

Confirmatory Factor Analysis of Self-efficacy Instrument among Special Education Teachers

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Abstract

Self-efficacy is pivotal in education because of its influence on an individual's personality and attitudes. It stems from the person's belief in his or her capabilities to achieve a desired performance level and is especially important to special education teachers who deal with continual teaching challenges. Thus, to contribute to the increasingly challenging field of special education in the 21st century, this study aims to measure the validity and reliability of a self-efficacy instrument among teachers of the Integrated Special Education Program for Learning Difficulties (ISEPLD). Three subconstructs were measured, namely 1) student engagement, 2) instructional strategies, and 3) classroom management. AMOS software program version 18 was used for the data analysis and values from Comparative Fit Index, Tucker Lewis Index and RMSEA were used to retain and correlate items. An instrument with three subconstructs containing 15 items of nine-point scale was tested in this study. The instrument was administered to 500 participants across Malaysia using the proportional stratified random sampling and by the means of Confirmatory Factor Analysis, the study has confirmed that the data corresponded to the model. Therefore, it is proposed that the 15-item instrument developed from the three subconstructs can be used in measuring self-efficacy among teachers of ISEPLD in Malaysia.

Keywords: confirmatory factor analysis, Malaysia, self-efficacy, special education

1. Introduction

In the new Education Development Plan for Malaysia 2013-2025, teaching profession was discussed as the first area of focus, a move which can be translated into the government's intent to transform and revitalize teaching as a major profession of choice. It signifies a national priority, indicating how important the education field is to the country. As students form the future human capital for the nation, their personal growth has become an issue of concern in the Malaysian education system. In meeting this demand, it is imperative that the system is orchestrated by teachers who believe in themselves and their personal abilities and teaching abilities because teachers' quality has a direct positive relationship to their students' quality (McEwen, 2008). These qualities are of utmost importance, particularly to special education teachers who handle students with learning difficulties on daily basis. On this note, teachers of the Integrated Special Education Program for Learning Difficulties (ISEPLD) in Malaysia are expected to be equipped with high self-efficacy beliefs to function effectively and contribute towards the preparation of quality human capital for the country.

To survive the current changes and innovation in the 21st century education field, educators need to be acquainted with high self-efficacy beliefs (Dibapile, 2011; Magno & Sembrano, 2008). This group of educators often display a character of high self-assurance, ending up being individuals who are confident in their skills and are able to implement the required changes and innovations in teaching (Harvey, 2009; Ng et al., 2010). Given its critical impact on a person's effort (Bandura, 1993), self-efficacy should be given top priority in the education system. In the research world, efficacy has been studied to understand its effect on teachers' job performance which in turn affects their work commitment (Billingsley, 2004; Korthagen, 2005).

1.1 Problem Statement

The self-efficacy theory by Bandura (1997) serves as the theoretical framework in this research project to guide the construction of the self-efficacy instrument for ISEPLD teachers. Self-efficacy is defined as a concept of individuals' personal beliefs to control various situations that occur in life (Bandura, 1997). It refers to the ability

to perform a task successfully according to prescribed standards. Confidence in one's ability to perform tasks efficiently and effectively will influence the person's 1) actions and behavior control, 2) choices in approaching a situation and environment; and 3) perseverance in completing a particular task. The self-efficacy theory explains a person's levels of confidence in performing a particular task (Bandura, 1997). In this theory, the concept of reciprocal determinism is discussed at length. It is defined as the interconnected cycle between the personal factor (cognitive) with environmental factor and behaviors, influencing one another and enabling individuals to produce the required behavior based on prior knowledge in responding to their environment.

Bandura (1997) defines teachers' self-efficacy as self-confidence in their ability to teach effectively in warranting student achievement. The concept of efficacy is closely related to the intensity of belief and confidence that influence a person's behavior in dealing with a particular situation. It is the teachers' judgment in their capability to carry out a teaching responsibility that encourages planning and coordinating the required behavior in meeting education goals. High efficacy facilitates teachers to be more determined to carry out teaching task by diversifying teaching activities and not to give up easily (Tschannen-Moran & Hoy, 2001). In the context of special education, teachers handling students with learning difficulties need to believe in their ability so that they can continue to understand, manage and teach students with disabilities who have different types and levels of learning difficulties.

