

## LITRE EXECUTIVE COUNCIL ANNUAL REPORT FOR 2005-2006

### EXECUTIVE SUMMARY

“Learning in a Technology-Rich Environment” (LITRE) is the subject of NC State’s quality enhancement plan, a requirement for reaffirmation of accreditation in 2004. LITRE is an empirical research project and its ultimate purpose is to improve student learning through a collection of projects in which faculty systematically investigate which aspects of technology are most effective in improving student learning.

In this report, the results of LITRE research to date are synthesized. Lessons learned from the project results available so far indicate how different technologies can best be used to increase student learning. Even though many of these early LITRE projects were on a small scale and the results are exploratory, indicating that more systematic investigation is necessary, this report shares important findings and issues for faculty to consider as they continue to incorporate technology into their teaching. The main findings on the effect of technology on student learning were:

- 1) Technology-enriched curricular content seemed to improve students’ depth of knowledge.
- 2) Technology-enabled visualization of content facilitated learning.
- 3) Technology-enabled communication/collaboration increased valuable feedback, which appeared to improve student performance.
- 4) Technology enabled new, flexible/adaptable learning environments that increased student motivation and engagement.

Additionally, important lessons learned about the LITRE process itself, and findings that have informed the next phase of LITRE are discussed. A brief history of LITRE and descriptions of the 2004-2005 and 2005-2006 LITRE projects are also included.

This report is based on reports from the LITRE Assessment Committee (LAC) on the grants program and from Joni Spurlin, University Director of Assessment, on the First Wave projects and other LITRE-related activities across campus. Those reports were in turn synthesized from available reports from the Principal Investigators of the LITRE-sponsored projects and of other campus projects with purposes similar to LITRE.

LITRE was launched in 2004 with three large first-wave projects and a faculty small-grants program (see <http://litre.ncsu.edu/>) under the leadership of professor Lavon Page and a LITRE Advisory Board. In fall 2006 LITRE moved into its second phase, which will last until fall 2009. For this second phase, a four-member leadership team, the LITRE Executive Council, will guide LITRE. The LITRE Assessment Committee and the LITRE Advisory Board will continue to function with new membership. During this second phase no new faculty grants will be funded. Instead focus will be on: 1) completing the assessment of projects and grants awarded to date, 2) implementing a faculty directory of technology practices that will help faculty network and provide an inventory of campus practices, and 3) choosing and implementing fewer, larger projects that will allow for more informative, reproducible and scalable results about student learning.

Based on the findings in this report, the LITRE Executive Committee recommends: 1) choosing projects for LITRE phase 2 that build on the results of earlier LITRE projects, 2) focusing on 3-5 large projects during the second phase of LITRE (a set of required and preferred criteria for the selection of the large projects is provided), 3) focusing on improving assessment activities and developing a common framework for analysis and reporting of LITRE projects and 4) assisting faculty to build appropriate pedagogical strategies as they relate to technology use, 5) continuing to improve technology support, infrastructure and scheduling, and 6) increasing communication among faculty about their innovative uses of technology.

## INTRODUCTION AND HISTORY

“Learning in a Technology-Rich Environment” (LITRE) is the focus of NC State’s quality enhancement plan. Consistent with the University’s mission “to create an innovative learning environment” the LITRE plan brings a faculty-based, reflective perspective to the University’s strategic planning and policy making related to student learning and learning technology.

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. We will use the results of these investigations to build on our successes, shape future investigations, and inform campus decision-making. LITRE’s overarching goals are:

1. To improve student learning across the University through the use of technology. We will monitor the impact of those 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.

### LITRE First Phase

In 2004, under the leadership of professor Lavon Page and a LITRE Advisory Board, LITRE was launched with three large First-Wave projects and a faculty small grants program. The three First Wave Projects were the G-108 experimental classroom, Flyspace, and ClassTech. Principal Investigators of these projects provided annual reports for 2004-2005 and 2005-2006. Additionally, based on 2004-2005 LITRE findings and endorsed by the LITRE Advisory Board, another observational study of the ClassTech Project was conducted during 2005-2006.

