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ORIGINAL RESEARCH

Learning style preferences of dental students at a single institution in Riyadh, Saudi Arabia, evaluated using the VARK questionnaire

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Background: Students differ in their preferred methods of acquiring, processing, and recalling new information. The aim of this study was to investigate the learning style preferences of undergraduate dental students and examine the influence of gender, Grade Point Average (GPA), and academic year levels on these preferences.

Methods: The Arabic version of the visual, aural, read/write, and kinesthetic (VARK) questionnaire was administered to 491 students from the first- to the fifth-year academic classes at the College of Dentistry, King Saud University. Descriptive statistics were used to characterize the learning styles of the students, and Chi-square test and Fisher's test were used to compare the learning preferences between genders and among academic years. Significance was set at a p-value of <0.05.

Results: A total of 368 dental students completed the questionnaire. The multimodal learning style was preferred by 63.04% of the respondents, with the remaining 36% having a unimodal style preference. The aural (A) and the kinesthetic (K) styles were the most preferred unimodal styles. The most common style overall was the quadmodal (VARK) style with 23.64% having this preference. These differences did not reach statistical significance (p>0.05). Females were more likely to prefer a bimodal learning style over a unimodal style (relative risk =2.37). Students with a GPA of "C" were less likely to have a bimodal or a quadmodal style preference compared to students with a GPA of "A" (relative risk =0.34 and 0.36, respectively). Second-year students were less likely to prefer a bimodal over a unimodal style compared to first-year students (relative risk =0.34).

Conclusion: The quadmodal VARK style is the preferred learning method chosen by dental students, followed by unimodal aural and kinesthetic styles. Gender was found to influence learning style preferences. Students with a "C" GPA tend to prefer unimodal learning style preferences. The VARK questionnaire is a relatively quick and simple tool to reveal the learning style preferences on an individual or a group level. Dental educators should adjust their delivery methods to approximate the learning preferences of their students. Dental students are encouraged to adapt a multimodal style of learning to improve their academic results.

Keywords: VARK, learning styles, dental students, gender, learning preferences

Introduction

Measurable differences have been described in the manner in which learners prefer to acquire, analyze, and recall new knowledge.[1–3] The unique learning preference of an individual, including the strategies used to interact with information, describes the individual's learning style.[4] It has been argued that being aware of these differences in learning styles allows teachers to adjust their methods to better match the preferences

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of their students, which will increase learning effectiveness and efficiency.[4,5] On the learner's side, identifying one's learning style preference may result in decisions that improve the outcomes of their learning in addition to increasing student satisfaction toward educational process.[4,6,7]

Over the past four decades, numerous models have been developed to characterize learning style preferences in pedagogics.[3,8,9] One of the more commonly used models to categorize instructional preferences is Neil Fleming's VARK model, which classifies the learning preferences based on the sensory pathways into four modes: visual (V), aural (A), read/write (R), and kinesthetic (K).[10,11] A visual (V) learner prefers the use of charts, diagrams, and other forms of illustrative imaging to acquire information. An auditory (A) learner prefers the spoken word through lectures, podcasts, and oral discussions as the means of learning. The read/write (R) preference is when the acquisition of new information is done through the printed word via books and handouts, and tables and lists, and using writing to record and recall new information. A kinesthetic (K) learner prefers to experience or participate in a physical activity in order to learn. This can involve field training, workshops, role playing, and other modalities and is considered a combination of sensory learning pathways. A learner's style preference can be singular with one main preferred modality, bimodal with two preferences, trimodal with three, or quadmodal with the preference including of all four types. As a tool to evaluate learning style preferences, the VARK questionnaire has achieved widespread use among different study populations in undergraduate and postgraduate settings. This is due to its simplicity, relative ease of implementation, good reliability, and validity.[12,13]

