



Learning in a Technology Rich Environment

LITRE Executive Council Annual Report for 2006-2007

Final Report March 2008:

The LITRE Executive Committee: Tom Miller, Karen Helm, Hugh Devine

Prepared by Dr. Geetanjali Soni, LITRE Assessment Coordinator

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LITRE Executive Council Annual Report for 2006-2007

EXECUTIVE SUMMARY

LITRE's purpose is to improve student learning through a collection of projects in which faculty systematically investigate the effectiveness of incorporating technology into their curriculum and pedagogical practices as measured by student learning. The results are disseminated to inform both practice and decision-making. LITRE also strives to improve the learning environment at NC State by creating a platform for dialog and collaboration on teaching and learning with technology.

This second annual report from the LITRE Executive Committee (LEC) synthesizes LITRE activities and the findings from LITRE research in the year 2006-07, and presents policy recommendations and strategic initiatives that the committee has derived as a result of careful deliberation on the results. Specifically, this report is based on the following 2006-07 reports:

- The LITRE Assessment Committee's (LAC) annual report
- Report on the LITRE Technology Practices Directory
- Report on LITRE Survey results
- Report on the Use of Technology Focus Group Study
- Analysis of other LITRE activities

Based on the Strategic Initiatives in the last annual report, several LITRE activities were completed in 2006-07.

- The LITRE Advisory Board (LAB) was established in fall 2006 with Dr. Devine as chair.
- Dr. Soni was hired as Assessment Coordinator to maintain focus on the improvement and research into student learning.
- The LITRE Assessment Committee developed a detailed Report Framework for use by LITRE project investigators.
- The Student Learning Task Force developed the LITRE Student Learning Toolkit to facilitate assessment of student learning.
- LITRE sponsored a daylong workshop for faculty or staff leading innovative and successful student learning initiatives at NC State.
- Three Phase 2 LITRE projects were chosen after a detailed process during which fourteen project proposals were generated.
- The LITRE Technology Practices Directory (TPD) was implemented to gather information on innovative technology use at NC State.
- Results from LITRE questions in the Graduating Senior Survey and the Sophomore Survey administered by UPA were analyzed to determine what students are saying about technology use on campus.
- Twelve final reports and two progress reports from the LITRE Faculty Small Grant PIs were received, reviewed, and synthesized by the LITRE Assessment Committee.
- A focus group study to provide information about students' use of technology at NC State was completed.

Although LITRE is still in its initial stage as a research program, the following synthesis of the findings to date suggests some useful trends and patterns.

1. NC State's students felt that technology helps them learn. When surveyed about the overall effect of technology on their ability to answer questions or solve problems in their field of study, to complete major projects and assignments, or use published information and conduct research to gain new knowledge, our students responded overwhelmingly that technology had helped "some" or "a great deal."

2. Student surveys indicated that the greatest number of students felt that the technology that helped them learn better in class was electronic presentation of content via animation, multimedia, simulations etc. Other technologies students felt helped them learn better in class were “Use of computer stations for course-specific software (e.g., SPSS, SAS, ALIAS, Design Studio, etc.” and “Static presentations like PowerPoint.”

Outside class the technology that the greatest number of students felt helped them learn better was “Electronic communication with the instructor (e.g., email, chat groups, audio/visual conferences).” Technologies that received the lowest ratings were: In class: Use of Computerized exams/quizzes and “Electronic feedback to the instructor during class via handhelds, pushbuttons, laptops, etc.” Outside class: Work to be submitted electronically.

Student focus groups also indicate that students see benefits of using PowerPoint and multimedia. The focus groups support the survey findings that students do not favor classroom response systems.

This indicates a student preference for technologies that allow interaction with content in the classroom and communication with instructor outside the classroom.

3. LITRE projects showed that technology motivated and stimulated student's active engagement with material and thus influenced student learning. In particular, technology enhanced student learning through:
 - Visualizations and simulations.
 - Communication and collaboration among peers, and between peers and experts.
 - Enriched content.
 - Content that is easily accessible outside of class.
4. Two important factors in the effective use of technology are:
 - A deliberate and planned awareness or adaptation of pedagogical strategies when deploying technology. Technology itself does not directly influence learning; pedagogical strategies enabled by technology do.
 - Students’ attitude towards technology, which is a determinant of effectiveness and use.
5. Technology must function well if it is to improve teaching and learning effectively.

In keeping with LITRE’s fundamental purpose to introduce and test innovations, and then to use the results to improve the university, the LITRE Executive Council offers the following observations and recommendations.

1. At every level, the university should couple its investments in technology (e.g., ClassTech, ETF, VCL, etc.) with opportunities for faculty development in pedagogy, incentives and rewards for innovative teaching, and reliable operational support. Failure to provide any one of these three key elements can significantly reduce the return on an investment in technology alone.
2. Accordingly, these principles should be used to enhance the allocation of technology resources (e.g. ClassTech, ETF, VCL, etc.) Proposals for resources should address not only the technology to be deployed, but also their potential for improving student learning and how faculty development, operational support, and faculty incentives and rewards will be provided.
3. Pedagogical support provided by the colleges, and by the university through DELTA and other units may be more effective and efficient if priority is given to faculty working in groups, rather than as individuals. NC State has benefited from many successful learning communities focused on using technology innovatively to address a pedagogical challenge, such as COE’s laptop

initiative, Scale-Up, the professional writing program in English, and the large class redesign project. Investments in pedagogy might return a greater investment if:

- a. they focus on improving student learning outcomes in courses with the greatest impact, either because they are taken by large numbers of students (such as English composition) or because they serve as gateways to many programs (such as calculus) or
 - b. they focus on courses taught by a specific group of instructors (such as graduate teaching assistants) or
 - c. they focus on development of technologies used in courses that are taught in series, for example the current experiment in Engineering computing which tracks students performance through four years of sequential courses in selected engineering programs.
4. As NC State increases it's hiring of faculty members new to the professoriate, we can expect both faculty and students with a greater willingness to experiment with technology. NC State should take advantage of this strategic opportunity by providing more incentives and rewards for documented educational technology innovation. Giving a faculty member time to redesign via course buy-outs, especially when coupled with recognition through RPT, may provide a very high rate of return.
 5. LITRE demonstrates that assessment results can be used to inform important decisions relative to NC State's investments in learning technologies and that it is essential to assess the impact on student learning of major deployments of learning technology. Therefore, whenever possible, technology investments should develop evidence of student learning effectiveness (e.g., ClassTech, ETF, VCL, etc.) We can't afford to misuse this expensive, but critical, strategic resource.
 6. LITRE expands NC State's focus on improving learning and teaching in our own courses and programs. The next step is to translate the lessons learned in LITRE and the larger academic community into a culture shift at NC State. To accomplish this transformation we need to both institutionalize the gains and insights from LITRE and continue LITRE's research mission. The first actions should include: 1) the development of a continuing program to disseminate LITRE related findings and 2) the establishment of a research program to support faculty led investigations of learning technology impacts.
 7. The institutionalization of LITRE functions is strongly recommended by the LITRE Advisory board. As conversations are underway to determine the role a vision for a new Center for Faculty Development or similar body, it is recommended that such a center house a LITRE like body responsible for:
 - a) providing support for faculty in doing Educational Research in their discipline.
 - b) Providing a database of literature on best practices regarding the use of technology
 - c) Dissemination of results of educational research.
 8. Dissemination of LITRE findings, both within and outside the campus should be made a priority.

LITRE's first phase was devoted largely to stimulating innovation through dozens of small grants. Its second phase is focused on learning what we can through fewer, larger projects. Perhaps in the third phase, LITRE will center on applying what we have learned via the set of above recommendations. LITRE should move to a Phase III implemented within a more permanent administrative structure (perhaps a redesigned FTCL) and should continue funding projects with a strong assessment component (maybe a combination of small and large efforts).