The faculty grants program awarded grants of \$2000 to \$10,000 to faculty to help implement innovative technology. To date, 41 grants have been awarded. (For a complete list and description of grants see <http://litre.ncsu.edu/dfiles/funded2005.html> and <http://litre.ncsu.edu/dfiles/funded.html>.) Each grant project applied new or existing technology in or outside the classroom, and included a plan to assess student learning. Reports from these First Wave Projects and the grants program are available on the LITRE website <http://litre.ncsu.edu/>. Findings from these LITRE projects are summarized in Appendix A. (A fuller description can be found in the LITRE Assessment Committee Report and the First Wave Projects Report- <http://litre.ncsu.edu/dfiles/reports.html>)

A review of assessment results identified some difficulties with implementing the LITRE plan as intended. Some of the grant projects were too small to assess learning effectively, some assessment plans were difficult to implement within the grant year, and LITRE did not have enough resources to support assessment activities. All the same, in its first phase LITRE was very successful in stimulating innovations and in exploring fundamental lessons about assessing student learning.

## **LITRE Second Phase**

Beginning fall 2006, LITRE moved into its second phase. For now, LITRE will not fund any new faculty grants. Instead, the second phase will build on what we've done so far by: 1) completing the assessment of projects and grants awarded to date, 2) disseminating an overview of findings about student learning outcomes, 3) assembling and implementing a faculty directory of technology practices for the whole campus, and 4) choosing a few large projects with substantial merit that will allow for informative results about student learning.

For this second phase, LITRE will be guided by a leadership team, the LITRE Executive Council, consisting of four members: Alton Banks, Director of Faculty Center for Teaching and Learning, Tom Miller, Vice Provost of DELTA, Karen Helm, Director of University Planning & Analysis, and Hugh Devine, professor in Parks Recreation and Tourism Management. A full-time Coordinator of LITRE Assessment, Geetanjali Soni, will focus on assessment. The LITRE Assessment Committee and the LITRE Advisory Board will continue to function with new membership.

## **LESSONS LEARNED TO DATE**

LITRE project results to date have shown that many different technologies can be used to increase student learning and motivation. Faculty across the campus are encouraged to use what has been learned through LITRE as they continue to integrate technology into their teaching. Administrators are urged to consider results as they make technology related decisions. Although, results were gleaned from several LITRE projects, for brevity's sake, only a few examples of projects are cited below.

### **I. LESSONS LEARNED ABOUT STUDENT LEARNING AND TECHNOLOGY**

#### **Lesson 1: Technology-enriched curricular content seemed to improve students' depth of knowledge.**

Many projects demonstrated the use of technology to provide students with additional information that they could not acquire easily. Technology can be used to develop richer context and content for learning through the use of multimedia, providing material outside the standard textbook, providing real-world data, etc. By having more content and richer context, the students learned more and were able to apply knowledge in more detail and in greater depth.

For example, Dr. Bykova created a web-based hypertext of Hegel's work, with links to explain Hegel's terminology, clarify important philosophical concepts and ideas, explicate his references to other thinkers, sources, or theories etc., to give philosophy students more information. Dr. Kramer & Dr. Arnold used the music clips, and audio and video media in online music courses and Dr. Fitzpatrick developed web-based archives that incorporated multimedia inquiry-based assignments for his archaeology courses.

Results from these projects showed that students learned more and increased their ability to apply knowledge to produce their own interpretations of the materials. Dr. Fitzpatrick's students for e.g. reported that the archives "made ... abstract concepts more intelligible."

#### **Lesson 2: Technology-enabled visualization of content facilitated learning.**

Technology allows students to visualize the material in new ways. Faculty found that access to Internet, simulations, or use of concept maps enabled students to represent material in new ways. Students were better able to visualize the material and showed that they learned the required content.

For example Dr. Norris used Maple software in class for visualization and animation of mathematical functions and demonstrated how it enabled students to perform the many complex computations. Dr.

