Original Research Paper

Validation of the Dundee Ready Education Environment Measure in Iran through factor analysis

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Abstract

Introduction: Although the Dundee Ready Educational Environment Measure (DREEM) has been accepted for educational environment assessment in various health education backgrounds, limited studies have confirmed evidence for its use in Iran. This study examined a shortened version of the DREEM-50 among Iranian students. **Method:** A sample of 316 medical and paramedical students from Iran's selected southwest Universities of Medical Sciences in 2020–2021 were invited to complete DREEM-33, a shortened version of the DREEM questionnaire. Psychometric criteria for assessing reliability included Cronbach's alpha, intra-cluster correlation coefficient (ICC), and composite coefficients. In the construct validity section, discriminant validity was measured using the Fornell and Larcker criteria based on the confirmatory factor analysis approach, and principal component analysis with varimax rotation using the exploratory factor analysis approach. Data were analyzed using SPSS 25, Smartpls 3.2.8, and Lisrel 8.8 software. **Results:** The shortened version had 33 items spread across all five components of DREEM-50. The exploratory factor analysis showed that the five components with eigenvalues > 1 accounted for 61% of the variance. Also, standard factor loadings ranged from 0.52 to 0.86. Confirmatory factor analysis supported the original five components of the DREEM ($\chi 2$= 2106.35; DF=490; P<0.001; CFI=0.94; GFI=0.86; AGFI=0.91; NFI=0.93; SRMR=0.038; RMSEA=0.08). The ICC and Cronbach's alpha for the whole DREEM was 0.92. All subscales had values ranging from 0.72 to 0.93. **Conclusion:** With satisfactory psychometric properties, the abbreviated DREEM-33 demonstrated its validity and reliability for future use in Iran in various educational environments.

Keywords: Medical education; Educational environment; Psychometrics; DREEM; Confirmatory factor analysis; Exploratory factor analysis

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Introduction

Many countries aim to develop comprehensive, integrated, and effective learning systems, influenced by factors like teachers, curricula, and resources—each potentially influencing the learning process. The educational environment is complex, encompassing curriculum implementation, teacher mindset, school culture, student perspectives, and social conditions.[1]

The educational environment encompasses the atmosphere experienced by learners and teachers,[2] encompassing infrastructure, leadership, approaches, cultural context, patient care quality, learning opportunities, teachers' skills, attitudes, and peer interaction, among other factors.[3–5] Understanding the educational environment impacts learners' motivation, satisfaction, perceived wellbeing, aspirations, and academic progress, thereby influencing their overall educational experience.[6–8]

An evaluation of the educational environment can identify obstacles and opportunities for enhancing students' learning experiences and can facilitate necessary changes.[5] Universities may monitor their educational environment to identify and address issues to improve learning[9] using the Dundee Ready Education Environment Measure (DREEM), a multicultural and independent tool.[10,11] Roff (1997) developed DREEM at the University of Dundee, Scotland, to evaluate medical schools and other health professions teaching environments.[12] It was facilitated by a Delphi panel of faculty members from international medical schools and health professions.[8] DREEM is a comprehensive educational assessment tool that provides unbiased

feedback on the strengths and weaknesses of an educational environment.[2] The tool has undergone psychometric testing in various countries.[5, 8, 13-19] Some researchers have asserted that the construct validity of the DREEM was established in Iran.[20, 21] However, it is important to note that no exploratory factor analysis (EFA) or confirmatory factor analysis (CFA) has been conducted for the short form of DREEM. This study aims to validate and revise Iran's abridged version of DREEM-50, providing a more concise tool for respondents who find the length of the document exhausting.

Methodology

Study design and target population

This cross-sectional (descriptive-analytical) study is based on exploratory and first- and second-order CFA to validate Iran's abridged version of DREEM-50. We conducted it at Iran's selected southwest Universities of Medical Sciences in 2020–2021, located in Ahvaz, Abadan, Dezful, and Lorestan. The study population was medical and paramedical students.

Research subjects

The study, approved by the Ethics Committee at Ahvaz Jundishapur University of Medical Sciences in Iran, involved 316 medical students from the fourth macro-region of Iran using convenience sampling selected through informed consent, and ensured privacy during the survey collection process. Inclusion criteria specified individuals without a history of academic leave and regular university presence. Exclusion criteria included: difficulty in contact, transfer students, and having a mental, psychological, or physical illness that causes difficulty in focusing and responding to questions. This cross-sectional (descriptive-analytical) study is based on exploratory and first- and second-order CFA.

