

The Relationship Between Learning Styles and Perceptions of Academic Skills and Learning Climate in Dental Students

Diş Hekimliği Öğrencilerinde Öğrenme Stilleri ile Akademik Beceriler ve Öğrenme Ortamı Algıları Arasındaki İlişki

Sultan Uzun¹

Orcid: 0000-0003-3743-055X

Kübra Nur Çakan¹

Orcid: 0000-0003-1749-9293

Gamze Şirin Sarıbal²

Orcid: 0000-0002-5191-377X

¹Bilecik Şeyh Edebalı University, Faculty of Dentistry, Dentomaxillofacial Radiology Department, Bilecik, Türkiye

²Pamukkale University, Faculty of Dentistry, Dentomaxillofacial Radiology Department, Denizli, Türkiye

Sorumlu Yazar:

Sultan Uzun

E-posta:

dtsultanzun@gmail.com

Keywords:

Dental Education, Learning Styles, DREEM, Academic Self-Perception, Learning Climate

Anahtar Sözcükler:

Diş Hekimliği Eğitimi, Öğrenme Stilleri, DREEM, Akademik Öz Algı, Öğrenme İklimi

Gönderilme Tarihi / Submitted:

27.01.2026

Kabul Tarihi / Accepted:

20.02.2026

Künye:

Uzun S, Çakan KN, Şirin Sarıbal G. The Relationship Between Learning Styles and Perceptions of Academic Skills and Learning Climate in Dental Students. World of Medical Education, 2026;25(75):126-136

Abstract

Background: The aim of this study was to investigate the relationship between dental students' learning styles (VARK) and their perceptions of the educational environment (DREEM), and to evaluate the effects of this relationship on academic self-perception and learning climate. In addition, the study aimed to examine the influence of demographic variables such as age, academic year, and faculty type on students' perceptions of the educational environment.

Methods: This cross-sectional study was conducted with 518 undergraduate dental students from different universities in Türkiye. Data were collected using a structured online questionnaire including sociodemographic characteristics, the VARK Learning Style Inventory, and selected subscales of the Dundee Ready Education Environment Measure (DREEM). Learning styles were classified as Visual, Aural, Read/Write, and Kinesthetic. Educational environment perceptions were evaluated through academic self-perception and learning climate subscales. A p-value <0.05 was considered statistically significant.

Results: The mean age of participants was 21.61±2.13 years, and 65.4% were female. Kinesthetic learning style showed the highest mean score among learning preferences. Total DREEM and learning climate scores were significantly lower in older students and in higher academic years (p<0.05).

Third-year students exhibited significantly lower DREEM scores compared to first-year students. No significant differences were observed according to gender. Students from private universities demonstrated higher learning climate and total DREEM scores than those from public institutions. Correlation analysis revealed a weak but significant association between kinesthetic learning style and total DREEM score. Regression analysis indicated that age was a negative predictor of DREEM scores, whereas total DREEM score strongly predicted academic self-perception ($R^2=0.739$).

Conclusions: The findings indicate that perceptions of the educational environment decline during the preclinical–clinical transition and are strongly associated with students' academic self-perception. The significant role of kinesthetic learning highlights the importance of practice-oriented and interactive educational approaches in dental training. These results suggest that dental curricula should incorporate early academic mentoring, enhanced clinical preparedness, and learner-centered instructional strategies to support students' academic and psychological well-being.

Özet

Amaç: Bu çalışmanın amacı, diş hekimliği öğrencilerinin öğrenme stilleri ile eğitim ortamına yönelik algıları arasındaki ilişkiyi incelemek ve bu ilişkinin akademik öz algı ile öğrenme iklimi üzerindeki etkilerini değerlendirmektir. Ayrıca yaş, sınıf düzeyi ve fakülte gibi demografik değişkenlerin eğitim ortamı algısı üzerindeki rolünün araştırılması amaçlanmıştır.

Gereç ve Yöntem: Bu kesitsel çalışma, Türkiye'deki farklı diş hekimliği fakültelerinde öğrenim gören 518 lisans öğrencisi ile gerçekleştirilmiştir. Veriler, sosyodemografik bilgiler, VARK Öğrenme Stili Envanteri ve Dundee Eğitim Ortamı Değerlendirme Ölçeği (DREEM) kullanılarak çevrim içi anket aracılığıyla toplanmıştır. Öğrenme stilleri görsel (V), işitsel (A), okuma-yazma (R) ve kinestetik (K) olarak değerlendirilmiştir. Eğitim ortamı algısı ise akademik öz algı ve öğrenme iklimi alt boyutları üzerinden incelenmiştir. İstatistiksel anlamlılık düzeyi $p<0.05$ olarak kabul edilmiştir.

