AC 2009-826: TEACHING WITH A TABLET PC, A NEW TECHNOLOGY FOR THE CLASSROOM AND ACADEMIC USAGE

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Abstract :

The continued emergence of Tablet PC's with higher performance, lower price and handwriting to text conversion capabilities make this a potential teaching tool for the modern classroom. This paper will document methods that can be used in the classroom and for personal/professional and academic usage. As a teaching tool, a tablet PC can be used to pre-post lecture notes and then during class time, adding additional information to the general outline. This would eliminate the old method of J.I.T. teaching (writing on the board and students copying into their notes). Any Microsoft document (Word, Excel, PowerPoint, etc.) can be "imported" and then written on top of in a live, or distance learning environment. The usage of OneNote software to coordinate professional or academic activities allows the user to have information on hand and no longer requires printed documents to be collated, stored in folders and in drawers of file cabinets. Demonstrations of these teaching methods along with an overview of the strengths and weaknesses of this technology will be presented in this paper.

Introduction:

Teaching in the classroom has been conducted using traditional methods that have evolved over the years. Starting with chalk and a blackboard to markers and whiteboards, advancements in materials and technologies have created new tools for the instructor in the classroom. With the advent of over-head projectors and mylar transparencies, followed by power point presentations using a computer and a video projector, new technologies continue to evolve the class room to what it is today. All of these methods have their strengths and weaknesses from start-up costs and continuing costs required by the university, to time and energy needed by the instructor. Many faculty have used all of these methods and learned first-hand the advantages and shortcomings of each of these classroom tools.

Although the chalk/blackboard or marker/whiteboard is the least expensive method to use in the classroom, it is also the most time and energy intensive. The pace of the class is slowed down by writing on the board and when the instructor is speaking, students are too busy copying what was written to listen. There is also the issue of strain to an instructor's shoulder, arm and wrist from the usage of a marker and erasing the board. Depending on the amount of material that needs to be written during the class, the length of the class and the number of classes an instructor teaches in a week this could lead to excessive wear to specific joints on the body and potential repetitive motion injuries to an instructor.

Freshman students tend to have poor note taking and organizational skills, and seldom make notes to themselves about ideas/concepts or specific points of interest that may come up in a discussion. Freshman students are usually not aware that they should also be writing down key points about what is said during a lecture. This causes students to lose important points of information because if it is not written on the board, it must not be worth copying to notes. If the instructor does not take the time to write every point made in a discussion of the subject matter at hand on the board, it is not captured by the students.

Mylar transparencies and over-head projectors have many limitations and require a large amount of preparation time. The determination of the slide content and then the creation of the transparency be first making a paper document and then copying to a transparency is time consuming. An alteration to lecture notes contained on a transparency may require modification to the original paper document and then re-creating the transparency. It has been attempted to create transparencies that would have spaces incorporated so the instructor could add comments/diagrams, etc. to the slide during a lecture. This required that the slides be cleaned off after each lecture. It was also attempted to project the transparency onto a whiteboard and using a marker add comments, diagrams, etc. eliminating the need to clean the transparencies, but still required writing on the whiteboard and erasing it. Ensuring that the sequence of transparencies presented in proper order (put away in said same order too) and the time to change from one sheet to another along with keeping the sheets in order would slow down the flow of the class.

Power Point Presentations and video projectors have been installed in all of the classrooms at this university. Some of the faculty have developed power point slides to support their lectures on the subject matter of a course. The inability to add information in real time (as discussion creates it) and the limitations to the amount of information that can be presented in an orderly fashion without becoming too cluttered are limitations of this medium. Graphics must be created using a different program and copied to each slide and sized/formatted correctly. Handouts that are done with multiple slides on one page can be unreadable and unusable.

Students tend to dislike Power Point presentations because they are static and there is no potential for interaction. Most students find it difficult to take notes around the format of the slide handouts as there is no standard for where to put "extra" notes/comments. Putting additional notes on a slide show handout in a random manner creates a loss of continuity of thought when attempting to recall the information at a later date. Studying from such notes would be difficult at best and more time could be spent trying to decipher the meaning of what is on the paper than remembering the content of the lecture.