In the realm of dental education, instruction relies heavily on a mixture of didactic and practical components, which engages learners through a combination of sensory inputs. This complex nature of dental education underlines the importance of knowing what preferences might exist among dentists-in-training, and what are the characteristics of these preferences. The knowledge of these preferences may potentially increase the efficiency of dental education process, which is known to be an expensive and a labor-intensive enterprise.[14] A study conducted at Temple University in the USA found a significant difference between dental student preferences when compared to the preference norms of a large sample extracted from the VARK website users.[15] In that study, they also found some differences in learning style preferences between different dental academic years. However, they did not investigate the relationship of learning style preferences with past academic performance, as measured by the Grade Point Average (GPA). A smaller study by Al-Saud investigated the learning preferences of first-year dental students in a single institution in Saudi Arabia, and found that 59% of the students had a multimodal preference, with the aural (A) modality being the most common preference among those who had a singular style preference.[16] It was also found that a significant difference in learning style preferences existed between students with low GPA when compared to students with a higher GPA, with the former having a preference for a unimodal learning style. However, the study was limited to only first-year dental students. Among dental students, the differences in learning style preferences and the effects of academic year level, gender, and GPA remain to be investigated. The aim of this study is to investigate the learning style preferences of dental students in a single academic institution using the VARK questionnaire, and examine the relationship between learning style preferences and gender, past academic performance, and academic year levels.

Methods

The study methodology was reviewed and approved by the College of Dentistry Research Centre (CDRC), King Saud University. A cross-sectional, questionnaire-based study was conducted at King Saud University, in Riyadh, Saudi Arabia. The Arabic version of the VARK questionnaire was administered to the first-, second-, third-, fourth-, and fifth-year undergraduate dental students at the College of Dentistry, King Saud University, with both female and male campuses being involved. Participation was voluntary, and the survey was distributed to a total of 491 students through emails, which included a description of the study, a consent page, and a link to the questionnaire on a website (www.surveymonkey.com). The completion of the questionnaire was considered as obtainment of informed consent. The questionnaire consists of 16 multiple-choice questions, each with four options. The students were requested to choose more than one option if more than one answer was applicable. The distribution of the VARK preferences was calculated according to the guidelines provided in the VARK website.[10] Accordingly, learning preferences were categorized as unimodal (V, A, R, or K), bimodal (VA, VR, VK, AR, AK, and RK), trimodal (VAR, VAK, VRK, and ARK), or quadmodal (VARK).

Statistical analysis

Data were analyzed using STATA 13 (StataCorp, College Station, TX, USA) statistical software. Descriptive statistics were used to describe the categorical study and outcome

variables in accordance with the guidelines given in the VARK website.[10] To determine the percentage of students for each VARK modality and for all possible combinations of modalities, the number of students who preferred each learning style modality was divided by the total number of students. Chi-square test and Fisher's test were used to compare the learning preferences between genders and among academic years and GPA levels. Then, three simple multinomial regression models were carried out. We used student characteristics as predictors to report the probability for preferences for each learning style compared to unimodal learning style. A p-value of <0.05 was used to report the statistical significance of results.

Results

A total of 368 students out of 491 completed the questionnaire, which represented a response rate of 75.1%. The distribution of the respondents is presented in Table 1. The gender distribution of the respondents was as follows: 73.1% male and 26.9% female. The majority of the sample were "C" students (38.6%), followed by "B" students (29%), "A" students (28.5%), and "D" students (3.8%). The distribution of the learning preferences of the respondents is demonstrated in Figure 1. About 63% of the total students described having a multimodal learning preference, with the bimodal, trimodal, and quadmodal being preferred by 20.91%, 18.48%, and 23.64% of the total, respectively, and the unimodal style of learning was the preference for 36.96% of the respondents. Those who had a unimodal preference preferred either an aural or a kinesthetic style of learning, followed by both visual and read/write learning styles as the least preferred methods. Among the bimodal learning styles, the AK (aural/kinesthetic) was the most preferred. Among the trimodal learning styles, the VAK (visual, aural, kinesthetic) was the most dominant (7.88%). The most preferred modality overall was the quadmodal style involving visual, auditory, read/write, and kinesthetic (VARK) method with 23.64% of the respondents having this preference.

The multinomial regression showed a statistically significant difference between genders with regard to preferred learning style. The distribution of learning style preferences among both genders is shown in Figure 2. Females had a higher probability of preferring a bimodal style compared to males (relative risk =2.37). Regarding the influence of GPA on VARK learning style preferences, "C" students had a lower probability to favor bimodal over unimodal style (relative risk =0.34) compared to "A" students. Moreover, "C" students had a lower probability to prefer quadmodal to unimodal style compared to their "A" peers (relative risk =0.36) (Figure 3).

