AC 2007-612: TEACHING COURSES WITH TABLET PC: EXPERIENCE AND STUDENT FEEDBACK

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Teaching Courses with Tablet PC: Experience and Student Feedback

Abstract

This paper summarizes the author's experience and student feedback from a sophomore level course on Electric Circuits that was taught using a Tablet PC in Spring of 2006. A Tablet PC (Lenovo X41) was used in the classroom, which was interfaced with a data projector. A screen capture software (Camtasia) was used to record voice and inscriptions on the screen of the Tablet PC. The classroom session was recorded as two files: a Camtasia video file which was converted to a movie file in the "Windows Media File" format, and a "Windows Journal" file for the screen writings which was converted to a PDF file. Both files were uploaded to the Blackboard Learning System within two hours after the end of the class. A detailed survey was conducted at the end of the semester on the effectiveness of using the Tablet PC in the classroom. Contrary to initial skepticism, student attendance remained normal throughout the semester, and students downloaded and replayed the movie files of lectures, and took printout of PDF files of classnotes. Students mentioned that by not taking classnotes during the live classroom session helped them concentrate more on understanding of concepts rather than transcribing the lecture. Movie files are a great supplement to classroom instruction since they can be replayed multiple times by the students to clarify concepts they missed in the classroom, or if they have missed a lecture altogether.   From the instructor's perspective, it was a great experience with better than expected student acceptance and classroom interaction.

1.   Introduction

Instructional methods have evolved over the ages from traditional writing on blackboard to the use of cellulose transparencies and overhead projectors to notebook computers and data projectors. The latest trend in instructional technology is the use of Tablet PCs and iPods in the classroom.   In recent years, Tablet PCs are making its headway into classroom instruction at every level, from K-12 to colleges, as well as in business meetings of corporate America. In fact, Georgia Tech has recently announced that all engineering students must use a Tablet PC in the classroom.

The advantages of using of tablet PC in a classroom have been reported [1-11, 14, 15] by various educators in last few years. Frolik and Zurn [7] used the Tablet PC in an upper level Electrical Engineering course for both content development and presentation. Tablet PC was also used in [2] for several undergraduate courses in Electrical Engineering, and Mechanical Engineering, which clearly showed it facilitates collaborative and active learning, and allows the instructor to spend more time on explaining concepts rather than drawing figures. Brophy [8] compared classroom instruction using a Tablet PC with standard PowerPoint presentation and whiteboard; Tablet PC based class presentation showed better attention rate and better comprehension of the material. From the students' perspective, note-taking is greatly improved if they use Tablet PCs as reported in [14] for a course on Precalculus.   Tablet PCs are also being increasingly used in K-12 education, such as, [16, 17], and many more schools across the country.   Ref [18] reported the use of Tablet PC in a zoo to assist visitors with visual and hearing disabilities.

In terms of instructional technology, PowerPoint is probably one of the most widely used presentation tool in the classroom. The Classroom Presenter [19] has the ability to inscribe on formatted PowerPoint slides as well as allows students to communicate among themselves and the instructor in real time. Use of electronic ink in Classroom Presenter is, however, restricted [10] only to static displays, such as PowerPoint. The WriteOn tool [10, 11] can be used for annotating on top of any application visible on the Tablet screen, static or dynamic.

In Spring of 2006, the author taught a sophomore level course on Electrical Circuits using a Tablet PC; the enrollment of the class was 26. It started as an experiment to investigate the possibility of using Tablet PC for asynchronous course offering on the web. A Lenovo X41 Tablet PC with Windows XP was used in the classroom. The Tablet PC was used as an electronic substitute of the blackboard for classroom instruction. Windows Journal was used in the background for writing on the Tablet screen, which provided an easy interface with other Windows software, such as, Matlab, Word, etc. The Windows Journal file provided a pdf printable record of inscriptions on the Tablet screen. The screen capture software, Camtasia, [12] was used to record the entire lecture as a movie including voice and all screen inscriptions. The Camtasia video file was converted to a Windows Movie file, and uploaded on the Blackboard [13] learning system.