Bulgular: Katılımcıların yaş ortalaması $21,61\pm 2,13$

yıl olup %65,4'ü kadındır. Öğrenme stilleri incelendiğinde en yüksek ortalama puan kinestetik öğrenme stilinde saptanmıştır. DREEM toplam puanı ve öğrenme iklimi puanları yaş ile negatif yönde anlamlı ilişki göstermiştir ($p<0,05$). Üçüncü sınıf öğrencilerinin DREEM toplam puanlarının birinci sınıf öğrencilerine göre anlamlı düzeyde düşük olduğu belirlenmiştir ($p<0.05$). Cinsiyete göre anlamlı fark saptanmamıştır. Fakülteler arası karşılaştırmalarda özel üniversite öğrencilerinin öğrenme iklimi ve toplam DREEM puanlarının daha yüksek olduğu görülmüştür. Korelasyon analizinde yalnızca kinestetik öğrenme stilinin DREEM toplam puanı ile anlamlı ilişki gösterdiği belirlenmiştir ($p<0.05$). Regresyon analizinde yaşın DREEM puanını negatif yönde etkilediği, toplam DREEM puanının ise akademik öz algının güçlü bir yordayıcısı olduğu saptanmıştır ($R^2=0,739$).

Sonuç: Bu çalışma, diş hekimliği eğitiminde öğrencilerin eğitim ortamına yönelik algılarının özellikle prelinik dönemde belirgin şekilde azaldığını ve öğrenme ortamının akademik öz algı üzerinde güçlü bir etkisi olduğunu göstermektedir. Kinestetik öğrenme stilinin olumlu algıyla ilişkili olması, uygulama temelli eğitimin önemini vurgulamaktadır. Bulgular, eğitim programlarının daha öğrenci merkezli, etkileşimli ve destekleyici biçimde yapılandırılması gerektiğini ortaya koymaktadır.

INTRODUCTION

Dental education has shifted from traditional teacher-centered instruction toward student-centered models emphasizing active participation and competency-based learning (1, 2). Within this demanding curriculum, students must integrate theoretical knowledge with psychomotor and clinical skills. However, the structured nature of dental training may not always align with individual learning preferences, potentially influencing students' engagement and perceptions of the educational environment (3).

Learning styles and the educational environment represent two key components shaping students' learning experiences (4). Among learning style models, the Visual, Aural, Read/Write, and Kinesthetic (VARK) framework is widely used in health sciences education due to its practical and learner-centered structure (1). Nevertheless, the

empirical validity of learning styles remains debated. Current evidence does not strongly support the “matching hypothesis,” which proposes that aligning instruction with individual learning styles directly improves academic performance (5-7).

Despite this debate, learning preferences continue to be explored in dental education. A recent systematic review by Ferrer-Valdivia et al. (8) reported that learning style distributions among dental students may vary across academic stages, possibly reflecting adaptation to changing educational demands. Rather than supporting strict instructional matching, these findings suggest that learning preferences may function as indicators of how students engage with different phases of training.

The educational environment, commonly assessed using the Dundee Ready Education Environment Measure (DREEM), encompasses academic support, teaching quality, and learning climate (9, 10). Among its dimensions, academic self-perception and learning climate are closely linked to student motivation and persistence. If learning preferences act as perceptual filters through which students interpret their educational experiences, examining their relationship with DREEM dimensions may provide meaningful insights (4, 11).

Therefore, the aim of this study was to examine the association between VARK learning styles and dental students' perceptions of the educational environment, focusing specifically on academic self-perception and learning climate within the Turkish context.

MATERIALS AND METHODS

Ethical Approval and Considerations

Ethical approval for this study was obtained from the Non-Interventional Clinical Research Ethics Committee (Approval No: 2025/12, Date: 23 December 2025). All procedures were conducted in accordance with the principles of the Declaration of Helsinki.

Prior to data collection, participants were informed about the purpose and scope of the study, and electronic informed consent was obtained through the online survey system. Participation was entirely voluntary, and students were informed that they could withdraw from the study at any stage without providing a reason.

Sample size estimation was performed using G*Power software (version 3.1). Based on a 95% confidence level, 80% statistical power ($1-\beta = 0.80$), and a medium effect size (Cohen's $d = 0.30-0.50$), the minimum required sample size for group comparisons and regression analyses was calculated as 350 participants.

Study Sample and Data Collection

The study population consisted of undergraduate students enrolled in the Faculty of Dentistry. Students from all academic years (1st–5th year) were eligible for participation. Inclusion criteria were being enrolled in the dental program, being 18 years of age or older, providing voluntary consent, and completing the questionnaire in full. Students who submitted incomplete or incorrect forms, declined participation, completed the survey more than once, or failed to provide informed consent were excluded from the study.

Data were collected using a 37-item online questionnaire prepared via Google Forms (https://docs.google.com/forms/d/1oU4Ewn_4_jArgXW2wJTQ6aA0RNWu-S8dNgw3JTSjuog/edit). Prior to accessing the questionnaire, participants were presented with an electronic informed consent form. No personal identifying information was collected, and IP address tracking was disabled to ensure anonymity. All responses were collected anonymously and used solely for scientific purposes.

Questionnaire Structure

The questionnaire consisted of three main sections (sociodemographic information, VARK learning style inventory, DREEM scale).

The first section collected demographic information, including age, gender, academic year, and faculty of enrollment. Age was recorded as a continuous variable. Gender was recorded as female or male. Academic year and faculty of enrollment were recorded as categorical variables.

