ORIGINAL ARTICLE

Dental Students' Perceptions of the Educational Environment at Universiti Kebangsaan Malaysia (UKM) during the pre-COVID-19 and COVID-19 periods using the Dundee Ready Educational Environment Measure (DREEM) Inventory

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ABSTRACT

Introduction: The learning environment encompasses curriculum design, institutional resources, social interactions, and educators' teaching approaches. These factors influence students' engagement, academic performance, and well-being, prompting dental schools to foster academic and emotional growth. This study compares dental students' perceptions at Universiti Kebangsaan Malaysia (UKM) regarding their educational environment during the pre-COVID-19 and COVID-19 periods. **Methods:** This cross-sectional study employed convenience sampling with two undergraduate dental cohorts: pre-COVID-19 (2017/2018; n = 195) and COVID-19 (2020/2021; n = 215). Data were collected using the Dundee Ready Education Environment Measure (DREEM), which assesses five subscales: Students' Perceptions of Learning (SPL), Teachers (SPT), Academic Self-Perception (SAP), Atmosphere (SPA), and Social Self-Perception (SSSP). Descriptive statistics (mean ± SD) and inferential analyses (independent t-tests and two-way ANOVA) were performed to compare scores across periods and academic levels.**Results:** Both cohorts reported positive perceptions, with total DREEM scores of 128.89 (pre-COVID-19) and 129.67 (COVID-19). Significant differences were observed in all subscales ($p < 0.05$), except for SPL, with the pre-COVID-19 cohort consistently perceiving a more positive educational environment across SPT, SPA, SSSP, and the total score. Preclinical students consistently rated the teaching lower than clinical students across both cohorts. However, the significant interaction ($p < 0.05$) indicates that the decline in SPT scores during COVID-19 was more marked among clinical students, suggesting that disruptions caused by the pandemic may have disproportionately impacted their perception of teaching quality. **Conclusion:** Findings emphasise the need to enhance teaching quality and clinical support, particularly for senior students affected by pandemic-related disruptions.

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Keywords: DREEM, educational environment, online learning, dental students, Covid-19

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INTRODUCTION

The learning environment encompasses education's physical, social, psychological, and pedagogical aspects. It includes the formal curriculum, infrastructure, administrative systems, and the informal curriculum shaped by relationships and institutional culture. This environment significantly affects students' attitudes, engagement, and academic performance (1). A positive learning environment promotes respect, inclusivity, and student-centred learning, supporting educational and emotional well-being (2, 3).

Three main dimensions influence students' experiences: the physical, pedagogical, and psychological environments (1, 4). The physical environment affects

comfort and readiness to learn; access to well-ventilated classrooms and sufficient learning resources promotes motivation and focus. Social interactions with peers and educators foster a sense of belonging and inclusion.

The pedagogical environment encompasses teaching strategies, curriculum design, and assessment methods. Effective teaching aligns with learner needs and facilitates the practical application of knowledge, particularly in clinical settings. Competency-based assessments and formative feedback improve satisfaction, professional identity, and academic outcomes. Dental curricula should prepare students to serve all societal groups, irrespective of socioeconomic background (5). A supportive environment fosters academic, social, and mental growth and development (6, 7).

A psychologically supportive environment encourages trust, safety, and fairness. Clear expectations, transparent grading, and respectful relationships between faculty and students are vital. Educators have a crucial role in shaping this environment (3). Teaching techniques, feedback, and professionalism affect both cognitive and emotional growth. Supportive educators foster autonomy, reduce anxiety, and increase engagement, which are vital in demanding programs like dentistry.
Clinical learning demands, intensive schedules, and performance expectations in health education influence how students perceive their studies. Satisfaction with the learning environment is linked to well-being, academic success, and professional development. An inclusive, student-centred environment is essential for effective learning.

Assessing students' perceptions helps identify institutional strengths and inform improvements. The Dundee Ready Education Environment Measure (DREEM), created by Roff et al. (8), is a validated instrument for evaluating health education environments and is extensively used globally.

The COVID-19 pandemic (2020–2021) disrupted global education. Dentistry, regarded as high-risk for SARS-CoV-2 transmission, underwent significant changes guided by international and national protocols, including those adopted in Malaysia (9, 10). Traditional dental education relies on face-to-face teaching and practical work. The pandemic prompted a rapid transition to online and hybrid formats.

The Movement Control Order (MCO) began in Malaysia in May 2020, followed by the Recovery MCO in June. During this period, in-person clinical teaching was reduced due to concerns about virus transmission. The CDC classified dental educational activities from low-risk (online lectures) to high-risk (aerosol-generating procedures) (11, 12).

The Faculty of Dentistry at Universiti Kebangsaan Malaysia (UKM), a public institution founded in 1996, offers a five-year undergraduate programme comprising two preclinical and three clinical years. Preclinical training concentrates on fundamental sciences and laboratory work; clinical years involve patient care and competency-based assessments. All Malaysian dental schools temporarily closed in February 2020. UKM responded by implementing online lectures and recorded demonstrations. However, digital alternatives could not fully replace hands-on clinical training. Operations resumed in May 2020 under strict protocols including PPE use, social distancing, and designated clinical zones. These changes created operational challenges and heightened anxiety among staff and students, highlighting the importance of clear communication and support systems (14).

Previous Malaysian studies using DREEM have demonstrated that students' perceptions influence stress levels, clinical competency, and readiness for graduation (15–18). However, none have examined perceptions before and during the COVID-19 pandemic.

This study aims to evaluate and compare students' perceptions of the educational environment at UKM using the DREEM inventory across two cohorts: pre-COVID-19 (2017/2018) and during COVID-19 (2020/2021).

MATERIALS AND METHODS

Ethical Consideration

Ethical approval was granted after submitting the study protocol to the Ethical Committee of Universiti Kebangsaan Malaysia (UKM PPI/111/8/JEP-2021-734). A cover letter outlined the study's objectives, emphasising confidentiality and voluntary participation. Participants were assured of anonymity and that no identifiable information would be collected or disclosed.

