

GOING WIRELESS: THE EMERGENCE OF WIRELESS NETWORKS IN EDUCATION*

*Ms. Leslie Moody
Washburn University
1700 SW College Avenue
Topeka, KS 66621
leslie.moody@washburn.edu*

*Dr. Gary Schmidt
CIS Department
Washburn University
1700 SW College Avenue
Topeka, KS 66621
gary.schmidt@washburn.edu*

ABSTRACT

This paper focuses on the emerging technology of wireless networks, and their use in education. This paper discusses some advantages of wireless networks, as well as some concerns that need to be addressed before implementing a wireless network. Wireless networks are being implemented in both K-12 institutions and post-secondary institutions, though it has been found that they are being used in a different manner. In K-12 settings they are being used primarily to integrate technology and its use into the classroom setting, replacing the standard computer lab that is located outside the classroom. At the university level, the wireless network is utilized more as a means of convenience. The students and teachers are able to access resources for learning regardless of their location. They can use laptops and PDA's to expand their learning capabilities to any location, not just the classroom. The ideal wireless network needs to bring more technology into the classroom and in turn enhance the learning experience, as well as provide the opportunity for students to access resources outside the classroom, which would provide those who are interested a way to obtain knowledge any time they are willing and able.

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INTRODUCTION

Decades ago when the technology wave hit, school administrators realized that in order to provide students with the best education possible they needed to give students access to new and emerging technologies. In a step towards meeting this goal, most schools implemented wired networks with one or two PC's in each classroom and isolated computer labs that provided limited in-class opportunities to introduce technology to the student and also provided some aid to the student in the form of outside research and preparation for certain projects. Because of the lab's location "off-site" in relation to the classroom, the integration of technology into the everyday classroom setting was restricted to activities and demonstrations by the teacher that utilized the classroom PC, but provided little or no hands-on experience to the students, unless they made a trip to the computer lab. The commute to the computer lab itself took away precious learning time. Aside from the commute, the labs were likely difficult to book due to their popularity as a teaching tool. So what is a possible answer to this dilemma? Many schools are turning to the emerging technology of wireless networking.

BACKGROUND

According to Sylvia Charp (2002), a wireless LAN (WLAN) is defined as, "a local area network, not connected by cables or wires, which uses a wireless technology to carry information between the nodes of the network" (p.12). A number of access points are setup at various points across the network to allow users to connect to the network wirelessly as long as they are within the proximity of an access point.

To make a distinction between the types of wireless networks available this paper discusses the two most widely used below:

- Wide-area networks utilize the same technology that cell phones use and due to limited bandwidth, usually charge a per-minute or similar fee for network usage. Cell phones and messaging devices are typical devices that use wide-area networks.
- Local-area networks are more likely to be used by companies and educational institutions. These networks are owned and operated by the user and the network is only available within a fixed environment. Access nodes that make up the wireless network provide connections within a range of 30' to 300', and bandwidth varies from 11 mbps to 54 mbps depending on the wireless standard that is implemented. Typically a user within their own network environment isn't charged access for network services. However, it is becoming ever-popular for users to be able to pay a flat fee for access to commercial WLAN's popping up around the country. These "hotspots" can be found at your local Starbuck's, McDonald's, or airport (Cover, 2003).

While most schools are not going totally wireless, a large percentage are utilizing some form of wireless technology. A number of K-12 schools are implementing mobile wireless labs connected to the school's wired LAN that can be taken to any classroom on campus for integrated learning. Taking an even bigger step, a few high schools and many universities are implementing a campus-wide wireless network that provides access to the network from every classroom, as well as virtually every other location on campus.

According to MDR (2003), an overwhelming 61% of colleges reported the use of wireless technology, a staggering 36% increase over last year.

Along with the networks themselves, the right equipment is needed to provide students with the tools to access the wireless network. Many schools provide PDA's or laptops equipped with wireless network cards for use within each classroom, while some of the higher level institutions utilize laptops and PDA's that the students provide themselves. Some smaller institutions have even provided students with laptops to keep as their own so their learning can take place "anytime, anywhere".

