

TABLET PC - IS IT WORTH IT? A PRELIMINARY COMPARISON OF SEVERAL APPROACHES TO USING TABLET PC IN AN ENGINEERING CLASSROOM

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Abstract

Tablet PCs are the latest technology in portable computing, but is it worth it for engineering faculty to make the investment of their time to change their course content development and delivery method to include a Tablet PC? In this paper, we will address a range of options that faculty have for course development and utilization of the Tablet PC. We will compare various lecture methods of using the Tablet PC including writing on it directly, using PowerPoint, and using Classroom Presenter. Student assessment of the various presentation methods will be shared as well. Faculty might have a range of motivations for moving to incorporating a Tablet PC in their classrooms from capturing content for faculty review, providing handouts for students, increasing active learning, and even distributed learning. Course content development can be a daunting and time consuming task for many engineering faculty. Making a gradual change from their current mode of delivery might be most comfortable and beneficial. The authors will discuss their experiences and lessons learned in moving from using a blackboard, transparencies made using WORD, and computer projection of PowerPoint to using a Tablet PC. We hope that this work will be helpful to other engineering educators as they strive to improve their teaching effectiveness. A Tablet PC is not a substitute for effective teaching. However, it might serve as a useful tool for our current students who are comfortable with technology and expect it to be part of their daily lives.

Introduction

Tablet PCs are the latest technology in portable computing. Featuring pen-based entry where the user writes “digital ink” directly on the computer screen, Tablet PCs typically offer the functionality of a laptop or notebook with less weight and added benefits. They are gaining acceptance in K-12[1,2] as well as college classrooms both for faculty presentations and student note-taking.[3,4] In this paper, we are interested in the use of the Tablet PC for instructors in their classroom lectures. Tablet PCs offer numerous attractive features for faculty such as capturing content for instructor review, providing handouts for students, ability to incorporate multimedia features such as simulations, websites, or images, generating excitement among students by using the latest technology, large-scale dynamic presentations, ability of instructor to face students and be mobile during lecture, increasing active learning, and even the possibility of distributed learning or ubiquitous computing. Engineering and computer science faculty have begun investigating their use in the classroom in a variety of ways.[5,6,7] However, is it worth it for faculty to make the investment of their time to change their course content development and delivery method to include a Tablet PC? Course content development can be a daunting and time consuming task for many engineering faculty. Making a gradual change from their current mode of delivery might be most comfortable and beneficial.

In this paper, we will address the question of whether or not moving to a Tablet PC might be useful by presenting a range of options that engineering and computer science faculty have. First we will describe various “traditional” methods for presenting information in lecture including blackboard, transparencies, and computer projection including possible shortcomings. Then we will describe a range of options for course development and utilization of the Tablet PC including writing on it directly, using PowerPoint, and using Classroom Presenter.[8] This is based largely on our experiences teaching engineering at a small private university, University of San Diego (USD), with typical class sizes of less than twenty students. We will discuss our experiences and lessons learned in moving from “traditional” methods such as blackboard, transparencies or PowerPoint on a laptop PC to digital ink on a Tablet PC. The following presentation methods will be discussed:

1. Blackboard/Whiteboard
2. Transparencies
3. PowerPoint on laptop
4. PowerPoint on Tablet PC
5. Classroom Presenter on Tablet PC

Advantages and disadvantages of the various methods will be considered. Student comments on the various presentation methods will also be included.

Various Presentation Methods

A number of different methods are commonly used by engineering educators. In terms of format, these may be broadly separated into those that use handwriting and those that are digital. A comparison of these formats is presented in Table 1. Note that some of the advantages of the digital format must be used carefully. A lecturer must exercise caution not to fly through too much material since there is no time spent writing or erasing on the board. Anytime that notes are distributed in advance, there is the potential for poor class attendance if

the students perceive that everything is in the notes. Leaving blanks on student handouts can address these problems. Answers can be handwritten by the instructor or animated in PowerPoint to engage the students and slow the pace of instruction.

