"Wireless Laptops in the Classroom: No Strings Attached?"

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Abstract

The search continues for ways to enhance education through the integration of computers in the classroom. A tool that is available to the Department of Civil and Mechanical Engineering at the United States Military Academy (USMA) at West Point is a mobile wireless network and twenty-one laptop computers that have the potential to turn any classroom into an "instant" computer lab. This mobile computing environment was recently put to the test instructing mechanical engineering design students in the use of Quality Function Deployment methods and software. The integration of laptop computers, wirelessly connected to the USMA network, was explored from a pedagogical as well as logistical perspective. Issues involved in the use of wireless laptops are discussed as well as lessons learned. In addition, an attempt is made to extrapolate future educational possibilities and pitfalls as more institutions move towards a mobile computing environment.

Introduction

The goal of any integration of technology into the classroom should be to facilitate the learning of the students. As a result, teachers must carefully review the learning outcomes to see

how technology might be used to enhance the learning experience.[1] More and more institutions are moving towards increasing integration of technology with instruction in the classroom as is being carried out at Northern Michigan University. Poindexter et al describe recent evolution of some of the instruction there to a 20/80 percentage ratio of lecture/interactive time which relies heavily on the use of technology. In their case study, students were each equipped with laptops and worked in teams inside and outside of the classroom. Student feedback was extremely positive to this new environment.[2] The Foundation Coalition has also made available the data, materials and teaching techniques from its member institutions on how to leverage technology in the classroom to improve learning outcomes. As a result of their studies, they report that students benefit from use of technology in the classroom primarily in three areas: students complete the learning cycle, since assessment on performance can be immediate; students can work through entire problems instead of small analytical pieces, since the technology reduces time to "crunch numbers"; and finally, students can get a better conceptual understanding as more information is available and since modeling in a software package can be modified quickly to conduct a sensitivity analysis for example.[3]

With this in mind, computers were selectively integrated into two lessons of an introductory mechanical engineering design course in order to facilitate the teaching of Quality Function Deployment (QFD) methods using QFD Designer v.4 software from Qualisoft.[4] In the opinion of the instructors, the use of QFD software adds value to the teaching of the QFD method by providing a framework that the students could visualize, providing a more professional output and allowing the students to focus on the content rather than the mechanics of the process. The instructors originally conceived the lessons to be taught in a traditional computer lab/classroom with desktop computers; however, due to limited availability of the computer lab, a mobile computer lab was created using laptop computers and a wireless network hub. This provided a unique opportunity to contrast the use of a mobile wireless network and laptop computers with the use of a more traditional computer lab. This insight is especially critical as more institutions consider the use of student laptop computers in their classrooms.

Background

The Department of Civil and Mechanical Engineering at the United States Military Academy has one mobile computer lab, consisting of wirelessly networked laptop computers. The idea is that almost any classroom can be transformed into a computer lab. This enables the students to meet in their usual classroom and also provides alternatives to using one of the two heavily used traditional computer classrooms. Each student was equipped with either a Gateway or Toshiba laptop computer. The Gateway laptops had a 700 MHz Pentium processor with 128 Mb of memory, a 6 Gb hard disk, CD-RW, 3.5" floppy drive, two lithium ion batteries, 15" CGA Active Matrix Color Display, and 11 Mbs wireless network card. The Toshiba laptops had a 500 MHz Pentium processor with 64 Mb of memory, a 6 Gb hard disk, CDROM, 3.5" floppy drive, two lithium ion batteries, 13" Color Screen, and 11 Mbs wireless network card. Additional laptop computers are available without a wireless network card although this mixing of capabilities decreases the flexibility of the instructor. Connectivity to the USMA network is enabled through the use of a wireless network hub. This requires that the classroom have at least one network connection to the network. Each computer can be battery powered, although there are potential pitfalls in relying on battery power as discussed later. Typically several power strips and extension cords are used with the mobile classroom configuration. Computer support personnel within the department are responsible for ensuring the laptops have current and consistent software configurations and are also responsible for security and storage when the laptops are not in use. In addition to the QFD software, each computer operates the MS Windows 2000 operating system with a complete suite of MS Office software to complement any course specific software package.

This type of technology testing is becoming more commonplace at USMA as many instructors are experimenting this year and next with incorporation of student notebooks into the classroom environment. The USMA freshman class of 2005 was issued handheld personal data assistants (PDAs), and the soon-to-arrive freshman class of 2006 is going to be issued PDAs and notebook computers.

