Assessing the Impact of Voice-Over Screen-Captured Presentations Delivered Online on Dental Students’ Learning

Dieter J. Schönwetter, MA, PhD; Nicole Gareau-Wilson, BA, BEd; Rodrigo Sanches Cunha, DDS, MSc, PhD, FRCD(C); Isabel Mello, DDS, MSc, PhD, FRCD(C)

Abstract: The traditional lecturing method is still one of the most common forms of delivering content to students in dental education, but innovative learning technologies have the potential to improve the effectiveness and quality of teaching dental students. What challenges instructors is the extent to which these learning tools have a direct impact on student learning outcomes. The aim of this study was to assess the impact of a voice-over screen-captured learning tool by identifying a positive, nil, or negative impact on student learning as well as student engagement (affective, behavioral, and cognitive) when compared to the traditional face-to-face lecture. Extraneous variables thought to impact student learning were controlled by the use of baseline measures as well as random assignment of second-year dental students to one of two teaching conditions: voice-over screen-captured presentation delivered online and the traditional classroom lecture. A total of 28 students enrolled in the preclinical course in endodontics at a Canadian dental school participated in the study, 14 in each of the two teaching conditions. The results showed that, in most cases, the students who experienced the online lecture had somewhat higher posttest scores and perceived satisfaction levels than those in the face-to-face lecture group, but the differences did not achieve statistical significance except for their long-term recognition test scores. This study found that the students had comparable learning outcomes whether they experienced the face-to-face or the online lecture, but that the online lecture had a more positive impact on their long-term learning. The controls for extraneous variables used in this study suggest ways to improve research into the comparative impact of traditional and innovative teaching methods on student learning outcomes.

Dr. Schönwetter is Associate Professor and Director of Educational Resources and Faculty Development, College of Dentistry, Faculty of Health Sciences, University of Manitoba; Ms. Gareau-Wilson is Master of Education student, Department of Educational Administration, Foundations, and Psychology, Faculty of Education, and Academic Advisor, Student Academic Success, University of Manitoba; Dr. Cunha is Assistant Professor and Head, Department of Restorative Dentistry, College of Dentistry, Faculty of Health Sciences, University of Manitoba; and Dr. Mello is Associate Professor, Department of Dental Clinical Sciences, Faculty of Dentistry, Dalhousie University. Direct correspondence to Dr. Dieter J. Schönwetter, College of Dentistry, Faculty of Health Sciences, University of Manitoba, D09-780 Bannatyne Avenue, Winnipeg, Manitoba, Canada, R3E 0W2; 204-480-1302; Dieter.Schonwetter@umanitoba.ca.

Keywords: dental education, educational technology, teaching method, screen-captured learning tools

Submitted for publication 2/26/15; accepted 6/13/15

It is ironic in this age of modern dental practice, with state-of-the-art technologies used in the dental school clinics, that the preclinical preparation of students still relies heavily on face-to-face classroom lectures. Added to this incongruity is imbalance between increasing demand for the expertise of dental specialists (endodontists, for example) in dental schools and the decreasing number of specialists who pursue academic careers. As dental schools move towards adopting innovative technologies to address this deficit, it is critical to evaluate the technology’s potential impact on student learning. Too often innovative technologies are purchased without full consideration of their potential benefit for teaching and/or learning. Research on the benefits of innovative technologies tends to rely more on perceptions of students’ and teachers’ satisfaction, along with student self-reports such as attitudes, satisfaction, and interest and perceived learning and engagement, and less on hard measures of student learning outcomes. This study sought to address this gap by assessing one innovative technology’s direct impact on hard measures of student learning in terms of engagement, retention, and recall.

