Comparing Face-to-Face, Synchronous, and Asynchronous Learning: Postgraduate Dental Resident Preferences

Marc Kunin, D.D.S., M.A.; Kell N. Julliard, M.A.; Tobias E. Rodriguez, Ph.D.

Abstract: The Department of Dental Medicine of Lutheran Medical Center has developed an asynchronous online curriculum consisting of prerecorded PowerPoint presentations with audio explanations. The focus of this study was to evaluate if the new asynchronous format satisfied the educational needs of the residents compared to traditional lecture (face-to-face) and synchronous (distance learning) formats. Lectures were delivered to 219 dental residents employing face-to-face and synchronous formats, as well as the new asynchronous format; 169 (77 percent) participated in the study. Outcomes were assessed with pretests, posttests, and individual lecture surveys. Results found the residents preferred face-to-face and asynchronous formats to the synchronous format in terms of effectiveness and clarity of presentations. This preference was directly related to the residents’ perception of how well the technology worked in each format. The residents also rated the quality of student-instructor and student-student interactions in the synchronous and asynchronous formats significantly higher after taking the lecture series than they did before taking it. However, they rated the face-to-face format as significantly more conducive to student-instructor and student-student interaction. While the study found technology had a major impact on the efficacy of this curricular model, the results suggest that the asynchronous format can be an effective way to teach a postgraduate course.

Dr. Kunin is Associate Director of Postgraduate Endodontics, Lutheran Medical Center, Brooklyn, NY; Mr. Julliard is Assistant Vice President for Clinical Research, Lutheran Medical Center, Brooklyn, NY; and Dr. Rodriguez is Vice President of Education, AAL, Atlanta, GA. Direct correspondence and requests for reprints to Dr. Marc Kunin, Lutheran Medical Center, 150 55th Street, Brooklyn, NY 11220; 718-630-8248; mkunin@lmcmc.com.

Keywords: dental education, postdoctoral dental education, distance education, distance learning, technology, computers in dentistry, video teleconferencing

Submitted for publication 9/3/13; accepted 12/3/13

Of the numerous studies comparing various learning formats, only a half dozen have done so in the discipline of dentistry. In a comparison of the effectiveness of an online course with a classroom presentation, Grimes found no statistically significant difference between experimental and control groups in teaching dental terminology to dental hygiene students.1 In a follow-up study analyzing student perceptions of the online course, she found that while the students enjoyed being able to access the program at their convenience and to work at their own pace, 69 percent of them reported feeling detached from the faculty and other students in the class and lacking a sense of belonging.2 She concluded that continuous faculty-student and student-student interactions are essential components of successful online learning. McCann et al. likewise reported that students expressed the need for face-to-face interactions with faculty,3 while Garland found little difference in outcomes between dental hygiene students taking an infection control course via web-based modules versus classroom instruction.4 Another study that evaluated dental and dental hygiene students’ perceptions of effective teaching reported that the most frequently recurring theme was individual rapport.4 When comparing course grades, Gadbury-Amyot and Brockman found that dental students did much better in an online pharmacology course than the traditional course, but acknowledged that “It was clear from the student responses that this model of course delivery was not ideal for all students.”6

These studies are difficult to compare as there is little consensus on what learning outcomes should be assessed, resulting in ambiguity as to which teaching platforms students preferred over others. To complicate matters more, many studies did not use control groups or randomly assign students, thus introducing possible bias into the research.7 Studies outside of dental and dental hygiene education have reported mixed results: two found that face-to-face instruction was preferred over asynchronous and synchronous learning,8,9 another reported synchronous was preferred to asynchronous,10 and others found no difference between face-to-face and synchronous learning.11,12 Other studies found web-based learning to be preferred over face-to-face,7,13 while another found no difference.14
These types of studies have been critiqued regarding their reliability for a number of reasons. First, most of them were not well controlled because subjects were free to choose any method they desired and most will choose the method with which they are most comfortable. Second, some of the advantages touted for one method can also be found in other methods. Third, some studies confuse the delivery method with the instructional method. One delivery method may have been rated better, but it is actually the instructional method of the lecture that was more effective, not the delivery method. For these reasons, it is difficult to develop a consensus about what students preferred in regard to delivery formats.

The aim of our study was to assess whether the new technology employed by Lutheran Medical Center provided its postgraduate dental residents with a format that fostered their learning by comparing their perceptions of and preferences for face-to-face, synchronous, and asynchronous methods. This study will thus help to fill a void in what is known about dental postgraduate residents and how they learn new information.

