Student's Perception of the Impact of E-learning on Dental Education

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ABSTRACT

Aim: The aim of this study is to assess the influence of e-learning on dental education as perceived by predoctoral dental students.

Materials and methods: In an institutional review board (IRB) approved protocol, a 14-question survey was created and electronically distributed to second-, third-, and fourth-year dental students. The participation was considered voluntary and all responses were anonymous.

Results: The survey targeted 1,130 predoctoral students, of which 255 (22.6%) responded. Of the respondents, 124 students (48.6%) preferred traditional lecture mixed with online learning, while 46 students (18%) preferred only the traditional lecture style. The top three electronic resources/applications, which students perceived as having the greatest impact on their learning, were: YouTube, Bone Box, and Google. The responses also indicated that 76.5% of the students gave high credibility (scores of 4 and 5) to electronic resources recommended by faculties. Sixty percent of students spent 1 to more than 4 hours per day on electronic resources for academic performance. The most important factor for online applications influencing academic performance was "organization and logic of content" (54%). E-learning had a significant perceived effect (scores of 4/5) on didactic understanding (65.1%) and on clinical understanding (71.4%). Students observed that faculties estimated to be under 50 years of age were more likely to incorporate e-learning into courses (52.6%) and more likely to use social media for communication (41.6%).

Conclusion: The results indicate that e-learning may successfully be used in a dental school's curriculum to enhance students' perceptions of fundamental concepts and to enable students to apply this knowledge to clinical cases.

Clinical significance: E-learning has recently been proposed as a basic supplementary tool to enhance medical and dental education. It is crucial to determine dental students' preferences regarding social media, online applications, and databases in order to incorporate e-learning into dental school courses.

Keywords: Curriculum, Dental education, Dentistry, E-learning, Social media.

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INTRODUCTION

During the last decade, due to widespread use of smartphones, the Internet, and smart devices, the use of social media has greatly increased, has gained popularity, and has enhanced learning among students.[1–5] Social media applications such as Facebook, Twitter, Google+, LinkedIn, and Student Doctor network allow users to connect, collaborate, and communicate with one another on a global scale.[1–5] In 2015, it was reported that 88% of 16–24-year-olds used social media daily, compared to 60% aged 65 and older, which supports the ever-increasing popularity of social media.[2]

Students are digitally literate, social, team-workers, both visual and interactive.[1,3] Thus, educators should match their teaching styles based on the learning needs of students.[5–9] In the past, educators relied primarily on textbooks, handouts, and notes during lectures.[5–9] These days, blended learning and e-learning are gaining popularity as successful and revolutionary teaching styles.[1,3,4,10–13] More specifically, e-learning is defined as learning while "utilizing electronic technologies to access educational curriculum outside of a traditional classroom."[13] Students are shifting more toward online applications, learning modules, and social media, such as YouTube, Facebook, Twitter, and Student Doctor network, to enhance their learning and supplement the information gathered from lectures by creating, sharing, and exchanging information with other users around the world. It has been suggested that blended learning, e-learning, and virtual learning environments, mixed with a traditional lecture style, improve competencies and core knowledge of students.[3–5,14–16] Moreover, some studies highlight the fact that blended learning

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complements a traditional teaching style and enhances the overall learning experience of students by addressing differences that exist in learning styles among students.[3,17–20] Thus, these interactive teaching strategies intensify students' focus, amplify their attention, and increase their long-term knowledge retention.[3–5,14–16]

In addition, many of the courses in a professional education environment, such as a dental school, are team-taught and contain inconsistencies between lecturers and lecture styles. A key issue facing dental educators is the amount of material faculties wish to cover in terms of time, content, and depth, as compared with expectations of students.[4,17] Faculty members teaching in dental schools, who are content experts (such as basic sciences), may have limited exposure to clinical dental concepts.[4,17] Therefore, they may not be able to incorporate relevant clinical visual aids and animations into their lecture presentations, connecting concepts

to clinical dentistry. As a result, students have been shown to lose motivation and interest in those lectures.[4,17]

The purpose of this study was to determine the extent to which NYU College of Dentistry students use social media, online applications, and databases; their preference for platforms; and their interest in incorporating e-learning into courses. The hypothesis of this study was that the implementation of e-learning and virtual education improves lecture attendance and students' perception of improved academic performance.

