RESEARCH

Impact of Electronic Device Use in Class on Pharmacy Students’ Academic Performance

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Objectives. To evaluate and assess the impact of pharmacy students’ electronic device (e-device) use during a lecture-based pharmacotherapeutics sequence.

Methods. A validated survey instrument to assess e-device use was e-mailed to 238 second- (P2) and third-year (P3) pharmacy students. Grades were reviewed retrospectively and correlated with e-device use to determine its impact on academic performance.

Results. Of 140 responding students (59% response rate), 106 reported using e-devices during class for course-related (91.5%) and non-course-related (81.1%) activities. When P2 and P3 students were combined, e-device use was not associated with academic performance ($p = 0.70$). Academic performance was not impacted among P3 students ($p = 0.86$), but P2 students performed better academically if they refrained from using e-devices during class (mean grade $= 88.5\%$ vs. $83.3\%; p = 0.019$).

Conclusions. The impact of e-device use on overall academic performance was negligible. Use of e-devices by students enrolled in their first pharmacotherapeutics course may negatively impact academics.

Keywords: electronic device, learning, technology, student

INTRODUCTION

The use of electronic devices (e-devices) such as laptop computers, smart phones, and tablets in daily activities is common, and the use of these devices by this generation of pharmacy students during class appears to be increasing. Some pharmacy colleges and schools are mandating that students use mobile computing devices in class to keep up with advances in education technology and to augment lecture content. Computer-assisted learning can increase knowledge and comprehension, but one of the biggest disadvantages of using e-devices in class is students engaging in non-course-related activities such as sending and checking e-mail and accessing material on the Internet.

Some academicians believe that non-course-related use of e-devices is detrimental to learning and may interfere with the learning environment of others. In support of this view, some students have reported that laptop use during class is distracting and interferes with their ability to learn. Despite some students’ negative perceptions, laptop use has not been associated with poorer academic performance among non-laptop users. To eliminate distractions, some faculty members have banned the use of e-devices during class, or restricted use to certain times, but this can be difficult to enforce. Others have considered blocking cell phone signals to lecture halls.

In contrast, some faculty members argue that because this generation of students is so accustomed to using these devices, we should embrace their use in the classroom. Furthermore, with healthcare providers of all disciplines now using e-devices in practice, and with many patients expecting their providers to use these devices, integration of e-devices into the classroom can be viewed as good preparation for future practice. The University at Buffalo School of Pharmacy and Pharmaceutical Sciences has no policy concerning student use of e-devices during class, although some faculty members have discouraged inappropriate use of these devices such as for social networking and checking personal e-mail.

While the type, nature, and extent of e-device use in the pharmacy classroom has been previously reported, the perceived and actual impact of e-device use on overall course performance is unknown. The primary objective of this study was to evaluate the impact of e-device use by doctor of pharmacy (PharmD) students during class on academic performance. The secondary objectives were to discern the type, nature, and extent/frequency of e-device use by pharmacy students during a pharmacotherapeutics...
sequence, and to evaluate the perceived impact of e-device use by pharmacy students on their learning.

METHODS

This study consisted of 2 parts: (1) survey evaluation of students’ self-reported use of e-devices during class and perceived impact on learning, and (2) retrospective analysis of final course grades to measure academic performance. Two pharmaco therapeutics courses were chosen as the setting in which to conduct this investigation because they were the school’s “flagship” courses for therapeutics, they were mandatory for all PharmD students, grades were easily attainable through the pharmacy practice department, and for the most part, the classes were administered in large-lecture format.

For the purposes of this study, an e-device was defined as a cellular or smart phone, personal digital assistant, laptop or netbook computer, tablet, e-book reader, MP3 player, or iPod (Apple, Cupertino, CA). Audience response devices (ie, “clickers”) were excluded as an e-device because (1) some but not all instructors integrated their use into the classroom and (2) the devices used at the university were quite basic and could not be used for non-course-related activities.

A 24-item survey instrument consisting of questions regarding use and perceptions about e-devices was developed by the investigators. For validation purposes, the survey instrument was sent to 24 fourth-year PharmD students who had completed the courses in previous years and agreed to provide feedback. Based on their responses and on subsequent feedback for a revised survey instrument pilot tested by 18 of the same students, the authors condensed the final survey instrument to 20 multiple-choice questions and ranking items using a Likert scale.

A link to the survey instrument distributed via Survey Monkey (www.surveymonkey.com, Portland, OR), was sent to all second- (P2) and third-year (P3) PharmD students (n=238) enrolled in Pharmaco therapeutics I and Pharmaco therapeutics III, respectively, during the 13th week of the fall 2011 semester. Four reminder e-mails were sent weekly thereafter. Students simultaneously enrolled in both courses were excluded. Participation in the survey was voluntary and anonymous. Definitions for course-related and non-course-related uses of e-devices were available to students. Students provided the last 5 digits of their university person number, which was used to assign a research number to crosslink survey data and course grades. A non-faculty staff member assigned research numbers and entered grades into a data sheet so they were de-identified for the investigators for data analysis.