Recruitment and Description of Participants

The study employed non-probability convenience sampling, which included all clinical and non-clinical students from the 2017/2018 (pre-COVID-19) and 2020/2021 (COVID-19) cohorts of the dental faculty at Universiti Kebangsaan Malaysia. This method was selected due to the accessibility of subjects during data collection, which was crucial given the COVID-19 restrictions. Although convenience sampling can introduce selection bias and affect generalizability, it was appropriate for comparing the two student cohorts.
This quantitative, cross-sectional study used the DREEM inventory. The 2020/2021 cohort experienced the COVID-19 pandemic, which began in early 2020. Data compared to a previous study (UKM PPI/111/8/JEP-2017-486) involved UKM dental students from 2017/2018. The COVID-19 cohort's academic year was disrupted

by the Movement Control Order (MCO) and limited clinical time. Numerous restrictions and regulations were implemented to reduce the transmission of viruses during clinical sessions. The challenges faced by the COVID-19 cohort may influence their perception of the educational environment, differing from that of the pre-COVID-19 cohort. Since both cohorts have a similar curriculum structure, comparing the effects of the pandemic is feasible.

The sample size calculation was performed using the formula (19).

$$n = \frac{2\sigma^2 (Z_{\alpha/2} + Z_{\beta})^2}{\delta^2} = 98$$

Where:
n = required sample size per group (the pre-COVID-19 and the COVID-19 batches)
$Z_{\alpha/2}$ = Z-value for 95% confidence (usually 1.96)
Z_{β} = Z-value corresponding to power
σ = estimated standard deviation (from previous study, typically around 20 – 30 for DREEM)
E = margin of error (e.g. ±5)
δ = minimum detectable difference between groups

Students were recruited through total population sampling within each academic cohort. Eligible students were invited to complete the DREEM questionnaire. Non-respondents were excluded, ensuring that the data reflected the perceptions of active participants from each academic period.

In the 2018 study, 195 out of 223 students from the 2017/2018 cohort completed the DREEM questionnaire during a morning lecture. In 2023, 215 out of 252 students from the 2020/2023 cohort responded to an online version distributed via Google Form over two weeks. All participants received information about the study, gave consent, and were assured of confidentiality. The responses reflected UKM dental students' perceptions of the educational environment before and during the COVID-19 pandemic.

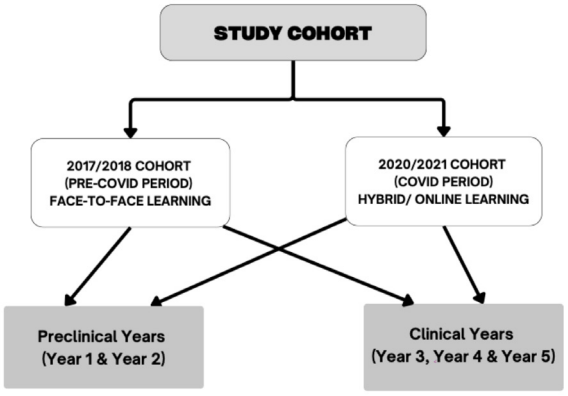

Figure 1: Categorisation of Study Cohorts and Levels of Study

Students were categorised into two study periods (Fig. 1) based on their enrolment relative to the COVID-19 pandemic: pre-COVID-19 (2017/2018 cohort) and COVID-19 (2020/2021 cohort). Each cohort was divided into preclinical years (Years 1 and 2) and clinical years (Years 3-5) according to the dental curriculum structure.

Technical Information

The Dundee Ready Education Environment Measure (DREEM) evaluates various aspects of the educational environment in medical schools and healthcare courses (8). It serves as a diagnostic tool that provides specific insights into an institution's learning environment. This tool has been utilised in studies of healthcare programs, including medicine, dentistry, nursing, midwifery, anaesthesiology, medical emergencies, paramedical sciences, and chiropractic education (15-18, 20-26).

The inventory highlights key factors essential for a supportive educational environment in dental institutions, including knowledge acquisition, personal development, and social awareness. It can pinpoint disruptions that may affect the quality of students' learning environments.

Permission from the co-author of the DREEM instrument was obtained (8) prior to the study's commencement. The questionnaire collected demographic data and utilised the DREEM inventory to assess students' perceptions of their educational environment across different academic years. Demographic information included year of study, study stage (preclinical and clinical), gender, and ethnicity. The 50-item questionnaire had response options: 0 for "strongly disagree" (SD), 1 for "disagree" (D), 2 for "uncertain" (U), 3 for "agree" (A), and 4 for "strongly agree" (SA). Nine items (4, 8, 9, 17, 25, 35, 39, 48, and 50) were negatively worded and reverse-scored, with 0 indicating strongly agree and 4 indicating strongly disagree (8, 20). This method prevents agreement with negative statements from lowering the overall DREEM score, maintaining the measure's validity and interpretability.

The DREEM inventory has a maximum score of 200, representing an ideal educational environment. Total scores are classified as follows: 0–50 indicates a very poor environment, 51–100 suggests problems, 101–150 reflects a more positive environment, and 151–200 represents an excellent educational environment. A score close to 100 indicates ambivalence and areas needing improvement (8).

The 50 items of the DREEM questionnaire can be further divided into the following five domains:
1. Students' Perceptions of Learning (SPL) (12 questions, maximum score: 48)
2. Students' perceptions of teachers (SPT) (11 questions, maximum score: 44)

3. Students' academic self-perceptions (SAP) (8 questions, maximum score: 32)
4. Students' perceptions of atmosphere (SPA) (12 questions, maximum score: 48)
5. Students' social self-perceptions (SSP) (7 questions, maximum score: 28)

The DREEM questionnaire identifies strengths and weaknesses in various domains. Items scoring 3.5 or higher are "real positive points." Scores of 2 or lower indicate problem areas, while scores between 2 and 3 suggest areas needing improvement.

Data analysis

Statistical analysis was performed using SPSS version 27 (IBM). A reliability test, Cronbach's alpha (α), was used to assess internal consistency. An α value of 0.7 is considered acceptable, 0.8 is regarded as good, and 0.9 or higher is deemed excellent.

The mean scores for the five subscales and the overall DREEM score were calculated for descriptive statistics. Frequencies and percentages based on student demographics were determined. To compare scores across each subscale and the overall scale, each mean score was divided by the maximum score and multiplied by 100 to get the percentage of the maximum possible score.

The Independent Samples t-test ($p < 0.05$) was used to assess differences in the dependent variable between two groups (5, 25, 26). It compared subscale and total DREEM scores for the pre-COVID-19 and COVID-19 cohorts.

