The University of Virginia
Teaching + Technology Initiative

A partnership between the University of Virginia’s
Office of the Vice President and Provost and
the Office of the Vice President for Information Technologies
The Teaching + Technology Initiative at the University of Virginia began in the spring of 1995 as a three-year experiment to provide intensive assistance to faculty members who wanted to explore the uses of technology for their teaching. We began to design the program by asking what was currently preventing faculty from integrating technology into their teaching. Not surprisingly, there was clear consensus as to what support the faculty needed: time, money (for hardware and software), and dedicated technical and logistical support.

In putting the program together and organizing the first group of TTI Fellows, we aimed to remove the basic impediments, but we rightly predicted that other impediments would present themselves. At a university largely designed before the age of technology, which classrooms, for example, would the faculty use for the technologically enhanced teaching? If students needed to have access to special hardware and software in order to participate in a particular class, how would this be achieved?

Both the successes of the various projects undertaken by the TTI Fellows over the past two years and the problems have proved instructive. In this regard, the Fellows and the technical support staff have been pioneers, continually confronting unexpected obstacles to success and inventing ways to remove them. It is a tribute to the determination of the Fellows and the skill of the Teaching Resource Center staff and the Instructional Technology Group that so many projects have succeeded beyond expectations and that so many impediments have been removed.

In the TTI program's present configuration, each of the faculty members applying for participation in the program has defined his or her own project and pedagogical objectives. The Fellows have not been selected so much for their prior technical expertise as for the creativity of their projects. And so their technical knowledge and skills, coming into the program, vary widely. Within the context of the monthly group seminars and the workshops organized by the Teaching Resource Center, however, the Fellows, whether advanced technicians or novices, share their progress and learn from each other. Because Fellows from nearly all schools at the University participate, this sharing is interdisciplinary while at the same time always focused on the application of technology to teaching. The crossovers the Fellows discover between one project and another, the techniques and strategies they learn from their colleagues in the monthly meetings, surprise and inspire. In this regard, a strong group dynamic has made of the community enterprise a success that far transcends the particular achievements of any single project.

The results to date of the TTI project are tangible: Fellows have developed and taught significant new courses; they have restructured old courses to take advantage of the new technology; and they have created new paths to learning for their students. As we begin the third year of the experiment, we have begun to take stock of the program's successes and look to its future configuration. On the basis of the thorough assessment now under way, we will be in a good position to determine how to move forward.
Opening Doors

The Teaching + Technology Initiative (TTI) supports faculty developing new paradigms for teaching and learning with emerging technologies. TTI offers its Fellows the resources needed for true educational innovation: time, technical support, access to new teaching technologies, software and hardware to create and deliver multimedia presentations.

TTI is a joint partnership between the Office of the Vice President for Information Technologies and the Office of the Vice President and Provost. Operational support for the program is provided by the Teaching Resource Center, the New Media Center, and the Department of Information Technology and Communication.

Fellows who have participated in the program lead the way in implementing creative redesign for courses and serve as role models for other faculty. Through the success of their projects, these faculty prove that access to special training, technical resources, necessary equipment, and technical support make a critical difference in development of new teaching approaches. Benjamin C. Ray, Professor of Religious Studies, says, “Even if you are not designing a new course as I did, but integrating technology into a course you’ve already done, the process requires you to rethink the course from top to bottom, making sure the technology is really doing something educationally beneficial, not serving as a little sideline, but enhancing the goals for the course and adding new goals.”

Reaching Goals

Quantifying the success of a particular project is difficult. However, an effective barometer of achievement can be found in “the sense of satisfaction and accomplishment of the faculty member,” says John Alexander, Manager of Instructional Technology. “They’re the ones who set the goals. We try to refine those goals with them. Sometimes through consultation they realize their goals are technically impossible, or their pedagogical goals must be more tightly focused. We’ve had projects where the faculty member did not achieve all the original goals, but was nevertheless excited, satisfied, and engaged and felt that the student was more intrigued by the material and more energized by the process. Such projects are definitely a success. The goals are to empower faculty and engage them with the students; technology is merely a tool.”