This research project, with its aim to measure constructs in a self-efficacy instrument, has applied the confirmatory factor analysis (CFA), a multivariate statistical procedure to identify items to be included in the instrument. CFA is claimed to be appropriate to use especially when researchers have little knowledge of the underlying structure of the latent variables (Byrne, 2010) and it is meant to examine the construct validation instrument to decide how well the constructs have managed to explain the variables (Stevens & Zvoch, 2007).

1.2 Literature Review

Self-efficacy significantly affects people's behavior, motivation and ultimately, their success or failure. Although the original focus of teacher efficacy was on the locus of control, Bandura's application of social cognitive theory to social learning theory expanded it to explore other factors that bear possible influence on teacher efficacy. Bandura (1997) suggests a framework with four sources of self-efficacy, namely mastery experience, vicarious experience, social (or verbal) persuasion, and physiological factors. This framework is a key component in the definition of teacher efficacy and has become the focus of study of professional development program evaluations (Tschannen-Moran & McMaster, 2009; Tschannen-Moran & Woolfolk Hoy, 2007). It also affords a critical part to Tschannen-Moran et al. (1998) teacher self-efficacy model. In 2009, the framework was used by Tschannen-Moran and McMaster to study teachers' implementation of a new instructional framework for reading class by elementary teachers.

A growing body of research on teacher efficacy has suggested positive relationships with teacher performance. Teachers with a strong sense of efficacy have been reported to 1) display a higher degree of flexibility to change (Ross & Bruce, 2007) and more effective pedagogical approach as well as innovation (Chu, 2011; Pan, 2014; Ross, 2007; Thoonen et al., 2011), 2) portray better stress management skills (Ross & Gray, 2006; Tschannen-Moran & Gareis, 2004) and have higher job satisfaction level (Eichinger, 2000; Lazuras, 2006; Viel-Ruma, 2010), 3) have increasing expectations on students' academic abilities (Deemer, 2004; Ross & Bruce, 2007), and 4) prevail against workplace challenges (Ross & Gray, 2006; Skaalvik & Skaalvik, 2010; Tschannen-Moran & Gareis, 2004; Tschannen-Moran & McMaster, 2009).

In a more recent study by Berg and Smith (2014), primary school pre-service teachers from New Zealand, England, and Malaysia were studied. The participants were required to complete the "Teachers' Sense of Efficacy" (long form) (Tschannen-Moran & Woolfolk Hoy, 2001) and the "Concerns about Teaching Scale" (Smith, Corkery, Buckley & Calvert, 2012) at the onset of their second year of teaching programs. The findings suggested that culture and context are imperative in shaping the participants' concerns related to their teaching and efficacy beliefs. The Malaysian pre-service teachers were found to have the comparatively lowest efficacy beliefs which could be raised by their concerns about a large class size (50 students), high parental expectations of the students' success, and subject-based instead of class-based interaction with the students.

1.3 Research Objectives

This study aimed to determine the validity and reliability of an instrument related to the self-efficacy model by testing whether the items have measured the three constructs of special education teachers' self-efficacy, namely student engagement, instructional strategies, and classroom management using CFA. These constructs were measured with reference to the three-dimensional teachers' self-efficacy by Tschannen-Moran et al. (1998).

2. Method

2.1 Research Design

This was a quantitative study of a survey design. Data were collected via paper-based questionnaires that were distributed to selected schools in every state across Malaysia. The sample size was determined based on the table by Krejcie and Morgan (1970) and Hair et al. (2010).

2.2 Participant

Five hundred teachers of the Integrated Special Education Program for Learning Difficulties (ISEPLD) throughout Malaysia were identified using the proportional stratified random sampling. The sampling was determined by the number of participants from 13 states and two Federal Territories (WP) of Kuala Lumpur and Putrajaya as obtained from the Ministry of Education Malaysia. The significantly different numbers of participants in each state have led to the use of proportional stratified random sampling technique. The selection of research sample from each sub-set (stratum) was drawn based on the percentage of the participants (Lim, 2007). Table 1 lists the number of participants of each state, its percentage from the population, and the number of sample to be used in the study. In the second stage, using the simple randomization technique, the questionnaires were mailed to schools with these criteria: a) national primary schools (government-owned and operated) with ISEPLD, and b) schools with a minimum of seven teachers who run the program, excluding substitute and temporary teachers.