Blackboard/Whiteboard

The most commonly used handwritten format is the blackboard. For generations, teachers, professors, instructors, and presenters have been utilizing the blackboard for communicating with an audience. Instructors use the blackboard to disseminate information via written discourse in order to educate students. Utilizing chalk on a black slate-like surface, the instructor can write the information in an organized fashion, filling the board left to right. Whenever the board is filled, the instructor must erase the board and then continue with the next concept on top of a residual white dust cloud blurring the next text or graphic. The whiteboard, similar to the blackboard, has a white background and is considered more “user-friendly” in that it provides the user with several pen colors as well as more complete erasure.

Course preparation can be a time consuming task for instructors, especially for first-time course preparations. Instructors are busy familiarizing themselves with the new material and do not want to be bothered with extraneous tasks. Creating presentation notes in a spiral notebook that are later presented to students on a blackboard is an easy transition. Although, simply presenting from written notes to a board can be unorganized and difficult to read. The “Essential Teaching Seminars for Engineering Faculty”[9] suggest partitioning your notebook paper into six quadrants with one quadrant per main concept in order to organize your thoughts on paper and on the board. Each quadrant on paper can be transposed onto each section of the blackboard keeping your thoughts and progression structured so that students can easily follow the instructor step by step. The six slides per page on notebook paper are

Table 1: Comparison of Handwritten vs. Digitized Lecture Formats

Format	Advantages	Disadvantages
<i>Handwritten</i>	<ul style="list-style-type: none"> • Class preparation simple (no computer or software skill) • Easy to write equations • Dynamic presentation (students write what instructor writes, changes can be made <i>in situ</i>) 	<ul style="list-style-type: none"> • Clarity depends on personal handwriting • Difficult to include graphics • No prewritten notes distributed in advance • No reusable notes that can be updated • Less material presented in lecture (takes time to write) • Hard for student to write, listen, and understand simultaneously
<i>Digitized</i>	<ul style="list-style-type: none"> • Legible type-written notes • Easy to read equations • Prewritten notes distributed in advance • Reusable notes that can be updated • Easy to incorporate graphics • More material presented in class (less time to write than to discuss) • Student can focus more on listening and understanding than writing 	<ul style="list-style-type: none"> • Longer course preparation times (especially the first time) • Need to learn software for text, equations, figures etc • More expensive (PC required) • Static presentation (material already prepared; hard to make changes during class) • Potential to move through material too fast

analogous to PowerPoint's six slides per page printout. In a survey conducted by Frolik and Zurn[5], students stated several advantages for using the board: learn by seeing the progression of the material, flexible format so that elaboration is easily incorporated, and student is engaged by writing and thus staying focused. One of the main drawbacks of using the blackboard is that students spend a majority of their time writing instead of engaging in discussion with the lecturer or listening and understanding what is presented. In large classrooms, such as auditoriums, the board can be difficult to read from seats in the rear. The writing utensils can also be messy and ruin clothing with dry-erase ink or chalk. Advantages and disadvantages of using the blackboard or whiteboard are summarized in Table 2.

Transparencies

Transparencies presented on an overhead projector may be used in either a handwritten format where the instructor writes notes on a

transparency during lecture or a digital format where the instructor prepares information on a computer before class and presents this in class making necessary annotations with a transparency pen. Advantages and disadvantages of these methods are summarized in Table 2.

One of the authors (SML) has used transparencies in a digital format for over ten years. She prepares her notes in Microsoft WORD dividing the material into sections that can be presented one transparency at a time. She includes necessary pictures, diagrams, equations, and problem statements. She prepares the file with hidden text for items such as answers to questions, problem solutions, or instructor notes. Preparation of these lecture handouts is time-consuming especially for the first offering of a course. Subsequent offerings require much less time as notes only need to be updated not created from scratch. She prints one copy with hidden text visible for her own use during lecture. She prints another copy without the hidden text for distribution to the students and for use in making transparencies