Over 50 types of Web-based learning technology applications are available to educators to enhance learning in the classroom. Of these, the most popular forms of software used in conjunction with PowerPoint to upload lectures to online classroom management systems are Camtasia (TechSmith Corp., Okemos, MI, USA), Adobe Captivate (Adobe Systems Inc., San Jose, CA, USA), and Articulate (Articulate Global Inc., New York, NY, USA). An extensive list of such innovative educational technologies can be found at http://tinyurl.com/kbpa3aj. Camtasia is a software suite for creating...
video tutorials. Camtasia Recorder allows audio-recording simultaneously with screen-capturing, so an educator can record live narration of an onscreen demonstration or presentation. Camtasia can also be used to edit existing static PowerPoint presentations to include audio, video, animations, and presenter screen captures. Adobe Captivate can similarly be used to revamp existing PowerPoint lectures by including actors, interactive elements, and quizzes. Captivate is used to create clinical software demonstrations or simulations, branched patient scenarios, randomized quizzes, screen captures, and Podcasts or to convert PowerPoint lectures into Adobe Flash format. Articulate Studio is a software extension of the PowerPoint program. Articulate includes three tools (Presenter, Engage, and Quizmaker), which allow users to quickly and easily create engaging courses, presentations, quizzes, and surveys through a comprehensive set of predefined interactions and customizable templates.

Studies have recently and increasingly included the quantifiable benefits of using learning technology in post-secondary settings, such as increased levels of student “soft” and “hard” measures of student learning. Soft or indirect measures of student learning include reported satisfaction and self-reported levels of student engagement, motivation, and interest. Even though self-reported student engagement may provide some sense of the impact of teaching, it in no way captures the three types of student engagement: affective, behavioral, and cognitive. Hard or direct measures of learning are less likely to be assessed and have included time spent on task, performance on exams, and final course grades. Moreover, these studies have focused on general learning outcomes and have not identified specific types of differences in terms of learning such as recall or recognition. The cognitive levels associated with recognition such as knowledge, comprehension, application, analysis, synthesis, and evaluation have not been assessed, nor have differences in terms of short- and long-term learning outcomes. Short-term learning refers to immediate learning usually assessed immediately following a lecture, whereas long-term learning is defined by learning that is sustained over a longer period and is often assessed by an exam well after a lecture has been given. Furthermore, these studies are not clear in their control of extraneous variables, including comfort in learning with technology, random assignment of students to different teaching conditions, controlling for students’ previous knowledge of lecture content, controlled methodologies that allow for comparisons of teaching methods such as live versus technologically mediated methods, and the lack of controlling for or ensuring the same content items presented across teaching methods.

This study focused on addressing each of these gaps by controlling for various extraneous variables. First, identical content items were used in both live and online teaching conditions. Second, participants were randomly assigned to one of the two teaching methods in order to control for variables associated with students (previous grades, aptitude for the content area, etc.). Third, a pretest was used to establish a baseline to compare prior knowledge of the content material with new material learned during the study. Fourth, both short- and long-term learning as well as different levels of learning such as knowledge, comprehension, and application were assessed. Fifth, student engagement was defined by three levels: affective, behavioral, and cognitive. The independent variable was the teaching method: a voice-over screen-captured learning technology using Articulate Studio and a live, face-to-face lecture. The dependent variables were short-term learning based on recall and recognition tests and long-term learning in the form of a recognition test, as well as student satisfaction, student attention to the lecture, perceptions of control and success of student learning, willingness to promote the lecture to other students, and perception of cognitive engagement. The aim of the study was to test the impact of the voice-over screen-captured learning tool Articulate Studio by identifying a positive, nil, or negative impact on student learning and student engagement as compared to the traditional lecture. The study was conducted at the University of Manitoba College of Dentistry.

Materials and Methods

The study was approved by the Bioethics Research Committee at the University of Manitoba. To test for the various influences of student differences, students’ gender, age, perceived comfort level learning from innovative technology, and prior knowledge of the content were identified. Students completed a pretest prior to the lecture to assess their prior knowledge of the content. This pretest included a five-minute free association test that prompted students to provide any words associated with the term “obturation.” The second part of the pretest included a multiple-choice or recognition test that assessed
three levels of cognition: four knowledge, four comprehension, and four application questions (contact the corresponding author for examples of questions). Short-term learning outcomes were assessed immediately following the lecture by recall and recognition tests, both identical to the pre-lecture test.