The distribution of learning style preferences among the students of the five academic years of dental school is shown in Figure 4. Second-year students had a lower probability to prefer bimodal over unimodal style compared to first-year students (relative risk =0.34). No other significant differences were detected between academic years.

Table 1 Academic year and gender distribution of respondents

Participants	Frequency	Males	Females
First-year dental student	40	17	23
Second-year dental student	87	68	19
Third-year dental student	67	42	25
Fourth-year dental student	103	89	14
Fifth-year dental student	71	53	18
Total	368	269	99

Discussion

There is a relative abundance of studies looking at the different learning styles in variable fields of study such as medicine,[17,18] engineering,[19] nursing,[20] and allied health specialties.[21] Existing studies examining VARK learning preferences among dental students are few with some limitations. The objective of this study was to investigate the learning preferences of dental students in Saudi Arabia, while examining the effects of gender, GPA, and academic level on the learning style preferences.

All students included in this study finished the university preparatory year before starting the required five years of dental school. This allows for inclusion of GPA as an indicator for past academic performance. The participation in the study was voluntary, and the questionnaire was disseminated through email. The response to this study was much higher from the male students compared to the female counterparts. Since there are separate campuses for male and female students, differences in scheduling of classes and exams might have contributed to the disparity between male and female student participation.

More than half of the participants had a multimodal VARK learning preference, which is found to be typical in all adult learners, and is in agreement with previous learning style preference investigations of medical and dental students.[16,22,23] In this study, preferences for bimodal, trimodal, and quadmodal learning styles represented about equal proportions as the multimodal preference. Among the bimodal learning styles, AK was the most preferred, which is in agreement with Al-Saud's observation among the Saudi dental students. The type of unimodal learning style preference was also in