for lecture. This copy might also include figures or diagrams from other sources incorporated using a copier. These handouts provide a framework for the students' notes. They are expected to fill in the missing text or problem solution and make their own notes on these pages. Students often comment on course evaluations that they like having the notes and that it enhances their learning and allows them to focus on what is being said rather than transcribing. Colwell's paper on digital note taking[4] discusses the advantages of having a way to write directly on the projected image while students have a handout to write on. These advantages are summarized as integration, permanence, interactivity, and immediacy. Some disadvantages of the transparencies are that this uses an older technology so that although projectors are commonly available, they are often of poor quality and they may not be replaced in classrooms as computer projectors become more popular. Transparencies and handouts may be prepared in portrait format which is nice for reviewing handouts later but awkward for transparencies where the entire slide may not be clearly visible at once. One can easily write on transparencies allowing for a record of what was done in lecture. However, this often gets messy. Even when using transparency sleeves, to reuse requires one to erase by hand which is tedious or use a new sleeve which is wasteful. The Tablet PC can help with these problems.

PowerPoint on a laptop

PowerPoint, a Microsoft software package, has evolved out of the business sector as the most prominent presentation development software applications. It has slowly migrated over to the education arena and is popular for course content preparation. One of the authors (LAP) has been using PowerPoint for instruction for almost ten years. As in blackboard or transparency preparation, PowerPoint can break concepts into slides that are manageable, but the course preparation is much more time consuming than for blackboard. The preparation requires proficiency in PowerPoint

as well as the included applets such as graphics, video and equation editors. Instructors can include graphics, video, art, websites into presentations which engages students, but increases preparation time. For engineering or other mathematically intensive course preparations, the incorporation of equations and figures into a presentation is a necessity, but can be difficult. One of the authors (LAP) estimates the time to develop course preparation using PowerPoint slides is twice as long as blackboard. The preparation time may be longer, but the rewards far outweigh the difficulties. A PowerPoint presentation has the advantages of a digitized format as summarized in Table 1 as well as additional advantages and disadvantages as summarized in Table 2. PowerPoint is an excellent choice, but it could be better if we could incorporate the benefits of writing on the blackboard and the reusable, dynamic, legibility of PowerPoint.

Using a Tablet PC

The Tablet PC is similar to a laptop in that it is lightweight, portable, and wireless but it has one significant addition, a stylus input device. That is, an electronic pen that can be used to write on the LCD screen as you would on a spiral notebook. There are several Tablet PCs available on the market, but the authors use the Toshiba Portégé M205-S810 and the NEC Versa Litepad. The Toshiba is a convertible tablet which means it is a laptop with pen capability. The NEC is a true tablet that has external devices to minimize weight and size of the tablet. The authors recommend transitioning to the digital pen technology using a convertible since it is a less dramatic transition. . There are three methods to utilize a Tablet PC for instruction: all handwritten notes in One Note, a hybrid of handwritten and typed notes in PowerPoint, and a hybrid of handwritten and typed notes in Classroom Presenter. Each of the three methods utilizes a different software package and has its own advantages and disadvantages as summarized in Table 3. Note that the Tablet PC offers the possibility of combining the advantages of handwriting with

those of digitizing or as Frolik and Zurn suggest [5]“the Tablet enables the instructor to seamlessly marry the best features of chalkboard and multimedia lecturing techniques.”

The first presentation method uses the software package included with Microsoft Windows XP for the Tablet PC, One Note. One Note is an application that simulates a spiral notebook in the electronic form allowing an instructor to write on the pad (screen) as if it is. The use of a tablet for writing has all of the advantages of the handwritten format plus many of the advantages of using PowerPoint on a laptop. The main advantage of using the Tablet PC in this scenario is that the instructor has a record of what was presented in class which can be used in the next offering of the course either directly or as a guide. A novice tablet user may feel most comfortable transitioning to the digital medium using this method so that the learning curve is minimized. It will feel like a whiteboard without the mess or erasing. One drawback is that the size of the tablet screen is much smaller than a whiteboard making references to earlier written concepts, still on the board, difficult.

