

Eliminating the Textbook: Learning Science With Cell Phones

By Jack T. Tessier

College faculty have myriad choices of resources for their students when designing courses. The rising prices of textbooks and the availability of cell phones with internet access open the question of using cell phones in the classroom. In this study, I compared student learning in an ecology course between a semester in which a textbook was used and a semester in which cell phones were used to access information. Student scores on quizzes and exams did not decrease without a textbook. In fact, some scores improved significantly. Students appreciated being able to use their cell phones and pointed out the economic and social benefits of using them instead of a textbook. The challenges posed by the elimination of the textbook are readily overcome and permit the benefits that are possible when teaching without a textbook.

When designing courses, faculty are encouraged to consider all of the factors that will affect learning. These factors include the class setting, who the students are, learning goals, how learning will be assessed, teaching activities, integration of topics, structure of the topics, teaching strategy, structure of the learning activities, grading system, and syllabus (Fink, 2003). Although we do not have control over some of these factors (e.g., the class size, the room, etc.), we do have the choice of what information students will need to learn and how they can access, use, and evaluate that information.

The standard knowledge base for college courses has long been the textbook. These serve as guidance to faculty as they develop courses and offer an authority for students. The cost of textbooks, however, has become an issue of concern to both students and faculty (Forman, 2005; Hsieh & Runner, 2005; Siegfried & Latta, 1998; Sommer, Estabrook, & Horobin, 1988). Students often sell their textbooks back at the end of the semester because the cash is more valuable to them than the knowledge in the book (Pecorino, 2006).

An alternative to using textbooks as sources of knowledge is the modern smart phone. These cell phones can access the internet with its wealth of information, as well as content that faculty can post for their students—which is becoming increasingly common (Rainie, 2010; Thornton & Houser, 2005). College students are comfortable with cell

phones and enjoy using them (Aoki & Downes, 2003). Although some teachers and school districts have taken strong stances against their use in school (Gilroy, 2004; Obring & Coffey, 2007), many students feel that the use of cell phones helps their learning and is not a distraction (Tessier, 2013).

The objective of this study was to assess the effect on student learning of replacing the textbook for an ecology course with the use of cell phones. The research question was: How will using cell phones instead of a textbook affect student learning? I hypothesized that cell phones will allow students to access as much information as a textbook and predicted that scores on quizzes and exams would not be affected if students used their cell phones instead of a textbook as a source of information.

Methods

This study was conducted in a 200-level ecology course that I taught and was approved in advance of implementation by SUNY Delhi's Institutional Review Board. This course runs in the spring semester with three lectures of 50 minutes per week and one laboratory of 3 hours per week. Enrollment is capped at 22 students. The teaching and learning format was a variation of team-based learning (McMahon, 2010; Michaelsen, Bauman Knight, & Fink, 2004; Michaelsen & Sweet, 2008), in which students work closely in groups to help each other learn. Students were placed in groups at the start of the

semester with peers of different backgrounds and experiences within each group to help students learn from one another. Group membership changed after midsemester on the basis of peer evaluations (Tessier, 2012). The course was divided into four content units. In each unit, the groups completed 10-question, multiple-choice quizzes for each topical area. Once per week, we read and discussed a piece of primary literature related to the unit's topics. At the end of each unit, students had a debate or developed a project (based on their preference) related to the topics of the units. For the projects, the class was divided in half systematically, and the group with the best project or that won the debate earned five bonus points for their exam grade. These projects and debates were not otherwise graded and were not used in the analysis.

In the textbook semester (spring 2012), students used *The Economy of Nature* (Ricklefs, 2008) as a textbook. For the quizzes, students were allowed to bring any notes that they wanted from the text or the Power Point presentations, which I developed and made available electronically. Most students brought transcripts of the PowerPoints along with redrawings of the figures from the textbook. Not allowing access to the textbook during quizzes is consistent with typical applications of team-based learning (Michaelsen et al., 2004).