A two-way ANOVA was used to compare subscale and total DREEM scores between pre-COVID-19 and COVID-19 cohorts, with academic year (pre-clinical and clinical) and periods as independent variables (27). Statistical significance was set at $p < 0.05$.

RESULTS

Reliability

The DREEM inventory's internal consistency and subscales were evaluated using Cronbach's alpha (α) for the pre-COVID-19 (2017/2018) and COVID-19 (2020/2021) cohorts. For the overall scale, α was 0.855 (2017/2018) and 0.943 (2020/2021), reflecting high reliability. The Students' Perceptions of Learning (SPL) subscale exhibited good consistency with α = 0.733 (2017/2018) and α = 0.832 (2020/2021). Students' Academic Self-Perception (SASP) and Students' Perceptions of Atmosphere (SPA) demonstrated acceptable reliability with α values of 0.719 and 0.665 (2017/2018), and 0.796 and 0.818 (2020/2021), respectively. Students' Perceptions of Teachers (SPT) improved from α = 0.307 (2017/2018) to α = 0.776 (2020/2021), achieving acceptable reliability. Similarly, Students' Social Self-Perceptions (SSP) significantly increased from α = 0.218 (2017/2018) to α = 0.697 (2020/2021). These results indicate an overall improvement in scale reliability, suggesting that the DREEM Inventory demonstrates excellent reliability in assessing dental students' perceptions at UKM.

Characteristics and Demographic of the Study Population

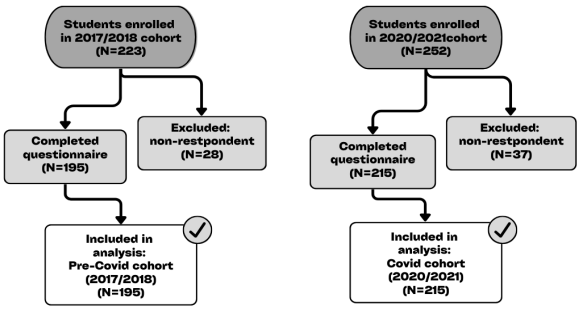

Figure 2: Study Recruitment Flow Chart

Fig. 2 illustrates the recruitment process for the 2017/2018 (pre-COVID) and 2020/2023 (COVID) cohorts. In the pre-COVID-19 cohort (2017/2018), hardcopy questionnaires were distributed during a morning lecture and collected immediately, resulting in an 87.4% response rate (195/223). Conversely, during the COVID-19 period (2020/2023), data were collected via an online Google Form due to social distancing measures. Students had two weeks to respond, with electronic reminders sent. This cohort achieved a slightly lower response rate of 85.3% (215/252).

Table I: Students demographic data

Demographic	Pre-COVID-19 Cohort		COVID-19 Cohort	
	2017/2018 batch		2020/2021 batch	
	n	%	n	%
Gender				
Female	141	72.3	157	73
Male	54	27.7	58	27
Ethnic				
Malay	107	54.9	113	52.6
Chinese	61	31.3	52	24.2
Indian	26	13.3	38	17.6
Others	1	0.5	12	5.6
Academic Year				
Preclinical	84	43.1	77	35.8
Clinical	111	56.9	138	64.2

Table I present the demographic data of the study. Most participants in both cohorts were female. In 2017/2018, 72.3% (n = 141) were female and 27.7% (n = 54) male. In 2020/2021, 73.0% (n = 157) were female and 27.0% (n = 58) male. The gender distribution remained stable, with no significant changes observed. In both cohorts,

most students identified as Malay, with 54.9% (n = 107) in 2017/2018 and 52.6% (n = 113) in 2020/2021. The proportion of Chinese students decreased slightly from 31.3% (n = 61) to 24.2% (n = 52), while the proportion of Indian students increased from 13.3% (n = 26) to 17.6% (n = 38). The 'Others' category (minority groups) rose from 0.5% (n = 1) to 5.6% (n = 12). Overall, there was a slight increase in ethnic diversity in 2020/2021 due to the rise in Indian and other minority students. In the 2017/2018 cohort (pre-COVID), 43.1% (n = 84) were preclinical students and 56.9% (n = 111) were clinical students. In the 2020/2021 (COVID) cohort, 35.8% (n = 77) were preclinical, while 64.2% (n = 138) were clinical.

Scores for individual DREEM items during the pre-COVID-19 and COVID-19 periods (Table II)

Table II: Scores for individual DREEM items during the pre-COVID-19 and COVID-19 periods