Table 1. Number of ISEPLD teachers in each state

State	Number of Teachers	Percentage of overall population (%)	Number of sample
Kedah	348	5.6	28
Perlis	65	1	5
Pulau Pinang	235	3.8	19
Kelantan	341	5.4	27
Pahang	466	7.4	37
Terengganu	420	6.7	34
Selangor	870	14	70
Perak	860	13.7	68
WP Kuala Lumpur	382	6.1	30
WP Putrajaya	44	0.7	4
Johor	828	13.2	66
Melaka	427	6.8	34
Negeri Sembilan	320	5	25
Sabah	287	4.6	23
Sarawak	377	6.0	30
TOTAL	6270	100	500

2.3 Instrument

This study adapted a self-efficacy instrument of nine-point Likert scale ranging from “not sure” to “very confident” from a study by Tschannen-Moran & Hoy (2001) with their permission. The instrument was used to measure 3 subconstructs with 15 items as follows: (i) student engagement (5 items), (ii) instructional strategies (5 items) and (iii) classroom management (5 items).

2.4 Validity and Reliability of Instruments

Validity refers to the ability of an instrument to measure what is supposed to be measured in a construct. There are three types of validity required for each measurement model, namely the convergent validity, construct validity and discriminant validity (Zainudin, 2014).

Reliability, on the other hand, is the extent of how reliable the said measurement model is in measuring the intended latent construct. The assessment of reliability in a measurement model could be performed using the following criteria (Zainudin, 2014):

- Internal Reliability – This reliability is achieved when the Cronbach's Alpha coefficient is greater than 0.7 (calculated in SPSS)
- Composite Reliability – The measure of reliability and internal consistency for a latent construct. A value of $CR \geq 0.6$ is required in order to achieve composite reliability for a construct.

$$CR = \frac{(\sum K)^2}{[(\sum K)^2 + (\sum 1 - K^2)]}$$

- Average Variance Extracted – The average percentage of variation as explained by the measuring items for a construct. An $AVE \geq 0.5$ is required.

AVE is calculated using the given formula:

$$AVE = \frac{\sum K^2}{n}$$

Note: K= Factor loading of every item

N= Number of items in a model

2.5 Data Analysis

The validating procedure was conducted using Confirmatory Factor Analysis (CFA). It has the ability to assess the Unidimensionality, Validity and Reliability of a latent construct. The CFA for all latent constructs in the study needed to be performed before modeling their inter-relationship in a Structural Equation Modeling (SEM). However, the Unidimensionality assessment had to be carried out prior to assessing the Validity and Reliability.

CFA conducted to validate the instrument of self-efficacy was according to three factors hypothesized using Moment Analysis of Structure - AMOS Version 18 (Golob, 2003; Hair et al. 2010; Schreiber, 2006). The program uses a maximum likelihood to generate estimates of the full-fledged measurement model. To check the suitability of the measurement model with 15 items, the analysis is dependent on the fitness indexes such as: (i) the minimum value of the dispute observed between the data and the model divided by (i) Chi Square Degrees of Freedom (CMIN/df), (ii) Comparative Fit Index (CFI), (iii) Tucker Lewis Index (TLI), and (iv) Root Mean Square of Error Approximation (RMSEA). Golob (2003), Schreiber (2006), Byrne (2010), Hair et al. (2010), and Zainudin (2014) stated that a model is fit if the fitness indexes show: (i) CMIN / df with a value between 1 and 5 are considered to be acceptable or acceptable fit between model and data; ii), CFI and TLI index approaching 1:00 indicates a perfect match; and (iii) index RMSEA 0:08 or less indicates error estimates that are reasonable and can be accepted.

3. Results

The steps involved in Confirmatory Factor Analysis for the measurement model of a latent construct:

First step: Run Confirmatory Factor Analysis (CFA) for every subconstruct.