THE ADVANTAGES OF WIRELESS IN EDUCATION

There are numerous advantages to implementing a wireless network instead of a wired network. One of the main advantages is flexibility. Along with pre-existing space constraints and the fact that re-wiring older buildings is sometimes a cumbersome task due to the physical aspects of the existing building, wireless is a viable option in older institutions with existing facilities (Charp, 2002). Another advantage related to the expansion of the network in the event that new facilities are built is that wireless networks are easily scalable. There is less physical work required when adding on to the wireless network, than adding on to the traditional LAN (Charp, 2002). Access points can be easily added or upgraded without rethinking the entire infrastructure.

Another obvious advantage is the mobility that is inherent with wireless networks. The level of mobility really depends on the level of wireless implemented. In K-12 institutions, mobile wireless labs, consisting of laptops and a portable power base can be easily wheeled between classrooms for integrated learning purposes. If the labs are setup prior to the lecture, the time that used to be wasted commuting to the isolated lab, will be better utilized using the technology in the learning environment (Rajala, 2003).

In situations where the wireless network is a permanent fixture, students will be able to access learning resources from any location on campus, anytime they would like. This provides for the opportunity of continued learning once the students have left the classroom. Though this may not be utilized by some students, those who have the desire to continue researching concepts taught during class will have the option without making a trip to the library. With wireless technology in place, professors could make certain students are using their wireless systems outside the classroom by assigning homework and outside projects that require the student to use resources available on the wireless network on their own time, outside the classroom. The goal here is not to drown students with homework, but a little self-guided instruction and learning will not only allow more content to be covered in a curriculum; it also teaches students the skill of independent study, which will likely be needed in their everyday lives and careers.

Finally, the mobility feature of wireless networks would also allow instructors to use the time normally devoted to lecturing in the traditional classroom, and move the lecture virtually anywhere on campus. For example, if an instructor is lecturing on a topic that requires maximum feedback from students, the novelty of having class on the university lawn may actually help foster an environment in which the students are more comfortable and likely to share in the discussion than they might be in the boring, ordinary classroom setting.

One last advantage of WLAN's is cost. Although wireless network interface cards cost more than standard network cards, if you're implementing a WLAN across campus, it is cheaper to install a wireless network rather than running wire to all existing buildings (Charp, 2002).

SOME THINGS TO CONSIDER BEFORE GOING WIRELESS

Though there are numerous advantages to going wireless, there are still some concerns that need to be addressed before a school implements a wireless network: designing the network, managing the network, and securing the network. I have briefly outlined each concern below:

Designing the network

One of the biggest challenges in implementing a WLAN is determining the layout of the access points, so that you get the most coverage with the least cost. Unfortunately, designing your network is not as easy as putting an access node every 300' or so. The layout and construction material of existing buildings on campus can be more of an issue than the actual terrain the signal crosses. Metal, brick, and concrete are materials that provide significant barriers for wireless signals. Along with this problem, stronger signals can knock weaker signals offline if two access points are placed too close together. There are software tools available to assist in designing your network. Some of these include SitePlanner from Wireless Valley, and AirMagnet, from AirMagnet, which can actually reveal rouge access points that students may have already set up around campus (Villano, 2003). Regardless of your design technique, Sun and Schneider (2003) warn,

"Don't underestimate the technical complexity of the network. At initial inspection, wireless networking seems easy. But while installing a single wireless network base station may be as simple as plug-and-play, this is definitely not the case when installing a building-wide wireless network. Such a network is as complex as any traditionally wired network, and subsequently needs the same level of technical expertise involved in its design and implementation." (p. 26)

It may even be worthwhile to hire a wireless network consultant to make sure your network is configured properly.