Items	2017/2018 Batch (pre-COVID 19) M±SD	2020/2021 Batch (COVID 19) M±SD	p-value
Subscale 1: Student's Perceptions of Learning (SPL)			
1. I am encouraged to participate in class	2.98 ± 0.673	2.99 ± 0.801	0.001
7. The teaching is often stimulating	2.76 ± 0.687	2.75 ± 0.778	0.037
13. The teaching is student centred	2.59 ± 0.777	2.52 ± 0.862	0.088
16. The teaching helps to develop my competence	3.07 ± 0.646	3.14 ±0.851	<0.001
20. The teaching is well focused	2.95 ± 0.607	2.96 ± 0.777	<0.001
22. The teaching helps to develop my confidence	2.79 ± 0.752	2.82 ± 0.947	<0.001
24. The teaching time is put to good use	2.82 ± 0.615	2.92 ± 0.749	0.014
25. The teaching over emphasizes factual learning	2.53 ± 0.845	1.66 ± 0.900	0.802
38. I am clear about the learning objectives of the course	2.77 ± 0.653	2.96 ± 0.759	0.384
44. The teaching encourages me to be an active learner	2.79 ± 0.745	2.69 ± 0.899	<0.001
47. Long term learning is emphasized over short term learning	2.89 ± 0.691	3.00 ± 0.832	<0.001
48. The teaching is too teacher centred	1.90 ± 0.777	2.02 ± 0.886	0.836
Subscale 2: Student's Perception of Teachers (SPT)			
2. The lecturers are knowledgeable	3.57 ± 0.526	3.66 ± 0.521	0.075
6. The lecturers are patient with patients	3.04 ± 0.717	2.94 ± 0.804	0.012
8. The lecturers ridicule their students	1.65 ± 0.975	2.10 ± 1.091	0.501
9. The lecturers are authoritarian	2.34 ± 0.941	1.56 ± 0.977	0.677
18. The lecturers have good communications skills with patients.	3.28 ± 0.638	3.19 ± 0.797	0.026
29. The lecturers are good at providing feedback to students	2.68 ± 0.712	2.48 ± 0.92	<0.001
32. The lecturers provide constructive criticism here	2.69 ± 0.778	2.68 ± 0.912	0.017
37. The lecturers give clear examples	2.68±0.675	2.92±0.714	0.311
39. The lecturers get angry in class	1.98±0.987	1.87±0.921	0.1
40. The lecturers are well prepared for their class	3.25±0.584	3.27±0.723	<0.001
50. The students irritate the lecturers	1.79±1.020	2.11±0.997	0.578
Subscale 3: Students' Academic Self-Perception (SAP)			
5. Learning strategies which worked for me before continue to work for me now	2.61±0.857	2.37±1.06	<0.001
10. I am confident about passing this year	2.76±0.752	2.54±0.994	<0.001
21. I feel I am being well prepared for my profession	2.54±0.781	2.75±0.882	0.171
26. Last year's work has been a good preparation for this year's work	2.66±0.739	2.67±0.941	0.002
27. I am able to memorize all I need	1.85±0.906	2.06±0.923	0.759
31. I have learned a lot about empathy in my profession	3.07±0.670	3.25±0.736	<0.001
41. My problem-solving skills are being well developed here	2.18±0.618	2.93±0.790	0.008
45. Much of what I have to learn seems relevant to a career in healthcare	3.16±0.587	3.23±0.726	<0.001
Subscale 4: Students' Perceptions of Atmosphere (SPA)			
11. The atmosphere is relaxed during clinical teaching	2.07±0.928	1.86±0.990	0.113
12. The course is well timetabled	2.41±0.960	2.37±0.997	0.66
17. Cheating is a problem in this school	1.99±1.239	2.34±1.312	0.147
23. The atmosphere is relaxed during lectures	2.73±0.767	2.70±0.890	0.003
30. There are opportunities for me to develop interpersonal skills	2.98±0.638	2.87±0.842	<0.001
33. I feel comfortable in class socially	2.77±0.658	2.85±0.837	0.001
34. The atmosphere is relaxed during seminars/tutorials	2.64±0.749	2.64±0.926	<0.001
35. I find the experience disappointing	1.50±0.949	2.45±0.993	0.481
36. I am able to concentrate well	2.37±0.849	2.42±0.839	0.612
42. The enjoyment outweighs the stress of the course	2.07±1.028	1.94±1.046	0.733
43. The atmosphere motivates me as a learner	2.74±0.777	2.39±0.970	<0.001
49. I feel able to ask the questions I want	2.59±0.777	2.50±1.071	<0.001
Subscale 5: Student's Social Self Perception (SSSP)			
3. There is a good support system for students who get stressed	2.06±0.956	2.08±1.12	0.012
4. I am too tired to enjoy the course	2.04±1.037	1.69±1.035	0.06
14. I am rarely bored on this course	1.96±1.062	2.29±1.039	0.838
15. I have good friends in this course	3.32±0.668	3.42±0.761	0.029
19. My social life is good	2.74±0.884	2.62±1.106	<0.001
28. I seldom feel lonely	2.13±1.035	2.16±1.159	0.17
46. My accommodation is pleasant	2.38±0.995	2.77±0.970	0.184

Negative statement is in italic.

Student's Perceptions of Learning (SPL)

The SPL subscale scores for both cohorts mostly ranged from 2.5 to 3.1, placing them within the DREEM-defined "areas that could be improved" category (2.1–3.4). Notably, two items - "The teaching overemphasises factual learning" (1.66) and "The teaching is too teacher-centred" (1.90)— fell below 2.0, highlighting them as problem areas. These findings suggest that, while students perceive some aspects of learning positively, targeted improvements are necessary, particularly in promoting more student-centred, concept-based teaching. Item 16 ("The teaching helps to develop my competence") had the highest score in both cohorts, with a significant improvement during COVID-19 ($p < 0.001$). Items 1, 20 and 47 also showed positive trends. However, item 48 received the lowest mean scores (<2) after reverse scoring, indicating a persistent perception of teacher-centredness. This emphasises the need for enhanced student-centred teaching approaches in modern dental education.

Student's Perceptions of Teachers (SPT)

The SPT subscale showed positive perceptions in both cohorts. Item 2 ("The lecturers are knowledgeable") recorded the highest mean scores, while Item 40 ("The lecturers are well prepared for their class") showed a significant improvement during COVID-19 ($p < 0.001$). Students rated lecturers' patience, communication skills, and feedback in the range of 2.5 to 3.3, which, according to DREEM criteria, suggests areas needing improvement rather than strong positive perceptions. After reverse-scoring, negative items scored around 2.0, indicating that students disagreed with negative lecturer behaviours. Overall, students regarded lecturers as professional and supportive but noted that enhancements in empathetic communication and constructive feedback could further elevate the quality of teaching.

Students' Academic Self-Perception (SAP)

The SAP subscale scores generally fell within the 2.1–3.4 range, indicating that students perceived their academic abilities as adequate but in need of improvement. Notably, one item, "I am able to memorise all I need", scored below 2.0, highlighting it as a problem area. Students rated Items 31 and 45 the highest, both exceeding a mean score of 3.0, with significant improvement during the COVID-19 pandemic ($p < 0.001$). Moderate scores were noted for confidence and learning strategies, with Item 41 showing significant improvement ($p = 0.008$). Memorisation ability remained low across cohorts, highlighting ongoing challenges in information retention.

Students' Perceptions of Atmosphere (SPA)

The SPA subscale indicated that students viewed the learning atmosphere as needing improvement, with most item scores falling within the 2.1–3.4 range. One item, "I find the experience disappointing," scored below 2.0 in the pre-COVID cohort, identifying it as a problem area. Positive ratings included Items 30 and 33, both scoring near 3.0, indicating a generally supportive atmosphere for social development and peer interaction. Several items scored moderately (2.0–3.0), including Items 23, 34, 43, and 49. This suggests that students generally found the environment engaging, although not consistently stimulating. Concerns arose with Items 11 and 42, both of which scored below 2.0, reflecting perceived stress and limited enjoyment during clinical activities, particularly during the COVID-19 pandemic. Additionally, the reverse-scored item 17 scored near 2.0, indicating moderate concerns about academic integrity. These findings underscore the need for enhanced emotional support, effective stress management during clinical training, and a more open and motivating educational environment.

