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Confirmatory Factor Analysis: Teacher Leadership Measurement Model

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Abstract

The purpose of this study was to describe a construct validation study of Teacher Leadership among secondary school teachers in Malaysia. This study used a confirmatory factor analysis method (CFA) to analyze the measurement model of this study. Participants included daily secondary school teacher in the state of Selangor, Malaysia involved in this study. Confirmatory factor analysis (CFA) was employed and carried out to verify the instrument of Teacher Leadership. The respondents were required to respond to a seven-point Likert scale in semantic differential form. The collected data were then analyzed using the SPSS23.0 and AMOS23.0 software packages. An exploratory factor analysis was conducted earlier than performing a confirmatory factor analysis. All constructs revealed the acceptable internal consistency reliability. A good model fit was found for the measurement model using several fit index tests like CMINDF, TLI, GFI, AGFI, CFI and RMSEA. The findings showed that all fit indices criteria were accomplished. It also showed the acceptable reliability and construct validity. The implication of this study is expected to provide additional information in the teacher leadership theory and provide a clear line of training and professionalism enhancement programs for teachers, schools and the Ministry of Education Malaysia.

Keywords: Confirmatory Factor Analysis (CFA), Teacher Leadership, Measurement Model, Validity, Index Fit.

Introduction

Over the past decade, teacher leadership strategies have been an important aspect of improving student performance through improving teaching and learning by teachers. However, teacher leadership is not only focused on teaching and learning in the classroom, but its role is seen beyond the classroom; influencing decision making and emphasizing aspects of organizational support. In addition, peer support and the administration line are seen as helping teachers develop greater knowledge, skills, confidence and impact on school development (Meirink et al., 2019; Poekert, Alexandrou, & Shannon, 2016; York-Barr & Duke, 2004). In addition, the combination of research and education policy is increasingly playing a

role in utilizing teachers' leadership capabilities in strengthening teaching and learning in the classroom in line with current educational goals, especially in improving the quality of education at the international level of education. The Ministry of Education must take drastic steps to strengthen teacher leadership as one of the agents of education transformation of the country. Therefore, the action of the Ministry of Education in Education Development Plan 2013 -2025 in Wave 3 (2021 - 2025) emphasizes that cultural aspects of excellence in colleague-based teacher professionalism is a necessary step in realizing the ministry's desire to improve the quality of national education (Ministry of Education, 2012). Therefore, the development of teacher leadership models is necessary, in line with the need to produce high quality teachers coinciding with international quality education goals (Sherinawani, Asri, Rohaila, & Hamidah, 2015; Abu Bakar, Basri, & Fooi, 2015).

Studies on the development of teacher leadership models are not foreign to the east although previous studies on instrument development have been conducted in the west either using quantitative or qualitative approaches or mix methods. Most researchers place collaborative criteria among teacher leaders as catalysts in improving teacher leadership (Flood & Angelle, 2017; Sterrett & Irizarry, 2015; Tsai, Padre, & Pereira, 2017). However, teacher leadership not only supports professional learning of fellow teachers but also influences decision making. School administration structures including principals are also key contributors to building teacher leadership. Overall, teacher leadership encompasses not only individual aspects of teacher leadership but also school climate and culture; aimed at enhancing school achievement and transformation (Angelle, 2017; Hunzicker, 2017; Wenner & Campbell, 2016). Therefore, there is a challenge to build a good model of teacher leadership with high validity and reliability so that it can be used to measure teacher leadership among teacher leaders.

The present model of teacher leadership has used Theory of Teacher Leadership developed by Barr and Duke (2004) and the Teacher Leadership Sphere Model (Fairman & Mackenzie, 2014) as the basis for this model. Based on Theory of Teacher Leadership Theory by York Barr and Duke (2004) and the Sphere Model of Teacher Leadership Actions (Fairman & Mackenzie, 2014), it is found that improving teaching practice is a key aspect of teacher leadership. Both models also agree that organizational development and teacher collaboration support the development of teacher leadership models. However, the Sphere Model of Teacher Leadership Action (Fairman & Mackenzie, 2014) found that teacher leaders expanded the role of collaboration not only among teachers but also with parents, the community, external organizations and the professional community. In addition, teacher leaders are also seen as experts in sharing their knowledge and experiences. The development of a Teacher Leadership Measurement Model that impacts student and school improvement is necessary to provide a more comprehensive understanding of teacher leadership. To date, there have been few studies on the development of teacher leadership models conducted especially among teacher leaders in Asia. The purpose of this study was to develop a model of teacher leadership that has high validity and reliability among daily secondary school teacher leaders in the state of Selangor, Malaysia. This model of teacher leadership measurement was conducted using confirmatory factor analysis (CFA).