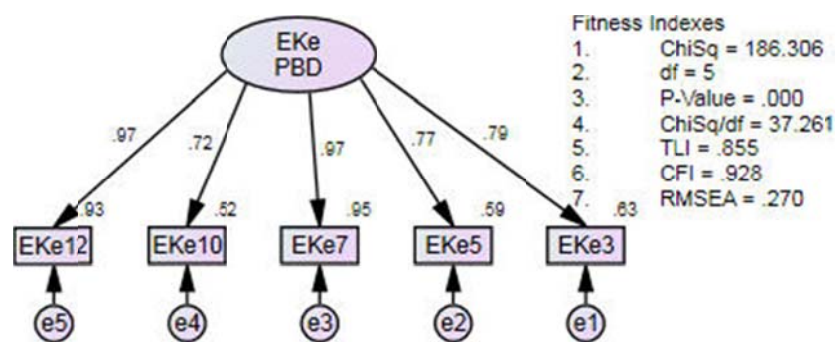


Figure 1. Factor loading for every item in the measurement model for Teachers' Self-efficacy of classroom management

The factor loading in the measurement model for Teachers' Self-efficacy for classroom management subconstruct is shown in Figure 1 which describes the relationship between the latent variable and item. According to Hair et al. (2010), the sample size exceeding 350 respondents requires a factor loading of at least 0.60 to determine its significance at the 0.05 level. It would determine the strength of an item or indicators that measure something related, construct, or latent variable in an analysis of the CFA. Based on Figure 1, the factor loading indicates that every item can successfully measure the construct of Teachers' Self-efficacy for classroom management.

Table 2. The fitness indexes for measurement model teachers' self-efficacy of classroom management

Name of category	Name of index	Index value	Comments
1	Absolute fit	RMSEA	.270 The required level is not achieved
2	Incremental fit	TLI	.885 The required level is not achieved
		CFI	.928 The required level is achieved
3	Parsimonious fit	Chisq/df	37.261 The required level is not achieved

Table 2 shows that the fitness index for RMSEA, TLI and Chisq/df have not achieved the required level even though the factor loading for all items are above 0.6, implying that certain items are redundant in the measurement model. The item redundancy can be examined by inspecting the Modification Indexes (MI). A high value of MI (above 15) indicates that there are redundant items in the model (Zainudin, 2014).

Table 3. The modification indexes present the covariance between each pair of items

	M.I.	Par Change	Comment
e2 <--> e4	156.267	.144	MI > 15 indexes Item Eke4 and item Eke10 are redundant

Table 3 presents the MI for a pair of correlated errors which suggested that redundant items exist in the model. The correlated measurement error is between e2 and e4. A review on the items would reveal that the redundant item is between Eke5 and Eke10.

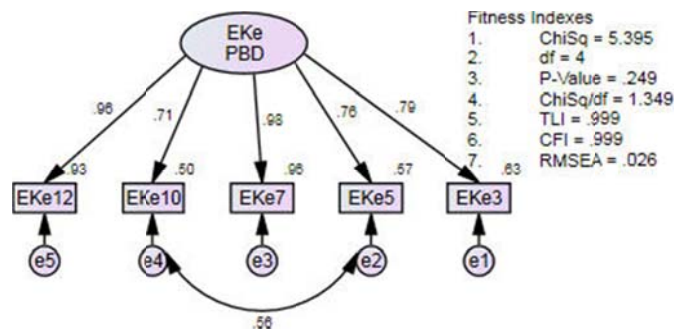


Figure 2. The new measurement model after item Eke5 and Eke10 are correlated

Table 4. The fitness indexes for new measurement model teachers' self-efficacy of classroom management

Name of category	Name of index	Index value	Comments
1	Absolute fit	RMSEA	.026 The required level is achieved
2	Incremental fit	TLI	.999 The required level is achieved
		CFI	.999 The required level is achieved
3	Parsimonious fit	Chisq/df	1.349 The required level is achieved

Table 4 shows how the fitness indexes have improved after the two redundant items are constrained in the model. The fitness index of RMSEA, TLI, CFI and Chisq/df have achieved the required level and the factor loading for all items are above 0.6.

