

THE WIRELESS NETWORK IN THE MATHEMATICS CLASSROOM: ONE YEAR LATER

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In 1986, each member of the incoming class of 1990 received a desktop personal computer. At the time, these computers were state of the art with 286 processors running at 6 MHz, 0.5 MB RAM and a 720 KB hard drive. Obviously, computers have continued to change and improve over the years and with the class of 2006, laptops computers were issued for the first time. In August 2003, the class of 2007 received laptop computers running on a 1.6 GHz processor, 512 MB of RAM, a 60 GB hard drive and an internal wireless card. It is the addition of the wireless card and the establishment of the wireless network across campus that has changed the way we look at technology in the classroom.

The first question the Department of Mathematical Sciences had to ask was “Why go wireless?” There were three driving factors for deciding to integrate the wireless program into our curriculum. First, the department had only two PC labs dedicated for their use. This was not sufficient to support the core mathematics program, which consisted of approximately 2000 students each semester. Only low-density electives had the opportunity to use these labs on a regular basis. Second, one-half of the student body had laptop computers, all of which had wireless capability either by using an external or internal wireless card. Third, the academy had invested in creating a wireless network that supported all of the mathematics classrooms. During the one year test, or pilot, this network provided itself to be both reliable and robust enough to support the department’s needs. Bottom line, the wireless network converted every classroom into a collaborative PC environment.

As mentioned above, the Academy initiated a pilot program during the fall semester of 2002. The purpose of the program was to learn more about the wireless network in the classroom from both the educational and technical perspective. The significant concerns were the level of support necessary to maintain the system, the security of the network, and the scale necessary to provide effective coverage. The test included 10 instructors from the Department of Mathematics, 6 instructors from the Department of English, approximately 500 students, and ninety-five classrooms configured to support the 802.11a wireless network. The 802.11a standard provided a significant improvement over 802.11b, allowing a typical class of 19 students to share one access point providing

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25 Mbps of bandwidth. The results of the pilot program showed the system was reliable and maintainable with the funds available to support the initiative.

At the start of the 2004 academic year, the pilot program terminated and the Academy fully embraced the wireless network. Currently eight academic buildings support the wireless network using 359 access points. All conference rooms, classrooms, and laboratories are wireless, as well as the library and student union. In addition to the student body, 75% of the faculty utilize laptops and have wireless capability. On average 400 to 500 users are logged into the network at any one time.

This conversion to a wireless environment has many academic implications. In the most basic sense, laptops and the wireless network turn every classroom into a computer lab, allowing the instructor to leverage real-time technology in the presentation of daily lessons. This has proven to be both a valuable asset, and at times, a cause for concern.

First, the wireless network has been effectively used to show visualization of mathematical concepts. One example of this is in the introduction of recurrence relationships. Prior to the wireless network, instructors introduced the classic problem, the Towers of Hanoi using wooden models. These models were limited in number and had to remain in the classroom. With the worldwide web, students were able to find many java scripts to “play” the game. This ability to “play” the game in real time helped instructors to guide the students through the development of the concept behind the game and allowed the students to return to their rooms with a virtual model for continued investigation. Other examples include the use of java scripts that allow students to see how a graph changes as they manipulate variables – leading to an understanding of how changing parameters effects functions.

Second, the wireless network can be used to share documents in real time. With either the internet or a course management software, such as Blackboard, students can download and work on files. Students can also send “work - in - progress” to the instructor who can then use the student’s work as immediate classroom examples. Additionally, the wireless web has been an effective tool for group work and projects. Students can easily share work and do collaborative research, sharing work and results via the wireless network.

Finally, instructors noticed the wireless web inspired students to become competent on computer skills. In the previous years, students would wait until specifically instructed to use a particular application before they would even turn on the computer. This year, students came to class and immediately turned on their computers and began using the web. This generally led to an improved level of comfort with the computer and seemed to increase enthusiasm for other mathematically oriented software.

Although the wireless web has proven to be an asset in many situations, it has also raised some concerns. The first concern comes with graded events. During the pilot program, instructors experimented with distributing digital quizzes using the wireless network.

Quizzes were distributed via e-mail or from a course webpage, and upon completion digitally collected in a similar fashion. This method did not seem to provide any added benefit to the educational process. With a hardcopy, the quizzes proved to be challenging to grade, and most programs did not easily accommodate mathematical symbol manipulation. However, with this said, if an instructor creates an exam using short answers or multiple choice, they may still be able to utilize the wireless network effectively as an assessment tool.

Of larger concern are the honor implications of having a networked classroom during graded events. The academy has encouraged students to use technology to aid in the problem solving process. This push is also reflected on graded events such as mid-terms and final exams. As the wireless web is always “on”, there is no way to disable the web during graded events. The availability of the web makes student access to each others work, as well as the internet, possible during exams. The strict honor code at the Academy has prevented this from being a problem to date, however, this issue is still be discussed and reviewed by the Academy’s Faculty Council.

Another concern has been classroom control. Students are now able to access the web and e-mail while in the classroom. As the wireless network allows students to bring the entire outside world into the classroom, it also allows student to bring in topics unrelated to that day’s lesson. Instructors have taken different approaches to this, from careful monitoring of activity, to not limiting the computer use at all and have set specific ground rules for computer use. Instructors who have issued very specific guidance on classroom standards have had success in guiding students to the appropriate use of the wireless web.

A final concern has been on the reliability of both the computer and the network. Experiences over the past year have shown the network itself presents the fewest issues. It has been extremely reliable, even with large numbers of users. The laptops themselves have taken much abuse, and students have developed skills to overcome these obstacles – everything from bringing back-up batteries and a mouse/mouse pad to class, to repeated disk backup in case of hard drive failures. Each student also received a specially designed backpack to help protect the computers while being transported. The Academy has also established a strong technical support program. Within the dorms, students provide peer support and at the Academy level, there is a 24-hour help desk. For the most serious problem, the laptops are covered by a 4-year warranty.

The wireless program continues to grow and improve at the Academy. The school is currently looking at purchasing a classroom control software package. These software packages allow positive control of the student’s laptops by the instructor. From their own computer, instructors can either passively monitor the student’s work or actively take control of the student’s computer in order to provide assistance. The software will also allow the instructor the ability to lock the student’s computer during the lecture in order to limit distraction. The Academy is also investigating the use of Tablet PCs. This relatively new technology will blur the lines between hardcopy and digital. Tablet PCs will allow assignments to be sent digitally to the students and then completed either by

using the keyboard or the digital ink tablet. The completed assignment can then be returned to the instructor via the wireless network. The school believes the Tablet PC holds great potential in the classroom, allowing students to use the power of the PC, but eliminates the tediousness of typing mathematical equations with the conventional keyboard.

As with all schools, the United States Military Academy continues to wrestle with bringing technology into the classroom. The introduction of laptops and the wireless network provided enormous potential for both the instructor and student. The faculty at the Academy, and specifically within the Department of Mathematical Sciences, is excited about the future and the chance to visualize and investigate using these tools.