Advancements in computer technology, with faster processing power, increased memory and storage and capabilities have allowed them to become extremely useful tools in the workplace and in the education process. The development of touch screen displays, stylus pens and handwriting recognition software have brought new features that can be used by Instructor's in the class room. Although Tablet PC's have been around for over a decade, the continued improvements and reductions in costs have made Tablet PC's a viable alternative when looking for new technologies that could be used in the classroom. Tablet PC's were at the Three Thousand Dollar level three years ago, are now below One Thousand Dollars, with faster processors and more capabilities than ever before.

Generation of the Concept and Selection of Tablet:

Being involved in the personal computer industry since 1980 gave me insights to the advancements of technologies. I had the opportunity to test a DOS based Tablet PC in 1997 and even then I could see the potential applications for such a tool but the limitations in processing power and software made it difficult to develop and distribute suitable information. With Compaq's introduction of a Windows based Tablet PC in 2001, a large number of the limitations had been overcome and the processing capabilities, along with the software applications gave this the potential to become an effective tool to be used in the classroom.

In November of 2005, I approached the department chairperson with the request to purchase, evaluate and develop methodologies for using a Tablet PC as a teaching tool in the classroom. I also wanted to explore the possibilities of using a Tablet PC for personal and professional usage. I was hoping to use this to replace my PDA, To Do Lists and to help organize personal and professional documents that I accumulated from the committees and project that I am involved with.

I evaluated over six different manufacturers of Tablet PC's and selected the IBM X41 Tablet PC because of its low weight (3.3 lbs), long battery life (+4.5 hours), excellent screen, durability and that the pen did not require replacement batteries (see Compaq/HP Tablets). Upon receiving the Tablet PC (and reading the accompanying manual) I realized that some of the accompanying software, such as Microsoft Journal and Microsoft Office – OneNote would be applications that would be best suited for my usage.

Development of Lecture Notes:

The course that was selected for implementation of this new medium was a freshman level course called Manufacturing Processes II, which is a class on the contemporary non-traditional methods of manufacturing that have emerged over the past fifty years. This course was chosen because it was considered a "cookbook" course with a lot of terminology, concepts and applications being discussed. The vast amount of information that needed to be covered made this course an excellent candidate for possible improvements. Traditionally the freshman have struggled with this course because of the large amount of information and what was assumed to be poor note taking skills and study habits.

In previous two years the course had been taught by me using traditional methods of marker/whiteboard intermixed with some transparencies and videos of applications. Working from a handwritten set of lecture notes that were divided by topic in folders that were intermixed with the transparencies the material was covered over a ten week period. Tests that were given were a mixture of multiple choice, true/false and fill in the blank nature, with the questions being changed or "altered" to minimize the potential of old tests being used by students to gain an unfair advantage. It was found that the changing of a key word can turn a T/F statement from true to false or give a multiple choice question a different answer. This subtle change usually goes undetected by a student attempting to memorize one of last year's tests as the questions appear the same and are in the same sequence.

Using Microsoft Journal as the writing tool, the prepared lecture notes were written into document files by topic and lecture date. Each file was created with a complete set of information that would normally be written on the whiteboard along with comments, diagrams, applications and specific points of interest. Once these files were completed they would be shared with the students using the university online learning system similar to Blackboard. Using a freeware (public domain) program called "Cute-PDF" the files could be exported in a PDF format because at the time Microsoft Journal Reader was available as a downloadable file from the Microsoft website. Many of the students did not have the program to open and view that file type and not everyone in the class was computer literate enough to understand what needed to be done to open/view the files. Adobe Acrobat Reader was a widely known and used program and PDF file types were much more common making the file conversions necessary. Microsoft Journal Reader was incorporated into the Microsoft Windows Service pack # 2 in 2006 so from that point forward conversions to PDF file formats were no longer necessary.

