Pilot Laptop Program: Planning Summary

College of Engineering and Science

Clemson University

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Abstract

In the fall of 1998, 105 engineering and science freshmen brought a prescribed laptop computer and software load to campus and matriculated in a minimum of three special courses taught in newly renovated classrooms. These classrooms provide a technology lectern for the instructor and power and network connections at the student tables. The laptop program is an experimental study of the use of information technology in support of a student centered, active learning model of instruction. This paper will describe the planning for this program.

Classroom Renovation Planning

In the fall of 1996, the Department of Mathematical Sciences was charged with developing a plan for the renovation of the Martin Hall classroom building, which would extend its life another 20 years. From the outset it was clear that the future role of information technology in teaching and learning would be a primary consideration. Based on the recommendations of a consultant, Dr. Daniel Niemeyer, two visits to Wake Forest University, and the examination of projects at other schools via written articles and web sites, the renovation plan was completed in April 1997. Renovation began in December 1997 and was completed in August 1998.

Information Technology Planning

On February 18 and 19, 1997, five faculty and staff attended the Wake Forest University, IBM Fly-in in Winston-Salem, NC for a presentation on the use of information technology in higher education. Subsequent research revealed that in the early 1990's a number of universities began to investigate and employ a new generation of information technology driven by a factors such as:

- The implementation of high capacity networks.
- The rapid rise of the world wide web as a medium of information exchange both on and off campus.
- The availability of desktop and laptop computers of high power.
- A new generation of video projectors with high brightness, resolution, and relatively low cost.
- The need to renovate older classrooms.
- A growing demand for technology across all disciplines.
- The adoption of a student centered, active learning model of instruction, which can be enhanced by technology.
- The rapid growth in the percentage of freshmen arriving on campus with a computer.

In the spring of 1997, a committee appointed by Provost Rogers met to discuss information technology projects for Clemson. In April 1997, this committee recommended a pilot laptop program to be centered in the College of Engineering and Science and a university wide Faculty Development Center. Dr. Melsheimer, Associate Dean for Undergraduate Studies, immediately formed a pilot laptop program committee. This committee submitted a proposal in August of 1997 and was given the go-ahead in December 1997. The laptop program was then factored into the final plans for the renovation of Martin Hall and the plans for the renovation of Earle Hall where the large chemistry and engineering laptop classes would be held.

Classroom Design Features

- Light banks parallel to the classroom front wall and separately switched with dimmers as needed.

- Instructor smart: a technology lectern providing fixed computer, VCR, sound system, cable TV, network, and video switching and amplification, together with a ceiling mounted LCD projector and an electric screen.

- Student smart: power and network connections at the student tables.

- Quiet HVAC, vertical blinds, carpet.

Mathematical Sciences Laptop Project

In July 1997, the Department of Mathematical Sciences was given a provost innovation grant of $49,000 to purchase laptops for six faculty members and to construct two smart classrooms. The experience gained by using these classrooms in the fall of 1997 figured heavily in the refinement of the Martin Hall renovation plan before work began in December. In addition, these six faculty members proved to be a valuable resource for the college pilot laptop program, which began in the fall of 1998.

College Pilot Laptop Program

In December 1997, Provost Rogers funded a three-year pilot laptop program and asked the college to provide matching funds. The annual program budget of $150,000 principally covers the salary of the program director, purchase of laptops and software for faculty participants, and summer support for faculty training and course development.

Student Centered, Active Learning

The laptop program is an experimental study of the use of information technology in support of a student centered, active learning model of instruction. College faculty members have been exposed to this form of instruction through workshops conducted by the Clemson University Pearce Center for Professional Communication and the SUCCEED Coalition. The mission of the Pearce Center is to ensure that students in all disciplines are well prepared to meet the challenges of communicating effectively in their chosen professions. The SUCCEED Coalition comprises eight southeastern colleges of engineering which have a shared vision of creating sustainable engineering education reform. As leaders of the SUCCEED faculty development task, Rich Felder and Rebecca Brent of North Carolina State University have conducted numerous workshops [Felder] to train faculty teaching leaders, faculty members, and graduate students. They use the following points to persuade faculty members to adopt active learning methods.

- Immediately after a lecture students typically recall about 70% of the information presented in the first ten minutes and only 20% of that from the last ten minutes.

- Students tend to remember at most 50% of what they learn through passive involvement – reading, hearing, and seeing. Students tend to remember as much as 90% of what they learn through active involvement – saying and doing.

- Active learning occurs when students are engaged in doing something besides listening to a lecture and taking notes. Students may be talking and listening to one another, or writing, reading, and reflecting individually.

Based on the SUCCEED workshops the laptop program makes the following recommendations to its instructors:

- Use instructional objectives. These are statements of specific observable actions students should be able to perform if they have mastered the course material. Instructional objectives reveal the thinking skill levels required by a course. They facilitate construction of class activities, out-of-class assignments, and exams.

- Place the responsibility for mastering these objectives squarely on the students.