At the beginning of the semester, the author and his colleagues were very much skeptical about the whole experiment; they were especially concerned about possible loss of class attendance due to the availability of movie files of recorded classroom sessions. Fortunately, the semester ended with no noticeable change in attendance, but with significant approval from the students as a great learning tool. A detailed survey was conducted at the end of the semester on the effectiveness of using the Tablet PC in the classroom. Students mentioned that Tablet PC helped them concentrate more on understanding the concepts rather than spending time transcribing the lecture, and coping material from the whiteboard.

The paper is organized as follows: Section 2 describes author's experience in teaching the sophomore Electric Circuits course, EE165. Analysis of a survey conducted in the class at the end of semester is discussed in Section 3. Section 4 gives some concluding remarks.

2.   Teaching with a Tablet PC

Classroom presentation methods have evolved considerably over the years from handwriting on blackboard to the use of Tablet PC. One can categorize the various approaches of classroom presentation as: a) Blackboard, b) Transparency, c) Whiteboard, d) Digitized Whiteboard, and e) Tablet PC.

Lord and Perry [5] summarized various options that instructors typically use in a classroom setting along with their advantages and disadvantages. Traditional method of writing on the blackboard is still favored by many instructors since it is easy to keep pace with students' learning, as well as to 'walk' the students through the complex mathematical derivation that is typical in many engineering courses. The final paradigm in classroom presentation is the use of Tablet PC, which provides the flexibility of traditional handwriting, ability of multimedia presentation as well as real-time collaboration among students, and submission of students'

responses to the instructor. Reference [5] compares the use of Tablet PC in three different modes: handwriting, simple PowerPoint, and PowerPoint with Classroom Presenter [19].

The author used a Tablet PC (Lenovo X41), which was interfaced with a data projector. The operating system for the entire setup was Windows XP. A screen capture software (Camtasia) [12] was used to record voice and writings on the screen of the Tablet PC. The classroom session was recorded as two files: a Camtasia video file which was converted to a movie file in the "Windows Media File" format, and a "Windows Journal" file for the screen writings that was converted to a PDF file. Both files were uploaded to the Blackboard Learning System within two hours after the class ended.

Before the beginning of the lecture, the author would start Windows Journal on the screen, and keep Camtasia in the background. Appropriate figures for the lecture were kept handy on a Microsoft Word screen for cut-and-paste operation.   This provides easy access to figures rather than searching for files from the computer hard disk during presentation.   The Matlab and other engineering design tools were started as need, and kept minimized.   The classroom session begins with starting of Camtasia, which remains in the background, but starts recording every stroke on the Tablet screen as well as voice.   One can choose appropriate thickness and color of stylus for inscription on the screen.   As the session progresses, Camtasia records the contents on screen and the instructor's voice.

In case the presentation requires graphics, the instructor simply switches to a Microsoft Word screen, and completes copy-and-paste of the figure onto the Journal screen.   This is a preferred approach than looking for graphics files from the hard disk. This was especially useful when the author was teaching frequency response using Bode plot. The author kept a blank semilog plot on a Microsoft Word screen, which is easily imported to the Journal screen as many times as needed.   Switching to Matlab or other engineering software is done at the click of the mouse. Since the print file of the classroom session is based on the Journal file, Matlab presentation will not be available for printing, however, Camtasia records everything the student sees so that Matlab presentation will be recorded in the movie file.

At the end of the classroom session, two files are saved in the computer hard disk: a) a Windows Journal file that contains everything that the instructor wrote of the Tablet PC screen, and b) a Camtasia video capture file that contains everything that the students saw on the projector screen.   The Journal file is easily converted to a pdf file using Acrobat or any other pdf writer, the video capture file was converted to a Windows Media movie File, which are uploaded to the Blackboard Learning System.   The Figure 1 shows a page recorded by the Windows Journal.