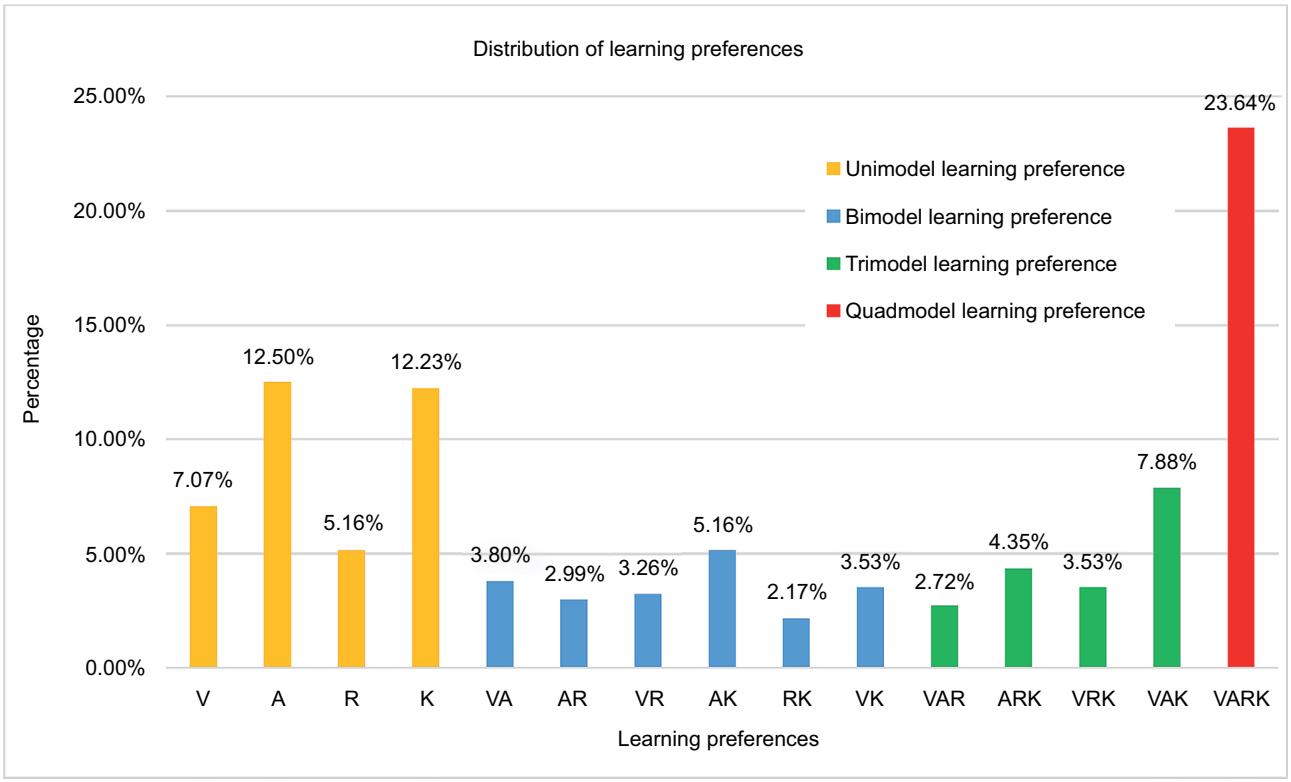

Figure 1 Overall distribution of VARK learning preferences among respondents.