Niedzlek-Feaver developed two web simulations in zoology, “Interactive Pedigrees” and “DNA fingerprints” within a Interactive Biology website to help students model or simulate the complex issues like the inheritance of a genetic disease and DNA banding patterns.

**Lesson 3: Technology-enabled communication/collaboration increased valuable feedback, which appeared to improve student performance.**

Technology was used by students in ways that lead to communication and collaboration with their peers and with experts in their field of learning. This gave students feedback on their learning and allowed them to practice critiquing others. Dr. Brock, for example, demonstrated how setting up a graphic design portal to supplement graduate and undergraduate courses in the College of Design enhanced learning by allowing students to interact with others within the NC State design community and external audiences such as guest critics, design specialists, and alumni in the US and abroad. This provided invaluable feedback, project evaluation and ongoing dialog. In another example of technology enhanced collaboration, Dr. Gehringer developed Expertiza, a suite of applications in which 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.

**Lesson 4: Technology enabled new, flexible/adaptable learning environments that increased student motivation and engagement.**

Technology can enhance student learning by providing them access to more accessible, convenient learning environments.

For example Dr. Neel incorporated the use of a virtual microscopy system, with virtual slides in two veterinary courses. Virtual slides offer students the convenience of studying from slides from a computer, without making the trip to the lab. Student surveys indicated that 80% of students said that they would spend moderately to significantly more time than they already spend studying slides, if virtual slides were available for studying. Similarly, Dr. Ames & Dr. Williams, faculty in social work, used video of two home visits and ancillary teaching materials to create a means to systematically take students through a home visit: preparation for the visit, “walking” through the home, assessing the hazards encountered, and documenting observations, virtually. Taking all students in the class to a home visit would not be possible ethically or logistically

Dr. Carrie Thomas demonstrated the effectiveness of using wireless-laptops and flexible configuration of the lab by using moveable tables for the creation of new learning spaces. Geology laboratory exercises frequently involve water and rocks, which are incompatible with computer use. Classes would meet in the lab and file back and forth to the computer lab as needed. The use of wireless laptops and moveable tables permitted more diverse laboratory use, allowing for on-the-fly changes as the students worked with different media.

## **II. LESSONS LEARNED ABOUT TEACHING WITH TECHNOLOGY**

LITRE projects have shown that learning and teaching in a technology rich environment involves a complex interaction of many variables. The effect of technology on student learning cannot be isolated but needs to be investigated within the context of curriculum, pedagogy, learner characteristics, etc. We have learned that in order for technology to have a positive impact on student learning, teaching must include attentive consideration of pedagogical and learning principles. For faculty to be able to exploit technology’s potential they must first determine what the student learning outcomes or learning goals are, examine their own pedagogical practices, understand their students’ characteristics, question how technology would affect their pedagogy or teaching and then ponder the extremely important question of how they would determine if indeed technology use had achieved the desired goals.

## **Lesson 1: LITRE results suggest that the greatest gains in student learning occur when faculty actively considered or modified their pedagogical strategies.**

Many of the faculty indicated that their pedagogy was changed when they used the technology in the classroom or because students were using technology outside of the classroom. Dr. Susan Katz, for example, noted that the use of online modules and WebCT discussion and quiz tools created for her business communications class allowed students to spend class time in a computer classroom practicing writing (as opposed to the use of class time to present content). This allowed her to give immediate feedback, answer questions, guide students to more appropriate composing behaviors, identify where students were having problems, and act as a “master craftsman” more like in a composition “workshop.”

Drs. Black, Niedzlek-Feaver and Brizuela noted that access to the Internet in biology courses was useful for increasing active and collaborative learning during class. (However, Palm PDA's, used in the project, were not found to be adequate and they recommended that low-end laptop computers be used in the future.) The faculty increased the use of active-learning exercises and the students could make concept maps, locate articles and images on the Internet, write essays, and taking on-line quizzes etc., activities that stimulated critical thinking skills and collaborative learning.

