

# U.S. Dental Students' and Faculty Members' Attitudes About Technology, Instructional Strategies, Student Diversity, and School Duration: A Comparative Study

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*Abstract:* In this study, attitudes and perceptions of U.S. dental students and faculty members were evaluated regarding four aspects of dental education: technology integration, instructional strategies, student diversity, and school duration. A survey instrument with eight statements using a five-point Likert scale and a free-text comment section was developed and distributed through SurveyMonkey. A total of 426 students and 187 faculty members from ten U.S. dental schools participated, a response rate of 17 percent of those surveyed. Faculty and student responses were compared using the Mann-Whitney U test. The results of this analytic procedure revealed that the groups differed in their average responses for seven of the eight statements. Analysis of the faculty and student comments revealed similar themes between the two groups. Both dental students and dental faculty members stated that technology integration should be viewed as only a supplement to conventional instruction and showed mixed opinions about electronic textbooks. Further, both groups had positive views of the roles of problem-based learning, community service, and the integration of research practice into dental education. Both groups also valued diversity in the student body and supported the current four-year duration of dental school.

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Changes in the dental field and the emergence of new ideas, approaches, and educational models require continuous evaluation of the applicability of new research-based practices to the field of dental education. Some of these changes include technology integration, including the use of electronic textbooks, problem-based learning, increased community-based learning, and increased call for diversity in the dental student body. Understanding and meeting the needs of dental students are of critical importance to recruitment and retention. However, these needs must be tempered by the vision, perspective, and expertise of leaders in the field, whose responsibility it is to prepare dental professionals who have the expertise needed for success. Therefore, it is important to investigate the degree to which faculty members (as leaders in the field) and students (as trainees and future leaders in the field)

agree on the future directions of U.S. dental education and whether there are significant differences between the two groups.

New developments in dental education include the integration of technological advancements into instruction and dental practice. Students now have access to electronic dental and basic science textbooks and can use their laptops in the classroom.<sup>1</sup> The library used by dental students, often the VitalSource Bookshelf, consists of textbooks that dental students need throughout their education. The high cost of this digital library is a disadvantage; in addition, not all students want to study at a computer monitor for hours. In contrast to students, however, faculty perceptions are unknown, and researchers have called for further investigation of this topic.<sup>2</sup>

Problem-based learning (PBL) is another trend being slowly incorporated into dental education.

Fincham and Shuler<sup>3</sup> presented the three “prime directives” of PBL as follows: the learning program is student-centered, occurs in small groups, and is organized around “problems” or cases for study. In medical education, where PBL is extensively practiced, it has been argued that medical students have a greater preference for PBL than do dental students;<sup>4</sup> however, one study reported that PBL was viewed positively by dental students.<sup>3</sup> Marshall et al.<sup>5</sup> found that PBL improved students’ performance following instructional changes in their curriculum. A study at Harvard School of Dental Medicine<sup>6</sup> found that PBL enhanced graduates’ abilities in “independent learning, communication, and cooperation skills.” Perhaps most importantly, research on the effects of PBL have revealed further advantages for students by significantly increasing National Board Dental Examination Part I scores, graduation rates, and acceptance into postdoctoral programs.<sup>7</sup> Taken together, these findings support potential positive change in “measurable outcomes” for dental education.

In addition to PBL, another important new trend in dental education is more community-based dental education, a form of clinical education in which students provide care for patients in community clinics and then are often guided through a reflective process. According to Strauss et al., fieldwork and course-related examples are drawn from community-based dental experiences to illustrate how reflective teaching approaches can enhance student learning.<sup>8</sup> Formicola and Bailit<sup>9</sup> expect that community-based dental education will become a core part of the clinical education of all dental students in the future.

Diversity in dental schools is another rapidly evolving topic reflecting the diverse U.S. population, students, faculty, dental practitioners, patients, and others in the dental field. There has been a sig-

nificant demand to increase diversity among dental professionals, and it appears that student and faculty attitudes toward these changes are unknown.

Regardless of the topic, recent trends in educational practice more broadly are leading dental professionals to wonder how these practices might enhance the educational experience for current and future dental students and faculty. Thus, educators need information on dental students and faculty members’ attitudes about these trends. More importantly, however, what remains to be understood is whether students and faculty members agree on the current and future directions of dental education in the United States and how this information might be used to improve the educational experience for students in particular. Therefore, the aim of this study was to evaluate the degree of convergence in the attitudes and perceptions of dental students and faculty members toward technology integration, instructional strategies, student diversity, and dental school duration.