The next method is a hybrid method incorporating handwritten and typed notes in PowerPoint. It allows the instructor to have all of the advantages of using PowerPoint on a laptop including handwriting capability. The course preparation for the Tablet PC is similar to PowerPoint preparation in that PowerPoint is still the presentation delivery mechanism. The handwriting will occur primarily during the classroom lecture. Presentations are developed in PowerPoint, but with a new strategy, simulating the whiteboard as much as possible. That is, type important definitions and equations in PowerPoint so that students and instructor do not have to be concerned with writing a formula incorrectly during the lecture, but purposely leave plenty of white space on your slides in order to have room for writing during class time. Leaving blank slides for working

examples is encouraged. A general “rule of thumb” is that an instructor should type definitions and formulas, include figures, and work examples using the stylus pen. Students become accustomed to filling in the blanks and writing whatever the instructor writes. Students do not spend the entire lecture writing notes and can concentrate on learning new material and participate in class discussions. There are some downsides to using PowerPoint on the Tablet PC. One missing feature is the ability to include hidden text that is only visible to the instructor. This allows instructors to have answers to problems and examples viewable only to them so that details or steps are not forgotten. Another obstacle when using PowerPoint is the ease with which the instructor can use additional writing space (new slide) for questions or side examples. It can be done, but it is time consuming and distracting in the classroom.

The final method uses software called Classroom Presenter (CP) and is a summation of all previous tablet presentation methods. That is, it utilizes PowerPoint, adds handwriting and includes hidden text to create a file that is exported into Classroom Presenter. The exported .CSD file is created using an applet installed in PowerPoint which takes care of the exportation with a click of the menu option. Classroom Presenter addresses the shortcomings of PowerPoint and adds many other distributed learning features as described in Simon.[7] CP allows instructors to add “hidden text” in course preparations so that the instructor can view notes to work through examples, explain details etc. CP also has an option to add new writing space to answer student questions or elaborate on topic or concept explanations. Before executing CP, the instructor must setup the dual monitor option on the Tablet PC. This allows the instructor to see the input screen with the editing tools while the students only see the presentation. Using this feature, instructors can work on solutions in Excel or Word without the students seeing the file before the instructor is completed. Even though CP addresses the

shortcomings of PowerPoint, it also has deficiencies. CP does not permit animations, video, or internet links to be embedded in the presentation. The software also has some problems during file exportation. The .CSD export file creates extremely large files that have problems converting certain fonts, Greek letters, and Visio drawings while large pictures lose resolution. The software is an excellent presentation package that is free and easily obtained by going to their website but it is a work in progress and under continuous development.

Progression for faculty examples

Thus there are multiple paths that an engineering educator could follow to incorporate a Tablet PC into lecture depending on what method one is using now, what activities one is most comfortable doing in class, and what one's goals for improvement are. For example, someone who is comfortable using a blackboard, whiteboard, or writing on blank transparencies might find the first helpful step would be to use the Tablet PC as an electronic board. They would continue writing out their notes by hand but write them on the Tablet. This would produce a record of the notes to be maintained for distribution to the students or review and continuous improvement by the faculty member. They could use the One Note software included with Microsoft XP on the Tablet or PowerPoint or Classroom Presenter with blank slides.

For someone used to using overheads from PowerPoint or WORD, moving to the Tablet using PowerPoint or Classroom presenter might be desirable. The quality of the projection should be improved using the data projector compared to an overhead projector. PowerPoint with overheads compared to PowerPoint with a Tablet PC offers the instructor the ability to write on the notes without messy pens or searching for pens and save different copies of files with and without the handwritten notes. The instructor notes feature of Classroom Presenter might be particularly attractive. The

instructor would have notes visible to his/herself on the Tablet in lecture and print out handouts without the instructor notes for the students.