Indirect measures of learning were student engagement, satisfaction with the teaching method, and perceptions of success and control in the classroom environment. Student engagement was assessed based on the three dimensions of affective, behavioral, and cognitive. Affective engagement was inferred by students’ satisfaction with the instruction (e.g., “Your satisfaction with the voice-over presentation is best described as?”; 1=poor to 5=excellent) and their recommendation to encourage another student to attend a similar type of instruction in the future (e.g., “To what extent would you encourage other students to attend the lecture on obturation in endodontics?”; 1=not at all to 5=very much so). Behavioral engagement was measured by students’ self-report with time on task during the lecture (e.g., “To what extent did you attend to the voice-over presentation during the full hour?”; 1=not at all to 5=very much so). Cognitive engagement was assessed by indirect measures of learning outcomes such as student achievement on various measures of recognition and recall. The more a student was able to recognize and recall, the more he or she had attended to the lecture. A self-report measure of cognitive engagement was assessed by the extent to which students perceived that they attended to the lecture material presented (e.g., “To what extent did you attend to the lecture presentation during the full hour?”; 1=not at all to 5=very much so) and the extent to which the lecture assisted in increasing their cognitive engagement (e.g., “The extent to which the voice-over presentation impacted your cognitive engagement with the topic material is best described as”; 1=poor to 5=excellent).

Two 60-minute teaching conditions were created: the traditional live lecture, and the voice-over screen-captured lecture delivered online. To control for lecture presentation differences, the same 20 content items on obturation were presented in both lectures using the same PowerPoint slides. To maintain instructor consistency, the same instructor was used for both conditions. Articulate was utilized to create the voice-over screen-captured presentation. The final narrated lecture was placed onto Desire2Learn (a learning management tool) and was available to students during the study. The college lecture theater and the computer laboratory were designed to provide realistic environments in which to study the impact of the traditional and online teaching conditions. Participants are often highly motivated to provide explanations for the outcome of the achievement event in a realistic classroom setting.

As part of the preclinical course in endodontics, second-year dental students received a foundational lecture on obturation in the classroom in which the fundamentals of the endodontic technique were presented just prior to a preclinical experience. The students were randomly assigned to one of the two teaching conditions (Figure 1). They completed the pre-teaching baseline assessment. The traditional live lecture was presented by the last author (IM), an endodontic expert, to 14 students in the lecture theater. The voice-over screen-captured lecture, which was prerecorded by the last author, was presented online to 14 students in the computer lab hosted on the Desire2Learn system. The first author (DJS), an expert in online learning, facilitated this session to ensure that students had no challenges accessing the online lecture. The two sessions were conducted at the same time and for exactly one hour. Upon completion of the lecture for both teaching conditions, students gathered in the preclinical laboratory to complete the post-lecture assessments. Two months later, all students completed a final examination, which included multiple-choice items based on content from the lectures. The data were analyzed using one-way analysis of variance (ANOVA) and Bonferroni t-tests; statistical significance was set at p<0.05.

Results

A total of 28 students (seven females and 21 males) enrolled in the preclinical course in endodontics participated in the study, 14 in each of the two teaching conditions (traditional face-to-face lecture and online voice-over screen-captured presentation). The age of the students ranged from 20 to 34 years (M=25.46, SD=3.47).

Baseline Assessment: Controlling for Confounding Effects

Critical to this study was the fact that each of the content assessment questions successfully distinguished students who learned their material from those who did not learn it. Thus, questions in which all students got the answer correct were eliminated.
what unreliable, a quiz on the content in the form of a recognition and recall test was completed by students prior to the lecture.\textsuperscript{18,21} Again, no statistically significant differences were identified between the two groups in terms of the recognition or recall tests, indicating that students in both conditions had similar minimal knowledge about the content material presented in the study. There were also no statistically significant differences in students’ perceived comfort level in learning from lectures in the traditional classroom, students’ perceived comfort level in learning from lectures in an online format, or students’ perception that technology can enhance their learning. Thus, the potential confounding variables identified in this study were controlled for by the random selection of students to the two teaching conditions.

