Electronics Engineering Technology Curriculum at a Thinkpad University

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Abstract

Northern Michigan University became the largest public university to be an IBM Thinkpad University in the Fall of 2000. Each student was issued a laptop (only freshmen and sophomores were mandatory for the first year) during registration complete with a "standard" software package. The challenge is to fully utilize the laptops - not necessarily in Web-based courses, on-line courses or distance education scenarios, but normal face-to-face courses taught to on-campus students. There are obvious advantages to every student having the same computer and software, however there are also challenges in fully integrating the laptop into the curriculum and making the student feel that the investment they have made in leasing the laptop is worthwhile. This paper presents some of the techniques used by the author in integrating the laptops into the courses offered in the fall and winter semesters. It also looks at the feedback obtained from students as to their comfort level with the laptops and their view of the value of the laptops in the curriculum.

I. Introduction

In August 2000 Northern Michigan University (NMU) distributed approximately 4500 IBM Thinkpads to students enrolling for the fall semester. A standard software package including Microsoft Office 2000 Premium Suite (Word, Excel, PowerPoint, FrontPage, Access, Outlook), MS Internet Explorer 5.5, MS Outlook Express, MS Netware Client, Eudora Pro 4.3.2, LPR (TCP/IP printing support), Cisco Wireless Card, Norton AntiVirus, Aladdin Expander, Adobe Acrobat,   RealPlayer, and Windows MediaPlayer was included with each laptop. In addition some software was available only for students taking certain classes (e.g. Visual Basic for students taking a Visual Basic programming class).

The challenge for the faculty was to integrate the laptops into the curriculum in the most efficient manner from both an educational and the student's perspective. This was not a matter of making the course a Web-based course or self-study course but a trying to integrate the use of the laptops into a regular college course.

There are really two goals. The obvious one, from the educator's perspective, is to maximize the learning, but from an institutional standpoint this is only part of the problem. The student is paying to lease the laptop and if they do not feel they are getting their money's worth then the retention of current students and recruitment of new students will suffer. These are not really

competing goals but both need to be addressed and satisfied if the program is going to be successful.

This paper will look primarily at two courses taught by the author in the Fall semester of 2000. The first is an introductory dc circuits course that should be primarily freshmen. The second is a sophomore level semiconductor course. As the laptop program is being phased in at NMU only freshmen and sophomores were required to participate in the 2000-2001 academic year, so students in both of these courses should have been participating in the laptop program. As it turned out, the majority of students in both courses were participating in the program but there were several students (transfers from other majors, students retaking the courses, etc) not in the program. All students at NMU however, whether required to participate in the program or not, were required to have equivalent computer resources, so the assumption was made in planning the instruction for both courses that all students would have the laptop (or equivalent) available.

II. Available Resources

The primary tool available at NMU for integrating the use of the Web / laptop into the curriculum is Web-CT. This is a fairly flexible, if somewhat "clunky", course presentation tool that has many more capabilities than utilized by the author for a normal classroom course. The only portions discussed in this paper will be those utilized by the author.

The other factor that has to be considered when planning on how to utilize the laptops in course presentation is the infrastructure available to support the laptop use. NMU has made great strides in making network access available in study areas, classrooms, dorm rooms and dial-up connections for off campus students. However, there is still work to be done, and even when all the planned upgrades are finished, all classrooms will not have network connections available for all students. So the assumption was made in planning for the semester that the student would have 24 hour access to anything on the web - but would not have access during lecture presentations. The lab utilized for both courses does have a network connection available for each bench (every two students), so for this portion of the course network access was assumed to be available.

III. Course Presentation

Both courses were presented in the same manner so no differentiation will be made between the two except where materials used differed between the two courses. Both courses were 4 credit courses with three hours of lecture and two hours of lab each week. Required work consisted of homework relating to the lecture material, lab reports that were required for each lab session, and three exams - two midterms and a comprehensive final.

For the lecture portion the author has utilized PowerPoint presentations for several years as an aid in lecture presentation. These were made available to the students in two forms to aid in note taking or as study aids. The presentations were "published" as html slide shows (a

capability of the presentation software) and then uploaded to Web-CT so the student had the capability to view the lecture slides at any time. In addition to the slide show another capability of the software is to print multiple slides on a page with room for the student to take notes. This was also made available to the student in PDF (Adobe Acrobat) format. These could either be used on the laptop as a study aid or printed (by the student) and used for both note taking during lecture and study. The advantage of the Adobe format is the much smaller size of the files compared to the html slide show and the ability to print the slides and take notes immediately adjacent to the slides.

Of course, the students also had the option of using their laptops to take notes during the lecture period, but none did that I am aware of. I believe this is difficult in technical courses of this type as there are many equations and schematics that are difficult to input into the computer. And while there are examples in the PowerPoint presentations, there were also many examples done in the traditional manner on the chalkboard.