The lecture files would be posted on the university online learning system the Friday before the week that the material was to be covered. The students were encouraged to print out the files, review the material both in the book and in the files before coming to class. The initial reaction from the students was extremely positive as they immediately recognized the time savings from having to copy notes off the whiteboard. They also became aware that the quality of the notes they were given were far better than the ones that they had been creating themselves in other classes. Shown below is a page from one of the handouts of a "complete" set of lecture notes.

Figure 1 – Sample of Full (completed) notes given to the 20053 (spring 2005) class

At the end of the quarter it was noted from the student evaluations that having the lecture notes provided was not only appreciated but that they all felt that it had helped them in improving their performance and allowed them to "earn" a better grade. It was also noted the amount of withdrawals, D's and F's had been reduced from over 15% to under 10% for the students taking that course when compared to students taking the course in previous years. Shown below is a bar chart of the student evaluations from this class compared to the cumulative scores for that course over the past five years.
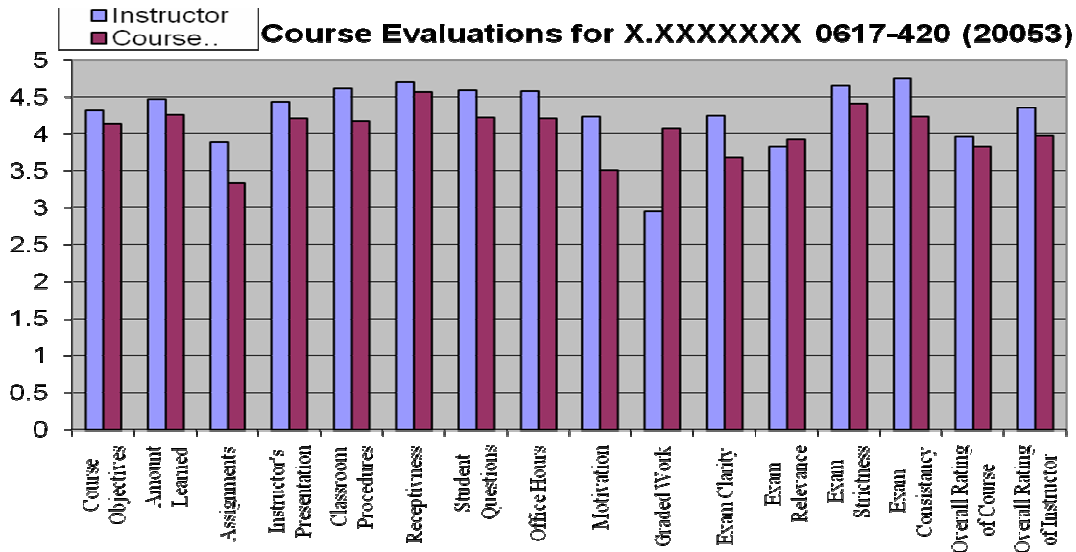
Figure 2. Student Evaluations: Instructor vs. Course Cumulative Ratings (spring 2005).

When sharing this information with some of the other faculty members in the department, a few comments were made that there may be a problem with using this methodology. Studies have shown that when people write things down it helps them retain the information. The fact that all of the information was provided which was being used for discussion during the class had removed the element of students having to write anything down. It was also noted that a small number of students no longer felt the need to attend class as they were already being given all of the notes already and in some cases attendance might suffer because of this.

Two changes were made to the overall method of presentation for the next time the class was offered. The first change was to have attendance become mandatory and that students would have to sign in or be accounted for at the beginning of each class. This ensured that students would understand that class time was important and that not showing up for class not only kept them from having information that they would be tested on but would also not allow them to complete the course.

The second change was that a streamlined set of notes that contained the substance of the material being covered would be given to the students. During the class and discussion, additional information would be added to the handouts with the instructor adding that information to the handouts using the Tablet PC in real time. This would show the students how to augment a set of notes and realize that comments or thoughts should be included with the basic subject matter when covered in class. In essence by the end of

the lecture, the students could start with the handout that appears in Figure 3 and end up with the "complete" set of notes that appear in Figure 1.