MATERIALS AND METHODS

A survey was developed after a pilot and a focus group discussion with voluntary predoctoral dental students who had experience using a variety of dental applications (Apps) and social media in their dental education. The survey instrument was designed to evaluate student perceptions of the influence of online applications and animations on their perceived academic performance. The exclusion criteria included: those students involved in the initial pilot discussion; those who did not consent to the survey; and those who did not complete the survey. This study was conducted in NYU College of Dentistry. The 14-question survey included: 7 multiple choice, 2 fill-in, 2 open-ended, and 3 Likert scale questions with sublevels (Table 1). The two open-ended questions were to allow students to list the names of any Apps that they may have used in their dental education and to allow students to comment on the impact of e-learning on their perceived academic performance (Table 1—questions 5 and 14). The survey was estimated to take less than 5 minutes to complete.

Institutional review board approval (IRB-FY2017-856) was obtained from New York University to administer this survey to predoctoral dental students currently enrolled at the College of Dentistry.

The confidential and voluntary consent form and survey were accessed online through Qualtrics, a web-based survey and evaluation tool, with a link provided to participants in an e-mail invitation. The survey was offered during a 2-week period in July 2017. The target groups were second-, third-, and fourth-year predoctoral dental students. The first-year predoctoral dental students were excluded because of their limited exposure to clinical teaching. Participation in the survey took place entirely online with all participants completing the survey anonymously using a device and browser of their choice, and at a time and place convenient for their schedules. No computer Internet Protocol (IP) addresses were collected. The survey anonymity assured that investigators had no way of identifying the participating students.

RESULTS

The survey targeted 1,130 predoctoral dental students, of which 255 (22.6%) responded (139 females and 116 males) with an average age of 25.8 years ± 3.8 years. Of the survey participants, 112 were second-year students (43.9%), 102 were third-year students (40%); and 41 were fourth-year students (16.1%).

A total of 563 responses were gathered from the open-ended survey question regarding the preferred electronic resources that students perceived to have enhanced their academic performance. Students identified 43 different electronic resources/Apps, with the top five identified being: YouTube (36.8%), Bone Box (13.4%), Google (10.1%), Dental Anatomy Master (5.2%), and Lecture Podcasts (5%) (Table 2). The amount of time spent daily by the respondents using electronic resources/Apps for academic purposes is shown in Table 3. The results indicate that 40% of students use the electronic resources for learning purposes less than 1 hour per day, but 11.4% use it for greater than 4 hours.

One-hundred twenty-four students (48.6%) indicated a preference for traditional lectures mixed with online learning; 47 students (18.4%) preferred online classes only; and 46 students (18%) preferred just traditional lectures. Also, 38 students (15%) reported that their classroom attendance is not related to the lecture format.

The observation of students regarding the gender and estimated age of faculty incorporating e-learning into their courses is presented in Table 4. Although the responses indicated that there was no difference in terms of the gender of faculty using e-learning, there was a significant difference in terms of the estimated age of faculty. One-hundred thirty-four students (52.6%) reported that the incorporation of e-learning in courses was more prevalent among faculties estimated to be under the age of 50, with only 6 students (2.3%) reporting such use by faculties over 50 years of age. In addition, the data showed that faculty's use of social media for communication was significantly more prevalent among faculties under 50 years of age (106 students, 41.6%) compared to the use of social media by faculties over 50 years of age (5 students, 2%) (Table 5).