Teacher Leadership

The Teacher Leadership Instrument for measuring teacher leadership among schoolteachers in Malaysia consists of six sub-constructs with 29 items. The six sub-constructs are Leading the teaching and learning, Become role model, Leading school development, Peer

collaboration, Working with parents and community, and finally Exemplary. Each of the six sub constructs has its own items for measuring the construct as shown in Table 1.

Table 1
Table of items and sub-constructs of Teacher Leadership instruments

Bil	Sub Constructs of Teacher Leadership	Item
1.	Leading the teaching and learning	1, 2, 3, 4, 5, 6
2.	Become role model	7, 8, 9, 10, 11
3.	Leading school development	12, 13, 14, 15
4.	Peer collaboration	16, 17, 18, 19, 20, 21
5.	Working with parents and community	22, 23, 24, 25
6.	Exemplary	26, 27, 28, 29

The seven-point scale was used in this survey using the scale (1) "strongly disagree" until scale (7) "strongly agree". Researchers chose the seven-point scale because the Likert scale of four points and above is suitable for factor analysis (EFA) as well as confirmatory analysis (CFA) (Chua, 2009; Dawes, 2008). Researchers used a seven-point Likert Scale with semantic differential words that had adjectives at both ends of the scale. Researchers are able to obtain information from respondents more precisely because of the more sensitive scale of these semantics (DeVellis, 2003).

Validation of Measurement Model

The researcher used confirmatory factor analysis (CFA) to analyze the fit of the Teacher Leadership measurement model among daily secondary school teachers in the state of Selangor, Malaysia. CFA analysis was used to validate the items in measuring the constructs of this study (Hair, Black, Babin, & Anderson, 2010). The sub-constructs and items created in this Teacher Leadership study are based on theory and literature studies and can be tested against sample data.

A total of 348 daily secondary school teachers in Selangor, Malaysia participated in this study. At least 200 respondents were required to perform CFA analysis. Therefore, a total of 348 respondents in this study were adequate (Hair, Money, Samouel, & Page, 2007). Normalized scattering data with skewness and kurtosis values between +1 and -1 values (Hair et al., 2010) is a requirement that must be met in CFA analysis. Determinants of uni-dimensionality, validity and reliability were conducted in this Confirmatory factor analysis (CFA).

(i) **Uni-dimensionality**

Uni-dimensionality refers to each indicator contained in only one factor. Uni-dimensionality can be shown when there is no correlation of measurement error on each indicator. There are at least three items for each factor in this CFA analysis (Kline, 2011). Uni-dimensionality is achieved when the factor loading value is greater than 0.6 and for the newly constructed item factor loading value is above 0.6. The researcher had to drop Items with a factor loading of less than 0.5 in this analysis (Hair et al., 2010).

(ii) **Validity**

Validity is the ability of an instrument to measure what to measure (Kerlinger, 1986). There are three types of validity required for this measurement model namely:

(a) **Convergent Validity**

Convergent validity shows that the correlation value of a measure with the predicted size is theoretically correlated. Focusing accuracy is achieved when all items of measurement model are in significant condition. Validity is demonstrated when all constructs have a AVE value of greater than 0.5 (Hair et al., 2010).

(b) Construct Validity

Construct validity refers to the item representing the construct to be measured. Construct validity is achieved when meeting the model fit index for the construct (Kline, 2011). The three categories of model fit in the measurement model are absolute fit, incremental fit and parsimonious fit as shown in Table 2.

Table 2
Index Category and Acceptance Value for Each Index

Category	Index	Acceptance Value
1. Absolute Fit	Chisq(Discrepancy Chi Square	$P > 0.05$
	RMSEA(Root Mean Square of Error Approximation)	RMSEA < 0.08
	GFI(Goodness of Fit)	GFI > 0.90
2. Incremental fit	AGFI(Adjust Goodness of Fit)	AGFI > 0.90
	CFI(Comparative Fit Index)	CFI > 0.90
	TLI(Tucker-Lewis Index)	TLI > 0.90
	NFI(Normed Fit Index)	NFI > 0.90
3. Parsimonious fit	Chisq/df(Chi Square/Degrees of Freedom)	Chi/df < 5.0

Source : (Hair et al., 2010)

(c) **Discriminant Validity**

Discriminant validity, on the other hand, argues that constructions are not correlated with other constructs in theory. Discriminant validity of high values indicates that the construct is unique. If the correlation value between the two latent variables exceeds 0.9 then it indicates that there is overlap between the constructs (Hair et al., 2010).