The original set of files was reviewed for content and areas of information that could be developed in discussion were erased from the Microsoft Journal documents. After this was done the files were converted to PDF form and then given to the students on the Friday before the material was to be covered. Students were encouraged to read the book alongside the handouts to become familiar with the material before class. Shown below is a page from one of the handouts of a "partial" set of lecture notes.
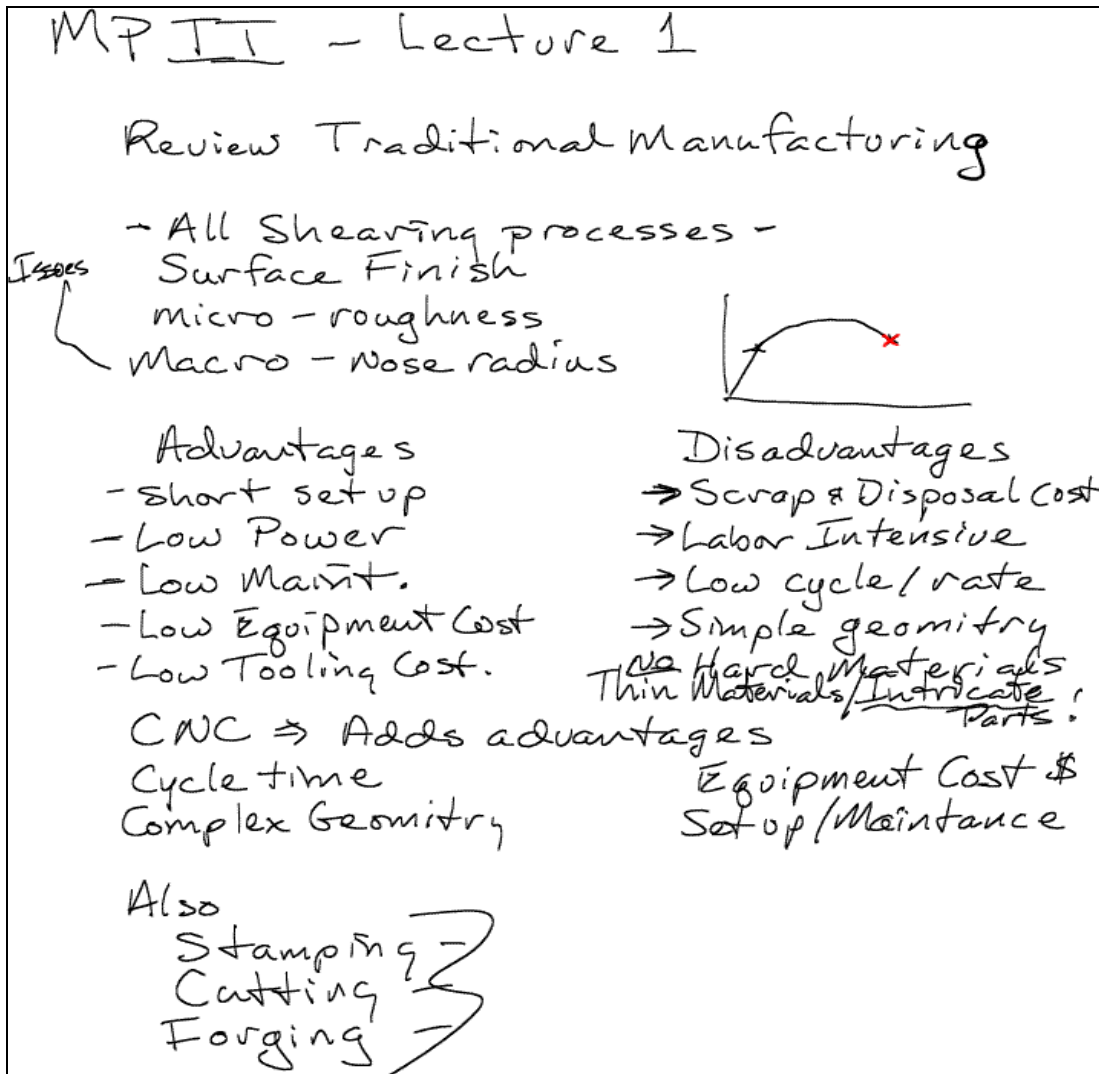

Figure 3 – Sample of Partial notes given to 20062 (winter 2006) class

It was noted that after the course was completed that student evaluations were similar to what was received in 20053. The number of withdrawals, D's and F's were still below 10% and the students had been more engaged in the discussions during the class. Overall the test scores were similar to what was seen in the 20053 class with the questions being altered or changed to insure that information from prior tests were not a major influence. The overall comments from the students were both positive and encouraging.

