Lessons Learned That Are Relevant to More Mature Ubiquitous Computing Programs--- a composite listing from the Pioneer Award Winners.  January 4, 2001

[Highlighted items will be discussed by their authors during the plenary session as the 4th Annual Conference on Ubiquitous Computing, Seton Hall University]

Jennifer Bolt, Director of the Institute for Teaching & Technology, Acadia University

1. The real advantages of mobile computing are the empowerment and increased confidence of students.
There is an assumption that the exposure to the technology and resulting technical literacy of our students were primary drivers behind our initiative. While these are certainly important benefits, they are not the primary ones that are of interest to employers, nor are having the most positive impacts on student success. It is, rather, the sense of confidence and empowerment that students assume when they are given resources to do new things. The entrepreneurial spirit that they discover, in the process of learning in new ways and having access to new tools, has had a profound impact on how our students are directly contributing to the process of educational transformation through their involvement in instructional design projects with faculty.

2. The opportunities to enhance the learning environment through mobile computing are far-reaching and go beyond improving academics.
At Acadia, we focused most of our resources and efforts in the mobile computing project on the academic world with a deliberate attempt to transform the delivery of education. That has been an important but difficult task and the results of our efforts are in some cases positive, and in many cases questionable. Far easier, to both accomplish and measure, are efforts aimed to improve student life through the mobile computing program. Enhanced communications for students and alumni, access to multimedia development facilities, administrative services to make tasks more convenient – these all have an undeniable positive impact on students and are relatively easy to accomplish compared to educational transformation.

3. Some of the most impressive positive results were unanticipated; some of the expected positive results were not achieved, therefore a tolerance for failure and an environment that values innovation are necessary.
An English student was given access to the School of Music’s digital recording studio and, with the help of technically capable students, made a recording of a song he wrote using software on the notebook. He burned a CD and got some great radio play ….and launched a music career. A history major received an international award nomination for
instructional design on her learning program that was created for an environmental science professor. A geology student got a great job offer from a mining company when they discovered her new application of mapping oil deposits using a graphic arts software program which saved them thousands of dollars. Meanwhile, test scores on physics exams went up marginally after implementing an expensive and carefully planned technology assisted learning environment.

4. **Pioneer institutions get lots of opportunities to do exciting things that are unrelated to the mission at hand….we must make a conscious effort to “stick to the knitting”**.

Opportunities to earn external revenue have been compelling, particularly given the expense of the technological appetite that our mobile computing program has created. All, however, come with a series of commitments and activities that can divert limited human resources from the very activities responsible for the success that attracted the external opportunity in the first place. Some financial incentives are far outweighed by the investment required in preparing to do business and the potential impact these have on the academic culture (eg. intellectual property issues, community and vendor relationships).

5. **We needed to plan to be in “do” mode and “research” mode simultaneously. Early efforts on implementation resulted in a loss of opportunity to do baseline evaluation that would have been tremendously valuable for ongoing research.**

Now, four years into the implementation of the mobile computing initiative, we are attempting to recreate the Acadia Advantage story. We have some good baseline research that began with an all-campus survey issued to students that has revealed some interesting changes in perspective about the impact of technology on learning. There were, in hindsight, many more interesting baseline data that should have been gathered.

6. **Expectations must be managed and there are many unrealistic expectations that come with technological change and mobile computing.**

We oversold the program to students and created an expectation that the technology would be used all the time in class. Despite efforts to change this message, the original expectation still holds. We also attempted to give students and faculty free dial-in access – not financially possible given the appetite for high bandwith applications and our geographical location. Our faculty support groups provided very special and individual attention to early adaptors in the initial phases. Now we work with three times as many faculty, but can still be perceived by some as offering more limited services.
Ray Cross, President, State University of New York at Morrisville

1. Seek out strategic partners
2. Communicate with students and parents, early and often.
3. Focus on learning -- not technology
4. Focus on the discipline of study -- not the technology
5. Focus on “adding value” -- not “cost-related issues”
6. Focus on the committed faculty -- not total involvement
7. Focus on learning -- not technology
8. Focus on developing faculty with the technology -- not developing the technical capability of faculty
9. Focus on strategic planning -- not technology planning
10. Focus on creating a comfort-level with technology -- not an infatuation with technology

John Oberlin, University of North Carolina at Chapel Hill.