Managing the network

Software programs can be very helpful in maintaining and managing your WLAN once it is implemented. While surveying users' needs is one way to evaluate the need for additional access points, using diagnostic software is much more useful. Wavelink Corp. makes LAN management software called Mobile Manager, which generates bandwidth reports, shows traffic patterns for each access point, and identifies weak links in the system. Another product available from Avaya Inc. is CajunView. This product runs many of the same diagnostics as Mobile Manager. With software products like these, networks maintain an unbelievable system uptime in the upper 90th percentile, and all with virtually no hands on maintenance (Villano, 2003). If students are using school

sponsored equipment, then another way to maintain performance and maximize bandwidth is to control the software and hardware that students use to access the network. For example, at Buena Vista University in Storm Lake, IA, laptops are set up to refuse applications that may use excessive amounts of bandwidth (Villano, 2003).

Securing the network

Security of the wireless network is a very important point to consider when installing a WLAN. In a setting like Buena Vista University, where the hardware is provided by the school the security issue is not a concern unless someone with access to the hardware gets has intentions of malice. However, when a WLAN is available to anyone with a network card, security is of the utmost importance. At the most basic level, wireless networks should at least require that the user authenticate themselves with a username and password. Administrators can go a step further by tracking each spot a user visits, which allows them to pinpoint the location of a delinquent user in the event of a security breach (Villano, 2003). Other security features are in use in more advanced networks. For example, at McGill University in Montreal, Canada, the WLAN is divided into three virtual private networks that restrict user access based on where the user is on campus. In public places like the library or union, any user with a username and password can access the network. However, in places like meeting rooms and administrative offices, only users with special privileges can access the network (Villano, 2003). Lastly, an emerging technique in use at some colleges is the use of 128 and 256-bit encryption. Data is encrypted both when students submit data and when the network returns data.

WIRELESS SUCCESS STORIES

Wireless networks provide enhanced access to technology and allow for its integration into everyday classroom activities. However, how wireless networks are used to enhance learning varies slightly from school to school. I found that, in general, grade schools and high schools are actually more apt to use the wireless computing environment as an interactive learning tool within the classroom, while most institutions of higher learning seem to take advantage of the convenience of wireless technology's mobility, and the concept of "anytime, anywhere" access to information.

Primrose School in Atlanta

Primrose School in Atlanta, GA implemented the first wireless curriculum for preschoolers earlier this year. A mobile computing lab consisting of eight laptop computers, all with Internet access, is wheeled to individual classrooms for use in learning. The wireless mobile lab allows computers to be integrated into the daily curriculum, within the natural learning environment, the classroom. Learning isn't interrupted to move the children from one room to another, and technology is not taught in the typical lab setting, just for the sake of exposing the children to technology (Scott, 2003). Instead, according to Scott (2003), the use of the mobile wireless lab, "acts as a catalyst for social interaction, language development and cognitive development, as the

children create, discuss, explore and share their ideas through technology-based activities" (p. 20). Children use the computers to access websites that pertain to the topic of discussion. Then after "researching" the topic at hand, they later participate in a hands-on activity, such as an art project to put their new knowledge to use. At Primrose, the children are also given a chance to utilize the laptops outside of the teacher's lesson plans. During playtime, the children can use the computers to access educational software programs approved by Primrose (Scott, 2003).

The use of computers with children this young has been a topic of controversy. Some believe that children this young should not use computers because it is developmentally inappropriate. But, recent findings show that using technology has a positive effect on cognitive and social development (Scott, 2003). Computers cannot replace traditional activities, such as story time, but they can introduce kids to a new facet of learning that can enhance learning, while exposing children to technology that is sure to be a part of their everyday lives at some point.