After the success of using the Tablet PC another trial was done to determine if there was a threshold to the amount of note taking that was done by a student verses the students performance on tests and retention of information covered in class. A third set of handouts were developed by removing even more of the information from the "partial" set of handouts. Key areas of information that could be found in the book were removed throughout all of the handouts. Shown below is a page from one of the handouts of an "outlined" set of lecture notes.
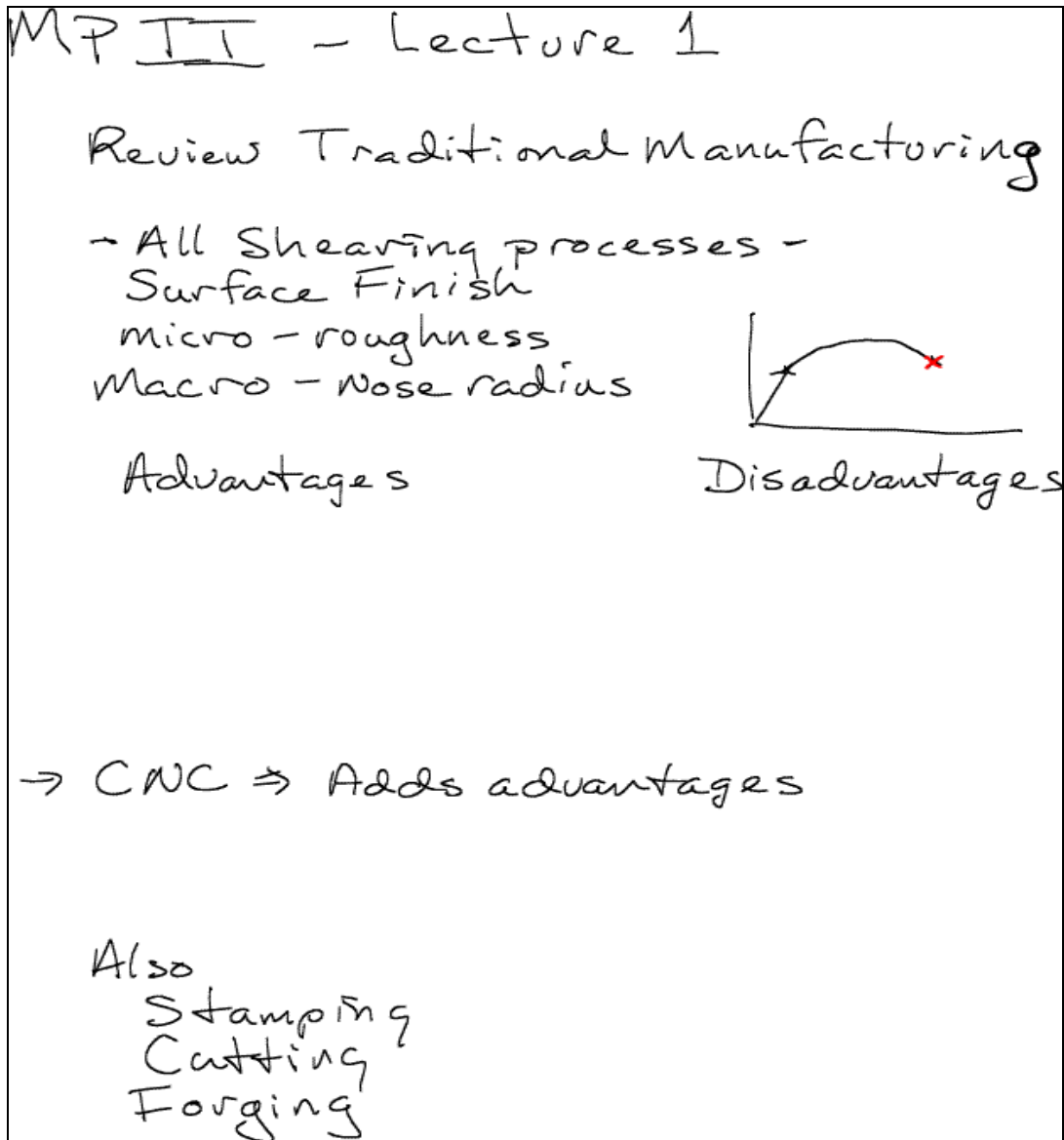

