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Confirmatory Factors Analysis of Learning Environment Instrument among Secondary School Students

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Abstract
Learning environment play an essential role in providing constructive learning atmosphere for students during their learning process. This paper aims to validate the Learning Environment Instrument (LEI) by using Confirmatory Factors Analysis (CFA). The instrument has fourteen items that measure using 10-point Likert scale. The Learning Environment (LE) construct consist of three (3) sub-constructs: Study Companion (SC), Parent Support (PS), and Teachers' Support (TS). After data cleaning 237 secondary school students as the sample of the study. The second order CFA result revealed unidimensionality, validity and reliability for the learning environment construct achieved. The measurement model is accepted. It can be assembled into structural model for further analysis using student's learning environment instrument.
Keywords: Learning Environment, Study Companion, Peer, Parent, Teacher, Support.

Introduction

Over a century peer, parent, and teacher play a significant role in students learning environment. A systematic review of research on students' perspectives toward a conducive learning environment in international higher education found two out of three listed categories domain are relationship and support service (Xu et al., 2022). These shown that majority students need social interaction with their learning environment and from the interaction they will enhance their learning process. From the previous research that related to students' performance, a learning environment has become one of the important factors in make sure the students' good result achievement (Cayubit, 2022; Fraser, 1998; Maat et al., 2015; Malik & Rizvi, 2018). Perception of the learning environment important in understanding student learning performance (Vandecandelaere et al., 2012). Learning environment play an important role towards student education (Cayubit, 2022; Chang & Fisher, 2003; Fraser, 1998; Maat et al., 2015; Malik & Rizvi, 2018; Vandecandelaere et al., 2012; Xu et al., 2022; Zedan & Bitar, 2014). Where previous studies, researcher mostly explored how learning environment improve student learning performance. Besides in previous research learning environment are commonly refer to learning space and physical setting that learning take place (Maat et al., 2015).

In this study context, learning environment refers to the student social environment that also consider as their learning environment. Student social environment during their learning process involved peer, parent, and teacher. Social environment play an important role in learning (Bandura, 2006, 2018; Nasser-Abu Alhija & Amasha, 2012; Núñez & León, 2015; Taylor & Fraser, 2013) as explained in Social Cognitive Theory (SCT). Bandura's Triadic Reciprocal Causation Model predicts dynamic relationships between intrapersonal factor, behavior (learning) and the environment where the three factors influences one another, bidirectionally learning environment and students' learning (Bandura, 1978, 1989a, 1989b; Tosto et al., 2016). For example in Núñez & León (2015) study suggested student environmental factors may explain such an important aspect as students' dedication in school. While Adamski et al (2013) research summary up a lot previous research that conducted and focused on the environment such as school and class, and their study attempted to determine the influence of school and class with home environment on students' attitudes and achievement outcomes. Besides considering school, class, and home environment influence students' reaction toward their learning process. The learning environment should give social more understanding regarding how learning environment able to contribute and enhance students learning process where this instrument evaluates based on self-description questionnaire with three (3) sub-construct Study Companion (SC), Parent Support (PS), and Teachers' Support (TS). Where in explaining triadic reciprocal causation in Social Cognitive Theory (SCT) Bandura (1989b) mentioned human behaviors as either being monitored and formed by environmental stimuli or led by internal tendencies. Students' perception toward their learning environment played a significant role in their learning process. Peer, parent, and teacher direct or indirect influence students' learning environment as the student reflective respond toward their learning environment that involve peer, parent, and teacher into the learning environment. This study, adapted, modified, and regroup the previous research instrument items into three group, students' perception using self-description questionnaire items asking student to evaluate how peer, parent, and teacher influence their agree level using 10 Likert scale based on their learning environment context. The 10 Likert scale ranging from "1" as "Not true about me"to "10" as "Very true about me". Since there have changes and regroup of the questionnaire items are made, all items sent for expert validate, and run EFA test using pilot before conducting field data for CFA. Thus, the research objective is to validate the learning environment instrument using CFA for secondary students.