Student's Social Self Perception (SSSP)

The Students' Social Self-Perception (SSSP) subscale assesses students' perceptions of social support, friendships, emotional well-being, and accommodation. The highest score was for Item 15. The higher results in the COVID-19 cohort suggest a greater sense of social connection during the pandemic. Items scoring 2 to 3 include Item 3, 19, 14, and 46. Students value support during the pandemic, although it could be improved. Item 4 scored below 2, indicating a lower level than the pre-COVID score, which highlights the impact of physical and mental fatigue during the pandemic on the enjoyment of the course.

Mean DREEM Score

The mean scores for total DREEM and subscales for the 2017/2018 and 2020/2021 cohorts are shown in Table III. An independent samples t-test was used to examine differences in DREEM and subscale scores between the two periods. Total DREEM scores for both cohorts ranged from 101 to 150, indicating UKM dental students generally held positive views of the educational environment. The 2020/2021 cohort had a slightly higher total DREEM score (129.67) than the 2017/2018 cohort (128.89), with a statistically significant difference ($p < 0.001$). The SPT had the highest mean percentage before COVID-19 (69.51%), but it dropped to 65.63% during the COVID-19 period. The SAP had the highest mean percentage in the COVID-19 cohorts (68.74%).

The lowest mean score was in SSSP for both cohorts, reflecting poor social self-perception. Mean scores increased during the COVID-19 pandemic for all subscales except the SPT. Significant differences were found between the pre-COVID-19 and COVID-19 cohorts for all subscales ($p < 0.05$), except for the SPL

Table III: The mean scores for total DREEM and subscales for the 2017/2018 and 2020/2021 cohorts

DREEM Subscales (Maximum score)	Pre-COVID-19 / 2017-2018 cohort DREEM Mean Score ± SD (score in percentage)					COVID-19 / 2020-2021 cohort DREEM Mean Score ± SD (score in percentage)				
	Min	Max	Preclinical (Year 1 – 2)	Clinical (Year 3 – 5)	All Year	Min	Max	Preclinical (Year 1 – 2)	Clinical (Year 3 – 5)	All Year
SPL	16	46	33.25 ± 4.50	30.57 ± 4.22	31.64 ± 4.33	15	47	33.60 ± 6.17	31.41 ± 5.55	31.97 ± 4.75
(48)			(69.28 ± 9.35)	(63.69 ± 8.80)	(65.92 ± 9.02)			(70.0 ± 12.9)	(63.2 ± 11.6)	(67.08 ± 12.24)
SPT	20	44	32.00 ± 4.13	28.12 ± 4.22	29.67 ± 4.19*	8	42	30.83 ± 5.51	27.81 ± 4.86	28.88 ± 5.30*
(44)			(73.25 ± 9.59)	(63.90 ± 9.60)	(69.51 ± 9.51)			(70.1 ± 12.5)	(63.2 ± 11.0)	(65.63 ± 12.05)
SAP	13	31	22.25 ± 3.85	21.36 ± 3.24	21.72 ± 3.48*	11	32	22.36 ± 4.42	21.80 ± 4.48	22.00 ± 4.47*
(32)			(69.52 ± 11.97)	(66.76 ± 10.13)	(67.86 ± 10.87)			(69.9 ± 13.8)	(68.1 ± 14.0)	(68.74 ± 13.97)
SPA	12	47	31.47 ± 4.35	27.94 ± 5.65	29.36 ± 5.13*	8	48	30.87 ± 7.06	28.86 ± 6.51	29.57 ± 6.78*
(48)			(65.57 ± 9.06)	(58.22 ± 11.77)	(61.16 ± 10.69)			(64.3 ± 14.7)	(60.1 ± 13.5)	(61.61 ± 14.12)
SSSP	7	26	17.52 ± 3.09	15.82 ± 3.63	16.50 ± 3.41*	4	28	17.21 ± 4.81	16.92 ± 4.05	17.02 ± 4.32*
(28)			(62.59 ± 11.05)	(56.50 ± 12.96)	(58.93 ± 12.19)			(61.5 ± 17.2)	(60.4 ± 14.4)	(60.80 ± 15.43)
Total	81	193	136.50 ± 16.31	123.82 ± 17.49	128.89 ± 17.02*	63	193	134.91± 24.44	126.81 ± 22.50	129.67 ± 23.52*
(200)			(68.25 ± 8.16)	(61.91± 8.74)	(64.45 ± 8.51)			(67.4 ± 12.2)	(63.4 ± 11.2)	(64.83 ± 11.76)

* Independent Sample t-test: $p < 0.05$

subscale.

In both stages, results indicated students viewed the learning environment (SPL) as "positive" and their perceptions of teachers (SPT) as "moving in the right direction." Students had generally positive views on the atmosphere (SPA), considered social self-perception (SSSP) as 'not too bad,' and saw academic self-perception (SAP) as 'more positive.' Mean perceptions, as percentages, ranged from 56.50% to 70.1% across all subscales.

The evaluation of DREEM subscales showed a moderately positive perception of the educational environment, highlighting strengths in teaching competence and peer support. However, it identified areas for improvement, particularly in creating a more student-centred learning atmosphere, managing academic stress, and enhancing social well-being.

Comparison of preclinical and clinical students' DREEM scores between pre-COVID-19 and COVID-19 (Table III).

SPL scores were higher for preclinical students in both periods. A slight improvement was noted during COVID-19 (70.0% ± 12.9%) compared to pre-COVID (69.28% ± 9.35%). Clinical students' SPL scores dropped slightly during COVID-19 (63.2% ± 11.6%). Teaching methods for preclinical students remained stable or showed slight improvement. In contrast, clinical-year students experienced statistically significant declines in several subscales, indicating a more negative perception of the learning environment during COVID-19.