Instrument

The DREEM is a 50-item questionnaire used to assess the learning environment in health education programs, with an item response scale ranging from complete disagreement to complete agreement.[22] DREEM-50 includes 41 positive and nine negative statements (4, 8, 9, 17, 25, 35, 39, 48,and 50). The tool can yield a maximum score of 200 based on students' perception of learning (12 items, maximum score = 48); students' academic self-perception (8 items, maximum score = 32); students' social self-perceptions (7 items, maximum score = 28); students' perceptions of teachers (11 items, maximum score = 44); students' perceptions of atmosphere (12 items, maximum score = 48). Higher scores in each domain indicate a more desirable learning environment. The DREEM questionnaire, which includes demographic questions like age, gender, and educational year, was distributed to qualified participants via the Porsline online platform.

Tool translation process

Initially, three English language experts—including two who teach medical education and one who teaches general English—individually translated the survey into Persian. Then, it was sent to an English-speaking faculty member to ensure accurate translation. All translations were thoroughly discussed during a meeting, and one was selected after considering all the comments. It was back-translated into English by a medical text translation expert. The new Iranian version was carefully crafted to ensure a precise alignment with the original English version through semantic, terminological, experimental, and conceptual equivalence.

Content and face validity

A pilot test was conducted with 15 PhD students and professors at selected Universities of Medical Sciences to assess content validity ratio (CVR) and content validity index (CVI).

Internal consistency reliability

The study assessed internal consistency reliability using Cronbach's alpha, composite reliability, and intra-cluster correlation coefficient.[23]

Construct validity

Fornell and Larcker's criteria were used to measure discriminant validity.[24] The criterion calculates shared variance between latent variables by requiring a construct's square root of average variance to exceed the correlation between the component and other components.

Statistical analysis

The data was analyzed using SPSS (version 25), Smartpls (version 3.2.8), and Lisrel (version 8.8) software. Descriptive statistics were utilized to determine leading indicators like mean, median, and mode, and item characteristics were analyzed using corrected item-total correlation coefficients for item homogeneity. The EFA and CFA were utilized for data analysis to determine the number of construct components. The adequacy of data is assessed before any analysis. The Kaiser-Meyer-Olkin (KMO) and Bartlett's tests can be used to ensure the appropriate sample size and sphericity of variables before conducting the EFA. EFA was conducted using principal component analysis and the varimax rotation method to evaluate and purify scale items. The measurement items are purified using a KMO value greater than 0.50.

The first- and second-order CFA model's fit was assessed using various metrics such as Chi-square, chi-square on the degree of freedom, Adjusted Goodness of Fit Index (AGFI), Goodness of Fit Index (GFI), Comparative of Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA).

Results

The revised tool is included in Tables 4, 5, and the Appendix. Out of the 350 students participating in the study, 316 of them completely answered all the questions in the questionnaire. Approximately 10% of the students answered the questionnaire incompletely. The gender mix was 117 males, 199 females, with an average age of 22.37 ± 0.18 (Table 1).

Table 2 presents the initial psychometric properties of DREEM-33 and the descriptive statistics for its five-factor component. The internal consistency for the total scale was 0.92. Cronbach's alpha of the subscales ranged from 0.72 to 0.93, and the intra-cluster correlation coefficient (ICC) was presented with a 95% confidence interval. The mean inter-item correlation ranged from 0.28 to 0.62, well above the threshold of 0.15, indicating reasonable item homogeneity.

The outcomes of EFA using principal component analysis and varimax rotation are displayed in Table 3. The 5-factor components with eigenvalues>1 and commonalities ranging between 0.34 and 0.75 could explain 61% of the variance of Dundee's tool. The variance rate of subscales was 38%, 7.4%, 6.7%, 4.9%, and 4.3%, respectively. Items with commonalities value <0.3 and factor loadings >0.9 were excluded. As shown in Table 3, factor loadings >0.5 is the criterion for extracting items and achieving an abridged tool.

A CFA was conducted with the total sample to test the five-factor component of the DREEM-33 (Table 4). The fit indices showed a nearly good fit ($\chi 2$= 2106.35; DF=490; P<0.001; CFI=0.94; GFI=0.86; AGFI=0.91; NFI=0.93; SRMR=0.038; RMSEA=0.08). All items were included in their constructs, with standardized factor loadings between 0.52 and 0.86.

Figure 1 displays the ranking of the Dundee tool's most valuable components, including students' perception of learning, teachers, the educational environment, academic capabilities, and social conditions. The estimation of the factor loadings of the data using the five-factor component of the original tool was consistent with one another. Figure 1 presents a visual representation of the most effective tool constructs used in the Dundee study. The figure compares the effectiveness of various components based on specific criteria or metrics. This overview of the utilized components aids in understanding the research methodology. The data shown in the figure helps identify the most effective components, which can inform decisions about component selection for future research projects in Dundee.

