RESEARCH ARTICLE

Establishing construct validity of AMEET (assessment of medical educational environment by the teachers) inventory

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Abstract

Objective: To establish the construct validity of Assessment of Medical Educational Environment by the Teachers inventory.

Methods: The cross-sectional analytical study was conducted from January to May 2017 and comprised doctors working as faculty in Rawalpindi Medical College, Rawalpindi, Pakistan, and its 3 teaching hospitals. Non-probability (purposive) sampling was used to meet the criteria of 5 participants per item of the Assessment of Medical Educational Environment by the Teachers inventory. Exploratory factor analysis was done using SPSS 20 and confirmatory factor analysis was done with version 16 of the Analysis of Moment Structures software.

Results: Of the 250 subjects, 126(50.4%) were males and 124(49.6%) were females. Exploratory factor analysis ended with extraction of 11 components. It showed sufficiency of sample size and no multi-collinearity. Three (50%) of the six domains were finalised on the whole and 10(20%) of the 50 items were debarred from the inventory. All three domains had high reliability. Root mean square residual and chi square / degree of freedom were within acceptable limit. However, comparative fit index, goodness of fit index, normed fit index and root mean square error of approximation portrayed not only poor model fit after re-running confirmatory factor analysis, but also led to omission of further 16(32%) items with poor loadings from the inventory. Thus, there was exclusion of total 26(52%) items from the tool and the finalised Assessment of Medical Educational Environment by the Teachers inventory comprised 24(48%) items.

Conclusion: Construct validity of Assessment of Medical Educational Environment by the Teachers inventory could not be established, but the tool was found to be reliable.

Keywords: AMEET inventory, Exploratory factor analysis, Confirmatory factor analysis, Construct validity. (JPMA 69: 34; 2019)

Introduction

Diverse teaching and learning strategies are employed in medical institutes all over the world to enhance learning of the students.[1] Communication gap between teachers and students was also found to be adversely affecting the learning climate of medical students. Therefore the need was felt to arouse interest among medical teachers to work for the improvement of the educational climate.[2]

Numerous instruments were devised to assess educational climate by getting viewpoints of the students like Postgraduate Hospital Educational Environment Measure (PHEEM), Dundee Ready Educational Environment Measure (DREEM) etc., but the Assessment of Medical Educational Environment by the Teachers (AMEET) inventory is a tool that is actually designed to get judgments of the tutors pertinent to educational environment of medical students.[3] AMEET is an instrument that is currently used to gauge educational climate of medical students by gathering opinion of the teachers. This tool is designed by medical teachers of the United Arab Emirates. It is based on 50 items and six domains. This inventory is grounded on a five-point Likert scale from 'strongly agree' to 'strongly disagree'. This tool has excellent reliability (Cronbach alpha 0.94) but unluckily the inventors could not establish its construct validity due to insufficient sample.[4] Construct validity can be established by factor analysis keeping in view five respondents per item.[5]

Construct validity is the extent to which any tool or trial measures what it is supposed to gauge.[6] Construct validity is broad-ranged. It covers all the verifications supporting specific interpretation of a score.[7] The validation process embraces accretion of proofs in order to have methodical explanation. Establishing construct validity of any tool is a strenuous practice and this could be done through factor analysis both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA).[8] We are confronted with diverse terminologies during EFA, while CFA results in the creation of a model and calculation of certain indices.[9]

The current study was planned to ascertain the construct

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validity of AMEET inventory in relevance to Pakistani culture and context following its factor analysis. The study was likely to confirm applicability of AMEET inventory in our setup for appraising the learning climate of our medical institutions.

Subjects and Methods

The cross-sectional analytical study was conducted from January to May 2017 and comprised doctors working as faculty in Rawalpindi Medical College (RMC), Rawalpindi, Pakistan, and its 3 teaching hospitals: Holy Family Hospital (HFH), Benazir Bhutto Hospital (BBH) and District Head Quarters (DHQ) Hospital. For factor analysis, data has to be collected from 5 participants per item.[5] Non-probability (purposive) sampling was used to meet the criteria for the 50-item inventory. The subjects filled AMEET inventory (Annexure-1) after first giving informed consent. Permission for use of AMEET inventory for the establishment of its construct validity was taken from one of the principal inventors of this instrument.[4] Approval was obtained from the ethics review board of Riphah International University, Rawalpindi and RMC. All doctors working in RMC and the three teaching hospitals were enrolled. House officers and postgraduate trainees were excluded.