Regarding a faculty's use of an external resource in the course, students were asked to determine the level of credibility of that resource (level 1 = least credibility; level 5 = most credibility) when recommended by the faculty. The results indicated that faculty's recommendation was an important factor affecting students' perception of credibility about the external resource. In fact, 76 students (29.8%) selected level 5, or "most credible" and 119 students (46.7%) selected level 4. Only one student (0.4%) chose level 1, or "least credible" (Graph 1).

Students rated the level of influence with respect to six factors related to online Apps/animations on students' perceived academic performance. The detailed analysis of the data for this question is presented in Table 6. When "*Organization/logic of the content*" was considered, 138 students (54.1%) indicated level 5 (most influence), and 83 students (32.5%) chose level 4. When "*Credibility of the video*" was considered, 102 students (42%) indicated level 5 (most influence), and 83 students (39.2%) chose level 4.

The students were also asked what perceived effect (level 1 = no effect; level 5 = greatest effect) would the e-learning have on their understanding of a topic. Graph 2 illustrates the results for these two closely related questions, offered in two parts: (1) didactic lectures and (2) clinical curriculum. For the didactic lectures, 60 students (23.5%) marked level 5 (greatest effect) and 106 students (41.6%) marked level 4 (great effect). For the clinical curriculum, 90 students (35.2%) selected level 5 (greatest effect) and 92 students (36.1%) chose level 4.

Questions 5 and 14 were the two open-ended questions of this survey. Question 5 asked students to list up to three most frequently used electronic resources/applications which have enhanced their academic performance; and question 14 asked them to provide any comment with regard to the impact of e-learning on their academic performance. In the analysis of question 5, students provided names of 43 applications and the top three applications that encompassed 60.3% of the total responses were: YouTube, Bone Box, and Google.

One of the open-ended survey questions allowed each of the participants to freely comment on the "impact of e-learning" with respect to his/her educational experience. Of the 255 participants,

Table 1: Survey instrument

Q1. Regarding study participation

    I consent

    I do not consent

Q2. What is your age?

Q3. What is your gender?

    Male

    Female

Q4. I am a __ year dental student

Q5. Please list up to three most frequently used electronic resources/applications which have enhanced your academic performance?
(e.g., YouTube, DAM: Dental Anatomy Master, Bone Box, Dental Decide, etc.)

Q6. On average, how many hours/day do you use electronic resources/applications for academic performance? (e.g., YouTube, DAM: Dental Anatomy Master, Bone Box, Dental Decide, etc.)

    < 1 hour

    1–2 hours

    2–3 hours

    3–4 hours

    > 4 hours

Q7. Regarding an external resource, what level of credibility do you give the resource if it is recommended by the faculty? (1 = least influence and 5 = most influence)

Q8. Regarding online applications/animations, please rate the following factors as to their influence on your academic performance
(1 = least influence and 5 = most influence)

    Online presentation under 15 minutes

    Depth of content

    Mobile friendly

    Up-to-date "look and feel" of the video

    Credibility of the video

    Organization/logic of the content

Q9. What perceived effect would e-learning have on your understanding of a topic?

    (E-learning can be defined as including multimedia, such as animation and video) (1 = no effect and 5 = greatest effect)

    E-learning within DIDACTIC lectures

    E-learning within CLINICAL curriculum

Q10. Regarding the incorporation of e-learning by faculties in their courses, which of the following have you observed?

    More prevalent among male faculties

    More prevalent among female faculties

    There is no difference in use

    I do not know

Q11. Regarding the age of faculties incorporating e-learning, which of the following have you observed?

    More prevalent among faculties over 50 years of age

    More prevalent among faculties under 50 years of age

    There is no difference in use by age groups

    I do not know

Q12. Regarding the faculty's use of social media for communication, which of the following have you observed?

    More prevalent among faculties 50 years of age and above

    More prevalent among faculties under 50 years of age

    There is no difference in use by age groups

    I do not know

Q13. Which of the following best describes your classroom attendance?