Learning styles were assessed using the VARK Learning Style Inventory, developed by Fleming (12). The validated Turkish version of the full scale was used without modification. The inventory consists of 16 multiple-choice items, and participants were allowed to select more than one option for each question, reflecting real-life learning preferences.

Each response corresponds to one of four learning modalities: Visual (V), Aural (A), Read/Write (R), and Kinesthetic (K). In accordance with the original VARK guidelines, percentage scores were not calculated. Instead, raw scores for each modality were obtained, as the instrument is designed to determine relative learning preferences rather than proportional distributions. Based on these scores, participants were classified as having either unimodal or multimodal learning styles.

Students' perceptions of the educational environment were evaluated using selected subscales of the DREEM, originally developed by Roff et al. (9) and validated in Turkish by Sezer et al. (10).

In line with the objectives of the study, only two subscales were included:

- Academic Self-Perception (7 items): This subscale evaluates students' perceptions of their academic competence, preparedness for examinations, and overall academic confidence.
- Perception of Learning Climate (10 items): This subscale assesses students' perceptions of the learning environment, including classroom atmosphere, student-teacher interaction, motivation, and psychological safety.

All items were rated on a 5-point Likert scale ranging from 0 (strongly disagree) to 4 (strongly agree). Negatively worded items were reverse-coded prior to analysis. Higher scores indicated more positive perceptions of the educational environment.

Statistical Analysis

Initially, data were obtained from 522 participants. Following data screening, individuals younger than 18 years of age and those with missing or invalid responses were excluded. After this process, a total of 518 participants were included in the final analysis. Descriptive statistics were calculated for all variables and are presented as mean \pm standard deviation. Learning styles were dichotomized into experiential (A and K) and visual-based (V and R) categories to reflect differences between active and passive learning approaches, with experiential styles representing active engagement in the learning process and visual-based styles reflecting more theory-oriented and passive learning preferences.

The distribution of DREEM total and subscale scores was examined using the Shapiro-Wilk

test. Although the test indicated deviation from normality, the large sample size and inspection of residual plots supported the use of parametric statistical methods. Group comparisons were performed using independent samples t-tests for gender and one-way analysis of variance (ANOVA) for class level and faculty comparisons. Post-hoc analyses with adjusted p-values were conducted where appropriate. Associations between variables were examined using Pearson correlation analysis. Multiple linear regression analyses were performed to identify predictors of total DREEM score and academic skills. Internal consistency of the DREEM subscales was assessed using Cronbach's alpha based on item-level responses; reverse-coded items were reverse-scored prior to reliability estimation. All statistical analyses were conducted using R software (version 4.4.0, January 2026 release), and a p-value of <0.05 was considered statistically significant.

RESULTS

A total of 518 students were included in the final analysis. The mean age of the participants was 21.61 ± 2.13 years. Based on this value, participants were categorized into two age groups for analytical purposes. The younger group consisted of 323 students (62.4%), while 195 students (37.6%) were classified as older. Regarding gender distribution, 339 participants (65.4%) were female, 175 (33.8%) were male, and 4 participants (0.8%) did not report their gender. Participants who selected the "no response" option were excluded from gender-based comparisons. The distribution across academic years was as follows: 1st year (14.3%), 2nd year (18.7%), 3rd year (16.8%), 4th year (27.8%), and 5th year (22.4%). Participants were enrolled in different dental faculties, with the majority attending Pamukkale University (77.2%), followed by Sakarya University (6.9%), Lokman Hekim University (5.0%), Bilecik Şeyh Edebali University (4.8%), Dicle University (2.3%), and Necmettin Erbakan University (1.4%).

When learning style components were examined, the mean scores were 4.49 ± 3.22 for V, 6.14 ± 3.79 for A, 4.60 ± 4.07 for R, and 5.63 ± 3.71 for K learning styles. The mean academic skills perception score was 16.36 ± 3.75 , the learning climate perception score was 22.58 ± 5.75 , and the total DREEM score was 38.94 ± 8.74 . Internal

consistency was acceptable for Academic Skills (Cronbach's $\alpha = 0.71$) and Learning Climate ($\alpha = 0.77$), with good reliability observed for the combined scale ($\alpha = 0.81$).

The distribution of total DREEM scores and its subdimensions according to gender is presented in Figure 1. Visual inspection revealed similar distributions between male and female students in terms of academic skills, learning climate, and total DREEM scores. These observations were

supported by independent samples t-test results, which showed no statistically significant differences between genders for any of the examined variables (all $p > 0.05$; Table 1). Similarly, when students were categorized based on their learning style preferences as experiential or visual-based, no significant differences were observed in academic skills, learning climate, or total DREEM scores (all $p > 0.05$; Table 1). The distribution of total DREEM scores according to academic year is illustrated