Dr. Sremaniak noted the effectiveness of the two online courses she developed (Computational Chemistry laboratory I and II). The students were given assignments where it was not immediately obvious what they were going to have to do. They had to figure out how to set up a given calculation to return the necessary results to analyze a particular problem or answer a particular question. Technology allowed these to be structured as set up as inquiry-guided courses, which was different pedagogy from the instructor's earlier lecture-based courses.

## **Lesson 2: Infrastructure and support are critical.**

Functional aspects of technology are important. When technology did not function, or was hard to install or access, faculty and students show increased frustration. LITRE projects have demonstrated that without support in terms of training and technology maintenance and support, faculty and students can be frustrated in their attempts to integrate technology in their teaching and learning.

It was also clear that improving the scheduling process for classrooms with technology (ClassTech or other) is a critical issue for faculty. Faculty need to know they will have access to equipment on a consistent basis, prior to making commitment to use technology in the classroom.

## **Lesson 3: Technology use needs time investment and requires university recognition and reward.**

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. When planning such innovations, time, support and resources need to be adequately allocated. Across campus a culture change is needed. Faculty, staff and administrators need to realize that investment of time is ongoing, technology itself changes rapidly, leading to the need for ongoing training as well as content development. Additionally, faculty face a sense of losing autonomy in the classroom as support for technology set-up and maintenance is usually in the hand of others. Many faculty also indicated that time spent on improving instruction and learning new or upgraded technology that will improve learning is not adequately rewarded.

## **Examples of Effective use of Technology in Teaching**

The bullets below point out some *specific* strategies that faculty found worked well in the technology-enriched environments they taught in. They are intended to help others as they design their own learning/teaching environments.

- Insistent **prompts** need to be given **in order to get students to use embedded technology** enrichment material in a course. (Arnold & Kramer)

- **Navigation** within technology based course content is vital and needs to be planned. Students tend to get lost in information. (Bykova, Arnold & Kramer) Suggestions for avoiding this problem include using a navigational framework or an index.
- **Students need orientation to a new technology.** Clear instructions on how to use the technology and what to do when it does not work are recommended. (Arnold & Kramer)
- **Technology can be a motivator** for student learning, positive attitude towards technology, ‘fun’ aspect. (Fitzpatrick)
- **Technology can foster collaboration, communication and peer learning.** Examples of successful collaboration were:
  - Students working in pairs on PDA’s (Black, Niedzlek-Feaver & Brizuela)
  - Using the web and blogs to build a “community of practice” with students, alumni, external faculty and students, professionals etc. (Brock). Benefits include using the site for peer assessment and feedback, as a research tool.
- **Assessment of student use and learning can be used to get feedback** to improve learning modules or learning/teaching technology and pedagogical practices. (Katz, Fitzpatrick, Bykova, Gehringer)
- **It is vital to model a safe and open environment when building a collaborative community, discussion forum, or other virtual group.** “Students who have found that sharing their thoughts comes without penalty or embarrassment are those who maintain and build online community.” Integrating online dialog early, not linking participation to grades, and keeping managing faculty engagement online to a minimum have shown to be healthy ways of maintaining the site. Certainly faculty presence online (should not be) excluded ...(but) kept to a minimum... (Brock)

### III. LESSONS LEARNED ABOUT THE LITRE PROCESS

Along with lessons learned about teaching and learning with technology, LITRE findings to date have also taught us a few lessons about the process of LITRE itself. As an example of how assessment results can be used for decision-making, data from LITRE is being used to inform the next phase of the project.

Though LITRE’s overarching goals remain the same, results from the projects so far have clearly demonstrated that our first approach to understand the impact of technology and student learning suffered from some limitations. From the LITRE small grants program, as well as the First Wave projects, we have learned some important lessons.

#### **Lesson 1: In order to make results replicable and generalizable, rigorous assessment is crucial.**

We have learned that for LITRE’s research purposes, the variable “student learning” needs to be clearly defined and measurable. To improve our ability to synthesize and learn from the results of LITRE projects, a common assessment framework needs to be developed. Assessment of LITRE projects has shown that learning and teaching in a technology rich environment involves a complex interaction of many variables. The effect of technology on student learning cannot be isolated but needs to be investigated within the context of curriculum, pedagogy, learner characteristics, etc. Accordingly, a rigorous assessment would involve interactions among a complex set of variables.