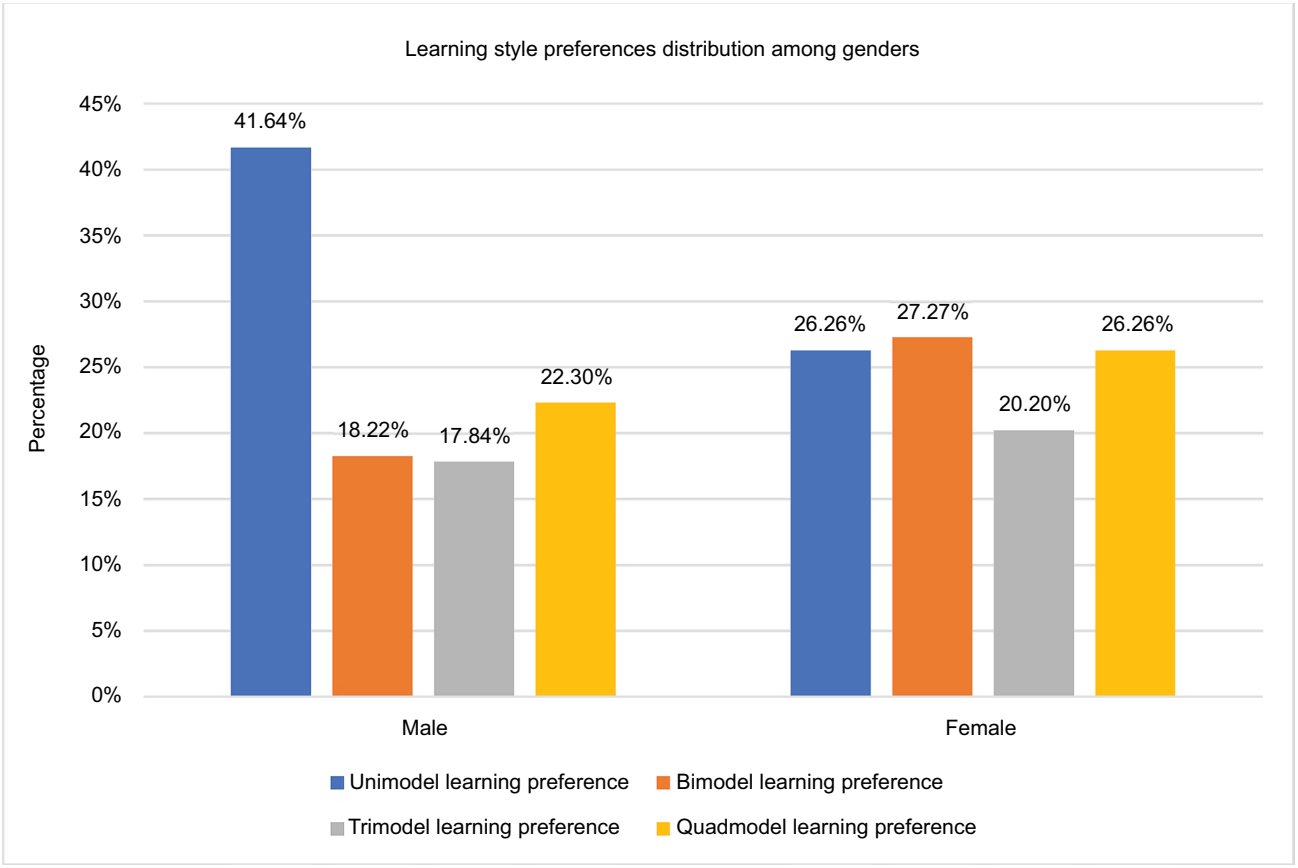

Figure 2 VARK learning style preferences distribution among genders.

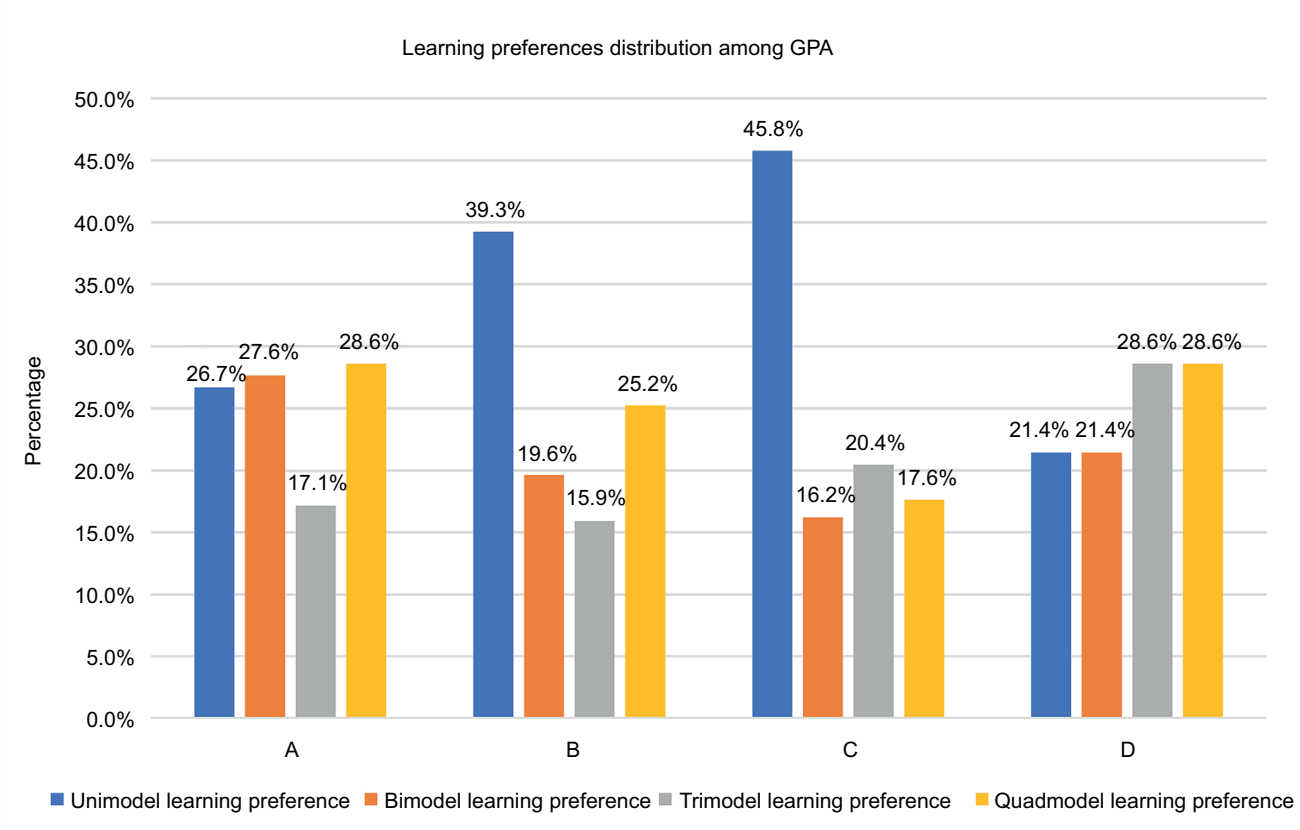

Figure 3 VARK learning style preferences distribution stratified according to GPA.
Abbreviation: GPA, Grade Point Average.