**Methods**

The Department of Dental Medicine of Lutheran Medical Center operates the largest postdoctoral dental residency program in the world. In 2012, 219 dental residents in five general and specialty programs were placed in community health centers in thirteen contiguous U.S. states, along with Hawaii, Alaska, Puerto Rico, the U.S. Virgin Islands, and Trinidad and Tobago. The department integrated remote and participatory education into its core curriculum more than ten years ago. Lectures were given live and through compressed videoconferencing, and residents participated in a weekly “virtual classroom.” The distance-learning curriculum linked together all of Lutheran Medical Center’s affiliated dental clinics around the globe for simultaneous didactic learning and collaboration. Online forums were utilized for literature review and educational discussions of dental disciplines. As the program expanded to even more locations and time zones, new solutions were sought, and the Department of Dental Medicine implemented a Sakai learning management system (LMS). This LMS allows for collaborative teaching, learning, and research and provides residents with access to lectures and discussion forums twenty-four hours a day, seven days a week. Prerecorded lectures, consisting of PowerPoint presentations, audio explanations, and a transcription of the presentation, are accessed via the Internet. Handouts, articles, and outside readings are also linked to the lecture. Online forums are available where students can post questions or ideas. Residents can thus, whenever needed, self-engage in learning and re-learning concepts.

Institutional Review Board approval for the study was obtained from both the University of the Pacific and Lutheran Medical Center. The interventions being compared were face-to-face, synchronous, and asynchronous learning formats. In this study, face-to-face formats were lectures in which the student was in the same room as the presenter giving the lecture. Synchronous formats were lectures in which the student was watching a live lecture as it was given but was not in the same room as the presenter, although questions could be asked of the presenter during the lecture. Asynchronous formats consisted of prerecorded lectures that students could watch at a time and place of their choosing; students could email questions to the presenter or post them to the online forum.

The goal of this research was to examine preferences of postgraduate dental residents of Lutheran Medical Center regarding the three learning formats. Questions to be addressed were as follows: 1) How were certain independent variables, such as age, gender, prior experience with online learning, computer expertise, and comfort with the online format, related to perceptions of different learning formats? 2) Did residents’ perceptions of student-teacher interaction, student-student interaction, ability to learn in different formats, and comfort with different formats change after experiencing the various formats? 3) How important were the following in selecting a lecture type (and did they change): ability to review a presentation at a later time, ability to view a presentation at the student’s own pace, ability to view a lecture at the student’s chosen time and place, ability to ask questions of a live presenter during the lecture, and participation in a lecture that occurs at a set time and place? and 4) How did residents perceive particular formats in relation to the achievement of learning outcomes?

The subjects were first-year dental residents in the General Practice Residency, Advanced Education in General Dentistry, endodontic, and pediatric postgraduate programs of Lutheran Medical Center. All those residents were invited to enroll in this research project during their orientation; none were
had previously taken these lectures as a pilot test to ministered to second-year endodontic residents who before the study was begun, the surveys were administered online when the lecture series was given after each lecture to assess the effectiveness after experiencing the formats. An online survey was completed to assess if their perceptions had changed was administered online when the lecture series was considered the control condition.

As the traditional learning format, face-to-face was as well as constructing all the Sakai online modules. These consisted of a PowerPoint presentation, audio explanations of each slide, and a transcription of the presentation. An online forum was available for the residents to post questions or comments. After each of the ten lectures, the residents were required to take an exam multiple times until reaching this goal. The same presenter gave all the live lectures as well as constructing all the Sakai online modules. As the traditional learning format, face-to-face was considered the control condition.

A pretest survey was administered online before any lectures were given in order to assess the residents’ expectations about the effectiveness of the different teaching formats. A posttest survey was administered online when the lecture series was completed to assess if their perceptions had changed after experiencing the formats. An online survey was given after each lecture to assess the effectiveness of the teaching format for that particular lecture. (Contact the corresponding author for all surveys.) Before the study was begun, the surveys were administered to second-year endodontic residents who had previously taken these lectures as a pilot test to ensure clarity of the survey questions. For the study, an IT administrator collected the online surveys and had no contact with the residents. This administrator transferred only aggregate data, without any student identifiers, to the investigators. No identifiers were used when reporting the results, and all files will be deleted after three years.

