

Psychometric validation of the Spanish version of the Dundee Ready Education Environment Measure applied to dental students

I. Tomás¹, M. A. Casares-De-Cal¹, A. Aneiros¹, M. Abad², L. Ceballos³, G. Gómez-Moreno⁴, J. J. Hidalgo⁵, C. Llena⁶, P. López-Jornet⁷, M. C. Machuca⁸, F. Monticelli⁹ and J. Palés¹⁰

¹ School of Medicine and Dentistry, University of Santiago de Compostela, Santiago de Compostela, Spain,

² School of Medicine and Dentistry, University of Salamanca, Salamanca, Spain,

³ School of Health Sciences, Rey Juan Carlos University, Madrid, Spain,

⁴ School of Dentistry, University of Granada, Granada, Spain,

⁵ School of Dentistry, Complutense University of Madrid, Madrid, Spain,

⁶ School of Medicine and Dentistry, University of Valencia, Valencia, Spain,

⁷ School of Medicine, University of Murcia, Murcia, Spain,

⁸ School of Dentistry, University of Seville, Seville, Spain,

⁹ School of Health and Sports Sciences, University of Huesca, Huesca, Spain,

¹⁰ School of Medicine, University of Barcelona, Barcelona, Spain

Keywords

educational climate; DREEM questionnaire; Spanish version; dental students.

Correspondence

Inmaculada Tomás
School of Medicine and Dentistry, Santiago de Compostela University
C./ Entrerrios s/n
15872 Santiago de Compostela, Spain
Tel: +34 981 563100 ext: 12344
Fax: +34 981 562226
e-mail: inmaculada.tomas@usc.es

Accepted: 24 October 2013

doi: 10.1111/eje.12073

Abstract

Aim: To carry out a psychometric evaluation of the Spanish-language version of the Dundee Ready Education Environment Measure (DREEM) applied to dental students.

Methods: A total of 1,391 students from nine Spanish public schools of dentistry responded to the DREEM questionnaire. To analyse the reliability of the DREEM questionnaire, the internal consistency was assessed and a 'test-retest' carried out. Validity was evaluated through analysis of item response rate, floor and ceiling effects, corrected item-total and item-subscale correlations and factor structure. A confirmatory factor analysis was performed to analyse the structure of the original DREEM scale.

Results: Cronbach's alpha coefficient for the 'Educational Climate' (EC) global scale was 0.92. In the subscales, the 'observed' Cronbach's alpha coefficients ranged between 0.57 and 0.79 and were higher than the 'expected' ones; except for the Social subscale. In the DREEM questionnaire, all of the corrected correlation coefficients between the items and the EC global scale, and the items and their corresponding subscales, were >0.2; except for items 50 and 17. All goodness-of-fit indices of confirmatory factor analysis showed acceptable values (close to one or zero, depending on the case), and there was consistency in the results.

Conclusions: The Spanish-language version of the DREEM questionnaire is a reliable and valid instrument for analysing the EC for dental students and its factor structure is supported by the data. Although our findings indicate that the DREEM may be as culturally independent as was originally stated, more research should be directed at verifying the factor structure in various languages and cultural environments.

Introduction

The learning and teaching environment is one of the determinants of an academic curriculum (1). The aim of any proposed

change to a curriculum is the improvement of the environment for teaching and students' learning (2). From a pedagogical point of view, this environment is called the 'Educational Climate' (EC) (1).

The EC is considered to mean, 'Everything that is happening in the classroom, department, faculty or university' (1). For some authors, the EC reflects the level of pressure in the academic and social environment of an institution, and this environment can vary from one course to another within a curriculum, or even from one class to another. Nowadays, the EC is recognised as a concept of great importance in teaching, due to its effect on the level of learning, degree of satisfaction and academic success of the student (3–5).

In 1997, Roff et al. (6) published the DREEM scale ('Dundee Ready Education Environment Measure'), which was originally developed by a Delphi panel of nearly 100 educators (specialists in health sciences drawn from 20 different countries), and subsequently validated in different educational contexts and different languages. In general terms, the DREEM scale is a generic, international instrument, which is not associated with a specific cultural level, and which facilitates an assessment of the EC for health science students in universities, health institutions, etc. It can therefore help guide the planning of improvements in education (7).