    I prefer online classes only

    I prefer traditional lecture mixed with online learning

    I prefer tradition lecture style only

    My attendance is not related to the lecture format (classroom or online)

Q14. Based on your experience in all your courses, please comment on the impact of e-learning on your academic performance

Table 2: The analysis of question 5 regarding the three most frequently used electronic resources/applications which have enhanced academic performance

Categories (43)	Number of responses	% of responses
YouTube	207	36.8
Bone Box	75	13.3
Google	57	10.1
DAM: Dental Anatomy Master	29	5.2
Lecture Podcasts	28	5
Wikipedia	23	4.1
Vitalbook/Vital Source	15	2.7
Instagram	15	2.7
National Board Dental Examination (NBDE) Dental Mastery App	14	2.5
Quizlet	12	2.1
Others (33)	88	15.5
Total	563	100

Table 3: The analysis of question 6 regarding the average hours/day that students use electronic resources/applications for academic performance

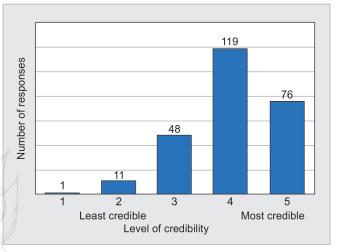| Time spent daily	Number of responses	% of responses
<1 hour	102	40
1–2 hours	66	25.9
2–3 hours	34	13.3
3–4 hours	24	9.4
>4 hours	29	11.4
Total	255	100

Table 4: The analysis of questions 10 and 11 regarding students' observations of incorporation of e-learning by faculties in their courses; and the age of faculties incorporating e-learning

	Number of responses	% of responses
More prevalent among male faculties	29	11.4
More prevalent among female faculties	26	10.2
There is no difference in use	95	37.2
I do not know	105	41.2
Total	255	100

	Number of responses	% of responses
More prevalent among faculties over 50 years of age	6	2.3
More prevalent among faculties under 50 years of age	134	52.6
There is no difference in use by age groups	48	18.8
I do not know	67	26.3
Total	255	100

176 chose to comment on this question. A total of 376 comments were identified and categorized as either "positive" (having impact) or "negative" (having no or negative impact). There were 255 positive comments (68%) and 108 negative comments (32%). Because the accumulated data from this open-ended question was substantial, the data were evaluated by a qualitative analysis methodology and will be reported as a supplement to this manuscript.

Table 5: The analysis of question 12 regarding students' observations of faculty's use of social media for communication

Responses	Number of responses	% of responses
More prevalent among faculties over 50 years of age	5	2
More prevalent among faculties under 50 years of age	106	41.6
There is no difference in use by age groups	65	25.4
I do not know	79	31
Total	255	100

Graph 1: The analysis of question 7 regarding the "level of credibility" given by students when the resource is recommended by the faculty
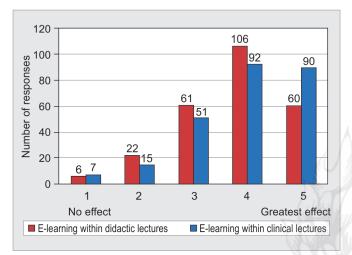
Discussion

Nowadays, one of the areas of concern in dental education is to balance the educational needs of students and the time constraints of the current didactic schedule.[4,17,21–23] The traditional teaching strategy focuses on notes, electronic presentations, and handouts, while the e-learning strategy mainly focuses on procedural videos, modules, flashcards, and software applications.[4,17,24,25] Dental students these days are from the "millennial generation" and are very familiar with e-learning and online resources.[4,17,25,26] However, a few faculties in dental schools are utilizing online learning tools.[17,27,28] Some of the reasons for faculty hesitation to shift their teaching style to e-learning has been associated with low perceived benefit, difficulty in developing these online resources, frequency of student's usage, and the time required to invest in this process.[1,28–30] Literature in the past supported the traditional learning strategy; however, this trend has shifted as the new generation has become technologically savvy, which were reported by Browne et al.,[31] and Naser-ud-Din.[3] Previous studies by Naser-ud-Din[3] and Clark et al.,[32] have indicated that students prefer e-learning due to accessibility, timetable, and flexibility when studying abroad.

