# AC 2009-1946: ENHANCING STUDENTS? LEARNING IN ELECTRONIC ENGINEERING TECHNOLOGY COURSES BY USING MOBILE TABLET PC TECHNOLOGY

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# Enhancing students' learning in Electronics Engineering Technology courses by using mobile Tablet PC technology

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**Abstract**

In this article, the authors address a modern method of instruction using the new instructional technology in the classroom. This project is funded by Hewlett Packard (HP) Higher Education Grant. The main objective of this project is to integrate the use of wireless/mobile technology in classroom instruction to improve teaching and learning. A wireless LAN (Local Area Network) composed of Tablet PCs was setup. Special interactive software was installed. The platform to deliver some of the EET (Electronics Engineering Technology) courses was developed. These EET courses were redesigned to adapt to the new system. Evaluations from the students showed that they are learning more and concentrating on the subject matter. They overwhelmingly gave positive feedback to this new instructional system. Feedback from all the instructors is positive as well. We plan to include more courses using this new system in the future.

## Introduction

One of the challenges facing faculty in Electronics Engineering Technology (EET) today, is how to deliver more effective lectures to students in the classroom. In our program, most of the courses are being taught in a traditional way. The instructors stand in front of the students and explain the material while writing on the dry erase board. The students sit at the desk, listening and taking notes. There is no doubt that the traditional way of teaching is still very effective and efficient. On the other hand, the shortcoming of this teaching method is that it is mainly a one way communication. Our faculties have always been trying hard to make class more interactive, because interactive instruction provides knowledge check and assessment[1]. This assessment obtained can lead to some modification of the instruction to cater to students' needs. But one problem commonly encountered by most instructors is that the interaction within the classroom is typically limited to only a few motivated and active students. The students whose performances are not satisfactory and who actually need more attention often tend to remain quiet when an instructor solicits answers from them. Those students usually are less confident about themselves and they do not want to be put in the spot by answering questions in front of the entire class. Therefore faculties need to find ways to get feedback from these students in way without hurting their feelings.

## Hewlett Packard Teaching Grant

The Hewlett Packard Higher Education Grant[2] provided us with the means and tools to implement new instructional methods to meet this challenge. In 2008, we were awarded the HP Higher Education Grant. The grant includes 20 Tablet PCS with wireless features, and a wireless access points. Also included are printer, camera and cash award. With this grant, we proposed to accomplish the following objectives.

Firstly, those Tablet PCs are used to form a wireless network, which will be the platform of our course delivery system. The wireless capabilities of those Tablet PCs will facilitate the interaction between instructor and students in the classroom. The instructor can give an on-line quiz to the students. The students are able to submit the answers anonymously to the instructor in real time. Then the instructor can use the answers from the students to initiate a targeted discussion. The instructor can also use the poll function to obtain an overview of how students understand certain point.

Secondly, facilitate course delivery process for instructors and reduce the burden of notes-taking for students. Using tablet PC, the instructor can make easy annotation with a 'pen' in the circuit diagram, block diagram, flow chart, etc. The PowerPoint Presentation can be saved and distributed to the students through Blackboard. The instructor can also use the laptop as a white board to write key points, derive equation, make calculations, etc. All of these can be saved and distributed to the student. The change will let students focus their attention on learning and help them to understand the material better.

Thirdly, in certain courses, such as microprocessor fundamentals and C programming, the lecture is closely related with programming. Usually, in lecture, the instructor explains the syntax of computer language; in the lab, the students will try to write some program and test it. Using Tablet PC technology, these two practices can be combined in the classroom. During lecture, the instructor can easily show the students some section of the code, and open the Integrated Development Environment and demonstrate to the students how the development process goes when necessary. This will deepen the students' understanding and give them direct hands on experience right in the classroom.

Lastly, it is hoped that this initiative will help to ignite an interest in technology for under-represented groups, which is the main focus of our program, and that the students will become more dedicated to their study.

**Implementation**

The HP Tablet PCs are housed in one specially assigned classroom permanently. They are all connected to the wireless network on campus. Ubiquitous Presenter (UP) software are installed in the Tablet PCs used by the instructors.