A retrospective analysis of student grades was performed following completion of the course. Mean and median numerical course grades were calculated for all students who consented to participate. Overall use of e-devices was correlated with final mean course grades to evaluate the impact of any e-device use on academic performance. The impact of e-device use on academic performance was also assessed for each course independently because the academic years of the students enrolled were different, and instructor/teaching methodology, level of difficulty, and grading tendencies may have varied between the 2 courses.

The impact e-device use had on academic performance was assessed using the Kruskal-Wallis test to compare mean numerical course grades between e-device users and non-users. The type, nature, and frequency/extent of e-device use were reported descriptively. Median Likert scores were reported for questions using a forced-ranking scale. Chi-square was used to compare overall e-device use and the Fisher exact test was used to analyze e-device use within each course independently. For statistical tests, a p value <0.05 was deemed significant. Statistical analyses were performed using SYSTAT 13 for Windows (SYSTAT Software Inc., Chicago, IL). This study was approved by the University at Buffalo Social and Behavioral Sciences Institutional Review Board.

RESULTS

One hundred forty-two of 238 students completed the survey instrument. Two of the 142 students were excluded due to simultaneous enrollment in both courses, resulting in a final sample size of 140 students (59% response rate). Most (98%) students in this study were born after 1981, indicating the respondents were predominantly from the millennial generation (Table 1). The final mean numerical course grade among students enrolled in the study was similar to the final mean numerical course grade for all students enrolled in the courses (89.7% vs. 88.7%, respectively).

One hundred six (75.7%) respondents had used an e-device during class during that semester’s pharmaco therapeutics course. A cellular/smart phone (84%) and a laptop/netbook computer (67%) had the highest reported prevalence of use. Use of e-devices was more common among P3 students enrolled in Pharmaco therapeutics-III (82.9% vs. 67.2%; p = 0.047).

When students in Pharmaco therapeutics-I and Pharmaco therapeutics-III were grouped, the final mean course grades for students using and not using an e-device during class were similar (89.5% vs. 90.6%, respectively; p = 0.70; Table 2). There was no difference between the final mean course grades for students using e-devices and
those not using e-devices to do either course-related activities ($p = 0.86$) or non-course-related activities ($p = 0.94$). When the courses were analyzed independently, no difference in academic performance was found between P3 students enrolled in Pharmacotherapeutics-III who did and those who did not use an e-device during class for any purpose ($p = 0.86$), for course-related activities ($p = 0.71$), or for non-course-related activities ($p = 0.99$). However, for P2 students enrolled in Pharmacotherapeutics-III, the mean course grade was lower among those who used an e-device during class for any purpose (83.3% vs. 88.5%; $p = 0.02$). There was no significant difference in mean course grade between P2 students who used an e-device for course-related reasons, 79.4% did so to view course materials, 77.3% to research topics discussed in class, and 61.9% to take notes. The two most common reasons for using e-devices for non-course-related reasons was to send/check e-mail (89.5%) and text messaging (86.0%), with 3.9% and 13.5% of students doing so more than 5 times per class, respectively. Other common reasons included social networking (59.3%) and using the Internet (55.8%), with 5.9% and 8.3% of students doing so for more than 25% of class time, respectively. Other less common activities in which students engaged during class included doing work for other classes or professional organizations, shopping online, gaming, viewing videos, and listening to music.

While 69.1% of students reported that using an e-device in class for course-related activities somewhat or strongly enhanced their ability to learn course material, 27.8% reported that using e-devices for course-related activities somewhat or strongly diminished their ability to pay attention during class. The majority of students (58.1%) acknowledged that using an e-device during class to do non-course-related activities somewhat or strongly diminished their ability to pay attention. However, the

### Table 1. Demographics of Pharmacy Students Who Participated in a Survey Regarding e-Device Use and Perceptions of Use During Class

<table>
<thead>
<tr>
<th>Variable</th>
<th>Respondents, No. (%)</th>
<th>N = 140</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pharmacotherapeutics-I</td>
<td>64 (45.7)</td>
<td></td>
</tr>
<tr>
<td>Pharmacotherapeutics-III</td>
<td>76 (54.3)</td>
<td></td>
</tr>
<tr>
<td>Prepharmacy education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early assurance</td>
<td>75 (53.6)</td>
<td></td>
</tr>
<tr>
<td>&gt;= 2 years prepharmacy</td>
<td>10 (7.1)</td>
<td></td>
</tr>
<tr>
<td>Bachelor’s degree or higher</td>
<td>55 (39.3)</td>
<td></td>
</tr>
<tr>
<td>Year of birth</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Before 1982</td>
<td>3 (2.1)</td>
<td></td>
</tr>
<tr>
<td>1982 or later</td>
<td>137 (97.9)</td>
<td></td>
</tr>
</tbody>
</table>

* Early assurance students are guaranteed a spot in the school provided they keep their grade point average above a pre-specified minimum and pass an entrance interview.