There have been other studies by Asiry[33] and Pilcher,[34] on e-learning; however, they had a limited number of participants. More specifically, in studies evaluating online course materials in fixed prosthodontics from students' perspective, Asiry[33] had 54 dental students and Plicher,[34] had 52 dental students' evaluations. These current data were intended to add to the body of knowledge and understanding of students' preferences.

Table 6: The analysis of question 8 regarding the influence of online applications/animations on the students' perceived academic performance

Scale	Least influence 1	2	3	4	Most influence 5
Factors	Responses (n = 255) (%)				
Online presentation under 15 minutes	5 (2)	16 (6)	59 (23)	109 (43)	66 (26)
Depth of content	2 (1)	10 (4)	70 (27)	114 (45)	59 (23)
Mobile friendly	23 (9)	31 (12)	65 (25)	85 (33)	51 (20)
Up-to-date "look and feel" of the video	8 (3)	17 (7)	55 (22)	98 (38)	77 (30)
Credibility of the video	1 (<1)	6 (2)	41 (16)	100 (39)	107 (42)
Organization/logic of the content	2 (1)	3 (1)	29 (11)	83 (33)	138 (54)

Graph 2: The analysis of question 9 regarding the perceived effect of e-learning on students' understanding of a topic

NYU students' preference for a mixture of traditional and e-learning is consistent with those of other studies published by Asiry,[33] Plicher,[34] and McCann et al.[35] In a study by Pilcher,[34] 96% of dental students participating reported that the online materials were either very helpful or helpful to them and 54% had a preference for online materials as an adjunct to the traditional lectures, while 28% suggested replacing the traditional learning with e-learning.

Based on the results of this study, the most commonly used application was YouTube, which seems ideal for visual learning. Of note is that the NYU classes' website, which is an internal online platform where faculties upload their presentations, videos, and other resources for student access, was not among the top three choices of NYU students. However, this finding is similar to findings from other studies by Mukhopadhyay et al.,[36] Duncan et al.,[37] and Knosel et al.[38] Thus, currently, a number of academic institutions are hosting their own YouTube channels which allows faculties and students to upload videos to enhance the students' learning.[36,37] This academic movement has led to a 1.7-fold increase in the number of educational videos uploaded to YouTube from 2007 (22%) to 2009 (38%).[33] Specifically, the visual demonstration of clinical procedures was considered the strength of e-learning.[36,37] Moreover, in a study by Duncan et al.,[37] it is suggested that the usage of YouTube closes the gap between theory and practice and promotes discussion and critical analysis. Faculty's inclusion of already existing resources (such as YouTube) into a course may be a more cost-effective approach for e-learning vs having faculty attempt to develop their own animations, applications, or videos.

Students did not observe a significant difference between male and female faculties regarding their use of e-learning in courses (Table 4). However, with respect to incorporation of e-learning in courses (Table 4) and the use of social media for communication (Table 5) based on students' estimate of faculty's age, it appears that students observed these activities to be more prevalent among those perceived to be under 50 years of age. Given the rise of the desktop computers since the early 1980s, and the advent of social media in the mid-1990s, this suggests that faculties under 50 were likely more exposed to technology in their education and early careers and, therefore, may be more inclined to use technology in learning situations and for communication. Moreover, the ubiquity of computers and the Internet will likely continue this usage trend as more and more educators bring technology-based activities into the classroom.

A limitation of this study is that it did not evaluate students' performance so their perceived performance may not be the same as their actual performance.

CONCLUSION

Students use a multitude of electronic resources in their learning and studying activities. Some of these resources are internally developed and some are externally produced and easily accessible. Since students give a high value to faculty recommendations, dental school faculties are encouraged to constantly review relevant electronic resources and include these along with traditional lectures. Students' high preference for YouTube suggests the utilization of this modality for educational material delivery. The results of this study suggest that e-learning may be used successfully in a dental school's curriculum to enhance students' learning, especially in the clinical curriculum. Further studies are needed to fully understand the impact of e-learning on students' performance including examinations and clinical competency outcomes.