Perspectives

The use of the mobile computing classroom was explored from two different perspectives: pedagogical and logistical. The pedagogical perspective explores the use of the

mobile computer classroom as it relates to instruction techniques and student learning while the logistical perspective explores the requirements and overhead entailed in the use of the mobile computer systems. From each perspective, relevant issues are explored as well as lessons learned from the experience. Finally an attempt is made to extrapolate the future educational possibilities and pitfalls of a more mobile computer-learning environment.

Pedagogical Perspective

As mentioned previously, the overall goal of introducing technology into the classroom should be to enhance the educational experience and to facilitate student learning. If this is not the case than the introduction of technology may be unnecessary and could be more of a hindrance and a distraction in the learning environment. Having said that, information technology itself is now so pervasive that universities must begin addressing the ways to best integrate these systems now or find themselves left behind those schools that act well and early. It is also important to note that technology can and should be selectively integrated into an existing course based on the value it adds. Before introducing computers into a lesson or course, the impact and potential benefit of the use of the computer should be carefully considered. Michigan State University has published data[5] from studies performed 1993-1997 illustrating the beneficial results of networked-based technology to enhance student learning (see reference 6 for the CAPA website that describes this study and the networked based system they currently use.) In our course, the instructors believed that the use of the QFD software application would enhance the students' learning and understanding of the QFD method by allowing students to construct a House of Quality as they were being taught. This method of instruction would allow the students to learn the method and use of the software at the same time.

The introduction of computers into the classroom, especially ones that are wirelessly networked, can be a significant distracter for the students. The students now have the ability to access the Internet and e-mail while in class, and the instructor must now compete with the computer screen for the attention of the student![7] In a University of Kentucky experiment with instruction in a wireless networked classroom, the professors there noted that there were times when bored students made use of the networked chat feature to pass e-notes rather than gather more relevant information about the class from fellow students.[8]

Incorporating laptop computers into the classroom takes more planning on the part of the instructor and makes classroom management more challenging. Given the potential distraction that the computer can create, the instructor must be well prepared to present a smooth, coherent lesson. There are two different approaches to the use of the computers in the classroom that have been discussed in detailed articles lately. In the approach adopted by Poindexter at NMU, she cut down on the amount of lecture, but did not have students focus 100% of their attention to the computer screen.[2] The instructors at the University of Kentucky opted to modify their teaching format by presenting all of the notes, discussion and problems through the computer screen with a networked based white-board program.[8] In other words, they essentially taught a web-based class with all the participants in the same room. We prefer a style much closer to the first method, which allows the instructor to continue to benefit from the added personal interaction with the students throughout the class. In either case, any technology delays or problems can easily result in the loss of the attention of the students. Instructors now have the added responsibility of directing the use of the computers and keeping the students attention. Instructors must add to their skill set both expertise in the use of the computers and also technical expertise to deal with hardware and software problems. In addition to being able to use a particular software application, the instructor must also be proficient at navigating the network and dealing with problems that are peripheral to successfully using the software application. The students must likewise be proficient in performing these tasks or the object of the lesson can be lost. The instructor has to be able to quickly fix problems or have other contingencies to continue the class. In a recent survey of schools in the Southern University and College Coalition for Engineering Education (SUCCEED), it was reported that a significant percentage of the faculty who participated in the surveys (360 respondents) of the coalition schools had little or no skills in the following areas: presenting from a computer (38%), using multimedia (54%), developing multimedia (83%).[9] The survey questions focused on content only, not hardware expertise. One might surmise that even fewer of these same respondents are technically capable of addressing many of the potential hardware problems that could develop in the middle of a class. The implications for these increased skill set demands is for more instructor training and preparation time for lessons. This can be problematic for instructors who already have high demands on their time and might require a decrease in the time devoted to other activities.

Lessons Learned

- Technology should be selectively integrated. It should not be simply added to what is currently being done in courses.[10] (See reference 11 for results from a study on three different approaches to integration of CyclePad software in Thermodynamic courses at three different universities.)
- Classroom management techniques must be revised to best incorporate usage of laptops in the classroom. One such technique is to close the screen of the laptop when the instructor wants the full attention of the students. This is an advantage of laptops that cannot be used with desktops in a traditional computer classroom setting.
- The instructor must develop contingency plans for dealing with problems with the technology. Examples include having cadets bring files on disks as well as storing them in shared files on the network. Spare laptops may be used to get a student back into the lesson after a technical failure. Computer support personnel, if available, may be able to aid the instructor in dealing with problems, however care must be taken that the additional personnel do not become a distraction.