BACKGROUND AND LITRE 2006-07 ACTIVITIES

“Learning in a Technology-Rich Environment” (LITRE), the focus of NC State’s quality enhancement plan, has now completed its third year of operation. Consistent with the University’s mission “to create an innovative learning environment” the LITRE project brings a faculty-based, reflective perspective to the University’s strategic planning and policy making related to student learning and learning technology. Findings from each step of LITRE implementation have been used to inform the next stage, defining LITRE as a continuously evolving endeavor.

To recap, LITRE’s ultimate purpose is to improve student learning. LITRE’s primary strategy is to establish an ongoing, systematic investigation into the effectiveness of technology-based innovations to improve learning. LITRE’s overarching goals are:

1. To improve student learning across the University through the use of technology. We will monitor the impact of these innovations on students’ abilities in four dimensions:
 - problem solving,
 - empirical inquiry,
 - research from sources, and
 - performance in the discipline.
2. To investigate systematically the effectiveness of technology-based innovations in learning and teaching, we will establish an ongoing mechanism to stimulate and study innovations.
3. To use the results of these investigations to scale our successes, shape future investigations, and inform campus decision-making. More specifically, we want to:
 - Increase student and faculty engagement with technology when shown to be effective in improving learning and teaching.
 - Develop appropriate, learning technology-friendly policies.
 - Improve the physical learning environment.

After launching LITRE in 2004 with three large First-Wave projects and a faculty small grants program, in fall 2006 LITRE moved into its second phase. In this second phase, LITRE is led by the LITRE Executive Council, consisting of four members: Tom Miller, Vice Provost of DELTA; Karen Helm, Director of University Planning & Analysis; Barbi Honeycutt, Acting Director of Faculty Center for Teaching and Learning; and Hugh Devine, professor in Parks Recreation and Tourism Management. Geetanjali Soni, Coordinator of LITRE Assessment, administers and assists in the research for the project. The LITRE Assessment Committee and the LITRE Advisory Board continue to function in advisory roles.

In 2006-07 LITRE made significant progress towards its goals. LITRE activities in this last year are summarized below: (See Appendix A for details on LITRE projects.)

- The LITRE Advisory Board (LAB) was established in fall 2006 with Dr. Devine as chair. This board is made up of faculty and staff from each of the Colleges and major administrative units and provides advice and guidance to the LITRE Executive Council. Members also serve as a campus forum for issues related to student learning and technology and as a liaison to their college or unit for LITRE-related matters.
- To help improve assessment of LITRE projects, Dr. Geetanjali Soni was hired as Assessment Coordinator and works with the PIs of LITRE projects, the LITRE assessment Committee, and the Student Learning Tool Kit Committee to maintain focus on research, assessment and improvement of student learning.

- The LITRE Assessment Committee developed a detailed Report Framework for Principal Investigators to use as a guide in designing the pedagogical and assessment components of their projects, and as a tool for organizing and presenting project reports.
- A Student Learning Toolkit was developed to facilitate research in the area of student learning. This toolkit presents a collection of annotated assessment and evaluation tools. The tools and methods focus specifically around student learning and the LITRE areas of problem solving/critical thinking, research from sources, empirical inquiry and performance.
- LITRE sponsored a daylong workshop for faculty or staff leading innovative and successful student learning initiatives at NC State with the intent of identifying potential initiatives for Phase 2 projects.
- Three Phase 2 LITRE projects were chosen after a detailed process during which fourteen project proposals were generated. LITRE Phase 2 projects are:
 - “Thoroughly Modern MILLIE” (Methods of Incorporating the Latest Learning Innovations in Education), PI: Dr. Robert Beichner
 - Virtual Online Learning and Teaching (VOLT), PI: Len Annetta, Co Investigators: Julia Storberg-Walker, Diane Chapman, Lynda Aiman-Smith, Claudia Kimbrough
 - Computer Based Modeling for Engineering, PIs: Amy Craig, Jan Genzer, Jeff Joines, Dianne Raubenheimer and Stephen Roberts.

Work on these projects was started in June 2007 and a preliminary report to the LITRE Advisory Board was presented in November 2007.

- The LITRE Technology Practices Directory (TPD) was developed and implemented to gather information on innovative technology use at NC State University. This directory is a fully searchable online database that lists innovative technology-enhanced teaching practices by faculty. Faculty can create an account in the directory, list one or more courses they teach and then outline how they use specific technologies in these courses.
- Starting in 2004 questions pertinent to LITRE were added to the Graduating Senior Survey and the Sophomore Survey administered by UPA. Results from these surveys were analyzed to determine what students are saying about technology use on campus.
- Twelve final reports and two progress reports were received from the LITRE Faculty Small Grant PIs. These were reviewed and synthesized by the LITRE Assessment Committee (LAC). (See LITRE Assessment Committee 2007 Annual report.)
- A focus group study to provide information about students' use of technology at North Carolina State University was completed. Professional staff from technology-support units, instructional technology services, teaching and learning support and university planning services created questions for the focus groups. Dr. Traci Temple conducted the focus groups, analyzed data and prepared the final report.

LESSONS LEARNED FROM LITRE FACULTY SMALL GRANTS

Like last year, this year's report synthesizes the results from the faculty grants into lessons learned about teaching and learning with technology. This year we received 12 final reports and two progress reports from LITRE PIs. Some of last year's findings were reinforced this year and new lessons were learned. Current findings are presented below along with examples from LITRE projects illustrating each finding.

I. Lessons about Student Learning

Lesson I: Technology enhances student learning by enhancing content in various ways.

Visualization of content facilitates student learning of the material. (Visualization is defined as the formation of mental visual images, the process of interpreting in visual terms, or of putting content into visual form to further understanding.)

For example, Oliver & Raubenheimer (2007) integrated web-based concept map (Cmap) assessments in five sections of graduate teacher education classes between fall semesters 2005 and 2006 (ECI 511, 41 students; EAC 595A, 26 students). Students found that using concepts maps was beneficial and helped

their learning. Cmaps helped them make connections, tie information together, link or group information, and to explicate relationships among concepts. Through repeated assessment both instructors showed that students' ability to identify and correctly relate concepts to each other improved over the semester, as shown by graded assignments. In addition, based on survey results, students generally agreed or strongly agreed that concept mapping activities helped them make connections between major topics and sub-topics of the courses.

Interactive simulations or modeling promote learning. (Simulations/modeling extends visualization by including the ability to manipulate variables or parameters and to see the effect of this manipulation. Simulations and models include imitation or representations [perhaps simplified] of some real thing, phenomenon, situation or process.)

For example, Peters (2007) prepared interactive modules for two of the laboratory sessions in MAE 405. Each module was composed of a series of PowerPoint slides using figures rather than equations to demonstrate practical examples of the material learned in that particular laboratory session. Additionally, interactive Maple and MATLAB based files were included to allow the students to see the effects of varying certain parameters in the example. For instance, one module demonstrated the vibration of the sail for a sailboat and a circular drum. The student could then change the aspect ratio of the sail or mode number to visually see how the vibration changed. Each laboratory module also contained an online quiz that the student needed to complete correctly before attending the in-class laboratory session. Analysis of data showed that both sections of the courses using the visualizations demonstrated an increase in student learning.

Technology provides enriched content material. (Enrichment is defined as the extension of content through technology enabled methods such as hypertexts, electronic archives, etc.)

One example of technology enriched content was the creation of a web-based diet analysis program, *NCSUNutrition* (<http://www.ncsunutrition.com>) to promote student understanding of the relation between energy intake and expenditure (Allen 2007). The effect on student learning was not reported in the project.

Lesson 2: Technology facilitates communication, collaboration, feedback and interaction, which can improve student performance.

Technology can be used to increase communication and collaboration between students and between students and faculty. Interaction with peers and faculty, feedback, and collaboration all contribute to enhancing student learning.