1. The CCI (Carolina Computing Initiative) is really noting new, it just a commitment to do what we are doing (or should be doing) well.
2. Developing the personal support infrastructure is more difficult than developing the technical infrastructure.
3. The CCI doesn’t “solve” everything (or maybe anything), but it does make everything better.
4. The CCI doesn’t integrate new technologies into the curriculum; it does however make it possible for faculty to do so better than ever before.
5. The CCI brings many things that were previously thought to be unmanageable into the realm of possibility. (campus-wide wireless, AFS-enterprise file systems, etc.)
6. The campus demands progress from information technology -- it’s change we have trouble with.
1. **Maintenance of the student computers can either "make or break" your plan**

Students cannot afford to be without their computers for more than 24 hours; therefore, you must have loaners, spares, or parts shelves capable of repairing all computers quickly. Confidence in this system is reflected in how many problems the students do NOT get repaired because they do not want to be without. Also, plan for surges at the beginning of each semester.

2. **Common platforms for all students and faculty offer many advantages**, such as:
   -- Ease of hardware and software maintenance
   -- Ability to test programs on faculty machines before giving them to students.
   -- Ease of sharing machines and resources between students, such as wireless cards, NICs, etc.

3. **Disk imaging is "the way to go"** - I wouldn't consider it any other way! Prepare a “master drive image” with all of your campus licensed software correctly installed, then have the computer vendor image all your machines. I recommend partitioning the hard drive into at least two partitions—system and data. This allows you to quickly restore all software without touching the student’s data. It also allows you to upgrade software and provide new images annually which can be made available via the network or CDs. Trouble-shooting software problems should be limited to 15-30 minutes—if not fixed in that time, then just perform a complete restore. (Students obviously lose their unique software, but at least they get a working machine quickly.)

4. **Be prepared for students to try anything on your network**. Have policies ready BEFORE, e.g. filtering, packet shaping, firewall, proxy, etc. How do you handle the few who misuse or abuse their network privileges? How do you handle cell phones or microwaves which interfere with wireless networks? What are your legal restrictions, and how do you protect yourself from lawsuits when students misbehave?

5. Do NOT look for best desktop or notebook price at constant specifications, or even best machine for a fixed price. **Look for “best value”** by fixing a ceiling price, and asking for the best machine the vendor can provide for under that ceiling. You don’t want the cheapest machine that meets the minimum specifications. This allows the vendors to concentrate on their strong points and use any excess funds in the budget to upgrade weak areas.

6. Unless you have unlimited funds (ha!) avoid the temptation to jump on popular bandwagons too early. The more limited your funds, the more conservative you must be—wait for firm standards which will drive prices down. (e.g. wireless investments) Notebooks and wireless may be popular, but is the increased cost worth the marginal utility gained?
Elliott McElroy, Vice President for Academic Affairs, Clayton College and State University

1. User-friendly instructional technology - an effective change agent

2. Chronicles of Change - a qualitative research project documenting faculty perceptions for a two-year period following implementation of ubiquitous laptop computing

3. The importance of having faculty in charge of faculty development in the ubiquitous computing environment

4. The importance of "just in time" assistance for faculty and students in the ubiquitous computing environment

5. The importance of supportive administrative leadership in the ubiquitous computing environment

6. The importance of student and peer pressure in effecting instructional change in the ubiquitous computing environment
Will Krause, Director, Technology Services, Houghton College

1. The cost of laptops is far easier to deal with if it is included in tuition. Not only does it eliminate the numerous telephone calls from students and parents asking why the laptop costs so much (requiring a detailed explanation of the components of the cost) but it comes across to students (and parents) as 'we are providing you with a laptop for your educational experience' rather than 'you have to purchase a laptop to attend here.' That is, it's a benefit of attending here instead of a liability.

2. A fully staffed and trained HelpDesk and PC support staff is essential. Don't try to 'just get by' on support. Service is what keeps people happy. Keep the HelpDesk and PC service people in close proximity; the communication between them is essential.