EFA was conducted using SPSS 20. Items of the AMEET inventory found with Eigen value less than 1 after EFA were eliminated from the inventory. It is mandatory for each domain to have at least 3-5 items for accuracy of the results from EFA.[10]

CFA was carried out by using version 16 of the Analysis of Moment Structures (AMOS) software. Parameters of CFA were also considered before eliminating irrelevant items. In AMOS 16, visual paths were drawn on graphic windows.

Results

Of the 250 subjects, 126(50.4%) were males and 124(49.6%) were females. Institutions and designations of the subjects were noted (Table-1).

Table-1: Designation of study participants.

Sr.#	Designation	Name of Hospital / Institute			
		*RMC	*HFH	*BBH	*DHQH
1.	Professor	4	3	7	2
2.	Associate Professor	2	2	1	0
3.	Assistant Professor	8	18	17	6
4.	Senior Registrar	0	35	18	13
5.	Medical Officer	0	16	16	16
6.	Senior demonstrator	25	0	0	0
7.	*APMO/ *APWMO/*PWMO	12	0	0	1
8.	Demonstrator	23	0	0	0
9.	Consultant	0	1	0	4
	Total	74	75	59	42

* RMC: Rawalpindi Medical College
*HFH: Holy Family Hospital
* BBH: Benazir Bhutto Hospital
*DHQH: District Head Quarters Hospital
*APMO: Additional Principal Medical Officer
*APWMO: Additional Principal Woman Medical Officer
*PWMO: Principal Woman Medical Officer .

Table-2: Kaiser-Meyer-Olkin Measure (KMO) and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.900
Bartlett's Test of Sphericity	Approx. Chi-Square	9603.163
	df	1225
	Sig.	0.000

Table-3: Total Variance.

Sr.#.	Components	Initial Eigen Values		
		Total	*% of Variance	Cumulative %
1	1	16.89	33.77	33.77
2	2	3.98	7.96	41.74
3	3	3.29	6.59	48.33
4	4	2.39	4.79	53.13
5	5	1.94	3.87	57.00
6	6	1.63	3.27	60.27
7	7	1.37	2.74	63.01
8	8	1.25	2.49	65.51
9	9	1.12	2.24	67.75
10	10	1.06	2.13	69.88
11	11	1.02	2.04	71.92

Kaiser-Meyer-Olkin (KMO) measure of sample adequacy was computed to be 0.900 which indicated sufficient

Table-4: Rotated Component Matrix.

Item No.	Components / Domains										
	1	2	3	4	5	6	7	8	9	10	11
28	.817										
10	.775										
48	.739										
21	.733										
23	.718										
02	.714										
11	.703										
09	.702										
20	.682										
12	.670										
25	-.666										
27	.659										
50	-.596	.401									
06	.595										
19	-.582	.566									
08	-.567										
30	.565						.416				
39	.551				.457						
04	.432	-.421									
16		.861									
17		.814									
18		.694									
15	-.413	.655									
07	.534	.564									
14		.510			-.441						
35		.508							.453		
47			-.738								
42			.657								
44	-.416		-.538								
49	.479		.494								
03											
43				.774							
46				.659							
45				.610	.472						
01											
29					-.779						
22	.536				.555						
31						.771					
32						.766					
26						.422					
34							.678				
33							.567				
36							-.471				
41	.493							.716			
40	.406							.631			
05									-.787		
24										.704	
38											
13		.456									.640
37				.435							.446

* Table of Rotated Component Matrix is assembled in the same manner as drawn following (EFA) in SPSS, depicting loading of items in some components while reflecting negative or no loading in other components / domains.