## Methods

To address the aims of this study, a survey with both quantitative and qualitative components was sent to the deans at a convenience sample of ten U.S. dental schools (Table 1) for distribution to their faculty and students. These schools from various geographic areas vary in research activity, clinical activity, instructional perspective, and class size. Prior to the survey being sent, a request to conduct this study was submitted to the Institutional Review Board of the University of Mississippi Medical Center; exempt status was requested and granted. The survey instrument consisted of a total of eight statements designed to evaluate the level of agreement of the respondents

**Table 1. Participating institutions**

Institution	City	State
University of Mississippi School of Dentistry	Jackson	Mississippi
University of California, Los Angeles School of Dentistry	Los Angeles	California
Western University of Health Sciences College of Dental Medicine	Pomona	California
Loma Linda University School of Dentistry	Loma Linda	California
University of Florida College of Dentistry	Gainesville	Florida
University of Louisville School of Dentistry	Louisville	Kentucky
Harvard School of Dental Medicine	Boston	Massachusetts
Columbia University College of Dental Medicine	New York	New York
University of Tennessee Health Science Center College of Dentistry	Memphis	Tennessee
University of Texas School of Dentistry at Houston	Houston	Texas

regarding four constructs: technology integration, instructional strategies, student diversity, and dental school duration. To better triangulate this quantitative data, respondents were also given the opportunity, via a free-text comment section, to expand on each of their responses to the statements in order to provide researchers with a more detailed examination of their perspectives on each of the topics.

The survey first required the respondent to self-identify as either a student or a faculty member, and then presented statements for the respondent to indicate his or her level of agreement. Validation of the survey instrument was established through two primary methods. First, a thorough review of the relevant literature and prior instrumentation used to measure each of the four constructs was conducted to develop the initial survey statements. After initial statements were constructed, the survey was pilot tested with five respondents, and these respondents were given an opportunity to provide feedback on the wording of items and the survey's overall format and/or structure. This information was carefully scrutinized and used to create the final survey instrument.

The final survey was constructed and administered as an electronic, online survey available through SurveyMonkey.com (SurveyMonkey, Portland, OR). Study participants were asked to indicate their level of agreement with the survey statements. The dependent variable response was measured on an ordinal scale. The five-point Likert scale offered options as follows: 1=strongly agree, 2=agree, 3=neutral, 4=disagree, and 5=strongly disagree. Participation in the study was completely anonymous and voluntary. To maximize participants' privacy and confidentiality, they were not asked about their institution or any demographic questions.

To analyze the quantitative data, IBM SPSS Statistics software for Windows, version 19.0 (IBM Corp., Armonk, NY) was used. The study sample contained two independent groups (dental faculty and students), and the dependent variable was measured on an ordinal, five-point Likert, scale. Individual responses for both students and faculty members were aggregated for each statement, and comparisons of the two groups were conducted via the non-parametric statistical Mann-Whitney U test to investigate differences between the student and faculty ratings for each statement. Our accepted Type I error rate ( $\alpha$ ) was 0.05 for all tests of significance.

For analysis of the qualitative data, responses from the comment sections of the survey were exported from SurveyMonkey and collected into one

Word document. Comments were then coded to identify common themes of the students and faculty members. In the coding process, comment data were organized initially by general topic area (technology, instruction, diversity, and duration) and then were analyzed in each topic area to uncover common themes. A pre-determined set of codes for subthemes was created, and all qualitative responses were analyzed and assigned these codes where appropriate. Data arrays were also utilized to determine, on each topic, whether the individuals were in general agreement or disagreement with the statement. After all qualitative data were coded in this manner, passages that shared common codes were organized together, and responses of faculty and students were again compared.

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## Results

Four hundred twenty-six students and one hundred eighty-seven faculty members responded to the surveys (613 total respondents, a response rate of 17 percent). Attitudes and perceptions of students and faculty members regarding each statement are shown in Table 2. In addition to the survey responses, a total of 407 comments on the statements were obtained for analysis. A synopsis of common themes and examples of comments on each theme is shown in Table 3.

These student and faculty respondents showed statistically similar attitudes toward only the first statement on the survey ( $p=0.159$ ). According to the data, average responses of the students and faculty toward the use of electronic textbooks were essentially neutral on this topic. The qualitative data also revealed ambivalence on the part of students: they agreed that electronic textbooks are convenient for searching keywords and typically cheaper than printed textbooks, but find them difficult to read. Interestingly, some faculty members rated electronic textbooks highly and reported appreciating their portability and ability to search.

