

# Application of the European-modified dental clinical learning environment inventory (DECLEI) in dental schools in Riyadh, Saudi Arabia

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## Keywords

dental students; clinical education; professional skills; undergraduate dental education.

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## Abstract

**Aim:** The aim of this study was to evaluate undergraduate dental students' self-perceptions of their clinical dental environment using a valid, concise and more practical version of the Dental Clinical Learning Environment Inventory (DECLEI) questionnaire.

**Materials and methods:** The 24-item DECLEI was self-administered to fourth- and fifth-year undergraduate dental students from public and private dental schools in Riyadh, Saudi Arabia, during the 2014–2015 academic year. Factor analysis revealed three underlying factors associated with the clinical learning environment. Independent sample *t*-tests were used to evaluate any associations amongst the items, the factors, the total DECLEI score and other demographic variables. For the scoring system, 6-point Likert scale responses were scored on a 100% scale ranging from excellent to poor.

**Results:** The mean DECLEI total score was 64.1 (good) of 100. Amongst the factors, the highest mean score, 71.3 (good), was obtained for the patient interactions and professionalism, and the lowest mean score, 50.2 (moderate), was observed for all the negatively worded statements in the DECLEI. The instrument exhibited good discriminant validity as it was able to record significant differences between genders and between public and private institutions in the total DECLEI, the factors and most of the items scored.

**Conclusions:** The new DECLEI scale identified several areas of strength and some aspects that could be improved. Overall, the dental students rated the clinical undergraduate programme as more positive than negative.

## Introduction

The mission for clinical dental training of undergraduate dental students ideally includes the enhancement of the education-care delivery relationship; a high level of patient focus; wide-ranging care-giving experiences; and learning reforms that encourage reflective clinical practice in terms of prevention, diagnosis and treatment of dental patients in an effective manner (1). From the students' standpoint, an ideal didactic and clinical environment should facilitate attainment of the essential theoretical,

high-quality clinical, technical and interpersonal competences and exposure to clinical experiences that are equivalent to the environment in which they are likely to be practicing dentistry after graduation to achieve precise and predictable clinical outcomes (2).

Over the years, the need for change in dental education has frequently been emphasised (3, 4). Wide differences are noted in curriculum content, philosophies and tools in dental education globally (5). Despite the potential for achieving a gradual move towards higher standards that depict an ideal educational

environment, several barriers, such as limitations in the availability and utilisation of resources, differences in regional or society-oriented traditional ideologies, and resistance of structures or authorities to change, inhibit this potential (2). However, some of the significant landmarks for a change for the better include the introduction of different adaptations of problem-based learning (6–8), the establishment of comprehensive care clinics (9, 10), the increasing potential of information and communication technology use (11, 12), the surplus of virtual and online opportunities that have become available for staff and students, and the creation of an academic progress file learning system or portfolio for students to monitor and maintain an official record of their achievements (13, 14).

As the 'consumers' of dental education, students play an important role in providing valuable feedback and suggestions for curriculum planning and improvement of the learning environment (15–17). Encouraging and implementing change in dental education is an extremely complicated issue. There is a need to acquire not only scientifically based evidence but also a mandatory broad consensus from educators during the initial stages of discussions and subsequently during implementation of these new methodologies, philosophies and innovations (18). In addition, the dental educational programme must be acceptable and satisfactory to those involved in it: the students, faculty members and patients. Taking this notion into consideration, the perceptions of students are of fundamental importance to provide the necessary feedback regarding their clinical learning environment.

A highly creative, interactive session amongst the students, the educators and the social and educational training environment is essential for an effective clinical learning experience (19). The dental education environment has been explored in previous studies that used tools that were either originally developed for medical education and not specifically updated for a dental undergraduate programme with a significant clinical component or were rather long, although comprehensive, consistent and informative (20). The Dental Student Learning Environment Survey (DSLES) and the Clinical Education Instruction Quality Questionnaire (ClinED IQ) were originally developed for medical students but have been applied to North American dental schools (21, 22). The 50-item Dundee Ready Education Environment Measure (DREEM) is a generic instrument that has recently been applied in dental schools in the Philippines (23) as well as previously in the UK (24), Germany (25), New Zealand (26), Greece (27), Pakistan (28) and India (29). Two additional questionnaires developed at the University of Hong Kong (30) and the University of Sydney (1) primarily focused on clinical dental teaching styles and perceptions of the clinical teachers. At this precise juncture, owing to the lack of any specific instrument for measuring the self-perceptions of undergraduate dental students regarding their clinical educational environment, this cause was addressed by Kossioni et al. (19). Through the innovative efforts of these researchers, a practical 24-item Dental Clinical Learning Environment Instrument (DECLEI) was developed and validated (19).