After a thorough review of the literature, we found that studies of the EC using the DREEM scale had been carried out on all five continents; more specifically in countries such as UK, Sweden, Chile, Canada, Germany, Saudi Arabia, India, Nigeria and Australia (2, 8–15). However, we found no reference to its use with health science students in academic or health institutions in Spain. Most of these analyses of the EC were carried out with medical students (9, 11, 14). Regarding other health science professions, few authors have used the DREEM scale to evaluate the EC in dentistry, and studies carried out in European dental schools are very scarce (16–21).

The DREEM scale is often used for cross-national comparisons, which makes ongoing psychometric analysis particularly important so as to avoid any cultural bias (22). If the psychometric properties of a device fluctuate across countries, conclusions based on the scale may actually reflect artefacts due to unreliability and lack of validity (22). Apart from the initial psychometric evaluation of the DREEM carried out by its originators (6), some published studies have assessed the psychometric aspects of the DREEM scale in a range of educational contexts and in different languages, providing evidence of reliability and validity (6, 22–26). However, few studies carried out in dentistry have undertaken the psychometric validation of the DREEM scale (20, 21).

Currently, like other degrees, dentistry studies in Spain are undergoing a transition from a traditional curriculum to one more in tailored to the requirements of the European higher education area (27). In this context, the aim of this study was to evaluate psychometrically the Spanish-language version of the DREEM instrument with dental students.

Methods

Study group

The DREEM questionnaire was applied to students in the final 3 years of their degrees in Spanish public schools of dentistry during the 2010–2011 academic year. All Spanish public dentistry schools were invited to participate in this project (12

schools), which nine schools decided to involve in it. These schools belonged to the following universities (in alphabetical order): Granada, Huesca, Madrid (Complutense U.), Madrid (Rey Juan Carlos U.), Murcia, Salamanca, Santiago de Compostela, Seville and Valencia. The Santiago de Compostela University served as the coordinating centre of the project. The deans of the different schools of dentistry gave permission for the study to be carried out, and the collaborators involved in the different schools received written instructions on how to implement the project.

The questionnaire was delivered to the students early in the morning (before the first class of the day in March). Before beginning the survey, each collaborator briefly explained the study's objectives and its data processing characteristics, giving special emphasis to the importance of voluntary participation and the anonymity of the process. The average time taken to complete the questionnaire was 7 min. Information on age, gender and academic year was collected from each participant.

DREEM questionnaire

The DREEM questionnaire consists of 50 items or statements, grouped into five domains or subscales: Subscale I: students' perception of learning (Learning), this subscale includes items 1, 7, 13, 16, 20, 22, 24, 25, 38, 44, 47 and 48; Subscale II: students' perception of teachers (Teachers), this subscale includes items 2, 6, 8, 9, 18, 29, 32, 37, 39, 40 and 50; Subscale III: students' academic self-perceptions (Academic), this subscale includes items 5, 10, 21, 26, 27, 31, 41 and 45; Subscale IV: students' perception of the atmosphere at the centre (Atmosphere), this subscale includes items 11, 12, 17, 23, 30, 33, 34, 35, 36, 42, 43 and 49; Subscale V: students' social self-perceptions (Social), this subscale includes items 3, 4, 14, 15, 19, 28 and 46 (Table 1). Each of the items was given a score based on a Likert scale of five options: 4 = strongly agree, 3 = agree, 2 = uncertain, 1 = disagree and 0 = strongly disagree. The items are positive statements, except for numbers 4, 8, 9, 17, 25, 35, 39, 48 and 50, which are negative, and so the scores assigned to them are reversed. The DREEM questionnaire was translated into Spanish by a teacher proficient in English and then translated back into English by a professional translator. Differences were discussed between the translator and two of the authors. The instrument was pre-tested on 25 students in the fifth year of their degree so as to diagnose any problems in understanding the meaning of the questions. No modifications in the wording were performed.

The DREEM scale provides results for each item, for each subscale (by adding up the scores of the corresponding items) and for the total score for the EC (adding up the scores of the subscales).