Table 5 presents the discriminant validity. The table demonstrates the discriminant validity of the DREEM instrument. The square roots of the Average Variance Extracted (AVE) for each sub-scale are higher than the correlations between different sub-scales. This indicates that the DREEM instrument effectively measures distinct constructs related to students' perceptions of the educational environment, including atmosphere, learning, academic self-perceptions, social self-perceptions, and perceptions of teachers. The results suggest the DREEM instrument can be considered a valid tool for assessing these specific aspects of the educational environment. The Fronell-Larcker criterion is one of the most popular techniques to check measurement models' discriminant validity.

Table 1: Demographic characteristics of students participating in the study

Variable		Frequency (Percent)
Sex	199(63)	Female
Marital status	279(88.3)	Single
	33(10.4)	Married
	4(1.3)	Others
Economic situation	10(3.2)	Weak
	108(34.2)	Moderate
	198(62.7)	Good
Field of Study	104(32.9)	Health
	125(39.5)	Nursing
	75(23.6)	Paramedical
	12(3.7)	Medical
Degree	300(94.9)	Undergraduate
	16(5)	Others

Table 2: Initial psychometric properties of DREEM (n=316)

Descriptive Statistics							
	Mean	Std. Deviation	Average inter-item correlation	Cronbach's alpha	Composite reliability	Intra-class Correlation Coefficient (95% CI)	n
Total	2.92	0.37	0.28	0.92	0.93	0.92(0.90 to 0.93)	33
SPoL	2.61	0.14	0.62	0.93	0.94	0.93(0.92 to 0.94)	10
SPoT	3.16	0.18	0.62	0.90	0.92	0.90(0.88 to 0.92)	7
SASP	3.39	0.32	0.54	0.72	0.82	0.72(0.67 to 0.77)	4
SPoA	3.07	0.28	0.57	0.88	0.90	0.88(0.85 to 0.90)	7
SSSP	2.61	0.34	0.48	0.72	0.81	0.72(0.67 to 0.77)	5

Discussion

The study validated DREEM-33, a shortened version of DREEM-50, and confirmed its validity and reliability through EFA and CFA approaches. It is the first study to validate the psychometric properties of DREEM among medical students from different grades in the fourth macro-region of Iran.

The overall DREEM scale had high internal consistency, as did the proposed five components revealed by EFA. All subscale internal consistency indices, including Cronbach's alpha, intra-cluster correlation, and composite reliability, were more than 0.70. Consistent efforts were made to review and improve the psychometric features of DREEM, as they had been in previous studies by Vaughan et al.[25] and Hammond et al.[26]

Removing items by item-total correlation (less than 0.30) is a current method of appraising the internal consistency of a scale. Results for item-total correlation can support exposing discrimination in review items.[27] Scores falling between zero and 0.19 may indicate that the question does not discriminate well. Values around 0.2 and 0.39 indicate good discrimination, while values of 0.4 and higher imply significant discrimination. Changes in Cronbach's alpha coefficients, intra-cluster correlation, and composite reliability, all point to the unique characteristics of each statistical sample, confirming the need to keep assessing DREEM's psychometric properties. As noted in earlier studies, item revision and reconstruction can enhance the subscales' internal consistency.[13]

Items with an item-subscale correlation below 0.2 and factor loading below 0.5 were removed in DREEM-33. The average inter-item correlation is a technique for examining the tool's stability of internal consistency, with the ideal range of this index between 0.15 and 0.50. Values <0.15 indicate the inadequate correlation of the item and lack of proper measurement. Further, values >0.50 show that items are so similar that they represent duplicates.

EFA yielded 5-factor components consistent with the prior findings, indicating that the fit model was satisfactory. The revised tool deleted 17 items: 2 referred to SPoL, 2 to SPoT, 4 to SASP, 5 to SPoA, and 2 items 5 to SSSP. The deleted items were presumably added originally through qualitative consensus rather than quantitative procedures. It is also possible that the cultural background of the participants in our study sample led to a different analysis of the latent factors. Assessment tools should be tailored to different populations to ensure the data collected is relevant, unbiased, and representative.[28]

Figure 1 presents a visual representation of the most effective tool constructs used in the Dundee study. It compares the effectiveness of various components

Table 3: Principal component analysis with Varimax rotation for DREEM scale (n=316)