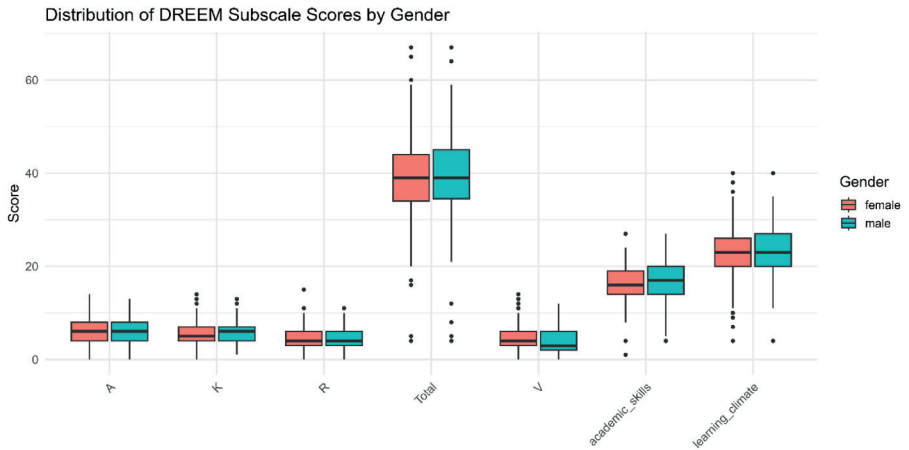


Figure 1. Distribution of DREEM subscale and total scores by gender

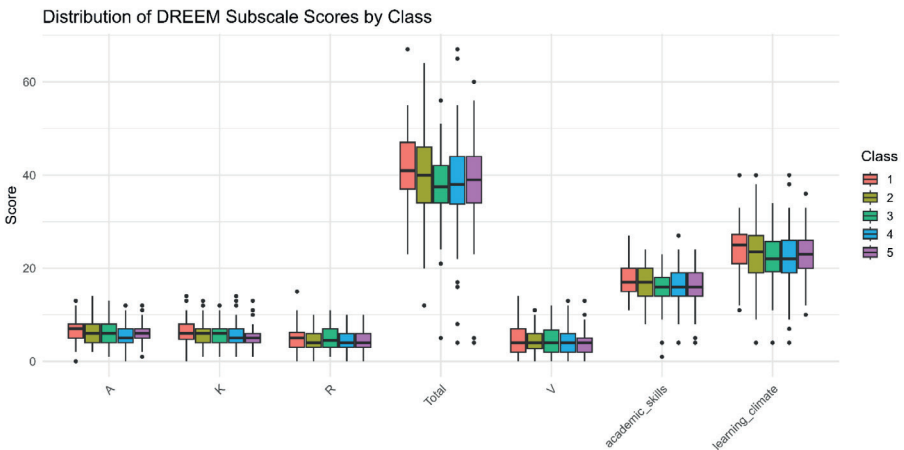


Figure 2. Distribution of total DREEM scores by academic year

Table 1: Comparison of DREEM scores according to sex and learning style

Grouping	Outcome	Group1	Group2	Mean_Group1	Mean_Group2	t_value	df	p_value	Cohens_d
Sex	Academic_skills	Female	Male	16.29499	16.56571	-0.73728	310.0186	0.461508	-0.07191
Sex	Learning_climate	Female	Male	22.48673	22.84	-0.64086	335.9387	0.522053	-0.06066
Sex	Total	Female	Male	38.78171	39.40571	-0.74596	325.1371	0.45623	-0.07147
VARK_group	Academic_skills	Experiential	Visual-Based	16.43413	16.2337	0.577133	371.3596	0.5642	0.053271
VARK_group	Learning_climate	Experiential	Visual-Based	22.71257	22.33152	0.683986	334.6543	0.494457	0.065419
VARK_group	Total	Experiential	Visual-Based	39.14671	38.56522	0.701799	342.6288	0.483281	0.066582

Values are presented as mean scores. Independent samples t-test was used for group comparisons. Cohen's d indicates effect size. ($p < 0.05$).

Table 2: Comparison of DREEM scores according to faculty and class level

Grouping	Outcome	Term	Df	SumSq	MeanSq	F_value	Eta2	p_value
VARK_dominant	Academic_skills	VARK_dominant	3	10.88688	3.62896	0.255558	0.001489	0.857379
VARK_dominant	Academic_skills	Residuals	514	7298.881	14.20016			
VARK_dominant	Learning_climate	VARK_dominant	3	23.54926	7.849752	0.230547	0.001344	0.87512
VARK_dominant	Learning_climate	Residuals	514	17500.86	34.04837			
VARK_dominant	Total	VARK_dominant	3	57.77594	19.25865	0.251629	0.001467	0.860181
VARK_dominant	Total	Residuals	514	39339.37	76.53574			
Faculty	Academic_skills	Faculty	6	114.4904	19.08173	1.355161	0.015663	0.230979
Faculty	Academic_skills	Residuals	511	7195.278	14.08078			
Faculty	Learning_climate	Faculty	6	612.9819	102.1636	3.087002	0.034979	0.005603
Faculty	Learning_climate	Residuals	511	16911.43	33.09477			
Faculty	Total	Faculty	6	1149.368	191.5613	2.559308	0.029174	0.018839
Faculty	Total	Residuals	511	38247.78	74.84888			
Class	Academic_skills	Class	4	98.93804	24.73451	1.759687	0.013535	0.135651
Class	Academic_skills	Residuals	513	7210.83	14.0562			
Class	Learning_climate	Class	4	376.2741	94.06853	2.814134	0.021471	0.024861
Class	Learning_climate	Residuals	513	17148.14	33.42717			
Class	Total	Class	4	855.4907	213.8727	2.846704	0.021715	0.023549
Class	Total	Residuals	513	38541.65	75.12993			

Df: degrees of freedom; SumSq: sum of squares; MeanSq: mean square; Eta²: effect size. Statistically significant results are highlighted in bold ($p < 0.05$).