The dental education system in Saudi Arabia is constantly attempting to upgrade its world-class standards by adopting best practices from around the world and is being recognised for its credential potential. Administering the DECLEI to a

sample of fourth- and fifth-year dental students in the capital of Saudi Arabia is the first attempt following its development and validation by a group of European researchers (19), and this study would be helpful in several ways. Most importantly, this study would provide insightful information about how the undergraduate consumers of dental education view their clinical educational environment. This information might allow institutions to address any key issues. Additionally, the findings of this study might be a useful point of reference for future DECLEI studies amongst undergraduate dental students and may provide a positive impact or inference to parallel trends for other regional and international dental institutions.

Therefore, the aim of this study was to administer the DECLEI in dental schools in Riyadh, Saudi Arabia, to evaluate the self-perceptions of undergraduate clinical dental students regarding their clinical learning environment. Thus, differences in gender, year of study, years of clinical experience and institutions in terms of favourable and unfavourable perceptions in the clinical educational environment were assessed.

## Materials and methods

This study was reviewed and approved by the ethics committee of the College of Dentistry Research Center (CDRC registration number FR 0220) on 29 March 2015 and was undertaken with the understanding and informed consent of each participant according to the ethical principles of the World Medical Association Declaration (31).

### Study sample and implementation of the study

The study sample was derived from two governmental and two privately funded dental schools in Riyadh, Saudi Arabia, which contained our targeted sample of officially registered fourth- and fifth-year undergraduate dental students for the 2014–2015 academic year. An invitation letter was mailed to the vice dean of student affairs of each of the four dental schools that briefly discussed the purpose of the study, the requirements for participation by those dental students with clinical experience at their respective institutions and the timetable for distribution to the students. We promised each participating school a report of the results based on their students' data as an incentive to participate. After obtaining permission to proceed with the study, the total number of the dental students enrolled in the fourth and fifth year from each of the four dental schools was obtained from the administration. Two of the co-investigators requested that the entire student body participate in the survey. However, of 1178 students, 613 students anonymously completed the study questionnaire in their classrooms prior to lectures. Those who did not wish to participate did so voluntarily, and some students were absent from the class at the time of the survey. The purpose of the study and information regarding how the data may help in the improvement of the clinical learning environment were communicated to the students well in advance, and student participation in the research was strictly confidential. No identifying data were requested from the students. Those willing to participate were given the questionnaire, which was to be completed by expressing their level of agreement and returned immediately.

## Survey instrument

This survey utilised a validated 24-item questionnaire from a recent study conducted in Greece (19) in a paper-based format. The authors determined the questionnaire to be a valid, comprehensive and practical instrument for measuring the undergraduate clinical dental environment. To identify any obstacles to its comprehension, the questionnaire was pretested in a pilot study of 10 fourth-year and 10 fifth-year students from King Saud University. Modifications were made to only the sequencing of the questions, which were arranged in a logical order based on their similar conceptual meanings. The DECLEI questionnaire was written in English and consisted of items on demographics and close-ended questions related to the clinical learning environment (see the Appendix). The demographics and background information included age, gender, institution, last scored cumulative grade point average (CGPA) and years of clinical experience. Students were requested to assess the 24-item questionnaire on a six-point Likert scale as follows: 'strongly agree', 'agree', 'slightly agree', 'slightly disagree', 'disagree' and 'strongly disagree'.

## Verification of validity of the survey instrument

The validity of the DECLEI questionnaire was verified by an explanatory factor analysis using varimax rotation with Kaiser normalisation. A principal component factor analysis was used to analyse the inter-relations amongst the items in the questionnaire. Cronbach's alpha was used to evaluate the internal consistency of the DECLEI.

## Statistical analysis

The data obtained from the survey were manually entered into a Statistical Package for the Social Sciences database (IBM, SPSS version 20, IL, USA) and were analysed using descriptive statistics with  $P < 0.05$  set as the level of significance. As promised initially, descriptive reports were generated and distributed to the respective dental schools based on their students' data upon completion of the survey data collection and entry. Pearson's correlation coefficient was used to assess the correlation between the total DECLEI scores and the scores of each factor with background variables, such as age, gender, years of clinical experience, type of institution, year of study and CGPA. Independent sample *t*-tests were used to evaluate any associations related to gender, private and government institutions, years of clinical experiences and year of study.