Regarding the items, those with an average value of ≥ 3.50 are considered to be 'educational aspects of excellence'; those between 3.01 and 3.49 are considered 'positive educational aspects'; those with average values between 2.01 and 3.00 are considered as 'educational aspects that could be improved'; those ≤ 2.00 are defined as 'educational problem areas' and should be examined more exhaustively later (7, 14). The maximum possible scores for the different subscales are as follows:

TABLE 1. The DREEM – items grouped by subscale (negative items in italics)

Subscale I: Students' Perception of <i>Learning</i>	
Item 1.	I am encouraged to participate during teaching sessions
Item 7.	The teaching is often stimulating
Item 13.	The teaching is student-centred
Item 16.	The teaching helps to develop my competence
Item 20.	The teaching is well focused
Item 22.	The teaching helps to develop my confidence
Item 24.	The teaching time is put to good use
Item 25.	<i>The teaching over-emphasises factual learning</i>
Item 38.	I am clear about the learning objectives of the course
Item 44.	The teaching encourages me to be an active learner
Item 47.	Long-term learning is emphasised over short-term learning
Item 48.	<i>The teaching is too teacher-centred</i>
Subscale II: Students' Perception of <i>Teachers</i>	
Item 2.	The teachers are knowledgeable
Item 6.	The teachers adopt a patient-centred approach to consulting
Item 8.	<i>The teachers ridicule the students</i>
Item 9.	<i>The teachers are authoritarian</i>
Item 18.	The teachers have good communication skills with patients
Item 29.	The teachers are good at providing feedback to students
Item 32.	The teachers provide constructive criticism here
Item 37.	The teachers give clear examples
Item 39.	<i>The teachers get angry in teaching</i>
Item 40.	The teachers are well prepared for their teaching sessions
Item 50.	<i>The students irritate the teachers</i>
Subscale III: Students' <i>Academic</i> Self-Perception	
Item 5.	Learning strategies that worked for me before continue to work for me now
Item 10.	I am confident about my passing this year
Item 21.	I feel I am being well prepared for my profession
Item 26.	Last year's work has been a good preparation for this year's work
Item 27.	I am able to memorise all I need
Item 31.	I have learnt a lot about empathy in my profession
Item 41.	My problem-solving skills are being well developed here
Item 45.	Much of what I have to learn seems relevant to a career in healthcare
Subscale IV: Students' Perception of <i>Atmosphere</i>	
Item 11.	The atmosphere is relaxed during ward teaching
Item 12.	This school is well time-tabled
Item 17.	<i>Cheating is a problem in this school</i>
Item 23.	The atmosphere is relaxed during lectures
Item 30.	There are opportunities for me to develop my interpersonal skills
Item 33.	I feel comfortable in class socially
Item 34.	The atmosphere is relaxed during class/seminars/tutorials
Item 35.	<i>I find the experience disappointing</i>
Item 36.	I am able to concentrate well
Item 42.	The enjoyment outweighs the stress of the course
Item 43.	The atmosphere motivates me as a learner
Item 49.	I feel able to ask the questions I want
Subscale V: Students' <i>Social</i> Self-Perception	
Item 3.	There is a good support system for students who get stressed
Item 4.	<i>I am too tired to enjoy the course</i>
Item 14.	I am rarely bored in this course
Item 15.	I have good friends in this course
Item 19.	My social life is good
Item 28.	I seldom feel lonely
Item 46.	My accommodation is pleasant

Learning: 48, Teachers: 44, Academic: 32, Atmosphere: 48 and Social: 28. The maximum score for the EC is 200. Taking into account these maximum scores, the data are converted into percentages of their respective subscale or of the global scale (6, 8). The scores for the different subscales and for the EC are grouped into four ordinal categories associated with a specific interpretation (7). Broadly, a higher score (or percentage) signifies a perception that is more positive than negative in relation to the aspect being examined.

Statistical analysis

The DREEM instrument was tested for reliability and construct validity.

Analysis of reliability

To analyse the DREEM questionnaire's reliability (in both the global scale and the subscales), the internal consistency was evaluated using Cronbach's alpha coefficient, whose results are expressed between 0 and 1. Using the methodology described by Dimoliatis et al. (26), we estimated the alpha coefficients 'expected' in the different subscales and compared them with those 'observed'. A 'test-retest' of the DREEM questionnaire was carried out with the dental students in the School of Dentistry at the University of Santiago de Compostela (with an interval of 1 month), calculating the respective Cronbach's alpha coefficients for the global scale (period 1 vs. period 2), and the correlation between the averages obtained from the total of items in both periods, using Kendall's tau-b test.

Analysis of validity

Validity was evaluated through analysis of item response rate and floor and ceiling effects. Item response rate was calculated as the percentage of respondents that had completed all items of the total instrument as well as all those in the subscales. A figure of 90% and above was considered as satisfactory. The proportion of floor and ceiling effects (i.e. people obtaining minimum and maximum scores, respectively) was studied amongst the subscales.