Figure 4 – Sample of Outlined Notes given to 20063 (spring 2006) class

This new set of "outlined" notes was then given to the students on the Friday before the material was to be covered in class. Students were encouraged to read the appropriate chapters covering the material and were to augment their noted before coming to class. These notes were randomly checked by the instructor before class but not graded. It was noted that some of the students did a more thorough job of developing a "partial" set of notes before the class than others, with a small number of students doing a very poor job.

As the material was covered in class and the "outlined" notes seen in Figure 4 were developed into a "partial" set of notes as seen in Figure 3. Once that was completed a discussion as to the concepts and applications of the material was done and additional information was added to the handouts until a "complete" set of notes on the given topic was created as seen in Figure 1. This did take more class time than the previous course as the amount of writing on the Tablet PC was greater and more often. The instructor was working from a "completed" set of hardcopy notes to ensure that nothing was overlooked.

This method did have the largest amount of student engagement when compared to the other times the course had been taught using the Tablet PC and giving the students "complete" or "partial" sets of notes as handouts. It was also found that not all of the students were as active as others in the discussions and that careful attention must be paid to ensure that all of the students have a chance to give input in the discussions.

This method also took the most time in the classroom to cover the material required by the course. It was noted by a student in the 20053 class who showed a lot of interest in the Tablet PC and was thinking of getting one for his personal usage. He made the comment that with using the Tablet PC in the manner that was being done "You can cover a lot more material in less time". Not having to write and erase on the Whiteboard and having to wait for students to stop copying their notes before trying to have a discussion on the subject material at hand was a tremendous time savings.

Additional Benefits

Microsoft Windows has some Tablet PC abilities now incorporated into the operating system. Microsoft Office can be used with a pen to input handwriting as text. Any of the Microsoft Office Documents can be imported into Microsoft Journal and then written on top of to embellish key points. Word, Excel and Power Point documents that have already been created can be used as templates for live additional comments and notes using the pen.

Programs that cannot be imported into Microsoft Journal can be converted into the correct file type by using selecting Microsoft Journal as the printer when printing any electronic document from any program. This means Adobe Acrobat PDF's, MathCAD, etc.. files can be used and written on using a Tablet PC during a lecture. This allows the usage and incorporation of any applications output into a real time lecture and pre-formatted notes.

For students submitting assignments, it was no longer required to submit a hard copy of their work but the students were to submit their assignments electronically. The usage of a universities online learning program allows the instructor to look at the time date stamp to determine if the assignment was handed in on time. The instructor is also able to evaluate the Microsoft Word document for its origin to ensure that one student is not copying another's work (that is how they caught the uni-bomber by embedded information inside the Microsoft Word document).

The ability to import word documents into Microsoft Journal and write comments on top of their work along with the grade for the assignment saved paper and printing supplies. Not only does this method cut down on the amount of paper that is normally consumed with large classes but also reduces the issues of carrying, handling and returning a large volume of assignments.

Saving the document in PDF format and emailing the graded assignment back to the student allows for quicker turnaround of assignments. Studies have shown that getting assignments back in a timely fashion helps reinforce that material being covered. This method of "paperless" grading of assignments and lab reports works very well for both on campus and distance learning students.

