Leadership (based on Valuing Individuals, Developing Individuals, Building Communities, Showing Authenticity, Providing Leadership, Sharing Leadership), Headteacher Motivation and Innovative Teachers 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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