Using iPads in Undergraduate Mathematics

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Abstract - Traditionally, technological advancements in the classroom have been restricted to computational aids like the graphing calculator or computer algebra system. The iPad provides a unique outlet in terms of integrating the entire student experience in the classroom: computing, text referencing, note taking and the ease of sharing information and communicating between classmates and the instructor. This paper seeks to share observations and insights on teaching an introductory college mathematics course using the iPad. In particular, how iPad applications were implemented to allow the student to: (1) use the course text as an electronic reference; (2) take course notes; (3) exchange information in and out of the classroom; and (4) organize their learning [1].

Introduction

After teaching an introductory math class using the iPad, I found that the iPad is a great tool with many positives but also some challenges. The iPad gives the ability to embed multimedia visual aids into a lecture [2]. Students can manipulate graphs and animations that give them a visual of the concept being covered in class. iPads can also be used to provide skeleton notes or slides to students that they are then able to mark up and annotate during class [2] [3]. Without a stylus and touch screen, it is difficult to take notes in a math class electronically because of the use of symbols, numbers, and the uneven spacing used to solve problems [3]. iPads can represent textbooks, notebooks, and computation devices all rolled into one.

Implementation of the iPad Pilot Study

iPads were issued to one of my three sections of a freshman level course on math modeling and introduction to calculus, MA103. Cadets were issued the iPad, a wireless keyboard, a stylus, and an iTunes card which was to be used for downloading the required apps for the course. The cadets had to turn in their iPads at the end of the semester. The iTunes accounts were specific to each iPad so that when different cadets were issued the iPad the following semester, the required apps would already be on the device without having to purchase them again.

One of the concerns going into the study was that no cadet should be disadvantaged by having participated in it. In the normal course of the core curriculum at West Point, MA103 serves as an introduction to Microsoft Excel and Mathematica which are then used in the following three semesters in the required math classes. Because of this, I would first show examples in and have cadets work with Excel and Mathematica and then move to apps on the iPad. This required cadets to bring both their laptop and their iPad to class.
Choosing apps was a daunting task. There are thousands of available applications and it would be infeasible to test all of the apps that could apply to the course. After a cursory search of reviews and teaching blogs, the following apps were chosen: iAnnotate, Numbers, Notes Plus, Space-time, and Dropbox. iAnnotate is a pdf reader and mark up app. Numbers is a spreadsheet app. Notes Plus is used for note-taking. Space-time is a computer algebra system. Dropbox is a file-sharing app.

iPad uses in the Classroom

E-Reader and Note-Taking

Some of the most effective ways that the students used the iPad was as an e-reader and note-taker. In MA103, the textbook has been written in house by instructors in the course. Consequently, the department owns the digital rights to the textbook. This is not the case with many textbooks and it can be difficult to get into a format that can be read on the iPad. Our text was saved as a pdf and available for mark up on the iPad. Students could highlight the text, make annotations, insert blank pages, insert note pages from other files into the textbook, and even take pictures of class notes and insert those directly into the textbook.

The students were also able to take notes in class on the iPad. They could use the stylus or keyboard and write on note sheets on files that I provided with an outline of the day’s lesson. Traditionally in the math department, we hand out board problem sheets. These are problems that the students work on at the chalkboard and then copy into their notes. I prefer to have cadets work at the chalkboard on these problems because at one quick look around the room, I can see their work and tell who needs help. Working up at the chalkboard also encourages the students to talk and work together. If one student is struggling, he or she can just look across the room to get an idea from another student. One common complaint about working at the chalkboard is that the students have to copy their work off of the board and into their notes. Sometimes the students run out of time and the work does not make it into their notes. With the iPad, I would still have the students work at the chalkboard but they were able to take a picture of their work, or another student’s work if their own was incorrect, and embed that picture directly into the note sheet for that day. Later, the student can bring up the problem and the picture of their solution to study from. This provided an interesting juxtaposition of technology, chalkboards and iPads.

Exchange Information

Another great use of the iPad is the ability to exchange information. During class, I could upload a file for the students to use and it would nearly instantly be available for them to take notes on. Solving math problems by writing them out by hand is preferred over having to type them out. Although it is possible to type out all of the steps for a math problem, formatting and syntax problems can make this time consuming. I could hand out a quiz electronically to the students and they could take the quiz using the stylus and hand it back in electronically.

