

# Learning Technology Infrastructure: Critical Needs

In the course of developing North Carolina State University's quality enhancement plan for "Learning in a Technology-Rich Environment", the LITRE team identified critical gaps in NC State's technology-rich learning environment. Since the beginning of the LITRE project in early 2004, NC State has made progress in many of these critical needs.

## Classroom improvement

In 2004, NC State had 247 general classrooms, with an additional 50 scheduled to be built or renovated by 2010. Although individual departments and colleges had already outfitted approximately 85 of these general-purpose classrooms with some level of multimedia capabilities beyond the standard overhead projector and screen, these upgrades were scattered, and there was no continuing stream of funds to maintain them. Computer-ready classrooms were a rarity. As Dennis Daley, then chair of the faculty, pointed out, NC State's classroom deficiencies had a direct effect on faculty's willingness to experiment with technology-enhanced teaching.

### Progress to date:

Since 2004, significant progress has been made to improve NC State's classrooms through bond projects, standards development and planning. Key steps include:

- Completing and publishing standards for general classrooms, which the university's Classroom Environment Committee is evaluating and updating regularly.
- Rolling out enhanced scheduling capabilities by Registration and Records.
- Finishing the ClassTech I and II projects, resulting in 54 centrally supported, technology-enabled classrooms: <http://www.ncsu.edu/classtech/tour.html>
- Completing a comprehensive classroom space and technology inventory. A portion of the inventory data is available on the Registration and Records "Room List Characteristics" webpage at: <http://www.ncsu.edu/registrar/scheduling/pdf/roomlist.pdf>
- Completing construction of Engineering Buildings I & II and other bond renovations, adding significant classroom and laboratory inventory to the university as whole.
- Improving coordination and communication significantly among centralized and individual academic units that support campus classrooms.
- Developing overarching recommendations to address the efficiency and structure of classroom and laboratory management, including management of classroom resources, through the newly formed Classroom Improvement Task Force. Tasks completed include:
  - University-wide survey on classroom support expenditures of personnel, physical construction and maintenance of existing facilities, and audio visual and information technology equipment.
  - The establishment of working groups to address specific classroom and laboratory concerns (teaching and learning, time and space management, standards and support).

## Faculty computing

NC State did not have a regular, university-wide system to provide faculty with computers. Many faculty at NC State worked on remaindered equipment from surplus or computers they bought themselves. If faculty had access to the same platform and software as their students, they could:

- ensure that course materials and tools work on the student platform;
- troubleshoot problems with applications, tools, and content;
- exchange materials with students more efficiently;
- devote more time to teaching and incorporating new technologies;
- build continuity between courses, thus improving long-range instructional planning

### Progress to date:

None

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## File space quotas

To take advantage of the vast computing resources that had been amassed for their use during a decade of development, students and faculty needed access to ample file space. AFS quotas were frozen at 50 MB (since 1999). IMAP mail quotas had been recently raised to 30 MB, but remained too small to handle the 15 attachment limit permitted. Students and faculty did not have enough space to execute programs, store large files, send/receive mail attachments, or archive valuable data objects and digital assets.

### Progress to date:

In August of 2004, the Information Technology Division (ITD) installed a SAN-based Storage Management System (SMS) so that student, faculty and staff storage needs could be met on a more cost-effective and scalable basis. Shortly thereafter, ITD implemented a web-based User Storage Management application, which provides the ability for users to allocate their own space allocations (or storage quotas).

Users combined space allocation is 300 megabytes, which can be allocated among AFS (personal or web space), IMAP (email), and Novell (user profile files). Users are required to maintain a minimum allocation of 50 megabytes in each of these quota types. Users may also purchase additional quota for \$1.80/100Mb/yr.

## Software licensing

In fall 2002, NC State's University Information Technology Committee formed a Software Subcommittee, including representatives from most colleges, with the director of Computing Services as chair. The goals of the subcommittee were to develop a process for identifying and prioritizing products for centralized license negotiation and acquisition (with the attendant cost savings) and to ensure that software was consistently and appropriately maintained and updated in the server environment and in NC State's multiple campus labs.