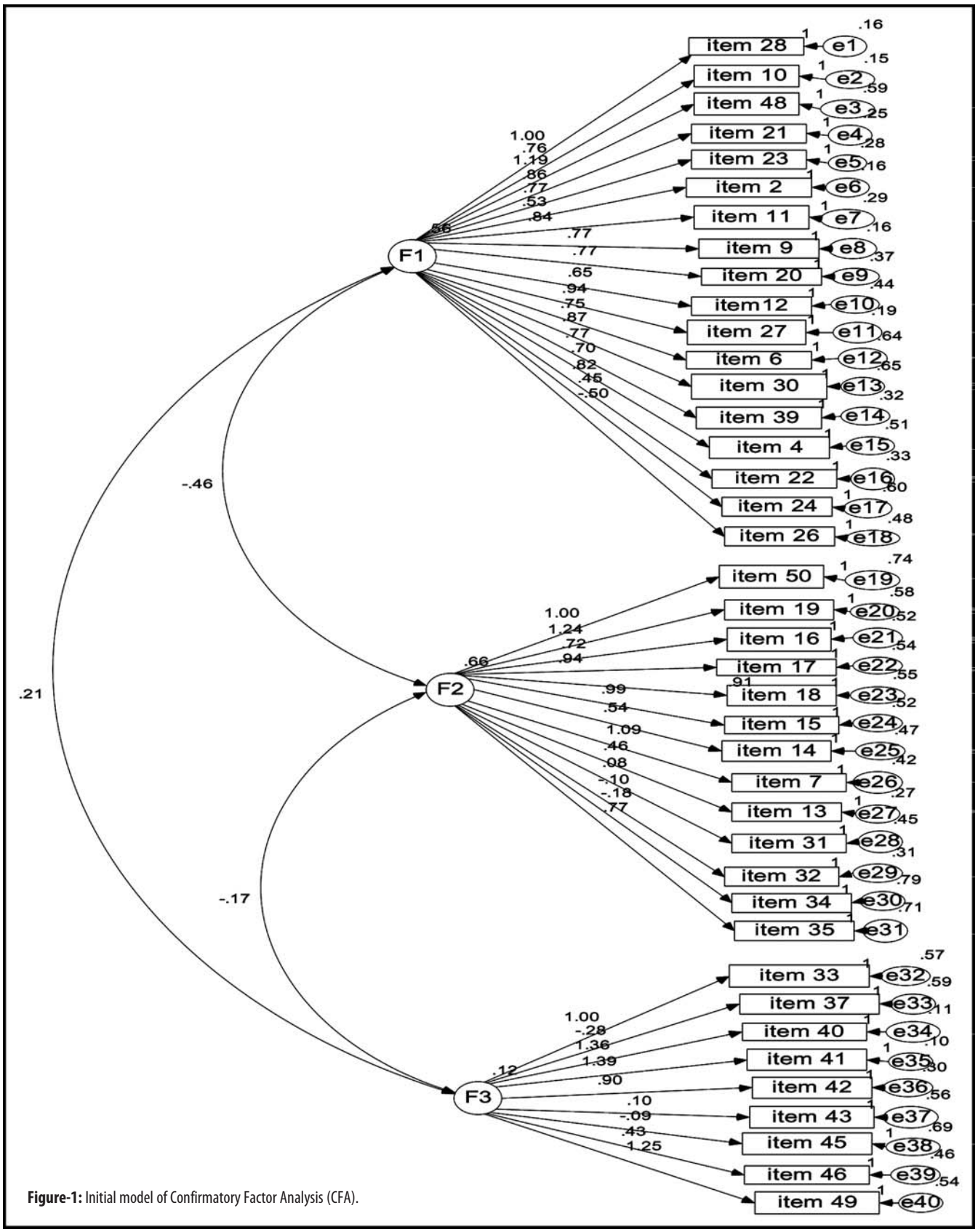

Figure-1: Initial model of Confirmatory Factor Analysis (CFA).