For example:

Expertiza, a suite of applications for developing reusable learning objects through peer review, was evaluated in several courses (CSC 216, CSC 253, CSC 379, ECE 463/521, CSC 506, and CSC 517, and others). In Expertiza, students submit assignments to the system, which then presents these assignments to other students for review. Both reviewer and author can communicate over a shared Web page, and the author has a chance to submit revised versions in response to reviewer comments. In a survey of students in one course (N=25), by a margin of 13 to 5, students thought doing the peer-reviewed exercises enhanced their learning. By a margin of 15 to 6, they felt that the experience of writing for their peers gave them a deeper understanding of the concepts in the course. Overall, students reported satisfaction with this tool (Gehring, 2007).

Neel (2006, 2007) notes how the use of virtual slides and computers can add to collaborative learning in a class. In most traditional microscopy systems only a single person or two people can easily view a slide at a time. This creates an obstacle for students trying to share information about what they are seeing on different slides or for instructors attempting to demonstrate various features of a slide. By viewing slides on a screen, more individuals can view the slides at once, which allows students to more easily compare slides. Additionally, instructors can more efficiently demonstrate or discuss important features of a slide with larger numbers of students, while still maintaining a small group focus.

II. Lessons about Teaching with Technology

Whereas the above section summarizes the reports in terms of student learning, this section summarizes themes about the complimentary side, the effect of technology on teachers and their teaching/pedagogy.

Lesson 1: Pedagogy is of vital importance. Technology itself does not directly influence learning, pedagogical strategies enabled by technology do.

It is not technology per se, but the pedagogical strategies that are afforded or supported by technology that are most likely having an effect on student learning. Use of technology is not an instructional method, but better viewed as a deliberately manipulated and deployed way of promoting, better enabling and scaffolding certain pedagogical methods or philosophies. Learning is promoted through interaction of content, technology and pedagogy. Much previous research has supported this¹. LITRE project results from last year also suggest that the greatest gains in student learning occur when faculty actively considered or modified their pedagogical strategies.

Rouskas and Miller (2007) present an example that illustrates this point. They designed, implemented, and incorporated a set of learning modules to demonstrate fundamental programming concepts into their CSC 216/316 courses (Fall 2006/Spring 2007). Students with laptops were able to download and use the modules during the lecture period to gain hands-on experience with the corresponding concepts. For assessment purposes, two sections were studied. One section required all students to bring and use laptop computers to each class. These computers were used for the exercises in the modules. The other section did similar exercises, but used paper and pencil. Special questions were developed and used on the final exam to assess the students' ability to solve realistic problems using Linked List data structures. Results from the technology-based and non-technology-based classes were collected and compared.

“The main conclusion from the results is that technology in the classroom provided no appreciable differences in learning. However, these results do not necessarily imply that the learning module approach does not have merit. Since both sections used the learning modules, it is possible that the learning modules benefited both groups of students regardless of the technology used (laptops versus paper and pencil). Therefore, it is possible that **the interactive learning experience *per se*, is more important than the underlying technology**. However, without the support from COE's laptop initiative and this LITRE grant, it is unlikely that the PIs would have undertaken the task of creating the modules and making classroom learning more interactive.”

On pedagogical change Gehringer (2007) notes, “... it requires more effort to disseminate a teaching/learning strategy than to disseminate a teaching/learning tool. It is much easier to find faculty who want to do electronic peer review in their courses than to find faculty who have ideas about how students can build resources to improve the learning of other students. Perhaps this should not come as a surprise; faculty can learn to use the software in a few hours, but thinking about how students can take charge in improving the course requires more careful planning and changes the kind of homework that is assigned.”

Lesson 2: Functional aspects of technology are important: Infrastructure, support and time investment are crucial.

Usability, Infrastructure and Support is Critical.

¹ Moore A. H., Watson, C.E. & Fowler, S.B. (2007), Active Learning and Technology: Designing Change for Students, Faculty and Institutions, *EDUCAUSE review*, September/October 2007; Ziegenfuss, D. H. (2005). By Instructional Design: Facilitating Effective Teaching and Learning with Technology, *Integrating Technology in Higher Education*, ed. M. O. Thirunarayanan and Aixa Perez-Prado, Lanham, Md.: University Press of America, 19-45.

Several faculty highlight this issue. For example, Rouskas & Miller (2007) state: “For programming projects, it is important to use standardized software that is readily accessible to students. Otherwise, it is likely to spend a large amount of time in-class to identify and resolve software incompatibilities. We have also come to realize the importance of infrastructure in terms of wireless access and availability of electrical outlets in the classroom. Neel (2007) notes that when technology is easy to use and works well, adoption can be smooth. “A very high proportion of both 2006 and 2007 students found the VM system easy to use and the system has been easily integrated into both the sophomore clinical pathology course and the senior clinical pathology rotation.” Similarly, Gehringer (2007) points out that students want to use tools that have an intuitive user interface.

Large Time Investment is needed.

Like last year, many faculty reported that the incorporation of technology, conversion of materials into an online form, or creation of technology-based applications was even more time consuming than planned. Some examples: Rouskas & Miller (2007) note that, “Preparing a well-defined learning module and making sure that the relevant JAVA code works correctly is a time-consuming task. We estimate that preparing for a technology-based section takes approximately 20% more time than a non-technology-based one, with a similar increase on TA effort.” Thoney (2007) noted, “Implementing the LTG and SCG (games software) require a lot of additional time when compared to preparing for a textbook-based lecture. Heber and Howard (2007) observe that, “Although developing a visualization library from scratch is a time consuming endeavor, the use of visualization in the classroom might even save preparation time once such a library has been created.”

Lesson 3: Attitude of users towards technology is crucial determinant of effectiveness and use.

Huff & Monaco (2007) did a study of the use of TaskStream, an eportfolio system in the College of Education. Student and faculty surveys (student $n = 43$, faculty $n = 6$) showed that both students and faculty seemed to have negative opinions regarding TaskStream. Motivation to use the eportfolio system was low – 95% of students reported that they did not use TaskStream for projects other than those that were required by their instructor(s), and 74% indicated that they had not explored additional features of TaskStream that were not used as part of required assignments. Students largely felt that the software did not increase their interest in course assignments and were unenthusiastic about its use. Faculty responses were similarly negative. Approximately 67% of respondents either disagreed or strongly disagreed that TaskStream enabled them to better align teaching objectives and evaluation strategies. Nearly 67% of participants strongly disagreed that TaskStream enabled them to more efficiently manage student assignments.

Similarly, Norris’ (2007) study of the use of QuickTime movies and interactive Maple worksheets in Calculus III, MA 242 showed that by a margin of about 3 to 1 the students felt that Maple did NOT help them to better learn calculus. Corresponding to this attitude was the finding that use of technology based modules had only a marginal effect on learning. The average grade for all students in the treatment groups was 0.6 points higher (out of 10 points) than the average grade for students in the control groups, a 6% increase.

FINDINGS FROM THE TECHNOLOGY PRACTICES DATABASE

The LITRE Technology Practices Directory is a fully searchable online database that lists innovative technology-enhanced teaching practices by faculty. Faculty can create an account in the directory, list one or more courses they teach, and outline how they use specific technologies in those courses.

As of October 1, 2007 there were 79 entries in the directory. A total of 49 unique users had completed data entries. To date, the number of entries has been disappointing. However, despite the limited number of entries, the directory has served some useful purposes. During the search for LITRE Phase 2 projects (see <http://litre.ncsu.edu>), searches of the database helped identify faculty using specific technologies. By

contacting these faculty we could facilitate conversations among them, leading to the development of at least one collaborate research proposal. Faculty development personnel on campus have also used the directory to determine innovative ways new technologies were being used across campus, and to share and promote some practices.

Reported Infrastructure Use

Faculty were asked what was the minimum infrastructure and support required to support their use of technology. Analysis of the entries to date, show that by a large majority, the most commonly required infrastructure was “Access to the internet outside the classroom” (73%).

Other commonly needed infrastructure were:

Access to specific software (51%)

Access to Internet inside the classroom (33%)

Projecting capability for computer (23%)

Computer labs (21%)

Access to remote software/services (17%)

Simple projection equipment (document cameras, overhead, etc.) (15%)

Student must have access to a laptop or portable computing technology (8%)

Recommendations for Technological Infrastructure Improvements

Faculty were also asked for recommendations of technological infrastructure improvements or expansions in order to optimize benefits of use of technology. Qualitative analysis of these recommendations resulted in recommendations in three main areas.

