Put Your Phone Down Please: Digital Devices and Student Performance

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Abstract for DBER Group Discussion on 2013-11-07

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Title:
Put Your Phone Down Please: Digital Devices and Student Performance

Abstract:
    The recent increase in use of devices such as laptop computers, iPads and web-enabled phones has generated concern about how technologies affect student performance. Combining observation, survey, and interview data, our two years of research quantifies the effects of this technology use on student learning. Faculty policy has a strong effect on student behavior, although all 8 faculty members whose classes were studied far underestimated the amount of off-task use taking place during their teaching (primarily phone use for texting).

    Our in-depth interviews with 24 students give insight into the students’ attitudes about technology use, and confirm results from Stanford that indicate students consistently overestimate their ability to multi-task. A general approach to deciding when and if to introduce technology into teaching will be briefly discussed. This approach and our data can be especially useful in universities where non-faculty (administrators, IT departments) push faculty to adopt new technology.
Plan of today’s talk

- How to think about the adoption of technology
- How technology affects student learning:
  - Gains and losses
- Why you must talk with your students about technology use!
- How to keep advances in technology from *decreasing* the allocation of faculty FTEs to your department (or mine).
The Researchers

Dr. Douglas Duncan (astronomy), Dr. Angel Hoekstra (sociology)
- Co-PIs, Duncan was on Hoekstra’s thesis committee
- Extension of Hoekstra’s research on the effects of clicker use for learning and behavior across disciplines

Ms. Bethany Wilcox (physics)
- NSF Fellow
- Physics graduate student, former Learning Assistant and current Teaching Assistant in Physics

Funding sources:
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- Steve Pollock  “
- Noah Finkelstein  “
- Kathy Perkins  “
- Carl Wieman  “
- Valerie Otero  Education
- Mike Klymkowsky  Biology
- xMichelle Smith  “
- xLeilani Arthurs  Geology
- Stefanie Molburn  Sociology
- Doug Duncan  Astronomy
- Seth Hornstein  Astronomy

X= faculty at other universities

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- Robert Talbot
- Colin Wallace
- Bethany Wilcox

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- Angel Hoekstra
- Steve Goldhaber
- Laurel Mayhew
- Noah Podolefsky
- Rachel Pepper
- Wayne Schlingman
How to think about the adoption of technology into your teaching?

Be aware of the latest technology and decide how you can use it in teaching?
What the *Most Successful* technology implementers do:

1. Decide what we want our students to do
2. Find the best technology to encourage that behavior

E.g. “encourage discussion in class.”

Or: more personal engagement

Determine your *goal* first!
I think I’m a great multi-tasker. Am I?

I bet the professor thinks we’re taking notes....

One more reason: it’s in your class anyway, more than you think!
Research Questions

- Does “digital distraction” affect performance (grades)?
- Do digital distractions bother other students?
- What are student attitudes and beliefs about technology such as laptops and cell phones?
**Motivation**

CU Professor Diane Sieber’s experiment:

- Track laptop use; note performance correlations
- With their permission, share this information with students so they can make their own choices

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Total students</th>
<th>Students with laptops open (consistently) prior to test</th>
<th>Test average, entire class</th>
<th>Test average, laptop subset</th>
<th>Average test score improvement, subset that stopped using open laptops in class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test #1</td>
<td>96</td>
<td>17</td>
<td>83</td>
<td>71 (=12)</td>
<td>--</td>
</tr>
<tr>
<td>Test #2</td>
<td>96</td>
<td>13</td>
<td>85</td>
<td>72 (=13)</td>
<td>+16 (av of 4 students)</td>
</tr>
<tr>
<td>Test #3</td>
<td>96</td>
<td>6</td>
<td>82</td>
<td>69 (=13)</td>
<td>+11 (av of 9 students)</td>
</tr>
</tbody>
</table>

Note that this was a pure lecture, non-clicker class.
First (full) year

- 5 large (100-200 student) non-major science classes

- Participant Observation (anonymous; in class)
  - 100 pages of notes; 31 observation dates
  - Both quantitative & qualitative data recorded

- Survey Questions, with anonymous clicker system
  - 23 Qs, N = 345 (77% response rate)
  - Qs request demographic data, student attitudes

- Qualitative Interviews
  - 24 semi-structured interviews; 13 men, 11 women
Second year

- Expand to Majors vs. Non-majors courses
- Traditional vs. Non-traditional lecture halls
- Effects of interactive engagement

Survey & observation data from 6 courses.
(34 days, N=541)
- 3 large introductory astronomy
- 1 small middle-division physics
- 1 small workshop biology
- 1 large introductory sociology
Phone use is much more common than faculty observe...