A related measure of success is the strong pattern of TTI Fellows participating in other programs within the University. For example, if we look at two other noteworthy fellowship programs, the University Teaching Fellows (originally the Lilly Fellows) and the Institute for Advanced Technology in the Humanities (IATH) we see a number of faculty winning multiple awards. For example, three of the four IATH Fellows this year are former TTI Fellows. By the same token, four of this year’s TTI Fellows have been either IATH Fellows or University Teaching (Lilly) Fellows. Clearly, these programs are making a difference in integrating technology into the University’s courses. Furthermore, the synergies between these programs have done a great deal not only to keep these large and ambitious projects progressing but also to support these accomplished faculty as they grow into leadership roles within the University.

Robert Ribando, Associate Professor of Mechanical Engineering, now teaches undergraduate heat transfer with a technologically enhanced format. The course meets for two lectures and a studio session each week, and the attendance rate for the latter is nearly 100 percent. Mr. Ribando says, “I got to know these students much better than in a normal lecture classroom environment. The students are working together and it’s very much a collaborative environment. The course is much, much richer because of the technology.”

Janet Horne, Associate Professor of French, teaches the history of French civilization. She notes, “Using images, sound, and the World Wide Web to make history come alive, it just jumps off the page. The students are riveted. On one very basic level it really helps students learn.”
African Art and the Virtual Museum

"It was reassuring and reinforcing for the students that their teacher was at their level of learning and taking on the challenge with them."

Benjamin C. Ray uses the World Wide Web to bring images of African art to students in a new 300-level undergraduate course. In creating a digital environment for the class, his special focus is the development of innovative research projects for the students. Each student in Mr. Ray’s class becomes a museum curator for the semester, creating an electronic exhibition of African art. They must choose a theme, select objects, research those objects in the library, and write descriptive labels for them, displaying the possibilities of the new medium for a different kind of in-depth cultural analysis. "The students share the progress on each other’s exhibitions in a very easy, readily accessible fashion," says Ray. "By getting the students involved in shaping the course, for which the technology itself paved the way, the process was very interactive and collaborative and cooperative."

In the traditional arts-related curriculum, research projects on cultural themes are limited by the text-based medium of paper, while museum exhibitions highlight objects but relegate text to a minimal descriptive and informational role. Students involved in curating real-life exhibitions are also restricted by the excruciatingly slow pace of gathering materials, seeking permissions, and mounting the objects. Often an individual student’s sole contribution is the writing of a few wall labels or catalogue entries. The World Wide Web opens up entirely new curatorial possibilities, offering the complete integration of still and moving images, text, and sound. Through the creation of their own richly layered visual and textual documents, students enter the exciting new world of publishing on the World Wide Web, making their work and the subject of African art accessible to the wider world. Mr. Ray remarks, "The students felt an incredible sense of ownership and responsibility for what they had done. And by the end of the course, when my students viewed and critiqued other universities’ websites that featured African art, they felt great pride and complete consensus that the content of U.Va.’s web pages was deep and rich.”

This is the only course on African art currently offered at the University of Virginia, and Mr. Ray expects it will attract students from all disciplines, including Art History, Afro-American and African Studies, Anthropology, and Religious Studies. An important source of course material is the University’s Bayly Museum. Mr. Ray has already mounted several exhibitions on African art at the Bayly. In the future, students may assist Mr. Ray in designing new themes and in creating attractive, computer-based interactive learning guides for the Bayly’s exhibitions.
Technologies for Teaching Design in Engineering and Architecture

“Technology becomes innovation when you’re driven to accomplish something that you can’t accomplish any other way.”