Methodology

A total 237 of secondary students from National Secondary School selected and used as CFA sample after completing the data screening. To conduct research at National School the researcher needs to obtained approval from Ministry of Education Malaysia (MOE) at their Educational Research Application System (ERAS) and followed by each state education department and school willingness to join and give cooperation in data collection process. Self-description and self-administered questionnaires with 10 Likert scale used for measuring students' Learning Environment Instrument (LEI) compromises a total of thirteen items. There are three (3) sub-constructs for learning environment construct: Study Companion (SC), Parent Support (PS), and Teachers' Support (TS).

This research learning environment construct is adapted and modified from previous study learning environment into three main element that need to consider when talking about

student learning environment which are peer, parent, and teacher. All these also reflect students learning environment with regard as student perception towards their environment in their learning process. As mentioned in Bandura's model of reciprocal determinism, other personal factor, behavior, cognitive, and environmental influences all operate as interlocking elements that affect each other bidirectionally (Bandura, 1985). Where CFA evaluates the theoretical pattern of factor loadings on prespecified constructs that represent the actual data and let researchers know how well the theoretical specification of the factors matches the reality (Hair et al., 2019) as CFA discovers the degree of confirmation for set measurements theory. In CFA, there are three (3) assessment: unidimensionality, validity, and reliability of latent construct (Awang, 2015; Awang et al., 2018; Hair et al., 2019). Before assessing the validity and reliability, researcher should make sure in the unidimensionality evaluate the factor loading for every item exceed 0.5. After done evaluate the unidimensionality, there are three (3) types of validity need to achieve are convergent validity (AVE ≥ 0.05), construct validity by evaluate fitness indexes (category of model fit: absolute fit, incremental fit, parsimonious fit), and discriminant validity (modification indices). While composite reliability (CR ≥ 0.60) and the average variance extracted (AVE ≥ 0.50) are the reliability measurement in CFA (Awang et al., 2018; Hair et al., 2019; Kline, 2016; Muda et al., 2018). Table 1 suggested the categories of model fit that need to achieve (Awang et al., 2018; Muda et al., 2018).

Table 1
The Model Fit Category with name of index and level acceptance for construct validity in CFA

Model Fit Category	**Name of index**	**Level of acceptance**
Absolute Fit Index	Root Mean Square of Error Approximation (RMSEA)	RMSEA < 0.1 (ideal < 0.08)
	Goodness of Fit Index (GFI)	GFI > 0.85 (ideal > 0.90)
Incremental Fit Index	Comparative Fit Index (CFI)	CFI > 0.85 (ideal > 0.90)
	Tucker-Lewis Index (TLI)	TLI > 0.85 (ideal > 0.90)
	Normed Fit Index (NFI)	NFI > 0.85 (ideal > 0.90)
Parsimonious Fit Index	Chi Square/Degree of Freedom (Chisq/df)	Chi-Square/ df < 5.0 (ideal < 3.0)

Results and Discussion

In this research researcher used IBM-SPSS-AMOS 24.0 software to validate the learning environment instrument. Result shown unidimensionality for the sub-construct achieved when factor loading items for the latent construct more than 0.5 as shown in Figure1 below.

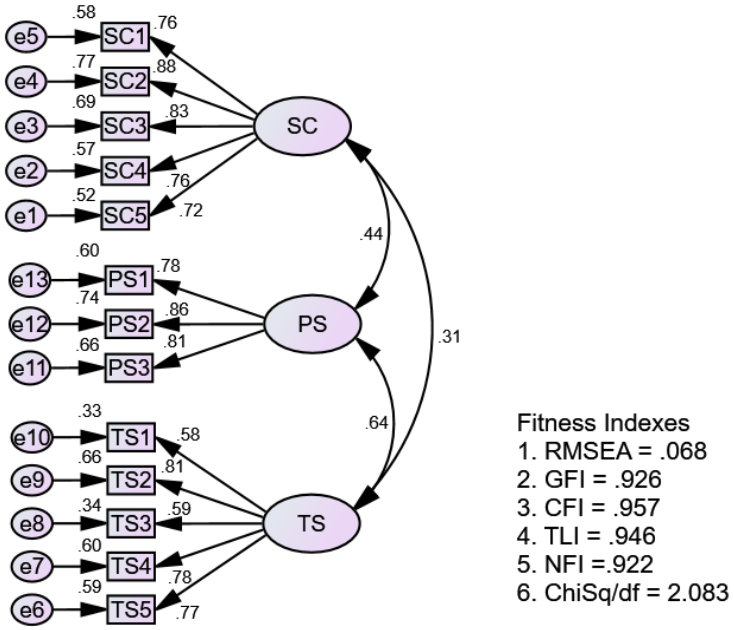

Figure 1. The CFA for LE sub-construct.