<table>
<thead>
<tr>
<th>Frequency of Cell Phone Use (per class)</th>
<th>Never</th>
<th>1-2 times</th>
<th>3-5 times</th>
<th>Over 5 times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-reported (N=445, Spring 2012)</td>
<td>22%</td>
<td>38%</td>
<td>21%</td>
<td>18%</td>
</tr>
<tr>
<td></td>
<td>(N=97)</td>
<td>(N=167)</td>
<td>(N=95)</td>
<td>(N=80)</td>
</tr>
<tr>
<td>Observed (N=178, Spring 2012)</td>
<td>53%</td>
<td>19%</td>
<td>12%</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td>(N=94)</td>
<td>(N=34)</td>
<td>(N=21)</td>
<td>(N=29)</td>
</tr>
</tbody>
</table>

Among phone users, average is ~6 times per class, but some are much higher.
Texting is an integral part of students’ lives…

**Interview Quotes**

“When you go to class, it’s a time to sit down and text.”
“Sometimes people are texting all the time and it really gets annoying.”
“I would say that I probably send sixteen text messages in a class, definitely.”

“There was a time I was getting 200 text messages a day, so every time I’d look at my phone there was something to look at…When the semester started, I remember trying to make a pledge to go through one class without looking at my phone. I did it once, and it’s tough. I had to keep pulling my hand out of my bag because…it’s just staying connected. I know if I look at my phone, there’s a good chance that someone’s gonna want to know if I want to go get a beer after class. There’s an email… I could be doing something else right now.” -- Female Geology student
Texting is correlated with grades, in a repeatable way.

-0.36 ± 0.08

-0.47 ± 0.14
There is a large variation among classes, and this is related to instructor policy.

**Instructor 1, Male – ASTR, N = 120**

Technology policy in syllabus? YES
Instr. Talk used in class @ policy? NO
Evidence of instructor behavior in class to enforce technology policy? YES
Student-centered pedagogy? YES

**Instructor 2, Male – ASTR, N = 165**

Technology policy in syllabus? YES
Instr. Talk used in class @ policy? NO
Evidence of instructor behavior in class to enforce technology policy? No
Student-centered pedagogy? YES
...It’s weird sitting in class taking notes and somebody’s on Facebook looking at their pictures from a party they had two nights ago. Sometimes the guys are sitting there watching a snowboard video. I’ve seen people Skyping, I don’t know how they get away with that in class, I don’t know why you’d have just the video feed. It’s just distracting in general if somebody’s playing a game.
Oh, yeah. People text all the time. It’s worse in biology, because it’s larger and it’s more difficult to get a seat down front, but I don’t like showing up 10 minutes early and just sitting. That drives me insane. I try to get there at least 5 minutes before class starts, but a lot of times, by then it’s full, so you sit farther back, and the further back you sit, the more people are in front of you, so more people with laptops. It’s hard to believe, but there’s still a lot of people who do Facebook, ESPN, who aren’t paying attention. It’s just distracting and annoying.
[Researcher:] I watch these four people, two on my left and two on my right, and all four of them texted within the context of that class. I count an act of texting. Pick it up, look at it, or type, either one, and then when people put it back down, that’s an act. I had, let’s see, one of the guys did it nine times, one did it once, the girl next to me did it 16 times in one 50-minute period, and the girl in front of her, it was, like, six.

I probably did it in this past class 15 to 20 times.

As someone who does text, what is it that makes it okay to text in class?

I do feel kind of bad because I know he can see me, since I sit in the front, and I feel rude, but—I don’t know. He doesn’t have a policy about it. Some teachers are like, “Put your cell phones away,” and in most classes I do. But he doesn’t care.
When you look at your phone during class, what do you do with it?

I will look through and see if I need to text anybody back. Answer an email, do Facebook, just check, check, check.

*Keep up-to-date? Keep on top of it?*

Yeah, it’s pretty weird. I can’t believe that I’m like that, because I’m just not that technological of a person. And now I see the other psychological effects that it has.

*It’s not like people are angry with you if you don’t check it?*

No. In fact, people more so get angry that I’m checking it so much.

*People that are with you, in your presence? I can understand that, if I’m talking to you and you’re on the phone.*

And I’ve taken classes on this, all of it.

*Communications major, that’s really interesting.*

[laughs] Yeah, I see a lot of what I read about in my own behavior.

*Do you think that people could get addicted to texting?*   *Totally.*
Your students are POOR judges of their own abilities and their own learning. They are not metacognitive. [These are Stanford students.]
Canadian Study of Laptop use

- Students were asked to use laptops to take notes on a lecture.
- $\frac{1}{2}$ the students – randomly assigned – were also asked to look up stuff “when you feel you can spare some time....”

- What do you think was the effect on grades?
Laptop multitasking hinders classroom learning for both users and nearby peers

Faria Sana¹, Tina Weston²,³, Nicholas J. Cepeda²,³, *

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The Effect of Multitasking on Comprehension of Lecture Content

[Bar chart showing the proportion of correct answers in multitasking vs. no multitasking conditions]
Those sitting in view of a laptop did even worse!
Our students are not experts. Experts don't just know a lot of stuff.....