Most of these students and faculty respondents agreed that technology integration should supplement but not replace traditional learning and that technology alone does not constitute worthy instruction. Several students indicated in their comments that they were highly literate in most computer software, and in fact, faculty members' comments reflected the belief that this knowledge is really a prerequisite to pursuing dental training. However, several students

**Table 2. Responses of students (n=426) and faculty members (n=187) in the study, by number and percentage of respondents to each statement**

Group	1 Strongly Agree	2 Agree	3 Neutral	4 Disagree	5 Strongly Disagree	Average Rating	Standard Deviation	Z statistic	p-value
1. Electronic textbooks (i.e., VitalSource) are preferred over regular textbooks.									
Students	77 (18%)	113 (27%)	91 (22%)	96 (23%)	46 (11%)	2.81	1.28	-1.410	0.159
Faculty	16 (9%)	44 (24%)	71 (39%)	39 (21%)	14 (8%)	2.95	1.05		
2. Dental students should be taught how to use computer software and other programs.									
Students	147 (35%)	176 (42%)	66 (16%)	28 (7%)	6 (1%)	1.98	0.95	-3.112	0.002*
Faculty	86 (46%)	74 (40%)	19 (10%)	7 (4%)	1 (<1%)	1.73	0.83		
3. Problem-based learning (learning through actual cases) is an important and useful learning tool.									
Students	161 (38%)	191 (45%)	54 (13%)	12 (3%)	5 (1%)	1.84	0.84	-3.999	<0.001*
Faculty	102 (55%)	66 (36%)	10 (5%)	7 (4%)	0	1.58	0.76		
4. Community service is a valuable learning experience for dental students.									
Students	162 (38%)	186 (44%)	51 (12%)	17 (4%)	6 (1%)	1.86	0.88	-4.442	<0.001*
Faculty	103 (56%)	69 (37%)	9 (5%)	4 (2%)	0	1.54	0.69		
5. Students should be given time to conduct research and present it at national meetings.									
Students	48 (11%)	170 (40%)	165 (39%)	30 (7%)	13 (3%)	2.51	0.89	-5.841	<0.001*
Faculty	46 (25%)	89 (49%)	41 (22%)	6 (3%)	1 (<1%)	2.05	0.81		
6. Less emphasis should be placed on conventional examinations.									
Students	50 (12%)	138 (33%)	139 (33%)	83 (20%)	10 (2%)	2.68	1.00	-5.780	<0.001*
Faculty	7 (4%)	51 (28%)	35 (19%)	73 (40%)	18 (10%)	3.24	1.08		
7. Diversity in the student body is desirable and should be increased.									
Students	82 (19%)	104 (24%)	164 (39%)	44 (10%)	32 (8%)	2.62	1.13	-6.140	<0.001*
Faculty	60 (32%)	67 (36%)	54 (29%)	5 (3%)	0	2.02	0.85		
8. The duration of dental school should be longer than four years.									
Students	12 (3%)	30 (7%)	55 (13%)	161 (38%)	167 (39%)	4.04	1.03	-9.963	<0.001*
Faculty	24 (13%)	56 (30%)	35 (19%)	49 (26%)	22 (12%)	2.94	1.25		

\*Significant at  $p < 0.05$

Note: Statement 1 showed similar ratings between students and faculty; all other statements showed significantly different ratings between students and faculty. Percentages may not total 100% because of rounding.

indicated that they needed more training on the school's management or dental software.

Regarding instructional strategies, most of these student and faculty respondents agreed that problem-based learning (PBL) is an important and useful learning tool, though the quantitative data revealed that faculty members had stronger agreement with this statement than students ( $p < 0.001$ ). However, both groups felt that PBL should serve as a supplement, not a replacement, to lecture-based learning. Furthermore, most of the students and faculty members considered community service a valuable learning experience for dental students, but again, faculty members agreed more strongly with this statement than students ( $p < 0.001$ ). Moreover, providing students with the opportunity and time to conduct research and present it at national meetings solicited statistically higher agreement among the

faculty members than the students. In fact, a common theme among the students suggested that conducting research should be optional. Lack of time or interest appeared to be the main reasons for this attitude. Some faculty members also stated that research should be optional for students.