Computations
Using the spreadsheet app and computer algebra system, students could use the iPad in order to solve problems. MA103 teaches discrete math so a spreadsheet program works well to iterate through these problems. Unfortunately, it is more difficult to use a spreadsheet with a touch screen than it is to use one with a mouse and keyboard. Also, with the requirement to introduce the students to Mathematica to be used in follow-on classes, learning the syntax for a separate program on the iPad proved to be too much for an introductory class. Because of these difficulties, I would show the students how to do computations on the iPad but most students stuck to using their laptops when Mathematica or Excel was required. Figure 1 shows that the students’ favorite use of the iPad was an e-reader.

Figure 1: Survey results of how much the student liked or disliked doing specific tasks on the iPad. [1]

Student Feedback

The students took surveys at the beginning of the semester and at the end of the semester in order to gauge their thoughts on using the iPad and how those thoughts changed throughout the semester. The students were asked to rate how well the iPad helped them learn the course material. Figure 2 shows the results from early in the semester and Figure 3 shows the survey results from later in the semester.
As you can see from Figure 2, initial excitement for the iPad was pretty high and then later in the semester (Figure 3) opinions on the technology shifted towards the left. This can be attributed to the novelty wearing off. Overall, the feelings were still positive but in the future it will be important to harness that initial excitement and keep it up over the entire semester. Another reason for the shift may have to do with technology overload. The students were forced to use many different programs and it may have been too much for some of them. One solution would be to streamline the number of apps and programs that I teach from in the future.
Teaching with the iPad

The iPad is a great tool, now what do I do with it? This is the initial question faced by any instructor trying to implement a lesson on the iPad. At the beginning of the semester, I initially made a lesson plan for my two non-iPad sections and then changed that plan to fit in with my iPad section. This seemed to be somewhat awkward and forced. As I got used to teaching with the iPad, I began to make a lesson plan for the iPad section first and then use the same plan in my other sections. This allowed me to focus on making handouts, note sheets, and problems that were easily used on the iPad. In my non-iPad sections, I would simply print out a hard copy for the students but I would still teach by projecting my iPad screen up on to the board. One effective technique was to have a partial outline typed out that I would fill in with notes and explanations using the stylus. The students would follow along and take notes. My iPad sections would follow along taking notes on the iPad and my other sections would take notes on hard copies.

One hurdle that surprised me during the semester was that a few of the students did not know how to use the iPad until they were forced to. I had presented the iPad as another tool that the students could use and encouraged them to use it. At about half way through the semester, I gave a quiz that the students had to complete on the iPad. This was the first time I had required them to do anything on the iPad. The majority of the students used the iPad regularly and did not have a problem. A minority of the class could not complete the quiz because they had not been using the iPad. In retrospect, I should have had a requirement forcing the students to use the iPad very early in the semester. This would have forced all of the students to overcome the initial learning curve at the beginning of the semester.

Future Work

I felt that during my semester teaching with the iPad, I did not use its full potential. One very exciting thing about the iPad or any tablet/e-reader device is the ability to have an interactive, multimedia textbook. The textbook could have interactive graphs, animations, and videos that would serve to help the student visualize and learn the material. Currently, we have apps that can do part of this but the student is required to leave the textbook and open a second application. A seamless integration of these into the textbook would help the student learn tough concepts.

Other tablets have classroom management programs that allow the instructor to see each student’s screen and to project the student’s screen onto the overhead. This would be very helpful because when the students are working on problems at their desk, the instructor could browse through their screens in order to see who needs help. Once the students are done with the problem, the instructor could immediately put one of the student’s solutions on the overhead so that student can share his solution with the rest of the class. There are some classroom management apps available for the iPad; however they were not as advanced as the software for other tablets.
Conclusion

iPads allow for textbooks, notebooks, and a computation device to be all rolled into one. The technology allows for easy electronic note taking and sharing of information. Instructors can face issues choosing from the plethora of apps available. There are so many out there that it is difficult to try each application that can apply to a math class. Instructors also need to be aware of the possibility of technology overload forced upon the student. Using the iPad in class and forcing the students to use it early in the semester can help students master the technology. The iPad is a great tool that can be used to make the math come alive and give a graphic representation of the concepts being taught.

Works Cited

