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iPads in an Algebra Writing Assignment

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Abstract

This study analyzes citation patterns in an algebra writing assignment completed by students in two sections of college algebra, one that used iPads throughout the semester and one that did not. Students in the iPad section did not prefer to use apps as an information source more than students in the non-iPad section, even though available apps were closely linked to course content. Open-ended assignments are a useful tool in tablet initiatives to gauge student interest in new learning technologies.

Introduction

The Apple iPad tablet computer has received equal measures of excitement and criticism as an educational tool. Mobile applications seem well-suited to educational endeavors because they focus students' attention on specific sets of knowledge and experiences. This is just what students do as they develop knowledge in a class—they reduce disciplinary analysis into smaller skills and bits of knowledge. Like any new technology, however, students must decide whether it is useful to spend time learning to use it. In a college algebra class, students had the opportunity to use iPads as a research tool for a writing assignment on mathematical and social perspectives on HIV epidemics. This article reports on students' citation patterns as a means of judging the extent to which they chose to use iPads as a research tool.

From fall 2010 to the present, the College of Education and Human Development (CEHD) at the University of Minnesota - Twin Cities has conducted one of the largest tablet initiatives in the world. At the beginning of the fall term, each incoming first-year student in CEHD, roughly 450 per year, received an iPad for personal and academic use. Twenty-seven instructors in the CEHD department of Postsecondary Teaching and Learning (PsTL), who have the primary responsibility of teaching the students' first year courses, also received iPads with the intent of examining how they might leverage these new mobile devices to enhance undergraduates' educational experiences (Wagoner, Hoover & Ernst, 2011). Students received an introduction to the basic features of the iPad, learning to navigate the device and to install apps. Students were encouraged to use their devices both on campus and at home, and were given a large degree of autonomy in deciding how to incorporate the iPad into their academic and personal lives.

The students who received iPads through the initiative shared some common experiences as part of the PsTL First Year Experience program. Each fall semester, students enroll in a course titled First Year Inquiry in which they complete a variety of iPad-based assignments, determined by the instructor, including peer writing review, video production, and development of digital stories. In the spring semester, most first-year students enrolled in learning communities, which are linked courses where students tackle assignments that integrate two disciplines and that seek to promote social and intellectual engagement with instructors and fellow students.

The iPad assignment discussed here was conducted in two sections of a college algebra class taught by Staats in the spring of 2011: a traditional, stand-alone algebra class and a learning community in which 24 first-year students enrolled concurrently for a college algebra class and a world literature class. Students in the learning community attended the algebra class and the world literature class separately, and earned liberal education credits in two categories, mathematical thinking and global perspectives. In the learning community offering, the two classes were conceptually integrated through assignments that highlighted disparities in global health and in economic opportunity. Algebraic analysis of health and economic data provided a broad, comparative framework for the highly personal narratives that students read in their literature course. The literature teacher highlighted examples of health and economic disparities that were portrayed in the readings.

The learning community instructors chose to use the iPad in ways that supported the interdisciplinary content of the two classes. Recommended apps, therefore, were centered on building knowledge of international issues. The most commonly-used app was World Bank DataFinder, a tool for accessing health and economic data for many countries. Students also used the CIA World Factbook, World Map, and the KLoan app that helped students track small business loans that they made to entrepreneurs in low-income countries as a part of their coursework.

iPads in Higher Education: A Global Experiment

The iPad has become the center of a small but growing global experiment in higher education. Colleges and universities in Canada, Australia, Norway, and the U.S. report introducing iPads into a variety of postsecondary classrooms. Early publications reveal trends in the approaches that these institutions take as they implement iPads in higher education.

In many cases, a relatively small group of graduate students or undergraduates in specialized programs have been the testing audience for the iPad. Ryerson University loaned five iPads to upper undergraduate and graduate students from a library committee (Eichenlaub, Gabel, Jakubek, McCarthy & Weina, 2011). Oslo University College tested the iPad with 12 master's students in nursing and in library science (Eikebrokk, Grødem, Knutsen & Thaulle, 2011). Reed College tested iPads in a Nuclear Politics course (Marmarelli & Ringle, 2011). University of Texas and Abilene Christian University implemented iPads in their teacher education programs (French et al, 2012; Hamm, 2012). Business programs, including Georgia State University's Robinson College of Business, Hult International Business School and University of Notre Dame's Mendoza College of Business have been early iPad testers (Bradshaw, 2011). Our earliest and fullest impressions of iPad use in higher education, then, are grounded in the experiences of highly experienced or academically-focused students.