The data were analyzed with IBM SPSS Statistics Version 20. Differences in groups were analyzed using the paired t-test or ANOVA for continuous variables. These included student-instructor interaction, student-student interaction, ability to learn (face-to-face, synchronous, asynchronous), comfort (face-to-face, synchronous, asynchronous), ability to review (at a later time, at my own pace), ability to choose time and place, ability to ask questions during lecture, and value of lecture occurring at a set time and place. Differences in groups were analyzed using the chi-square test for the following categorical variables: gender, age group, and level of computer expertise. A p-value of <0.05 was considered statistically significant.

The study was powered to detect a difference of 0.5 (SD 1.0) points on the rating scale, requiring a minimum of thirty-four residents per format. The power analysis for differences in demographic groups assumed a 30 percent difference in expert versus novice and preferences for set time and place, requiring a minimum of forty-two residents per group to achieve statistical significance. The number of residents enrolled was sufficient to meet these requirements.

Results

Out of the 219 residents, 169 (77 percent) participated in the surveys. Of these, 55 percent were female, and 45 percent were male. The ages ranged from twenty-three to fifty-six, with a mean age of 29.4. Almost 70 percent had previously taken an online course, and 13.5 percent rated their computer expertise as expert, 81.9 percent as intermediate, and 4.7 percent as novice. The only finding of gender significance was that females placed more importance on taking a course at a set time and place than did males. Thirty-nine women (56 percent) rated having a set time and place highly (4 or 5 rating), whereas twenty-one men (39 percent) did so (p=0.03).

Survey Results

In terms of level of computer expertise, those who rated their level of computer proficiency as expert were significantly more comfortable with the
online learning format than the other groups. On a 1-5 rating scale, with 1=lowest and 5=highest, nineteen self-defined experts (82.6 percent) rated their comfort level highly (4 or 5 rating), whereas eighty-seven self-defined intermediates (62.2 percent) and three self-defined novices (37.5 percent) rated it that highly (p=0.02). Those who rated their level of computer expertise as novice put significantly more importance on having a lecture that is given at a set time and place than did the other groups. Six self-defined novices (75 percent) rated having a set time and place highly (4 or 5 rating), whereas eleven self-defined experts (47.8 percent) and fifty-eight self-defined intermediates (41.4 percent) rated it that highly (p=0.03).

Student-teacher and student-student interaction. Before taking the lecture series, the participants were asked which teaching method they thought was most conducive for quality interactions. In this pretest, the residents rated face-to-face instruction highest for the quality of student-instructor and student-student interactions, followed by synchronous and then asynchronous methods (p<0.001). The survey after the residents took the lecture series showed that they still rated face-to-face instruction highest (p<0.001), but there was no significant difference between the synchronous and asynchronous formats (p=0.887 and p=0.137). After taking the lecture series, the residents rated the quality of student-instructor and student-student interaction in the synchronous and asynchronous formats significantly higher than before taking the lecture series (Table 1).

Ability to learn. After taking the lecture series, the residents rated their ability to learn highest in the face-to-face format (Table 2). However, they rated the asynchronous format significantly higher than the synchronous format, whereas before taking the lecture series, there was no difference between the two (p=0.21). The residents rated their ability to learn
The residents were also asked to rate the importance of certain factors when choosing an online format (synchronous or asynchronous). The residents evaluated these factors both before and after taking the lecture series, and the mean ratings were very similar in the two surveys. Table 4 shows the ratings for the factors, listed from most to least important.

Table 1. Comparison of residents’ ratings of quality of student-instructor and student-student interaction in synchronous and asynchronous formats from pre- to post-lecture

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean (SD)</th>
<th>Change</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student-instructor interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-lecture, synchronous</td>
<td>108</td>
<td>3.4 (0.80)</td>
<td>0.2</td>
<td>0.05</td>
</tr>
<tr>
<td>Post-lecture, synchronous</td>
<td>108</td>
<td>3.6 (1.0)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-lecture, asynchronous</td>
<td>114</td>
<td>3.1 (1.0)</td>
<td>0.4</td>
<td>0.004</td>
</tr>
<tr>
<td>Post-lecture, asynchronous</td>
<td>114</td>
<td>3.5 (1.2)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student-student interaction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-lecture, synchronous</td>
<td>110</td>
<td>3.1 (0.88)</td>
<td>0.4</td>
<td>0.003</td>
</tr>
<tr>
<td>Post-lecture, synchronous</td>
<td>110</td>
<td>3.5 (1.14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-lecture, asynchronous</td>
<td>115</td>
<td>2.7 (1.07)</td>
<td>0.5</td>
<td>0.002</td>
</tr>
<tr>
<td>Post-lecture, asynchronous</td>
<td>115</td>
<td>3.2 (1.4)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Rating scale ranged from 1=lowest to 5=highest.