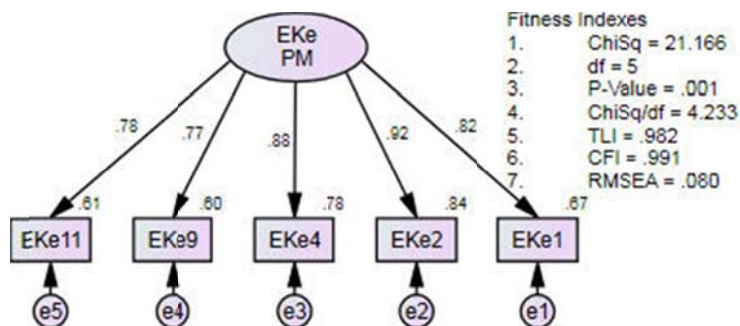


Figure 3. Factor loading for every item in the measurement model teachers' self-efficacy for student engagement

Table 5. The fitness indexes for measurement model teachers' self-efficacy student engagement

Name of category	Name of index	Index value	Comments	
1	Absolute fit	RMSEA	.080	The required level is achieved
2	Incremental fit	TLI	.982	The required level is achieved
		CFI	.991	The required level is achieved
3	Parsimonious fit	Chisq/df	4.233	The required level is achieved

Table 5 shows that the fitness index for RMSEA, TLI and Chisq/df have achieved the required level and the factor loading for all items are above 0.6.

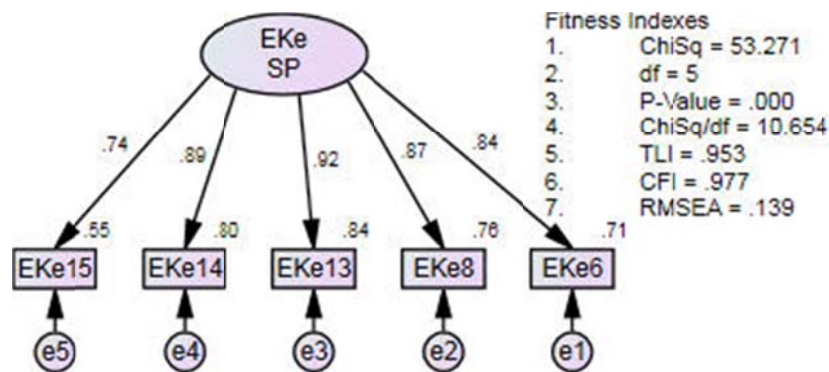


Figure 4. Factor loading for every item in the measurement model teachers' self-efficacy for instructional strategies

Table 6. The fitness indexes for measurement model teachers' self-efficacy instructional strategies

Name of category	Name of index	Index value	Comments	
1	Absolute fit	RMSEA	0.139	The required level is not achieved
2	Incremental fit	TLI	.953	The required level is achieved
		CFI	.977	The required level is achieved
3	Parsimonious fit	Chisq/df	10.654	The required level is not achieved

Table 6 shows that the fitness index of RMSEA and Chisq/df have not achieved the required level even though the factor loading for all items are above 0.6. Thus, one might argue that certain items are redundant to each other in the measurement model.

Table 7. The modification indexes present the covariance between each pair of items

	M.I.	Par Change	Comment
e1 <--> e4	24.338	.060	MI > 15 indexes Item Eke6 and item Eke14 are redundant

Table 7 presents the MI for a pair of correlated errors which suggest that redundant items exist in the model. The correlated measurement error here is between e1 and e4. If we look at the items, the redundant item is between Eke6 and Eke14.

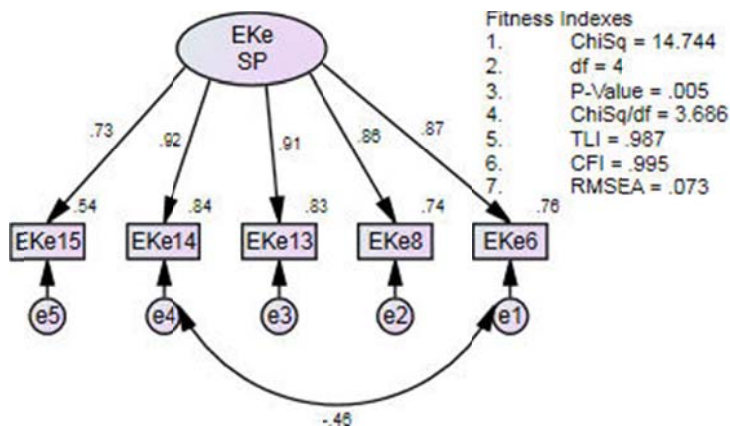


Figure 5. The new measurement model after e1 and e4 are correlated

Table 8. The fitness indexes for new measurement model teachers’ self-efficacy instructional strategies