Hardware/infrastructure

This included recommendations for more computer labs, computers in the classroom and requiring students to bring a laptop to class. Easier broadband, high-speed access to wireless on campus and in dorms was recommended. Also, it was felt that the web-space allocation for students needed to be increased.

Software

Many recommendations in this category had to deal with WebCT VISTA. Recommendations were made to improve its usability and capacity, have automatic tracking of bugs, have better Wolfware –WebCT integration and included complaints about its terrible survey tool. Survey tools were also mentioned several times. There was need for a robust but easy to use survey tool. One user recommended CALS free easy-to-use-tool. Requests were also made for the ability to have live videoconferences, to easily share drawings, and for a course bulletin board.

Support and Training

The most often mentioned request was for Elluminate training. It was also mentioned that faculty are often not aware of the training and other resources that are available to them and that maybe more localized workshops at each college would help to inform faculty of options. Training recommendations for Flash, training in videotaping, editing, encoding, etc, more professional support for the upkeep and development of innovative demonstration apparatus were also made.

From our experience we conclude that making the directory structure more intrinsically rewarding to faculty would increase the data entry. Suggestions for this would be to extend the directory to include other social networking features, like a wiki, social tagging software, etc. for collaborating and sharing successful pedagogies, as well as “how to” guides. Additionally a design that allows for the entry of multiple tools, not at a course level, would make data entry faster and easier for faculty.

FINDING FROM SURVEYS

Starting in 2004, questions pertinent to LITRE were added to the Graduating Senior Survey and the Sophomore Survey administered by UPA. For more information about LITRE survey results see Appendix A and the LITRE 2007 Survey report. A summary of some findings is presented below.

Technology Use In Classroom or Labs

Students were asked to indicate how many courses they had taken that used six specific technologies in the classroom or lab and whether the technology helped them learn the material better than they would have if the technology had not been used. (See Table 1 and 2 in Appendix A for examples of detailed results.)

- The most common use of technology, in all surveys, was for “Static electronic presentations (e.g., PowerPoint).” “Electronic presentation of materials using animations, simulations, etc.” and “Instructor demonstrations of Web materials (e.g., library resources)” were other technologies used frequently, but these were used far less often than static electronic presentations.
- In the first year of the survey (2003-2004) less than 50% of both sophomores and seniors indicated that the use of listed technologies in class helped them learn better. In later surveys, more students felt that the technology helped them to learn better. However a majority of sophomores (2006 survey) felt this only for “Electronic presentation of course concepts via animations simulations, etc.” Majority of graduating seniors (2004-2005 and 2005-2006 surveys) felt they learned better with:
 - “Static electronic presentations (e.g., PowerPoint)”
 - “Use of computer stations for course-specific software (e.g., SPSS, SAS, ALIAS, Design Studio, etc.)” and
 - “Electronic presentation of course concepts via animation, multimedia, simulation, etc.”

Conclusion: There is an increasing use of technology in the classroom over the survey years. Students do not perceive all technology helps them equally. Student surveys indicated that the greatest number of students felt that the technology that helped them learn better in class was electronic presentation of content via animation, multimedia, simulations etc. Other technologies students’ felt helped them learn better in class were “Use of computer stations for course-specific software (e.g., SPSS, SAS, ALIAS, Design Studio, etc.)” and “Static presentations like PowerPoint.” On the other hand, students perceive technology tools such as computerized exams and electronic feedback devices less useful: these technologies received the lowest percentage of students saying that they learned better with their use. (see Tables 1 and 2 in Appendix A).

Technology use Outside the Classroom

Students were also surveyed about the use of technology (for coursework) outside the classroom or lab and asked whether each technology helped them learn the material better than they would have if the technology had not been used. Results show:

- Greatest use of technology outside the classroom was the use of technology as a delivery or presentation tool. Among sophomores (2006 survey), the greatest use of technology outside the classroom was for “work to be submitted electronically.” This was followed by use of learning management systems (e.g., Wolfware, WebCT). Seniors’ responses showed that the greatest use

³ LITRE Student Learning Task Force: Dr. Geetanjali Soni, Chair (University Planning and Analysis), Dr. Diane Chapman (Adult & Higher Ed.), Dr. Alan Dupont (Under Graduate Academic Program), Dr. Scott Fitzpatrick (Sociology & Anthropology), Dr. Donna Petherbridge (DELTA), Dr. Dianne Raubenheimer (Engineering), Dr. Joni Spurlin (University Planning and Analysis), Dr. Carrie Thomas (Marine, Earth & Atmospheric Sciences), Dr. Candace Goode Vick (Parks Recreation and Tourism Management).

was for “work to be prepared with a word processor, spreadsheet, graphic program, etc.” This was followed by “electronic communication with the instructor (e.g., email, chat groups, audio/visual conferences).”

- Sophomores and graduating seniors largely felt that most technologies made no difference to their learning (as compared to courses where these technologies were not used) with **only one technology** “Electronic communication with instructor outside classroom” being seen as favorable to learning by a majority of students.

Conclusion: Most of the technology use outside the classroom was not perceived by students to help them learn better. Students’ however found electronic communication with the instructor to have a positive effect on their learning.

Overall Usefulness of Technology in the Field of Study

Though students did not rate all of the individually listed technologies very highly in helping them learn better, overall both sophomores and graduating seniors' felt that technology had indeed helped their learning. When asked about the extent that “all the various teaching and learning technologies (used either in or outside the classroom) at NC State” had affected different aspects of learning in their field of study, students overwhelmingly felt that technology had helped some or a great deal in each of these areas.

Table: Usefulness of technology in field of study

To what extent has technology helped in your ability to	Graduating senior 2004-2005			Graduating senior 2005-2006			Sophomore 2006		
	Some	Great deal	Some/ Great deal	Some	Great deal	Some/ Great deal	Some	Great Deal	Some/ Great Deal
Answer questions in your field of study.	40.6	50.5	91.1	41.9	48.4	90.3	26.4	58.6	85
Solve problems in your field of study.	42.8	46.9	89.7	42.6	47.3	89.9	21.1	56.5	77.6
Use the methods of research in your field to gain new knowledge.	43.6	44.8	88.4	44.9	43.8	88.7	25.9	56	81.9
Use information available from sources such as books, journals, etc.	44.3	44	88.3	48.7	41.4	90.1	27	54.2	81.2
Use the skills and technologies of your field to complete a major project/ assignment.	52.7	40.5	93.2	53.4	39.8	93.2	28.6	56.1	84.7

This could indicate that students perceive that other (non-listed) technologies impact their study. It could also imply that there is a difference in their perception in the usefulness of technology at the course level, as compared to their general learning.

Conclusion: Data shows that students perceived that technology helped them learn better in each of the LITRE defined areas of learning, problem solving, empirical inquiry, research from sources and performance. The higher positive ratings from seniors could be because they have a better defined sense of “field” of study and that the upper level courses directly relate to their major.

LITRE EXECUTIVE COUNCIL RECOMMENDATIONS

In keeping with LITRE’s fundamental purpose to introduce and test innovations, and then to use the results to improve the university, the LITRE Executive Council offers the following observations and recommendations.