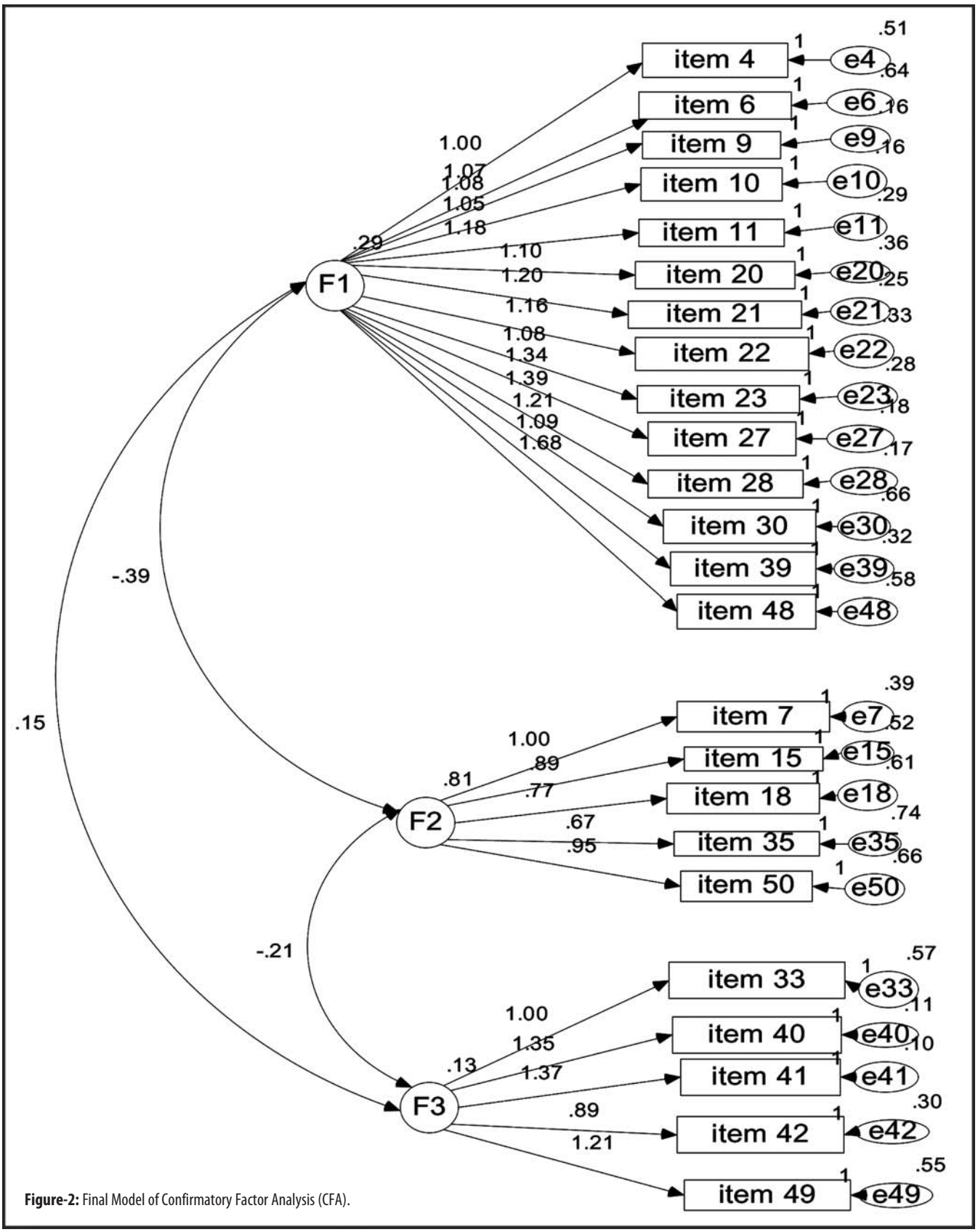

Figure-2: Final Model of Confirmatory Factor Analysis (CFA).

sample size. In addition, highly significant Bartlett's test of sphericity value (0.000) suggested rejection of null hypothesis and efficient application of EFA on the data set with varimax rotation (Table-2).

The computed determinant equivalent was 9.6, revealing no multi-collinearity.

Percentage of variance and eigen value constituted by each domain was separately (Table-3).