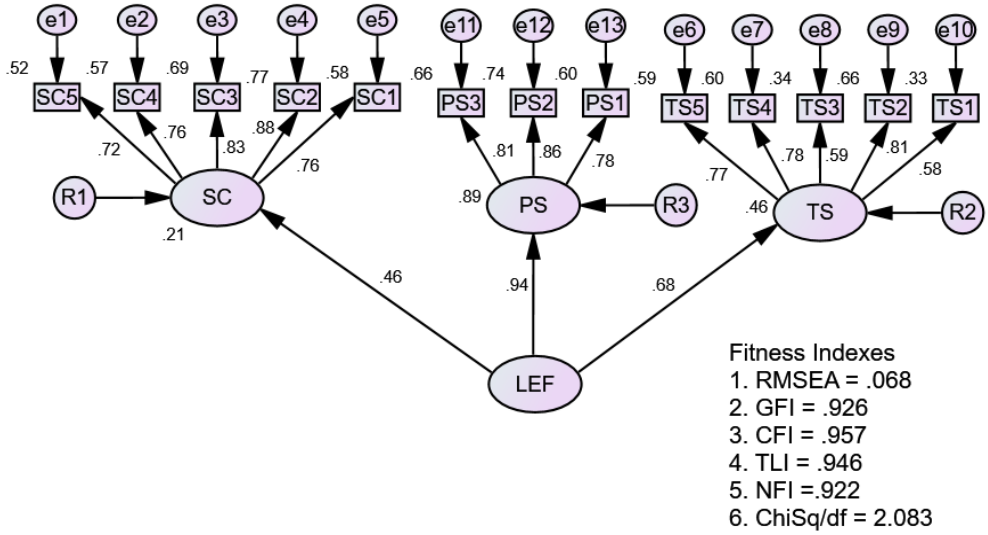

Figure 2. The Second Order CFA for LE

The result in Figure 1 shown that there is no multicollinearity problem in between the sub-construct because the correlation value between sub-construct less than 0.85. Vital in CFA to identify the correlation between sub-construct below threshold 0.85 so that there is no redundancy among the sub-constructs (Awang, 2015; Awang et al., 2018; Hair et al., 2019; Muda et al., 2018). While in Figure 2 shown the second order construct for LEI and result construct validity achieved. The fitness indexes value for the three (3) types of model fit summary in Table 2 below.

Table 2
The Fitness Indexes for CFA

Model Fit Category	Name of index	Index value	Result
Absolute Fit Index	RMSEA (<0.08)	0.068	Achieved
	GFI (>0.90)	0.926	Achieved
Incremental Fit Index	CFI (>0.90)	0.957	Achieved
	TLI (>0.90)	0.946	Achieved
	NFI (>0.90)	0.922	Achieved
Parsimonious Fit Index	Chisq/df (<3.0)	2.083	Achieved

Over decade in majority research the Fornell–Larcker test supports initial evidence of discriminant (Fornell & Larcker, 1981; Hair et al., 2019; Henseler et al., 2014). Meanwhile Ab Hamid et al (2017) have conducted a research to comparisons two (2) approach of discriminant validity between Fornell–Larcker and Heterotrait-monotrait (HTMT) using the SmartPLS sofware version 2.0.M3. However, the revised and re-evaluated finding shown that Fornell and Larcker approach are inadequately sensitive to detect discriminant validity when compared with HTMT approach. On the other hand in variance-based SEM social science researcher also tend to test discriminant validity using HTMT and less relies on the Fornell–Larcker measure, which mostly used in covariance-based SEM research (Henseler et al., 2014). Since in the recent year there are a lot study that highlight the HTMT method (Henseler et al., 2014) but majority make comparison using SmartPLS sofware (variance-based SEM). In 2019, Gaskin and James team have produced a HTMT plugin that enable researcher to test HTMT using IBM-SPSS-AMOS 24.0 and above version software. In this study researcher test discriminant validity for LEI using the two (2) approach by using IBM-SPSS-AMOS 24.0 software with HTMT plugin from Gaskin and James (2019) to check the discriminant validity for LEI. The result Fornell-Larker measure shown in Table 3 and the output of HTMT approach produced by AMOS plugin display in Figure 3.