A Tablet PC is a laptop or slate-shaped mobile computer, equipped with a touch screen or graphics tablet/screen hybrid technology which allows the user to operate the computer with a stylus or digital pen, or a fingertip, instead of a keyboard or mouse. This adds more way for the user to interact with the computer. Combined with the right software, it will empower the students with the ability to write on the computer screen and save their writing. The software used is Ubiquitous Presenter (UP), which is an outgrowth of University of Washington's Classroom Presenter (CP)[3]. It is open source software. Supporting student interaction in class via ubiquitous devices is a key feature of UP. The UP program uses Tablet PC ink, which allows instructors to annotate pre-prepared slides and allows students to create submissions for in-class activities. It has the following features:

- Lectures, including instructors' inking, are archived on the web and can be accessed and replayed after lecture for review.
- Students can interact in and outside of class via a browser-based interface. Current interaction models supported include typed text, inked "drawing" (using a Java applet which supports non-Tablets), and radio-button polling (aggregated in the manner of clicker systems). Using this feature can greatly improve the interaction between students and faculty. Because of the anonymity, it is hoped that more students will participate in the classroom activity.
- UP provide the instructor with the ability to get the survey using polling function or multiple choice functions.

In order to use this software, the instructor needs to register in the UP's website. Then he/she needs to create the course to be taught. The students also need to register as students on the website. After registration, they need to enroll in the course. Before each class session, the instructor will upload PowerPoint slides using UP software. In the class, every student uses a Tablet PC, as does the instructor. The instructor uses UP software and the students just need to use web browser. The students will follow the instructor with explanation of each slide in their own computer or from the project which is connected to the instructor's Tablet PC. The instructor can also use white board to improvise some derivations and also use 'ink' to annotate on the PowerPoint slides. If there are no PowerPoint slides for the class session, then the instructor can just use the Tablet PC the same way as use the dry eraser board to write directly on the computer screen. The only difference is that the notes the instructor writes on the computer will be saved in the server for the students to review. Therefore students do not need to take notes as in the traditional classroom setting. The instructor can also prepare some quick question to solicit the answers from the students. Since the students can submit answers anonymously, it is expected that more students will participate in this interactive activity.

This is one area of which this technology provides a solution. When a problem is given to the students and answers are solicited, the students can use inking features of tablet PC to answer and submit it anonymously to the class. In this way, they avoid being pressured and the instructor will know who submits the answers and can give more one-on-one attention to those who need it.

Additionally, this technology could alleviate the note taking dilemma, i.e., students should follow a derivation by the instructor rather than focusing on writing it all down, because it is difficult to take the notes and try to understand the process at the same time. With Tablet PC, instructor can write directly on the screen. These notes will be saved and posted online. Therefore, the students' main objective is to try to understand the concept and the process, which is the essence of leaning..

**Project Outcome**

In the past year, four EET courses (EET 2106 Electronic Device I, CET 3468 Computer Aided Circuit Analysis, EET 2036 Electrical Fundamentals II, and CET 2365 C Programming Language) have been taught by two faculty in the newly equipped classroom. In order to assess

the outcome of this new instructional system, two kinds of evaluation methods are utilized. One is objective measurement in terms of exam grades, passing rate, etc. The other is subjective evaluation using surveys.