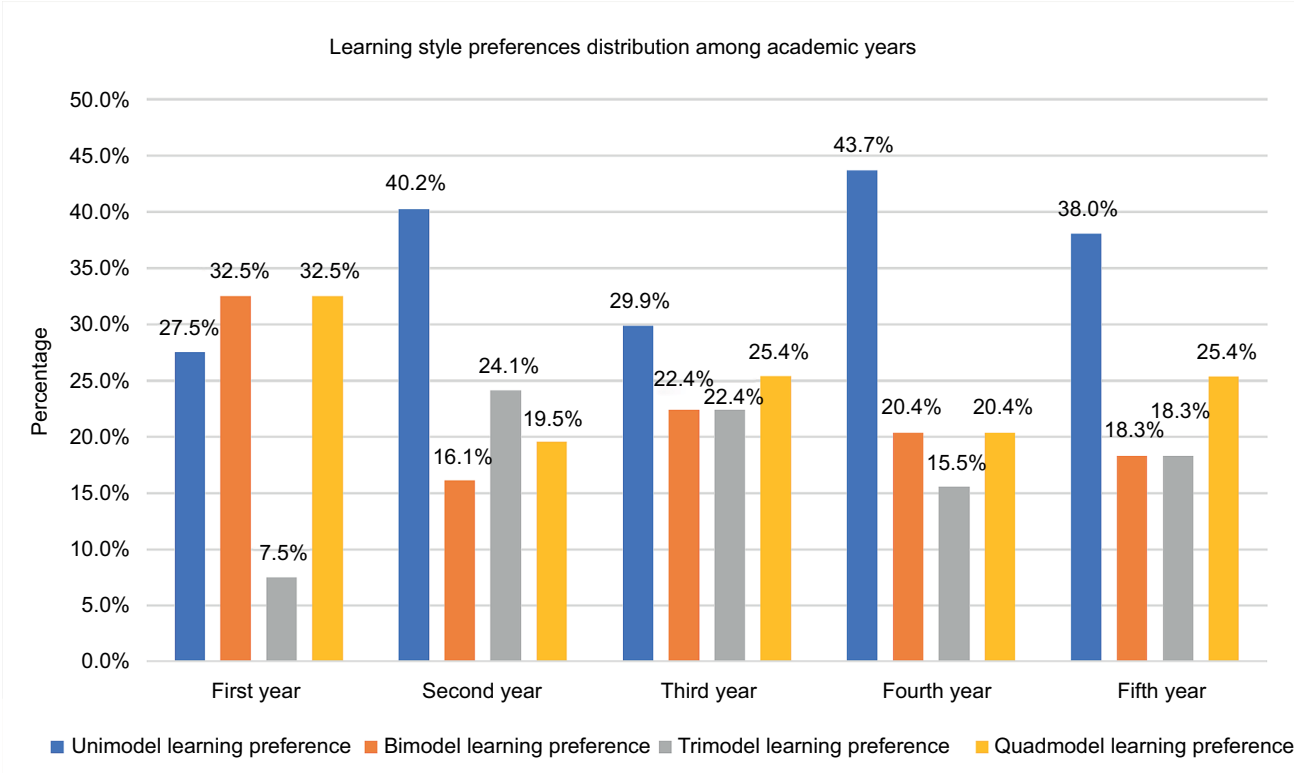

Figure 4 Learning style preferences according to academic year of study.

agreement with the Al-Saud's study, with the majority of the respondents' preferences being either aural (A) or kinesthetic (K). Among the trimodal learning styles, VAK was the most preferred, which is in contrast to the Al-Saud study which found the ARK modality to be the most preferred.