The analysis of validity was completed by means of corrected item-total and item-subscale correlations for the original DREEM structure, following the recommendations established by Stuive et al. (28). A threshold value of 0.20 for the absolute value of the corrected correlations was considered as the minimum to be interpreted as evidence supporting construct validity (29).

To evaluate the factor structure of the DREEM instrument, a confirmatory factor analysis was carried out for ordinal data (Likert scale), based on a correlation matrix consisting of polychoric correlations between the ordinal variables. The factors were defined in accordance with the subscales in the instrument, whilst correlation between the latent variables, factor loadings on the latent variables and the residuals were set as free parameters. The chi-square test and the value of the chi-square statistic divided by its degrees of freedom ('relative chi-square') were calculated. In addition, to assess how well the

model reproduces the data, we calculated the following fit indices: goodness-of-fit index (GFI), adjusted-goodness-of-fit index (AGFI) (30), normed fit index (NFI) (31), non-normed fit index – also known as Tucker-Lewis index – (NNFI or TLI) (31, 32), comparative fit index (CFI) (33), relative non-centrality index (RNI) (34), incremental fit index (IFI) (35), standardised root mean square residual (SRMR) (36) and root mean square error of approximation (RMSEA) (37). Whilst there are no golden rules for assessment of model fit, reporting a variety of indices is necessary because different indices reflect a different aspect of model fit (38, 39).

The GFI, AGFI, NFI, NNFI (TLI), CFI, RNI and IFI indices with values close to one is a general rule that can be interpreted as an acceptable fit of the model (40). In relation to the SRMR and RMSEA indices, values of 0.05 or less indicate a close approximation and values up to 0.08 reveal a reasonable fit of the model in the population (40).

The analysis was carried out using the R software, including the R packages 'sem' and 'polycor' (41–43).

Search strategy

To obtain a good reference list, we searched the literature by Internet and PubMed using the words 'educational climate' and 'Dundee Ready Education Environment Measure'. Also, we reviewed the Reference section included in different papers.

Results

Description of the study group

A total of 1,391 dental students answered the DREEM questionnaire (which means an average rate of 75% in relation to the number of those enrolled). The average age of the study group was 22.4 ± 3.1 years. Of the participants, 404 (29.0%) were men and 987 (71.0%) women. Regarding the academic year, 487 students (35.0%) were in their third year, 467 (33.6%) in fourth year and the remaining 437 (31.4%) in fifth year. The frequency of dental students (number of students and response rate) from different universities who participated in the survey was as follows: Granada (267, 95%), Huesca (72, 82%), Madrid (Complutense U.) (170, 49%), Madrid (Rey Juan Carlos U.) (194, 84%), Murcia (105, 69%), Salamanca (85, 89%), Santiago de Compostela (120, 80%), Seville (156, 57%) and Valencia (222, 97%).

Analysis of reliability

Cronbach's alpha coefficient for the EC global scale was 0.92, and when adjusted for the variables gender, academic year and faculty, these coefficients ranged from 0.88 to 0.93. In the subscales, the 'observed' Cronbach's alpha coefficients ranged between 0.57 and 0.79 and were higher than the 'expected' ones; except for the Social subscale (0.57 vs. 0.61) (Table 2).

As regards the 'test-retest' ($n = 83$), the Cronbach's alpha coefficients for the EC global scale in periods 1 and 2 were 0.89 and 0.89, respectively. The Kendall's tau-b correlation coefficient for the average scores of all the items obtained in both periods was 0.91 ($P < 0.001$).

TABLE 2. Cronbach's alpha coefficients for the different global scales and subscales ('observed values' and 'expected values')

DREEM	ITEMS	n	CASES	ALPHA
Global scale	50	1,391	1,387	0.92
Subscales				<i>Observed (expected)</i>
Subscale I	12	1,391	1,389	0.75 (0.73)
Subscale II	11	1,391	1,390	0.79 (0.71)
Subscale III	8	1,391	1,391	0.69 (0.64)
Subscale IV	12	1,391	1,390	0.75 (0.73)
Subscale V	7	1,391	1,389	0.57 (0.61)
Global scale (gender)				
Women	50	987	984	0.91
Men	50	404	402	0.92
Global scale (year)				
3rd year	50	487	484	0.92
4th year	50	467	466	0.92
5th year	50	437	436	0.92
Global scale (faculty)				
Granada	50	267	267	0.89
Huesca	50	72	72	0.92
Madrid (U. Complutense)	50	170	170	0.93
Madrid (U. Rey JC)	50	194	194	0.92
Murcia	50	105	105	0.92
Salamanca	50	85	84	0.89
Santiago de Compostela	50	120	120	0.88
Seville	50	156	156	0.91
Valencia	50	222	218	0.93

ITEMS, number of items in the scale or subscale; n , number of questionnaires (participants); CASES, number of questionnaires without value lost on which the alpha coefficients were calculated.