Table 3
Fornell–Larcker Discriminant Validity Index Summary for LE Sub-constructs

Sub-Constructs	SC	PS	TS
Study Companion (SC)	**0.79**		
Parent Support (PS)	0.44	**0.82**	
Teachers' Support (TS)	0.31	0.64	**0.71**

Discriminant validity Index summary for LE sub-constructs shown the square root of the average variance extracted (AVE) value in bold (SC=0.79, PS=0.82, TS=0.71) are larger than the correlation between sub-constructs value (0.44, 0.31, 0.64) that in position off-diagonal. The Fornell–Larcker discriminant validity index for LEI achieved.

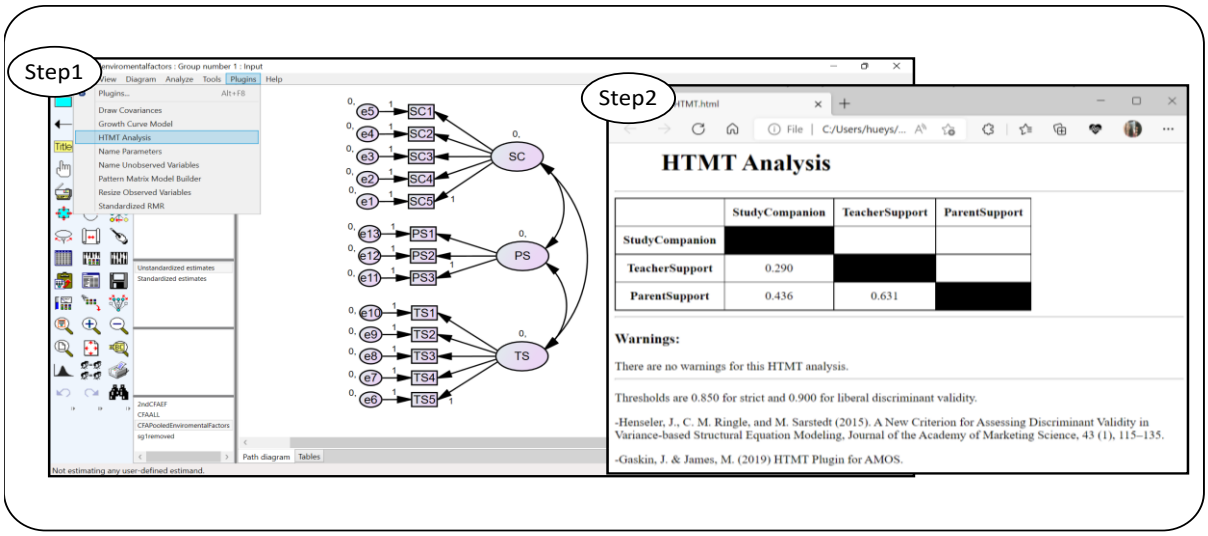

Figure 3. HTMT Analysis Result

Gaskination's StatWiki platform (http://statwiki.gaskination.com/index.php?title=Plugins) providing the plugin that able generates an HTMT table in AMOS for researcher to use (Gaskin & James, 2019; Henseler et al., 2014). Figure 3 shown screenshot perform HTMT table using HTMT analysis plugin and HTMT output table. The HTMT analysis result indicated there are no warning for the HTMT analysis that having 0.850 strict threshold and 0.900 as the liberal discriminant validity (Gaskin & James, 2019; Kline, 2016). From the result shown the discriminant validity Fornell–Larcker and HTMT analysis for LEI have achieved. Validity for the measurement model supported when the convergent validity (AVE ≥ 0.5), construct validity (fitness indexes), and discriminant validity. However, in this study researcher still think that there are still need more research and empirical study to support HTMT in covariance-based SEM.