To control for potential confounding effects, tests were made on students’ awareness and experience with the content material presented and their perceived comfort level in learning from innovative technology. One-way ANOVAs (traditional lecture vs. online lecture) were conducted on each of the dependent variables (Table 1). No statistically significant differences were found in students’ self-reported awareness of the term “obturation in endodontics.” Since students’ self-reported knowledge is some-

---

**Figure 1. Linear flow diagram of procedures used in study**
Post-Teaching Assessment: Short- and Long-Term

Short-term learning outcomes were assessed by a recall and recognition test. A recall test, which assessed students’ learning of key lecture content concepts without any content clues, was conducted immediately following the lecture. A one-way ANOVA (traditional lecture vs. online lecture) demonstrated no statistically significant differences in terms of the recall test (Table 1). A recognition test in the form of multiple-choice questions assessed three levels of cognition: one item representing knowledge, two items representing comprehension, and three items representing application. (Originally, there were five items representing each of the three levels of cognition, but seven items were removed as the result of all students’ being able to answer those questions, which thus demonstrated poor discrimination power.) All three items were used in the recognition test. No statistically significant differences were found between the two conditions in the recognition test.

Indirect measures of learning included student engagement. Student engagement was assessed based on the three dimensions: affective (two questions), behavioral (one question), and cognitive engagement (three questions). Affective engagement was inferred by students’ satisfaction with the presentation and their recommendation to encourage other students to attend a similar type of presentation in the future. No statistical differences were found between the two conditions in terms of students’ satisfaction or recommendations. Behavioral engagement was assessed by students’ self-report on the extent to which they attended to the presentation during the full hour. No statistical differences were found between the two conditions in this self-report. Cognitive engagement was inferred by students’ perception of success and control over their learning as the result of the presentation and more specifically by a self-report on the extent to which the presentation impacted their cognitive engagement with the topic material. Again, no statistical differences were found between the two conditions in terms of students’ perception of success or control or the cognitive engagement self-report.

The third research question focused on the long-term learning impact of the teaching methods. A one-way ANOVA (traditional lecture vs. online lecture) demonstrated two statistically significant findings for long-term recognition test scores, as well as the difference between baseline and long-term recognition test scores (Table 1).

Overall Learning Across Teaching Methods

Given that minimal differences were observed between the two teaching conditions, the questions remained whether students actually learned from the lecture, regardless of the manner (traditional or online) in which it was presented. To test for this question, pre- versus post-presentation assessments of recall and recognition were conducted. The unit of analysis was the percentage of correct items on the recall from pre- to post-presentation and the percentage of correct items on recognition from pre- to short-term post- to long-term post-presentation. A one-way ANOVA (pre-presentation vs. post-presentation) demonstrated statistically significant differences in recall (Table 2). A one-way ANOVA (pre-presentation vs. short-term post-presentation vs. long-term post-presentation) demonstrated statistically significant differences in recognition (Table 3). Bonferroni t-tests demonstrated statistically significant differences on two of the three comparisons: pre-presentation versus post-presentation and pre-presentation versus long-term post-presentation.

Discussion

When student learning is assessed, it is usually based on short-term learning, such as a test following presentation of content. Less frequent are studies that also look at technology’s impact on long-term learning. The purpose of this study was to test the impact of the voice-over screen-captured learning tool Articulate Studio by identifying a positive, nil, or negative impact on student short- and long-term learning as well as students’ perceptions of engagement, success, and control as compared to the traditional face-to-face lecture. After carefully controlling for extraneous variables, confirming the validity of the test items, and ensuring that students did learn from the content presentation regardless of the method used, this study was able to discriminate differences based on the technology used to teach these students. The students who experienced the online lecture had higher long-term recognition scores than those who experienced the face-to-face lecture. This finding not only supports previous research that found technology enhanced student learning but also extends the research by identifying specific areas of learning: recognition and long-term learning. No differences were observed, however, in terms of levels
### Table 1. One-way analysis of variance (ANOVA) results (traditional lecture vs. online lecture) for each dependent variable