**Lesson 2: Faculty involvement is key to successful assessment.** Successful projects need to be led by the faculty members responsible for the courses that are a part of the LITRE projects. Without commitment by faculty the focus is usually on technology and not teaching or learning.

#### **Lesson 3: In order to make results replicable, scalable, and generalizable, larger projects affecting a substantial number of students are needed.**

Whereas the small grants have brought some interesting issues regarding technology and learning into focus, to be able to extend these findings, and use the results of our investigations to scale our successes, a systematic investigation of the chosen areas of investigation needs to be undertaken.

## STRATEGIC INITIATIVES

Based on the lessons we have learned from the successes and limitations of projects to date, the LITRE Executive Council has adopted the following strategic initiatives to move LITRE into its 2<sup>nd</sup> phase:

### **Initiative 1: Build on the results of LITRE Phase I projects by incorporating lessons learned to date into future projects.**

Both the First Wave results as well as results from LITRE grants indicated broad themes about the effect of technology on learning. The first two rounds of small, individual grants to faculty provided an opportunity to introduce and implement varied technologies in varied settings. Following up these smaller projects by focusing on a few large-scale projects would allow for more in depth and systematic assessment of student learning as well as assessment over a longer period of time. The LEC recommends further investigation of these themes:

- Enriched content led to increased knowledge.
- Visualization of material facilitated student learning of the material.
- Communication/collaboration among peers and experts increased learning and feedback on student learning.
- Technology enabled new, flexible/adaptable learning environments that increased student motivation and engagement.

**Initiative 2: Focus on 3-5 large LITRE projects in the second wave of LITRE:** Based on last year's and this year's findings, we recommend focusing on 3-5 large projects that would be chosen and designed during 2006-2007 and implemented during 2007-2009. This will allow for in depth, systematic assessment, with a large sample of students, which will hopefully provide results that are reproducible and scaleable. Hugh Devine, faculty representative on LITRE Executive Council, would coordinate these projects and Geetanjali Soni and the LITRE Assessment Committee would support the assessment activities of these projects. Additionally, we may have initially oversimplified the LITRE hypothesis – that technology can be used effectively to improve student learning. We cannot really assess the impact of technology alone on learning. In reality, learning occurs in complex environments where variable like pedagogy, curriculum, learner characteristics, etc. interact with technology. Required and preferred criteria for selection of these large projects are listed below.

Selected projects must:

#### **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.

**Initiative 3: Improve assessment activities.** The LITRE Assessment Committee should develop a framework to improve assessment and reporting. For example, LITRE could use a framework based on the one developed for the ClassTech project. This framework would contain an outline (much like a grant proposal does) for Principal Investigators to use as a guide in designing their pedagogical and assessment component as well as a tool for organizing and presenting project reports. Additionally, as mentioned earlier, improved learning results from positive interactions among technology, pedagogy, and the students' use of the technology. Accordingly, a rigorous assessment would involve interactions among a more complex set of variables.

**Initiative 4: Help faculty increase their pedagogical strategies repertoire.**

LITRE projects have shown that student learning was increased the most when teaching and learning with technology included attentive consideration of pedagogical and learning principles. FCTL and DELTA are both focused on working with faculty related to pedagogical issues and it is recommended they continue to work with faculty to build pedagogical strategies that relate to technology use and to assist faculty reexamine their pedagogy in light of how technology can enhance teaching and learning. It would be beneficial to ongoing LITRE activities, if assessment follow-up of the faculty who use FCTL and LTS services could be reported to LITRE Assessment Committee, and vice-versa, periodically.

**Initiative 5: Continue to advocate for technology support, infrastructure, training and scheduling.**

LITRE projects have demonstrated that without support in terms of training and technology maintenance and support, faculty and students can be frustrated in their attempts to integrate technology in their teaching and learning. It was also clear that improving the scheduling process for classrooms with technology (ClassTech or other) is a critical issue for faculty. Faculty need to know they will have access to equipment on a consistent basis, prior to making commitment to use technology in the classroom

**Initiative 6: Increase communication among faculty about their innovative uses of technology.**

Showcasing LITRE results across campus would help both disseminate findings from LITRE projects as well as help build a community of practice. This can be achieved by a) distributing this report, b) encouraging the use of the Technology Practices Database and, c) an EdTech-like showcase.