Logistical Perspective

Currently the mobile computer classroom requires increased preparation time for the class just based upon logistics alone. Since most instructors don't have their own secure classrooms, it is reasonable to assume that laptop computers must be stored in a separate, safe and secure location requiring the instructor to take possession of and set up the computers shortly prior to the class. Plenty of time is necessary to ensure that all of the equipment works properly prior to the class. Also additional time is necessary at the conclusion of class to clean up the computers and return them to a safe and secure location.

In order to take advantage of the wireless network, the classroom must have a network connection already in place to support the mobile hub. This limits the capability of the wireless network to pre-wired classrooms. Laptops should have common software configurations that must be maintained and updated. This is similar to the requirements of a traditional computer lab, although the difficulty is compounded by the mobile nature of the laptops since they are

easily moved around and typically not stored in an operable condition. Updating laptop configurations often involves the added burden of removing them from storage, putting them into operation and returning them to storage. One way to circumvent this is to re-write software licensing agreements to take advantage of server access by having students sign-out "keys" so that only one central location requires the software upgrade.

As with a traditional computer lab, currently the number of available laptops limits the size of the class. Ideally this will soon go away as a relevant issue, since most of the universities will start relying on the student to provide the laptop for each lesson, just as one might expect or require a student to bring a text to class. So, the good news is that the facility overhead will decrease since the facility will only be required to support power and networking requirements, along with increased space for the students to place their laptop computers. The interesting challenge will be that, faculty will have to rely on the students to maintain a working, powered-up system just to achieve the goal of each day's instruction.

Power requirements may remain a problem as each of the laptops has a battery; however, the duration of the battery is limited and uncertain. Batteries dying part way through a class would negatively impact student learning and are almost a certainty when teaching or attending multiple classes throughout the day. We decided to rely instead on the use of external power, which introduced other issues. The classroom must have a sufficient number of conveniently-located power outlets to support the laptops. There is potential for an increased safety hazard associated with having numerous power cords. Also there is an increased risk of property damage due to power cords around the room connected to computers on desks.

Lessons Learned

- Early set up of the classroom and computers is a key to success although extremely time-consuming until such time as students are all bringing their own equipment to class.
- Time and resources must be devoted to train faculty to be prepared to operate in a high-tech classroom. Dedicated technical support is also a key to success in solving and avoiding potential problems, especially in this time of technology transition.
- Power is an issue. Unlike calculator batteries, computer batteries will run typically 2-3 hours. Should schools provide outlets for recharging at desks? Should students be

required to carry extra batteries? As more courses incorporate use of this technology into the classrooms, it is conceivable that students might need their systems to operate six or more hours in a given day of classes and labs.

- Until students all have their own equipment, security and storage must be well thought out to prevent potential liability, loss and damage problems and facilitate quick issue and return of the computers.

Future Possibilities and Pitfalls

The introduction of portable computing has the potential to be an intellectual force multiplier by enabling students to do different things in different ways than has previously been possible.[1] At the United States Military Academy we are moving towards a future that will see each student with their own personal laptop within the year. A potentially significant benefit of this is that students could be connected to their coursework at any time and in any place. The idea is to connect the learning that takes place in the classroom and outside of the classroom through the use of the portable computer. Another potential benefit to a student-owned portable computer is that it could also connect the learning in different subjects by the use of the same tool in each class. Of course placing the ownership of the computer with the student is not without its pitfalls. Schools will have to relook how software license agreements are written to take best advantage of the portable computing environment. Instructors must also be prepared to respond to the inevitable problem of what to do when a student's computer is broken or being repaired. These are important issues to consider now as we move towards the future.

As instructors continue to experiment and share ideas about the ways to best incorporate the exciting new technologies into the classroom, we should also be careful not to try to supplant the important role of the instructor. There are still personal interactions and hands-on demonstration capabilities that are years away from being available in a software-only environment.

Conclusion

Any integration of technology into the classroom must be carefully conceived and integrated. Preparation is the key to success in effectively employing the mobile, networked computers. The use of the mobile classroom is not without its costs and may currently result in increased overhead for the department in terms of instructor preparation and training time, computer support resources and ultimately scarce educational dollars. We are in the midst of a major educational technology transition, we should be prepared to move forward, but not do so blindly. The technology itself will never substitute for well-prepared and soundly-delivered content, whatever the medium. Wireless laptops in the classroom can enhance and facilitate student learning however there are definitely still strings attached!

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