Validation of learning environment inventory for secondary school contexts

Nurulhuda Md Hassan[1], Norliza Abdul Majid[2], Nur Khairunnasuha Abu Hassan[3]
[1,2]Department of Educational Studies, Sultan Idris Education University, Malaysia
[3]Sultan Idris Education University, Malaysia

Article Info	ABSTRACT
	This study was conducted to describe the validation of learning environment inventory (LEI) for secondary school contexts. A survey method was used for data collection through the 20-item LEI. This study consists of two phases. In Phase 1, an exploratory factor analysis (EFA) was conducted using the Statistical Package for Social Sciences (SPSS 21) involving data collected from 150 students, which resulted in the extraction of four factors related to learning environment; (a) Learner-centered, (b) Knowledge-centered, (c) Assessment-centered, and (d) Community-centered. A confirmatory factor analysis (CFA) was carried out in Phase 2 with a new sample (N = 268) which resulted in strong model fit estimation. Such results confirmed the factor structure of Phase 1 and resulted in a final 12-item scale, which may be considered as an acceptable model.

Corresponding Author:

Nurulhuda Md Hassan,
Department of Educational Studies,
Faculty of Human Development,
Sultan Idris Education University,
35900 Tanjong Malim, Perak, Malaysia.
Email: nurulhuda.mh@fpm.upsi.edu.my

1. INTRODUCTION

Learning environment has been a major concern in educational research after it was introduced by Lewin [1] and Murray [2], due to its cucial role in determining the extent to which the teaching and learning process is effective [3, 4]. It implies a variety of aspects that influence students' intellectual development, which include psychological, emotional, social, and cultural [5]. Higher academic achievement among students due to the exposure to positive classroom environments is consistent with developmental theory, even though it is not yet well documented in the educational literature [6].

The literature is replete with evidence that shows learning environment has the potential to influence students' academic achievement [7-27]. The new reform in education emphasizes the need for creating collaborative and learner centered learning environments. However, most teachers were found to be continually practicing traditional approach, especially in secondary schools [28]. They preferred to use lecture as their primary teaching method [3, 29] and emphasized summative rather than formative assessment. These practices led to poor students' participation which eventually resulted in substandard student performance.

2. BRANSFORD, BROWN AND COCKING LEARNING ENVIRONMENT MODEL

The learning environment model introduced by Bransford, Brown, and Cocking [30] sought to ensure that a holistic learning environment is provided to students by taking into account various aspects that affect

students' development. These aspects include psychological, emotional, social, and cultural [5]. The model has four different dimensions that mutually support each other, namely, learner-centered, knowledge-centered, assessment-centered, and community-centered. Reviews of the literature confirmed the importance of including the characteristics of those dimensions in improving student achievement [5, 31-34].

Learner-centered environments refer to the learning environments that attend to students' pre-existing knowledge, skills, attitudes, and beliefs. Besides, it also entails the importance of integrating students' cultural background into the teaching and learning process and having a sense of respect for the students' language practices in order to help students engage in meaningful learning. Learner-centered environments help students to construct meaning by establishing a connection between students' prior knowledge, skills, attitudes, and beliefs with current learning through active learning [35, 36].

In order to provide learner-centered environments, it is crucial for teachers to draw out students' preconceptions to be used as the basis for a more formal understanding of what is being learnt [37]. This requires teachers to practice learner-centered approaches in their classrooms, such as diagnostic and responsive teaching [38-40]. Besides, teachers are also expected to link what is learnt in the classroom to the real world experience encountered by students outside the school setting, as an approach to cultivate authentic learning [35, 36].

Knowledge-centered environments put strong emphasis on learning with understanding and subsequent transfer. Inaddition, such environments also stress on sense-making through metacognitive approaches [41-43] that can help students to become metacognitive experts, who can regulate their own learning. Learning with understanding involves the ability to organize knowledge in a meaningful pattern [44], while transfer entails the ability to apply knowledge in multiple contexts [45]. In order to encourage learning with understanding and learning transfer, knowledge-centered environments focus on the information and activities that are believed to help students develop an in-depth and integrated understanding of a particular discipline. Besides, such environments also require the teaching of major concepts in various contexts [46] to promote learning transfer.