Next, in the Table 5 CFA result for the measurement model for LE construct and sub-Constructs proved that the AVE value 0.50 and above indicate the convergence validity achieved while CR 0.60 and above indicates composite reliability has achieved. The CR value for LEF 0.750 and AVE value for LEF is 0.519 more than the threshold for both measurements. The CR and AVE values calculation formula in Table 4 below where K refer factor loading of every item, n is the number of items in a model, and Σ mean the sum.

Table 4
CR and AVE Calculation Formula

CR	=	$(\Sigma\kappa)^2 / [(\Sigma\kappa)^2 + (\Sigma 1 - \kappa^2)]$
AVE	=	$\Sigma\kappa^2/n$

Table 5
The CFA Result for the Measurement Model for Learning Environment Construct and Sub-Constructs

Construct	**Sub-Construct**	**Factor Loading**	**CR (Minimum 0.60)**	**AVE (Minimum 0.50)**
Learning Environment Factor (LEF)	**Study Companion (SC)**	0.46	0.750	0.519
	Parental Support (PS)	0.94		
	Teacher Support (TS)	0.68		
SC	SC1	0.76	0.893	0.627
	SC2	0.88		
	SC3	0.83		
	SC4	0.76		
	SC5	0.72		
PS	PS1	0.78	0.858	0.668
	PS2	0.86		
	PS3	0.81		
TS	TS1	0.58	0.835	0.508
	TS2	0.81		
	TS3	0.59		
	TS4	0.78		
	TS5	0.77		

Before continuing with SEM, researchers need to ensure the normality of the data distribution after the CFA assessment achieved (Awang et al., 2018). The normality result product using IBM-SPSS-AMOS 24.0 software shown in Table 6 below.

Table 6
Assessment of Normality

Item	min	max	skewness	c.r.	kurtosis	c.r.
PS1	1.000	10.000	**-.855**	-5.371	-.101	-.317
PS2	1.000	10.000	**-.922**	-5.795	.288	.906
PS3	1.000	10.000	**-.557**	-3.499	-.401	-1.262
TS1	5.000	10.000	**-1.161**	-7.300	.237	.743
TS2	5.000	10.000	**-1.202**	-7.558	.683	2.146
TS3	2.000	10.000	**-.883**	-5.550	-.024	-.074
TS4	3.000	10.000	**-.998**	-6.274	.171	.538
TS5	3.000	10.000	**-.955**	-6.000	.017	.054
SC1	1.000	10.000	**-.661**	-4.153	-.444	-1.396
SC2	1.000	10.000	**-.916**	-5.755	-.104	-.326
SC3	1.000	10.000	**-.710**	-4.465	-.435	-1.366
SC4	1.000	10.000	**-.545**	-3.425	-.380	-1.195
SC5	1.000	10.000	**-1.012**	-6.363	.125	.394
Multivariate					15.576	6.071

Normality assessment in SEM by using the skewness measurement evaluation for each item and the absolute value for skewness 1.0 or less shown the data is normal distributed. But the result skewness value for items TS1 (-1.161), TS2 (-1.202), and SC5(-1.012) are more than 1.0. However Awang et al (2018) mentioned that for SEM that use IBM-SPSS-AMOS software and Maximum Likelihood Estimator (MLE) absolute value below 1.5 still acceptable if the sample size more than 200 and critical region (CR) for the skewness not more than 8.0 since the MLE estimator robust with skewed data. As result the normality assessment for the research data are normally distributed.

Conclusion

This study aims to validate the learning environment instrument using CFA for 237 of secondary students. CFA result proof that the degree of confirmation for set measurements theory for LEI has achieved. The data manage accomplished the three (3) assessment in CFA: unidimensionality, validity, and reliability of latent construct. In conclusion, the LEI is valid and reliable in measuring the learning environment in this study context. Researcher believe in future the present study can be extended to different setting, sample and even adding more constructs that supported by theory to achieve a better measurement model and facilitate students' learning for better learning outcomes.

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