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Exploratory Factor Analysis (EFA) of Assessment Practice Skill Among Lecturers in Malaysia

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Abstract: The aim of this study was to adapt the Assessment Practices Inventory Modified (APIM) scale instrument developed by Matovu, (2019) for higher education lecturers in Malaysia. To ensure that the adapted questionnaire was apt for the lecturers, the exploratory factor analysis (EFA) method was used. This research was carried out as part of a pilot study involving 102 lecturers from Malaysian higher education institutions. Multistage random sampling was used to select the respondents. Results of the Exploratory Factor Analysis (EFA) shown five underlying components of assessment practice skill among Malaysian's lecturer with 27 indicators namely design, interpretation, management, application and evaluation. Apparently, the five components explained 73.3% of the total variance. The reliability of the APIM construct was 0.96, while that of sub-constructs ranges from 0.74 to 0.94. Apart from contributing further insight to the current literature on assessment practices skill among the lecturers, the results also provide a reliable source of information to researchers for future research in assessment practice skill in Higher Education Institutions (HEIs).

Keywords: *Assessment Practice Skill, Exploration Factor Analysis, Higher Institution, Lecturer*

1. Introduction

Progression in the field of education has always been the main focus of the Malaysian government. It is often the main agenda in the national budget where in the year 2022, the Malaysian government allocates RM14.5 billion for the development of higher education in the country which is seen to be increasing in terms of achievement, especially at the international level through the ranking in the QS World University Ranking (MOHE, 2021). In the Malaysia Education Development Plan 2015-2025, the Ministry of Higher Education (MOHE) emphasizes the skills that need to be mastered by graduates in facing a globally competitive environment. Thus, one of the agendas in the plan is to focus on the use of assessment (Sulaiman et al., 2020). The plan encourages university students to actively learn (Swaran et al, 2017). Therefore, two things that Higher Education Institutions (HEIs) must do (i) The program structure must have measurable learning outcomes and (ii) quality assessment in line with learning outcomes (Badariah et al., 2014). A new emerging of assessment which include formative and summative demand highly skilled lecturer in executing the process. Matovu (2019) mentioned several skills need to be possessed by a lecturer;

(a) Design assessment method

This factor is the fundamental requirement of assessment in which it must aligned with the desired learning outcomes (Biggs, 1995; Stiggins, 2008). A well-designed assessment should be based on priority standards, include unwrapped standards, and multiple measures (Ainsworth & Viegut, 2006). All the test preparation must meet accordingly learning objectives (Robinson-Karpius, 2006). Gonzales (1999) proposed that educators must create a test strategy that incorporates a variety of questions that tap into different levels of cognitive complexities. Unfortunately, the design of

assessment requires strong support and discussion among lecturers in their respective faculties but study showed that academics prefer to work alone rather than working with colleagues (Barton et al., 2020).

(b) Interpretation of assessment

Educators must provide clear instructions, motivate students, and ensure that there is enough physical space for them to perform well in the assessment. Somehow, the contemporary assessment practices in higher education do not perform these functions as every educative process starts and end with narrow assessments and learners shrink into meaningless scores or grades (Areekkuzhiyil, 2019).

(c) Management of assessment

This is the management assistance provided by individual lecturers or the university administration to the assessment process. The quality of assessment in universities is also often disputed. Academicians do not store and analyze information on educational interventions such as curriculum, pedagogy and assessment activities experienced by students (Smith et al., 2018).

(d) Application of assessment

Following the completion of an assessment, the results can be used for a variety of objectives throughout the learning process like education decisions (Ainsworth & Viegut, 2006) and recognizing unethical assessment methods.

This study is to adapt the Assessment Practices Inventory Modified (APIM) instrument to lecturers in Peninsular Malaysia using the Exploratory Factor Analysis (EFA) method. Is Exploratory Factor Analysis (EFA) able to form a questionnaire tailored to lecturers in higher institution in Malaysia? The objective of this study is to use the Exploratory Factor Analysis (EFA) method to adapt the Assessment Practices Inventory Modified (APIM) questionnaire to lecturer in Peninsular Malaysia. Figure 1 shows conceptual framework of Assessment Practices Inventory Modified (APIM).