Table 3: Post-hoc analysis of significant differences in learning climate and total DREEM scores according to faculty and academic year

Grouping	Outcome	Group1	Mean1	Min1	Max1	N1	Group2	Mean2	Min2	Max2	N2	p_adj
Faculty	Learning_climate	Lokman Hekim University	26.07692	17	40	26	Diele University	19.41667	15	28	12	0.016803
Faculty	Total	Pamukkale University	38.3625	4	67	400	Lokman Hekim University	44.07692	32	67	26	0.019993
Class	Learning_climate	3	21.68966	4	34	87	1	24.2973	11	40	74	0.036365
Class	Total	3	37.54023	5	56	87	1	41.59459	23	67	74	0.026748
Class	Total	4	38.10417	4	67	144	1	41.59459	23	67	74	0.040332

Mean values. Minimum-maximum ranges, and adjusted p-values are presented. Only statistically significant comparisons are shown ($p_{adj} < 0.05$).

Table 4: Correlation between age, learning styles and DREEM scores

Variable_X	Variable_Y	Correlation_r	p_value
Age	Academic Skills	-0.07792	0.076426
Age	Learning Climate	-0.09547	0.029809
Age	Total DREEM	-0.09724	0.026899
V	Total DREEM	0.007438	0.865894
A	Total DREEM	0.045136	0.305218
R	Total DREEM	0.062258	0.15709
K	Total DREEM	0.091926	0.036477

r: Pearson correlation coefficient. Statistically significant correlations are shown in bold ($p < 0.05$).

in Figure 2. A gradual decreasing trend in total DREEM scores was observed as the academic year progressed. One-way analysis of variance demonstrated a statistically significant difference in total DREEM scores among class levels ($p = 0.023$, $\eta^2 = 0.021$; Table 2). Post-hoc analyses indicated that this difference was primarily attributable to significantly lower total DREEM scores among third-year students compared to first-year students ($p_{adj} = 0.026$; Table 3). A similar pattern was observed for the learning climate subscale, which also showed a significant difference between class levels ($p = 0.025$). In contrast, academic skills scores did not differ significantly across years of study.

Faculty-based comparisons revealed significant differences in learning climate ($p = 0.006$, $\eta^2 = 0.034$) and total DREEM scores ($p = 0.018$, $\eta^2 = 0.029$). Post-hoc analyses demonstrated that students from Lokman Hekim University had significantly higher scores compared to those from Dicle University and Pamukkale University (Table 3). No statistically significant differences were observed between faculties with respect to academic skills scores.

Correlation analyses examining the relationships between learning styles and DREEM scores generally revealed weak associations (Table 4). A weak but statistically significant negative correlation was found between age and total DREEM score ($r = -0.09$, $p = 0.026$). Among the learning style subdimensions, only the K component showed a significant association with total DREEM score ($p = 0.036$, $r = 0.09$).

In the multiple linear regression analysis, age emerged as a significant negative predictor of total DREEM score ($\beta = -0.38$; $p = 0.036$). In the model in which academic skills were treated as the dependent variable, total DREEM score was identified as a strong positive predictor, explaining 73.9% of the total variance (Table 5).

The assumption of normality was assessed using the Shapiro-Wilk test, which indicated a deviation from normal distribution for the total DREEM score ($p < 0.001$). However, given the large sample size and the approximately symmetrical distribution observed in the residual plots, the use of parametric statistical tests was considered appropriate.

Table 5: Multiple linear regression analysis predicting DREEM and academic skills scores

Model	Variable	Beta	Std_Error	t_value	p_value	R_squared
Model_1_DREEM	(Intercept)	45.05329	4.410734	10.21447	2.07E-22	0.023943
Model_1_DREEM	Age	-0.38498	0.183729	-2.09538	0.036629	0.023943
Model_1_DREEM	SexMale	0.718106	0.81649	0.879504	0.379542	0.023943
Model_1_DREEM	SexNo response	-7.01186	4.414274	-1.58845	0.112804	0.023943
Model_1_DREEM	V	-0.00274	0.141385	-0.01938	0.984548	0.023943
Model_1_DREEM	A	0.023892	0.166239	0.143722	0.885777	0.023943
Model_1_DREEM	R	0.147171	0.17863	0.823887	0.410389	0.023943
Model_1_DREEM	K	0.214571	0.163092	1.315641	0.188886	0.023943
Model_2_AcademicSkills	(Intercept)	1.777529	0.988477	1.798249	0.072725	0.7395
Model_2_AcademicSkills	Age	0.00764	0.040311	0.189529	0.849753	0.7395
Model_2_AcademicSkills	SexMale	0.037246	0.179985	0.206938	0.83614	0.7395
Model_2_AcademicSkills	SexNo response	-0.52161	0.974363	-0.53533	0.592654	0.7395
Model_2_AcademicSkills	Total	0.3701	0.009791	37.79844	2.2E-150	0.7395

β : standardized regression coefficient; R^2 : coefficient of determination. Statistically significant predictors are shown in bold ($p < 0.05$).