- They know how to learn
- Their knowledge is organized with deep understanding
- They self-check (metacognition)

Our students are not very good at this. Coaching their learning behavior helps!
This is NOT to say ALL technology reduces learning. Some improves it…
In a traditional lecture class, students master about 25% of the concepts (that they don’t already know).

R. Hake, “…A six-thousand-student survey…” AJP 66, 64-74 (‘98).

\[ \langle g \rangle = \text{Normalized learning gain} \]
The graph shows the fraction of *everything taught* students learn *thoroughly* during the semester. Red and blue histogram bars are for 52 classes throughout the US.
Clickers

So does clicker technology increase student learning?
If you use clickers...

- Not only to check comprehension.
- Require or encourage peer discussion—students know they are expected to participate.
- Mix of difficulty.
- Use results to direct further instruction.

Stress Metacognition.

*No brain – No gain*
“In this class, no, they do not help us learn class material. It feels like she uses them just for attendance purposes and then doesn’t really fully go over them. It’s mostly just a waste of time… My physics professor used them very well… let us discuss them with our classmates, and then went over the right answer, thoroughly explained [the clicker question], and then told us why the other options were wrong, that really helped.”

(journalism student)
What difference does interactive engagement make?

The graph shows the fraction of everything taught students learn thoroughly during the semester. Red and blue histogram bars are for 52 classes throughout the US.

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Traditional lecture (popular professor)       Clickers       Clickers + tutorials

red = traditional, blue = interactive engagement

The graph shows the fraction of *everything taught* students learn *thoroughly* during the semester. Red and blue histogram bars are for 52 classes throughout the US.
Colorado LA Program as a model for institutional change: critical elements, national impacts, local implications
CU-Boulder LA Model Emulation

Auburn University
Black Hills State University
Boise State
Boston University
California Polytechnic State
California State University - LB
Cornell University
Florida International University
Indiana University (UTA Program)
James Madison (Planned 11/12)
Louisiana State University
Marshall University (Planned 11/12)
New Jersey Institute of Technology
North Dakota State University
Rutgers University
Seattle Pacific University
South Dakota State
Towson University
UNC Chapel Hill
University of Arizona
University of Arkansas
University of Maine
University of Maryland
University of Minnesota - St Paul
University of Oklahoma
University of Texas - Austin
University of Texas - El Paso
Utah State University
Virginia Tech
Western Kentucky University
Learning takes place in the mind of your students.

They must actively construct their understanding.
This requires focus.

(Poorly encoded knowledge is poorly retrieved.)
You can do several things at once, but only if they are easy and undemanding.

You have a limited budget of attention—cognitive load—and if you go beyond that you fail. It is a mark of effortful activities that ... you cannot do more than one at a time.
Say this series:  10, 9, 8, ....1.   Fast.

Say this series:  a, b, c....f.   Fast.

Say this series:  10, a, 9, b, 8, c.....    Fast.
It’s NOT about the technology.

It’s about what your students do.
Which of these lead to students constructing their own knowledge?

- PowerPoint?
- Videos or computer apps shown in class?
- Demonstrations?
- Lecturing as well as Jay Leno or Neil Tyson?

Is a MOOC with a great lecturer good?!
The graph shows the fraction of *everything taught* students learn *thoroughly* during the semester. Red and blue histogram bars are for 52 classes throughout the US.
Teaching in today’s technological environment...

You are competing for the attention of your students. To benefit learning, instructors must set clear policies – for cell phone and laptop use, and use regular meta-narrative explaining “appropriate device behavior” and “good learning behavior” to students.

[Metacognition]
## Survey: Student Attitudes Toward Cell Phone Use in Class

How disrespectful do you think using a phone during class is to your professor?

### 2010-11 – 3 courses, N = 345

<table>
<thead>
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<th>Description</th>
</tr>
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<tbody>
<tr>
<td>22%</td>
<td>A) Very disrespectful, especially if a student uses their phone often</td>
</tr>
<tr>
<td>15%</td>
<td>B) Very disrespectful, regardless of how often a student uses their phone</td>
</tr>
<tr>
<td>47%</td>
<td>C) Somewhat disrespectful but <strong>it depends on the instructor’s policy</strong></td>
</tr>
<tr>
<td>7%</td>
<td>D) Not disrespectful at all</td>
</tr>
<tr>
<td>9%</td>
<td>E) Other</td>
</tr>
</tbody>
</table>

### Spring 2012 – 6 courses, N = 541

<table>
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</tr>
<tr>
<td>29%</td>
<td>D) Somewhat disrespectful but <strong>it depends on the instructor’s policy</strong></td>
</tr>
<tr>
<td>6%</td>
<td>E) Not disrespectful at all</td>
</tr>
</tbody>
</table>
Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?

T. S. Elliot

Teach your students metacognition – what true learning means.
My speculative warning: if students can multi-task in your class and succeed, in the future your teaching will be replaced by a MOOC….

Or by a machine!

…and your department will lose FTEs…