In terms of gender preferences, female dental students showed a significantly higher preference for bimodal learning styles compared to their male counterparts. This is in contrast to the conclusions of Murphy et al,[15] Al-Saud,[16] Nasiri et al,[22] and El Tantawi,[24] where no significant differences were observed between genders among dental students. This disparity with our finding may be attributed to the larger sample size in our study compared to the sample sizes of such similar studies. It is noteworthy, however, that among samples of Saudi medical students, a significant difference between genders in terms of learning styles preferences was present, with females showing a predilection toward a bimodal style of learning.[25,26] Female participants also showed a more equal distribution across the different VARK modalities when compared to males, as shown in Figure 2. Before joining the university, Saudi children undergo a 12-year school education that is gender segregated from elementary to secondary grades with different curriculums. This early and prolonged segregation could have led to differences in learning preferences that persist into the university levels. A study investigating the VARK learning style differences among schoolchildren in Saudi Arabia is needed to demonstrate this effect.

As dental students progress through multiple academic years in dental school, dental instruction shifts from a mainly didactic-focused teaching to the one with an increased reliance on practical and hands-on training in simulation labs and clinics, which may affect the dental students learning style preferences.[27] Comparing the learning preferences of different academic years may show how these preferences may change over time. In this study, it was found that second-year students were more likely to prefer a unimodal learning style compared to first-year students, but no other differences were detected between academic levels. This observation is similar to the one described by Murphy et al as no clear trend was found between the different dental academic levels. However, students in the first year were more variable in their VARK style preferences compared to the subsequent years, which could indicate the first year as where students are finding a preferred VARK style. Also noteworthy is the increase in the unimodal style preference as students move from third to fourth year in dental school. This does correlate with a distinctive shift in the format of dental instruction from the mixed didactic and clinical courses of the third year to the predominantly patient-based clinical courses in the fourth year, a shift that seems to be sustained in the following fifth and final year of dental program. The only longitudinal study investigating the changes in dental student learning preferences over the years was done by Hendricson et al which found that initial preferences mostly remained the same over time with no drastic shifts.[28] However, the study which was done in 1987 used a different learning style assessment tool than the VARK sensory pathway preference questionnaire. This demonstrates the need for a similar longitudinal study of dental students learning style shifts using the more modern VARK questionnaire.

Only 3.8% of the respondents had a GPA of "D", which led to any comparisons with other grades not reaching statistical significance. Students with a GPA of "C" demonstrated an increased preference for unimodal learning styles when compared to their classmates with the GPA of "A", who were more inclined to have bimodal and quadmodal preferences. This is similar to the observation from the Al-Saud's study and the study by Nuzhat et al[29] of medical students, which found multimodal learning to be associated with a higher GPA among the surveyed students. However, no such association was found among medical students in Almigbal's[25] and Paiboonsithiwong et al[17] studies. Similar to the medical curriculum, the dental curriculum also includes didactics but is traditionally much more centered on manual and practical proficiencies, areas where a multimodal learning style may position students with this preference at an advantage over other peers. This may indicate some possible benefit for students with less-than-satisfactory academic results to try to actively incorporate other sensory pathways of learning during their studies. This can be done by adding methods such as making diagrams during studying, transcribing the audio of lectures, etc., in a manner that ensures having a multimodal learning approach. Regarding the differences between dental and medical students, a study directly comparing medical and dental students learning style preferences and their relationships with student GPA is needed to reveal any differences.

This was a cross-sectional study with the sample limited to one dental institution. A multicentered survey, preferably in multiple countries of different cultural backgrounds, is recommended. Cultural background differences influence the way students prefer to learn, so a multiregional investigation would shed some light on any cultural effects extending into the dental student population.[30–32] This endeavor would yield a more accurate illustration of the features of learning style preferences of dental students and what factors may modify these preferences. Also, a longitudinal study following a

group of dental students from first year to last would be suited to detect any changes in learning style preferences over time, as the curriculum material changes from first year to last.

Conclusion

The majority of the dental student participants were found to have a multimodal learning style preference. Gender differences in the learning style preferences exist, with female dental students more likely to having a bimodal preference instead of a unimodal preference compared to their male counterparts. Students with a multimodal learning style tend to have achieved better academic results in the past. No significantly appreciable trend was found when comparing VARK style preferences between different academic years. Teachers should attempt to tailor their educational subject delivery to accommodate the styles of their students, especially those with a unimodal style of learning. On the learner's side, students with a unimodal learning style preference should try multimodal learning styles if their past academic performance was less than ideal.

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Disclosure

The authors report no conflicts of interest in this work.

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