A few universities have introduced iPads within a wide range of undergraduate classes. Pepperdine University (n.d.), for example, conducted a three-term experimental comparison of iPad- and non-iPad-using classes across disciplines including calculus, business, nutrition, and religion. Seton Hill University distributed 1,850 iPads that students used in history, art and laboratory classes, among others (Gawelek, Spataro & Komarny, 2011). An iPad project in English Language foundations postsecondary programs in the United Arab Emirates produced very positive faculty interest in developing innovative learning activities along with increased student engagement (Hargis, Cavanaugh, Kamali, & Soto, 2014).

Another approach to iPad adoption has been to focus on faculty use. Manuguerra and Petocz (2011) report success with using iPads to produce video lectures for statistics classes. This was easy for faculty to do with little specialized training, students enjoyed it, and it helped integrate distance-learning students into the class. Georgia Southern University College of Education also focused their initiative on faculty development (Hodges et al, 2012). Still, Murphy (2011) found that only a few higher education institutions that are piloting iPads are also modifying broad institutional practices to work well with the devices.

Turnock (2011), a medical educator, asks "Is there an iPad app for that?" This question belies a trend in iPad usage in higher education pilot projects. The majority of early iPad initiatives emphasized the use of generalized apps that support media manipulation rather than developing disciplinary knowledge through the unique capabilities of the device. General applications include such things as e-book readers, PDF

annotators, and research tools such as Evernote. Perry, Thrasher and Lee (2014) outline the value of file sharing apps such as DropBox for managing mathematics classrooms.

Only a few early iPad teaching experiments committed to using disciplinary-based apps. Molumby (n.d.), for example, used iPad apps in a class dedicated to aural training. Apps provided students with perfectly-tuned musical samples and the ability to record their own voices as they developed their singing and listening skills. Students could work singly or in groups. Even in this case, when the choice of app was closely tied to course content, Molumby found that while students demonstrated greater responsibility for their learning during the pilot, they made only modest gains in singing and listening skills. In recent years, apps designed to strengthen mathematical learning have become available, e.g. Sketchpad Explorer, Data Analysis app, MathGraph app (Perry, Thrasher & Lee, 2014) and Desmos app.

Still, designing a class around disciplinary-based apps is accomplished more easily in K12 classrooms than in higher education settings. Many university students own a mobile device, but not all disciplinary-based apps are constructed for all platforms. Even in our own technology-rich environment, students from other colleges within the University of Minnesota may enroll in one of our classes; often, instructors must design assignments that do not rely entirely on disciplinary-based apps. This variability has led us to emphasize collaborative group projects in our recent work on learning undergraduate mathematics with iPads.

A Creative Writing Assignment for Algebra

Designing assignments to integrate algebra and world literature in a learning community was challenging but rewarding. For the assignment outlined here, students first learned to model an HIV epidemic using a logistic curve (Staats & Robertson, 2009). The logistic graph represents an epidemic that spreads slowly at first, then rapidly, and then slowly again as nearly all the people in a community are sick. After completing this initial model in the algebra class, students reinterpret the maximum prevalence of the illness as the carrying capacity of the illness in the community rather than the total population size.

Students developed a model of the HIV epidemic in South Africa over the years 1990 to 2005. They wrote three short stories or fictional episodes based on their graph using the viewpoint of a journalist who was covering the epidemic in the years 1991, 1997 and 2005. Students were asked to learn about HIV issues and the South African case through any source—internet, apps, or print sources—and to use their writing as a way to imagine the interpersonal relationships that might have been in play at different points in the graph. Through this creative writing assignment, students could demonstrate knowledge gained in the algebra class and in the world literature class, and in particular their understanding of the dilemmas that people face in low-income countries.

The grading rubric assigned points based on 1) using a journalist character as the narrator, 2) creating several fictional characters to be interviewed for each entry, 3) detailing the effects of the epidemic on each character's emotions, opinions, and relationships, and 4) documenting the sources of information used in creating the characters. Items (3) and (4) encouraged students to seek additional information on HIV epidemics as a basis for creating characters and dialogue. Free iPad apps were recommended, such as DataFinder, World Factbook, World Map, Lazarus Effect, and World of Viruses Comic Viewer. Web-based sources that were recommended included Wikipedia, Avert.org, Human Development Reports (pdfs provided on the course website that list global health and economic data) and a YouTube video on the Lazarus Effect. Students could also use and cite notes from the algebra, world literature, or any other class. The assignment description and suggested sources were the same for both sections of the iPad and non-iPad using class.

Students had a week to work on the project, which was intended to be more of an informed creative writing assignment than a formal research assignment. This flexible assignment was an opportunity to judge students' preferences for accessing information. It required significant algebraic and writing effort, but otherwise allowed for a great deal of personal choice in how to access information and express it in narrative form.

Participants

The 20 students in the learning community were all first-year students who were also taking a world literature course, all had iPads, and all had training on use of several apps, including DataFinder, World Factbook, and World Map. The second section was a stand-alone algebra class. It had the same algebra content, but the algebra projects did not address international issues. Students were not enrolled as a cohort in a second class. Although a few students had iPads, most did not. The class included 22 students, but the analysis below is based only on the first-year students, of whom there were 12. Because all the learning community students were in their first year of classes at the University of Minnesota, restricting analysis of the stand-alone class to first-year students allowed us to compare students with similar experiences with college-level research, writing and citation expectations.