Assessment-centered environments highlight the importance of continuous feedback in improving student learning [47]. In order to be effective, such feedback should be on time, specific, understandable, and provides room for improvement [48]. Besides that, these environments also require that assessments are designed to assess students' understanding and provide opportunities for students to enhance their learning [49]. This model put greater emphasis on formative assessments since they can provide information about students' level of understanding continuously. Apart from that, such environments also stress the importance of developing self-assessment skills among students in order to help them monitor their own learning [50].

Community-centered environments put a strong emphasis on the establishment of positive norms to learn from each other through the collaboration among learning community members. In this environment, teachers and students are given freedom to make mistakes in order to improve students' learning [51, 52]. To promote such environments, learning community members, including those inside and outside of school setting, need to work together to achieve common learning goals [53]. Learning community inside the school setting, which involves classroom and school community, can be promoted through cooperative learning approaches [54, 55]. Meanwhile, the learning community outside school setting which entails the connections between classroom learning experience and out-of-school learning experience can be promoted through after-school programs [56].

According to Bransford, Brown and Cocking [30], incorporating the elements of learner-centered, knowledge-centered, assessment-centered, and community-centered learning environments can optimize students' learning. This study was conducted to (i) explore the four dimensions of learning environment model proposed by Bransford, Brown and Cocking [30] using Exploratory Factor Analysis (EFA), and (ii) test the adequacy of the measurement model by using the Confirmatory Factor Analysis (CFA).

3. RESEARCH METHOD

A survey method was used for data collection through the 20-item LEI which was developed according to the four dimensions of learning environment proposed by Bransford, Brown and Cocking [30]. In total, 418 secondary school students responded to the questionnaire. From this number, data from 150 students were subjected to the Exploratory Factor Analysis (EFA) involving Principal Component Analysis (PCA) with varimax rotation, in order to obtain possible factors of the LEI. EFA of the data from this group was carried out using Statistical Package for Social Sciences Version 21 (SPSS 21). Prior to EFA, Kaiser-Meyer-Olkin (KMO) and Barlett's Sphericity Test were conducted to determine the adequacy of the sample and to indicate the extent to which the data fit to the factor analysis. Next, data from 268 students were subjected to the Confirmatory Factor Analysis (CFA) in order to cross-validate the results obtained from EFA. In this regard, the acceptable indexes for CFAwere [1 < Normed Chisquare (χ^2/df) < 5,

Comparative Fit Index (CFI) ≥ 0.90, and 0.03 < Root Mean Square Error of Approximation (RMSEA) < 0.08], as recommended by Hair et al. [57].

4.   RESULTS AND DISCUSSION

The obtained results for Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was 0.873 and Bartlett's Test of Sphericity was significant ($p < .001$). These results indicate the strong inter-correlations among the items in the questionnaire which allows factor analysis to be carried out. A Principal Component Analysis (PCA) followed by Varimax rotation resulted in the extraction of four factors which explain 53.604% of the variance. Individually, the extracted factors could account for 33.88%, 7.2%, 6.585%, and 5.939% of the total variance. Four aspects were taken into account in deciding the number of factors to be retained; 1) interpretability of the results, 2) the factors explaining over 1 Eigenvalue, 3) the parallel analysis, and 4) the minimum average partial correlation. Additionally, consideration was also given to the theoretical background of the questionnaire. In this regard, the researchers adhered to Hair et al.'s [57] recommendations to ensure a more accurate decision regarding the number of factors.

12 out of 20 items were acceptably loaded on the four factors after checking the factor loadings. The removal of items with loadings lower than .30 and those that clearly loaded on more than one factor, reduced the 20-item scale to a 12-item one. Items 1, 2 and 5 were loaded on factor 1, items 17, 18 and 19 were loaded on factor 2, items 11, 12 and 16 were loaded on factor 3, and items 7, 9 and 10 were loaded on factor 4. The groupings of the particular items were indicated by the factor loadings of the 12-item questionnaire. In order to interpret the groupings of items, the items clustered together under the same factor were studied carefully. This was done to find out if there was any commonality among the items and whether items grouped together could create a new underlying construct.