Factors						
Items	**I.**	**II.**	**III.**	**IV.**	**V.**	**Communalities**
• Q11	0.79					0.71
• Q4	0.78					0.67
• Q3	0.76					0.68
• Q8	0.73					0.71
• Q7	0.71					0.60
• Q1	0.71					0.57
• Q6	0.68					0.64
• Q9	0.68					0.64
• Q2	0.66					0.50
• Q10	0.58					0.61
• Q6		0.78				
• Q4		0.75				
• Q5		0.72				
• Q8		0.69				
• Q10		0.69				
• Q12		0.60				
• Q2		0.52				
• Q5			0.79			0.66
• Q1			0.69			0.53
• Q6			0.58			0.58
• Q7			0.55			0.56
• Q5				0.71		0.63
• Q1				0.67		0.63
• Q6				0.66		0.64
• Q4				0.65		0.74
• Q12				0.56		0.56
• Q8				0.56		0.62
• Q9				0.51		0.59
• Q7					0.75	0.59
• Q3					0.74	0.61
• Q6					0.72	0.59
• Q4					0.60	0.53
• Q1					0.52	0.34
Eigenvalues	12.51	2.425	2.188	1.604	1.392	
% Variance	37.91	7.35	6.63	4.86	4.22	
% Cumulative	37.91	45.26	51.89	56.75	60.97	

based on specific criteria or metrics. The data shown in the figure helps identify the most effective components, which can inform decisions about component selection for future research projects in Dundee. The new 5-factor components in the abridged model still need to be validated as an appropriate measurement model compared to the original model. Some CFA efforts failed to produce a satisfactory model fit because they gained too few items (ratio of 20 items per parameter).[29] Nonetheless, several model fit indices suggest a relatively acceptable model was obtained, suggesting that the DREEM tool had reasonable construct validity.

Limitations

One of the limitations of the current research is the non-random and potentially biased sample from a macro-region in Iran, which limits the generalizability of the results. The different socio-demographic and cultural backgrounds in various parts of the country may amplify this limitation. However, the sample draws from a range of student advancement levels, which may reveal perceptions at differing levels of education.

Conclusion

The findings indicate that the DREEM-33 is a reliable and effective tool for evaluating educational environments' readiness to facilitate students' learning and development. The evidence suggests that the DREEM-33 has the potential to be valuable in Iranian educational settings for both evaluating and enhancing the quality of teaching and learning.

Table 4: Confirmatory factor analysis of DREEM (n=316)

Factors					
Items	**I.**	**II.**	**III.**	**IV.**	**V.**
I=SPoL					
• Q11	0.83				
• Q4	0.80				
• Q3	0.82				
• Q8	0.85				
• Q7	0.77				
• Q1	0.77				
• Q6	0.80				
• Q9	0.81				
• Q2	0.68				
• Q10	0.74				
II= SPoT					
• Q6		0.86			
• Q4		0.76			
• Q5		0.84			
• Q8		0.82			
• Q10		0.79			
• Q12		0.74			
• Q2		0.72			
III=SASP					
• Q5			0.69		
• Q1			0.50		
• Q6			0.84		
• Q7			0.85		
IV=SPoA					
• Q5				0.74	
• Q1				0.76	
• Q6				0.80	
• Q4				0.82	
• Q12				0.73	
• Q8				0.76	
• Q9				0.69	
V: SSSP					
• Q7					0.57
• Q3					0.72
• Q6					0.71
• Q4					0.84
• Q1					0.52

$\chi 2$= 2106.35; DF=490; P<0.001; CFI=0.94; GFI=0.86; AGFI=0.91; NFI=0.93; SRMR=0.038; RMSEA=0.08.

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Competing Interests
The authors declare that there are no conflicts of interest.

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Consent for publication
All authors have given consent to publication.

Authors' contributions
Both authors (AS and HM) participated in the presentation of the idea, the initial design, data collection, analysis and interpretation, the initial writing process of the paper and its revision, and both took responsibility for the accuracy and correctness of the paper's content.

Table 5: Discriminant validity of DREEM (Fornell---Larcker criterion)

Subscales	I.	II.	III.	IV.	V.
I. Students' perceptions of atmosphere	0.76				
II. Students' perception of learning	0.64	0.79			
III. Students' academic self-perceptions	0.51	0.52	0.73		
IV. Students' social self-perceptions	-0.30	-0.33	-0.10	0.68	
V. Students' perceptions of teachers	0.69	0.70	0.45	-0.33	0.79

1. Students' perception of learning
2. Students' perceptions of teachers
3. Students' academic self-perceptions
4. Students' perceptions of atmosphere
5. Students' social self-perceptions

Availability of data

The study data are accessible upon reasonable request from the corresponding author.

Ethics approval and consent to participate

This study was accepted based on the principles constituted by the Ahvaz Jundishapur University of Medical Sciences Ethics Committee (IR.AJUMS.REC.1398.972).

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