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>ANOVA</th>
<th>Online Lecture Group</th>
<th>Traditional Lecture Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-teaching baseline assessments: controlling for potential confounding effects</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Students' self-reported awareness of term “obturation in endodontics”</td>
<td>F(1,27)=1.99, MSE=2.89, p=0.17</td>
<td>M=2.71, SD=0.61</td>
<td>M=2.71, SD=0.83</td>
</tr>
<tr>
<td>2. Recognition test</td>
<td>F(1,27)=0.59, MSE=0.711, p=0.45</td>
<td>M=2.14, SD=0.95</td>
<td>M=2.43, SD=1.01</td>
</tr>
<tr>
<td>3. Recall test</td>
<td>F(1,27)=0.31, MSE=0.21, p=0.59</td>
<td>M=1.07, SD=0.92</td>
<td>M=0.86, SD=0.66</td>
</tr>
<tr>
<td>4. Students’ perceived comfort level in learning from lectures presented in traditional classroom</td>
<td>F(1,27)=1.91, MSE=2.89, p=0.17</td>
<td>M=4.21, SD=0.699</td>
<td>M=3.57, SD=1.56</td>
</tr>
<tr>
<td>5. Students’ perceived comfort level in learning from lectures presented in online format</td>
<td>F(1,27)=0.018, MSE=0.036, p=0.89</td>
<td>M=2.86, SD=1.41</td>
<td>M=2.93, SD=1.39</td>
</tr>
<tr>
<td>6. Students’ perception that technology can enhance their learning</td>
<td>F(1,27)=0.293, MSE=0.21, p=0.69</td>
<td>M=3.62, SD=1.87</td>
<td>M=3.09, SD=0.70</td>
</tr>
<tr>
<td><strong>Post-teaching assessments</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Recall test</td>
<td>F(1,27)=0.293, MSE=0.893, p=0.59</td>
<td>M=4.64, SD=1.15</td>
<td>M=5.00, SD=2.18</td>
</tr>
<tr>
<td>8. Recognition test</td>
<td>F(1,27)=0.301, MSE=0.321, p=0.59</td>
<td>M=2.57, SD=1.28</td>
<td>M=2.79, SD=0.70</td>
</tr>
<tr>
<td>9. Students’ satisfaction with the presentation</td>
<td>F(1,27)=1.16, MSE=1.39, p=0.29</td>
<td>M=3.15, SD=1.35</td>
<td>M=3.64, SD=0.67</td>
</tr>
<tr>
<td>10. Students’ recommendation to encourage other students to attend similar type of presentation in future</td>
<td>F(1,27)=1.49, MSE=1.87, p=0.24</td>
<td>M=3.08, SD=1.32</td>
<td>M=3.64, SD=0.81</td>
</tr>
<tr>
<td>11. Students’ self-report on extent to which they attended to the presentation during the full hour</td>
<td>F(1,27)=1.49, MSE=1.87, p=0.24</td>
<td>M=2.57, SD=1.28</td>
<td>M=2.79, SD=0.70</td>
</tr>
<tr>
<td>12. Students’ perception of success</td>
<td>F(1,27)=1.65, MSE=1.16, p=0.02</td>
<td>M=2.92, SD=1.04</td>
<td>M=3.36, SD=0.51</td>
</tr>
<tr>
<td>13. Students’ perception of control</td>
<td>F(1,27)=0.314, MSE=0.514, p=0.58</td>
<td>M=3.38, SD=1.61</td>
<td>M=3.09, SD=0.70</td>
</tr>
<tr>
<td>14. Students’ cognitive engagement self-report</td>
<td>F(1,27)=0.046, MSE=0.029, p=0.83</td>
<td>M=3.62, SD=0.87</td>
<td>M=3.55, SD=0.69</td>
</tr>
<tr>
<td><strong>Long-term post-teaching assessments</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Long-term recognition test scores</td>
<td>F(1,27)=3.93, MSE=7.51, p=0.05</td>
<td>M=5.71, SD=1.44</td>
<td>M=4.68, SD=1.32</td>
</tr>
<tr>
<td>16. Difference between baseline and long-term recognition test scores</td>
<td>F(1,27)=4.98, MSE=12.22, p&lt;0.05</td>
<td>M=3.57, SD=1.55</td>
<td>M=2.25, SD=1.58</td>
</tr>
</tbody>
</table>