1. At every level, the university should couple its investments in technology (e.g., ClassTech, ETF, VCL, etc.) with opportunities for faculty development in pedagogy, incentives and rewards for innovative teaching, and reliable operational support. Failure to provide any one of these three key elements can significantly reduce the return on an investment in technology alone.
2. Accordingly, these principles should be used to enhance the allocation of technology resources (e.g. ClassTech, ETF, VCL, etc.) Proposals for resources should address not only the technology to be deployed, but also their potential for improving student learning and how faculty development, operational support, and faculty incentives and rewards will be provided.
3. Pedagogical support provided by the colleges, and by the university through DELTA and other units may be more effective and efficient if priority is given to faculty working in groups, rather than as individuals. NC State has benefited from many successful learning communities focused on using technology innovatively to address a pedagogical challenge, such as COE’s laptop initiative, Scale-Up, the professional writing program in English, and the large class redesign project. Investments in pedagogy might return a greater investment if:
 - a. They focus on improving student learning outcomes in courses with the greatest impact, either because they are taken by large numbers of students (such as English composition) or because they serve as gateways to many programs (such as calculus) or
 - b. they focus on courses taught by a specific group of instructors (such as graduate teaching assistants) or
 - c. they focus on development of technologies used in courses that are taught in series, for example the current experiment in Engineering computing which tracks students performance through four years of sequential courses in selected engineering programs.
4. As NC State increases it’s hiring of faculty members new to the professoriate, we can expect both faculty and students with a greater willingness to experiment with technology. NC State should take advantage of this strategic opportunity by providing more incentives and rewards for documented educational technology innovation. Giving a faculty member time to redesign via course buy-outs, especially when coupled with recognition through RPT, may provide a very high rate of return.
5. LITRE demonstrates that assessment results can be used to inform important decisions relative to NC State’s investments in learning technologies and that it is essential to assess the impact on student learning of major deployments of learning technology. Therefore, whenever possible, technology investments should develop evidence of student learning effectiveness (e.g., ClassTech, ETF, VCL, etc.) We can’t afford to misuse this expensive, but critical, strategic resource.

6. LITRE expands NC State's focus on improving learning and teaching in our own courses and programs. The next step is to translate the lessons learned in LITRE and the larger academic community into a culture shift at NC State. To accomplish this transformation we need to both institutionalize the gains and insights from LITRE and continue LITRE's research mission. The first actions should include: 1) the development of a continuing program to disseminate LITRE related findings and 2) the establishment of a research program to support faculty led investigations of learning technology impacts.
7. The institutionalization of LITRE functions is strongly recommended by the LITRE Advisory board. As conversations are underway to determine the role a vision for a new Center for Faculty Development or similar body, it is recommended that such a center house a LITRE like body responsible for:
 - a) Providing support for faculty in doing Educational Research in their discipline.
 - b) Providing a database of literature on best practices regarding the use of technology.
 - c) Dissemination of results of educational research.
8. Dissemination of LITRE findings, both within and outside the campus should be made a priority.

LITRE's first phase was devoted largely to stimulating innovation through dozens of small grants. Its second phase is focused on learning what we can through fewer, larger projects. Perhaps in the third phase, LITRE will center on applying what we have learned via the set of above recommendations. LITRE should move to a Phase III implemented within a more permanent administrative structure (perhaps a redesigned FTCL) and should continue funding projects with a strong assessment component (maybe a combination of small and large efforts).

APPENDIX A: Summary of LITRE activities 2006-2007

LITRE Report Framework

Based on the perceived need in the previous year and the recommendation of the LITRE Executive Council, the LITRE Assessment Committee (LAC) developed a framework to improve assessment and reporting. This detailed report framework provides Principal Investigators with a guide to use in designing the pedagogical and assessment components of their projects and a tool for organizing and presenting project reports.

This framework has already proven to be a valuable resource as:

- a) LITRE second phase project proposals were submitted in this format, making obtaining and comparing relevant information much easier,
- b) LITRE second phase PI's will be using this framework as the format for submitting their final reports, and
- c) the framework was sent to the faculty who had previously received small grants and not yet submitted their final reports as a suggested submission format. Several faculty have used this format, making the summarizing and compiling of a final report more effective.

Student Learning Tool Kit

The LITRE Student Learning Task Force,³ a committee of NC State faculty members and assessment professionals, developed a collection of tools and resources to facilitate research in the area of student learning. A growing collection of assessment and evaluation tools and methods is presented, with annotation and background provided, to allow the reader to make informed choices to meet their assessment needs. The tools and methods focus specifically on student learning and the areas of problem solving/critical thinking, research from sources, empirical inquiry and performance.

An effort has been made to:

- Include both qualitative and quantitative tools.
- Allow for flexibility of use across disciplines.
- Be adaptable to fit diverse learning environments.
- Include multiple methods for the same task.

The tool kit can be accessed at http://litre.ncsu.edu/sltoolkit/LITRE_Toolkit_final.htm

Phase 2 Big Projects

Selection Process

The process to select on-going, high impact projects for the LITRE Phase 2 effort was extensive and successful. It was initiated in the spring and summer of 2006 with a series of meetings among LITRE staff and faculty to establish the criteria for project selection and to develop the mechanisms for project solicitation and selection. The resulting criteria were:

Required Criteria

- Focus on student learning.
- Be potentially transformative to undergraduate education at NC State.
- Address the interrelationship between pedagogy, technology and learning. Projects must research and specify change in pedagogy.
- Investigate and assess one or more of the four student learning outcomes specified in the LITRE plan. (Problem solving, Empirical inquiry, Research from sources, and Performance.)
- Use the LITRE framework when developing the project goals and assessments.
- Have extensive faculty engagement.
- Write yearly reports, during summer, that focus on impact of student learning.
- Completed within 18-20 month and be fully implemented beginning Fall 2007.

Preferred criteria:

- Include faculty from a variety of disciplines.
- Follow-up on one or more themes identified from first phase of LITRE.
- Build on currently successful initiatives.
- Be based on technology already deployed or in use.

Due to the focus on learning assessment, the selected projects had to be already in place on campus and the proposal solicitation process was limited to existing projects identified by leaders of the campus communities. A list of potential projects was compiled by contacting all the campus groups involved in undergraduate and graduate instruction and inviting proposals from the identified project leaders.

The first step in the process was the establishment of the LITRE Advisory Board. The board is made up of appropriately involved faculty and staff from each of the Colleges and major administrative units. Membership nominations for the Board were solicited from the Deans and Program Directors (DELTA, FCLL, NCSU Libraries, UPA, and the Graduate School). The Board was established in fall 2006 with Dr. Devine of the LITRE Executive Council appointed as chair. This Board's initial task was to provide oversight for project identification and selection.

The solicitation process started with presentations to the: 1) Deans Council, 2) Council of Associate Deans for Instruction, 3) IT Directors Council, and the 4) LITRE Advisory Board. Each of these groups were asked to provide names of faculty or staff who were leading innovative and successful student learning initiatives and that might be interested in supported assessment research. LITRE then sponsored a daylong workshop for these leaders with the intent of identifying potential initiatives for Phase II projects.

The potential project list that emanated from the solicitations and the workshop was compiled in early winter 2007 and became the proposal solicitation list for Phase II. Dr. Soni and Dr. Devine then worked with each of these potential PIs to develop fourteen proposals that were the set from which the funded projects were selected.

The fourteen proposals were presented to the LITRE Advisory Board in late spring 2007 for their suggestions and comments. The LITRE Executive Council Executive then selected three (3) projects based on their potential relative to the selection criteria above and the \$80,000 per year total LITRE budget limit. This selection was completed in May 2007 and presented to the Provost for his approval. The three (3) projects were all started in June 2007 and a preliminary report to the LITRE Advisory Board is scheduled for November 2007.

The Projects

1. **Thoroughly Modern MILLIE" (Methods of Incorporating the Latest Learning Innovations in Education)** (Robert Beichner) seeks to update the traditional lecture/lab-based university course and take advantage of recent advances in instructional technology and pedagogies. Videos, pod casts etc. and the textbook will supply the bulk of new material presentation. Faculty will be shifted from the lecture hall podium and placed into smaller settings where they can spend their class time helping students work through the more difficult content and motivating them to learn more. Faculty will still work with the same number of students and for the same total number of hours, but instead of talking at 100 students three hours per week; they will talk with 33 students during three different hour-long sessions. The course will have students performing the following:
 - Watching** on-demand videos that will replicate, as much as possible, one-on-one tutoring and then expand upon that model.
 - Talking** to each other and a faculty member in small discussion sections.
 - Doing** hands-on activities in a SCALE-UP like setting, guided by graduate TAs.
 - Practicing** complex problem solving skills in teams and individually.
 - Reading** a textbook with the most modern physics content available.
 - Demonstrating** their understanding through regular quizzes and exams.