The homework that was associated with the lecture was also "published" in PDF format and made available through a link on the course schedule page. This was published in such a manner that the student could print it out, work the problems on the printed pages and turn them in, or they had the option of just viewing the problems on the computer screen, doing the problems on notebook paper and turning in just the solutions. Once the homework had been collected, a version of the homework with solutions was posted in place of the assignment. This arrangement was very well accepted. Most students printed out the homework assignments and turned in the homework in this manner. Many also printed out or downloaded the solution sets when posted to use as study aids and reference.

In lab work the primary use of the laptop was obtaining the lab assignment and the preparation of the lab report. Lab assignments were available in the same manner as the homework–a PDF document linked off the schedule on Web-CT. The original concept was that the student could look at the assignment on the network right from the lab table. However one experience with network problems caused the emphasis to change to encourage the student to download the PDF file prior to the lab so that it would be available no matter what the status of the network during the two hours the student was in lab. Several of the labs in both courses involved graphing data gathered in the lab. This was required to be done using the spreadsheet program available on the laptop. This forced the students to learn to use the graphing function in the spreadsheet.

Many of the students turned in the lab reports in electronic format (Word) by email and thus never had to print the report out and incur the printing expense or worry about getting the printed document in if they weren't in class on the day the report was due. The report could then be emailed from anywhere at any time. This seems a good learning experience for today's technical world and is going to be tried as a mandatory method of turning in reports in the coming semester.

An additional use of the computer that was utilized for both the lecture and lab was the use of MicroSim PSPICE (a circuit analysis program). The students in both classes were required to learn to use the software and had several assignments for which the software was used either to reinforce material learned in the classroom or to prepare the students for laboratory sessions so that they had an idea of what they were looking for before preforming the lab. An additional use of the program was the drawing of schematics required in the lab reports. These were allowed to be hand drawn, but many students preferred the ease and appearance of the circuits copied from the PSPICE schematics program.

For exams the students were allowed to use their computers (all exams in both courses are open-book, open-notes), but were not allowed to be connected to the network while taking the exam. This allowed the student to access all the study material that they could download, but didn't allow them to "confer" with other students over the network while taking the exam.

Another use of the Web-CT program that was popular was the grade book function. Due to privacy concerns NMU has a policy that grades may not be posted even when codes are used to protect individual identity. With the Web-CT program however, the instructor can input all the grades but when the student signs on to the system they can see only their own grades. The instructor can make available the average and other statistical information so the student can see how they are doing in relation to other students. This allows the student to see how they are doing in the course at any time and also allows the student to confirm that the instructor has the correct grades recorded.

There are several other functions in Web-CT that were made available to the students but didn't appear to be very useful for regular classroom courses. A bulletin board was made available. However, while the instructor posted several general notices during the semester, no students made use of this function. Also, chat rooms were available for the students' use however, again, virtually no use of these were make during the semester (sessions were logged so the instructor could monitor all activity). While both of these functions may be useful in distance education or Web-based courses, I believe the students find very little use for them when they are in class (lecture or lab) four days a week.

Web-CT also has the capability to do online quizzes and surveys. While this type of activity may be useful for many subjects, the technical material presented in these two courses didn't lend itself to multiple choice or essay types of quizzes. Therefore, while this might be valuable in other disciplines or even other subject matter, it was not utilized in either of these two courses.

So, the primary uses for the laptop from the instructional standpoint was really to distribute course materials–lecture material, homework assignments and solutions, and lab assignments electronically instead of hardtop format. This not only greatly reduced reproduction costs but also allowed the instructor to rapidly make changes in the material whenever it was required.

From the student's standpoint the advantages were that a great deal of material could be obtained and referenced without collecting a massive amount of paper and at much lower cost. If the student did decide they wanted something in hard copy format they could always print it at much lower cost than they could have bought it from the campus bookstore or copied it. Additionally, many tasks, such as graphing, were made much easier using the programs available on the laptop rather than manually plotting the data.

In summary, the laptop was used in these two courses not as a primary focus of the course, but as an aid to be able to readily access course materials and to aid the student in learning. The student had access to much more course material than would have otherwise been possible. Additionally, many tasks such as preparation of lab reports, graphing data, etc. demanded less time and allowed the student to concentrate on the material to be learned. Overall, the laptop was viewed as another tool to aid in the course material presentation–not a focus of the course itself.

IV. Student Feedback

A survey was used to elicit student views of the laptops and how happy they were with them. In both classes there were students that were in the program and some that were not in the program due to either being Junior or Senior standing and electing not to participate. Since this survey was designed to sample students' acceptance of the laptop program, only students who did participate in the program were used in the statistics shown. Please note that NMU's electronics program is fairly small, so although I have confidence that the survey captures the sentiment of the electronics students in these two classes, the sample size is too small to make any sweeping generalizations.