## Interpretation of scoring system

For the scoring system, the 6-point Likert scale was scored on a 100% scale as follows: strongly disagree = 0, disagree = 20, slightly disagree = 40, slightly agree = 60, agree = 80 and strongly agree = 100. Responses to four negatively worded statements (Q11, Q17, Q23 and Q24) were reverse coded such that higher scores represented higher levels of agreement. These negative statements were scored as follows: strongly disagree = 100, disagree = 80, slightly disagree = 60, slightly agree = 40, agree = 20 and strongly agree = 0. The scores for

each item in the three factors were averaged to determine the level of agreement for each factor. The total DECLEI score was calculated by the mean of the 24 mean item scores of all the participants. The total DECLEI score was then interpreted as follows:  $\leq 19.9\%$  very poor, 20–39.9% poor, 40–59.9% moderate, 60–79.9% good and  $> 80\%$  excellent. The scoring system and the interpretation of the scores are similar to those proposed in the Greek study (19), wherein individual item scores for specific domains may be identified for interventional purposes. A poor score (i.e.  $\leq 39.9\%$ ) was interpreted as a negative educational environment that required several radical changes. A moderate score of 40–59.9% indicated a few drawbacks in the educational environment that may warrant improvement. The last two scores, identified as good and excellent ( $\geq 60\%$ ), were interpreted as a positive clinical learning environment, and interventions in specific items may be required to make further improvements.

## Results

### Sample characteristics

The sample distribution is presented in Table 1 and indicates an overall response rate of 52%. From a total of 1178 dental students, only 613 participated in this survey. It should be noted that the student body can be characterised as homogeneous in terms of educational background, ethnicity and other sociocultural characteristics given that all of the dental students who participated were originally from the Arabian Peninsula. The mean age of the respondents was  $23.70 \pm 2.19$  years with a range of 20–38 years. Approximately, 49.3% ( $n = 302$ ) of the respondents were male and 50.7% ( $n = 311$ ) were female. The majority of participants were in the fifth year (57.6%,  $n = 353$ ), and 42.4% ( $n = 260$ ) were in the fourth year of the dentistry programme. In our sample of dental students, the majority reported having 3 years of clinical experience (53.5%,  $n = 328$ ), and 46.5% ( $n = 285$ ) had 2 years of clinical experience.

### Factor analysis and internal consistency results

Factor analysis led to the identification of three underlying factors that were consistent with the Greek study (19) with the exception of differences in the item distributions. As presented in Table 2, the first factor consisted of 11 items concerning the facilities of the dental school that enabled clinical training, clinical teachers' roles and learning opportunities in the clinics (Q1-5, Q7-10, Q12-13). The second factor consisted of nine items and was related to patient interactions and professionalism (Q6, Q14-16, Q18-22), and the third factor comprised the four negatively worded items related to overall satisfaction with the teachers and study experience and individual commitments towards the profession (Q11, Q17, Q23-24). Cronbach's alpha for the 24 standardised items was 0.887; the corresponding value for each factor is provided in Table 1, including the item-total correlation and the loading of the 24 items on the three factors. All three factors demonstrated acceptable internal consistency, with Cronbach's alpha exceeding the minimum standard of 0.7.

TABLE 1. Distribution of the dental schools in Riyadh that participated in the DECLEI study and the number of students who responded based on gender and year of study

	Gender	Fourth year	Fifth year	Total	Response rate (%)
Dental schools: Public					
KSU-BUC	Males	45 of 66	51 of 72	175 of 218	80.28
KSU-GUC	Females	40 of 40	39 of 40		
PSBAU	Males	27 of 30	11 of 32	38 of 62	61.29
Dental schools: Private					
		9 <sup>th</sup> and 10 <sup>th</sup> levels	11 <sup>th</sup> and 12 <sup>th</sup> levels		
RCDP-BC	Males	32 of 72	41 of 84	224 of 395	56.71
RCDP-GC	Females	62 of 122	89 of 117		
AFDC-BC	Males	43 of 110	52 of 90	176 of 503	35.00
AFDC-GC	Females	11 of 195	70 of 108		

KSU, King Saud University, BUC, Boys University Campus, GUC, Girls University Campus; PSBAU, Prince Sattam Bin Abdulaziz University; RCDP, Riyadh College for Dentistry and Pharmacy; AFDC, AlFarabi Dental College; BC, Boys Campus, GC, Girls Campus.

TABLE 2. Data reduction by exploratory factor analysis and item–total correlations for the 24-item DECLEI survey of dental students