DISCUSSION

This study examined dental students' perceptions of the educational environment in relation to learning styles and selected demographic variables. The findings demonstrate that perceptions of the educational environment are shaped by a

combination of academic stage, age, institutional context, and learning preferences. Rather than remaining stable throughout training, students' perceptions appear to evolve in response to increasing academic demands and professional expectations. This dynamic nature of perception has

also been highlighted in recent studies conducted in Türkiye, where dental education has been described as a highly structured and progressively demanding process requiring continuous adaptation by students (13).

One of the most notable findings of the study is the significant decline in DREEM scores observed among third-year students compared with first-year students. This suggests that the deterioration in educational environment perception begins earlier than is often assumed. While previous studies have emphasized the clinical years, particularly the fourth year, as the most stressful phase of dental education, our findings indicate that the preclinical period may already represent a critical transition point. The third year is typically characterized by an intensified curriculum, increased preclinical workload, and growing anxiety related to upcoming clinical responsibilities. These academic and psychological demands appear to converge during this period, potentially leading to a more critical evaluation of the learning environment. Recent research conducted in Egypt has similarly reported a decline in educational environment scores during the transition from preclinical to clinical phases (14). This combination may contribute to students perceiving the learning environment as more demanding and less supportive. Similar patterns have been reported in previous studies, where increased stress, emotional exhaustion, and reduced quality of life were observed as students progressed toward clinical training (15-17). Within the Turkish context, recent findings further support that perceived quality of life and academic satisfaction decline as students advance in dental education (15).

Age-related findings further support this interpretation. In the present study, age emerged as a significant negative predictor of total DREEM score, indicating that students' perceptions of the educational environment tend to decline as they advance in their training. This trend is consistent with earlier research demonstrating that cumulative academic pressure, concerns regarding clinical competence, and uncertainty about future professional life contribute to increased stress and burnout among senior students (15-18). Studies conducted in Türkiye similarly emphasize that academic burden and examination pressure intensify with advancing years, negatively affecting

students' psychological well-being and learning satisfaction (15, 19). Students in the earlier stages of their education, particularly those in their first year, may approach dental education with higher motivation and idealism. Conversely, as students age and advance to higher academic years, they are more likely to experience fatigue and reduced optimism as academic and clinical demands accumulate.

In contrast, gender was not associated with significant differences in DREEM scores in the present study. Although some studies have reported higher levels of stress and anxiety among female students, our findings align with research suggesting that perceptions of the educational environment are influenced more strongly by structural and curricular factors than by gender itself (15, 18). This indicates that educational conditions such as workload, assessment structure, and learning climate may exert a more uniform impact across genders.

A particularly important finding of this study is the strong relationship between the educational environment and academic self-perception. Regression analysis revealed that total DREEM score was a strong predictor of academic self-perception, accounting for a substantial proportion of its variance. This finding supports previous evidence indicating that students' academic confidence is closely linked to the quality of their educational environment rather than to individual ability alone (20, 21). Studies conducted in Türkiye using validated academic self-efficacy scales have similarly demonstrated that supportive learning environments and positive faculty-student interactions significantly enhance students' academic self-beliefs (11, 20). These findings emphasize the central role of educational climate in shaping students' confidence, motivation, and academic persistence.

With regard to learning styles, only the kinesthetic learning style showed a significant association with total DREEM score. This finding is consistent with the practice-oriented nature of dental education, which heavily relies on manual skills and experiential learning. Recent studies focusing on the Turkish validation of the VARK inventory have similarly highlighted the predominance of kinesthetic preferences in applied health sciences (22). Students with a kinesthetic learning preference

may therefore perceive the educational environment more positively, as it aligns more closely with their learning needs. In contrast, the lack of significant associations for visual and aural learning styles may indicate that theoretical components of dental education are still largely delivered through traditional teaching methods. Current educational literature increasingly emphasizes the importance of integrating interactive and student-centered approaches, such as simulation-based learning, problem-based learning, and flipped classroom models, to enhance engagement among students with diverse learning preferences (23-26). However, this association should be interpreted with caution. Although kinesthetic learning style demonstrated a significant relationship in the bivariate analysis, it did not remain a significant independent predictor in the multivariate regression model. This pattern is consistent with established statistical principles indicating that crude (bivariate) associations may be attenuated after adjustment for additional covariates in multivariate models (27). In the present study, the observed relationship may partly reflect shared variance with other variables such as age and class level, rather than representing a purely independent effect. As regression analysis estimates the unique contribution of each predictor while controlling for others, correlated independent variables may show reduced individual effects within the model (28).