## APPENDIX A

### SUMMARY OF LITRE ACTIVITIES 2004-2006

#### First Wave Projects

The LITRE First Wave Projects were a) G-108, an experimental classroom where instructors develop and test new instructional models, b) Flyspace/Collaboratory, well-equipped, technology-enabled workspaces for student group projects, and c) ClassTech, classrooms fully equipped state-of-the art technologies. (For details, see the First Wave Report that summarizing the findings of PIs of the projects.) Following is a synopsis of the impact of these technologies on student learning.

During 2004-2005, much of the investigators' initial effort on the First Wave projects focused on installing the technology and developing the infrastructure. The PIs of the First Wave projects made tremendous progress with implementing their projects and developing the technology infrastructure including equipment and technical support for faculty. During 2004-2006 much of the research consisted of usage information and user surveys.

G-108: G-108 illustrated the importance of technology support staff in ensuring successful teaching and learning in sophisticated classrooms. This project resulted in a recommendation that a clear policy or service level agreement be approved by all those using and supporting these classrooms, including faculty, IT support, department heads and deans G-108 project was a LITRE project only during 2004-2005.

Flyspace/Collaboratory: Even though student learning was not directly assessed, all involved consider the Flyspace/Collaboratory spaces a valuable service for students. This project has elicited enough interest to affect the design of new buildings on campus. The College of Natural Resources has adopted the design for a similar space for their use. These spaces are an exciting innovation but should not be continued as LITRE projects after 2006 because of inability to find faculty to help investigate the impact on student learning.

ClassTech: The number of ClassTech designed classrooms increased from zero rooms in Fall 2003 to 12 in spring 2004, then to 20 for fall 2004, 54 in fall 2005, and to 70 by spring 2007. Assessment results from surveys showed that most faculty found the equipment essential or important for their teaching. Computer-projection was used most frequently, followed by the document camera, laptop input, DVD/VCR player and overhead transparency projector. There was an increase in the use of the computer from 41% in the spring 2004 survey up to 64% in spring 2006. The importance faculty place on a particular type of technology was highly correlated to how often that equipment was used. Assessment showed many important issues but in summary the main findings were:

- The faculty in the ClassTech classrooms used technology primarily to communicate information to students using non-static multimedia, and secondly to access data from the Internet or their own websites. In the opinion of the Classtech assessment team, faculty are not exhibiting teaching or learning methods that reflect best use of this space. The learning examples and observations indicate that students are learning at least the basic course content. The faculty are facilitating learning by increasing student involvement, covering material in greater depth, accommodating different learning styles, and enhancing visualization of concepts.
- There seems to be reluctance on the part of some faculty to invest time and energy in preparing material for use in multimedia classrooms because of uncertainty about whether these spaces or similar technology would consistently be available for their use.

On the basis of assessment findings, the following recommendations were made:

- Improve scheduling of technology-equipped classrooms. Faculty need to know they will have access to equipment on a consistent basis, prior to making commitment to use technology in the classroom.

- Considerations when developing learning/teaching spaces should move beyond asking, “What do faculty want to be able to do in this space?” and look into the question of “What should students be able to know and do at the end of the course/curriculum?”
- Increase faculty pedagogical strategies repertoire. Projects have shown that student learning increased the most when teaching and learning with technology included attentive consideration of pedagogical and learning principles.

### **LITRE 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>.) 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 report). Although the assessment activities in the grant projects varied in quality and depth, several themes have emerged that show how students use technology to improve their learning.

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

- a) Enriched content led to increased knowledge.
- b) Visualization of material facilitated student learning of the material.
- c) Communication/collaboration among peers and experts increased learning and feedback on student learning.
- d) Motivation for learning increased with more technology usage.
- e) Technology stimulated students’ engagement with learning material and as a result students learned more.
- f) Other benefits of technology were easier, cheaper access and student exposure to innovative technology.

