Student Learning Preferences and Teaching Implications

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Abstract: One of the most serious challenges that dental educators face today is improving the level of student satisfaction with the curriculum and learning environment. To determine whether a particular teaching method might enhance student satisfaction with the learning process, a learning preference survey linked to sensory modalities was given to students in the four classes of the Temple University School of Dentistry. New Zealand educator Neil Fleming developed the survey called VARK (an acronym for Visual, Aural, Read/Write, and Kinesthetic) in 1998. The purpose of this study was to measure the distribution of learning preference mean scores of the dental students and note any significant differences among classes, gender, and a sample population determined using 31,243 participants on the VARK website. Results clearly demonstrate that the dominant preference distributions for the two populations (dental student and sample population) are different. In particular, the proportions of learners who selected visual or kinesthetic are significantly different for the two populations, while the proportions of learners who selected aural or read/write are not significantly different. Dental students prefer visual learning at a higher percentage and kinesthetic learning at a lower percentage than the sample population measured in the VARK website. Inter-class differences varied, and gender differences were not significant. The distribution of dental student scores shows a preference for instructors who use strong visual presentations and facilitate note-taking during lectures. Dental educators should be aware of these differences in order to explore opportunities for making the educational experience more productive and enjoyable.

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One of the most serious challenges that dental educators face today is improving the level of student satisfaction with the curriculum and learning environment. In predoctoral dental education, didactic and clinical training is condensed into four years or less. Little opportunity is given for students to acquire a sense of “connectedness” between biomedical science courses generally completed during their first two years and patient clinical experiences required for graduation. Although integration of science with clinical practice is a key objective of any dental curriculum, students often perceive that the mantra of survival in school is to pass the science courses by rote memorization and to discover the relevance of this material in actual practice.1

Bertolami has suggested that one of the focal points of student frustration with the curriculum is the disparity between learning (content) and the delivery of instruction (form).2 A substantial number of dental school students have a preference for several learning styles, yet dental faculty teach overwhelmingly in a single mode: the lecture. Lecturing is essentially a passive learning method that encourages rote memorization and note-taking as the means of assimilating knowledge.3 It is important for dental educators to recognize that students have different learning styles, to reflect on the effectiveness of their methods of instruction, and to consider accommodating other learning preference modalities.

On any given day in dental school, absenteeism from lecture can be a serious concern for dental faculty. Are these missing students uninterested in learning dentistry? Bertolami observed that many students eschew lecture and engage in self-directed learning, a practice typical of adult learners.2 Adult

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students are generally aware of their learning strengths and weaknesses, and want relevant, useful information presented in a way that is comfortable, intellectually challenging, and time efficient. In addition, they seek a collaborative learning process with their instructors.1

Educational researchers postulate that everyone has a learning style and, if instruction is adapted to accommodate that style, it is anticipated that improved learning will result.5,6 Keefe defines learning style as the “composite of characteristic cognitive, affective, and physiological characters that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment.”7 Reiff and Keefe note that a better understanding of learning styles by faculty can help reduce the students’ level of frustration and improve instructional delivery methods.7,8 Suskie suggests that instructors should attempt to alter their methods of teaching to give students with differing learning styles an opportunity to learn in an environment more conducive to their preferences.5

In their identification of the four stages of cognitive development, Bruner and Piaget describe how humans assimilate knowledge about their environment through four sensory modalities: visual (observing pictures, symbols, or diagrams), auditory (listening, discussing instructional material), visual/iconic (reading and writing), and kinesthetic (using tactile sensory abilities such as smell and touch).10,11 Evaluation of sensory preference has been incorporated into several learning styles and preference survey instruments.

While many educators agree that learning style or preference models make intuitive sense, few have been validated.1 One of the instruments used in assessing preferred learning methods, the Myers-Briggs Type Indicator (MBTI), has been demonstrated by researchers to have construct validity with well-known personality factor measurements,12 and has been employed in assessing dental student learning performance in previous research.13 One of the trait measures, sensing, describes how the mind collects and creates information using the five senses. New Zealand educator Neil Fleming created the VARK survey in 1998 to assess learning style preferences corresponding to the MBTI measures for sensing.