- Make students responsible and accountable for a first exposure to course material outside of class.

- Devote at least 10 minutes of class time to one or two active learning activities to engage students in processing and applying the material they have learned.

- Use problems, questions, or simulations, not merely content coverage, as points of entry into the subject and as sources of motivation.

- Convert some individual homework assignments to cooperative group assignments and some individual projects to cooperative group projects.

- Encourage student-instructor and student-student communication by e-mail, bulletin board, and chat room.

Universal Access

In the October 1997 issue of the Journal of Engineering Education [Crynes], Billy L. Crynes, Dean of the College of Engineering at the University of Oklahoma, states that "There is a growing movement among the 3,300 United States institutions of higher education to provide universal access to computers for students. This movement is driven by the innovative and early adopter faculty and administrators who are convinced that computers and other forms of information technology can positively, significantly change the teaching-learning enterprise."

Dean Crynes further reports on a survey of United States engineering deans which indicates that by the 2000/2001 academic year over 100 engineering programs are likely to require student ownership of computers and that nearly all the programs that are currently evaluating the requirement specify preference for a laptop. Over 70 universities in the United States and Canada currently require student ownership of laptops. This list consists mostly of small, private liberal arts schools, with the program at Wake Forest University receiving the most recognition.

The University of North Carolina is the first large (22,000 students) public institution to announce a laptop requirement. Beginning in 2000, all freshmen must bring a laptop to campus. The University of Florida is the first large (42,000 students) public institution to require all students to own a computer [McCollum]. The policy will be phased in over the 98/99 academic year. About 70% of Florida's students already own computers, but making computers an official requirement will let all students add the cost to financial-aid calculations.

The number of Clemson freshmen arriving with computers remained at about 50% for the last few years but is estimated to be around 70% for the fall of 98. About 10% of these students brought laptops not counting the students participating in the laptop program. While administrators try to figure out what to do about student ownership, students are quietly making the decision for them by bringing computers to campus in increasing numbers. Rather than fight this trend, innovative universities are building on it.

These universities are basing their decisions on sound business models. They are providing their students with

- Reliability – students and faculty will fully utilize information technology only if they can trust it.
- A first class support structure.
- A high capacity network encompassing dorms and common areas and affordable off-campus Internet access.
- Volume purchasing power for hardware and software.
- A business level warranty backed by first level, on-campus vendor support that emphasizes the importance of uptime.
- High capacity servers for e-mail, backup, and course management systems.
- Public labs for high-end applications like CAD and GIS.

Laptop Program Goals

Our goals include improvement in

- retention rate
- oral and written communication skills
- cooperative learning skills
- team building skills
- asynchronous collaboration skills
- life long learning skills
- curriculum integration
- quantity and quality of applicants

Program Planning

Between January 1998 and August 1998, the laptop committee concentrated on the following issues:

- Courses to be offered for 98/99. Calculus 106, 108, 206, and Honors 108 and 206; Chemistry 101 and 102; English 101, 102, 20x, and Honors 102; Computer Science 101 and 102; Engineering 101, 120, and Honors 120; Physics 122; History 122.

- Program admission requirements and application. All admitted freshmen in the College of Engineering and Science were to be invited to apply to participate. Applicants had to agree to purchase the specified laptop and software package and to register for three laptop courses.

- Recruitment of faculty participants. Each member of the laptop committee recruited additional faculty from their departments. The Mathematical Sciences laptop project provided faculty with a year's experience using laptops. The English faculty participants were eager to experiment with curriculum integration.

- Network improvements. By the fall of 98, the final phase of dorm wiring was completed. The latest network technology was installed as part of the renovation of Martin Hall and the Earle Hall auditorium. Laptop tables were installed in the Martin Hall and Riggs Hall computing labs and in the library. Dynamic Host Control Protocol was implemented so that laptop students and faculty could seamlessly attach to the campus network in classrooms, dorm rooms, and common areas.

- Hardware vendor interviews. Three hardware vendors were interviewed during the spring of 98. In order of priority hardware selection criteria were

    - Durability – The laptop should withstand rough handling.

    - Support – A three-year, world wide, business level warranty with the option of creating a first level vendor support center on campus, installation of program software load at the factory, and direct purchase via an 800 number.

    - Features – An affordable but cutting edge machine that would last the students a minimum of three years and would not be too heavy to carry to classes.

- Hardware configuration. The program laptop for 98/99 is a Dell Latitude CPi with a 233 MHz Pentium II processor, 64 MB of memory, 3.2 GB hard drive, 3Com 10/100 Cardbus network card, 56k Psion Dacom modem card, CD-ROM, floppy, 3.5 hour ion battery, and 12.1 inch active matrix screen.

- Software load. The software load was partially installed at the factory and included Windows 95, Microsoft Office Standard, Maple, MATLAB, Eudora Pro, Netscape Communicator Pro, Adobe Acrobat Reader, VET Anti-Virus, and Netware 32 client.