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

- a) Faculty pedagogical strategies and technology use was interdependent and interactive. Many of the faculty indicated that their pedagogy was changed when they used the technology in the classroom or because students were using technology outside of the classroom. It was noted that when faculty teaching included attentive consideration of pedagogical and learning principles student learning was increased.
- b) Functional aspects of technology are important. Infrastructure and support is critical. When technology did not function, faculty and students show increased frustrations.
- c) Many faculty also 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. Many faculty members mentioned in discussions across campus, that time spent on improving instruction and learning new technology is not adequately rewarded.

The LAC report also documented some effective teaching with technology practices. Finally the LAC made a series of recommendations to:

- a) Develop 3-5 large LITRE projects that would be designed during 2006-2007 and implemented during 2007-2009.
- b) Improve assessment activities. To improve assessment and reporting, the LITRE Assessment Committee should develop a common framework, which allows for flexibility of interpretation and use as well as uniformity for analysis and reporting

c) Help faculty build on pedagogical strategies repertoire. It was recommended that FCTL and DELTA continue to work with faculty to build appropriate pedagogical strategies as they relate to technology use and to assist faculty to reexamine their pedagogy in light of how technology can enhance teaching and learning.

d) Encourage campus leaders to determine how best to showcase LITRE Results across campus. Showcasing LITRE results across campus would help both disseminate findings from LITRE projects as well as help build a community of practice.

### **Other LITRE Projects**

Classroom Management task force membership was assigned during fall 2005. Since then the task force has worked on technology and management issues of all classrooms and will submit a report that will be presented to the Provost in December 2006.

In addition, a Digital Assessment Management subcommittee was formed from the LITRE Advisory Board. In spring 2006, the subcommittee wrote a proposal, which was endorsed by the LITRE Advisory Board and submitted to the provost. A report and recommendations were submitted May 5, 2006. (See <http://litre.ncsu.edu/dfiles/DAMTF.pdf>)

### **Other campus LITRE related projects**

The use of technology in teaching at NC State appears to be increasing, and assessment results from early studies suggest that technology can be used to improve student engagement with class material and improved learning. Technology provides a way for not only the instructors, but also the students to organize their learning and the material they are learning. The faculty are using technology to organize lecture materials and the learning materials for students' use within and outside of class time. Two projects of particular note due to their broad scope are the Vista Learning Management System project (<http://vista.ncsu.edu/>) and the College of Engineering Student Owned Computing initiative (<http://www.eos.ncsu.edu/soc/>).

In the fall of 2006, 1,159 NC State course sections representing 61% of the university's student population utilized the Vista Learning Management System. A usage analysis examined the use of Vista and each of its tools. Preliminary analysis of the last eight weeks of spring semester 2006 showed that the *content* tools (tools that faculty used to create and deliver course content to students) were used more than any other tool. Within the set of communication tools, (i.e. tools faculty use to facilitate communications between and among themselves and the students), the asynchronous discussions/*message board* tool was used the most, overall.

The COE Student Owned Computing laptop project is a good example of the collaboration needed between faculty, students, IT staff, pedagogy experts and assessment professionals. Future LITRE project should employ a similar collaboration model. It is important to note that all of the infrastructure and pedagogical efforts in the COE laptop project had to occur **first**, before assessment could effectively show impact on student learning. These efforts took many years to put into place.

Because LITRE is focusing on student learning, the more advanced a future large LITRE project is in terms of implementing established technology and advanced pedagogy, the more chance of transformative results will be obtained from the assessment results.

### **Assessment Coordinator Hired**

Based on the findings from the past two years, it was clear that more resources were needed for LITRE assessment activities. A full-time LITRE Assessment Coordinator was hired beginning August 2006.