### Progress to date:

NC State has shifted energies toward collaboration with the University of North Carolina system for the licensing of high demand and /or expensive software products. Due to limited UNC system-wide resources, NC State has taken the lead (evaluation, negotiations, legal contract, etc.) on many key software packages and then moved them to UNC General Administration, allowing the other fifteen UNC campuses to participate in the licenses. UNC-GA has also licensed software such as Adobe/Macromedia where multi-university purchasing power allows for the negotiation of the lowest cost and extended the cost savings to the entire UNC system. Another initiative is to license products that can be distributed to every faculty, staff and student.

NC State uses Sassafras' Keyserver software to consistently and appropriately maintain campus licenses and to update software available in our campus computing lab environment. In the near future, the Software Subcommittee plans to build a business case for purchasing an additional ten to fifteen of NC State's most critical and expensive software licenses. The committee will prioritize initiatives based on the greatest savings and services provided to the campus. This 'centralization of funding' will provide some internal business efficiencies.

## Learning management systems

In 2004, the LITRE plan indicated that Learning Management Systems (LMS) could make instruction more flexible, accessible, and effective. Selecting an appropriate LMS was considered crucial to accommodating the various learning styles and teaching methods that uniquely characterized various disciplines. In 2004, LMS in use at NC State were WebCT Campus Edition and a university-developed course management system known as WolfWare. The plan indicated that an effective system must enable active, self-paced learning; provide flexible and efficient access to

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instruction; accommodate different learning styles; and provide continuous assessment of student progress. The LMS infrastructure should have allowed for access and interoperability between both credit and noncredit instructional programs.

## **Progress to date:**

Since 2004, NC State has implemented an enterprise-level learning management system that combines WebCT's Vista and NC State's open source course management system, WolfWare. Vista was released to NC State in fall 2005 and has experienced extremely rapid adoption in number of sections, enrollments, unique student headcount and number of departments represented. WebCT Vista and WolfWare are tightly tied to the campus student information system (SIS), allowing for the automatic updating of class rosters and submission for both systems.

A variety of user programs have been developed to support use of NC State's enterprise-level LMS. Learning Technologies offers a series of faculty and staff workshops on WebCT Vista, which run throughout the year. Customized training sessions have been offered across the colleges, and a support web site has been developed for that includes a library of job aids. "Vista Reps" for each college and major division were recruited to discuss LMS implementation issues and better coordinate faculty and student support across campus. The ReVamp program has assisted faculty in the transition of course content from WebCT Campus Edition to WebCT Vista. The University Help Desk has also been heavily involved in the roll-out of Vista to ensure that the consultants are able to provide tier one support and can properly escalate calls, when necessary.

Assessment has been an important element of the LMS implementation. Faculty and student surveys were conducted through all phases:

[http://zope.delta.ncsu.edu/portal/delta/slic/slic\\_committees/delta/slic/slic\\_committees/Assessment/](http://zope.delta.ncsu.edu/portal/delta/slic/slic_committees/delta/slic/slic_committees/Assessment/)

In summer 2005, NC State transitioned server and networking administration of WebCT Vista to MCNC (provider of North Carolina's research and education network). NC State has focused on developing and supporting middleware, applications and integration, administration duties and user support. This transition benefited WebCT campuses within the University of North Carolina system as it anticipates the expected growth and expansion of online course materials and management, in addition to the need to conserve scarce IT resources. Next fall, UNC-Charlotte will join NC State to offer WebCT Vista from the MCNC-hosted service at the production level. Shortly after, UNC-Wilmington, Western Carolina University and UNC-Asheville will join the consortium.

## **Digital asset management**

Although many individuals and units at NC State were hard at work creating and collecting images and multimedia resources in both analog and digital formats, NC State had no overarching scheme for ensuring that assets would be accessible in the future. The plan indicated that NC State students and faculty could benefit from a scaleable, university-wide system for digital asset management, or, at a minimum, a common set of standards and access mechanisms. Ready access to a well-indexed collection of digital materials was of obvious value for research and study. The hope was that a well-chosen digital asset management system could provide the database infrastructure and techniques that allowed new content to be easily cataloged, indexed, and archived into the system, and content within the system could be easily identified and retrieved by authorized users.