For those used to using PowerPoint and a data projector, the Tablet PC and Classroom presenter allow for hidden text visible to the instructor only. In addition, after becoming comfortable with the Tablet PC and Classroom Presenter, one could expand into distributed learning in a digital lecturing environment where students have Tablets and can use these to submit their own work via the World Wide Web for review and presentation by the instructor.[10] This might be particularly valuable for instructors with large classes.

Regardless of how one might incorporate the Tablet PC, it can have benefits for the instructor in terms of capturing lecture content, maintaining notes, and facilitating student handouts. It can also be beneficial for the students if it is used to facilitate more active learning which enhances learning.[11]

Student Feedback

Students were asked for their anonymous feedback during several offerings of courses by the authors. Their response to the use of the Tablet PC clearly depends on how the technology is used as well as what their expectations are from previous experience.

In Spring 2005 and Fall 2005, one of the authors (SML) used transparencies prepared using WORD for the first half of the semester and the Tablet PC with Classroom Presenter for the second half of the semester. Seven of the eight students enrolled in these two classes provided feedback. Handouts were provided to the students for all lectures. Students were asked to comment on the effect of the Tablet PC compared to transparencies using WORD. Four students preferred the Tablet PC, two thought the two methods were equal and one preferred the transparencies. When asked to list the main

Table 2: Comparison of Various Traditional Presentation Methods.

Method	Resources Required	Advantages	Disadvantages
<i>Blackboard or Whiteboard (Handwritten)</i>	<ul style="list-style-type: none"> • Black or white board • Chalk or pens • Eraser 	<ul style="list-style-type: none"> • Black or white board available in virtually all college classrooms • Familiar 	<ul style="list-style-type: none"> • No facing the audience during discourse • Takes time to erase the board • Hard to read board that has been erased many times • No record of what was presented in class
<i>Transparencies (Handwritten)</i>	<ul style="list-style-type: none"> • Overhead projector • Screen • Transparency pens • Transparencies 	<ul style="list-style-type: none"> • Projectors commonly available • Face the audience during discourse • Record of what was done in class • No erasing the board 	<ul style="list-style-type: none"> • Messy pens & erasing for reuse • Old overhead projectors make it hard to read notes • Instructor or projector may block view
<i>Transparencies (Digitized)</i>	<ul style="list-style-type: none"> • Overhead projector • Screen • Transparency pens • Transparencies • Computer to prepare slides 	<ul style="list-style-type: none"> • Projectors commonly available • Face the audience during discourse • Record of what was done in class including what instructor writes • No erasing the board • Incorporate hidden text for handouts 	<ul style="list-style-type: none"> • Messy pens & erasing for reuse • Old overhead projectors make it hard to read notes • Instructor or projector may block view
<i>PowerPoint on Laptop (Digitized)</i>	<ul style="list-style-type: none"> • Data Projector • Screen • Laptop • <i>PowerPoint</i> 	<ul style="list-style-type: none"> • Embedded graphics, videos, or websites • Animation of text and graphics • Present on large screen for big audience • Portability of all lecture notes • Face the audience during discourse • No erasing the board • Record of what was done in class 	<ul style="list-style-type: none"> • Move through material too fast • No hidden text

Table 3: Comparison of Various Digital Ink Presentation Methods Using a Tablet PC.