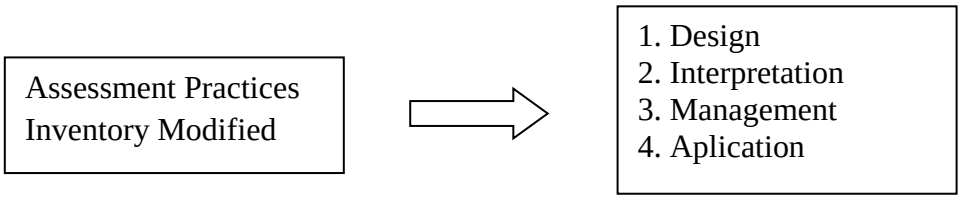

Figure 1. Conceptual framework of Assessment Practices Inventory Modified

2. Methodology

The quantitative study was carried out using the questionnaire method. The current study used a cross-sectional design where all the measures were administered at one point at a time. For this pilot study, 102 lecturers from private and public higher institutions were chosen

using multistage sampling. The questionnaire survey method is widely used in research in a variety of sectors, including social science and education (Chua, 2012). Population is denoted as the aggregate sum of all subjects, objects and members corresponding to a set of specifications (Majid, 2018). More precisely, according to Creswell (2012) states that the population is a group of individuals who have the same characteristics and criteria for the purpose of the study where the same criteria can be observed and measured. Therefore, the target population of this study consists of teaching staff of higher learning institutions in Malaysia. The completed questionnaires have been retrieved and analysed using IBM-SPSS 26.0 for Exploratory Factor Analysis (EFA) (Hashim et al., 2021).

3. Results and Discussion

3.1 Content validation

The extent to which a measurement tool represents the measured construct is referred to as content validity, and it is regarded as critical evidence to support the validity of a measurement tool such as a questionnaire (Yusoff, 2019). APIM questionnaire was developed by Matovu (2019) and consists of a 50-item questionnaire scored on a 5-point Likert scale from 0 (highly unskilled) to 5 (highly skilled). The original APIM questionnaire was translated into Malay using Brislin technique (Brislin, 1970) and were presented on a 10-point interval scale (1= highly unskilled to 10=highly skilled), thus it need to undergo the process of content validity. The content validity index (CVI) can be used to represent evidence of content validity. Even though it is not mandatory but the CVI calculation is highly recommended (Taherdoost, 2018). The average CVI for this research is 0.996 for five experts in the field which considered as acceptable as Polit et al., (2006) recommended I-CVI = 1.00 with 3 to 5 experts as shown in Table 1. Then, the total number of items before the Exploratory factor analysis (EFA) conducted was 50 items and it was reduced after the EFA was conducted.

Table 1. CVI for APIM

APIM items	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
Items rated ‘not relevant’ and ‘somewhat relevant’	0	0	0	1	0
Item rated ‘quite relevant’ and ‘highly relevant’	47	47	47	46	47
Total initial items	47	47	47	47	47
Content Validity Index (CVI)	1	1	1	0.98	1

3.2 Exploratory factor analysis (EFA)

EFA is a multivariate statistical method that has evolved into a fundamental theoretical validation method (Watkins, 2018). Many commercial statistical packages (for example, SPSS, SAS, and Stata) include EFA (Lloret et al., 2017). EFA is employed by researchers for several reasons (Hair & Black,2010). (i) To determine the suitability of items through factor loading and their dimensionality. (ii) To analyze the relationships among items in its most

common arrangement by describing the underlying dimensions. (iii) To explore and assess the instruments in terms of some factors such as culture, languages, time-lapse, and study subjects.

In this study, Kaiser-Meyer-Olkin (KMO) is used to check the adequacy of the sample size. A minimum acceptable score for this test is 0.5 (Kaiser, 1974). But, some researchers recommended the value of 0.7 for KMO (Lloret et al., 2017). Hair et al., (2010) mentioned that KMO less than 0.5 is unacceptable as it indicated that the correlation matrix is not factorable. Table 2 shows the value of KMO is 0.901 and the Bartlett's Test of Sphericity indicates that there is a significant impact on the factorability of the data set with a signifies value of 0.000 < 0.05. Therefore, these findings indicate that the factorability of the data set exists.

Somehow, for the sample size less than 300, it is worth looking at the average communality of the retained items (Samuels, 2016). An average value above 0.6 is acceptable for samples less than 100 (MacCallum et al.,1999). In this study, the communality of the retained items is between 0.6 - 0.8 which is above the value of acceptance (Table 3). Then, the principal component analysis (PCA) method with varimax rotation was performed for the extraction of underlying factors. PCA is a popular factor extraction method that is used as the first stage of exploratory factor analysis. Each factor and subgroup of factors extract the maximum amount of variance from the total variance of a construct, so the factor model must apply the factor rotation approach to complete the PCA procedure (Mishra et al., 2017).