The most important aspect of teaching the course with the Tablet PC was that students have the option to replay the movie times as many times as they need to clarify concepts they missed in the classroom. *It is this feature that was used and appreciated by the students most often, and has made the most positive impact in students' mind about the use of Tablet PC in the classroom.* In addition, students have the ability to know what was done in the class that they may have missed. Replaying of the recorded movie files are sufficient to provide a reasonable classroom experience for any missed lectures, and are certainly far more effective than reviewing of printed lecture notes.
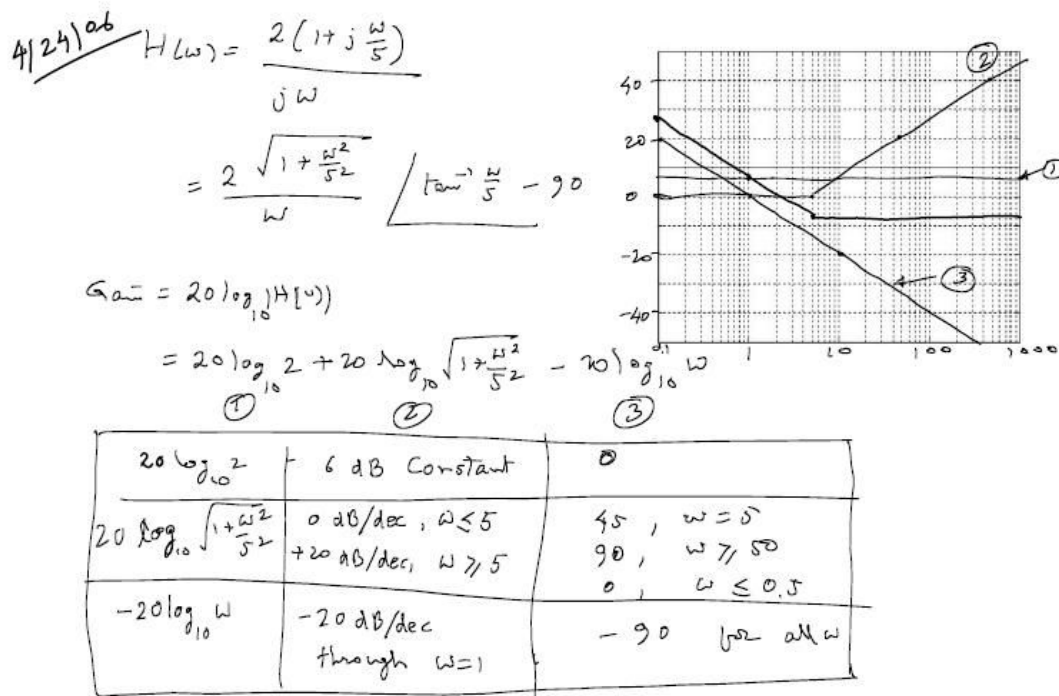
Figure 1: **A Windows Journal page**

There was no change in the author's course preparation time since the course was taught much the same was as one would do in a in a traditional blackboard setting.   Instead of writing on the blackboard, the author just wrote on the Tablet PC screen. The main difficulty the author experienced for using the Tablet PC was writing on slippery glass surface.   No matter how good one's handwriting is, it is not easy to write on a glass surface. This problem could become worse for those whose handwriting is not as good. Nevertheless, with some practice, one gets used to writing on the Tablet PC. The advantages and disadvantages of using a Tablet PC in the classroom can be summarized as follows:

Advantages:

1) Ability to present the lecture material in the traditional way of writing on the board
2) Ability to use colored stylus for clarity and for emphasizing concepts
3) Ability to use PowerPoint slides
4) Ability to use PowerPoint slides and scribing on it during lecture, but without altering the originals
5) Ability to face the students during lecture, which improves student interaction
6) Ability to record the entire classroom session as a movie file which can be shared to the students

7) Ability to record the session as a print file which can be shared with the students as a well-prepared classnote
8) Students can replay the movie files multiple times for further clarification of material learned
9) Students can play the movie files in case they have missed any classroom lecture
10) Students can concentrate on understanding the concepts rather than transcribing the instructor's lecture and copying contents from the board
11) Ability to reuse the recorded movie and print file for next offering of the course as a guide
12) Ability to use the recorded movie and print file as a guide for a new junior faculty who might be teaching the course for the first time
13) Ability to integrate Matlab and other engineering design and analysis software in the lecture
14) Ability to promote active learning through students' use of wireless communication among themselves and with the instructor

Disadvantages

1) Difficulties in stroke control of the stylus may make the instructor uncomfortable.
2) Instructors with poor handwriting may find their writings on Tablet screen even worse.
3) Some instructors may find the Tablet screen too small to cover large engineering drawings, or sectionalizing the screen for clarity of presentation, or for referencing parts of presentation already covered

3. Student Feedback

In the Spring of 2006, the author started teaching the course with the Tablet PC with a big skepticism about its success. The author and as many of his colleagues were very much concerned about possible loss attendance; after all the author does not use classroom attendance as one of the items for the final grade. As the semester progressed, it came out as a big surprise that classroom attendance remained normal as usual with occasionally only one or two students missing.