Method	Resources Required	Advantages	Disadvantages
<i>Handwritten Notes</i> <i>on</i> <i>Tablet PC</i> <i>(digital ink)</i>	<ul style="list-style-type: none"> • Data • Projector • Screen • Tablet PC • <i>One Note</i> 	<ul style="list-style-type: none"> • Advantages of handwritten • Present on large screen for big audience • Portability of all lecture notes • Face the audience during discourse • Record of what was done in class • No erasing of the board 	<ul style="list-style-type: none"> • Disadvantages of handwritten
<i>PowerPoint</i> <i>on</i> <i>Tablet PC</i> <i>(Digital Ink)</i>	<ul style="list-style-type: none"> • Data • Projector • Screen • Tablet PC • <i>PowerPoint</i> 	<ul style="list-style-type: none"> • Advantages of handwritten and digitized • Embedded graphics, videos, or websites • Animation of text and graphics • Face the audience during discourse • No erasing the board • Record of what was done in class including what instructor writes 	<ul style="list-style-type: none"> • No hidden text • No additional workspace for questions
<i>Classroom Presenter</i> <i>on</i> <i>Tablet PC</i> <i>(Digital Ink)</i>	<ul style="list-style-type: none"> • Data • Projector • Screen • Tablet PC • <i>Classroom Presenter</i> 	<ul style="list-style-type: none"> • Advantages of handwritten and digitized • Incorporate hidden text for handouts • Present on large screen for big audience • Portability of all lecture notes • Face the audience during discourse • “Whiteboard” for additional workspace • No erasing the board • Record of what was done in class including what instructor writes 	<ul style="list-style-type: none"> • No embedded graphics, videos, or websites • No animation of text or graphics • Export file created very large • Problems converting certain fonts, Greek letters, & Visio drawings • Pictures lose resolution in export file

advantages of the Tablet PC for their learning students main responses included :

“Easily organized and able to write on PC.”
“Nothing in the way of our view.”
“Made the lecture more interactive”
“advantages aren’t huge except the use of new technology”
“we write more notes.”

When asked to comment on the pace and level of interaction of the class, three students said it was the same for the two methods of lecture presentation. In Fall 2005, one student much preferred the amount of class interaction and pace of the class with the Tablet PC. In Spring 2005, one student said the pace was same but there was more interaction with the Tablet PC. One student said the pace was faster with the Tablet PC but that could be due to end of the semester rush while another said the pace was slower but with increased interaction.

Handouts from PowerPoint or Classroom Presenter continue to be a challenge for this instructor. In Spring 2005, three out of four students preferred the handouts from WORD. Part of this is that the instructor has had over a decade of experience in preparing handouts in portrait in WORD compared to two semesters in landscape in PowerPoint. Based on student feedback, the handouts from the Tablet PC have changed from framed two handouts to a page from PowerPoint to unframed 2 slides to a page (using a printer option rather than a handout option to make the text larger and more readable). Two students in Fall 2005 still preferred the handouts from WORD to those from PowerPoint while one preferred those from PowerPoint.

In several courses offered by one of the authors (LAP) students were enthusiastic in their support of using the Tablet PC. All of the students prefer PowerPoint slides on Tablet PC over PowerPoint slides on laptop and transparencies. Students prefer two slides/page if double sided, otherwise they prefer four

slides/page. The students commented favorably on the use of the Tablet PC over using PowerPoint and even whiteboards and blackboards. The students felt that using Tablet PC is a great compromise between continuously writing and simulating the blackboard to sitting back and listening to a PowerPoint presentation. Student writing is focused on working examples and important details. Instructors must be careful to provide adequate spacing on handouts for student notes.

Main Advantages of Tablet PC (Student comments)

“The professor is actively showing problems and lecture material and highlighting key points. The teacher isn’t just showing the class; it is like the professor is doing example problems with the class rather than showing us examples.”

Main Disadvantages of Tablet PC (Student comments)

“The only problem that I honestly have with the tablet pc lectures is that it can be hard for the teacher to write clearly and completely legibly.” (Author (LAP) has bad handwriting in general.)

Summary

In this paper, we have summarized a range of options that engineering educators have for course development and classroom presentation using the Tablet PC. We described the advantages and disadvantages of handwritten versus digitized presentation formats. We also compared traditional presentation methods including the blackboard, transparencies, and PowerPoint on a laptop. We showed several ways in which an engineering educator who is comfortable using one of these traditional methods might transition to using a Tablet PC to incorporate the advantages of handwriting and digitizing using digital ink. The Tablet PC course preparation may take more time initially but the updates and reuse far outweigh the

initial investment. As engineering educators continually improve their teaching effectiveness, the Tablet PC can be helpful. A Tablet PC is not a substitute for effective teaching. However, it might serve as a useful tool for our current students who are comfortable with technology and expect it to be part of their daily lives.

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