In the SPT subscale, preclinical students scored higher than clinical students across both cohorts. Percentage scores declined slightly during the COVID-19 period, from 73.25% to 70.1% for preclinical students, and from 63.9% to 63.2% for clinical students. This suggests a relative decline in students' perception of teaching quality during the pandemic, particularly among clinical-year students. The perception of teaching staff remained positive but slightly declined during the pandemic, particularly among clinical students.

SPA scores declined during the COVID-19 pandemic for both preclinical and clinical students. Preclinical SPA fell from 65.57% to 64.3%, while clinical SPA decreased from 58.22% to 60.1%. The learning atmosphere felt increasingly stressful during the pandemic, particularly for clinical students, who faced restrictions on clinical activities and patient care.

SSSP scores were the lowest among all subscales in both periods. Preclinical scores declined from 62.59% to 61.5% during the COVID-19 pandemic, while clinical scores remained near 60%. The social aspect of education suffered most due to social distancing, reduced peer interactions, and isolation during the pandemic.

The analysis of DREEM scores revealed significant trends across the 2017/2018 (pre-COVID-19) and 2021/2022 (COVID-19) cohorts, as well as between preclinical and clinical studies (Table 4). The total DREEM mean score was slightly higher for preclinical students than for clinical students in both periods: Pre-COVID-19: 136.5 ± 16.31 (68.25% ± 8.16%) and COVID-19: 134.91 ± 24.44 (67.4% ± 12.2%) for preclinical; 126.81 ± 22.50 (63.4% ± 11.2%) for clinical. This indicates that preclinical students viewed the educational environment more favourably than clinical students, regardless of the pandemic period.

Stratified comparison of DREEM score with Clinical year and Different Periods as independent variables (Table IV).

Table IV: Stratified comparison of DREEM score with Clinical year and Different Periods as independent variables.

Source	df	MS	F	p-value
SPL				
Period	1	4.079	0.191	0.662
Year	1	116.348	5.461	0.02*
Period x Year	1	63.928	3	0.084
SPT				
Period	1	101.252	4.467	0.035
Year	1	956.673	42.202	<0.001*
Period x Year	1	3.715	0.164	0.686
SAP				
Period	1	6.645	0.406	0.524
Year	1	30.634	1872	0.172
Period x Year	1	0.033	0.002	0.964
SPA				
Period	1	3.526	0.097	0.756
Year	1	666.09	18.28	<0.001*
Period x Year	1	4.26E+01	1.169	0.28
SSSP				
Period	1	7.083	0.459	0.499
Year	1	65.365	4.235	0.04*
Period x Year	1	28.083	1.82	0.178
Total DREEM Score				
Period	1	4.001	0	0.923
Year	1	8189.192	19.143	<0.001*
Period x Year	1	158.292	0.37	0.543

* two-way ANOVA is significant at $p < 0.05$

A two-way ANOVA evaluated the effects of Period (pre-COVID-19 vs. COVID-19 cohorts) and Year of Study (preclinical vs. clinical) and their interaction (Period Ч Year) on DREEM subscale scores and the total DREEM score (Table IV). Results are summarised in Table V.

Students' Perceptions of Learning (SPL)

The analysis showed no significant main effect for Period ($p = 0.662$) but a significant effect for Year ($p = 0.02$), indicating preclinical students had higher SPL

Table V: Summary of findings

DREEM Subscales	Year	The Direction of the Score from Pre-COVID-19 to COVID-19 Cohort	Cohort	The Direction Of the Score from Pre-clinical to Clinical Year
SPL	Pre-clinical	↑		
	Clinical	↑	Pre-COVID-19	↓*
	All	↑	COVID-19	↓*
SPT	Pre-clinical	↓		
	Clinical	↓	Pre-COVID-19	↓*
	All	↓*	COVID-19	↓*
SAP	Pre-clinical	↑		
	Clinical	↑	Pre-COVID-19	↓
	All	↑*	COVID-19	↓
SPA	Pre-clinical	↓		
	Clinical	↑	Pre-COVID-19	↓*
	All	↑*	COVID-19	↓*
SSSP	Pre-clinical	↓		
	Clinical	↑	Pre-COVID-19	↓*
	All	↑*	COVID-19	↓*
Total Score	Pre-clinical	↓		
	Clinical	↑	Pre-COVID-19	↓*
	All	↑*	COVID-19	↓*

* statistically significant

scores than clinical students. Additionally, there was no significant interaction between Period and Year (p = 0.084). Variations in SPL stem from study level (preclinical vs clinical) rather than the pandemic period.

Students' Perception of Teachers (SPT)

The period significantly affected students' perceptions of teachers (p = 0.035), particularly in the comparison between pre-COVID-19 and COVID-19 periods. The year also had a significant effect (p < 0.001), with notable differences between preclinical and clinical students. No significant interaction was found (Period Ч Year; p = 0.686). Both the pandemic and the study level influenced perceptions independently.

Students' Academic Self-Perception (SAP)

No notable effects emerged for Period (p = 0.524), Year (p = 0.172), or their interaction (p = 0.964). Students' academic self-perception remained consistent, showing no significant impact from the study period or level of study.

Students' Perceptions of Atmosphere (SPA)

No significant Period effect was found (p = 0.756). However, a significant Year effect was observed (p < 0.001), indicating that clinical students perceived the atmosphere more negatively than preclinical students. No significant interaction effect was present (p = 0.280). The differences in SPA scores are due to the year of study, with clinical students experiencing the environment more negatively than preclinical counterparts.

Student's Social Self Perception (SSSP)

There was no significant Period effect (p = 0.499). A significant Year effect was observed (p = 0.04), indicating that preclinical and clinical students differed in social self-perception. There was no significant interaction effect (p = 0.178). Social self-perception was higher among preclinical students, regardless of the pandemic's impact.

Total DREEM Score

A significant year effect (p < 0.001) shows preclinical students rated their overall DREEM scores higher than clinical students. No interaction was found (p = 0.543). Overall, preclinical students viewed the educational environment more positively than clinical students, with minimal impact from the COVID-19 pandemic.

DISCUSSION

The DREEM inventory, originally designed to assess medical schools, is now frequently used in dental education, where its relevance and reliability have been well established (7, 16, 17). In Malaysia, it assists dental schools in comparing the educational environment with factors such as graduate preparedness (16), stress (17), and readiness for simulation-based teaching (18).