CLINICAL SIGNIFICANCE

In the last 10 years, e-learning was suggested as an important additional tool to improve dental and medical education. It is essential to know dental students' preferences regarding social media, and online applications in order to successfully incorporate e-learning into dental school courses. The implementation of e-learning and virtual education will improve lecture attendance and students' perception of improved academic performance.

REFERENCES

1. Hillenburg KL, Cederberg RA, et al. E-learning and the future of dental education: opinions of administrators and information technology specialists. Eur J Dent Educ 2006;10:169–177. DOI: 10.1111/j.1600-0579.2006.00413.x.

2. Bhola S, Hellye P. The risks and benefits of social media in dental foundation training. Br Dent J 2016;221:609–613. DOI: 10.1038/sj.bdj.2016.854.
3. Naser-ud-Din S. Introducing scenario based learning interactive to postgraduates in UQ orthodontic program. Eur J Dent Educ 2015;19:169–176. DOI: 10.1111/eje.12118.
4. Miller C, Metz M. Can clinical scenario videos improve dental students' perceptions of the basic sciences and ability to apply content knowledge? J Dent Educ 2015;12:1452–1460.
5. Mahmoodi B, Sagheb K, et al. Catalogue of interactive learning objectives to improve an integrated medical and dental curriculum. J Contemp Dent Pract 2016;17:965–968.
6. Blaum WE, Jarczweski A, et al. Towards Web 3.0: taxonomies and ontologies for medical education—a systematic review. GMS Z Med Ausbild 2013;30:Doc 13. DOI: 10.3205/zma000856.
7. Cook DA, Erwin PJ, et al. Computerized virtual patients in health professions education: a systematic review and meta-analysis. Acad Med 2010;85:1589–1602. DOI: 10.1097/ACM.0b013e3181edfe13.
8. Hempel G, Neef M, et al. Study of medicine 2.0 due to Web 2.0 – risks and opportunities for the curriculum in Leipzig. GMS Z Med Ausbild 2013;30:Doc 11. DOI: 10.3205/zma000854.
9. Sucha M, Engelhardt S, et al. Internet discussion forums as part of a student-centered teaching concept of pharmacology. GMS Z Med Ausbild 2013;30:Doc 2. DOI: 10.3205/zma000845.
10. Schonwetter DJ, Reynolds PA, et al. Online learning in dentistry: an overview of the future direction for dental education. J Oral Rehabil 2010;37:927–940. DOI: 10.1111/j.1365-2842.2010.02122.x.
11. Kavadella A, Tsiklakis K, et al. Evaluation of a blended learning course for teaching radiology to undergraduate dental students. Eur J Dent Educ 2012;16:88–95. DOI: 10.1111/j.1600-0579.2011.00680.x.
12. Jackson T, Hannum W, et al. Effectiveness of web-based teaching modules: test-enhanced learning in dental education. J Dent Educ 2011;75:775–781.
13. Tan PL, Hay DB, et al. Implementing e-learning in a radiological science course in dental education: a short-term longitudinal study. J Dent Educ 2009;73:1202–1212.
14. Al-Jewair TS, Azarpazhooh A, et al. Computer-assisted learning in orthodontic education: a systematic review and meta-analysis. J Dent Educ 2009;73:730–739.
15. Al-Riyami S, Moles DR, et al. Comparison of the instructional efficacy of an Internet-based temporomandibular joint (TMJ) tutorial with a traditional seminar. Br Dental J 2010;209:571–576. DOI: 10.1038/sj.bdj.2010.1085.
16. Chen ML, Su ZY, et al. Influence of dentistry students' e-learning satisfaction: a questionnaire survey. J Med Syst 2011;35:1595–1603. DOI: 10.1007/s10916-010-9435-x.
17. Gautum M, Shaw DH, et al. Physiology education in North American dental schools: the basic science survey series. J Dent Educ 2013;78:886–894.