3. Form a partnership with your PC/laptop vendor. Technical issues will arise. Having a vendor who is willing to work with you is essential.

4. Give the faculty LOTS of attention and help. With them on your side you can succeed, without them on your side you can't succeed.

5. Ubiquitous connectivity with laptops turns every room and gathering place into a study place where laptops will be used. Computers in dorm rooms don't get used nearly as much.

6. If you are using student workers: fewer, more trained student workers is much better than lots of poorly trained student workers.
1. Information - the first (and most important) term in an IT program for higher education - focus on the expansion of resources managed and delivered by a technology savvy library staff

2. Lease - the only effective way to keep current with the technology and train the financial folks that this will be an ongoing expense

3. Laptop - you might get by with a desktop for some staff however faculty, students, admissions personnel, development staff need access to information resources and information process wherever they might be working

4. Projection vs. Wired Classrooms 60/20 - Faculty will find projection more useful and more necessary than a network connection at every seat in every classroom. Projection is needed in perhaps 60% or more of the classrooms while network and power at every seat is only needed in a small fraction (20%) of the classrooms

5. One platform/standard software load - Support is critical and having only one platform/load to support is critical in achieving effective and affordable support

6. Network First - If you only have money for one thing, install the network

7. Faculty Support - early and often with faculty not "techno" staff

8. Faculty/Top Administration Approval - To be effective you must have interest in and support by both faculty and top levels of administration as this will dramatically shape the focus and financials of the institution
1) The purposeful use of computer technology must be encouraged for the majority of the faculty for the laptop initiative to be successful. Professional faculty support for software innovations must be provided where computer science students play an important role. Incentives must be provided to faculty/students to inspire innovative/useful developments, e.g. small grants, course relief, funding to attend (and to present) at conferences, encourage cross-institutional partnerships.

2) Quantitative assessment of computer-rich materials and testing modules must be regularly performed and should therefore be coupled to data storage systems for subsequent analysis. These types of systems often require sophisticated software and faculty/student leadership is needed to develop these tools. An experiment to measure computer enriched student learning is challenging.

3) Classroom design must allow for the simultaneous use of multiple delivery modes, e.g. spacious student work space, laptop connectivity, overhead projection, white/chalk board space. Classroom use of technology should be subsidized by ancillary materials obtainable asynchronously.

4) Renewal of laptops should occur every two or three years which require an organized infrastructure and manpower. Laptop leasing programs are also expensive as is software licensure, having an indirect affect on tuition rates and housing costs in order to remain competitive.

5) Delivering courses on-line requires a functional infrastructure to disseminate information, register, exchange money and deliver courses. An IT center is needed to facilitate the development multimedia such as streaming technology and to invoke WebCT strategies.

6) If given the option, students will choose to become distracted during class by browsing the Internet, playing games or chatting via ICQ-like tools. As a result, Instructors must work hard to make their lessons Interactive so as to minimize these tendencies.
Alan Candiotti, Assistant Vice President, University Technology, Drew University

1. Equipment is not enough. You need a strong faculty development program to put the equipment to good use in the academic program. With such a program, however, the student equipment gives the college a strong platform for implementation.

2. Demand for classroom facilities will mushroom and, with it, demand for support for the equipment. Be prepared to support and maintain the classroom equipment and to allocate sufficient staffing to classroom support.

3. An independent student computing culture will develop. Students will generally lead faculty in "worldware," i.e. e-mail, word processing, web pages, networking. This is good in itself, and such student expertise is also helpful for support.

4. State policies clearly. Tell students (and parents), for example, that you provide a warranty for the computer, not "free repairs."

5. Push service issues with the computer vendor. Computers will need repairs, and they should be accomplished as quickly as possible. Negotiate this at the time of purchase.