The author also noted that some of the students were taking classnotes during lecture, while others were just listening without writing anything. Classroom participation was better than what the author had experienced in previous years for the same course. Students were more active, and the classroom atmosphere was live. At the end of the semester a survey was conducted about usefulness of the Tablet PC in the classroom. The survey instrument contained questions in several categories given below:

a) Attendance
b) Replaying of movie files
c) Printing of lecture notes
d) Technology
e) Classroom presentation

f) Learning environment
g) Final comments

Contrary to our initial skepticism, the semester ended very well with better than anticipated acceptance of Tablet PC in the classroom.   Overall the student attendance remained normal as usual, and students reported that they have downloaded the movie files to play from their home computer, and also many of them have printed pdf files of classnotes.   Recommendation from the students about using the Tablet PC in this and other courses was a resounding 100%.   The following Table summarizes the student feedback.

Table 1

Total number of lectures missed during the semester. Total number of lectures in the semester was 42. Total enrollment was 26 out of which 24 students participated in this survey.	33.4% missed 0 lectures 25% missed 1 lecture 25% missed 2 lectures 16.6% missed 3 or more lectures
Reasons for missing a lecture:	100% - for personal reasons, and not due to availability of recorded movie files
Playing of movie files	91.7% - played movie files 8.3% - didn't play movie files
Average number of times each movie file was replayed by students	50% played each movie file once 37.5% played each movie file twice 4.2% played movie files 3 or more times 8.3% didn't play movie files
Took classnotes during the session	58.3% - took classnotes in the class 41.7% - didn't take classnotes
Printed classnotes of recorded PDF files	95.8% - printed pdf files from Blackboard 4.2% - didn't print pdf files Reasons for not printing PDF files: Took good classnotes
Recorded classroom session helped learn better	70.8% - strongly agree 12.5% - neutral 16.7% - no opinion
Recommend recording for this and other courses	100% - definitely yes

Student's Comments

One of the objectives for using the Tablet PC in the classroom was to determine if it can be used for asynchronous teaching of courses on the Internet.   Thus students were specifically asked if they would prefer playing movie files of lectures rather than attending the lectures in the classroom. These are some of the comments students wrote on the survey:

"Even though movie files are available, I attended lectures so I can interact with the professor and other students."

"Classroom atmosphere is important. Although the movie files helped, I think it is important to have classroom teaching."

"Yes, movie files are good enough to run without a class, but you would still like to ask questions to the professor."

"Movie files were important to review the material seen in the class, but going to the class was necessary."

"You cannot ask any questions when you are just playing the movie files."

"Movie files are great, and I can pay more attention to the lecture without copying from the board."

"When you replay the movie files, it's like reviewing the entire material."

"I love the movie files, but I learn by writing."

"I feel the classroom discussions are important."

"I learn better by being physically in the classroom."

"I feel writing classnotes is better than watching a movie."

"Movie files were good for review, but not enough to skip lectures."

"It was a good to sit through the lecture, and then review the movies multiple times."

"Thanks for putting such an effort into teaching."

"I would go to class and watch the movie files again to understand better."

4.   Summary

This paper summarizes the author's experience and student feedback for teaching a course using Tablet PC. The classroom session was recorded as two files: a Camtasia video file which was converted to a movie file in the "Windows Media File" format, and a "Windows Journal" file for the screen writings which was converted to a PDF file. There was no noticeable change in classroom attendance. Students mentioned that by not taking classnotes during the live classroom session helped them concentrate more on understanding of concepts rather than transcribing the lecture and copying information from the whiteboard. Movie files are a great supplement to classroom instruction since they can be replayed multiple times by the students to clarify concepts they didn't understand in the classroom. Students felt that the Tablet PC greatly helped them learn, but it is not a substitute of face-to-face classroom session. From the instructor's perspective, it was a great experience with better than expected student acceptance and classroom interaction.

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