## **Progress to date:**

In January 2005, the LITRE Advisory Board established and charged the Digital Asset Management Task Force to implement the investigation described in the LITRE plan. Representatives from most of the university's colleges, the library, and several information technology support units are serving on this task force. During 2005, the group surveyed existing and anticipated collections of digital assets across the university and developed a set of general specifications for a system that would facilitate their organization, preservation, access, and use. Such a system should function at both the enterprise level and within the desktop computing

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environments of individuals with personal collections to manage. Preliminary evaluations of a number of digital asset management software applications, both commercial and open-source, are being conducted currently. Findings regarding costs and benefits of several of these options will be included in the task force report, to be submitted in spring 2006. If the recommendations are endorsed and funded, a smaller technical implementation committee could be asked to address the final selection of an application and manage the implementation process.

## Student electronic portfolios

The 2004 LITRE plan indicated that the use of e-portfolios should be approached thoughtfully and integrated into the curriculum so that students and faculty have appropriate expectations. For example, in some programs, the emphasis might be on outcomes assessment, while in others; the e-portfolio might be primarily for the student's own use or presentation to potential employers. By 2004, a few curricula had already begun to require student e-portfolios or their precursors at the course level, such as the College of Education and the College of Natural Resources. However, there was no university-wide documentation, guidelines, infrastructure, or organized support for these efforts.

### Progress to date:

NC State has made limited progress in the e-portfolio space. An ad-hoc working group has formed with representation from various campus groups, including the NCSU libraries, Learning Technologies, the Faculty Center for Teaching and Learning, Undergraduate Programs, Student Affairs, the College of Engineering, and others interested in e-portfolios. This group has met to discuss e-portfolio issues on campus and to try to identify areas where e-portfolio pilots are already taking place on campus.

NC State is one of five campuses represented in the world-wide WebCT Portfolio Design Partner initiative (NC State uses WebCT Vista as its enterprise-level learning management system). This group is helping WebCT craft an e-portfolio product that will interoperate with Vista.

In January 2006, the University of North Carolina system contracted for an installation of SAKAI that includes the Open Source Portfolio Initiative (OSPI) e-portfolio. NC State's SAKAI interest group and NC State participants in the UNC system's open source interest group will investigate the use of OSPI tools at NC State.

## Technology support for students

The LITRE plan stated that technology is an effective learning tool only when it is in the hands of skilled users. When a student is unskilled in technology applications, technology can constitute a barrier to learning, frustrating the student and usurping learning time from the subject or discipline. NC State's student surveys consistently showed a need for enhanced access to trained staff for help and access to technology training classes.

### Progress to date:

Resources for a broad-scale effort have not been identified, however, the Information Technology Division piloted a series of basic computer training courses specifically for undergraduate students in Spring 2005. Response has been positive and the classes have continued, with several more courses being added to the schedule as a result of student feedback. See [http://www.ncsu.edu/it/education/student\\_ed/](http://www.ncsu.edu/it/education/student_ed/) The College of Engineering successfully redesigned its one-hour Introduction to Computing Environments course to tailor it toward student self-support as a part of the college's Student-Owned Computer initiative. See <http://www.eos.ncsu.edu/soc/>

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## Faculty innovation grants

To enhance the technology-rich learning environment, the LITRE plan indicated that NC State must support faculty in their efforts to explore the use of instructional technology as a pedagogical tool. NC State had a successful model in its IDEA Grants program, which provided funds and personnel to NC State faculty and staff to support innovation in the use of instructional technology in distance education. Although the IDEA Grants program had been very successful, the restriction of the grants to distance education was not appropriate to the direction that on-line education was taking. Programs did not break neatly into categories like “distance education” (space and time independent) and “classroom education” (space and time dependent). Instead, the trend was toward incorporation of successful on-line learning pedagogies wherever they were appropriate.