Factor name	Item number	Factor I	Factor II	Factor III	Item–Total correlation	Cronbach's alpha
Facilities, teachers and clinical learning opportunities	Q1	<b>0.598</b>	0.197	0.111	0.543	0.892
	Q2	<b>0.694</b>	0.210	0.034	0.607	
	Q3	<b>0.580</b>	0.234	−0.032	0.526	
	Q4	<b>0.579</b>	0.186	−0.067	0.478	
	Q5	<b>0.594</b>	0.352	0.028	0.606	
	Q7	<b>0.799</b>	0.124	−0.001	0.628	
	Q8	<b>0.809</b>	0.094	0.023	0.629	
	Q9	<b>0.742</b>	0.185	0.090	0.648	
	Q10	<b>0.764</b>	0.186	−0.024	0.638	
	Q12	<b>0.467</b>	0.413	−0.187	0.491	
Patient interactions and professionalism	Q6	0.387	<b>0.480</b>	0.111	0.535	0.779
	Q14	0.131	<b>0.602</b>	0.129	0.414	
	Q15	0.211	<b>0.578</b>	−0.279	0.367	
	Q16	0.071	<b>0.657</b>	−0.091	0.358	
	Q18	0.207	<b>0.340</b>	−0.318	0.223	
	Q19	0.257	<b>0.574</b>	0.068	0.483	
	Q20	0.185	<b>0.641</b>	0.188	0.490	
	Q21	0.489	<b>0.545</b>	0.011	0.634	
	Q22	0.338	<b>0.499</b>	0.142	0.521	
	Overall satisfaction and individual commitments	Q11	0.199	−0.068	<b>0.710</b>	
Q17		−0.195	0.069	<b>0.740</b>	0.017	
Q23		0.027	0.174	<b>0.709</b>	0.243	
Q24		0.116	0.017	<b>0.825</b>	0.242	
Eigenvalue		5.74	3.43	2.58		
% of variance		23.90	14.29	10.73		

The numbers in bold represent each DECLEI question as an element of factors I to III.

### Assessment of correlations

It should be noted that the total years of treating patients or clinical experience reported by the fourth- and fifth-year dental students was either  $\leq 2$  or  $\geq 3$  years. This value can vary depending on the particular curriculum of each dental school. Pearson's correlations revealed few significant positive correlations with regard to age, gender, duration of clinical experience, type of institution, year of study and CGPA, as presented in

Table 3. A weak correlation was noted amongst age, factor I (facilities, teachers and learning opportunities) and years of clinical experience. Gender exhibited weak correlations with duration of clinical experiences, factor III (overall satisfaction and individual commitments) and total DECLEI score. The years of study exhibited a positive correlation with CGPA and weak correlations with all of the demographic variables, whereas the type of institution or dental school was positively correlated with all of the analysed variables except factor III.

TABLE 3. Correlations of the DECLEI with the factors of age, gender, years of clinical experience, type of institution and CGPA

	FI	FII	FIII	DECLEI total	Age	Gender	Clinical experience (years)	Dental school	Year of study	CGPA
FI	1.00									
FII	<b>0.65**</b>	1.00								
FIII	0.06	0.03	1.00							
DECLEI total	<b>0.72**</b>	<b>0.67**</b>	<b>0.68**</b>	1.00						
Age	<b>0.16**</b>	0.05	-0.10	0.00	1.00					
Gender	-0.05	0.04	<b>0.26**</b>	<b>0.16**</b>	-0.26	1.00				
Clinical experience (years)	-0.05	-0.05	0.04	-0.02	<b>0.27**</b>	<b>0.10*</b>	1.00			
Dental school	<b>0.47**</b>	<b>0.31**</b>	0.00	<b>0.33**</b>	<b>0.26**</b>	<b>0.20**</b>	<b>0.09*</b>	1.00		
Year of study	-0.00	-0.03	0.06	0.03	<b>0.30**</b>	<b>0.13**</b>	<b>0.68**</b>	<b>0.15**</b>	1.00	
CGPA	0.12**	0.17**	0.12**	0.19**	<b>-0.18**</b>	<b>0.42**</b>	<b>0.00</b>	<b>0.26**</b>	0.09*	1.00

Pearson's product moment correlations.

\*\*Correlation is significant at the 0.01 level (2-tailed).

\*Correlation is significant at the 0.05 level (2-tailed).

Bold indicates significant difference at the 0.05 level.

CGPA showed a negative correlation with age and weak correlations with all of the other variables except years of clinical experience.

### Determination of the scores

The mean scores and the distribution of the respondents for each factor related to the dental clinical learning environment are provided in Table 4. The mean total DECLEI score was  $64.1 \pm 11.7$  standard deviation (SD) (interpreted as good). Amongst the factors, the highest mean score was obtained for factor II ( $71.3 \pm 12.6$  SD, interpreted as good) and the lowest for factor III ( $50.2 \pm 22.6$  SD, interpreted as moderate). The mean scores for each item, the three factors and the total DECLEI mean score based on gender (male vs. female), year of study (fourth vs. fifth year) and type of institution (government vs. private) are provided in Table 5. Independent sample *t*-tests revealed that the DECLEI exhibited good discriminant validity given that the instrument was able to record significant differences between the total DECLEI score, factor scores and several individual items. The duration of clinical experience was also assessed by *t*-tests, but no significant differences were found except with regard to Q19 (I am satisfied with the community service I provide as a dentist), wherein students with 2 years or less of clinical experience reported higher agreement than students with 3 years or more of clinical experience. The total DECLEI score and the overall satisfaction and individual commitments towards their studies were significantly associated with gender; female dental students had a higher DECLEI score and more moderate level of agreement than the male dental students. Of eight items (Q1, Q11, Q14, Q17, Q20, Q22-24), three (Q1, Q14 and Q20) exhibited excellent scores with regard to female responses, and four (Q9-10, Q12, Q18) were more favourable for males. When the year of study (fourth vs. fifth year) was compared, two items, Q21 (The topics in the clinical seminars helped me in my clinical training) and Q24 (I am disappointed with my overall study experience), exhibited significant differences ( $P < 0.05$ ). The fourth-year dental students had a relatively better appreciation regarding clinical seminars