Kirk Martini’s project integrates teaching technologies into a course on Structural Design in the Department of Architecture, now required for all undergraduate architecture students. He uses the available technology to help address the lack of interactive visual material, a serious flaw in the traditional design curriculum. The ultimate goal of structural design is to produce tangible physical objects. Mr. Martini is convinced that structural designers need images—and lots of them—of structures in situ and under construction, for appropriate learning to take place, and he now has the capacity to provide those images in digital form. “Technology has changed the way I can use visual materials,” says Mr. Martini, “because of the ability to manipulate material graphically to illustrate concepts. The greater impact for students comes when they learn to see engineering principles.”

Digital media have significant advantages over traditional slides and photographs. They can be easily annotated; they suffer minimal degradation over time and with use; they are easily organized; and they can be widely distributed over computer networks, allowing students access to essential material outside the class. Mr. Martini closely integrates relevant images into course content and pedagogy. The project allows images used in the lectures to be available over the World Wide Web, with accompanying commentary as hypertext documents, thus giving students unlimited access to the essential content of the course. Through this thorough review of the images and their meaning in structural design, Mr. Martini motivates the students to explore their significance in greater depth. “One of the great advantages is that once you’ve set the course up on the Web, it’s there and any additional time you spend on it incrementally improves it. You begin in an incomplete state, but you can continually improve on your work,” says Mr. Martini.

An important feature of Mr. Martini’s project is interactive analysis. Structural behavior—the nature of a given structure’s response to stimuli—is a critical component of the curriculum. There are now available on the market several structural analysis programs, and Mr. Martini’s project integrates these programs into his hypertextual classroom presentations to illustrate a variety of structural concepts. Responding to a need in his field to integrate design and technical issues, Mr. Martini uses the computer as a tool to investigate the interaction of creativity with scientific rigor. With the World Wide Web as his delivery platform, the results of his inquiry become available to his students wherever and whenever they want to view the material.
Links to the Past: French Culture Through the Lens of History

“One of the features of the World Wide Web that’s so exciting is being able to travel, to have the feeling of moving through space and time without limits.”

Janet Horne’s course, The History of Contemporary French Civilization, is a multidisciplinary endeavor drawing upon a variety of fields such as history, literature, anthropology, art, architecture, and music. The challenge to students is to think analytically about a broad array of cultural artifacts and thereby become initiated to major themes and events in French history and culture. “By introducing a multimedia learning environment to the course,” says Ms. Horne, “I can capture in ways never before possible the rich conceptual dynamic between these related disciplines and enhance the excitement of classroom discovery.”

In the traditional classroom setting, the pedagogical aims of the course were held back by the necessary arsenal of slide projectors, map easels, overhead projectors, and videocassette recorders. Through the TTI project, Ms. Horne is implementing a series of CD-ROM modules featuring audio files and video segments as well as images. The CD-ROM component challenges the students’ linear reasoning by offering a thematic interface that will entice them to explore across decades and even centuries. Recent historiography has stressed the extreme linguistic, ethnic, and cultural diversity of the French people. Particularly for students who have not yet traveled to France, these themes become more apparent when presented in an integrated multimedia classroom.

Ms. Horne comments, “There are certain things I can do with multimedia that I can’t do with a slide show. For instance, I show students that one characteristic of French culture is that the French consciously try to reinscribe their history into the present. They are constantly linking themselves to the past and that’s an important feature to learn about French culture. Also, if I’m presenting information on the Eiffel Tower with a CD-ROM, I can move diagonally, not just chronologically. The students can see the text around the debates about the Eiffel Tower when it was first presented to the public, follow thematic links about the importance of engineers in French industrial society and culture, then hear poetry or see art about the Eiffel Tower from today. Being able to make the connections between what we study of the past and its real-life impact today has certainly been enhanced by the Web.”
“Using technology forces you to look at the material in a new way and decide what is fundamental. There is a huge amount of effort involved in developing the modules, so you must focus on fundamentals.”