Geetanjali Soni, Coordinator of LITRE Assessment, will oversee and coordinate assessment for the LITRE projects and grants to help improve the quality of assessment of current and future projects. The coordinator will assist faculty in developing and implementing assessment methods and tools. Dr. Joni Spurlin, University Director of Assessment in UPA, will also continue to provide leadership and guidance for LITRE assessment. The LITRE Assessment Committee will be nominated periodically and continue to play an integral role in LITRE assessment.

### **Development of LITRE Technology Practices Directory**

Discussions during the fall of 2005 and early 2006, showed a need to know more about what faculty were doing with technology at NC State University. The LAC directive was 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 during summer of 2006 and was implemented in November 2006. This will be an ongoing database, so that changes over time can also be tracked. Kevin Oliver, faculty Principal Investigator for this project, provided the overall focus of the directory and will develop periodic reports from this database. This database is open to all NC State University staff and faculty. Faculty can create an account in this directory, list one or more courses they teach, 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.

## APPENDIX B

### LITRE Project Reports cited in Annual Report

Natalie Ames and Linda Williams: Using Video to Teach Social Work Assessment and Documentation. (2004-2006).

Betty L Black, Marianne Niedzlek-Feaver and Brenda Brizuela; Increasing Interactivity and Collaborative Learning in the Classroom with Wireless, Handheld Tools. (2004-2006).

Tony Brock: The Digital Design Studio: Multi-modal Collaboration Through the Integration of Online Design Tools. (2004-2006).

Marina Bykova: Hypertexts as Means of Interactive Student-Centered Learning in History of Philosophy Courses. (2004-2006).

Scott Fitzpatrick: Developing Computer Based Modules for Introductory and Advanced Archaeology Courses. (2004-2006 and 2005-2007).

Ed Gehringer: Disseminating Electronic Peer Review Throughout the University. (2004-2006 and 2005-2007)

Susan Katz: Interactive Online Modules for Writing Instruction. (2004-2006).

Jonathan Kramer and Alison Arnold: Development of a media-rich online course in the Global Approach to Understanding Music. (2004-2006 and 2005-2007)

Vernon Matzen, Abhinav Gupta and James Nau: Web Based Observation and Control of an Undergraduate Civil Engineering Laboratory Experiment. (2004-2006).

Gary Moore: Using Handheld Electronic Responders in the Classroom to Provide Immediate Feedback and Enhance Student Learning (2004-2006).

Jennifer Neel, Valarie Pallatto, Carol Grindem and David Bristol: Virtual Microscopy Practical Exam and Survey Results. (2005-2007).

John Neitfeld and Jason Osborne: The impact of CPS technology in monitoring, performance, and pedagogy in educational psychology. (2004-2006).

Marianne Niedzlek-Feaver: Learning by application: Problem-solving web exercises on DNA fingerprinting and Pedigrees. (Two web simulations and a resource web site) (2004-2006).

Larry Norris: Curriculum Enhancement: Incorporation of Technology into MA 401. (2004-2006 and 2005-2007)

Kevin Oliver, Dianne Raubenheimer and Phil Emer: Collaborative Online Concept Mapping. (2005-2007).

Laura Sremaniak: Computational Chemistry Laboratories I & II. (2004-2006 and 2005-2007)

Carrie Thomas, John Fountain, Donna Wolcott, and Edward Stoddard: Integrating Interactive Learning into the Geosciences. (2004-2005).

Stan North Martin, Joni Spurlin, Dianne Raubenheimer, Brad Mehlenbacher, and Dickran Paruanak: ClassTech Survey Report (2005-2006)

Strategic Learning Management System Implementation Assessment Committee, DELTA: Learning Management System Usage report (2006)

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

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

Jonathan Allen and Sarah Ash: Nutritional analysis web site (2005-2007)

Lisa Grable, Tom Oppewal & Malina Monaco: Implementing Student Digital Learning Portfolios. (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)

Stephan Heber: Integrating Algorithm Visualization into CSC 505. (2005-2007).

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

Faye Cobb Payton: Integrating Wireless laptops in an IT Capstone Classroom. (2005-2007).

Kara Peters: Interactive Modules for Undergraduate Laboratory Preparation. (2005-2007)

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

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

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