Quantitative Results:

Looking at the performance of the students over a three year span reveals some interesting results. In the attempt to demonstrate the effectiveness of the different teaching methods and to minimize the potential for one class being "better" than the other a normalization method was developed. Using the cumulative GPA of the students taking the course and dividing that into the test score average should allow a normalized ranking of how the different groups of students performed in the course.
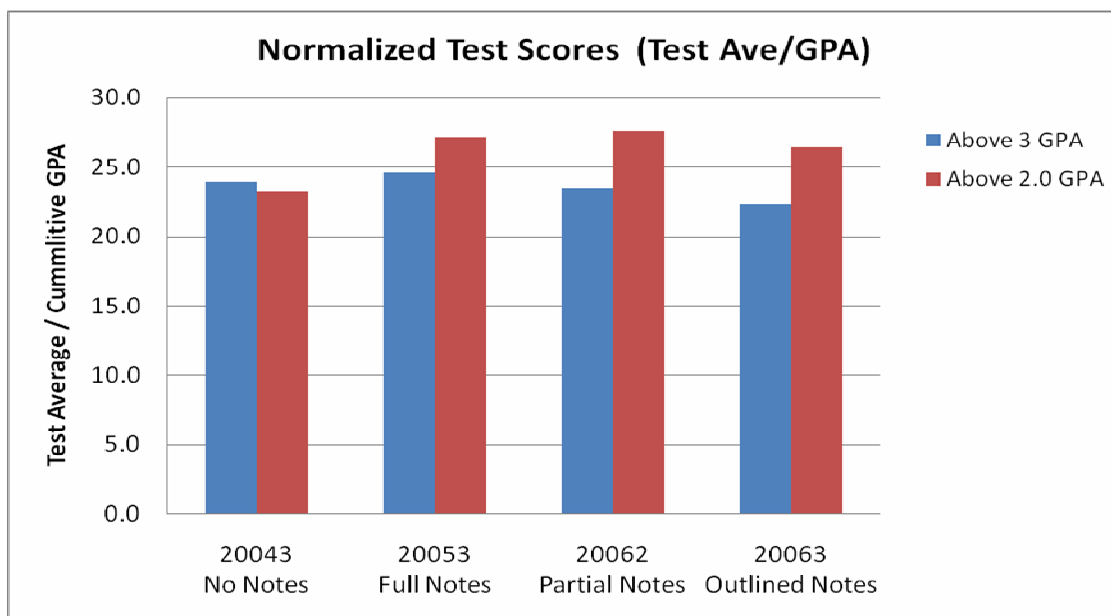
Figure 5 – Normalized test scores for students using a Tablet PC.

The values showed that the students that traditionally do well (above a 3.0 GPA) were not really affected by the change in methods of information being presented in the classroom. The students who were not as strong (above a 2.0 GPA) measured an increased score that is significant when given a full set of notes before the lecture. That same category of students even scored higher when given just a partial or outlined set of notes than those that were "forced" to copy their notes from what was written on the whiteboard.

What is shown here is that the students who already had good study habits and note taking skills (above a 3.0 GPA) continued to do well in this course regardless of the method that was used but that the students who have not traditionally performed as well (above a 2.0 GPA) did much better in this course because a set of well constructed notes were supplied to them. This improvement may be attributed to the fact that some students do not have good note taking skills developed in high school or may not have strong organizational skills to allow for the construction of a coherent set of notes to study from. Feedback from the student's comments help lead to this conclusion but there may be other factors that have yet to be explored.

One other development that has come from the usage of a Tablet PC and pre-posted lecture notes is that this is a course taken by freshman in the second or third quarter of the school year and had traditionally a high (above 15%) rate of withdrawals, D's and F's. Since using a Tablet PC the rate of withdrawals, D's and F's has been below 10%. There is no doubt that student success and student satisfaction in this course has risen dramatically in the years that this method has been put into usage.

Future studies will be done on the possible improvement in the student's abilities to perform well in courses by looking at the GPA of students before and after taking classes. It is expected that there is a correlation between being exposed to structured note taking and developing the thought processes by example. Another study will be done with the students being first exposed to proper note taking methods and development of their own personal style. Tracking the student's performance in previous courses and after this course would be done to determine what impact this exposure could have on their subsequent course work.