than the fifth-year students. Regarding their opinion about the overall study experience, students in both years gave moderate scores, whereas fifth-year students showed a comparatively higher level of agreement with the negatively worded statement than the fourth-year students. In addition, statistical analyses identified significant differences between public and private institutions in the total DECLEI score, factors I and II, and most of the items except for three (Q16, Q23-24).

### Discussion

The formal dental education system in Saudi Arabia is a hierarchical system in which students are educated with a similar set of knowledge according to their age group and is provided through both public and private universities. All dental schools are segregated into male and female campuses (32). The dental schools follow the traditional lecture-based format with elements of a problem-based learning approach. We intended to show that the DECLEI instrument validated in European dental schools might be applicable to dental schools in the Middle East. The current study explored the dental students' perceptions of their clinical training environment in three areas: the facilities available to enhance the clinical sessions and clinical learning opportunities; patient interactions and professionalism; and overall satisfaction and individual commitments towards their dental studies.

In the current study, the mean total DECLEI score was 64.1 of 100, which is higher than that reported for Greek dental students in the study by Kossioni et al. (19) (a total DECLEI score of 56.1 of 100). Moreover, the three factors deducted cannot be correlated given that our study used a different set of items for data reduction by factor analysis. Factor I included 11 items related to scope of the dental programme; clinical infrastructure; research opportunities; selection criteria; and attitude, behaviours and duties of the clinical teachers. Except for item 11 (The teachers are not adequately prepared for their class), all other roles of clinical teachers were grouped as factor I given that these factors influence the clinical learning environment in a significant manner. Factor II comprised nine items dealing

TABLE 4. Summary of the scores and the distribution of the responses on the level of agreement for the DECLEI and the factors

Factors	Distribution of the score <sup>1</sup>			Mean scores $\pm$ SD <sup>2</sup>	Minimum score	Maximum score
	Good n (%)	Moderate n (%)	Poor n (%)			
Factor I Facilities, teachers and clinical learning opportunities (11 items)	481 (78.5)	108 (17.6)	24 (3.9)	70.9 $\pm$ 15.8	7	100
Factor II Patient interactions and professionalism (9 items)	517 (84.3)	89 (14.5)	7 (1.1)	71.3 $\pm$ 12.6	18	100
Factor III Overall satisfaction and individual commitments (4 items)	232 (37.8)	204 (33.3)	177 (28.9)	50.2 $\pm$ 22.6	0	100
Total DECLEI (24 items)	379 (61.8)	225 (36.7)	9 (1.5)	64.1 $\pm$ 11.7	29.7	97.3

<sup>1</sup>Responses were scored on a scale of 0–100% and classified as poor ( $\leq$  39.9%), moderate (40–59.9%) and good ( $\geq$  60%).

<sup>2</sup>Mean  $\pm$  standard deviation of the 6-point Likert scale, ranging from 0–100.

TABLE 5. Comparison of the individual scores between each item on the DECLEI and gender, years of clinical experience and type of institution