The results are broken down into two groups, the returns from the freshman basic circuits class and results from the sophomore semiconductor class. In the freshman class 17 of the 21 returned surveys were from students participating in the laptop initiative and those results are shown. In the sophomore class only 12 of the 20 returned surveys were from students participating in the laptop initiative. The raw results of the survey are shown in the table in Appendix A of the paper. Appendix B shows a sample of the survey given.

The first two questions on the survey examined how often the students thought they used the laptops–first for the author's class, then generally for any class work. Note that while the percentage in both classes of those who used their laptop daily or often–64% in the freshman class and 92% in the sophomore class–is fairly high, it is less than the almost 100% daily use you would expect if the student were using the laptops as envisioned in the laptop initiative. When the numbers for use in class work are evaluated, the utilization rate drops even more.

I believe part of the reason for the low utilization rate can be found in Question 4. In the two classes combined, well over 50% of the students had computers other than the laptop. I believe from the survey results, and additionally from remarks from the students during the semester,

that many students were more comfortable using a computer that they already had–even if it was not as "powerful" as the laptop–and used it instead. Overall however, when looking at utilization, all the students except for one in both classes used the laptop for schoolwork at least once a week.

Question 3 asks what the students used the laptop for. A category that was inadvertently left out, but probably should have been included, was email. This was mentioned on several surveys under the "other" category, but I believe would have shown much wider use if specifically queried in the survey.

The top two laptop uses were as could be expected–general word processing and accessing course materials. Since all homework and lab assignments had to be accessed on the network and lab reports at least had to be word processed, this result could be expected. Spreadsheet use also ranked fairly high, which probably reflects the author "forcing" the students to do their graphs on the spreadsheet.

Dedicated programs (programs specifically used for a class–such as the MicroSim PSPICE program which all the students in these two classes had to use, or Visual Basic for students in the programming class) also ranked fairly high in the laptop utilization. In some of the comments at the end of the survey students that had programming classes were especially favorably impressed that they could work on their programming assignments at any time and not just when they went to a dedicated lab. (Programs such as Visual Basic are not loaded on all students' laptops, but are selectively loaded for students in specific classes.)

Last in the uses of the laptop was research on the Web. This is probably due more to the students in these two classes being mostly Freshmen and Sophomores and not yet in classes that required a lot of research. It was impressive however that 26 of the 41 surveyed students had used the laptop for some research and thus were at least introduced to it.

The last several questions dealt with how satisfied the students were with the laptop program. In both classes approximately 50% were satisfied and would probably participate in the program if they had a choice. (Note that the reason students are not given a choice is that to qualify for financial aid the program must be mandatory.) While it would obviously be desirable to have better acceptance of the program than 50%, this is probably partially a symptom of the program being in its first semester. Hopefully acceptance will grow as the program matures and students and faculty know what to expect.

There were several essay questions somewhat unrelated to this paper at the end of the survey, mostly looking for what the students would like to see improved in the laptop. This yielded the expected answers for the most part. Students would like more powerful laptops at a cheaper price and would like for the program to not be mandatory (even if they would participate). Obviously the first two desires (more powerful and cheaper) work against each other and some

compromise has to be made. And as explained earlier, the program must be mandatory to qualify for financial aid.

V. Conclusions

Overall I believe the laptop initiative at NMU was reasonably successful in its first semester. While obviously a greater acceptance than 50% would be desirable, I believe this will improve as both students and faculty gain experience with the program.

From the faculty's point of view in providing a better quality of education, I believe the laptops can and have been used to great advantage. With experience, and as technology evolves, I'm sure even greater advantage can be gained from the laptop program. From my perspective it makes providing materials to the students much easier. It also makes it fairly simple to update any information or change it. Administratively it is also a benefit to the instructor as it is much easier to distribute materials via posting on the Web or by email than reproducing large numbers of notes or other course materials.

That being said, however, there is defiantly a learning curve for the faculty and unfortunately not all are interested in exploring new methods of instruction. It greatly simplifies instruction when all the students are working with the same tools. For example, previously I would have to cover graphing using a spreadsheet utilizing several different programs. Now all the student have Excel, so I only have to cover one program and how to use it.

I did not approach using the laptop to make the courses Web-based or do away with the traditional lecture or lab. Instead I tried to incorporate the laptops into the course so that the students would see the laptops as a tool that they could use in the course to their advantage. From the course evaluations several of the students had positive comments about the ease of accessing materials and laptop integration and I had no negative comments on how the laptops were used. I realize I didn't really do anything that couldn't have been done without the laptop initiative–however, the standardization made the semester much easier for both myself and the students.

The students were never required to bring their laptops to class, however there were times, such as when we covered how to graph using Excel, that they were encouraged to bring their laptops and work along. This greatly improved learning and cut down on the follow-up questions.