In the cell phone semester (spring 2013), students did not have a textbook and were allowed to access any resource they could with their cell phones. Two students used electronic devices that were not cell phones, but the rest used smart phones. The PowerPoint presentations were modified from the textbook semester to eliminate all graphics from the textbook and replace them with content from primary scientific literature. Most students used their cell phones to

access the PowerPoint presentations and look up definitions and additional information on websites. Students in the cell phone semester lacked the organizing power of the textbook for notes that they could bring to the quiz but had access to more information during the quiz because of their cell phones. These differences offset the absence of the actual textbook during the quiz in the textbook semester and made the quizzes more of an in-the-moment effort during the cell phone semester. Although I did not police the sources that students used, they learned the correct answers to the quiz questions during the class period in which they

took the quiz. Through this method, they could quickly evaluate the merit of the sources they were using.

The composition of the class was similar between semesters. The incoming cumulative GPA of the students was 2.66 ± 0.22 (mean \pm standard error) for the textbook semester and 2.67 ± 0.33 for the cell phone semester. Students from both semesters had majors of general studies, park and outdoor recreation, adventure recreation, and environmental studies.

In both semesters, exams were taken at the end of each unit. Exams were taken individually with only the use of the student's brain and a

FIGURE 1

Voluntary and anonymous survey regarding academic cell phone use delivered to students in BIOL 245 General Ecology at SUNY Delhi during the spring 2013 semester.

This survey, which should take less than five minutes to complete, is designed to assess the effectiveness of using cell phones in the classroom to promote learning. Your completion of this survey is voluntary and will not affect your course grade.

1. Did **your group** use a cell phone in class for learning purposes during this course (**circle one**)?
All the time Frequently Sometimes Never
2. Did **you** use a cell phone in class for learning purposes during this course (**circle one**)?
All the time Frequently Sometimes Never
3. Do you feel that using the cell phone in class helped you learn (**circle one**)?
Absolutely Yes A little No
4. Did you find the use of cell phones in the class to be distracting from your learning (**circle one**)?
Absolutely Yes A little No
5. Did you enjoy using your cell phone in class (**circle one**)?
Absolutely Yes A little No
6. Did you find that being able to use your cell phone in class encouraged your attendance of class (**circle one**)?
Absolutely Yes A little No
7. Did you find that being able to use your cell phone in class improved your success in class (earning a C or better) (**circle one**)?
Absolutely Yes A little No
8. Please provide any comments you have regarding the use of cell phones in class for learning purposes.

writing implement. Three quarters of the exams were multiple-choice questions sampled from the quizzes. One point was earned for the correct answer and up to four points were earned for an explanation of why it was the correct answer. The final page of each exam was a short essay about one of the journal articles that was read for that unit. Exams, therefore, provided individual accountability for the learning done in groups.

I kept track of the scores that students earned on exams and each quiz question during both semesters. Each quiz question was identified in terms of its level in Bloom's taxonomy before the semester started (Bloom et al., 1956; Krathwohl, 2002): low level (knowledge, comprehension, and application) or high level (analysis, synthesis, and evaluation). Of the 180 total quiz questions, 117 were low level (65%) and 63 were high level (35%), which is an ap-

propriate mix for a 200-level course. Low-level questions focused on facts and understanding of those facts. An example of a low-level question is:

Which category has the most described species?

- flowering plants
- chordates
- insects
- prokaryotes

High-level questions required students to think about facts, integrate ideas, and make decisions. An example of a high-level question is:

Which of the following is the best design for a nature reserve?

- a long rectangle running east-west
- several circles spread across the summit of Rocky Mountain peaks
- a square centered on a biodiversity hotspot

- an ellipse encompassing a biodiversity hotspot running north-south.

A voluntary and anonymous survey was completed by the students in the cell phone semester to assess their opinions of the use of cell phones in class (Figure 1). Each student was counted as a replicate because group membership changed within the semester, and each student's collective quiz grades were therefore unique. Percentage of questions answered correctly for low-level quiz questions, high-level quiz questions, all quiz questions, and exams were compared between semesters using *t*-tests at $\alpha = 0.05$.