Items	Total Mean $\pm$ SD	Gender		P-value	Year of clinical study			Type of institution		
		Males Mean $\pm$ SD	Females Mean $\pm$ SD		Fourth year Mean $\pm$ SD	Fifth year Mean $\pm$ SD	P-value	Public Mean $\pm$ SD	Private Mean $\pm$ SD	P-value
Q1	78.7 $\pm$ 17.7	77.2 $\pm$ 17.9	80.2 $\pm$ 17.5	<b>0.034</b>	78.4 $\pm$ 18.5	78.9 $\pm$ 17.2	0.710	72.7 $\pm$ 19.8	81.9 $\pm$ 15.7	<b>0.000</b>
Q2	75.1 $\pm$ 19.3	75.5 $\pm$ 18.4	74.7 $\pm$ 20.1	0.626	75.4 $\pm$ 18.9	74.9 $\pm$ 19.6	0.748	66.0 $\pm$ 19.6	80.0 $\pm$ 17.2	<b>0.000</b>
Q3	68.4 $\pm$ 23.8	67.6 $\pm$ 24.7	69.1 $\pm$ 22.8	0.431	66.9 $\pm$ 26.1	69.4 $\pm$ 21.9	0.212	56.9 $\pm$ 26.1	74.5 $\pm$ 19.9	<b>0.000</b>
Q4	69.7 $\pm$ 24.5	69.7 $\pm$ 23.3	69.7 $\pm$ 25.7	0.983	70.0 $\pm$ 25.8	69.5 $\pm$ 23.6	0.836	58.1 $\pm$ 25.4	75.9 $\pm$ 21.7	<b>0.000</b>
Q5	75.1 $\pm$ 19.1	75.4 $\pm$ 17.4	74.8 $\pm$ 20.6	0.709	76.2 $\pm$ 20.2	74.3 $\pm$ 18.2	0.225	68.3 $\pm$ 18.9	78.8 $\pm$ 18.2	<b>0.000</b>
Q7	78.1 $\pm$ 17.0	69.1 $\pm$ 22.9	67.5 $\pm$ 24.7	0.412	77.2 $\pm$ 18.6	78.7 $\pm$ 15.8	0.304	58.4 $\pm$ 22.9	73.6 $\pm$ 22.6	<b>0.000</b>
Q8	68.3 $\pm$ 23.8	72.7 $\pm$ 20.2	71.6 $\pm$ 21.8	0.515	67.8 $\pm$ 23.9	68.6 $\pm$ 23.8	0.683	63.8 $\pm$ 21.0	76.6 $\pm$ 19.5	<b>0.000</b>
Q9	72.1 $\pm$ 21.0	75.5 $\pm$ 20.9	71.5 $\pm$ 27.1	<b>0.039</b>	72.0 $\pm$ 19.7	72.2 $\pm$ 21.9	0.928	62.9 $\pm$ 23.5	79.0 $\pm$ 22.9	<b>0.000</b>
Q10	73.4 $\pm$ 24.3	69.2 $\pm$ 23.2	63.6 $\pm$ 28.4	<b>0.008</b>	74.1 $\pm$ 23.3	73.0 $\pm$ 25.1	0.588	52.5 $\pm$ 26.3	73.8 $\pm$ 22.8	<b>0.000</b>
Q12	66.4 $\pm$ 26.1	62.2 $\pm$ 24.8	57.2 $\pm$ 30.2	<b>0.025</b>	67.4 $\pm$ 25.0	65.6 $\pm$ 26.9	0.421	47.2 $\pm$ 27.7	66.3 $\pm$ 25.4	<b>0.000</b>
Q13	56.6 $\pm$ 28.1	74.4 $\pm$ 19.4	71.6 $\pm$ 25.0	0.114	54.7 $\pm$ 28.4	57.9 $\pm$ 27.9	0.157	62.1 $\pm$ 23.6	78.8 $\pm$ 19.5	<b>0.000</b>
Q6	59.6 $\pm$ 27.7	77.4 $\pm$ 16.4	78.7 $\pm$ 17.6	0.347	58.2 $\pm$ 29.0	60.7 $\pm$ 26.8	0.260	74.4 $\pm$ 15.8	80.1 $\pm$ 17.3	<b>0.000</b>
Q14	73.0 $\pm$ 22.5	74.3 $\pm$ 20.0	80.5 $\pm$ 17.7	<b>0.000</b>	74.5 $\pm$ 20.3	71.8 $\pm$ 23.9	0.132	72.4 $\pm$ 18.5	80.1 $\pm$ 18.9	<b>0.000</b>