VARK is an acronym for Visual, Aural, Read/Write, and Kinesthetic.14 Visual learners prefer the use of diagrams and symbolic devices such as graphs, flow charts, hierarchies, models, and arrows that represent printed information. They may also explain a concept to others by drawing a diagram or picture. Visual learning is broken into a second category called Read/Write. Read/Write learners prefer printed words and text as a means of information intake. They prefer lists, glossaries, textbooks, lecture notes, or handouts. These learners prefer to arrange lecture notes into outlines, paraphrase classroom notes, and study old multiple choice exams.

Aural learners concentrate on what lecturers say. They would prefer to listen rather than take notes. After lecture, they may choose to discuss presented topics with classmates as a means to clarify their understanding. To aid their studying, aural learners may talk out their answers or listen to taped discussions about exam topics.

Although it is measured in VARK as a separate category, kinesthetic learning is a multimodal measurement employing a combination of sensory functions. Kinesthetic preference refers to learning achieved through the use of experience and practice. In other words, the kinesthetic learner has to feel or live the experience in order to learn it. In dental school, kinesthetic learning may be achieved through preclinical laboratory simulation or clinical instruction.

Sensory modality measurements have been included in previously validated learning preference instruments, but have not been statistically validated as stand-alone measurements.14 Fleming states that the goal of instruments like VARK is to be a catalyst for dialogue between students and educators.14,15 The instruments are quick and easy for students to use and understand, and ensuing discussions about survey results may help create a sense of self-awareness for the student as to how he or she learns best and a motivation to seek out the best methods to improve learning performance. Suskie urges students and educators to be wary of the predictive ability of learning style inventory measurements and cautions that while sensory preferences are useful as a launching point for inquiry, they should not be used as the sole source of information for creating learning improvement.

The VARK, a learning preference survey linked to sensory modalities, was given to students in the four classes of the Temple University School of Dentistry. The purpose of this study was to measure the distribution of learning preference mean scores, note any significant differences between the classes, compare results based on gender, and determine whether
a particular teaching method might enhance student comfort with the learning process. Once a baseline measurement was established, the knowledge acquired could act as a catalyst to initiate collaborative discussions between students and faculty to improve learning processes. It should again be noted that a learner’s comfort level with a particular teaching method might not necessarily lead to enhanced academic performance. Did students display strong, single preferences, or were they comfortable with the multiple modalities typical of most adult learners? How were current teaching methods congruent with expressed learning preferences?

**Methods**

In March 2003, the VARK survey was sent electronically to the entire predoctoral student body of the Temple University School of Dentistry (498 students, mean age 23.5 years). An attachment provided a cover letter explaining the purpose of the survey, as well as supplemental reference materials suggesting optimal study strategies based on the learning preference scores. Completed surveys were returned to an electronic site where results could be stored, tabulated, and classified. After three weeks of the electronic mailing, the response rate was only 15 percent. To increase response rate, a paper version of the VARK survey was distributed directly to students attending lecture and preclinical laboratory sessions. Instructors granted permission for the surveyor to explain the purpose of the survey before distribution, and surveys were collected as students exited the sessions. Duplicate responses were checked and removed. This method change increased the collection rate to 46.2 percent (n = 228).

The VARK survey instrument was selected because it is concise and quick to complete and it provides useful information for the student about his or her learning preferences. The survey is comprised of thirteen multiple-choice questions with three or four answer selections corresponding to the four sensory modalities. The questionnaire is designed to provide information about learning preferences that may be useful to both students and educators. Once provided with knowledge of their preferences, students may wish to employ learning techniques that coincide with these choices. Questionnaire results may also provide educators with insight into using alternate lesson delivery strategies that may appeal to a particular audience or to a wider spectrum of learning preferences and possibly increase student satisfaction with course content.

Student questionnaires were scored and tabulated to determine the distribution of VARK preferences. Preference rankings were calculated by totaling all A responses (visual), all B responses (aural), all C responses (read/write), and all D responses (kinesthetic). Each category was equally weighted, and dominant preference was defined by determining which category received the most responses. Scoring was further refined using the stepping-stone method detailed in the website (instructions provided at www.vark-learn.com). Mean scores with standard deviations were calculated for each VARK component on the basis of class and gender. Inter-class means were compared for statistical significance using the Student t-test. A chi-square test for independence was performed to determine whether an association exists between the two categorical variables of class and learning preferences.