### **Progress to date:**

In 2004, the LITRE grants program was created with the goal of enhancing student learning as its focus. The initial 19 grants were announced in December 2004, with production and assessment underway or complete. The next 20 grants were announced this week. The LITRE Advisory Board encourages innovative projects which may have wide applicability towards the improvement of student learning. Since the LITRE implementation effort will last for several years, the hope is that successful projects from the early years of LITRE implementation will be expanded and tried on a larger scale as NCSU progresses with its LITRE efforts. Assessment plans for each project is a major component of the grants program. Faculty work with members of the LITRE Assessment Committee to provide a well-defined assessment plan with learning outcomes and measurements prior to obtaining their funding.

## Information exchange

The 2004 LITRE plan stated: “The changes—both positive and negative—that accompany the permeation of new technologies in teaching and learning is subject to the rigorous examination and discussion appropriate to any academic field of inquiry.” The successful integration of new technologies in teaching and learning depended on the promotion of discussion among faculty, the circulation of information about diverse aspects of technological adoption, shared knowledge about teaching strategies, and results of assessment studies. Effective communication was one of the fundamental challenges of a university as large and diverse as NC State.

### **Progress to date:**

Since 2004, The Teaching, Learning, and Technology Roundtable (TLTR) sessions addressed topics that touched on broad issues that are essential to LITRE implementation. These sessions included: 1) How an education that leads to “information fluency” for NC State students is to be defined and realized, which led to 2) What values the university community holds for sharing knowledge, such as open access courses. A session arose from a lengthy and volatile discussion on the TLTR listserv about whether and how student email addresses should be standardized, again touching on both policies and system procedures that form part of the fabric for a technology-rich environment.

The Layer 8 Initiative was another instigator of increased conversation among campus constituents. Delivered to the campus as a white paper entitled “Layer 8: A White Paper on Managing Information Technology Investments to Advance NC State's Mission,” the paper responded to the perceived need for the university as a whole to review and coordinate its technology investments in order to provide the resources needed to bring LITRE to realization in its 10-year projection.

The LITRE Assessment Committee is creating an Active Learning Repository to showcase LITRE grant efforts. In addition, the LITRE Advisory Board is showcasing and updating all LITRE activities at NC State (whether those activities are generated from formal LITRE activities or not).

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## Accessibility and universal design for learning

In part as a result of federal law, it was standard practice to incorporate accessibility into the design of many technological products and services. Some faculty at NC State discovered that using the principles of accessibility and universal design diversified and enhanced their on-line and digital course materials. The NCSU Libraries had incorporated accessibility considerations into digital resources since the 1990s. Generally speaking, the learning needs of students with disabilities at NC State were generally accommodated with a reactive retrofit “as needed” model. In terms of Web and other digital learning content, this model was expensive and provided learning benefits for fewer students. Greater education, collaboration, and coordination were needed if the university was to reap the full benefits of an accessible learning technology environment.

### Progress to date:

In the past two years, NC State has made considerable progress in implementing proactive and scalable solutions to accessibility challenges—both technological and procedural. Among the objectives is to increase the accessibility of the web and the digital learning environment in order to reduce the need for ad hoc accommodations for people with disabilities. The implementation of accessible web page and web application design has become standard practice for central academic and administrative web developers. As of spring 2005, the university's most frequently visited official web pages (administrative home pages, all College home pages, and online student services such as course registration and records, etc.), are compliant with federal Section 508 and state accessibility standards. Accessibility solutions are also being integrated into new campus learning environments, ranging from multimedia classrooms to the remote-access Virtual Computing Lab. Beyond compliance, the goal is to foster self-sufficiency and to enhance access to STEM as well as other curricula for students with diverse learning styles and needs.

To further the growth of campus expertise in accessible web and digital course content production, NC State has provided new accessibility tools, training and consultation/evaluation resources to staff and faculty. "Train the trainer" workshops and classes on accessible web and software design are offered by the Information Technology Division, Learning Technologies and Resource Management Information Systems. A comprehensive IT accessibility website was launched in 2004 ([www.ncsu.edu/itd/access](http://www.ncsu.edu/itd/access)) that includes extensive online tutorials as well a growing selection of accessibility tools that have been site-licensed for the campus (e.g. LIFT, courseGenie). NC State has an IT Accessibility team, which includes expert testers and programmers with disabilities. This group works with vendors as well as campus developers to integrate accessibility into the purchase, design and deployment of campus-wide IT resources. NC State's information technology and learning technologies accessibility staff also collaborate on accessibility and universal design projects within the University of North Carolina System, regional and national consortia.

