

Students distracted by electronic devices perform at the same level as those who are focused on the lecture

Background: Little is known about the characteristics of internet distractions that students may engage in during lecture and the objective of this pilot study is to identify some of the internet based distractions students engage in during in-person lectures. The findings of this pilot study will help to identify what activities most commonly cause students to be distracted from the lecture and if these activities impact student learning. **Methods:** In the current study, one class of third year students were surveyed after a lecture on special needs dentistry. The survey identified self reported utilization patterns of “smart” devices during the lecture. Additionally, fourteen quiz-type questions were given to assess the students’ recall of the important points of the lecture material that had just been covered. **Results:** 59.3% of the class checked their email during the lecture. Of those, 69% used their smart phone, 18% used their laptop and 13% used an iPad. A total of 14.8% checked their Facebook account during the lecture. All 27 students in the sample felt they learned the important learning points taught during the lecture. There were 14 questions related to the lecture materials and the proportion of the class that got each question correct is listed: Q1, 100%; Q2, 67%; Q3, 70%; Q4, 93%; Q5, 82%; Q6, 78%; Q7, 85%; Q8, 41%; Q9, 89%; Q10, 37%; Q11, 96%; Q12, 56%; Q13, 89%; Q14, 100%. Overall mean score for the post-lecture quiz was 77% **Conclusions:** Every class member felt that they acquired the important learning points during the lecture but the mean score in a post-test was 77% with only 37% of the class getting certain questions correct. However, those who were distracted by electronic devices during the lecture performed similarly to those who were not. Educational institutions should perform thorough cost-benefit analysis, including evaluation of educational outcomes, before abandoning traditional lecture for modern educational strategies.

1 **Students distracted by electronic devices perform at the same level as those who are focused**
 2 **on the lecture**

3 Romesh P. Nalliah BDS¹, Veerasathpurush Allareddy BDS MBA MHS MMSc PhD²

4 1- Instructor, Department of Global Health, Harvard School of Dental Medicine, Boston,
 5 MA, 02115

6 2- Associate Professor, Department of Orthodontics, College of Dentistry – The University
 7 of Iowa, Iowa City, IA 52242.

8 **Key words:** Flipped class room, learning methods, dental education

9 **Please address correspondence and reprint requests to**

10 Veerasathpurush Allareddy

11 Department of Orthodontics

12 University of Iowa – College of Dentistry

13 Email: Veerasathpurush-Allareddy@uiowa.edu

14 Telephone: 319-353-5806

15 ABSTRACT

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38 INTRODUCTION

39 Most students currently enrolled in dental schools in the United States (US) were born in
40 the 1980's or 1990's.^{1,2} This generation is referred to as Generation Y and they function very
41 differently to previous generations of dental students. Research in dental hygiene education has
42 shown that Generation Y students revel in group work and are sagacious technology users.³ It
43 would seem that traditional lectures, which isolate students and deny them the opportunity to
44 work and may be in conflict with the way Generation Y likes to operate. Anecdotally, most
45 lecturers recognize that many students become distracted with activities on their laptop or other
46 electronic devices and it is not know how this impacts learning.

47 Previous research has shown that passively listening to lectures is less effective than being
48 engaged in a lecture where the student must solve "retrieval" questions that require them to go
49 back to the information and find the answers.⁴ The flipped classroom model is based on this
50 concept and retrieval questions and discussions are during the classroom session. Generation Y
51 students also have a proclivity to multitask and a need for immediate feedback³ which the
52 retrieval questions would provide. It is not currently known if multitasking during lectures
53 impacts learning outcomes. Lectures are designed to be uni-tasking experiences that require the
54 student to be fully engaged in the verbal and (sometimes) visual dissemination of information.
55 Traditional lectures do not support multitasking activities, and, may actually be in conflict with
56 them.

57 The concept of a Flipped Classroom (FC) is not new. Dr Eric Mazur is accredited with the
58 first experimentations with FC in the early 1990's.⁵ FC is the transfer of lecture material to online
59 video format that enables classroom time to be used for discussion and hands-on activities that
60 enhances the learning experience. Another approach that may help keep students engaged during
61 classroom time is the use of "clickers." These devices enable "clicking" yes or no answers to
62 questions posed by the lecturer. Research has shown that participation in the use of "clickers" in

63 lecture equips students to solve exam questions better.⁶ Notably, there was no clear correlation
 64 between the percentage of “clicker” answers that were correct and exam results. Little is known
 65 about the characteristics of internet distractions that students may engage in during lecture and
 66 the objective of this pilot study is to identify some of the internet based distractions students
 67 engage in during in-person lectures. The findings of this pilot study will help to identify what
 68 activities most commonly cause students to be distracted from the lecture and if these activities
 69 impact student learning.