Of all the statements in the survey, the topic of diversity of the student body elicited the most comments by students and faculty members, with eighty-two comments total. While the quantitative data revealed that both groups, on average, agreed with the survey statement on diversity, with faculty members showing significantly stronger agreement ( $p < 0.001$ ), analysis of the qualitative data revealed a more complex picture. Most of the comments by the students and faculty members suggested that the best applicants should be admitted based on merit, regardless of their distinguishing characteristics

**Table 3. Selected examples of comments made by students and faculty members in study: summary of qualitative data by area (407 total comments received)**

Area	Comments by Students	Comments by Faculty Members
Technology integration	<ul style="list-style-type: none"> <li>• Electronic textbooks are convenient for searching keywords and usually cheaper than printed ones; however, they are difficult to read. Printed [books] are preferred for reading.</li> <li>• Technology integration should be a supplement rather than a replacement for facts and lectures.</li> <li>• Most students are computer software literate and do not require formal computer software training. Training on school management software is necessary.</li> </ul>	<ul style="list-style-type: none"> <li>• Printed textbooks are generally preferred by faculty. The portability and ability to search through electronic textbooks are the main advantages of electronic textbooks.</li> <li>• Technology integration cannot replace solid instruction. Creativity and engaging stories are superior.</li> <li>• Software fluency is expected before matriculation into dental school. It is a core competence.</li> </ul>
Instructional strategies	<ul style="list-style-type: none"> <li>• Problem-based learning is important as a supplement to lecture-based learning. PBL alone is not sufficient.</li> <li>• Community service is valuable, occasionally a waste of time.</li> <li>• Conducting research by students should be optional. Lack of time or lack of interest is the main reason for that.</li> <li>• Exams are important; there is no alternative or substitute.</li> </ul>	<ul style="list-style-type: none"> <li>• Problem-based learning depends on the subject. It is important. It should be used only as an adjunct to structured didactic training.</li> <li>• Community service should be beneficial for both students and patients.</li> <li>• Conducting research by students should be optional and only for those who are interested.</li> <li>• Students must be evaluated.</li> </ul>
Student diversity	<ul style="list-style-type: none"> <li>• Best-qualified applicants should be admitted based on merit, regardless of their background (i.e., race, gender).</li> <li>• Diversity is highly desirable, but admission for the sake of diversity should not be at the expense of a better applicant.</li> <li>• It is unfair to accept less-qualified applicant, and standards of admissions should not be lowered for the sake of diversity.</li> <li>• The current level of diversity in students is appropriate and should neither be increased nor decreased.</li> </ul>	<ul style="list-style-type: none"> <li>• Best applicants should be admitted, regardless of their background (i.e., race, gender). Acceptance into dental school should be based on academic standards.</li> <li>• Diversity is highly desirable, but several admitted students for the sake of diversity struggle in their studies.</li> <li>• Students currently are highly diversified.</li> <li>• Diversity in student body at the present is appropriate and should not be changed.</li> </ul>
School duration	<ul style="list-style-type: none"> <li>• The four-year duration is either insufficient to learn dentistry or not utilized properly.</li> <li>• The duration of dental school should not be increased. In fact, three-year duration may be appropriate. However, an additional year of practical training is beneficial.</li> <li>• Increasing duration would increase tuition and students' debt. Therefore, this is unfavorable.</li> <li>• Clinical and practical instruction in dental schools should be increased.</li> </ul>	<ul style="list-style-type: none"> <li>• The four-year duration is not sufficient; it should be increased or better if students pursue a residency.</li> <li>• Additional training beyond dental school such as a one-year residency should be required. It would improve clinical learning.</li> <li>• Education cost would be a major concern if duration of dental school is increased.</li> <li>• The clinical experience that students are receiving nowadays is deteriorating. Additional residency or specialty training is important.</li> </ul>

(e.g., race, gender). They argued that it is unfair to accept less-qualified applicants solely for the sake of diversity. They also argued that standards of admissions should not be lowered for the sake of diversity. Several students and faculty members mentioned that student bodies currently are highly diversified and that diversity in the student body at the present level is sufficient and should not be changed.

A high percentage of the students disagreed that the duration of dental school should be longer than

four years, with an average rating of 4.04 (disagreement). In contrast, the faculty members reported mixed opinions on this statement and an average rating close to neutral (2.94). Several students argued that the length of dental school is not utilized properly and that clinical and practical instruction should be increased. Several faculty respondents reported awareness of students' financial concerns and that the clinical experience that students are receiving is deteriorating.