This project adapts an existing course, PY205, Introductory Physics for Scientists and Engineers 1, (this course has already been the subject of considerable reform in SCALE-UP, Dr. Beichner's nationally and internationally adopted project). In depth assessment of impact on learning will be conducted.

2. **Computer Based Modeling for Engineering:** (Amy Craig, Jan Genzer, Jeff Joines, Dianne Raubenheimer and Stephen Roberts)

The primary objectives of the project are to examine how to develop students' problem solving and computational skills early in their course of study and to further enhance their skills by building upon critical computing concepts semester after semester. The project stems from the new introductory computer-based modeling courses that were created in several engineering departments at NCSU. The focus of these courses are to educate students to model problems relevant to their specific engineering discipline, solve these problems using modeling tools (using a range of software platforms, including VBA for applications), and then to analyze the solutions through decision support (i.e., become "power users" not programmers). Additional engineering departments at NCSU are interested in initiating similar introductory courses in their programs, building on the experiences of other disciplines that already have changed their curricula.

Another focus is to develop plans for integrating computational tools beyond the introductory computer-based modeling courses. To achieve this, several initiatives are underway; for example the creation of an online faculty repository to house newly developed, discipline-specific, problems that reiterate particular computational skills at subsequent levels in the program curricula (level 200, 300 and 400 courses).

Numerous forms of assessments of student learning and problem solving are being undertaken. The problem-solving framework developed by Woolcott (2006) will be used to frame the assessment work. Students complete surveys, problem solving tasks and reflective assignments to elicit reflection on their level of engagement with the task, approach to problem solving, and approach to modeling. The problem-solving task responses and reflections will be examined for emerging themes and trends, and also scored using a rubric.

3. **Virtual Online Learning and Teaching (VOLT)** Len Annetta has harnessed the video game medium in learning contexts among undergraduate students in science education and graduate students in science education, Adult and Higher Education, and Business Management. VOLT is impacting a diverse student population spanning the two aforementioned colleges and three program areas. Through the modification of a commercial MMO gaming engine, Dr. Annetta and his VOLT team designed and created an online, synchronous 3D virtual environment for distance learning courses offered at North Carolina State University. VOLT uses a case based design where students enrolled in distance classes can interact with each other, their instructor and computerized agents in missions that derive from real case studies. It is the goal of VOLT to engage online learners in synchronous interaction, immerse them in virtual worlds where they need to solve problems, and allow them to take on epistemic roles that will better prepare them for real-world problems they might encounter after earning a degree.

For more details on the three projects, see <http://litre.ncsu.edu/dfiles/Big3.html>

LITRE Small Faculty Grants Program

To date, 41 grants have been awarded to faculty. (For a complete list and description of grants see <http://litre.ncsu.edu/dfiles/funded2005.html> and <http://litre.ncsu.edu/dfiles/funded.html>.) As in the previous year, this year the LITRE Assessment Committee (LAC) reviewed available reports from the

Principal Investigators of the LITRE-sponsored projects and wrote a synthesis of these grantees' report (see LITRE Assessment Committee Annual 2007 Annual report).

This year findings from twelve final reports and two progress reports from the LITRE grants were analyzed.

Five themes that showed how students used technology to improve their learning emerged:

- Technology enhanced student learning through visualizations, simulations and enriched content material.
- Communication/Collaboration Among Peers, Peers and Experts Increased Interaction, Feedback and enhanced Student Learning.
- Technology motivated and stimulated student engagement with material and thus influenced student learning.
- Technology stimulated students' engagement with learning material and as a result students learned more.
- Accessibility to learning materials and exposure to cutting edge technologies is increased.

The report by the LAC also identified important lessons learned about teaching with technology. The report noted that:

- Pedagogy is of vital importance. Technology itself does not directly influence learning, pedagogical strategies enabled by technology do.
- Functional aspects of technology are important: Infrastructure, support and time investment are crucial. Perceived usability and liking of the technology may have an impact on the effect on learning.
- Attitude towards technology is crucial determinant of effectiveness and use.

The LAC report also documented some effective teaching with technology practices.

Finally the LAC made a series of recommendations to:

1. Disseminate results around campus.
 - Share best practices with faculty senate and encourage faculty to include best practices in their courses.
 - Suggest that the Provost write an email to all faculty pointing to the results on the LITRE websites and the reports.
 - Ask that TA training, graduate student training, COAT's training etc., integrate these themes into their training.
 - Present findings to associate deans (and encourage people to let us know about "technology related projects).
 - Get on the agenda of the technology committees of the colleges/departments.
 - Expand website to showcase different pedagogical strategies incorporating technology.
2. Encourage faculty development groups to promote workshops on collaboration, visualization, and content enrichment.
3. Create an avenue where faculty members present: "This is how I make education 'fun' for my students. (This could come out of the next three (3) projects that are heavily tied into student engagement.)

4. Provide information to the Provost and the Associate Vice Chancellor for facilities, as they make technology-funding decisions. Influence technology investments based on research.
5. Recommend that resources go to pedagogy/faculty development.

LITRE Technology Practices Directory

Discussions during the early stages of LITRE implementation showed a need to know more about what faculty were doing with technology at NC State University and to assemble an inventory of current NC State projects in which faculty are using technology to improve teaching and learning. The LITRE Technology Practices Directory was developed to gather this information.

The directory was developed during summer of 2006 and early fall 2007, and has been operational since November 2006. It is a fully searchable online database that lists innovative technology-enhanced teaching practices by faculty. Dr. Kevin Oliver, assistant professor in the College of Education provided the overall pedagogical framework for the directory and with Dr. Joni Spurlin, Dr. Geetanjali Soni and Dr. Nancy Whelchel from University Planning and Analysis, designed the directory. Programmers from DELTA developed the directory.

This database is open to all NC State staff and faculty. Faculty can create an account in the directory, list one or more courses they teach, and then outline how they use specific technologies in those courses. It is also hoped that the directory will be used by faculty to identify colleagues with whom to collaborate on technology-based projects. Deans and department heads will be able to use the directory to illustrate innovative teaching practices. Students can use it to see what technology may be incorporated in courses they are planning to take, and policy makers can use it to identify promising ideas and investments. Units like FCTL and Delta will be able to use the directory to identify topics and pull together groups of faculty for further discussions and projects.

Other Campus LITRE Related Projects

As a part of LITRE we are also attempting to gather information of other projects on campus that incorporate technology for the enhancement of teaching and learning. Information on projects was solicited from the LITRE advisory board, gathered through the efforts of the LITRE faculty representative, and through various other means. Some projects and faculty who are involved with innovative educational technology projects include:

- Learning Management Systems (LMS) are widely being used on campus across a variety of disciplines by thousands of students on the NC State campus. For example David Covington and the Professional Writing faculty are using LMS to teach are about 400 students a semester in 20+ sections taking courses like ENG 331 Communication for Engineering and Technology, ENG 332 Communication for Business and Management, and ENG 333 Communication for Science and Research, online. In addition, the approximately 400 students a semester taking these same courses in classroom sections also use LMS as well to supplement classroom activities.
- Dr. Eric Wiebe, in the College of Education, is actively researching the use of the Virtual Computing Laboratory as a universal tool for delivery of computational tools for interactive learning.
- Drs. Anita Flick and Miriam Ferzli, Biological Sciences, and Jason Boccaro, PRTM, are deploying classroom response systems with exceptional effectiveness in both face to face and distance learning environments.

- Dr. Kay Sandberg is doing award-winning work in Chemistry education including very innovative applications of Webassign in her organic chemistry classes. Cooperating with Dr. John Risley and his staff, she has developed interactive techniques for improving student learning of difficult material while keeping the experience engaging and stimulating.
- An outstanding campus-wide project is the “learning spaces” effort underway in all of our campus units. Highlighted by the library’s “learning commons” (directed by Carolyn Argentati and Joe Williams) this program ranges from “Flyspace,” to laptop-enabled classrooms, to experimental teaching laboratories and continues to innovatively expand.