The COVID-19 pandemic has compelled the UKM dental school to adopt alternative teaching methods. This study examines the perceptions of the learning environment among UKM dental students following this disruption and identifies areas of concern. This research utilises the DREEM inventory to assess perceptions in two cohorts: the 2017/2018 batch (pre-COVID-19) and the 2020/2021 batch (COVID-19). The DREEM questionnaire was selected for its widespread use in the health sciences to evaluate educational environments, as evidenced in the literature among medical and dental students.

Methods of administering the questionnaire varied, impacting response rates. The pre-COVID-19 group had in-person sessions, likely boosting participation, while the COVID-19 cohort used asynchronous online responses, leading to lower rates. This discrepancy highlights remote data collection challenges (28) and potential response bias, stemming from students' views on the urgency of submitting the questionnaire. In-person settings foster peer pressure to respond, whereas online formats lack immediate rewards and feel less formal. Despite adequate sample sizes in both cohorts, this methodological variation must be considered in

comparative findings. Future research could explore hybrid or incentivised strategies to enhance participation assessment between cohorts.

Female students dominate in both cohorts. The rise of women in dentistry is well-documented in Malaysia. According to the Ministry of Health's Human Resources for Health Country Profile (2019–2021) (29), 70% of registered dental practitioners in Malaysia were female in 2021. This finding aligns with prior studies in Malaysian dental schools (15, 17, 18).

During the COVID-19 pandemic, the clinic made structural adjustments like limiting operational chairs and reducing patient care hours to mitigate infection risk. Patients' attendance declined due to health issues from COVID-19, childcare challenges, or reluctance to risk infection (30,31). These factors can influence perceptions of the learning environment, especially regarding teaching quality, emotional support, and motivation (23, 32).

The overall perception of the educational environment
This study found that the total DREEM score was 129.67/200 during COVID-19 and 128.89/200 pre-COVID. DREEM scores above 120 suggest a more student-centred educational approach with an innovative curriculum (8, 20). A score of over 120 indicates that students generally hold more positive views of their learning environment. Several studies on the educational environments of dental students in Malaysia (12-15), conducted before the pandemic, reported scores ranging from 146/200 to 126/200. This result contrasts with findings from a similar study conducted in Spain (33), which compared pre-COVID-19 and during-COVID-19 cohorts and reported a slight decrease in overall DREEM scores, from 126.55/200 before the pandemic to 124.93/200 during the pandemic. The findings may be due to variations in institutional responses to the pandemic, educational delivery methods, or contextual factors such as curriculum structure, clinical exposure, and student support systems.

The scores from all five DREEM subscales revealed positive student perceptions. These scores suggest an optimistic outlook while highlighting areas for improvement in the dimensions measured by the DREEM Inventory. Significant increases were noted in SAP, SPA, and SSP during the COVID-19 pandemic compared to pre-pandemic periods ($p < 0.05$). Notably, the SPL score remained consistent across cohorts, whereas the SPT score experienced a slight decline in the COVID-19 cohort.

Contrary to expectations, this study found no decline in the total DREEM scores. The flexibility of online learning, with easier access to materials, likely contributed to this outcome (34). Universiti Kebangsaan Malaysia's pre-existing digital platform supported a seamless transition to remote education, minimising disruption (35). Although physical distancing is no longer enforced, the benefits of online learning, particularly its flexibility, remain relevant, while student engagement through active learning remains essential.

Despite the challenges faced by faculty and students, such as limited time for implementing changes to prevent virus transmission and the transition to online education, student perceptions of their learning environment show an increasing trend. The significant increase in SAP, SPA, and SSSP scores has a substantial impact on the overall score, although there was a notable decrease in SPT and an insignificant rise in the SPL score.

Students' Perceptions of Learning (SPL)
The insignificant change in SPL scores in both pre-COVID-19 and COVID-19 cohorts indicates that students' perceptions of learning remained stable despite the shift to online or hybrid instruction. Students maintained a positive view of their learning experience, regardless of format. This may reflect high satisfaction with the curriculum and instructional design before the pandemic, which persisted despite modifications in delivery. Studies show that when students perceive their learning environment positively, they are more resilient to change and adaptable to disruptions in delivery methods (11, 36).

The shift to online learning had minimal negative impact due to well-structured digital transitions. Although UKM's online platform, UKMFolio (37), was not widely used prior to the pandemic, its availability facilitated a smooth transition to online teaching during COVID-19, enabling faculty and students to adapt to remote instruction with minimal disruption (38).

The SPL score remains stable despite the COVID-19 pandemic when clear communication, adequate resources, and regular feedback are provided to support online teaching (11). Similarly, students receiving structured, interactive virtual instruction reported learning outcomes comparable to those in in-person sessions (39). These findings show that with institutional preparedness and faculty engagement, students can maintain consistent perceptions of learning quality despite significant educational disruptions.

Moreover, the consistency in SPL scores highlights the importance of pedagogical continuity and instructional quality, regardless of the delivery mode. This reinforces the need for resilient curricula to maintain educational standards during crises, ensuring positive student learning experiences. Stable SPL scores suggest curriculum satisfaction and effective online adaptations, emphasising instructional quality over delivery mode.

Assessment methods were also revised, with a reduction in clinical requirements and a greater reliance on

coursework. These changes helped to alleviate stress and support learning continuity. However, such adjustments must be carefully balanced to ensure they do not compromise clinical competency, which is critical for public trust and patient safety. Competency-based education prioritises the integration of knowledge, skills, and behaviours for independent practice, and authentic clinical assessments remain essential to ensure that graduates meet professional standards. While temporary modifications are acceptable during crises, they must be thoughtfully designed to preserve educational quality and uphold graduate competence.

Preclinical students perceive learning more positively than clinical students. The lower scores of clinical students align with findings from other dental and medical education contexts (15-18, 21-23, 33). The reduced DREEM score among clinical year students signifies challenges in fostering a positive learning environment. In the initial two years of dental training, learning activities mainly include lectures, seminars, laboratories, and simulations without direct patient interaction. As students enter the clinical phase, they transition from structured learning to a demanding, unpredictable environment. Clinical students encounter increased workloads, time stresses, assessment pressures, and inconsistent teaching quality due to diverse supervision and case complexity.