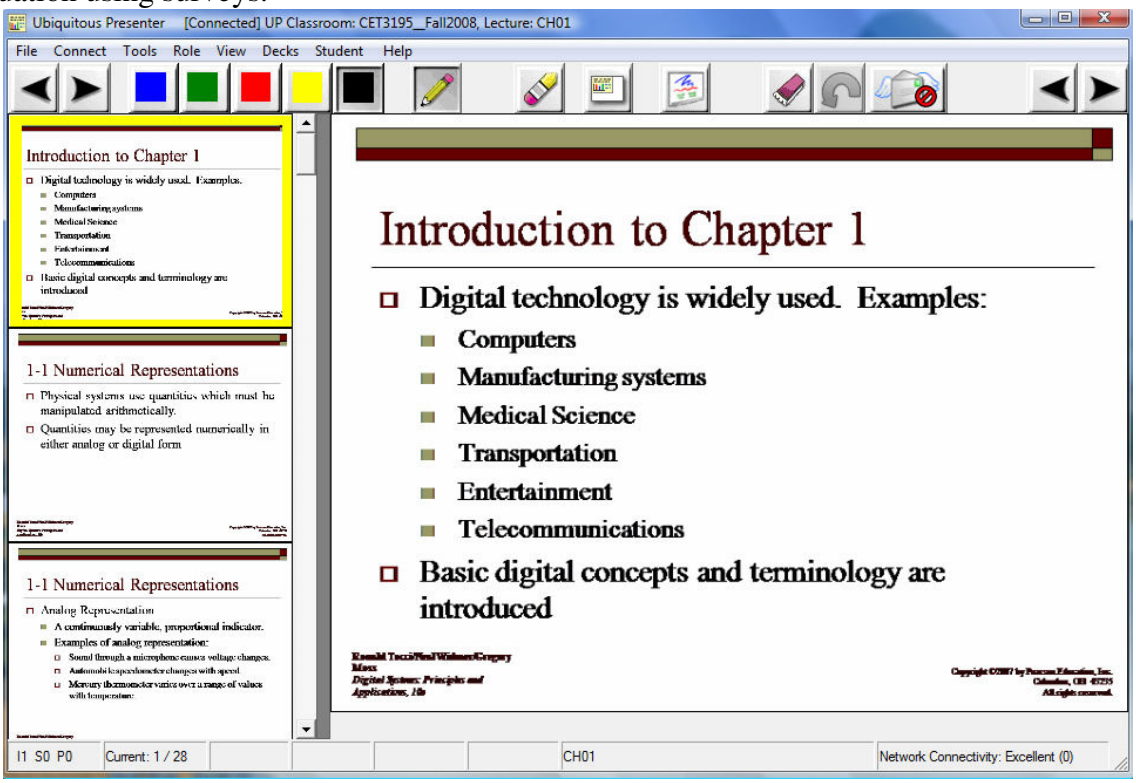


Figure 1 GUI for Ubiquitous Presenter Software (Used by instructor)