LITRE Survey Data

Background

At NC State, sophomores are surveyed biannually (even-numbered years). Administered by UPA, the survey includes questions about satisfaction with their overall educational experience, faculty contributions to their educational experience, and academic and support services, about campus climate, self-rated knowledge, skills, and development; and their suggestions for improvement. Starting in 2004, questions pertinent to LITRE were added to the survey. LITRE questions were revised for the 2006 survey.

Similarly, seniors graduating in both fall and spring are surveyed every year through a web survey, administered typically as part of the graduation checkout process. This questionnaire is also administered by UPA and has similar questions to the sophomore survey. Questions related to LITRE were added in 2003-2004 and then revised for the following years.

Data is now available for the years 2004-05 and 2005-06.

Summary of Survey Results

Table 1. Technology used IN the classroom or lab: How many courses used each technology

	Senior 2004-05		Senior 2005-06		Sophomore 2006	
	All/Most / Some	Few/None	All/Most/Some	Few/none	All/Most/Some	Few/None
All numbers are percentages						
Static electronic presentations (e.g., PowerPoint).	80.5	19.5	83.7	16.3	78.5	21.5
Electronic presentation of course concepts via animation, multimedia, simulation, etc.	49.4	50.6	50.5	49.5	49.2	50.8
Instructor demonstrations of Web materials (e.g., library resources).	50	50.1	54.0	46.0	45.5	54.5
Computerized exams/quizzes in class or lab.	31.2	68.8	33.5	66.5	38.5	61.5
Use of computer stations for course-specific software (e.g., SPSS, SAS, ALIAS, Design Studio, etc.).	26.3	73.7	25.7	74.3	22.6	77.3
Electronic feedback to the instructor during class via handhelds, pushbuttons, laptops, etc.	16.3	83.7	16.3	83.6	26.3	73.7

Table 2. Technology used IN the classroom or lab: Effect of technology on learning

	Senior 2004-05			Senior 2005-06			Sophomore 2006		
	Learn Better	No diff	Not as well	Learn Better	No diff	Not as well	Learn Better	No diff	Not as well
All numbers are percentages									
Static electronic presentations (e.g., PowerPoint).	50.0	39.9	10.1	54.2	39	6.9	49.3	41.8	8.8
Electronic presentation of course concepts via animation, multimedia, simulation, etc.	56.8	39.8	3.4	56.4	41.4	2.1	54.4	41.8	3.8
Instructor demonstrations of Web materials (e.g., library resources).	45.9	49.8	4.4	42.6	53.8	3.6	39.6	55.2	5.2
Computerized exams/quizzes in class or lab.	27.5	53.6	18.9	24.8	57.3	17.9	30.0	54.1	15.9
Use of computer stations for course-specific software (e.g., SPSS, SAS, ALIAS, Design Studio, etc.).	55.4	39.2	5.4	50.5	42.5	7.0	45.6	46.4	8
Electronic feedback to the instructor during class via handhelds, pushbuttons, laptops, etc.	38.9	52.8	8.2	37	57.5	5.5	39.4	53.1	7.4

Table 3. Use of Technology outside the classroom: How many courses used each technology

	Senior 2004-05		Senior 2005-06		Sophomore 2006	
	All/most/Some	Few/None	All/Most/Some	Few/None	All/Most/Some	Few/None
All numbers are percentages						
Learning management systems (e.g., Wolfware, WebCT).	67.6	32.4	73.5	26.5	70.5	29.5
Electronic communication among students (e.g., email, chat groups, audio/visual conferences).	68.6	31.4	66.7	33.2	54.8	45.2
Electronic communication with the instructor (e.g., email, chat groups, audio/visual conferences).	75.6	24.5	75.5	24.5	63.2	36.7
Work to be submitted electronically.	67.4	32.7	67.6	32.4	74.9	25.1
Work to be prepared with a word processor, spreadsheet, graphic program, etc.	83.5	16.5	82.6	17.3	64.3	35.7
Use of digital content resources (e.g., online articles, digital images, multimedia, databases).	64.7	35.4	65.3	34.7	46.5	53.5
Use of course-specific software (e.g., Maple, SAS, ALIAS, Design Studio, GIS tools, JAVA, etc.) for homework or out-of-class assignments.	36.1	63.9	30.8	69.2	40.2	59.8

Table 4. Use of Technology outside the classroom: Effect of technology on learning

	Senior 2004-05			Senior 2005-06			Sophomore2006		
	Learn Better	No diff	Not as well	Learn Better	No diff	Not as well	Learn Better	No diff	Not as well
All numbers are percentages									
Learning management systems (e.g., Wolfware, WebCT).	38.9	53.6	7.6	37.9	55.1	7.1	37.8	57.1	5.1
Electronic communication among students (e.g., email, chat groups, audio/visual conferences).	46.7	48.9	4.4	43.2	52.7	4.1	46.4	50.7	2.9
Electronic communication with the instructor (e.g., email, chat groups, audio/visual conferences).	52.1	44.5	3.4	49.4	48.4	2.2	50.7	47.3	2
Work to be submitted electronically.	29.1	63.6	7.3	28	66.3	5.7	36.9	54.3	8.7
Work to be prepared with a word processor, spreadsheet, graphic program, etc.	49.5	48.2	2.3	46.4	52.1	1.5	31.7	65.0	3.3
Use of digital content resources (e.g., online articles, digital images, multimedia, databases).	40.8	55	4.2	39.4	55.9	4.7	32.7	62.2	5.1
Use of course-specific software (e.g., Maple, SAS, ALIAS, Design Studio, GIS tools, JAVA, etc.) for homework or out-of-class assignments.	46.2	41.9	11.9	41.2	46.3	12.5	33.3	41.1	25.6

ClassTech

ClassTech services continue to grow on campus with 70 general-purpose classrooms, additional conference rooms and other learning spaces supported during 2006-07. Again, this year ClassTech conducted surveys of its faculty users at the end of the fall and spring semesters. However, the surveys were not as in-depth as in the past several years, focusing primarily on usage of and satisfaction with equipment and services. Respondents' usage patterns remained fairly consistent in fall and spring when compared with spring 2006 results. (Results are online at http://www.ncsu.edu/classtech/survey_results/.)

The lectern computer continues to be used the most frequently, with 66% of spring respondents indicating they used it in all or most all courses and an additional 17% using it at least sometimes. The document camera was again used second most frequently, followed by laptop connections. Even though laptops are widely available, faculty continue to rely on the convenience of the in-room computer.

A growing number of faculty are asking for a way to easily record and distribute the content of their classes. New technology allows the audio and content being projected to be stored, encoded and delivered for re-use and review to enhance student understanding; however, currently-available commercial systems are cost-prohibitive to implement on more than a very limited scale, with some costing up to \$25,000 per room. As consideration is given to teach more courses as a hybrid of face-to-face and online, this resource will likely become more important. A lower-cost solution (~\$1,500/room) was developed and tested in several spaces this year, with a somewhat broader pilot planned for 2007-08.

Another area of growth has been in the usage of classroom response systems, or clickers. Multiple vendors' products have been used on campus and it has become increasingly clear that a campus standard was needed. A campus working group was formed to evaluate systems and in the spring the Classroom Environment Committee and University IT Committee endorsed the group's recommendation to adopt Turning Technologies' Turning Point as the campus standard. The latest Turning technology is being piloted in 2007-08, primarily by PAMS and CALS faculty, for possible broader implementation by campus.