The distribution of dental student responses for dominant and multimodal preferences was compared to the composite data on the VARK website database consisting of 31,243 participants (cited 12/30/2003). Using the Fisher’s exact test and the chi-square test, comparisons were made between 100 dental students and 13,122 subjects in the VARK database, all displaying a single dominant learning preference. Additional comparisons were performed regarding the total distribution of learning preferences for the entire dental student body and the VARK website respondents, using the chi-square test.

**Results**

For each of the thirteen questions, a respondent could select anywhere from zero to four response choices. Four of the thirteen questions have three response choices, and the others have four each. Conceivably, if the respondent felt all the answers were correct, a total of forty-eight responses could be recorded. VARK mean scores for options selected by dental students showed that read/write and visual preferences ranked highest (4.1 and 4.0 mean scores per respondent respectively), followed by aural (3.2) and kinesthetic (1.7) preferences.

Inter- and intra-class mean score differences based on gender were not statistically significant. Using a cutoff p-value = 0.05, based on the Student
t-test, inter-class comparisons of the preference mean scores showed no statistically significant differences except in two instances (see Table 1):
1. There is a significant difference between the mean aural scores of the freshman and sophomore classes (p-value = 0.033).
2. There is a significant difference between the mean read/write scores of the freshmen and seniors (p-value = 0.045).

Scores for each individual respondent were evaluated for dominant or multimodal preference using the stepping-stone method. Dental student learning preferences reflected multimodal patterns typical of adult learners. Forty-four percent of the students (n = 100) surveyed showed a single dominant learning preference. The remaining 56 percent of the students (n = 128) displayed multimodal preferences (bimodal preference strength or greater, no single dominant style). This compares very closely to the 42/58 percent distribution (single/multimodal) Fleming has compiled of 31,243 entries in his VARK website database.14 (See Table 2.)

A further comparison was made of the distribution of single dominant preference dental students with the sample population included in the VARK website. Of the 31,243 respondents compiled in the database, 83.8 percent (26,194) were involved in education either as students or teachers, and 80 percent (20,903) of the respondents were either university students or teachers. The website does not distinguish between university and non-university teachers; however, the total number of teacher respondents for the website equaled 5,673. The distribution of university respondents, based upon academic disciplines, was evenly distributed among business, education, social science, basic science, and applied science majors. The database did not distinguish graduate from undergraduate learners, nor did it distinguish between those students who may have been attending professional schools.

The 100 dental students with a single dominant preference appeared to have a much higher percentage of visual learners and a much lower percentage of kinesthetic learners than the 31,243 respondents included in the VARK database. A chi-square test of independence was performed to determine whether the distributions came from statistically different populations. (See Table 3.)

Kinesthetic preference for the dental student sample has a reported value of one. To avoid unnecessary approximations for this case, the visual, aural, and read/write responses were combined under Others, resulting in the 2x2 contingency table shown as Table 4.

### Table 1. Dental students inter-class mean VARK scores (approximate class size 125)

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshman</td>
<td>77</td>
<td>3.8</td>
<td>1.4</td>
<td>3.0</td>
<td>1.6</td>
<td>4.4</td>
<td>1.6</td>
<td>1.8</td>
<td>1.1</td>
</tr>
<tr>
<td>Sophomore</td>
<td>64</td>
<td>4.0</td>
<td>1.3</td>
<td>3.6</td>
<td>1.7</td>
<td>3.9</td>
<td>1.7</td>
<td>1.5</td>
<td>1.2</td>
</tr>
<tr>
<td>Junior</td>
<td>43</td>
<td>4.0</td>
<td>1.6</td>
<td>3.0</td>
<td>1.9</td>
<td>4.2</td>
<td>1.9</td>
<td>1.7</td>
<td>1.1</td>
</tr>
<tr>
<td>Senior</td>
<td>44</td>
<td>4.1</td>
<td>1.4</td>
<td>3.3</td>
<td>1.5</td>
<td>3.8</td>
<td>1.5</td>
<td>1.8</td>
<td>1.2</td>
</tr>
<tr>
<td>Totals</td>
<td>228</td>
<td>4.0</td>
<td>1.4</td>
<td>3.2</td>
<td>3.2</td>
<td>4.1</td>
<td>1.7</td>
<td>1.7</td>
<td>1.2</td>
</tr>
</tbody>
</table>