### Table 2. One-way analysis of variance (ANOVA) results: pre-presentation and post-presentation

<table>
<thead>
<tr>
<th>Variable</th>
<th>ANOVA</th>
<th>Pre-Presentation</th>
<th>Post-Presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recall</td>
<td>F(1,54)=115.87, MSE=44.94, p&lt;0.0001</td>
<td>M=4.82, SD=3.96</td>
<td>M=24.11, SD=8.61</td>
</tr>
</tbody>
</table>

### Table 3. One-way analysis of variance (ANOVA) results: pre-presentation, post-presentation, and long-term post-presentation

<table>
<thead>
<tr>
<th>Variable</th>
<th>ANOVA</th>
<th>(A) Pre-Presentation</th>
<th>(B) Post-Presentation</th>
<th>(C) Long-Term Post-Presentation</th>
<th>Comparisons Using Bonferroni t-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognition</td>
<td>F(2, 83)=17.79, MSE=214.48, p&lt;0.0001</td>
<td>M=51.42, SD=19.35</td>
<td>M=65.93, SD=9.69</td>
<td>M=74.52, SD=13.23</td>
<td>A vs. B: p&lt;0.001 A vs. C: p&lt;0.0001 B vs. C: p&lt;0.09</td>
</tr>
</tbody>
</table>
of recognition such as knowledge, comprehension, or application. It is possible that the minimum number of items in each of these three areas were limited in extracting this complexity of learning differences.

In this study, learning outcomes assessed by recall tests demonstrated no statistical differences between the traditional and online lecture groups. This finding was the same for each of the indirect student learning outcomes (affective, behavioral, and cognitive engagement). This lack of significant difference is not surprising. By controlling for most extraneous variables and ensuring random assignment of students to the two teaching conditions, these results suggest that each of the two teaching conditions had an overall impact on student learning. In both lecture conditions, students learned the content in terms of short-term learning (tests immediately following the presentation) and long-term learning as demonstrated by recall and recognition performance two months later.

Although a number of steps were made to control for extraneous variables, there were limitations in this study that need to be addressed by future research. First, the cohort size was fairly small and limited to one school, so its results may not be generalizable to other groups of students. Also, in most cases, the students who experienced the online lecture had higher learning scores than those in the face-to-face lecture, but the differences did not achieve statistical significance. Larger sample sizes may allow for differences between these cohorts in future studies. Second, a number of test items that all students answered correctly had to be removed from the study and may have also influenced the outcomes. Future research needs to provide a larger sample of test items representing each of the three cognitive domains of knowledge, comprehension, and application in order to see if differences can truly be determined by the type of technology used in teaching students.

A third limitation comes from the fact that PowerPoint was used in both lecture conditions. The inclusion of a third condition—strictly live lecture without PowerPoint—would help to control for any influence the PowerPoint technology had in the face-to-face lecture. Fourth, as researchers are integrating technology into post-secondary courses to improve student engagement and learning outcomes, it would be of value to test the influence of other technology rather than just Articulate. Fifth, testing students’ affective engagement needs to be explored further in the future to include variables such as increased interest in the subject material. Each of these additions will enhance future research.

**Conclusion**

This study sought to assess the impact of an online voice-over screen-captured learning tool by identifying its impact on student learning and student engagement when compared to the traditional face-to-face lecture. The results showed that the students had comparable learning outcomes whether they experienced the face-to-face or the online lecture, but that the online lecture had a more positive impact on their long-term learning. The controls for extraneous variables used in this study suggest ways to improve research into the comparative impact of traditional and innovative teaching methods on student learning outcomes. Despite its limitations, this study thus provides important next steps in exploring the impact of technological teaching aids on students’ soft and hard learning outcomes.

**Acknowledgments**

Support for the study was provided through a University of Manitoba Teaching and Learning Enhancement Fund grant given to the first, third, and fourth authors.

**REFERENCES**