Method

Students used a reference page rubric to enter their sources into an app section, a website section, and a section for other sources. This allowed us to count sources and to distinguish apps from websites. A potential source of ambiguity was that some students referenced a parent website once, such as avert.org, while others referenced individual pages within the same website. Because there is no objective way to determine what students considered “different sources,” our counts were based on the number of references that a student listed.

Results

In the learning community, students cited apps nine times. Of these, six citations were to the DataFinder app and three were to other apps. They cited websites 54 times, of which 15 were to Wikipedia. Learning community students also cited course notes 12 times. In the stand-alone class, students cited apps one time. They cited websites 23 times, of which 10 were to Wikipedia. They also cited course notes three times.

A two-tailed Fisher's exact test suggests that students in the two classes did not differ significantly in their preference for sources of data. Comparing use of apps to websites yields $p = 0.2725$; comparing use of apps to course notes yields $p = 0.6265$, and comparing use of websites to course notes yields $p = 0.5431$; none are significant.

Discussion

We expected that students in the non-iPad course would use apps infrequently. It is notable, however, that although students in the learning community used iPads apps throughout the course and in other courses, they did not choose them as a tool of informal research more than non-iPad users. Currently, relatively few comparative studies of iPad and non-iPad users have been published, but this result is consistent with qualitative reports. Weider (2011), for example, notes a Notre Dame study in which students usually chose to complete an online test with a laptop rather than an iPad.

Rogers' (2003) discussion of technology diffusion identifies several factors that may explain students' reluctance to rely on iPad apps as reference sources in this assignment. His concept of “compatibility” suggests that the apps explored in this assignment conflicted with students' pre-existing information-seeking habits. The fact that so many students turned to web resources—particularly Wikipedia—suggests that students may already have established channels of navigating online information during their K-12 experience, and that they may be slow to adjust these channels during their early undergraduate experience.

Another important factor is the principle of “relative advantage.” Web browsing has become an ordinary part of many students' lives, and it offers quick access to a wide range of sources. Seeking information through a less familiar mode may not have offered sufficient information or ease of use to encourage students to experiment with a new process. Still, it is important to note that iPad usage represents the “early adopters” stage in Roger's diffusion model. Overall, small mobile devices are one of the most successfully diffused technologies with close to 6 billion units in use (International Telecommunications Union, 2011). The appropriate roles of the iPad and other mobile devices within higher education classrooms and their significance are likely to develop over the next several years.

In 2011, Murphy noted that although classroom collaboration is the basis of a great deal of contemporary learning theory, many iPad educational apps had not yet fully developed this capacity. Since then, the effects of mobile technology on collaboration have become an emerging research interest. Beatty and Geiger propose four categories of learning technologies according to whether they are designed specifically for mathematics learning or not; and whether they are designed for collaboration or not (2010).

In our more recent work, we have found the concept of relative advantage combined with Beatty and Geiger's disciplinary/collaboration framework to be useful in designing mobile learning activities. First, we have focused on assignments in which the mobility of the iPad is a clear advantage. In 2013, college algebra students used iPads to collect photos of artwork at the university art museum—objects that cannot be touched for mathematical measurement (Staats, Ernst, Berken, & Robertson, 2015). Students used sketching apps to layer coordinate systems over their photos, and to create algebraic models of the mathematical properties of the artwork. They completed the assignment using a video editor to create a video that explained how the mathematical properties of the artwork supported its artistic impact.

In this recent assignment, most students used the recommended Sketchbook Xpress and iMovie apps, but some chose the Explain Everything app or laptop video editors. Focusing on general types of apps for sketching and video editing, rather than specific disciplinary-based apps, in a collaborative assignment, allowed students to complete a creative and challenging assignment using a variety of digital tools.

Conclusion

While iPad apps did not offer a not clear educational advantage in this study, their significance may improve over time. Teachers who plan to incorporate iPads into their teaching might start by deciding whether to use disciplinary-based apps, as we did in this project, or apps that support general media manipulation skills such as e-book readers, PDF annotators, video editors and sketching apps. The educational technology research community needs more projects that use disciplinary-based apps to determine whether mobility, touch control, and focused information of apps involve students effectively in the development of disciplinary knowledge and skills. Teachers using iPads may also find it useful to incorporate open-ended assignments such as this one to be able to monitor how student learning preferences either change or remain the same.

Endnote

[1] This article updates an article published earlier in *Academic Exchange Quarterly* (2013; iPads in an Algebra Writing Assignment; Staats, Link, Robertson, & Sintjago).

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