Also, 11 components / domains were extracted from AMEET inventory following EFA and varimax data rotation (Table-4). Ten (20%) items were totally eliminated from the inventory after EFA, out of which 8(16%) were excluded because of their negative scores and 2(4%) others because they did not load in any component. Out of six domains, 3(50%) were finalised and the items of other domains (with less than 3 items) were also shifted to the 3 major domains keeping in view their theoretical confirmation to the respective domain. Ultimately CFA also led to the elimination of further 16(32%) items which were computed to have poor loading (<0.4) in their respective domains (Annexure-2).

The 3 major domains were established from results of EFA keeping in view rotated component matrix and reliability (internal consistency) of all the items within each domain

Table-5: Domains established following exploratory factor analysis (EFA).

Domain / Factor No. 1 Teachers' perception of teaching and learning atmosphere	Domain / Factor No. 2 Teachers' perception of learning activities and collaborative atmosphere	Domain / Factor No. 3 Teachers' professional self-perceptions
Item 2	Item 7	Item 33
Item 4	Item 13	Item 37
Item 6	Item 14	Item 40
Item 9	Item 15	Item 41
Item 10	Item 16	Item 42
Item 11	Item 17	Item 43
Item 12	Item 18	Item 45
Item 20	Item 19	Item 46
Item 21	Item 31	Item 49
Item 22	Item 32	
Item 23	Item 34	
Item 24	Item 35	
Item 26	Item 50	
Item 27		
Item 28		
Item 30		
Item 39		
Item 48		

The reliability index (Cronbach ?) of domain 1, domain 2 and domain 3 established after EFA was calculated to be 0.94, 0.87 and 0.63 respectively.

(Table-5).

EFA was followed by CFA and the initial model was designed pertinent to all the factors and their relevant items (Figure-1).

Items with negative loadings and poor loading in each factor were further removed and modification indices were computed after re-running CFA in order to get values closer to an acceptable model fit (Figure-2).

The reliability index (Cronbach α) of domains 1,2 and 3 established after elimination of items with poor loadings in relevant domains and re-running CFA was computed to be 0.94, 0.88 and 0.71 respectively. However, reliability of modified tool was also found to be acceptable (Cronbach α= 0.77). Fit indices were computed for both models and their comparison with benchmarks was done (Table-6).

Discussion

Establishing construct validity is actually evaluation of the degree to which statistical and theoretical confirmation support the aptness of inferences.[11] Moreover, researchers should try to establish construct validity of an already developing instrument instead of developing and validating a new tool.[12]

Both EFA and CFA were carried out in the present study for the establishment of construct validity of AMEET inventory by getting this tool filled by the faculty of RMC and its allied hospitals. A similar study was conducted by doctors of a Saudi university medical school that was aimed at establishing the validity of PHEEM inventory by doing EFA.[13] Like the present study, the Saudi doctors applied principal component analysis with varimax rotation, and also retained those items in the inventory that had Eigen value greater than 1.[13] but they did not do CFA. Psychometric analysis of Jefferson scale of physician empathy[14] was done by doing both EFA and CFA. EFA was done by performing principal component analysis to appraise the relationship between variables and factors. Like the present study, factor co-efficient of 0.40 or greater was selected for retention of variables in this international research.[14] But contrary to the current study, factors with Eigen value greater than 1.25 were retained and apart from using AMOS software, structural equation modelling was also done for CFA. Jefferson scale revealed excellent goodness of fit compared to our study. This difference might be due to huge sample of 853 respondents who filled the questionnaire compared to the current sample of 250 doctors.

In 2002 a study opined that we should not rely on favourable approximate indices calculated from CFA because the appropriateness of goodness of fit indices might be due to huge variance and low correlation

Table-6: Fit Indices of both models of CFA in comparison with Yardstick.