The Cronbach's alpha coefficients ('expected values') were calculated using the Spearman–Brown formula.

Bold print represents those Cronbach's alpha coefficients 'observed values' which were inferior to the Cronbach's alpha coefficients 'expected values'.

Analysis of validity

The number of incomplete questionnaires was very low. Of the four people (0.3%) who failed to complete all 50 items, the number of missing responses in each item ranged between 1 and 2 (0.1%). Missing responses in the subscales (when all the items were included) were 0.1% in all subscales. Analyses of floor and ceiling effects showed no major problems. No floor effects were identified, and only minor ceiling effects were detected; subscales II and IV had 1 respondent (0.1%) who reached the maximum value, and subscale III had two respondents who reached the maximum.

Table 3 shows the values of the corrected item-subscale and item-total correlations of the original DREEM structure (50 items). All of the corrected correlation coefficients between the items and their corresponding subscales were >0.2 (absolute value), except for item 17 ($\rho = -0.05$). All of the corrected correlation coefficients between the items and the EC global scale were >0.2 (absolute value), except for item 17 ('Cheating is a problem in this school'; $\rho = -0.03$), and item 50 ('The students irritate the teachers'; $\rho = 0.15$).

TABLE 3. Corrected item-subscale and item-total correlations of the original DREEM structure (50 items)

Item	Subscale I	Subscale II	Subscale III	Subscale IV	Subscale V	Global scale
1	0.42	0.33	0.37	0.45	0.38	0.48
7	0.53	0.45	0.43	0.48	0.38	0.56
13	0.54	0.41	0.43	0.45	0.35	0.54
16	0.42	0.32	0.37	0.34	0.28	0.42
20	0.62	0.48	0.54	0.49	0.40	0.62
22	0.58	0.46	0.56	0.54	0.42	0.62
24	0.49	0.41	0.42	0.44	0.29	0.51
25	-0.51	-0.37	-0.39	-0.37	-0.26	-0.47
38	0.38	0.32	0.41	0.36	0.27	0.42
44	0.57	0.43	0.50	0.55	0.42	0.60
47	0.32	0.24	0.29	0.29	0.22	0.32
48	0.22	0.28	0.14	0.23	0.19	0.27
2	0.35	0.39	0.29	0.31	0.23	0.39
6	0.34	0.44	0.27	0.30	0.23	0.38
8	0.35	0.52	0.27	0.34	0.26	0.43
9	0.28	0.40	0.20	0.29	0.22	0.34
18	0.35	0.44	0.30	0.34	0.25	0.41
29	0.61	0.51	0.48	0.59	0.46	0.66
32	0.50	0.55	0.41	0.50	0.33	0.56
37	0.47	0.44	0.35	0.48	0.30	0.51
39	0.18	0.40	0.11	0.23	0.13	0.26
40	0.44	0.48	0.36	0.40	0.27	0.48
50	0.09	0.23	0.08	0.13	0.09	0.15
5	0.26	0.17	0.30	0.29	0.25	0.30
10	0.25	0.20	0.31	0.34	0.32	0.33
21	0.53	0.38	0.38	0.41	0.31	0.50
26	0.42	0.29	0.37	0.32	0.25	0.40
27	0.28	0.14	0.34	0.29	0.28	0.31
31	0.36	0.32	0.33	0.34	0.25	0.39
41	0.52	0.41	0.48	0.45	0.35	0.54
45	0.35	0.33	0.30	0.31	0.25	0.38
11	0.49	0.48	0.38	0.53	0.35	0.56
12	0.51	0.36	0.38	0.35	0.30	0.48
17	-0.06	0.05	-0.04	-0.05	-0.02	-0.03
23	0.49	0.46	0.36	0.55	0.38	0.55
30	0.39	0.33	0.41	0.39	0.34	0.44
33	0.24	0.25	0.23	0.36	0.39	0.35
34	0.37	0.37	0.33	0.51	0.29	0.46
35	0.39	0.37	0.33	0.37	0.35	0.44
36	0.26	0.20	0.39	0.31	0.32	0.34
42	0.26	0.17	0.27	0.33	0.38	0.33
43	0.62	0.48	0.50	0.57	0.45	0.65
49	0.42	0.41	0.36	0.42	0.33	0.48
3	0.44	0.33	0.31	0.40	0.20	0.43
4	0.30	0.25	0.23	0.33	0.26	0.33
14	0.39	0.27	0.31	0.31	0.25	0.38
15	0.17	0.17	0.19	0.26	0.28	0.25
19	0.27	0.19	0.29	0.37	0.39	0.35
28	0.28	0.24	0.32	0.38	0.42	0.38
46	0.17	0.16	0.21	0.23	0.22	0.23