Table 2. Comparison of residents’ post-lecture perceptions of their ability to learn in face-to-face, synchronous, and asynchronous formats

<table>
<thead>
<tr>
<th>Ability to Learn</th>
<th>N</th>
<th>Mean (SD)</th>
<th>Difference</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-lecture, face-to-face</td>
<td>76</td>
<td>4.2 (0.81)</td>
<td>0.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Post-lecture, synchronous</td>
<td>76</td>
<td>3.5 (0.98)</td>
<td>0.3</td>
<td>0.002</td>
</tr>
<tr>
<td>Post-lecture, face-to-face</td>
<td>82</td>
<td>4.2 (0.80)</td>
<td>0.3</td>
<td>0.002</td>
</tr>
<tr>
<td>Post-lecture, asynchronous</td>
<td>82</td>
<td>3.9 (0.98)</td>
<td>0.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Post-lecture, synchronous</td>
<td>116</td>
<td>3.5 (1.0)</td>
<td>0.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Post-lecture, asynchronous</td>
<td>116</td>
<td>3.9 (0.95)</td>
<td>0.4</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Note: Rating scale ranged from 1=lowest to 5=highest.

in the asynchronous format significantly higher after experiencing that format (p<0.001).

Level of comfort. After taking the lecture series, the residents were significantly more comfortable with the face-to-face and asynchronous formats than they were with the synchronous format. There was no statistical difference in comfort level between the face-to-face and asynchronous formats (Table 3).

Format effectiveness, presentation clarity, and technology. In terms of effectiveness and clarity of the presentations, the residents rated face-to-face and asynchronous formats statistically higher than the synchronous format. When asked how well the technology worked for each lecture, they rated the asynchronous format higher than both the face-to-face and synchronous formats (p<0.001). There was a direct relationship between the residents’ perceptions of how well the technology worked and the effectiveness of the lecture format. Similarly, there was a direct relationship between the residents’ perceptions of how well the technology worked and the clarity of the presentation (p<0.001).

Importance of factors in choosing online format. The residents were also asked to rate the importance of certain factors when choosing an online format (synchronous or asynchronous). The residents evaluated these factors both before and after taking the lecture series, and the mean ratings were very similar in the two surveys. Table 4 shows the ratings for the factors, listed from most to least important.

Qualitative Analysis

The residents were also asked what they found most useful about the lectures and if they had any suggestions for improvement. Qualitative assessment of their responses divided them into five main topics: lecture method, lecture content, lecturer (who delivered the content), the synchronous format, and the asynchronous format. For each topic, the comments were rated as either positive or negative. Table 5 shows representative comments for these topics.

The suggestions can be summarized as follows. Regarding lecture method, suggestions were to make the lecture interactive; include the off-sites
in the synchronous format; include clinical cases that students will commonly see in clinic; post the lecture beforehand or provide an outline; and use videos or live demonstrations instead of PowerPoint slides if they present the information in a more understandable way. Regarding lecture content, the suggestions were to include new postgraduate-level material and a review of important predoctoral concepts. Regarding the lecturer, suggestions were to be animated in delivery; present the information in a clear manner; and keep the audience’s physical comfort in mind. Regarding the synchronous format, comments indicated it was important to the residents to have the ability to view the presentation at their own pace and at a convenient time and place. It was also important to them to be able to review the lecture at a later time and to view any topic when they needed that information, and they appreciated being able to view a transcription of the entire lecture.

### Discussion

Previous studies have emphasized the importance of interaction in education and have asserted that learning is greatly dependent on interactions, collaboration, and social exchanges. A number of studies have also shown that higher levels of interaction between instructors and students or among...
Faculty members have been using technology in education for many years. The advent of online education has brought many new opportunities and challenges to the educational process. Technology can facilitate learning and improve student outcomes, but it can also detract from the learning experience if not used effectively.