Since many of the students that has taken this course and been exposed to this method are still attending this university, a survey could be done to gage student response to this method now that some time has passed. Student feedback on what they feel was the values and after affect of being exposed to this learning style could be collected and evaluated.

Additional Outcomes

The collection of electronic documents of homework assignments and lab reports also gives the instructor the ability to create a data base of material that can be accessed for future reference. If the university is ABET or regionally accredited there are times when samples of student work is required and having that information stored in electronic format saves paper, space and the time and effort required to catalog such a vast amount of information. An instructor can use previously submitted work to evaluate student success and possible areas of improvement. When areas of improvement are found, making changes to lecture notes can be done easily and quickly without having to chase a paper trail of file cabinet drawers and folders.

With the continuing (and in some instances increasing) problem of student plagiarizing material either from previous students work or is using published information that can be found on the internet, having student's work submitted in electronic format makes the usage of programs such as "Turn It In" to automatically scan for instances of plagiarism much easier and more effective. An instructor can create a data base of previous students work for assignments or lab reports that can be used to scan new submissions against and detect these occurrences.

Professional and Personal Usage

Microsoft Office – OneNote has been an excellent application to keep track of committee's/meetings, projects, personal and professional development. The need for file cabinets full hanging folders that are labeled and collated can be eliminated using this software application. Using the left sidebar you can create the "virtual cabinets" (called Notebooks) of your filing system. Assigning the tabs at the top of the page to different "virtual drawers" (called Section Groups) and inside of those tabs can be created "virtual folders" (called Sections) allows the structure to be created for origination of information. Inside of each Section can be created different pages (see tabs on the right side) and those tabs can be labeled by date or

words to keep track of the content. Each topic or project that needs to be kept track of can have handouts copied into the page by pasting the electronically created documents into OneNote. An example of a page from one of the meetings is shown below in Figure 6.

Parking Advisory Group

Agenda
February 15, 2007
2:00pm -3:30pm
Campus Safety Conference Room
Grace Watson Hall

- January Meeting Minutes
- Current Hot Topic – Reserved Parking Program
- Car Sharing Programs
- Misc. Information & Discussion
- Old Business

Demand driven!
Winter 1/4 highest demand.
Purchase by 1/4, year (w/Discount)
by Lot or multiLot.

Lots Converted to reserved only.
Dorm Circles

1771 reserved spots (winter)
Some "Bagged" for Spring
and 1/2 "removed for summer.

Figure 6 – Sample of One Note page from a meeting of the Parking Advisory Board.

 Instead of having to leaf through volumes of papers to find a specific document (that many not be in order) a person can just click on tabs for the year, and then side-tabs for the meeting dates to find the appropriate document and any personal notes containing or thoughts about what was discussed at the time. One bad thing about using this application is that the handwriting to text conversion works very well and you may find that you get "assigned" to take notes at more than one meeting and then need to convert/distribute those notes to the group. Taking meticulous notes does require more work and at times it is difficult to contribute to the conversation when trying to capture what is being said.

Caveat Emptor:

As instructors become more reliant on these tools and more information is collected in electronic format it becomes even more important to create backups of the information stored on the computer being used. A "Father/Grandfather" method of creating and always having two sets of backups is recommended with the older backup being replaced with a newer one is the most effective way to ensure data will not be lost in the event of hard drive failure or a Tablet PC being stolen.

An encryption method to secure the information that is stored on a hard drive is also recommended. Records of students performance in grade books and other personal data that can exist needs to be kept confidential. If an instructor is working on research and needs to maintain secrecy of the materials that are created using the Tablet PC then encryption and backup's becomes an even more important aspect of making sure data is not lost or stolen.

Summary:

This new technology has many potential applications for both academic and professional usage. Many of them have been explored and reviewed in this document with other still to be developed or requiring further development. Continuing advancements in both handwriting conversion and speech recognition will allow for even greater applications of Tablet PC's.

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