A closer scrutiny of the first factor content, which explained 33.88% of the total variance, showed that all the items are in line with the characteristics of learner-centered learning environment. Therefore, this factor was labeled as Learner-Centered Learning Environment.The three items that were loaded in the second factor, which explains 7.2% of the total variance, were related to community-centered learning environment, and was labeled as Community-Centered Learning Environment. The third factor, explaining 6.585% f the total variance, consists of items related to assessment-centered learning environment and was labeled as Assessment-Centered Learning Environment. Further, the three items in the fourth factor, which explains 5.939% of the total variance, were related to knowledge-centered learning environment. It was correctly labeled as Knowledge-Centered Learning Environment. Table 1 depicts the total variance explained for each factor, while Table 2 shows the grouping and loading of allthe items onto the four factors in the EFA.

Confirmatory Factor Analysis (CFA) was conducted with a new set of data (n=268) in order to test the model fitness.The results yielded that learning environment dimensions were rather adequate with chi square ($\chi2$) =82.202, degree of freedom (df) = 48, significant level (p) = 0.000 and normed chi-square ($\chi2/df$) = 1.713. The incremental fitness result indicated model fit; Comparative Fit Index (CFI) = 0.941. The absolute fitness result showed an excellent model fit; Root Mean Square Error of Approximation (RMSEA) = 0.052. Figure 1 depicts the results obtained from CFA.

Table 1. Total variance explained

Component	Initial		
	Eigenvalues	% of Variance	Cumulative
1	6.776	33.880	15.447
2	1.440	7.200	41.080
3	1.317	6.585	47.665
4	1.188	5.939	53.604

Table 2. Item and factor loadings

| Learning Environment	Factor Item	Indicators	Factor Loadings
1) Learner-Centered	L1	Teachers relate the topic I am studying with the topics that I've learned.	0.683
	L2	Teachers relate what I've learned in the classroom with my experience in real life.	0.389
	L5	Teachers use easy-to-understand language when teaching.	0.559
2) Community-Centered	L17	Teachers encourage me to learn with my friends while conducting learning activities.	0.513
	L18	Teachers emphasize the importance of resolving conflict if opposing ideas emerge among students.	0.728
	L19	Teachers create a positive social environment where teachers and students are open to make mistakes during the teaching and learning process.	0.463
3) Assessment-Centered	L11	Teachers give me the opportunity to evaluate my own learning.	0.469
	L12	Teachers give me the opportunity to evaluate the work of my friends.	0.487
	L16	Teachers give me the opportunity to share ideas when learning a particular topic in the classroom.	0.439
4) Knowledge-Centered	L7	Teachers give me the opportunity to learn similar topic in different contexts.	0.324
	L9	Teachers emphasize learning with understanding, not memorization.	0.376
	L10	Knowledge of a subject is linked with other subjects that I learned.	0.661
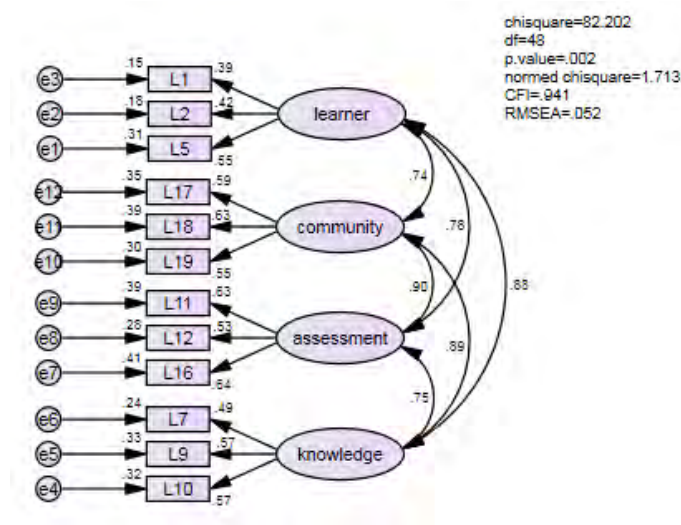
Figure 1. Measurement model of the LEI

5. CONCLUSION

This study was conducted to validate a measuring instrument related to a learning environment called Learning Environment Inventory (LEI). Four learning environment dimensions served as the conceptual model for developing the instrument and its validation. The results obtained from EFA yielded that four factors can be extracted by the instrument, which were in line with the conceptual model. Additionally, all the parameters obtained from CFA indicated that this model is an acceptable model. Therefore, it can be concluded that LEI is a valid instrument. However, care should be taken for wider application of the tested model and the developed LEI, since this study focused only on secondary school students from one of the states in Malaysia as samples. For future research, cross-validation of LEI is recommended by including a larger number of secondary school students in Malaysia.

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