70 METHODS

71 The current study is a pilot cross-sectional study at Harvard School of Dental Medicine.
72 Harvard School of Dental Medicine - Harvard Medical School Institutional Review Board
73 approval was obtained for this study. A traditional lecture (on special needs dentistry) was
74 delivered and a post-lecture questionnaire was administered to a 3rd year class at HSDM. After
75 the traditional lecture, a post-session questionnaire was administered which included 14 multiple
76 choice quiz questions relating to the lecture content to evaluate how effectively students learned
77 the information in the lecture. The post-session quiz measured understanding and knowledge of
78 the important concepts from the lecture. For the purpose of this lecture, we felt that scores less
79 than 100% meant that the student failed to learn all important concepts. Subsequently, we
80 grouped students as “grasping all important concepts (scoring 100%)” or “failing to grasp all
81 important concepts correctly (less than 100%).” The post-session questionnaire also has several
82 questions about what electronic activities students were engaged in during the lecture. Simple
83 descriptive data is presented.

84 RESULTS

85 There were 27 students (67% female) who participated in this lecture. One student did not
86 complete the questionnaire and this was omitted from the evaluation. There were 14 post-lecture
87 multiple choice questions related to the lecture materials and the proportion of the class that got
88 each question correct is: Q1, 100%; Q2, 67%; Q3, 70%; Q4, 93%; Q5, 82%; Q6, 78%; Q7, 85%;
89 Q8, 41%; Q9, 89%; Q10, 37%; Q11, 96%; Q12, 56%; Q13, 89%; Q14, 100%. The overall mean
90 score on the post-lecture content test was 77% but 100% of students believed that they
91 understood the most important points from the lecture [table 1]. During the lecture, 59% reported
92 that they checked their email and 11% reported sending an email. Of those who checked their
93 email 69% used their smart phone, 18% used their laptop and 13% used an iPad. Fifteen percent
94 of the class reported checking their Facebook account during the lecture and 8% reported sending
95 a text message.

96 Quiz results for students who were distracted during lecture and for those who were not
97 distracted during lecture are summarized in tables 2 and 3 respectively. Seventeen students (65%
98 of class) reported being distracted by electronic resources during the lecture. Of these students,
99 59% still answered all questions correctly in the post-session quiz and 41% had at least one
100 incorrect answer. Nine students (35% of class) reported not being distracted by electronic
101 resources during the lecture. However, only 56% answered all questions correctly and 44% had at
102 least one question incorrect.

103 DISCUSSION

104 The Khan Academy is an internet based non-profit organization⁷ that provides free
105 education on various topics. Its popularity has grown dramatically with the ease of access through
106 the internet. Similarly, the world renown Massachusetts Institute of Technology's open
107 courseware is freely available to anyone who has internet access.⁸ Lecture theaters used to be the
108 only source of information but the direction education is moving is readily available information
109 that is convenient and accessible at times when the learner wants to learn. Harvard School of
110 Dental Medicine (HSDM) is undergoing major curricular changes including the introduction of
111 the Flipped Classroom (FC) mode of teaching. Current generations of students are thought to
112 require more engaged teaching modalities.⁹ In fact, a Pew report found that 87% of teachers
113 believed modern technology was creating an easily distracted generation of students with short
114 attention spans. Another Pew study showed that 24% of Generation Y report that technology use
115 is what makes their generation unique.¹⁰ However, little is known about the impact on learning of
116 being distracted by technology during lecture. This paper reports outcomes of a small study that
117 was designed to evaluate the learning outcomes of a traditional lecture among Generation Y
118 students.

119 In the current study, students attended a traditional lecture and were given a post-test
120 about the lecture topic and a questionnaire. The questionnaire asked the students whether they
121 checked/sent email, checked Facebook accounts or sent text messages during the lecture.
122 Certainly, there is a possibility that students were not completely honest with their answers and
123 our findings may be an underrepresentation of the actual amount of involvement with electronic
124 devices and the internet that was unrelated to the lecture. We found that 59% of students checked
125 their email; 11% sent an email; 15% checked their Facebook account and 8% sent a text message
126 during the lecture. Remarkably, the "distracted" group (those that engaged in one of these
127 activities during the lecture) performed similarly well in the post-test to the undistracted group.

A total of 64.4% of the class reported engaging in “distracting” behavior such as emailing, using Facebook or texting. Nonetheless, 100% of the students believed that they had understood the important concepts discussed in the lecture. However, the mean score in the post-test was 77% and, in some questions, only 37% of students knew the correct answer. The major concern is that all students believed they understood the important concepts but there were three questions in the post-test where less than 60% knew the correct answer. Overall learning outcomes were not ideal, however, the group that reported being distracted performed similarly to the group that said they were not distracted. Existing research concurs with this finding and reports that media multitasking was not related to self-reported difficulties in distractibility.¹¹ In the current study, 58.8% of the “distracted” group and 55.6% of “non-distracted” answered all questions correctly. However, when considering our study results by gender there was an important difference.