- Program manager. Laurie Smith was hired in March 1998 to manage all aspects of the laptop program.

- Student selection. 105 students were selected including 10 students with financial need. Dell supported these 10 students by providing reduced cost machines, which are loaned to these students. The basis of selection was construction of a pilot group representative of the college entering class.

- Student Orientation Workshop. A student orientation workshop was held in Martin Hall a few days before fall 98 classes began. Network cards and the Maple and MATLAB software packages were installed. Students were shown how to backup their MyDocuments folder to the university U drive.

- Help desk. First level Dell support is available at the college help desk. A dead hard disk can be replaced in a matter of minutes. The project software load is maintained on a CD-ROM. By inserting a floppy and this CD-ROM, a corrupted hard disk can be returned to factory fresh in about seven minutes.

- Course management system. A license for WebCT (Web Course Tools) was purchased along with a Dell PowerEdge 4200 server. Server specifications include dual 333 MHz Pentium II processors, dual power supplies, dual fans, 512 MB of memory, dual 9.1 GB mirrored, SCSI-3 fast, wide disks, 100 Mbps Ethernet interface. This server is running RedHat Linux 5.1. WebCT can be used to create on-line courses, or to simply publish materials that supplement existing courses. WebCT is platform independent. Students and course designers

can read, edit, upload, and download WebCT course materials using a Web browser from anywhere in the world. WebCT provides a wide variety of tools that can be added to a course including a conferencing system, on-line chat, student progress tracking, group project presentation, student self-evaluation, grade maintenance and distribution, access control, navigation tools, timed quizzes, electronic mail, automatic index generation, and course content searches. Currently four publishers are providing WebCT course materials to supplement some of their texts.

- Faculty training and course development. Faculty participants were given a course in WebCT and one month of summer support for course development. Following Wake Forest University, a STARS program was introduced to hire and train talented undergraduate students to work one-on-one with faculty in the area of information technology support for teaching and learning.

- A laptop program web site was constructed to provide information to the university community. In addition, separate WebCT courses were established for laptop students and course designers as a means of keeping these groups informed.

Program Assessment

A faculty member from the English Department along with two graduate students began planning a program assessment in the fall of 98. Using surveys and interviews, responses from a control group will be compared with those from the laptop students. Laptop faculty participants will also be interviewed. Questions will focus on enhancement of collaboration, effectiveness and efficiency of learning, accommodation of learning styles, and satisfaction with computing environment.

Lessons Learned to Date

At this writing, the initial semester of laptop classes have been under way for only six weeks, so it is premature to reach conclusions on as to whether the goals of the laptop program are being met. However, our experience to date does give some information that may be of value to others considering similar efforts, and gives at least limited insight into the ultimate outcomes. Some key points include:

- The effort that was put into planning of the maintenance and support of the student and faculty computers was essential. In this regard, we benefited greatly from the prior experience of Wake Forest University and others. It was absolutely essential to have a well-qualified technical professional fully engaged in the final planning stages and in the initial startup.

- The "smart" classroom designs have worked well, but there were (and still are) start up problems that result from the fact that they are brand new. Still, we would do little different in terms of outfitting the classrooms.

- The decision to standardize on a single hardware platform was clearly the right one. Two students were permitted into the program with different laptops, and they probably took more time and attention than the other 103.

- Software support issues have been minimal because the project load is available on a CD-ROM. A corrupted hard disk can be returned to factory fresh in about seven minutes. The project laptop is a sturdy, well-received machine. There have been a few hardware issues that were easily resolved at the help desk. After some initial tuning during the first week of fall 98 classes, the network in the dorms, classrooms, and common areas has worked well.

- While use of the laptop environment in class is expected to continue to evolve, some notable pedagogical initiatives are already seen. Particularly notable is a collaboration between English composition and engineering courses that suggests the opportunity for greater curriculum integration facilitated electronically,

- At this point, the students appear to be uniformly enthusiastic about the laptop classes and the laptop computer environment.

Again, these are preliminary observations. Subsequent presentations will report on the assessment results for the full year, and beyond. However, our experience to date has been overwhelmingly positive, and we have determined that we will continue the project at least to a second pilot group with the 1999 freshman class.

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Bill Moss is a Professor of Mathematical Sciences at Clemson University. He has a BS in Electrical Engineering from MIT and a Ph.D. in Mathematics from the University of Delaware. He has worked at Lockheed Aircraft, the Naval Nuclear Power School, Georgia Institute of Technology, Old Dominion University, and Clemson University. His research involves mathematical modeling including modeling fires in buildings. He is currently experimenting with student-centered, active learning methods supported by information technology.

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Laurie Smith

Ms. Smith is the Laptop Project Manager at Clemson University. She has a BA in Mathematics from Clemson and a MAT in Mathematics from The Citadel. She has taught mathematics and computer science in a number of colleges and universities. Additionally, she has worked as a computer programmer/analyst and as a network administrator/PC support technician.