Table 2. KMO Schedule and the Bartlett Test of the Assessment Practice Skill

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.901
Bartlett's Test of Sphericity	Approx. Chi-Square	1622.522
	df	351
	Sig.	.000

Table 3. Communalities of the retained items

	Initial	Extraction
1	1.000	.786
2	1.000	.744
3	1.000	.737
4	1.000	.744
5	1.000	.743
6	1.000	.788
7	1.000	.703
8	1.000	.722
9	1.000	.674
10	1.000	.721
11	1.000	.640
12	1.000	.811
13	1.000	.819
14	1.000	.826
15	1.000	.707
16	1.000	.668
17	1.000	.656

18	1.000	.684
19	1.000	.642
20	1.000	.641
21	1.000	.797
22	1.000	.787
23	1.000	.733
24	1.000	.789
25	1.000	.722
26	1.000	.809
27	1.000	.813

Extraction Method: Principal Component Analysis

PCA with varimax rotation was performed for fifty items of assessment practice skill construct. As presented in Table 4, five factors were extracted for an eigenvalue of more than 1, explaining 73.342% of the total variance. Factor one contributed 50.988%, factor two contributed 8.395%, factor three contributed 5.322%, factor four contributed 4.494% and factor five contributed 4.134%. The eigenvalue is less than 1 after fifth factors, thus only five factors are selected.

Table 4. Total Variance Explained for Assessment Practice Skill

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	13.767	50.988	50.988	13.767	50.988	50.988	5.676	21.021	21.021
2	2.267	8.395	59.383	2.267	8.395	59.383	4.681	17.338	38.359
3	1.440	5.332	64.715	1.440	5.332	64.715	3.812	14.119	52.478
4	1.213	4.494	69.208	1.213	4.494	69.208	2.983	11.050	63.528
5	1.116	4.134	73.342	1.116	4.134	73.342	2.650	9.814	73.342

Extraction Method: Principal Component Analysis

Next, the scree plot for the assessment practice skill construct had sorted 27 items into five components neatly (Figure 2). The examination of the scree plot illustrated a clear point of inflation after the fifth factor.

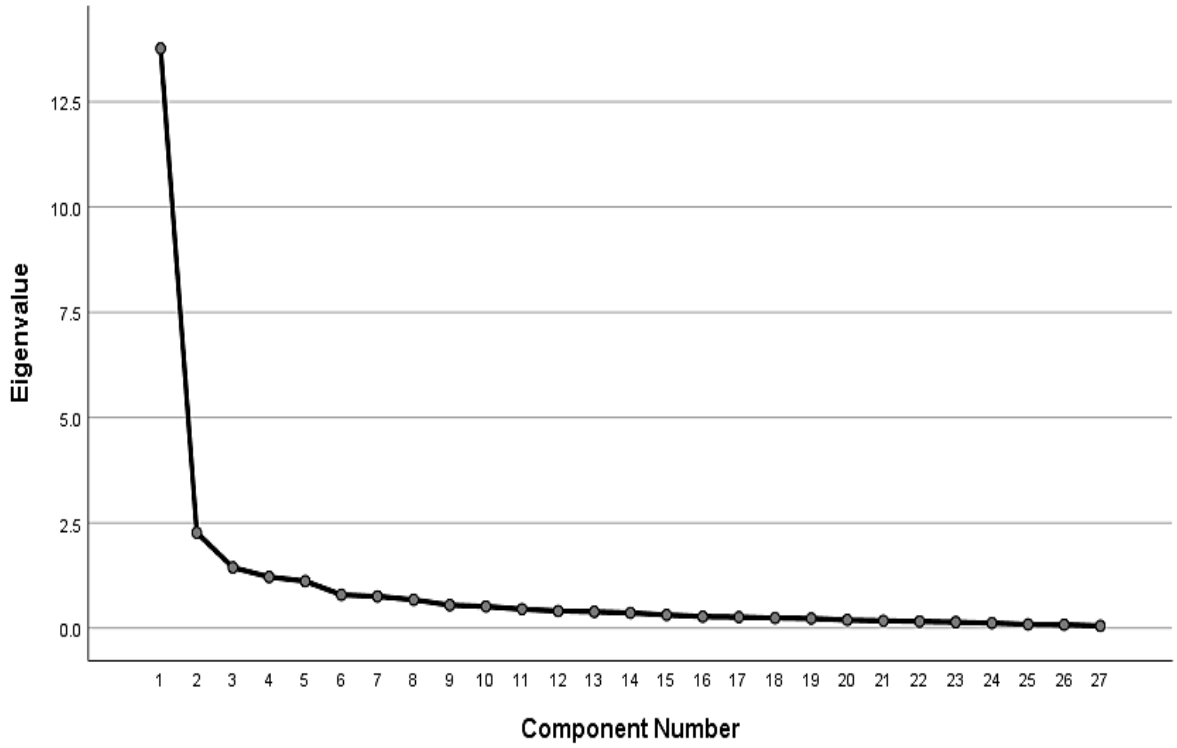

Figure 2. Scree Plot for Assessment Practice Skill

Then, the researcher run the EFA analysis by suppressing a small coefficient less than 0.5 as recommended by Tabachnick & Fidell (2013) and the rotated component matrix was obtained. As indicated in Table 5, twenty-seven items were loaded on five factors as the components. The first factor was comprised of eight items loaded as component one, the second factor consisted of five items as component two, the third factor consisted of six items as component three, the fourth factor consisted of five items as component five and the fifth factor consisted of three items as component five.