Notably, in the current study all males who were engaged in a “distracting” behavior scored 100% in the post-test. However, among females engaged in “distracting” behaviors and only 50% got all questions correct. Our pilot study is small and there is insufficient statistical power to demonstrate that men multitask better during dental school lectures, however, it is interesting that males seemed to outperform females when “distracted” during the current study. This finding is in conflict with several articles in the media¹²⁻¹⁴ but concurs with one previous scientific study.¹⁵ It may be possible that multitasking during a lecture does not significantly affect learning among males but does reduce learning among females. Larger studies are necessary to evaluate this further.

An interesting study comparing emergency room (ER) doctors to regular ward doctors found that ER doctors switched tasks more frequently. However, ward doctors multi-tasked more frequently than ER doctors.¹⁶ It seemed from the study that safety may be implicit in task-switching and multitasking decisions. In the current study of dental students, we found that multitasking didn’t necessarily have a negative impact on learning performance as those who were

153 “distracted” and those who were not performed similarly on post-test.

154 Since current generations of students are very comfortable with technology and often
155 have their electronic device near them, some thought should be given to the integration of these
156 devices as learning tools for medical and dental students as they transition to independent
157 practice. More research is necessary to evaluate patient perception of electronic device use by
158 doctors and the merits of including appropriate use of electronic devices during education and
159 patient visits.

160 Additionally, caution should be used when embracing new methods of teaching. The
161 current study shows that students who became distracted during a traditional lecture performed
162 similarly to those who were not. Educational outcomes and costs to the institution should be
163 thoroughly considered when implementing curricular changes. Larger studies that compare
164 educational outcomes of traditional lectures to other modalities of teaching will help determine
165 the place of the traditional lecture in modern curricular.

166 CONCLUSIONS

167 Sixty four percent of students in a traditional lecture reported being distracted by email, Facebook
168 or text messages. Those who were distracted during the lecture performed similarly in the post-
169 lecture quiz to the undistracted group. However, males who were distracted outperformed
170 females who were distracted.

171 REFERENCES

- 172 1. Pew Internet and American Life Project. Generations 2010. Washington, DC: Pew
173 Research Center;2010. 29 p.
- 174 2. Elam C, Stratton T, Gibson DD. Welcoming a new generation to college: the millennial
175 students. J Col Admis. 2007;Spring(195):20-5.
- 176 3. Blue CM. Do dental hygiene students fit the learning profile of the millennial student? J
177 Dent Educ. 2009;73(12):1372-8.
- 178 4. [Karpicke JD](#), [Blunt JR](#). Retrieval practice produces more learning than elaborative
179 studying with concept mapping. Science. 2011 Feb 11;331(6018):772-5. doi:
180 10.1126/science.1199327. Epub 2011 Jan 20.
- 181 5. Harvard University website. Accessed 2/10/14 and available at
182 <http://mazur.harvard.edu/emdetails.php>
- 183 6. [Levesque AA](#). Using clickers to facilitate development of problem-solving skills. CBE
184 Life Sci Educ. 2011 Winter;10(4):406-17. doi: 10.1187/cbe.11-03-0024.
- 185 7. Khan Academy Website. Accessed 2/4/14 and available at
186 <http://www.khanacademy.org/about>
- 187 8. Massachusetts Institute of Technology website. Accessed 2/4/14 and available at
188 <http://ocw.mit.edu/about/>
- 189 9. Pew study. [http://www.pewinternet.org/2012/11/01/how-teens-do-research-in-the-digital-](http://www.pewinternet.org/2012/11/01/how-teens-do-research-in-the-digital-world/)
190 [world/](http://www.pewinternet.org/2012/11/01/how-teens-do-research-in-the-digital-world/)
- 191 10. [http://www.pewsocialtrends.org/2010/02/24/millennials-confident-connected-open-to-](http://www.pewsocialtrends.org/2010/02/24/millennials-confident-connected-open-to-change/)
192 [change/](http://www.pewsocialtrends.org/2010/02/24/millennials-confident-connected-open-to-change/)
- 193 11. [Ralph BC](#), [Thomson DR](#), [Cheyne JA](#), [Smilek D](#). Media multitasking and failures of
194 attention in everyday life. Psychol Res. 2013 Nov 1. [Epub ahead of print].

12. Huffington Post website. Accessed 2/15/14 and available at
http://www.huffingtonpost.com/2013/10/29/women-better-than-men-multitasking-study-finds_n_4175470.html
13. Live Science website. Accessed 2/15/14 and available at
<http://www.livescience.com/40740-women-better-at-multitasking.html>
14. National Geographic website. Accessed 2/12/14 and available at
<http://news.nationalgeographic.com/news/2013/13/131101-multitasking-women-productivity-psychology/>
15. [Mäntylä T](#). Gender differences in multitasking reflect spatial ability. Psychol Sci. 2013 Apr;24(4):514-20. doi: 10.1177/0956797612459660. Epub 2013 Mar 5.
16. [Walter SR](#), [Li L](#), [Dunsmuir WT](#), [Westbrook JJ](#). Managing competing demands through task-switching and multitasking: a multi-setting observational study of 200 clinicians over 1000 hours. BMJ Qual Saf. 2013 Oct 17. doi: 10.1136/bmjqs-2013-002097. [Epub ahead of print].