Student Technology Use Focus Group Study

In early 2007 the LITRE Executive Council proposed conducting a focus group study to provide information about students' use of technology at North Carolina State University. This information was sought to inform the process of selection of the second phase LITRE projects. Other objectives for this research was to try and understand what technologies students are using now and anticipating what they will be using in the future to plan for campus computing environments, technology, and technology-services support. Professional staff from technology-support units, instructional technology services, teaching and learning support and university planning services formulated a collaborative team to create questions for the focus groups. Dr. Traci Temple conducted the focus groups, and analyzed and prepared the final report. This report can be found at http://www4.ncsu.edu/~tltemple/student_it_ncsu.pdf. A summary of some of the findings is presented below:

Technologies used for by students for completing coursework and other tasks

- A large percentage of students bring technology such as alarm clocks, DVD players, computer and video games, iPods®, televisions to help with their coursework or for social and recreational purposes. Not all students bring computers to college when they begin their freshman year. These students learn about and discover what technologies to purchase after they have arrived at NC State.
- A majority of students interviewed are satisfied with the hardware and software available for use at NC State.
- They prefer and rely on e-mail to communicate to faculty, and use IM in limited ways to talk with classmates about course assignments and group work.

Student reactions to technologies used by professors for teaching

- Students showed a preference for faculty using document cameras during lecture. Not all instructors could effectively use in-class technology.
- Students indicate that the difficulties they have navigating and using software applications can misrepresent how much they know about a subject. Pedagogical decisions made by faculty who require students to use technology for learning, i.e., MAPLE and classroom response systems (clickers), are not focused on learning course content. Instead, students often tackle a difficult learning curve when using software packages, because of the emphasis on how to use the tool.

Student use of and opinions of campus resources

- Students express satisfaction with the technology resources available at NC State. The Learning Commons, D.H. Hill Library, is mentioned as an often used and popular location for studying, working on group assignments and socializing.
- NC State's Digital Media Lab, Collaboratory, and Flyspace are not as well known and therefore are not used for creating visual media or collaborative work.

Student Experiences with and Preferences for Technologies Used for Teaching and Learning

- Typically, students take basic level online courses because the classes are convenient and needed before enrolling in a higher-level course required for their major. Online courses help students fit classes into their schedules, especially if an in-class course section conflicts with another class or work. They can study where they want, when they want, and with whom they want.
- Students are direct about the difficulties they experienced using Blackboard Vista, and described it as being "adequate" for learning. Because they see its drawbacks outweighing its benefits, students prefer to be in a traditional classroom setting where they can interact with their professors and peers.
- WebAssign—an online system that lets faculty distribute, collect, grade, and record homework assignments online—is popular among students and preferred to Vista. When compared to using MAPLE and clickers, students say they prefer WebAssign for completing homework assignments and taking quizzes.

How Students Learn About New Technology

- Learning about new technology and how to use software applications is determined by students' needs, course requirements and personal interest.
- Students learn how to use technology from peers, friends, and family, as well as using Google® to search the Internet. Programs and workshops offered at NC State that focus on teaching specific software applications are not convenient for students' schedules, the content is too basic, or the events are not publicized in ways students can find the information.
- More freshman entering college are "computer literate," but there is still a significant number of students who do not know how to use common hardware and software needed for their courses. Students interviewed want faculty to include software instruction as a part of their curriculum, especially when students are required to use applications for homework, research papers, graphic design projects, and quizzes.
- Students do rely on the NC State Help Desk to answer technical problems relating to ResNet. Opinions about NC State's Help Desk are generally positive. Students did say that waiting for the Help Desk to reply to a request often takes too long.

Student use of Social and Recreational Technologies

- Students use DVD players, video games, the Internet (Google News®, Wall Street Journal®, YouTube™, Facebook®, etc.), cell phones and iPods® for social and recreational purposes.
- Students check the social networking sites MySpace and Facebook multiple times a day to keep up with what is being discussed by friends and classmates. They prefer these sites remain student-student social spaces and do not want professors using these sites to find information about students or to communicate with individual students. Students prefer to communicate with their professors using email.

Students' Suggestions and Recommendations

- Students use course lecture notes and course materials posted online by their instructor(s) and by other faculty. Students emphasize the benefits of having online access to class lectures to supplement the information they need and help with learning. They would like all departments and professors make course materials available online for classes in which students are not

registered. This will allow them to build upon what they learn and increase the likelihood the transfer of knowledge will span from course to course and from college to their professional careers.

- The term “convenience” and the need for “face-to-face” interaction are reoccurring themes throughout this study. The need and desire for face-to-face interaction with professor and students in a traditional in-class setting is emphasized by a majority of students. Students want their professors to use technology but they do not want technology to drive or dominate how they are taught and how they learn at NC State.
- According to the students interviewed, a moderate use of technology is ideal, providing their instructors are capable of using hardware and software correctly and in ways that engage students in learning.

APPENDIX B: LITRE Grant Reports Used in this Annual Report

Jonathan Allen: Nutritional Analysis Web Site (2007).

http://litre.ncsu.edu/pdf/Allen_Final%20Report2007.pdf

Edward Gehringer: Assessment of Expertiza: A Methodology for Building Reusable Learning Objects Through Peer Review (2007). http://litre.ncsu.edu/pdf/gehringer_Finalreport2007.pdf

Steffen Heber and Brian Howard: Integrating Algorithm Visualization (2007).

http://litre.ncsu.edu/pdf/Heber_ProgressReport%202007%20.pdf

Jennifer Neel, Valarie Pallatto, Carol Grindem and David Bristol: Introduction and Evaluation of Virtual Microscopy in Teaching Veterinary Cytopathology (2007).

<http://litre.ncsu.edu/pdf/NeelFinalReport2007.pdf>

Larry Norris: Curriculum Enhancement: Incorporation of Technology into MA 401 (2004-2006 and 2005-2007). <http://litre.ncsu.edu/pdf/NorrisLITREFinalReport2007.pdf>

Kevin Oliver and Dianne Raubenheimer: Collaborative Online Concept Mapping (2007).

Kara Peters, Eric Klang, Chau Tran: Interactive Modules for Undergraduate Laboratory Preparation (2007). http://litre.ncsu.edu/pdf/Peters_FinalReport2007.pdf

Laura Sremaniak: Computational Chemistry Laboratories II & I (2007).

http://litre.ncsu.edu/pdf/Sremaniak_FinalReport2007.pdf

Jessica Huff, Malina Monaco: Implementing Student Digital Learning Portfolios (2005-2007).

http://litre.ncsu.edu/pdf/Monaco_grable_FinalReport2007.pdf

Fay Cobb Payton: Integrating Wireless laptops in an IT Capstone Classroom (2007).

http://litre.ncsu.edu/pdf/Payton_FinalReport2007_rev8_13_07_.pdf

George Rouskas: Learning with In-class Technology: The 15-Minute Learning Module Approach (2007).

http://litre.ncsu.edu/pdf/Rouskas-Miller_FinalReoprt2007.pdf

Kristin Thoney: Department of Textile and Apparel, Technology and Management (2005-2007).

http://litre.ncsu.edu/pdf/thoney_Finalreport2007.pdf

Other Reports Received But Not Used in This Report, As Assessment Phase is In Progress or to Be Completed Later

John Williams: Immersive Imaging as a Way to Increase Academic Contact with the Collection of NC State's Gallery of Art & Design. <http://litre.ncsu.edu/pdf/WilliamsProgress%20Report2007.pdf>

Other LITRE Projects (Assessment Phase in progress or to be done later)

Pam Arroway and Roger Woodard. Online Computing for Introductory Statistics Courses (2005-2007).

Hanna Gracz: Nuclear Magnetic resonance solution for Chemist, Biochemist and Polymer Scientist (2005-2007).

Murthy Guddati: Development of a Virtual Testing Module for an Undergraduate Course on Materials Design (2005-2008).

Helen Kraus and Anne Spafford: Development Of An On-Line Store To Enhance Student Learning In Up To Four Horticulture Courses (2005-2007).

Emmett Summer: Digital Recording of Large Scale Structural Testing for use in Undergraduate and Graduate Civil Engineering Classrooms (2005-2007).

John Williams: Immersive Imaging as a Way to Increase Academic Contact with the Collection of NC State's Gallery of Art & Design (2005-2007).