### Table 2. Sample distribution of single dominant learning preference as a percentage of the total sample population: dental students v. VARK website composite

<table>
<thead>
<tr>
<th>Dominant Preference</th>
<th>Dental Students N = 228</th>
<th>VARK Website N = 31,243</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominant Subgroup</td>
<td>n = 100</td>
<td>n = 13,122*</td>
</tr>
<tr>
<td>Visual</td>
<td>14.5 percent</td>
<td>3 percent</td>
</tr>
<tr>
<td>Aural</td>
<td>9.2 percent</td>
<td>5 percent</td>
</tr>
<tr>
<td>Read/Write</td>
<td>20.1 percent</td>
<td>16 percent</td>
</tr>
<tr>
<td>Kinesthetic</td>
<td>0.4 percent</td>
<td>18 percent</td>
</tr>
<tr>
<td>Totals</td>
<td>100 percent</td>
<td>100 percent</td>
</tr>
</tbody>
</table>

Applying the Fisher’s exact test results in a p-value = 7 x 10^{-23} implies that the preference of dental student learners for kinesthetic is significantly different with respect to the kinesthetic learners included in the VARK website database. Analyzing only the preferences for visual, aural, and read/write responses (combined under Others) results in the contingency table shown as Table 5.

Using the chi-square test results in a p-value = 3 x 10^{-9} implies that the preferences of dental student learners for visual, aural, and read/write are significantly different from those of the learners included in the VARK website database. Restricting the analysis to aural and read/write results in the contingency table shown as Table 6.

Using the chi-square test results in a p-value = 0.218 implies that the preferences of dental student learners for aural and read/write are not significantly different from the preferences of the learners included in the VARK website database.

These results clearly demonstrate that the dominant preference distributions for the two populations (dental student and VARK website) are significantly different. In particular, the proportions of learners who selected visual or kinesthetic are significantly different for the two populations, while the proportions of learners who selected aural or read/write are not significantly different for the two. For single dominant preference learners, dental students prefer visual learning at a higher percentage and kinesthetic learning at a lower percentage than the sample population measured in the VARK website. (See Table 7.)

Using the chi-square test, a p-value = 2 x 10^{-141} is obtained, also suggesting that the two populations are significantly different. Moreover, following the steps described above, we conclude that the proportions of learning preferences by the dental students were significantly different with respect to the proportions of learning preferences of the VARK website participants. (See Table 8.)

A chi-square test for independence was performed to determine whether an association existed between class designation and the categorical variables of single dominant and multimodal learning preferences. The null hypothesis could not be rejected (p-value = 0.66). No association appeared to exist between class designation and the number of students having a single dominant learning preference. Similarly, the null hypothesis could not be rejected when comparing class designation and the distribution of dominant and multimodal learning preferences in the entire student body (p-value = 0.145).

**Discussion**

Based on these findings, dental students appear to distinguish themselves from other populations by having a stronger visual learning preference. This preference, coupled with strong read/write preference scores, would suggest that the lecture presentation...
highlighted with pictures, diagrams, PowerPoint presentations, handouts, or guided notes would satisfy the needs of most dental students. Interactive, nonlinear, electronic curricula might be utilized as an adjunct for the self-directed learner.

The findings do pose possibilities for further inquiry. As the dental curriculum shifts from primarily lectures in the freshman and sophomore years to clinical training for juniors and seniors, do preferences change for some students to accommodate a new learning environment? A past longitudinal study, using a nonsensory-based inventory, showed no change. Meta analysis of learning style applications in higher education, however, indicates that preferences may shift if a student perceives this as necessary to master the learning objectives. A longitudinal study tracking incoming dental students’ sensory-based learning preference scores and continuing throughout their stay in dental school may provide an indication of possible shifts in learning preferences over the course of the four years. First-year students may find the need to accommodate aural and kinesthetic skills as they enter the second year when they tackle more challenging manual skill projects in preclinical dentistry. Schematic workbooks may be available, but may not provide adequate information to address the nuances of clinical dentistry. Receiving the maximum benefit of instruction from preclinical professors may require the student to develop better listening skills. Senior students spend considerably less time in lecture and more time in clinical encounters. To develop competency, senior students often seek verbal instruction from clinical faculty. In the dental operatory, students may not always be in a position to take notes or study diagrams with the instructor. Listening to detailed oral explanations may be the only practical mode of learning available in the patient care setting.