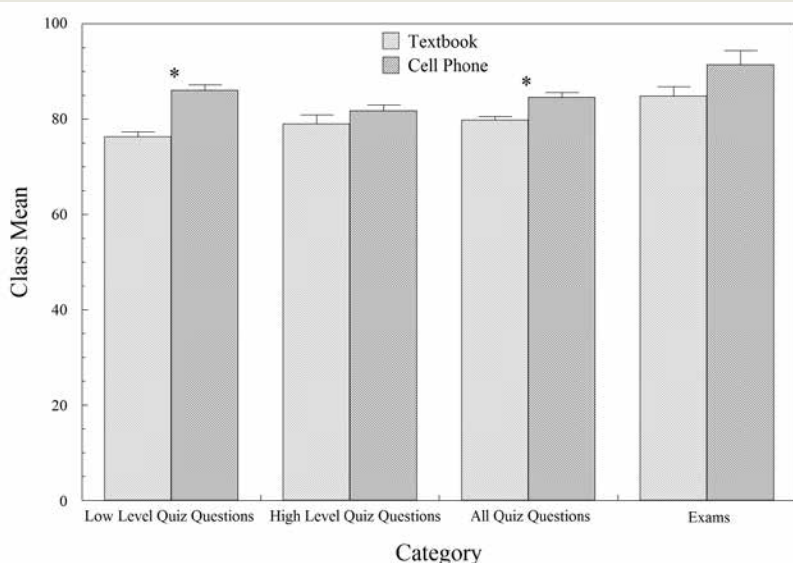
Results

All 19 students from the textbook semester permitted use of their data, and 13 out of 16 students from the cell phone semester permitted use of their data. Students' scores were significantly higher for the cell phone semester than the textbook semester on low-level quiz questions ($T = -6.34, P < 0.0001$; Figure 2) and all quiz questions, collectively ($T = -3.63, P = 0.001$; Figure 2). There was not a significant difference between semesters for students' scores on high-level quiz questions ($T = -1.24, P = 0.224$; Figure 2) and exam grades ($T = -1.84, P = 0.080$; Figure 2).

Students in the cell phone semester reported that individuals and their groups used cell phones between "frequently" and "all the time" (Table 1). Only one student reported individually using a cell phone "sometimes," whereas all of the other students reported using their cell phone "all the time" or "frequently." Students responded between "yes" and "absolutely" to cell phones helping them learn, being enjoyable to use in class, and helping their grades (Table 1). In contrast, when asked if using cell phones

FIGURE 2

Mean scores from quiz questions and exams between course sections of BIOL 245 General Ecology at SUNY Delhi taught with a textbook versus letting students use their cell phones to gather information. Error bars represent one standard error. Means within a cluster with an asterisk are significantly different at $\alpha = 0.05$ based on a *t*-test.



in class was distracting, students responded either “a little” or “no” (Table 1), with only 4 students out of 13 responding “a little.” There was a wide range of responses to whether using cell phones promoted student attendance. The most common response was “yes” (Table 1), with four students responding “no” and one student responding “absolutely.”

Students’ comments expressed appreciation for the use of cell phones in place of a textbook (Figure 3). Responses cited changes in society, the speed of information access, cost savings, teacher–student respect, and breadth of available information as reasons for liking the use of their cell phones. One student also volunteered, in person, that she liked being able to access the PowerPoint presentations electronically instead of printing them as she had done for other courses.

Discussion

The results of this study matched the prediction in support of the hypothesis that students can access as much information on their cell phones as in their textbooks. Scores on quizzes and exams did not go down after eliminating the textbook, and some scores went significantly up (Figure 2). Although it could be argued that the increase in grades on low-level quiz questions is tied to students finding more information on their cell phones than in their notes, exam grades would have gone down if the textbook was a useful learning tool for students. Students needed to prepare for the exams by drafting explanations for why the correct answers to the multiple-choice questions were right. The explanation was worth four of the five points available for the multiple-choice questions. If access to a textbook benefited students in their preparation for the exam, then exam grades would have been better for the textbook semester than for the cell

TABLE 1

Frequency count for responses to a voluntary survey regarding academic cell phone use in the classroom in BIOL 245 General Ecology at SUNY Delhi during the spring 2013 semester.