The results of the performed confirmatory factor analysis are shown in a 'path diagram' (Fig. 1). All the items had factor loadings ≥ 0.3 , except for items 17, 48 and 50. The chi-square test yielded a value of 5373.33 with 1165 degrees of freedom and a *P*-value of

<0.01 , and the value of the 'relative chi-square' (chi-square statistic divided by its degrees of freedom) was 4.61. The goodness-of-fit indices of confirmatory factor analysis were as follows: GFI = 0.84, AGFI = 0.83, NFI = 0.92, NNFI (TLI) = 0.93, CFI = 0.93, RNI = 0.93, IFI = 0.93, SRMR = 0.09 and RMSEA = 0.05.

Discussion

In a systematic review of the determining of the EC in health professions, Soemantri et al. (44) recently concluded that 'Analysis of EC should form part of the appropriate educational practices developed in an institution'. Really, previous authors did the Spanish translation of the DREEM for measuring medical students' perceptions of the Educational Climate in South of America (6, 25). However, the Spanish language used in South of America shows a lot of semantic differences with respect to the Spanish language used in Spain. Consequently, a new translation was required. The present study represents the first multicentre analysis of the EC in a health science profession that has been carried out in our country, more specifically, in dentistry studies. Seventy-five per cent of Spanish public dentistry faculties were involved in this project, and the average percentage of students who participated, in relation to the total number enrolled on the course/in the faculty, was 75%. The study group analysed ($n = 1,391$) therefore represents a satisfactory representative sample of the population of dental students in public schools of dentistry in our country.

It was decided to use the DREEM questionnaire in the present study, because in recent years, it has been the most commonly used instrument worldwide for the investigation of the EC in professions associated with health, and it does not need to be modified for application to dentistry. After an exhaustive review of the literature, we were able to confirm that the present study represents one of the widest in which the DREEM scale ($n = 1,391$) has been used to evaluate the EC, alongside other studies conducted with medical students, for example, Whittle et al. in the United Kingdom ($n = 968$), Herrera et al. in Chile ($n = 1,092$) and Rothhoff et al. in Germany ($n = 1,119$) (11, 14, 15). According to Till (2), students in the initial health science courses are not sufficiently experienced to respond to the items related to clinical matters in the DREEM questionnaire, because the curriculum followed during these first years includes a large proportion of basic sciences, and it offers little clinical training. Based on this opinion, we evaluated the EC for students in the last 3 years of the dentistry degree, because they have a certain 'academic career', and these academic courses include practically all the clinical training related to this profession.

There are few references to validate the DREEM scale in dentistry studies (16, 20, 21), and so our results were contrasted not only with those of the aforementioned studies, but also with those described in other health science professions. There have been repeated calls for rigorous evaluation of the psychometric properties of measures used cross-nationally (45, 46), but they are not commonly applied in studies on EC (22).

Analysis of the reliability of the DREEM scale

In relation to reliability, the achievement of Cronbach's alpha coefficients >0.50 indicates a good internal consistency (29),