Q15	77.4 $\pm$ 19.1	56.0 $\pm$ 26.9	55.7 $\pm$ 25.0	0.873	77.4 $\pm$ 18.3	77.4 $\pm$ 19.7	0.980	51.8 $\pm$ 24.2	58.0 $\pm$ 26.7	<b>0.005</b>
Q16	55.8 $\pm$ 26.0	69.1 $\pm$ 20.2	69.2 $\pm$ 20.3	0.937	57.7 $\pm$ 27.3	54.5 $\pm$ 24.9	0.139	67.7 $\pm$ 18.3	69.9 $\pm$ 21.1	0.201
Q18	69.1 $\pm$ 20.2	67.8 $\pm$ 21.2	63.7 $\pm$ 24.8	<b>0.027</b>	70.4 $\pm$ 20.6	68.2 $\pm$ 19.9	0.187	58.6 $\pm$ 23.0	69.5 $\pm$ 22.5	<b>0.000</b>
Q19	51.4 $\pm$ 28.1	74.3 $\pm$ 19.0	72.4 $\pm$ 24.3	0.270	51.9 $\pm$ 28.3	51.1 $\pm$ 28.0	0.737	67.3 $\pm$ 23.2	76.6 $\pm$ 20.4	<b>0.000</b>
Q20	65.7 $\pm$ 23.2	75.8 $\pm$ 16.0	80.2 $\pm$ 17.6	<b>0.001</b>	66.6 $\pm$ 22.9	65.1 $\pm$ 23.4	0.446	74.1 $\pm$ 17.5	80.2 $\pm$ 16.3	<b>0.000</b>
Q21	73.3 $\pm$ 21.9	73.2 $\pm$ 18.9	70.5 $\pm$ 23.4	0.111	75.6 $\pm$ 19.8	71.7 $\pm$ 23.2	<b>0.028</b>	63.6 $\pm$ 23.0	76.2 $\pm$ 19.0	<b>0.000</b>
Q22	78.0 $\pm$ 17.0	69.6 $\pm$ 21.6	75.2 $\pm$ 23.7	<b>0.003</b>	78.5 $\pm$ 16.6	77.7 $\pm$ 17.3	0.601	64.0 $\pm$ 24.0	76.9 $\pm$ 21.0	<b>0.000</b>
Q11	71.8 $\pm$ 21.3	53.5 $\pm$ 27.4	59.6 $\pm$ 28.5	<b>0.008</b>	72.5 $\pm$ 21.9	71.3 $\pm$ 21.0	0.523	52.1 $\pm$ 23.3	58.9 $\pm$ 30.1	<b>0.002</b>
Q17	72.5 $\pm$ 22.9	44.4 $\pm$ 27.1	58.3 $\pm$ 27.4	<b>0.000</b>	69.4 $\pm$ 24.5	74.7 $\pm$ 21.3	0.006	55.7 $\pm$ 25.3	49.1 $\pm$ 29.3	<b>0.004</b>
Q23	38.0 $\pm$ 30.6	29.6 $\pm$ 26.5	46.2 $\pm$ 32.1	<b>0.000</b>	36.6 $\pm$ 29.0	39.1 $\pm$ 31.8	0.321	38.3 $\pm$ 25.3	37.9 $\pm$ 33.2	0.863
Q24	54.7 $\pm$ 31.1	49.5 $\pm$ 28.7	59.7 $\pm$ 32.5	<b>0.000</b>	50.7 $\pm$ 30.5	57.6 $\pm$ 31.3	<b>0.006</b>	53.7 $\pm$ 27.2	55.2 $\pm$ 33.0	0.532
FI	70.9 $\pm$ 15.8	71.7 $\pm$ 14.2	70.2 $\pm$ 17.3	0.240	71.0 $\pm$ 16.5	70.9 $\pm$ 15.4	0.925	60.8 $\pm$ 14.1	76.3 $\pm$ 14.0	<b>0.000</b>
FI1	71.3 $\pm$ 12.6	70.8 $\pm$ 12.2	71.8 $\pm$ 13.1	0.334	71.7 $\pm$ 13.7	71.1 $\pm$ 11.8	0.546	66.0 $\pm$ 11.4	74.2 $\pm$ 12.4	<b>0.000</b>
FI3	50.2 $\pm$ 22.6	44.2 $\pm$ 19.8	56.0 $\pm$ 23.7	<b>0.000</b>	48.5 $\pm$ 22.7	51.4 $\pm$ 22.5	0.112	49.9 $\pm$ 18.0	50.3 $\pm$ 24.8	0.827
Total	64.1 $\pm$ 11.7	62.2 $\pm$ 9.8	66.0 $\pm$ 13.1	<b>0.000</b>	63.7 $\pm$ 12.0	64.4 $\pm$ 11.6	0.450	58.9 $\pm$ 10.1	66.9 $\pm$ 11.6	<b>0.000</b>