18. Bains M, Reynolds PA, et al. Effectiveness and acceptability of face-to-face, blended and e-learning: a randomized trial of orthodontic undergraduates. Eur J Dent Educ 2011;15:110–117. DOI: 10.1111/j.1600-0579.2010.00651.x.
19. Haden NK, Andrieu SC, et al. The dental education environment. J Dent Educ 2006;70:1265–1270.
20. Henzi D, Davis E, et al. North American dental students' perspectives about their clinical education. J Dent Educ 2006;70:361–377.
21. Miller CJ, Aiken SA, et al. Perceptions of D.M.D. student readiness for basic science courses in the United States: can online review modules help? Eur J Dent Educ 2015;19:1–7.
22. Azab E, Saksena Y, et al. Relationship among dental students' class lecture attendance, use of online resources, and performance. J Dent Educ 2016;80:452–458.
23. Phillips JA, Schumacher C, et al. Time spent, workload, and student and faculty perceptions in a blended learning environment. Am J Pharm Educ 2016;80:102. DOI: 10.5688/ajpe806102.
24. Ariana A, Amin M, et al. Integration of rraditional and E-learning methods to improve learning outcomes for dental students in histopathology. J Dent Educ 2016;80:1140–1148.
25. Santos GN, Leite AF, et al. Effectiveness of E-learning in oral radiology education: a systematic review. J Dent Educ 2016;80:1126–1139.
26. Barry DS, Marzouk F, et al. Anatomy education for the YouTube generation. Anat Sci Educ 2016;9:90–96. DOI: 10.1002/ase.1550.
27. Hendricson WD, Panagakos F, et al. Electronic curriculum implementation at North American dental schools. J Dent Educ 2004;68:1041–1057.
28. Tricio JA, Montt JE, et al. Impact of faculty development workshops in student-centered teaching methodologies on faculty members' teaching and their students' oerceptions. J Dent Educ 2017;81:675–684. DOI: 10.21815/JDE.017.014.
29. Grillo AC, Murdoch-Kinch CA, et al. Student evaluations of teaching: dental and dental hygiene students' and faculty members' perspectives. J Dent Educ 2016;80:439–451.
30. Abdelkarim A, Benghuzzi H, et al. U.S. Dental students' and faculty members' attitudes about technology, instructional strategies, student diversity, and school duration: a comparative study. J Dent Educ 2014;78:614–21.
31. Browne L, Mehra S, et al. Comparing lecture and e-learning as pedagogies for new and experienced professionals in dentistry. Br Dent J 2004;197:95–97. DOI: 10.1038/sj.bdj.4811484.
32. Clark GT, Mulligan R, et al. Developing and providing an online (web-based) clinical research design course in Japan: lessons learned. J Prosthodont Res 2011;55:61–68. DOI: 10.1016/j.jpor.2011.01.004.
33. Asiry MA. Dental students' perceptions of an online learning. Saudi Dent J 2017;29:167–170. DOI: 10.1016/j.sdentj.2017.03.005
34. Pilcher ES. Students' evaluation of online course materials in fixed prosthodontics: a case study. Eur J Dent Educ 2001;5:53–59.
35. McCann AL, Schneiderman ED, et al. E-teaching and learning preferences of dental and dental hygiene students. J Dent Educ 2010;74:65–78.
36. Mukhopadhyay S, Kruger E, et al. YouTube: a new way of supplementing traditional methods in dental education. J Dent Educ 2014;78:1568–1571.
37. Duncan I, Yarwood-Ross L, et al. YouTube as a source of clinical skills education. Nurse Educ Today 2013;33:1576–1580. DOI: 10.1016/j.nedt.2012.12.013.
38. Knosel M, Jung K, et al. YouTube, dentistry, and dental education. J Dent Educ 2011;75:1558–1568.