Name of category	Name of index	Index value	Comments	
1	Absolute fit	RMSEA	.073	The required level is achieved
2	Incremental fit	TLI	.987	The required level is achieved
		CFI	.995	The required level is achieved
3	Parsimonious fit	Chisq/df	3.686	The required level is achieved

Table 8 shows how the fitness indexes have improved after the two redundant items are constrained in the model. The fitness index for RMSEA, TLI, CFI and Chisq/df are achieved the required level and the factor loading for all items are above 0.6.

Reliability instrument

Cronbach alpha reliability analysis findings, the critical ratio (CR), and Average Variance Extracted (AVE) for instruments used in this study are summarized in Table 9.

Table 9. The CFA result for the measurement model

Construct	item	Factor Loading (≥ 0.60)	Cronbach’s Alpha (≥ 0.70)	CR (≥ 0.60)	AVE (≥ 0.50)
PBD	Eke3	0.79	0.929	0.926	0.718
	Eke5	0.76			
	Eke7	0.98			
	Eke10	0.71			
	Eke12	0.96			
PM	Eke1	0.82	0.919	0.920	0.699
	Eke2	0.92			
	Eke4	0.88			
	Eke9	0.77			
SP	Eke11	0.78	0.930	0.934	0.741
	Eke6	0.87			
	Eke8	0.86			
	Eke13	0.91			
	Eke15	0.73			

Table 9 shows that the reliability index of the three self-efficacy subconstructs is between 0.919 to 0.930 for the Alfa Cronbach, 0.920 to 0.934 for CR and 0.699 to 0.741 for the AVE that meets the acceptable reliability index.

Second step: Run Confirmatory Analysis (CFA) pooled measurement model for construct.

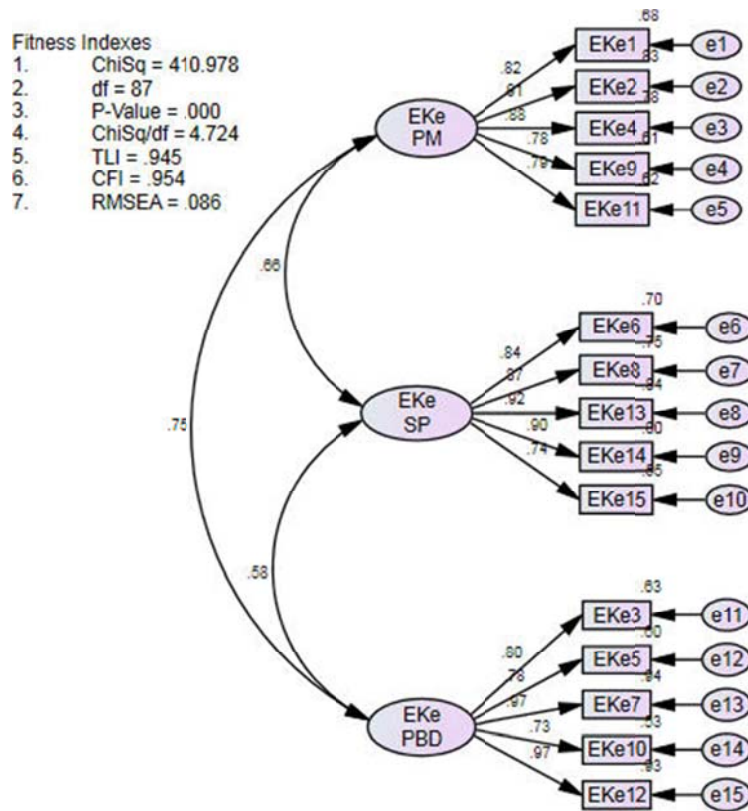


Figure 6. The factor loading for all items of the respective construct

The fitness index for RMSEA (Figure 6) is still below the required level even though the factor loading for all items are above 0.6. Thus, one might suspect that certain items are redundant in the measurement model. The items redundancy can be examined by inspecting the Modification Indexes (MI).