6. You can accomplish a lot with imaging at the time of distribution - not only set-up and software, but getting everyone on the network immediately.
1. In order to leverage limited support services and enable users to do more for themselves, we have made an extensive effort to put as many services as possible on our website. This enables users to take care of many of their problems or issues without requiring personal service. Examples of some of the services we have web enabled are:
   a. activating all computer related accounts and managing those accounts—activating shell access—as soon as students are accepted and in the student administrative database they can take care of this
   b. reserve computer classrooms, sign up for workshops
   c. submit trouble tickets for help desk attention
   d. online photo classlists for professors and automatically create mailing lists for students with one click
   e. check grades, change addresses, check personnel benefits check financial aid and bill status, register for classes, check transcripts
   f. carefully documented directions for many technical problems and issues so when help desk assists someone, they can leave user with a url that they can refer to later if then encounter same problem or forget the solution

2. In order to expand staff in cost effective way we have established a formal, well developed training program for student employees to make effective use of that potentially valuable resource. In addition to providing adequate training, it is also necessary to provide high quality supervision for students to both ensure that they will deal effectively with users and have a valuable learning experience for themselves. This helps to build a cadre of students who continue to work over time and can be relied upon to do higher levels of support over time. We also use students a great deal with web development projects and in many cases they have skills or experience with tools that staff do not and end up teaching them. We have set up an online clearinghouse where students can register and list their skills and interest in working with faculty an faculty can search to identify students who are willing and able to work with them on technological projects, websites or other projects.

3. Promote and facilitate greater communication on campus related to technology issues, changes, policies and such. It is necessary for the IT staff members to communicate among themselves so that infrastructure changes are known by support staff and can be conveyed to the user community. Email can work for many of these items but it is also good to have regular meetings to get all groups within the computing area to discuss problems, solutions and the ramifications of various options or scenarios. Often technical operations staff make changes or implement things based only on their own perspective and do not consider how it will effect users or if alternative solutions may be easier to
support, implement, and communicate. We also try to bring various departmental tech support staff together as well to discuss licensing issues, hardware changes and such. In addition, we have established an online newsletter which goes to faculty and staff every other week with information related to technical changes, opportunities, policies and such and each article, while brief, has an associated url containing more details and information.

4. We have found it increasingly necessary to **provide ongoing training for professional staff, both internal and external**. Because cost of commercial training is so great, we do it seldom and usually for software/systems which effect the entire community. For more specialized topics we rely extensively on internal training and staff who have developed special expertise in certain areas prepare 1.5 –2 hour training sessions for fellow staff members. We reserve a block of time each week when everyone is free for the trainings and usually have a couple per month.

5. **Regardless of how long faculty have been involved in integrating technology into their courses, they still require extensive support** to take advantage of new technologies and new software applications. We provide a Faculty Development Center with lots of specialized hardware (scanners, CD burners, video editing etc) and software as well as staffing it with both technical staff and academic staff who can assist with instructional design and course reengineering issues. We also provide frequent opportunities for faculty to share what they are doing and problems they may be having (brown bag lunches) and each term we have an event for faculty dealing with academic technology integration.

6. We have found it beneficial to **reorganize support staff more by skills and specialties** and to assign them accordingly. This includes having specific staff assigned to support specific “mission critical” offices and have them housed there 90% of their time. They remain our staff members and have offices in our area, attend all staff meeting and trainings but spend all of their time at the remote site working with users there. We have created specialty work groups within our larger group (web development and support, hardware, administrative support) and those groups each have a leader and meet regularly to biweekly to stay coordinated and keep projects on track and moving forward.
1. **Nothing is forever.** Now it’s wireless. Soon it will be PDA’s. Peripherals are soon to become obsolete.

2. **Graduates prefer obsolete computers.** When given an opportunity to buy the computers to be provided to incoming freshmen, graduating seniors opted to keep what they had without upgrading. This has serious implications for our strategy of providing distance learning courses for alumni.

3. **My.Wake Forest is here but who knows?** Students are not taking advantage of the rich opportunities for programming their own entry screens.

4. **The 80/20 Rule.** Our most effective courses are hybrid. They are somewhere between 80% face to face and 80% virtual.

5. **Communication is central.** Our research shows that 87% of the faculty and students believe that their learning has increased because professor-student and student-student communication is so much better.

6. **Use a commercial Course Management System.** We had our own and couldn’t afford to keep it up.