Assessment structures vary between phases of dental training. The clinical grading system is less objective, relying on multiple assessors, which leads to inconsistent feedback (41). Dental schools must recognise the unique challenges clinical students face and implement strategies to enhance learning environments, such as structured mentoring, consistent supervision, stress management programmes, and improved feedback. Addressing these can boost student satisfaction, clinical preparedness, and well-being, ultimately supporting better educational and professional outcomes.

Although clinical students scored lower than preclinical students, they reported an increase in total DREEM scores during the COVID-19 period. In contrast, the preclinical year shows a decline in their perception of the educational environment during the pandemic. However, the two-way ANOVA test indicates that these changes are not statistically significant.

Students' Perception of Teachers (SPT)

The reduction in SPT scores reflects the challenges of maintaining effective student–teacher interactions during the transition to online learning. Schlenz et al. (42) reported that approximately 60% of dental lecturers admitted to lacking prior experience with online teaching before the pandemic, which may have impacted the quality of instruction and student engagement.

Lower SPT scores among clinical dental students were attributed to challenges arising from limited hands-on training, which is essential for developing practical skills. The absence of in-person sessions impeded skill acquisition and diminished opportunities for mentorship and feedback, contributing to these lower SPT scores.

Online learning offers flexibility and eliminates physical constraints, but it also presents challenges such as maintaining stable internet connections and fostering student engagement (43). Incorporating interactive elements, such as seminar-style sessions or problem-based learning, can enhance participation and mitigate drawbacks (44). The decline in SPT scores during the pandemic highlights the need for more effective strategies to promote student–teacher relationships in virtual learning, particularly in clinical training.

Students' Academic Self-Perception (SAP)

The rise in SAP scores during the COVID-19 pandemic shows increased student confidence compared to pre-pandemic levels, likely due to the shift to online platforms, allowing students to conveniently review recorded sessions. The effectiveness of online learning depends on factors such as learning styles, multimedia design, image and audio quality, internet connectivity, and delivery methods (45), which must align with learning objectives to support student goals (46). Preclinical and clinical students' SAP scores are not significantly different; despite differing views on their experiences, their academic perceptions remain similar. A score above 20/32 (62%) suggests students generally feel confident academically, but concerns about long-term success, assessment anxiety, and feedback persist (17).

The shift in teaching methods during COVID-19 raised concerns among students about the institution's readiness for online learning (47) and meeting clinical competency levels. Dental students worldwide expressed worries over pandemic-related challenges, including family health, academic performance, financial burdens, and mental health (48). Strong pedagogical practices established pre-pandemic helped students and educators navigate learning during it (33). Alternatives to traditional instruction, like problem-based learning seminars, may ease these concerns (49). Curriculum enhancements regarding assessment methods and applications are essential for maintaining consistency in assessments, including clinical ones. Course outcomes must align with assessment scope and methods.

Time management skills are crucial for students' well-being and academic success. Allocating time wisely can reduce stress and boost confidence (50). A positive learning environment significantly influences students' control, satisfaction, and achievement (2, 24). Thus, effective coping skills and institutional support are

essential for a productive academic experience.

Students' Perceptions of Atmosphere (SPA)

The increase in Students' Perceptions of Atmosphere (SPA) during COVID-19 ($p = 0.001$) shows improvements in students' feelings about their educational journey. This subscale assesses the emotional tone of the learning institution. Preclinical students score higher than clinical students, a finding consistent with other studies. Factors contributing to this may include the shift to online platforms, which provided greater flexibility and likely led to more positive perceptions among preclinical students. A study on dental undergraduates' views of online education during COVID-19 noted their appreciation for adaptability and accessibility, boosting SPA scores (42). Universities offered support mechanisms like virtual counselling and mental health resources, enhancing well-being and atmosphere perception. For example, the UKM Dental Students Association (UKMDensta) organised a 'Mental Health Awareness Week' in 2021. The postponement of clinical sessions due to pandemic restrictions may have temporarily reduced stress related to clinical requirements, allowing students to focus on theory and adapt to new learning methods. However, this raised concerns about clinical experience adequacy and uncertainty about graduation timelines, significant stressors for dental students, contributing to lower SPA scores among clinical students.

Clinical students often face fatigue and burnout from demanding sessions. During COVID-19, barriers between cubicles limited infection risk (31), potentially reducing peer support. Patient no-shows, time pressure, and new regulations can create perceptions of disorganisation.

Student's Social Self Perception (SSSP)

The SSSP subscale recorded the lowest percentage scores in both cohorts, indicating weak social self-perceptions among students, likely due to limited support from peers, faculty, and family. Preclinical students show better SSP scores than clinical students. This perception might arise from group dynamics during the pandemic, which included strong classroom support even before COVID-19. A notable increase in SSSP scores among clinical students during COVID-19 may indicate greater awareness and access to mental health resources (47). Literature suggests that mental health initiatives and peer engagement during the pandemic positively impacted students' perceived support and resilience (47, 48). Pandemic-related stress can be alleviated through smoother transitions and robust faculty support (48). While peer support was substantial, social well-being and emotional resilience faced challenges due to fatigue and reduced social interaction during the pandemic. Strengthening mental health and fostering social interactions is vital for holistic student development.

This study is not without limitations. It excluded qualitative factors such as students' backgrounds and personalities, which can influence perceptions of the learning environment. Incorporating open-ended questions or interviews in future studies may provide richer insights. Different data collection methods between cohorts may have introduced response bias, and the use of online surveys during the pandemic may have limited responses to more motivated or digitally proficient students.

Additionally, the study did not evaluate how pandemic-related changes affected clinical performance or exam outcomes. While some argue student perceptions may not reliably reflect curriculum effectiveness during disruptions, the findings suggest areas for improving the learning environment in a public dental school. Further research is needed to help dental institutions better prepare for future crises.

CONCLUSION

The DREEM instrument revealed differences in dental students' perceptions of the educational environment between the pre-COVID-19 and COVID-19 cohorts at Universiti Kebangsaan Malaysia. The study shows a positive trend in perceived educational quality; however, certain aspects require further improvement to enhance the learning environment.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

ETHICAL CLEARANCE

The study was conducted in compliance with ethical principles outlined in the Declaration of Helsinki and Malaysian Good Clinical Practice Guideline. Detailed protocol and ethical approach were approved by the UKM Research Ethics Committee, with ethical reference number JEP-2022-310.

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