Fit indices	Indices calculated from initial model	Indices calculated from final model	Yardsticks (Leach, 2008)
*X2/df	4.7	4.7	<5
*RMR	0.08	0.06	<0.08
*CFI	0.61	0.78	>0.93
*GFI	0.56	0.70	>0.93
*NFI	0.56	0.74	>0.93
*RMSEA	0.12	0.12	<0.08

P-value was calculated to be 0.000.
* X2/df: Chi square / degree of freedom.
*RMR: Root Mean Square Residual.
*CFI: Comparative Fit Index. *GFI: Goodness of Fit Index
*NFI: Normed Fit Index. *RMSEA: Root Mean Square Error of Approximation.
Modified AMEET inventory is attached as Annexure.

between the variables.[15] Moreover, it has been suggested that paradoxical effect of reliability seems to greatly affect confirmatory fit index (CFI).[16]

A study among 656 Malaysian medical students for the establishment of construct validity of DREEM was done using CFA. This 50-item tool ultimately had 17 items after CFA.[17] The current study eliminated 26 items from the AMEET inventory to make it valid for Pakistani culture, while 33 items were removed from the DREEM questionnaire following CFA to make it fit the Malaysian culture and context.[17] Contrary to the current study, the Malaysian study was done on a huge sample size of 656. This could be one of the reasons of our inability to establish the construct validity of AMEET inventory.

Similar to our study, the faculty of the School of Dentistry in Indonesia worked for the establishment of construct validity of DREEM by getting it filled by 352 medical students. Apart from CFA, Pearson Product Moment Correlation test was applied to test the validity of this tool.[18] Ultimately 17 items out of total 50 were sorted out as bad due to weak correlation ($r<0.3$). Again, this tool was found to have good reliability (Cronbach $\alpha = 0.883$) but its construct validity could not be proven in Indonesian culture and context. The limitation of that study[18] was found to be insufficient sample size. Although study participants in the Indonesian research were more than those enrolled in the current study, it failed to determine the construct validity of the tool. This is a matter of great concern and should be scrutinised by further research.

Psychometric assessment of DREEM inventory has also been carried out by researchers of Ireland by getting responses of 239 final year medical students.[19] Like the present study, it revealed acceptable reliability (Cronbach $\alpha = 0.89$) of the inventory, but CFA showed a weak model fit. Contrary to our study on AMEET inventory within which all domains in the final model showed good reliability, the reliability of one subscale (students' social self-perception) of DREEM had poor reliability (Cronbach $\alpha = 0.55$) which also arouses suspicion regarding vagueness of construct validity of DREEM inventory.[19] The reason might be the inadequacy of the sample size. Ultimately it was suggested that factor analysis of DREEM inventory should be followed by huge sample full Structural Equation Modelling (SEM) analysis for psychometric evaluation of this instrument.[19]

IN terms of limitations, the current study had doctors alone as respondents and were likely to have studied in English-medium schools. Therefore, the questionnaire was not translated in Urdu. Besides, data was not gathered by probability sampling technique in order to have a large sample size.

In future studies, methods other than factor analysis should also be employed to determine the construct validity of a tool. In addition, construct validity of this tool should be established in other cultural contexts by getting responses from still more medical teachers so as to get a better model fit. The factor analysis carried out on still large sample size followed by SEM technique is most likely to prove the construct validity of a tool. Moreover, criteria of 5 participants per item need to be revised for authenticity of factor analysis.

Conclusion

AMEET inventory was found to have acceptable reliability. Two indices of CFA met standards, but 4 indices could not, so construct validity could not be established.

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Annexure-1: Assessment of Medical Educational Environment by the Teachers (AMEET) Inventory.