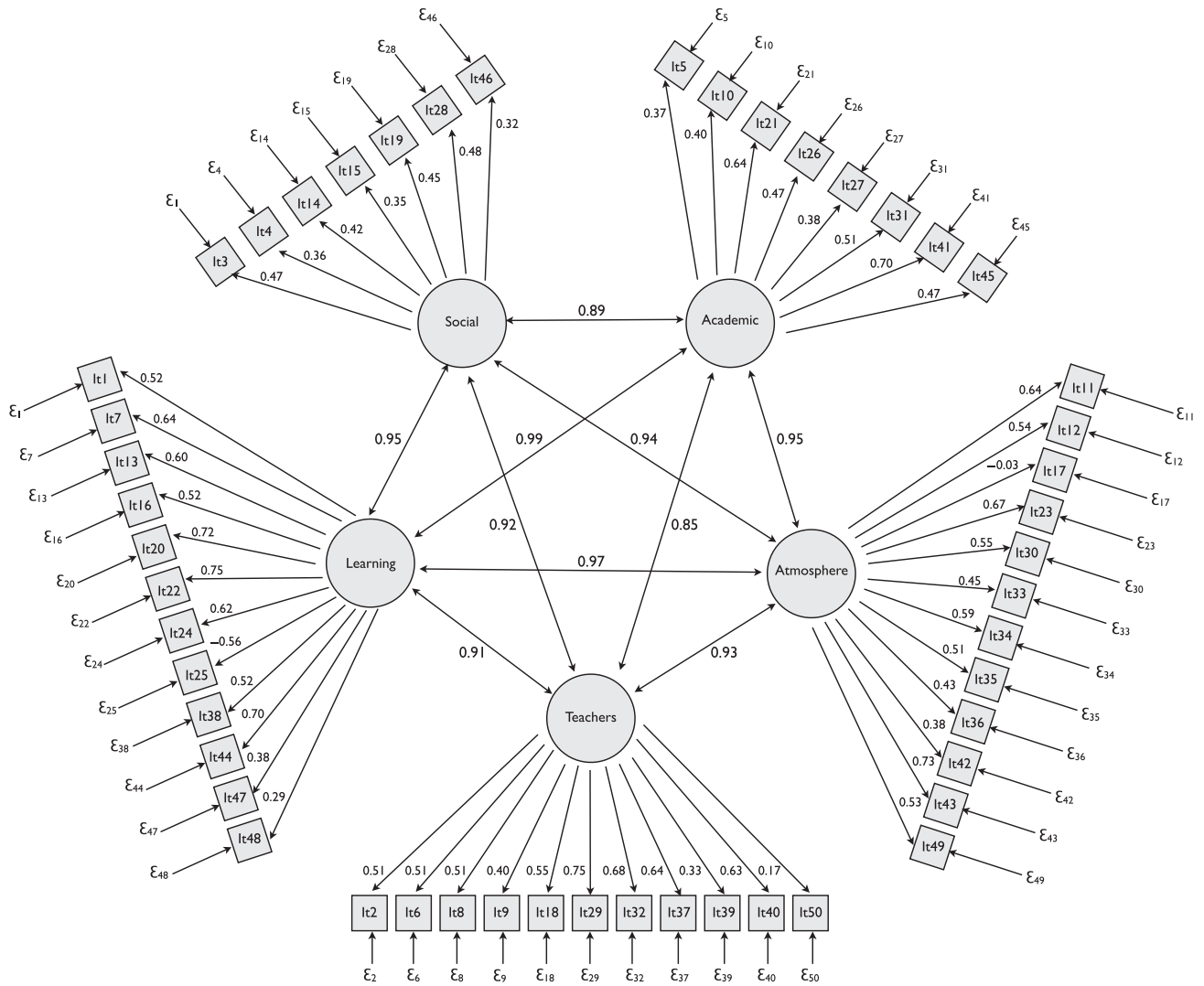


Fig. 1. Path diagram of the confirmatory factor model.

whilst values >0.70 (47) or >0.80 (48) are considered highly reliable. In 1996, Deza studied the reliability of the first Spanish-language version of the DREEM scale (58 items) with students from the Tucumán Faculty of Medicine in Argentina, and a high level of reliability was obtained (Cronbach's alpha = 0.91) (6). Similar results were recently described by Riquelme et al. (25), following their evaluation of the Spanish-language version of the DREEM scale in the Pontificia Universidad Católica in Chile. In the present study, our results agree with these authors, and the Spanish-language version of the DREEM scale applied to Spanish dental students achieved a high level of reliability (Cronbach's alpha = 0.92).

In accordance with other analyses of the DREEM scale's reliability in languages other than English, such as Portuguese (23), Chinese (24), Greek (20, 26) and German (21), the results of Riquelme et al.'s series (25) on the Spanish-language version applied to Chilean medical students revealed Cronbach's alpha coefficients for each subscale lower than that obtained for the global scale (they ranged from 0.58 for Social and 0.75 for