Institutional differences also played a significant role in shaping students' perceptions of the educational environment. Students from the private university reported higher DREEM scores than those from public institutions. In addition to differences in instructional approaches, this finding may be partially explained by structural factors such as lower student-to-faculty and student-to-patient ratios, better access to clinical materials, and more individualized supervision. These factors may contribute to a more supportive and less stressful learning environment. In contrast, higher patient loads and limited resources in public institutions may negatively affect students' perceptions by increasing pressure and reducing opportunities for personalized feedback.

Our findings should be interpreted within the broader debate on the "matching hypothesis," which proposes that aligning instruction with self-reported learning styles improves academic outcomes (5, 6). However, experimental evidence indicates that

direct instructional matching does not consistently enhance achievement and that pedagogical effectiveness depends more on the nature of the content and instructional design than on declared preferences (7). In dental education, systematic evidence suggests that learning style distributions may vary between preclinical and clinical stages, indicating that such tendencies may adapt to curricular demands rather than represent fixed traits (8). Accordingly, the associations observed in the present study should not be interpreted as support for strict style-based instruction, but rather as reflecting the interaction between learner tendencies and the experiential structure of dental training. Recent evidence in dental education further indicates that learning styles may moderate the effectiveness of flipped instructional formats in influencing satisfaction and performance (29). Taken together with the small effect sizes observed in our analyses, these findings reinforce the view that educational environment perceptions are influenced by multiple interacting factors. Therefore, rather than tailoring dental education exclusively according to learning preferences, greater emphasis should be placed on strengthening faculty development in multimodal and integrated teaching approaches within dental schools.

Limitations

Several limitations of this study should be acknowledged. First, the cross-sectional design limits the ability to draw causal conclusions. Although differences in DREEM scores were observed across academic years, it is not possible to determine whether these differences reflect true longitudinal changes or cohort-specific effects. Longitudinal studies following the same group of students throughout their education would provide more robust evidence regarding changes in educational environment perception over time.

Second, although students from multiple universities were included, participation across institutions was not evenly distributed. This limits the generalizability of the findings and suggests that institutional comparisons should be interpreted with caution. In addition, the study relied on self-reported measures, which may be influenced by temporary emotional states or social desirability bias. This limitation is particularly relevant for constructs such as academic self-perception.

Finally, the study did not assess several external variables that may influence students' perceptions, such as socioeconomic status, financial stress, peer relationships, or objective institutional characteristics (e.g., number of faculty members, clinical workload, or access to resources). Moreover, while the VARK instrument provides insight into learning preferences, it does not assess actual learning effectiveness. Therefore, the observed association between kinesthetic learning style and DREEM scores should be interpreted as reflecting perceived compatibility with the educational environment rather than superior academic performance.

CONCLUSION

This study highlights that students' perceptions of the educational environment decline notably during the preclinical–clinical transition, emphasizing the third academic year as a critical period requiring targeted educational support. The strong link between learning environment and academic self-perception, together with the positive role of kinesthetic learning, underscores the need for student-centered, practice-oriented, and psychologically supportive educational strategies. These findings suggest that dental curricula should be restructured to include earlier academic mentoring, enhanced clinical preparedness, and more interactive teaching approaches, particularly during preclinical years. Addressing these factors proactively may not only improve students' educational satisfaction but also contribute to the development of more confident, resilient, and professionally competent future dentists.

References

1. Lee S. Educational Implications of VARK Learning Styles: Academic Performance and Pedagogical Preferences among Korean Pharmacy Students. *Indian J Pharm Educ Res.* 2025;59(2):512-7.
2. Shafer F, Almisari M, Alhabshi N, Al-Amoodi H, Abdulghani MA. Preference for Unimodal Learning Among Dental Students: Insights from the VARK Learning Style Model. A Cross-Sectional Study. *Yemeni J Med Sci* 2025;19(2).
3. Castro-Rodríguez Y. Student perceptions of the educational environment in the dental context. *Odontoestomatología.* 2025;27(46).
4. Kolcu G, Alkış M, Kolcu MİB, Ezberci S. Diş Hekimliği Eğitiminde Eğitim Ortamının Değerlendirilmesi Evaluation of the Educational Environment in Dentistry Education.
5. Glenn D. Matching teaching style to learning style may not help students. *Chron High Educ.* 2009:1-3.
6. Rogowsky BA, Calhoun BM, Tallal P. Matching learning style to instructional method: Effects on comprehension. *Journal of educational psychology.* 2015;107(1):64.
7. Rogowsky BA, Calhoun BM, Tallal P. Providing instruction based on students' learning style preferences does not improve learning. *Front Psychol.* 2020;11:511773. doi: 10.3389/fpsyg.2020.00164.
8. Ferrer-Valdivia N, Herrera-Barraza V, Garrido-Urrutia C. Learning Styles in undergraduate dentistry students: A systematic review. *Jpn Dent Sci Rev.* 2025;61:79-89. doi: 10.1016/j.jdsr.2025.03.004.
9. Roff S, McAleer S, Harden RM, Al-Qahtani M, Ahmed AU, Deza H, et al. Development and validation of the Dundee ready education environment measure (DREEM). *Med Teach.* 1997;19(4):295-9.
10. Sezer B, Teker GT, Sezer TA, Elçin M. Dundee Mevcut Eğitim Ortamı Değerlendirme Ölçeği (DREEM-TR): Türkçe Uyarlama Çalışması. *Tıp Eğitimi Dünyası.* 2019;18(56):16-29.
11. Ekici G. Akademik Öz-Yeterlik Ölçeği: Türçeye Uyarlama, Geçerlik Ve Güvenirlik Çalışması. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi.*43(43).
12. Fleming N, Mills C. VARK: A guide to learning styles. Retrieved November. 2001;30:2004.
13. Aksu S, Erturk-Avunduk AT, Delikan E, Buldur B. Metaphorical perceptions of dental students toward dental education: a cross-sectional study from Türkiye. *BMC Med Educ.* 2025;25(1):440.