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## Discussion

An examination of overall survey results revealed that seven of the eight statements elicited statistically different average responses between the students and faculty members, though these differences were often in the *degree* of agreement/disagreement not due to divergence in overall opinion (Figure 1). For example, for the statement “dental students should be taught how to use computer software and other programs,” the students agreed overall; however, the faculty members showed a statistically stronger agreement, with higher percentages of agree and strongly agree ratings. The qualitative data revealed the reasoning behind this particular statement. Most students are digital natives and are comfortable with computer software and other programs above and beyond faculty expectations.

Regarding electronic textbooks (e.g., Vital-Source), the findings in this study are consistent with prior studies that found not all students preferred to study in front of a computer monitor for hours.<sup>2</sup> In Strother et al.’s study, students at Louisiana State University School of Dentistry were overwhelmingly dissatisfied with extensive reading online.<sup>2</sup> Similarly, in our study, the students stated that electronic textbooks are useful for keyword searching rather than studying in front of a computer screen for hours. It appears that the students preferred materials/notes over studying lengthy electronic textbooks. This is also consistent with the findings of Ditmyer et al.<sup>10</sup> that students used electronic textbooks less frequently

than materials/notes provided by dental school faculty members. As Brunet et al.<sup>11</sup> found in their study, students entering dental schools do not have sufficient exposure to electronic books as a learning modality because this method of delivery is not as prevalent among undergraduate students despite the rapidly increasing popularity of electronic publications.

In 2009, Strother et al. advised that faculty preferences for digital or printed collections are areas that should be further investigated.<sup>2</sup> In our study, faculty respondents reported mixed opinions toward these two options, although several faculty members had positive perceptions of electronic textbooks. In general, as Dorn suggests in the journal *Science*, the use of digital over hardcopy textbooks appears to be a matter of preference.<sup>12</sup> Continuous advancements of technology and shift to electronic delivery of instruction and informatics are positively perceived. Improved technology supports clinical teaching that benefits both the faculty and students.<sup>13</sup>

The students in our study seemed to be aware of innovative instructional strategies, but overall, the faculty members showed stronger agreement about integrating these strategies into school curricula. Tu et al.<sup>4</sup> found that medical students rated PBL higher than did dental students. In contrast to this finding, 83 percent of the dental students in our study agreed that PBL is a useful learning tool. This agreement is consistent with previous research conducted by Fincham and Shuler, who found that PBL was positively perceived by dental students.<sup>3</sup> The findings of our study also suggest that faculty members have even higher agreement than students about the value

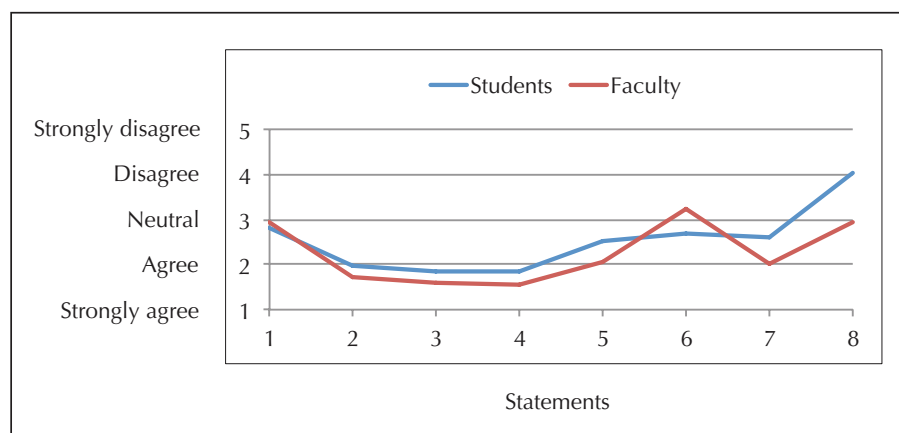


Figure 1. Average ratings of statements by students and faculty members

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of PBL. This positive rating by faculty members is also consistent with the findings of Garvey et al. that PBL is exciting for students and faculty members.<sup>14</sup>

Community-based dental education is another innovative instructional strategy that is becoming a part of the clinical education of many dental students.<sup>9</sup> The benefits of community-based dental education, as explained by Mofidi et al., include the “wide range of situations that would prepare students for their professional life, increased self-awareness, enhanced communication skills, and increased self-confidence as a result of these experiences.”<sup>15</sup> In our study, community service was generally perceived positively by the respondents, but with some dissenting opinions, the majority of which cited lack of time as the reason. We acknowledge that the wording of our question as “community service” may have been confusing for respondents since it is not the same as “community-based dental education,” which is part of the dental curriculum.