Not all educators agree that matching teaching methods to a preference or style improves learning. Some researchers have suggested that the strongly preferred mode may not always be the best way to learn, depending on particular circumstances. Grasha and Stellwagen indicate that the indiscriminate use of learning style inventories may result in students thinking that they are linked to one particular style or group of styles. This undue focus may obscure the understanding that learning style evolves over one’s life and one’s academic/professional career. Students may need to adapt to learning modalities differing from their preferences because of real life environmental constraints. The need to learn under pressure may cause the student to realize that he or she may be equally comfortable using other learning modalities. In the first two years of the curriculum, dental students and faculty may prefer visual and read/write delivery styles to convey necessary foundation knowledge, but may need to develop aural styles to perform more effectively in the clinical portion of the curriculum. Grasha suggests that some faculty introduce different modes of instructional delivery to acknowledge the diversity of the learners that they teach. This may be especially critical in reaching out to self-directed learners who may be expressing frustration with current methods of instruction by not attending lectures. The sensory template of a lecture presentation may be augmented by introducing an audience participation segment where theory may be brought to life by coaching students through a simulated clinic situation.

### Table 7. Comparison of preference response distribution on the VARK survey: dental students v. VARK website composite

<table>
<thead>
<tr>
<th></th>
<th>Visual</th>
<th>Aural</th>
<th>Read/Write</th>
<th>Kinesthetic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental Students</td>
<td>1,011</td>
<td>770</td>
<td>938</td>
<td>343</td>
<td>3,062</td>
</tr>
<tr>
<td>VARK Website</td>
<td>14,356</td>
<td>15,710</td>
<td>20,080</td>
<td>22,336</td>
<td>72,482</td>
</tr>
<tr>
<td>Totals</td>
<td>15,367</td>
<td>16,480</td>
<td>21,018</td>
<td>22,679</td>
<td>75,544</td>
</tr>
</tbody>
</table>

### Table 8. Percentage comparison of visual/kinesthetic preferences

<table>
<thead>
<tr>
<th>Sample Group</th>
<th>Visual</th>
<th>Kinesthetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental Students</td>
<td>31 percent</td>
<td>13 percent</td>
</tr>
<tr>
<td>VARK Website</td>
<td>20 percent</td>
<td>31 percent</td>
</tr>
</tbody>
</table>
Conclusion

The distribution of dental student scores for both multimodal and single dominant learning preferences shows a preference for instructors who use strong visual presentations and facilitate note-taking during lectures. However, there is a small, but significant number of dental students who prefer to learn by listening or doing. While dominant preference aural learners may appreciate lectures, they also enjoy in-class discussion and case studies to understand the material better and relate to its relevance. More student opportunities to participate actively in lecture or preclinical demonstrations, with the instructor playing the role of coach, will appeal to the kinesthetic learner. Some dental students may undergo a shift in learning preferences as the learning environment changes from lecture hall to preclinical laboratory to patient clinic. Educators should be aware of these differences in order to accommodate or at least explore the possibilities of improving opportunities for aural and kinesthetic learners. Academicians should also recognize that many students are engaged in a high level of self-directed learning, demonstrating a need for more interactive, electronic instructional media. They may misconstrue poor lecture attendance as lack of interest in the instructional material or even disrespect. Faculty should temper these feelings by making an attempt to understand why students want to learn in different ways. The simple gesture of an instructor asking a student “How would you like me to teach you?” may lead to a meaningful discussion of new ways to create a deeper level of learning.

The purpose of introducing the VARK survey is to provide a vehicle for self-knowledge and to explore opportunities for making the dental educational experience both more productive and enjoyable for students and faculty members.

REFERENCES