(iii) **Reliability**

Reliability coefficient refers to the internal consistency measure of the construct referring to the uniformity of the latent variables and the construct validity studied (Hair et al., 2010). Once the model has reached an index value of compatibility then the reliability and validity of the construct can be determined.

Internal Validity, Composite Reliability, and Average Variance Extracted (AVE) need to be achieve to meet the reliability of a measurement model. The reliability of a measurement model is achieved when Internal reliability is met. Composite Reliability is met when the Composite Reliability (CR) value is at or above 0.6. Average Variance Extracted (AVE) is achieved when AVE values are equal to 0.5 or greater to prove adequate convergent validity (Hair et al., 2010).

Steps to Verify Teacher Leadership Skill Measurement Model

The researcher has taken several steps to validate this Model of Teacher Leadership. Researchers begin CFA analysis by looking at the model fit index. If the model fit index is not reached, the researcher will drop an item that has a Factor Loading value of less than 0.5. The process of dropping an item is done one by one by dropping the lowest factor load. Researchers will look at the Modification Indices (MI) if the model's compatibility index level is not reached. Items with high MI values will be removed. Researchers also should ensure that there is no overlap of items between constructs. Sub constructs are aggregated if the correlation value exceeds 0.9 between the two sub constructs. Finally, researchers need to obtain the reliability of this measurement model by obtaining Cronbach's Alpha, CR and AVE values (Kline, 2011; Zainuddin, 2012).

Results

Figure 1 shows the CFA analysis of the teacher leadership measurement model. The Teacher Leadership Measurement Model has four latent variables, namely, Working with Parents and Communities (IBKOM), Exemplary (DTL), Peer Collaboration (KOLB) and Leading School Development (PBGSK).