The study was conducted to evaluate the impact of technology on student learning. The researchers surveyed students about their experiences using online resources and compared their results to traditional face-to-face teaching methods. They found that students who used technology in their education reported higher levels of engagement and satisfaction with the learning process. Additionally, they noted that technology allowed for greater flexibility in terms of time and location, which benefited students who had busy schedules or lived far from the location where the course was offered.

The study also highlighted some potential drawbacks of using technology in education. For example, some students reported feeling isolated and disconnected from their peers when using online resources. Additionally, some students struggled with accessing the technology or with the technical aspects of using it.

Overall, the study suggests that technology can be a valuable tool in education, but it should be used thoughtfully and effectively to support student learning. The researchers concluded that further research is needed to better understand the impact of technology on learning and to develop strategies for optimizing its use in education.

Table 5: Representative comments by residents about lecture method, lecture content, lecturer, synchronous format, and asynchronous format

<table>
<thead>
<tr>
<th>Positive Comments</th>
<th>Negative Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture method</td>
<td>Post the lecture up before actual presentation; that way we can follow/write notes.</td>
</tr>
<tr>
<td>I liked how Dr. Kunin made it interactive and provided examples on cases we would normally see in practicing clinical dentistry.</td>
<td>Maybe present more cases, including symptoms, radiographs, and have us diagnose the case.</td>
</tr>
<tr>
<td>Lecture content</td>
<td>I knew most or all of the information from predoctoral training.</td>
</tr>
<tr>
<td>The instructor provided various methods in which a canal can be cleaned and shaped. I found it very helpful and interesting as we were only taught limited methods in dental school.</td>
<td>A video or animation demo of obturations would be very helpful in visualization.</td>
</tr>
<tr>
<td>Reinforced what I had learned in dental school about pulpal diagnosis and treatment.</td>
<td>Lecture was starting to get a little long towards the end. I noticed a lot of people, including myself, started to get restless because of the long lecture.</td>
</tr>
<tr>
<td>Lecturer</td>
<td>Short clips and sounds are great, but if the technology isn’t working properly, and it’s not crucial to the presentation, it might be okay to just move forward.</td>
</tr>
<tr>
<td>He was dynamic and stuck to the main points without too much fluff. Good for long-term retention of information.</td>
<td>Once again, our site had difficulties with the technology and clarity of the presentation, which unfortunately took away from my ability to learn the material. We weren’t able to see the words (content) and radiographs well.</td>
</tr>
<tr>
<td>The content and the lecturer were excellent. Relevant information delivered in a clear manner with excellent real-life examples.</td>
<td>Fewer questions to distant sites. I understand the involvement thing, but the time it takes for questions to be asked and answers to be given is distracting.</td>
</tr>
<tr>
<td>Synchronous format</td>
<td></td>
</tr>
<tr>
<td>I liked the interaction between the different sites and going through different scenarios one by one and how we would appropriately treat them. The larger pool of participants contributed to some positive discussion.</td>
<td></td>
</tr>
<tr>
<td>Asynchronous format</td>
<td>I would have liked the ability to ask questions.</td>
</tr>
<tr>
<td>Being able to stop and start when I wanted. I like the ability to go at my own pace.</td>
<td></td>
</tr>
<tr>
<td>Control; allowing repetition where I need it—and glazing where I don’t.</td>
<td></td>
</tr>
<tr>
<td>I really enjoy the potential that the technology has to offer.</td>
<td></td>
</tr>
<tr>
<td>Being able to hear and see the lecturer and see the slide presentation is a very effective way to learn.</td>
<td></td>
</tr>
</tbody>
</table>

Students themselves resulted in greater learner motivation, more positive attitudes towards learning, and improved outcomes. Other studies reported that learner-teacher interaction was an important predictor of student satisfaction and success. We therefore concluded that student-instructor and student-student interactions were a primary metric to measure. We measured the residents’ perceptions of student-instructor and student-student interaction in the face-to-face, synchronous, and asynchronous formats, both before and after taking the lecture series. Before taking the course, the residents (as predicted) expected there would be the most interaction in the face-to-face format and that the online formats would be very limited. However, after experiencing the asynchronous format, their attitudes changed, and they rated it higher in terms of interaction, comparable to that in the synchronous format. In addition,
they seemed more satisfied with interaction in both the synchronous and asynchronous formats than they expected they would be before experiencing those learning modes.