Table 5. The Rotated Component Matrix and Items Retained

	Item description	Component				
		1	2	3	4	5
1	Aligning tests to university assessment standards.	.606				
2	Using cognitive taxonomies (Bloom) in designing assessment.	.793				
3	Constructing tests items that match classroom instruction.	.729				
4	Constructing tests based on clearly defined course objectives.	.753				
5	Constructing marking schemes for scoring essay questions	.777				
6	Emphasizing quality control when assessing students.	.534				
7	Marking according to university assessment standards	.712				
8	Considering rubrics when marking students in an assessment.	.769				
9	Demonstrating ‘good’ or ‘bad’ projects when I give assessments.		.617			
10	Using previous assessment results in designing the next test.		.744			
11	Using overall results of students’ performance (e.g. Grades, CGPA etc.).		.662			
12	Revising tests based on item analysis.		.848			

13	Obtaining diagnostic information from assessment results.	.833			
14	Developing standardised proficiency tests.	.567	.616		
15	Selecting an appropriate assessment that can accurately measure students' achievement.		.656		
16	Writing test items at higher cognitive levels (inference and evaluation)		.696		
17	Ensuring adequate content sampling when setting tests		.629		
18	Providing students with guidelines to assess their own work.		.536		
19	Using the grading model.		.593		
20	Avoiding teaching to test when preparing students for assessments.			.777	
21	Organizing student assessment results to make meaning.			.569	
22	Interpreting student assessment scores.			.551	
23	Interpreting grades from assessments.			.549	
24	Using assessment results to enhance teaching.			.607	
25	Using previous assessment results to improve course outlines.				.705
26	Using assessment results to prepare content for the next lecture(s).				.802
27	Comparing obtained assessment results with instructional and course objectives.				.626

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.[a]
a. Rotation converged in 8 iterations.

A total of 23 items did not appeared in the rotation component matrix. Items were eliminated due to uncorrelated to form single constructs in the survey questions (Hair et al., 2010). Items and the reasons for items being eliminated are referred in Table 6. The process of eliminating these items is by omitting items that do not meet the loading factor value requirement which is less than 0.5 should be dropped (Awang et al., 2015).

Table 6. Reason the items were dropped

Items	Reason
5	The items fail to fit in the supposed factor
18	The factor loading is less than value of 0.5

3.3 Assessment of Reliability

Reliability refers to the consistency and stability of scores of the measuring instruments (Creswell, 2015). After performing EFA, a reliability test was conducted with pilot study data to ensure the quality of research instruments used in this study. It was conducted to examine up to what level the items of latent constructs in the proposed measurement model are suitable and appropriate (Awang et al., 2015). Moreover, the reliability test examined the existence of relationship among the construct indicators (Hair et al., 2010). Table 7 demonstrates that Cronbach's Alpha values for all underlying constructs are above the threshold point and meet the suggested criteria. Cronbach's Alpha value for assessment practice skill was .96.

Table 7. Reliability analysis of the underlying sub-constructs and construct

Construct	Sub-construct	Total Item	Items	Cronbach's Alpha for each sub-construct	Cronbach's Alpha for construct
Assessment Practice Skill	Design	8	1-8	.94	.96
	Administration	5	9-13	.89	
	Interpretation	5	14-18	.74	
	Application	6	19-24	.83	
	Evaluation	3	25-27	.84	

4 Conclusion

This study summarized that different contexts may have varied dimensionality of a single construct. The findings of this study indicated that assessment practice skill has 5 sub-constructs instead of four as the original Assessment Practices Inventory Modified (APIM) instrument and retains high reliability as well as good validity. A new sub-construct represented as 'evaluation' is added. It can be concluded that assessment practice skill in this study comprises of 27 items and five different sub-constructs that exhibited sufficient distinction to merit consideration as separate and distinct variables. An extended study using Confirmatory Factor Analysis (CFA) is advised to further validate the existence and contribution of the current factor structure with the goal of producing a more comprehensive scale of assessment practice skill among educators (Alias et al., 2020).

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