## Wireless data connectivity & mobile computing/communications systems

Secure wireless access to NC State's data network was not available everywhere at NC State. Although Communication Technologies had a complete “student first” wireless data network plan in place, implementation awaited funding. To support this network, NC State needed to develop a coherent wireless and mobile computing environment—including systems, software, and training for faculty. Wireless communications and computing technologies were already converging. Most NC State students came to campus equipped with personal cell phones, and they were facile with multiple modes of wireless communication, including voice, e-mail, and instant messaging.

### Progress to date:

NC State's strategy for wireless computing has been approached through multi-year investments focused on integration of mobile computing into the learning experience. The rollout of wireless service has received significant budgetary support from multiple sources such as reallocation of budget within NC State's Communication Technologies group, the Student Educational Technology Fee (ETF) committee, the Office of the Provost, and information technology departments within the

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colleges. A semi-ubiquitous wireless topology is now available across the campus. Ongoing investment in wireless has emphasized understanding customer needs and efficient design. Dialogue with the university community has led to wireless initiatives such as a web-based voting system for determining coverage needs and the provision of guest access for web browsing.

Colleges, such as The Colleges of Agriculture and Life Sciences and Veterinary Medicine have deployed PDA-based wireless devices to allow students to have mobile access to information as well as integrating wireless access with in-class teaching opportunities. The College of Agriculture Life Sciences' incoming freshmen survey reflects national trends that place ownership of cell phones by students at over 90%, pointing towards a trend where wireless access to information on mobile devices is rapidly becoming a commonplace part of a student's university experience.

## Advanced remote access services

As students expected "anytime/anywhere" access to computing resources, the dial-up access service NC State offered did not meet needs. The LITRE plan indicated that NC State should explore the possibility of using the new blade computers and other grid-related technologies to offer easy-to-use, cost-effective remote access to the complex and expensive specialized software applications students need for success in their disciplines. The plan further indicated that this technology would allow students to log into virtual workstations from their homes so that they could use software without downloading it to their computers and without paying for a software license. The Information Technology Division proposed the development of a grid-based, specialized, remote-access service that would expand and enhance the technology environment available to NC State students on and off campus.

### Progress to date:

In response to the need for remote access services, NC State created the Virtual Computing Lab (VCL). The VCL provides on-demand reservation-based remote access to a selection of NC State's extensive library of engineering, design, and scientific software applications, preinstalled on high-end computing resources. The VCL addresses the increasing needs of both local and distance students and faculty by providing 24x7 access to these advanced computing laboratory facilities wherever they are. VCL service is end-user platform agnostic, i.e., for delivery of services it can use a variety of computer and operating systems (e.g., Macintosh, Windows, UNIX). The current implementation is hosted on IBM Blade Center platform and provides both local and distance education students with dedicated remote access to expensive, specialized or license-specific NC State University Windows based applications and idle Linux and Solaris public computing laboratory machines and software.

The VCL pilot began during the fall 2004 semester involving approximately 600 undergraduate and graduate students across different NC State colleges. During 2005 access was extended to 900 students in the spring 2005 semester and more than 1900 students during the fall 2005 semester. This included both on-campus and off-campus students in 105 courses in the Colleges of Natural Resources, Humanities & Social Sciences, Education, Physical & Mathematical Sciences, and Engineering. Distance education (DE) students were also given access. During fall 2005, about 6,000 College of Engineering students were given access to Linux and Solaris images. Additional information can be found at:

<http://vcl.ncsu.edu>

<http://vcl.ncsu.edu/site/pages/default/about-vcl>

<http://vcl.ncsu.edu/site/categories/project/course-access-list>

<http://vcl.ncsu.edu/site/pages/project/vcl-application-list>