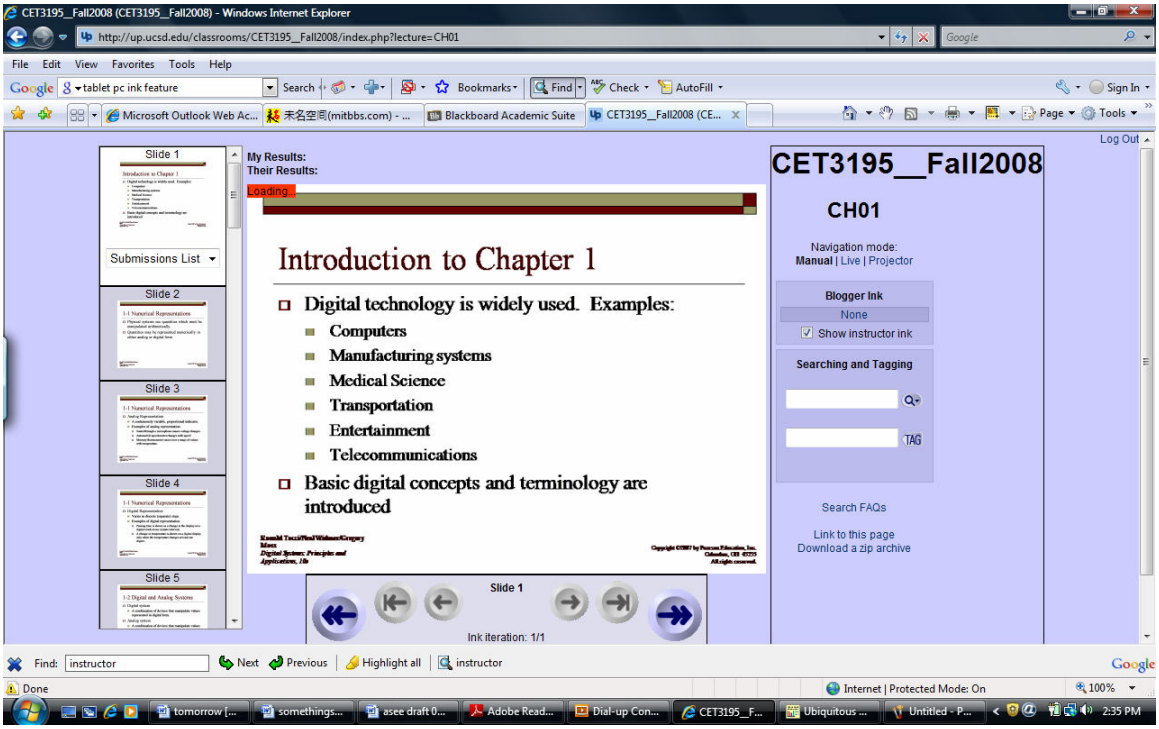


Figure 2 Using web browser to synchronize with course instruction (Students)

For each of the experimented classes, the same contents of material were covered as previous semesters. In the homework, quiz and exams, problems with similar difficulty were given to the students as before. It is a fair assumption that students enrolled in this year's class have the similar credentials and ability as the previous students. Then the only variable factor is the new course delivery system. The following table shows the grade distribution for EET 2142 for the year 2007&2008. In 2007, this class was taught in the traditional way. While in 2008, the course was taught using the new course delivery system. The columns in Table 1 represent the percentages for each grade category: A to F.

Table 1 Grades distribution for EET 2142

| | *A%* | *B%* | *C%* | *D%* | *F%* |
|---|---|---|---|---|---|
| **2007** | 21% | 26% | 42% | 11% | 0% |
| **2008** | 22% | 34% | 33% | 11% | 0% |

It is observed that the final grade distribution improved considerably toward better grades. It seems that the new instructional system help the marginal students more than other students. Since these marginal students are less confident themselves and more reserved in classroom participation, the new system provides them a means to participate in the classroom activities. Therefore it confirmed that their grades have improved. Since only 10 to 15 students in average enrolled in theses courses in each year, therefore statistically it is hard to make a conclusion that these changes are due to the new instructional system. More students need to be involved in these new instructional experiments to be able to make sound conclusion from it.

For the subjective measures, a survey consisted of 9 questions was developed. At the end of the survey, some spaces were left for the students to write any comments they have. These survey questions can be classifies as the following two categories:

- Helpfulness of the new instructional course delivery system
- Usability of this new instructional course delivery system

Here are some of the sample questions from the survey:

Question1: Using Tablet PC in the classroom has a positive impact on my learning in general.
Question2: I am more willing to share my thoughts with the rest of class and the instructor.
Question7: The ubiquitous software is easy to use. I can submit the answer and I can view the notes live or offline.
For each of the question, there are four choices: strongly agree, agree, disagree, and strongly disagree. The students need to select one from those four choices.

For each course, surveys were handed out to the students at the end of the semester. The survey results show that the students are very interested in the new course delivery system. For answers to the questions in the first category, almost unanimously the students agree or strongly agree that the new instructional system has a positive impact on their learning. Over 90% of students feel that they become more active in the classroom and there are more interaction between students and instructor. All the students agreed that they are relieved from the burden of notes

taking and can concentrate more on the lecture. As far as the usability, over 90% of students feel the system is easy to use; they can write the answer using the pen of Tablet PC and submit the answer easily. It seems that the students are excited about the new instructional system. This is also reflected by the increase in attendance and latency in the class session compared to previous class attendance and record.

In the comment area, one student raised a concern on using the new system. He pointed out that students need to develop the oral presentation skills and students need to be encouraged to take the initiative and answer questions in front of all the class. Those communication skills are very important in the work place and are important of the success of them. For the classes using this system, more interaction is done using the web. Oral responses in some cases are replaced by web response. Those issues are really needed to be taken into consideration in future lectures.

Overall, the new instructional system is a great success. Students are excited about this new system. They overwhelmingly gave positive feedback to this new instructional system. Feedback from all instructors is positive as well. We plan to include more courses using this new system in the future.

## Acknowledgment

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