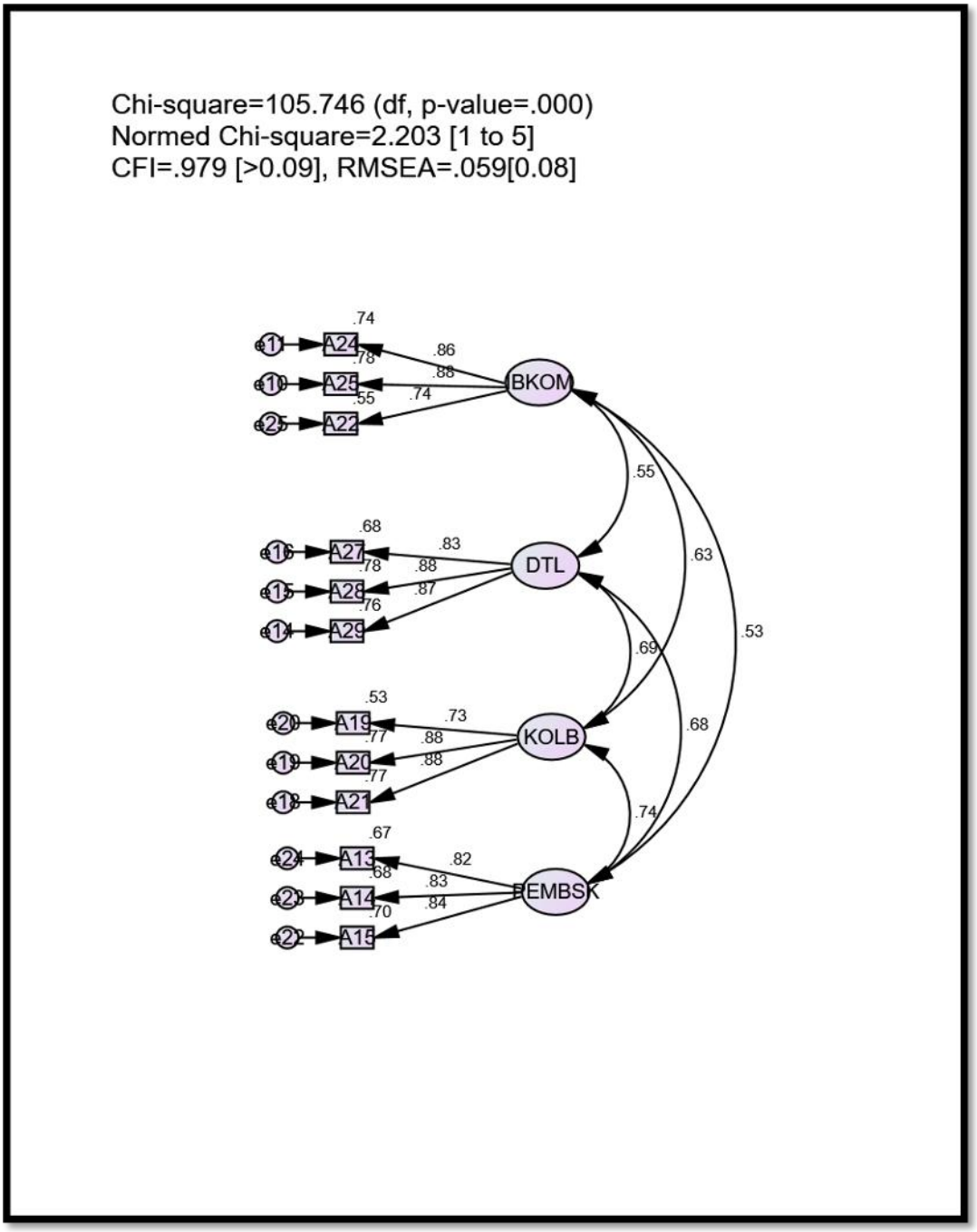

Figure 1. Teacher Leadership Measurement Model

Goodness of Fit Indices

CFA (Confirmatory Factor Analysis) analysis showed that all sub-constructs qualify as the model of Teacher Leadership measurement as shown in Figure 1. Goodness of fit indices has been met as shown in Table 3.

Table 3
Index Category and Acceptance Value of Each Construct in Teacher Leadership Model

Category	Index	Acceptance Value	Teacher Leadership Model
1. Absolute Fit	Chisq (Discrepancy Chi Square)	*P* > 0.05	*P*-Value = .000
	RMSEA (Root Mean Square of Error Approximation)	RMSEA < 0.08	RMSEA =0.059
2. Incremental fit	CFI (Comparative Fit Index)	CFI > 0.90	CFI = 0.979
	TLI (Tucker-Lewis Index)	TLI > 0.90	TLI = 0.971
	NFI (Normed Fit Index)	NFI > 0.90	NFI = 0.962
3. Parsimonious fit	Chisq/df (Chi Square/ Degrees of Freedom)	Chi/df < 5.0	Chi/df = 2.203

Source: (Hair et al., 2010)

Validity and Reliability of Teacher Leadership Construct

Validity is accepted when the convergent validity and construct validity is achieved. The standardized factor loading of each item for the accepted construct is shown in Table 4.

Table 4
Loading Factor, Cronbach's Alpha dan AVE Teacher Leadership Model

Construct	Item	Loading Factor	Cronbach's Alpha (>0.7)	CR (*Composite Reliability*) (> 0.6)	AVE (*Average Variance Extracted*) (> 0.5)
Working with Parents and Community (BKOM)	A24	0.86	0.863	0.867	0.687
	A25	0.88			
	A22	0.74			
Examplary (TDL)	A27	0.83	0.894	0.895	0.740
	A28	0.88			
	A29	0.87			
Peer Collaboration (KOLB)	A19	0.73	0.859	0.869	0.689
	A20	0.88			
	A21	0.88			
Leading School Development (PEMBSK)	A13	0.82	0.868	0.868	0.686
	A14	0.83			
	A15	0.84			

Convergent validity is obtained when the AVE (Average Variance Extracted) value is greater than 0.50 (Hair et al., 2010). The AVE value of all constructs of teacher leadership model are in AVE> 0.50 where BKOM (0.687), DTL (0.740), KOLB (0.689) and PEMBSK (0.686)

that are shown in Table 4. The previous Table 3 indicates that the Construct Validity test is satisfied when this Teacher Leadership construct meets the model fit indexes.

Reliability tests are also accepted when internal reliability, composite reliability and average extracted variance are achieved. Based on Table 4, all sub-constructs showed high internal reliability with Cronbach's Alpha values above 0.70. CR (composite reliability) is accepted when all constructs show a CR value greater than 0.60. Average extracted variance (AVE) was also accepted because all sub-constructs showed AVE values above 0.50.

Conclusion and Future Agenda

This study shows the development of a Teacher Leadership Measurement Model that can help provide additional information to educators in education management as well as policy makers in the Ministry of Education. This study provides evidence that the Teacher Leadership have four constructs - Collaborating with Parents and Communities, Exemplary, Peer Collaboration, and Leading School Development. The findings suggest that teacher leadership needs to be nurtured by applying the knowledge and skills of teacher leadership to optimize teacher competence in today's era of globalization of education. The purpose of this study is to add information to the theory of teacher leadership in order to improve the level of teacher leadership in school. The findings of the study also help the Ministry of Education Malaysia to provide training and programs to enhance professionalism for teachers and schools.

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