Proportions tested using *t*-tests.

SD, standard deviation.

Numbers in bold indicate *P*-values  $<$  0.05, which are statistically significant.

with clinical responsibilities, clinical seminars, self-evaluation, community service and all patient-associated items, excluding item 17 (My association with my patients leads to many problems) and item 23 (I am too tired to work effectively in the clinics). The items in factor II are an important aspect of professionalism and focus on the ability of the students to apply their interactions and communication skills to a generally specified number of patient procedures in a variety of disciplines during their clinical training (33). It was rather intriguing to find that all the negatively worded statements grouped together in factor III, which comprised four items that were scored the lowest by the students. This finding captured the subjective attitudes of the students towards the clinical learning environment and their overall satisfaction with their study experience as they disagreed on the statement that the study experience was disappointing.

Unlike the study conducted in Greece (19) that indicated no statistically significant variations between male and female dental students, our study identified several gender-related variations. This result may be related to the specific sociocultural environment, particularly the deeply embedded and complex nature of gender inequality in Saudi Arabia (34). Such a finding was expected as the previous study conducted in Saudi Arabia and Yemen (35), which used the predecessor DREEM questionnaire in undergraduate medical schools, reported the same findings. However, a direct comparison with DREEM may not be appropriate as DREEM serves a different purpose than the questionnaire used in this study. Several variations were observed between the public and private institutions, and this finding may be attributed to their dissimilarities in the curriculum organisation, infrastructure and educational system. The students in the public institutions provided lower scores for most of the items in the questionnaire. Students from the public institutions likely undervalue the privileges they experience, unlike the students in the private institutions, who are more appreciative of the clinical environment in which they study. This observation may be due to certain factors that have been overlooked in our study. For example, the private colleges may have a better clinical student-to-dental assistant ratio than the public colleges, which could correlate to most of the factors addressed in the questionnaire. Moreover, the number of students in the surveyed private colleges was increased compared with public colleges, and this finding potentially enhanced the social and competitive interactions of the students in the clinics.

The effect of age, year of study and duration of clinical experience of the students did not majorly impact our study. The fourth-year students and those with less clinical experience were more satisfied with the community service they provided as a dentist. Traditional school-based clinics remain vital for exposing students to certain treatment modalities, but community-based services offer students more experiences with more diverse groups of patients (36). This finding is encouraging in that the students feel sufficiently competent to act as community health care providers, which is an important aspect for developing the time-honoured values and attitudes that are fundamental to any care-giving profession. In addition, the fourth-year dental students were also relatively less disappointed with the overall study experience than the fifth-year

students. Self-perceptions of the fifth-year dental students regarding their disappointment with the overall study experience might be related to the future uncertainty, the pressure of fulfilling their clinical obligations and the difficulties they face to graduate in a timely manner (33). It is a common response from dedicated professionals under psychological stress to relate themselves to the sociopsychological phenomenon of the so-called fundamental attribution error (37). This notion implies that an individual is likely to hold external circumstances accountable for disappointments in performance or condition. However, some strongly believe that these self-perceptions are the result of internal aspects of the individual (38).

Certain limitations in connection with the results of this study merit mention to improve future studies. First, a lack of previously published studies using similar protocols makes a comparison of all aspects of the results difficult. As the DECLEI is a questionnaire-based survey, some elements of under-reporting bias might occur in the study. The cross-sectional design, the use of English language rather than Arabic-translated questionnaire and non-respondent bias may also be considered limitations. The influence of the dental assistants, who are some of the important members in the field assisting the students during their clinical training, in the clinical environment, was not assessed in the DECLEI. However, the benefits of introducing a shorter comprehensive version of the questionnaire might be jeopardised if other parameters were added. It would be interesting to know the extent to which the dental assistant-to-student ratio may affect clinical productivity, particularly in reducing the stressful environment in the clinics. Particular attention should be given to female students, who are faced with multiple roles as women, and final-year dental students as they cope with the demanding and stressful clinical studies. Therefore, the faculty, policy makers and institutional directors need to make strategic plans to enhance the learning environment in the clinical settings, a lesson the field of dentistry can learn from medical education (39).

## Conclusions

In conclusion, this study points to the importance of illuminating the clinical learning environment for clinical students by providing them with extra motivation and adequate exposure to diverse clinical scenarios. The selection of highly proficient clinical teachers and motivators with empathic skills for clinical learning should become an essential criterion during faculty recruitment. The new DECLEI scale identified several areas of strength and a few aspects of weaknesses in the dental undergraduate clinical environment based on genders, year of study and type of institution. Overall, the dental students rated the clinical undergraduate programme as more positive than negative.

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## Conflict of interest

The authors report no conflict of interest.

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## Appendix

Factors derived from the DECLEI instrument adopted from the study by Kossioni et al. (19).

### *Factor I: Facilities, teachers and clinical learning opportunities*

1. The dental study program prepared me adequately for the clinics
2. The clinical infrastructure of the dental school is satisfactory
3. The dental units' technical problems are quickly dealt with
4. We use up-to-date materials and equipment in the clinics
5. I am learning a sufficient number of clinical techniques
7. The clinical teachers fulfil their duty and maintain the work hours of the clinics
8. My clinical teachers are approachable
9. I feel I can freely ask any question I have
10. The clinical teachers are chosen with strict and appropriate criteria
12. I have sufficient research opportunities in my dental school
13. In the clinics, there is a feeling of mutual respect between the teachers and the students

### *Factor II: Patient interactions and professionalism*

6. The clinical cases that I handle adequately prepare me for my profession
14. I adequately organize my patients' folders
15. The patients are on time for their appointments
16. The patients are polite toward the students
18. I treat patients with similar demands and difficulties as my colleagues
19. I am satisfied with the community service that I provide as a dentist
20. I systematically self-evaluate my progress
21. The topics in the clinical seminars have helped me in my clinical training
22. I am confident that this year I will complete my clinical responsibilities

### *Factor III: Overall satisfaction and individual commitments*

11. The teachers are not adequately prepared for their classes
17. My association with my patients leads to many problems
23. I am too tired to work effectively in the clinics
24. I am disappointed with my overall study experience