Table 10. The modification indexes present the covariance between each pair of items

	M.I.	Par Change	Comment
e12 <--> e14	151.772	.140	MI > 15 indexes Item Eke4 and item Eke10 are redundant

Table 10 presents the MI for a pair of correlated errors which reflect redundant items exist in the model. The MI value of 151.772 is considered high since it is greater than 15.0. The correlated measurement error here is between e12 and e14. If we look at the items, the redundant item is between Eke5 and Eke10. These items have caused the measurement model to have a poor fit.

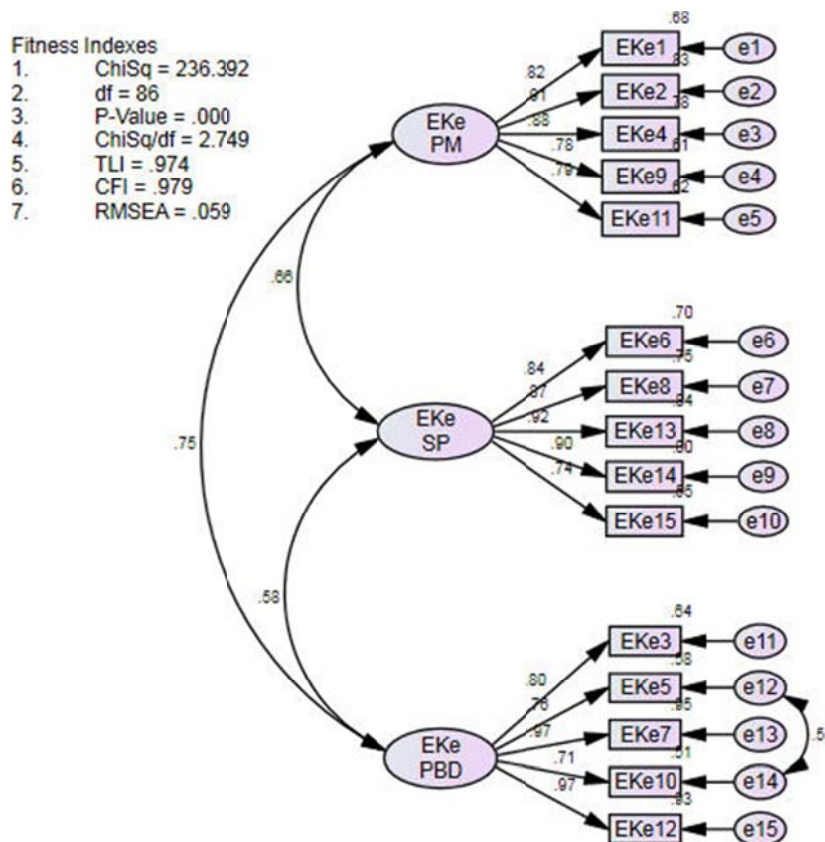


Figure 7. The new measurement model after e12 and e14 are correlated

Table 11. The fitness indexes for measurement model teacher self-efficacy

Name of category	Name of index	Index value	Comments	
1	Absolute fit	RMSEA	.059	The required level is achieved
2	Incremental fit	TLI	.974	The required level is achieved
		CFI	.979	The required level is achieved
3	Parsimonious fit	Chisq/df	2.749	The required level is achieved

Table 11 indicates how the fitness indexes have improved after the two redundant items are constrained in the model. The fitness index for RMSEA, TLI, CFI and Chisq/df have achieved the required level and the factor loading for all items are above 0.6. The analysis results of the overall fit of a model for Teacher Self-Efficacy is fit and may be accepted based on the indicators suggested by Hair et al. (2010), Golob (2003) and Zainudin (2014).

Table 12. The discriminant validity index summary

Construct	PBD	PM	SP
PBD	0.718		
PM	0.563	0.699	
SP	0.339	0.439	0.741

The diagonal values (in bold) is the square root of AVE while other values are the correlation between the respective constructs. The discriminant validity for all constructs is achieved when a diagonal value (in bold) is

higher than the values in its row and column. Referring to Table 12, it can be concluded that the discriminant validity for all three constructs are achieved (Fornell & Larcker, 1981).