When we assessed the residents’ perceptions of their ability to learn in the various formats, they rated the asynchronous format much higher after experiencing it. This finding disagrees with previous studies that reported student-faculty and student-student interaction were essential for successful online learning and learner satisfaction.\textsuperscript{2,10,20,21} The asynchronous format in our study had virtually no interaction and yet was rated very highly.

We also measured how comfortable the residents were with the various formats. The results showed that, after taking the lecture series, the residents seemed equally comfortable with the face-to-face and asynchronous formats. Their discomfort with the synchronous format may again have been due to trouble with the technology. This finding differed from Ward et al.’s study,\textsuperscript{12} which found the mean ratings for synchronous and face-to-face formats were consistently higher than those for the asynchronous format.

When evaluating format effectiveness and presentation clarity, we found that how well the technology worked had a direct influence on perceived format effectiveness and presentation clarity. These results agreed with Caruso and Kvavik,\textsuperscript{9} who found that, among students who had used a course management system, more than 75 percent reported a positive or very positive experience using the system and that they needed IT services that were reliable. Without basic reliability, students generally seem to feel they cannot count on the technology.

In addition, our study measured what was important to the residents when choosing a lecture format. Interestingly, what the residents thought was important when choosing a format did not change after experiencing the three formats. They viewed the ability to review what they learned and to view a presentation at their own pace as most important, followed by taking a lecture at a time and place of their choosing. Our results agreed with Grimes,\textsuperscript{2} who found similar results. Surprisingly, the residents in our study ranked as fourth the ability to ask questions of a live presenter during the lecture, followed only by the ability to take a lecture at a set time and place. These results agreed with other studies that found human interaction did not affect learning from web-based instruction and that learners can be just as successful in an online environment as in a face-to-face environment if not more so.\textsuperscript{14,22,23}

As we analyzed the results of the study, it became apparent that the older age group routinely selected 5 (highest on the 1-5 rating scale) for most of the questions. As this consistency called into question the validity of answers based on age, age was not taken into account in the analysis.

**Suggestions in the Comments**

Regarding lecture method, residents commented that the lecturer should try to make the lecture interactive, as most residents want to be involved in the lecture and enjoy the interaction among themselves. In a synchronous format, they noted it is important to include the off-site participants. There were comments, however, that calling on a site that was having transmission difficulties and having to wait for a response from them wasted time and detracted from the lecture. Participants also commented that the presenter should try to include clinical cases in the presentation—specifically, cases that the students will commonly see in clinic. This takes the lecture out of the classroom and makes it seem more practical to them. If a copy of the lecture is not posted beforehand, residents suggested that distributing an outline be considered, as it would let students know where the lecturer is while moving through the presentation and make it easier to see connections between the parts. Instead of explaining a certain topic for thirty minutes, they suggested showing a five-minute video, which would save time and probably be clearer.

The residents also made comments regarding lecture content and the lecturer. In a postgraduate program, they suggested presenters should try to balance new material with a review of important material taught in dental school. Since residents enter the program with various levels of education, they noted that the postgraduate program may be the last time the residents will hear this information so if they do not get it then, they never will. However, one participant noted that, by doing this, the lecturer should be prepared for comments that “I did not learn anything new. It was just a repeat of dental school.” Residents expressed an awareness that the lecturer cannot please everyone, but expected that all students should leave with at least the essential information. The residents also noted that the presenter must be excited about the topic since if the presenter is not excited, the residents will not be either. They empha-
sized that the content should be as clear as possible, asking, for example, if students did not know very much about the topic, would they still understand the lecture? No matter how great the contents of the lecture are, the residents pointed out the lecturer should know when it is time for a break. In addition, no matter how beneficial the video the lecturer wants to show, they commented that if the technology is not working, the lecturer should just move on.

In comments regarding the synchronous format, the residents noted they enjoyed interacting with their peers and discussing questions others raised. As they had all gone to different dental schools, they said they enjoyed learning what other schools taught and how graduates from those schools would handle certain situations. They emphasized that the reliability of the technology is of the utmost importance, noting there is nothing worse than traveling to participate in a lecture and not being able to connect to it due to faulty technology. Most students said they enjoyed the opportunity to ask questions during the lecture, though some noted it may be distracting for the lecturer and the other students. A suggestion was made that perhaps questions could be texted in, which the lecturer could address when it would be least disruptive. Another suggestion was to have a discussion board where questions could be posted and answered.