Sr.#	Statements	SA	A	Neutral	D	SD
	Teachers' perception of teaching					
1	I find my role as a teacher interesting					
2	There is too much of emphasis on learning factual information					
3	The comments given by the teachers help students to improve themselves					
4	The preparation that the teachers undertake for doing their classes is adequate					
5	The emphasis in classes is on what the teacher does rather than on what the student learns					
6	The content and the teaching methods match the learning objectives of the course					
7	The teacher respects the students' viewpoints					
	Teachers' perceptions of learning activities					
8	The learning is ''student centered''					
9	Students have sufficient opportunities to develop competence					
10	Students have sufficient opportunities to develop confidence					
11	The students have a clear idea of what they are expected to gain from the course					
12	The class environment makes the students want to get actively involved					
13	The students are encouraged to be life-long learners					
14	Students are encouraged to understand and apply what they learn rather than remember isolated facts					
	Teachers' perceptions of students					
15	The students are well mannered and respectful					
16	The students complete their assignments on time					
17	The students are motivated to learn					
18	The students come well prepared for their learning activities					
19	The students are not sufficiently prepared for the formative assessments (the assessments conducted for giving feedback/practice)					
20	The students feel comfortable in learning with other students coming from varied background(s)					
	Teachers' perceptions of learning atmosphere					
21	The atmosphere in the hospital setting is conducive to learning					
22	The time allotted to different learning sessions is appropriate					
23	The atmosphere during most of the teaching/learning activities is conducive to learning					
24	The students have sufficient opportunities to improve their communication skills					
25	The students find the learning experience disappointing					
26	The teaching learning experience is very stressful for the students					
27	The students find studying medicine enjoyable					
28	The students feel comfortable about asking any questions they want					
29	The students' feedback about the curriculum is taken into consideration					
30	Teachers are encouraged to provide suggestions regarding curriculum					
	Teachers' perceptions of collaborative atmosphere					
31	Teachers are involved in collaborative efforts related to educational activities					
32	Teachers are encouraged to take a trans-disciplinary approach to health problems					
33	Teachers have good interpersonal communication skills for dealing with peers and students					
34	Teachers are flexible and open to change/suggestions					
35	The attitudes of the teachers are conducive to effective team work					
36	Teachers dominate over subordinates, peers or students					
37	I am satisfied with the opportunities that I get for working with other faculty					
38	There is a formal support system for faculty who get stressed					
39	Teachers have sufficient time to plan their teaching activities					
	Teachers' professional self-perceptions					
40	I am knowledgeable in educational concepts for my role as a teacher					
41	I possess the necessary teaching skills for undertaking my duties					
42	I have effective communication skills for dealing with hospital patients					
43	Opportunities are available for trying out alternative approaches in teaching					
44	I have opportunities for learning research methodology and research communication skills					
45	I have opportunities for developing the skills of educational administration					
46	The Faculty Development Programs are adequate in preparing me for the tasks expected from me					
47	The teachers adopt a variety of teaching methods to cater to diverse styles of learning					
48	Adequate teaching and learning resources (including physical and material) are available					
49	The students have sufficient opportunities to discuss their learning problems with the faculty					
50	I am encouraged to go to conferences that improve my knowledge and skills					

Annexure-2: Items Eliminated from AMEET Inventory.

Item No.	Statements
Item 1	I find my role as a teacher interesting
Item 2	There is too much of emphasis on learning factual information
Item 3	The comments given by the teachers help students to improve themselves
Item 5	The emphasis in classes is on what the teacher does rather than on what the student learns
Item 8	The learning is student centered
Item 12	The class environment makes the students get actively involved
Item 13	The students are encouraged to be lifelong learners
Item 14	The students are encouraged to understand and apply what they learn rather than remember isolated facts
Item 16	The students complete their assignments in time
Item 17	The students are motivated to learn
Item 19	The students are not sufficiently prepared for the formative assessments
Item 24	The students have sufficient opportunities to improve their communication skills
Item 25	Students find learning experience disappointing
Item 26	The teaching learning experience is very stressful for the students
Item 29	The students' feedback about the curriculum is taken into consideration
Item 31	Teachers are involved in collaborative efforts related to educational activities
Item 32	Teachers are encouraged to take trans-disciplinary approach to health problems
Item 34	Teachers are flexible and open to change and suggestions
Item 36	Teachers dominate over subordinates. peers or students
Item 37	I am satisfied with opportunities that I get for working with other faculty
Item 38	There is a formal support system for faculty who get stressed
Item 43	Opportunities are available for trying out alternative approaches in teaching
Item 44	I have opportunities for learning research methodology and research communication skills
Item 45	I have opportunities for developing skills of educational administration
Item 46	The faculty development program are adequate in preparing me for the tasks expected from me
Item 47	The teachers adopt a variety of teaching methods to cater to diverse styles of learning