I believe one of the things that will have to happen for a greater number of students to be satisfied with the program is for more faculty to embrace the laptop and utilize it more in their classes. Again, there need not be any revolutionary course revisions–just utilize the students' laptops as a tool that enhances the course. This needs to happen not only in the technological courses where the support for the laptops by the faculty is already fairly strong, but also in the rest of the courses the students take across the campus. Some faculty all across campus have readily embraced the program, but many are working into it more slowly. Admittedly there is

quite a bit of initial work to fully utilize the laptops, and hopefully many faculty will utilize the laptops more as they become more comfortable with the technology. Unfortunately it only takes one or two faculty not really utilizing the laptop to make the student feel he or she is not getting full value for the money spent.

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Appendix A - Survey Results

	ET 112 (17 Total)		ET 210 (12 Total)	
1. How often do you use your laptop for this class?				
a. Daily (every day).	3	17%	2	16%
b. Often (3-4 times a week)	8	47%	9	75%
c. Seldom (1-2 times a week)	5	29%	1	8%
d. Never.	1	6%	0	0%
2. How often do you use your laptop for any class work?				
a. Daily (every day).	4	23%	2	17%
b. Often (3-4 times a week)	8	47%	8	67%
c. Seldom (1-2 times a week)	4	23%	2	17%
d. Never.	1	6%	0	0%
3. During the semester what have you used your laptop for? Rank (with 1 being the most usage) all that apply.				
Activity	Average Rank		Average Rank	
word processing	1.5		2.1	
spreadsheet	2.9		3.7	
dedicated programs (e.g. PSPICE, VBasic, C)	3.8		2.4	
accessing course material (Web)	2.4		1.6	
research (Web)	4.3		3.7	
Other	3.5		3.5	
4. Do you have a second computer you use in addition to your laptop				
yes	8	47%	8	67%
no	9	53%	4	33%

Appendix A - Survey Results

5. Were you required to participate in NMU's Laptop program?				
Yes	16	94%	7	58%
No - but I did participate	1	6%	5	42%
6. Were you in favor of the laptop initiative prior to it being started.				
a. Yes	5	29%	3	25%
b. No	8	47%	7	58%
c. Wasn't here / didn't have an opinion	4	23%	2	165
7. Do you feel you are getting your money's worth out of your laptop.				
a. Yes I am satisfied with the laptop program	5	29%	3	25%
b. I am marginally satisfied with the laptop program	4	24%	4	33%
c. I am somewhat dissatisfied with the laptop program	2	12%	1	8%
d. No I am very dissatisfied with the laptop program	6	35%	3	25%
e. I don't really know	0	0%	1	8%
8. If you had a choice would you participate in the laptop program.				
a. Yes definitely would	4	23%	2	17%
b. Probably would	5	29%	4	33%
c. Probably would not	3	18%	4	33%
d. No definitely would not	5	29%	2	17%

Appendix B - Survey

Class - ET _____   Are you a Freshman / Sophomore / Junior / Senior

1.   How often do you use your laptop for this class?

        a.   Daily (every day).
        b.   Often (3-4 times a week)
        c.   Seldom (1-2 times a week)
        d.   Never.

2.   How often do you use your laptop for any class work?

        a.   Daily (every day).
        b.   Often (3-4 times a week)
        c.   Seldom (1-2 times a week)
        d.   Never.

3.   During the semester what have you used your laptop for? Rank (with 1 being the most
        usage) all that apply.

        ____   word processing
        ____   spreadsheet
        ____   dedicated programs (e.g. PSPICE, VBasic, C)
        ____   accessing course material (Web)
        ____   research (Web)
        ____   Other _____

4.   Do you have a second computer you use in addition to your laptop

        a.   Yes
        b.   No

5.   Were you required to participate in NMU's Laptop program?

        a.   Yes
        b.   No - but I did participate
        c.   No - and I did not participate

Appendix B - Survey

6.   Were you in favor of the laptop initiative prior to it being started.

        a.   Yes
        b.   No
        c.   Wasn't here / didn't have an opinion

7.   Do you feel you are getting your money's worth out of your laptop.

        a.   Yes I am satisfied with the laptop program
        b.   I am marginally satisfied with the laptop program
        c.   I am somewhat dissatisfied with the laptop program
        d.   No I am very dissatisfied with the laptop program
        e.   I don't really know

8.   If you had a choice would you participate in the laptop program.

        a.   Yes definitely would
        b.   Probably would
        c.   Probably would not
        d.   No definitely would not

9.   What improvements/upgrades if any would you like to have for your laptop?

10.   Has your laptop made this semester easier or harder - why

11.   Is there one class for which your laptop has been especially valuable - if so which one?

12.   Do you use your laptop for anything other than schoolwork? - If so what?