Survey question	All the time/ Absolutely	Frequently/ Yes	Sometimes/ A little	Never/ No
Group use of cell phone	9	4	0	0
Individual use of cell phone	8	4	1	0
Helped you learn	8	5	0	0
Distracting	0	0	4	9
Enjoyed cell phone use	4	9	0	0
Improved attendance	1	5	3	4
Improved success in class	6	7	0	0

phone semester. Exam scores were, however, not significantly different without the textbook (Figure 2). Students felt that using cell phones benefited their learning, was not distracting, and (for some students) improved their class attendance (Table 1; Tessier, 2013). These results demonstrate that textbooks are not essential items for student learning when cell phones are effectively used for academic purposes regarding content that is available through the internet.

The elimination of the textbook offers multiple benefits, not all of which can be seen in scores on quizzes and exams. Students save money by not buying a textbook (Forman, 2005; Hsieh & Runner, 2005; Siegfried & Latta, 1998, Sommer et al., 1988). Students in this study pointed out that they appreciated not having to spend money on a textbook (Figure 3). Students also pointed out that permitting them to use their cell phones in class eliminates the policing of unauthorized use and demonstrates respect for the stu-

dents, while giving them access to more information than a textbook would offer (Figure 3). Just as most people do outside academia these days, students could look up information that is always available via the internet. This shift from policing to encouraging cell phone use is beneficial for teachers and students. For years I have wished for the presence of computers in the classroom for information access, but budgetary constraints have prevented such a development. Students have now brought the internet with them in their cell phones. Further, removing the textbook encourages the use of primary literature in the course and its materials, which brings students closer to the true conduct of science (American Association for the Advancement of Science, 2009; Wenk & Tronsky, 2011). Collectively, the removal of the textbook favors the investigative nature of science. Even if a course does not use team-based learning (Michaelsen et al., 2004), any design that involves students finding information can be promoted

FIGURE 3**Comments provided by students on a voluntary survey regarding academic cell phone use in BIOL 245 General Ecology at SUNY Delhi during the spring 2013 semester.**

Student	Comment
1	Education is changing with society. Dr. Tessier understands this.
2	No comment provided.
3	No comment provided.
4	I enjoyed using my cell phone as a tool for learning.
5	Easy to use and made work twice as fast.
6	It was cheaper than buying another textbook.
7	It's good because you still learn everything without having to buy a book.
8	I think it shows respect and trust for students, and it allows modern technology to be used for good.
9	It was a good tool to access documents posted [online].
10	This technique was effective, without a cell phone the quizzes were impossible.
11	I enjoyed having the use of a cell phone because it allowed me to contribute to my team regardless if I knew the topic or not.
12	I believe that in this generation students are well attached to their cell phone. So giving them the right to use them in class takes away the stress of looking at it without having a teacher look over their shoulders.
13	Cell phones can use the internet with unlimited amounts of information, when a text book is restricted only on the one topic. Faster and easier than books.

with the use of cell phones (Tessier, 2013).

Removing the textbook does pose some challenges. Shifting toward primary literature can be unnerving for students who are not used to reading it (Rybarczyk, 2006). Additionally, removing the textbook takes away the course-design crutch of following the sequence of topics as presented in the textbook. College faculty are experts in their disciplines, and with the electronic availability of search engines and primary literature, finding appropriate articles is not as daunting as it may seem. With careful attention to proper course development (Fink, 2003), we can design our courses to match our students' needs and capabilities without feeling beholden to a textbook. The intentional design

of a course to match the skills of the teacher to the capacities and needs of students is one of the most important roles of a faculty member (Saroyan et al., 2004). The challenges posed by the absence of a textbook can be overcome with sufficient effort and will provide the aforementioned benefits to students and teachers (Table 1 and Figure 3).

In conclusion, using cell phones as a source of information instead of a textbook offered learning gains instead of losses. Students enjoyed using the cell phones, and removing the textbook was seen as beneficial by students for multiple reasons. The challenges posed by eliminating the textbook are readily overcome with sound course development, and the benefits realized from such action are well worth the investment. ■

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