Learning and Atmosphere vs. 0.91 for the global scale). These results coincide with those obtained in the present study (the Cronbach's alpha coefficients ranged from 0.57 for Social to 0.79 for Teachers vs. 0.91 for the global scale). Such outcomes are probably due to the fact that Cronbach's alpha coefficient is influenced by the length of the scale (that is, the number of elements it contains) and the correlation of the items within the scale. Because of this, Dimoliatis et al. (26) and Kossioni et al. (20) calculated the 'expected' Cronbach's alpha coefficients for the subscales and contrasted them with those 'observed', as part of their analysis of the Greek-language version of the DREEM questionnaire, which was applied to medical and dental students. To confirm that the subscales are sufficiently reliable, the 'observed' Cronbach's alpha coefficients must be higher than the 'expected', an outcome which 2 of the 5 subscales did not achieve in the respective Greek studies (Atmosphere and Social, and Academic and Social, respectively) (20, 26). In our series, the 'observed' Cronbach's alpha coefficients in all the subscales were >0.5, and greater than those 'expected', with the exception

of the Social subscale (0.57 vs. 0.61). Thus, in both Greek studies, as in ours, the Social subscale results were not good for reliability, which could indicate the need for a re-evaluation of this subscale for education specialists.

There are few studies that have implemented a 'test-retest' to evaluate the reliability of the DREEM questionnaire with health science students (26). Coinciding with the results described by Dimoliatis et al. (26), the present study produced similar Cronbach's alpha coefficients for the two periods – both of which were of a high value (period 1 = 0.90 vs. period 2 = 0.89), and the correlation between the average scores of all of the items between both periods was very high ($\tau\text{-}b = 0.91$; $P < 0.001$).

Analysis of the validity of the DREEM scale

In contrast to the results obtained by Jakobsson et al. (49), in the present study, the percentage of questionnaires answered completely (all items) was higher than 99% and was considered satisfactory. A threshold value of 0.20 for the absolute value of the corrected correlations was considered as the minimum to be interpreted as evidence supporting construct validity (29). The present study demonstrated, as did the findings of Wang et al. (24) in relation to the Chinese-language version of the DREEM, that only item 17 ('Cheating is a problem in this school') displayed a very low corrected correlation coefficient as regards the global scale and its corresponding subscale ($\rho = -0.03$ and -0.05 , respectively). This indicated that the reliability of the scale could be improved if this item were modified or omitted (28). In fact, omission of item 17 would increase the reliability of the Spanish version of the DREEM in our environment (the new Cronbach's alpha coefficients for the global scale and the subscale Atmosphere would be 0.92 and 0.79, respectively, vs. 0.91 and 0.75, respectively).

Factor analysis is one of the most useful methods for studying and validating the internal structure of instruments (50). Specifically, confirmatory factor analysis is a tool that addresses the relationships between observed measures or indicators (for example, test items) and latent variables or factors (51). Recently, Jakobsson et al. (49) in Sweden, Hammond et al. (22) in Ireland and Yusoff (52) in Malaysia explored the construct validity of the DREEM for medical students. Applying a confirmatory factor analysis, these authors concluded that the putative 5-factor model proposed by the developers of the DREEM is not supported and may be in need of revision (25, 30, 52). Hammond et al. (22) stated that as their findings were based on Irish medical students, it is unlikely that these weaknesses can be attributed to translation factors. Jakobsson et al. (49) stated that the original model was developed by a qualitative method, and this could explain the differences. On the other hand, in this paper, we present a full confirmatory factor analysis of the DREEM scale applied to dental students, where the measurement of model fit with the data is checked with model chi square, goodness-of-fit and approximate fit indices (35). Although the result of the chi-square test may suggest that the model is not adequate, it should be noted that this test is highly dependent on the sample size. Hence, the value of 'relative chi-square' was also calculated, being <5 , so the result can be considered acceptable (53, 54). In addition, goodness-of-fit indices of the confirmatory analysis confirmed the suitability of the

model. Regarding GFI and AGFI indices, values were about 0.9, the cut-off point traditionally considered an acceptable value, and the remaining indices are very close to the cut-off point 0.95, proposed by Hu and Bentler (40) to ensure a good fit. The SRMR index is close to 0.08 and RMSEA is <0.06 , both cut-off points proposed by Hu and Bentler (40) to consider the acceptable fit. Consequently, all indices had acceptable values (close to one or zero, depending on the case), and there was consistency in the results, which lead us to conclude that the DREEM model was supported by the data.

Although our findings indicate that the DREEM may be as culturally independent as was originally stated (6), more research should be directed at verifying the factor structure in various languages and cultural environments (15).

In conclusion, the Spanish-language version of the DREEM questionnaire is a reliable and valid instrument for analysing the EC for dental students, and its factor structure is supported by the data.

Conflict of interest

The authors report no conflicts of interest.

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