Regarding the asynchronous format, the residents said they appreciated the ability to view the presentation at their own pace, at a convenient time and place, and the ability to review parts at a later time. Since the Sakai system consists of a PowerPoint presentation, audio explanations, and a transcription of the presentation, the residents found it helpful to follow along with the transcription when listening to the lecture, as some of the audio files may not have been clear. Some residents noted that any who are visual learners will benefit from seeing the lecture, but it is important that the transcriptions are accurate. They also commented on the value of having all the lectures posted at the beginning of the lecture series, so residents are able to access any lecture that pertains to a patient they are treating and not have to wait until that lecture is given in a live situation.

Limitations and Implications of Study

This study measured residents’ perceptions, which introduces a degree of subjectivity that may not coincide with reality. Outcomes, such as an increase in test scores, were not evaluated. In addition, the failure of the technology seems to have played a role in the responses. The results may have been different had the technology worked well. Ward et al.\textsuperscript{12} quoted a respondent in their study observing, “The SIOI [Synchronous Interactive Online Instruction] application is often criticized because of frequent technological lapses,” and concluded, “the implication was that frequent user problems will brand the SIOI technology unfairly.” The same can be said about our experience with the synchronous format. Markova et al.\textsuperscript{24} found, however, that the residents in their study perceived the distance learning technology was implemented effectively and viewed distance learning as an important method for delivering didactic conferences.

The strengths of our study offset these limitations. The study was designed to address some of the criticisms offered by Clark,\textsuperscript{15,16} including participants’ being able to choose the delivery method with which they were most comfortable, leading to a lack of experimental controls. In addition, some studies confuse the delivery method with the instructional method. When the results showed a difference in the delivery method, it was really the educational method that was responsible for the difference.

The results of our study support the idea that an asynchronous curriculum would be beneficial in many different situations. As Keck et al.\textsuperscript{25} reported, numerous pediatric dental residency programs currently either lack faculty to teach the didactic portion of the curriculum or are not affiliated with a dental school. An asynchronous curriculum, once put in place, could solve this deficiency by serving as the basis for a postgraduate specialty syllabus. Furthermore, it could help expand postgraduate programs to areas that lack access to care. Local dentists, who may feel more comfortable supervising in the clinic than lecturing, could provide clinical coverage and make the didactic component available via the asynchronous format. This could make more specialists and clinicians available in Health Professionals Shortage Areas (HPSAs) where more practitioners are needed.

While using asynchronous instructional methods will not lead to a global, unified curriculum, it could allow schools to give their students access to the best presenters from other institutions. By pooling their intellectual resources, schools can provide their students with access to the best and brightest in their fields. These modules would be regularly updated, keeping the students up-to-date in the latest developments in all aspects of dentistry. Whereas
the survey by Andrews and Dcmpz found the least likely area for web-based learning implementation is graduate dental education, this study shows that an online curriculum is not only feasible but perhaps even preferred because of its advantages.

No one format is the ideal solution in an educational environment. As Hrastinski wrote, “instead of trying to determine the best medium, the e-learning community needs an understanding of when, why, and how to use different types of e-learning.” Perhaps a blended curriculum, as Paechter and Maier suggested, would be ideal since it incorporates the advantages of both synchronous and asynchronous technologies.

## Conclusion

This study found that the postgraduate dental residents preferred face-to-face and asynchronous formats to the synchronous format in terms of effectiveness and clarity of presentations. This preference was directly related to their perception of how well the technology worked in each format. The residents also rated the quality of student-instructor and student-student interactions in the synchronous and asynchronous formats significantly higher after taking the lecture series than they did before taking it. However, they rated the face-to-face format as significantly more conducive to student-instructor and student-student interaction. While the study found technology had a major impact on the efficacy of this curricular model, the results suggest that the asynchronous format can be an effective way to teach a postgraduate course.

## Acknowledgments

The authors thank Dean Lynn Beck of the University of the Pacific Gladys L. Benerd School of Education for her tremendous encouragement and support of this project from its inception. We thank Dr. Neal Demby, Director of Dental Medicine of Lutheran Medical Center, for his mentorship, leadership, and friendship. We thank Mr. Chad Bearden and the staff of Bear Den Designs for implementing the online surveys and for data-processing. This research represents Dr. Kunin’s partial fulfillment of the requirements for the degree of Master of Arts (M.A.) in Education from the University of the Pacific Benerd School of Education and AAL.

## REFERENCES