The diversity of the student body was the topic that generated the most comments. Interestingly, most of those who argued that students should be accepted based on merit added that “race or gender” should not be determining factors in student selection. These respondents perceived diversity as “race and gender” only and missed the fact that diversity includes many demographic attributes (race, gender, marital and family status, age, socioeconomic status, educationally or financially disadvantaged background, rural, state, or national origin, languages spoken, religious and spiritual beliefs, and culture). Furthermore, diversity includes personal attributes such as communication, talents and skills, work habits, and life experiences such as educational background, research, health care, volunteering activities, community service, leadership, and previous employment. Thus, diversity is not limited to race and gender. An American Dental Education Association (ADEA) report noted that “the numbers of underrepresented minorities remain woefully disproportionate to their representation in the U.S. population. Minority populations in the United States are growing at a faster rate than the white majority.”<sup>16</sup> Aside from the many other benefits of having a diverse student body, minority practitioners have been found to be more like to serve minority communities, which are often underserved in oral health care.

The idea of increasing the duration of dental school beyond four years found significant disagreement among the students versus an average neutral rating by the faculty members. In other words, more

faculty members approved of this idea than students. Students in general felt that clinical training is insufficient but that this should not result in changing the length of school. Education cost appears to be the main concern. The faculty members and students suggested that a residency would aid in enhancing students’ clinical skills. This was also found by Walton et al., in whose study the students showed positive attitudes toward advanced education and specialty training beyond dental school and would choose to further their education if increasing debt was not a factor.<sup>17</sup>

This research study evaluated the attitudes and perceptions of a limited number of dental students and faculty members. The attitudes and perceptions of practicing dentists may differ from those of the two studied groups, so the opinions reported do not reflect all opinions in the dental community. Possible confusion in the survey questions was a significant limitation. In addition to the confusion over community-based dental education/community service, it is difficult to interpret responses to the second question, for example, since it can be assumed that all dental students already know how to use computer software, so the basis for their response to that question is unknown. In addition, there was no option given in the questions for “Not applicable,” which would have allowed respondents to designate those areas not in use in their schools. Finally, the low response rate and the fact that fewer than one-sixth of dental schools in the United States were included means that these findings should not be interpreted as representing opinions of U.S. dental students and faculty members as a whole.

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## Conclusion

Whereas the students and faculty members in this multi-school study shared statistically significant similar attitudes toward only one of ten statements, the general agreement among the two groups regarding traditional and innovative approaches to dental education was clear; this is evidenced visually in Figure 1, which shows the average ratings of students and faculty members on all statements. This figure demonstrates that the general trend of ratings between the two groups for the statements was close overall. It is important to note that scrutinizing the rating percentages and the pattern of average ratings of all statements, as shown in Figure 1, reveals that the statistical difference is due to either a slightly

stronger agreement of one group over the other or a slightly stronger disagreement of one group over the other. It was not due to opposing dispositions between the students and faculty members towards the statements. This was strongly validated by the qualitative data. The themes and comments made by these respondents revealed general agreement between the two groups.

Overall, technology integration into instruction was desired by the respondents, but they reported it should not replace conventional instruction, should have an educational rather than entertainment purpose, and should not constitute worthy instruction. In fact, for those experienced instructors able to deliver generative rather than supplementary instruction, creativity and engaging stories were said to be far superior to technology integration. The respondents also reported that instructional strategies should continue to evolve. PBL was highly valued by the students and faculty members, especially the latter group. Perhaps the students did not fully realize the importance of PBL or had not experienced it yet.

Most of the students and faculty members in our study perceived the current level of student body diversity to be appropriate. Unfortunately, most of these students and faculty perceived diversity in limited terms. It is important to define diversity in terms of demographic attributes, personal attributes, and life experiences. Inclusion of diverse students would enrich the teaching and learning environment. Moreover, a holistic approach in admissions would not be discriminatory if it considers all of these attributes.

As the qualitative data revealed, these students did not believe that the duration of dental school should be increased due to the fear of a significant increase in tuition and debt. They reported that efficiency in instruction and clinical training would be a better strategy. Effective instructional strategies were clearly desired by students, as this study shows, and they should increase effectiveness of dental education.

The results of this study can be used in several ways. Those who set strategic plans in dental schools, such as administrators, will find the attitudes and perceptions of these dental students and faculty members to be interesting and may benefit from their perspectives on dental education in decision making.

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