Table 2. Differences in Course Grades Between Pharmacy Students Who Reported Using or Not Using E-Devices During a Pharmacotherapeutics Course

<table>
<thead>
<tr>
<th>E-device use for any purpose</th>
<th>Course Grade of Respondents Who Used e-Devices, Mean (Median)</th>
<th>Course Grade of Respondents Who Did Not Use e-Devices, Mean (Median)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>89.5 (90.9)</td>
<td>90.6 (90.8)</td>
</tr>
<tr>
<td>PT-I</td>
<td>83.3 (84.5)*</td>
<td>88.5 (89.1)*</td>
</tr>
<tr>
<td>PT-III</td>
<td>93.7 (95.1)</td>
<td>93.9 (94.6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>E-device use for course-related activities</th>
<th>Course Grade of Respondents Who Used e-Devices, Mean (Median)</th>
<th>Course Grade of Respondents Who Did Not Use e-Devices, Mean (Median)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>89.5 (90.8)</td>
<td>89.6 (91.6)</td>
</tr>
<tr>
<td>PT-I</td>
<td>82.3 (83.1)</td>
<td>89.1 (89.4)</td>
</tr>
<tr>
<td>PT-III</td>
<td>93.9 (95.0)</td>
<td>90.7 (96.3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>E-device use for non-course-related activities</th>
<th>Course Grade of Respondents Who Used e-Devices, Mean (Median)</th>
<th>Course Grade of Respondents Who Did Not Use e-Devices, Mean (Median)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>89.4 (90.7)</td>
<td>90.0 (92.0)</td>
</tr>
<tr>
<td>PT-I</td>
<td>82.6 (84.0)</td>
<td>85.7 (85.5)</td>
</tr>
<tr>
<td>PT-III</td>
<td>93.8 (95.2)</td>
<td>93.9 (95.5)</td>
</tr>
</tbody>
</table>

PT-I = Pharmacotherapeutics I; PT-III = Pharmacotherapeutics III

* Comparison of mean grades between respondents who did and did not use e-devices, $p = 0.02$ as calculated using the Kruskal-Wallis test.
Instructor intolerant of e-device use 3.5
Instructor tolerant of e-device use 40.7
High likelihood of being called on
Low likelihood of being called on
Teaching style is engaging 2.3
Teaching style is not engaging 74.4
Instructor uses active
during class 51.2
lecture format
Instructor uses active learning modalities 24.4
Teaching style is not engaging 74.4
Teaching style is engaging 2.3
Low likelihood of being called on during class 41.9
High likelihood of being called on during class 4.7
Instructor tolerant of e-device use 40.7
Instructor intolerant of e-device use 3.5

a Responses of “somewhat likely” and “very likely” were combined.
e-device use during class may be beneficial if used appropriately. Similar to previous reports, course-related use is perceived by students to enhance their ability to learn the course material, although using an e-device to carry out activities that are unrelated to the course may be a distraction.5-8,13 Structured in-class use of laptops, such as for taking notes and focusing on course-related activities, is one way that faculty members can reduce distractions and keep students on task.15 In addition, classroom policies restricting laptop use to specific zones of the classroom are preferred by both laptop users and paper notetakers.11

There are several limitations to this study. Student learning styles and instructor teaching styles used in the Pharmacotherapeutics I and III courses may have differed, potentially resulting in different e-device use and/or academic performance between P2 and P3 students. Also, because of attention given to the issue of e-device use in the classroom (including within other courses in our school’s curriculum), students who participated in the survey may have underreported their use of e-devices during class, especially for non-course-related reasons. Nevertheless, the frequency/rate of e-device use reported in this survey is still higher than previous reports. However, students answered the questions regarding time spent and frequency of e-device use based on recall rather than objective documentation. Individual frequencies, durations, and purposes of e-device use may have confounded the results, and this was not accounted for in our study design. Our definition of an e-device included both laptops and smart phones, the former of which is more likely to be used for classwork while the latter is more likely to be used for communication. While some e-devices may have a more significant impact on in-class learning than others, our study was unable to account for this difference because of the significant overlap in the type of e-device use among users. Also, our study did not account for the amount of time students spent studying and reviewing class materials outside of class, which could have had an impact on examination performance and ultimately on mean grades for the course. Finally, we did not assess attendance at lectures. This was an important limitation because absenteeism has been shown to negatively impact academic performance.16

CONCLUSION

The use of e-devices during lecture for both course-related and non-course-related reasons is common among pharmacy students. Although e-device use is associated with a negligible impact on academic performance overall, their use by students in large lecture settings earlier in the curriculum may negatively impact grades. Studies that look at larger groups of students in wider varieties of courses should be performed to confirm these data. These findings should be considered when colleges and schools of pharmacy develop policies pertaining to the use of e-devices during class.

ACKNOWLEDGEMENTS

We thank Ms. Kelly Sustakoski for her assistance with assigning research numbers and entering participant grades into a de-identified datasheet that allowed for anonymous data analysis. We also thank Dr. Alan Forrest for his assistance with statistical analysis.

REFERENCES