14. Mustafa SS, Felefel W, Ibrahim SH. Evaluation of the dental educational environment in upper Egypt using the DREEM tool: a cross-sectional study. *BMC Med Educ.* 2026;26(1):102. doi:10.1186/s12909-025-08340-y.
15. Uzun S, Altındağ Ö, Altındağ A. Evaluation of the quality of life of dentistry students with a survey study. *Adnan Menderes Üniversitesi Sağlık Bilimleri Fakültesi Dergisi.* 2025;9(3):299-308. doi:10.46237/amusbfd.1483850.
16. Alzahem A, Van der Molen H, Alaujan A, Schmidt H, Zamakhshary M. Stress amongst dental students: a systematic review. *Eur J Dent Educ.* 2011;15(1):8-18. doi:10.1111/j.1600-0579.2010.00640.x.
17. Basudan S, Binanzan N, Alhassan A. Depression, anxiety and stress in dental students. *Int J Med Educ* 2017;8:179. doi: 10.5116/ijme.5910.b961.
18. Lugassy D, Ben-Izhack G, Zissu S, Shitrit Lahav R, Rosner O, Elzami R, et al. Anxiety, stress, and depression levels among dental students: gender, age, and stage of dental education related. *Psychol Health Med.* 2025;30(7):1394-408. doi: 10.1080/13548506.2025.2476085.
19. Hosseini SM, Amery H, Emadzadeh A, Babazadeh S. Dental students' educational achievement in relation to their learning styles: a cross-sectional study in Iran. *Glob J Health Sci.* 2015;7(5):152.
20. Lizzio A, Wilson K, Simons R. University students' perceptions of the learning environment and academic outcomes: implications for theory and practice. *Stud High Educ.* 2002;27(1):27-52.
21. Ihm JJ, Lee G, Kim KK, Jang KT, Jin BH. Who succeeds at dental school? Factors predicting students' academic performance in a dental school in Republic of Korea. *J Dent Educ* 2013;77(12):1616-23. PMID: 24319133.
22. Türker Ü, Somoğlu MB, Koç M, Bostancı Ö. Psychometric properties of the Turkish version of the VARK learning style inventory for athletes. *BMC Sports Sci Med Rehabil.* 2026. doi:10.1186/s13102-026-01529-8.
23. Ahmed SZ, Deraney PM, Sadaf SA, Siddiqui IA, Madi M, AlHumaid J. Active Learning Strategies for Improving Dental Students' Skills in Preclinical Restorative Dentistry. *Eur J Dent* 2025.
24. Alam BF, Anwar M, Nayab T, Zaidi SAA, Hussain T, Uzunçubuk H, et al. Team-based learning or problem-based learning: which is the best learner-centered approach for undergraduate dental students? *AME Med J* 2026;11.
25. Muktiadji H, Degeng INS, Setyosari P, Kuswandi D, Haq AS. The Effect of Flipped Classroom Model and Learning Styles on Improving Students' Conceptual Understanding: An Experimental Study. *J Ekon Pendidik Kewirausahaan* 2026;14(1):1-24.
26. Baiju R. Teaching and Learning in Dentistry: The Current Paradigm. *The Dental Teacher: A Reference Guide to Instructional Strategies and Evaluation Principles.* 2026:1-8. doi:10.1007/978-3-032-07551-2_1.
27. Pourhoseingholi MA, Baghestani AR, Vahedi M. How to control confounding effects by statistical analysis. *Gastroenterol Hepatol Bed Bench.* 2012;5(2):79. PMID: 24834204.
28. Tabachnick B, Fidell L. *Using multivariate statistics (7th -d.).* Published online. 2019.
29. Baherimoghadam T, Naseri N, Tabesh A, Hamedani S, Mousavi SF. The influence of learning styles on the efficacy of flipped classroom in dental education. *BMC Med Educ.* 2025;25(1):1385. doi: 10.1186/s12909-025-07916-y.