3.1 The Assessment of Normality for the Data

Table 13. Assessment of normality distribution for items

Construct	item	Min	Max	Skewness	c.r.	Kurtosis	c.r.
PBD	Eke3	6.000	9.000	-.264	-2.411	-.440	-2.010
	Eke5	6.000	9.000	-.340	-3.104	-.322	-1.468
	Eke7	6.000	9.000	-.403	-3.681	-.252	-1.150
	Eke10	6.000	9.000	-.447	-4.079	-.029	-.134
	Eke12	6.000	9.000	-.403	-3.681	-.252	-1.150
PM	Eke1	5.000	9.000	-.301	-2.749	-.971	-4.430
	Eke2	5.000	9.000	-.461	-4.204	-.734	-3.351
	Eke4	5.000	9.000	-.561	-5.124	-.611	-2.789
	Eke9	5.000	9.000	-.406	-3.710	-.778	-3.551
	Eke11	5.000	9.000	-.419	-3.828	-.973	-4.439
SP	Eke6	2.000	7.000	-.246	-2.245	-.587	-2.680
	Eke8	2.000	7.000	-.361	-3.294	.052	.235
	Eke13	2.000	7.000	-.403	-3.681	-.110	-.502
	Eke14	2.000	7.000	-.399	-3.641	-.046	-.211
	Eke15	2.000	7.000	-.595	-5.431	.703	3.207
Multivariate						20.483	10.141

In this study a test of Skewness and Kurtosis was used to view the data normality. Skewness and kurtosis values are in the range of +3 to + / - 3 indicating that the data is scattered normally and a parametric test should be run (Kline 2005) and multivariate kurtosis value should be lower than 50 (Zainudin, 2012). Descriptive analysis found that all the items are in the range of +3 to + / - 3 and multivariate kurtosis value is 20.483, as shown in Table 13. Therefore, it can be concluded that the data sample is normal.

4. Discussion

On the basis of calculations, it can be perceived that Validity is a measure of consistency of questioned items of an instrument. So, the questioned items are strongly believed to be able to measure what is to be measured. Validity requirement was achieved through the following processes: Convergent Validity: AVE > 0.50: Refer to the following table (Table 9). Construct Validity: All fitness indexes for the models meet the required level. The discriminant validity for all constructs is achieved when the square root of is higher than the values of the correlation between the respective construct. By referring to Table 12, it can be concluded that the discriminant validity for all three constructs have been achieved.

Figure 7 shows a model of the three factors used to measure the Teacher Self-Efficacy, namely classroom management, student engagement, and instructional strategies. Items for each factor is considered to measure only the latent variables respectively. Standardized loading for the three constructs were established to measure the Teacher Self-Efficacy and it shows that the factor loading is high (more than 0.6). It suggests that all three constructs formed have successfully measured Teacher Self-Efficacy. The results of the analysis of the overall fit of the model is considered fit and may be accepted based on the indicators suggested by Hair et al. (2010), Golob (2003) and Zainudin (2014).

The Reliability requirement was achieved through the following process; Internal Reliability: Cronbach Alpha > 0.70: Refer to Table 8 (use SPSS). Composite Reliability: CR > 0.60: Refer to Table 8 (using a formula). Average tVariance Extracted: AVE > 0.50: Refer to Table 8 (using a formula). By referring to Table 11, it can be concluded that the Internal Reliability, Composite Reliability and Average Variance Extracted for all three constructs are achieved. Table 11 shows that the data is fit with the model. Confirmation factor analysis (CFA) has confirmed that the significant item for the three subconstructs, consisting of 5 items of classroom

management, 5 items of student engagement and 5 items of instructional strategies. When the Chi Square test Degrees of Freedom (CMIN / df) show values between 1 and 5 (Chisq/df = 2.749) and RMSEA values for the hypothesis that the model is smaller than 0:08 (RMSEA = 0.059), they indicate where significant hypothetical model reserved is commensurate with the study of data collection, rather than study participants. These results are consistent with the analysis of the compatibility index TLI and CFI in excess of the value of 0.90 (0.974 and 0.979). The results of the analysis of the overall fit of a model for Teacher Self-Efficacy is fit and may be accepted based on the indicators suggested by Hair et al. (2010), Golob (2003) and Zainudin (2014). It is proposed that the 15-item-instrument based on three factors model can be used to measure self-efficacy of teachers of ISEPLD in Malaysia.

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