John Jay Middle School in New York

Another example of the successful integration of a wireless computing lab into the classroom setting is the sixth and seventh grade math classes at John Jay Middle School in New York. Mobile labs were used in comparison with traditional computer labs by both science and math students. Though the wireless labs provided a more novel environment, the results of this little experiment showed that both wired labs and wireless labs were able to accomplish the objectives outlined (Sun and Schneider, 2003). However, the math teacher discovered that under certain conditions the wireless lab could help reach a new level of learning. The answer seemed to lie in the students' self-guided use of technology. Rather than being told how to use the computers to solve the problem, the students were given a task and followed their own direction as a means of solving it. The majority of the students' time was spent discussing the problem and making decisions in small groups. Technology was accessed only as the students saw the need, much like real life problem solving. Students were in charge of their own learning and direction. The students in the math unit "owned" their technology use. In other words they had the choice of how and when to use it, this ownership produced a greater impact on student learning (Sun and Schneider, 2003).

South Carolina's Erskine College

While a majority of colleges and universities cling to the convenience of "anytime, anywhere" access that wireless networks provide for its students and faculty, some colleges, such as South Carolina's Erskine College, are beginning to take advantage of the increased learning opportunities that the interactive classroom provides. In *Wireless Networks and Mobile Devices*, Steve Cover (2003) outlines some possible uses of wireless devices in a university setting. These have been summarized below:

- Instant surveys and pop quizzes can be given and graded in real-time. The instructor gets instant feedback on how students are taking in the material and change their lessons plans on the fly if the need exists.

- Web-based homework can be provided online. This provides a way to ensure that all questions get answered and keep track of work turned in. These assignments can be accessed anywhere on campus, as long as a wireless network exists.
- Background material can be accessed by students while the instructor discusses the topic in class. The professor can also provide links to materials that facilitate in the understanding of the lecture. Also, lecture outlines and notes can be provided to students in order to free up their time spent on note taking and increase their participation in the class lecture or discussion.
- Reference tools used for data collection and calculations can be used outside the classroom. This allows the instructor to take the classroom, and its tools, to where the information is found. This provides a rich learning environment full of real life examples.
- Teaching computer science fundamentals is also inherent with the use of wireless in the classroom. Students from any major will learn basic computer science concepts that arise from the use of the technology. Aside from the basics of using a computer or wireless device, they will encounter technical issues, such as how their mobile devices' processor speed, limited memory, and the network connection itself impact their use of the software.

CONCLUSION

Like it or not wireless technology is here to stay. With so many schools, both K-12 institutions and universities alike, utilizing some form of wireless, it is a topic that is impossible to ignore. For educators that have not yet jumped on the bandwagon, the time is drawing near, or you and your students will likely be left behind.

Wireless networks and devices are changing the face of the traditional classroom in three ways. First, everyone in the class can be forced to answer questions and provide their input. Second, their answers can be evaluated immediately, providing immediate feedback. Third, working in groups to solve problems, becomes easier to accomplish, which adds peer-to-peer learning to the equation instead of the teacher being the sole source of information (Ciampa, 2003).

However, universities are falling behind high schools when it comes to providing this integrated learning experience within the classroom. Though it is great to have remote access to the network outside of the regular classroom, more professors need to bring the wireless capabilities available into the classroom to help aid in learning. Wireless technology can also be used successfully in the field, by bringing the technology to the source of information (Ciampa, 2003). Some colleges, like Erskine College mentioned above, are using wireless technology in the classroom to enhance learning. Hopefully, this and other similar examples will provide motivation for other colleges and universities to follow.

In conclusion, it is the feeling of these authors that wireless networks should be used to enhance learning within the classroom, as well as provide access to resources once class is over. Also, it is the feeling of these authors that the learning experience can be enhanced in one other way. It bears mentioning that students at the university level, at

least those with computer networking majors, should have some hands-on experience with the wireless networks. They should gain some experience in installing new access points, as well as, learning about and participating in maintaining and securing the wireless network. This will provide hands-on experience for what they will likely face once they reach the workforce.

While not all students need to understand the wireless network at its most complex level, these authors think students of all ages should be provided with a background of the technology. If students are not only using technology from a young age, but also understand the basic way that it is implemented, they are more likely to be technology savvy as they grow older. As a nation falling behind in technically skilled workers, revealing the inner workings behind a technology being used, rather than just using the technology for the end result, may produce students that are more interested in math and science, and in turn technology.

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