Before the advent of the computer, differential equations that describe physical processes were solved tediously using analytical techniques. Often the solutions were evaluated using mechanical calculators and graphed or tabulated for use in engineering design. While convenient and the only feasible approach at the time, these solutions and a few assigned homework problems making use of them rarely build any physical insight at all. Now those same equations, as well as far more complicated ones, can be approximated and solved in a matter of seconds on an inexpensive desktop computer. More importantly, relatively simple but creative graphical depictions of the solutions can aid greatly in actually understanding the physical principles underlying the process. “The students are learning the subject matter by experimentation,” says Robert Ribando. “Many of these simulated experiments in fact are far more powerful than anything we could conceive of doing in our laboratories.”

The course that is the focus of Mr. Ribando’s TTI project was previously taught in a three-lecture-a-week format with a related laboratory taken the following semester, too late for timely reinforcement of lecture material. Under the new format, there are two lectures a week plus a two-hour studio session. In the studio session students perform a variety of computer-facilitated design and analysis activities. Some weeks they do “virtual” experiments using computational simulations of heat transfer processes, actually taking data from the screen display for later analysis. They see and use modern visualization techniques similar to what they will routinely encounter in real world engineering.

Unlike commercial software packages, which are designed for ease of use rather than for instructional value, these studio exercises generally require preliminary “pencil and paper” analysis and provide training in the verification and interpretation of results as well. Other weekly exercises demonstrate the use of computer-aided solutions in the design process, allowing plenty of “what if?” calculations in minimum time. Mr. Ribando remarked, “The most common paradigm in engineering education for the last fifty years has been largely writing equations on the board. But we don’t have to do that anymore. We can’t afford to go back to the laboratory- and shop-intensive curricula that once prevailed in engineering, but at least now we can visualize the physical process that’s going on right in front of us on the computer screen.”
Brian Balough teaches a large undergraduate lecture course entitled "Viewing America," which relies heavily on different types of media—particularly video—in its exploration of modern American politics and culture. Mr. Balogh uses the very latest form of mass communication, the World Wide Web, as the vehicle for delivery of ideas about modern American culture. “I’ve become much bolder,” says Mr. Balogh, “about using a whole range of sources that I never thought I’d be using in the classroom. On the other hand, I feel a much greater need to offer some guidance to students as to what to look for and how to use this material so they aren’t overwhelmed. In revising this course I decided it just wasn’t fair to withhold this technology from my students.”

The core component of the “Viewing America” web site is an “electronic sourcebook” containing much of what the students need to master as preparation for the weekly discussion session. The sourcebook consolidates in one location study questions that help guide the students’ reading. There is also a section called the Archive, where students can look at three to six primary sources, which can be photographic, text, audio, or a combination. Graphics and interactive maps are included, as are links to a limited number of relevant Web sites. The sourcebook also provides an extensive background and context section for the students. Mr. Balogh comments, “It encourages the students to go beyond what they get in the lecture, beyond what they get in their readings, and to explore some primary sources on their own.”

“Viewing America” is rich in multimedia material, integrating text, still images, video clips, and audio clips in an easily navigable site. Short video segments will be played from video tape in class. Those same clips are digitized and are included in the site so that students can study the material in depth, with the ability to play the scene repeatedly as needed. In addition, the site will contain a searchable interface with citations to all the visual and audio material used in the lectures, giving students retrieval information for the original sources.

Mr. Balogh’s primary goal is to engage students more actively in the learning process. “Viewing America” offers them the opportunity to explore a rich variety of media carefully chosen and presented to support specific course topics, and it encourages intellectually curious students to explore subjects of interest in greater depth.
Michael Gorman teaches courses on the psychology of discovery and invention to engineering students. He believes that the best way for students to learn this fascinating but inherently complex subject is to have them reproduce the key experiments of great inventors like Bell, Faraday, and Edison. But one problem that confronts this hands-on approach to history is the prohibitive cost, in time and money, of recreating laboratory conditions for a number of students.

In response to this problem, Mr. Gorman has developed—with the aid of the World Wide Web and the object oriented programming language “Java”—a series of virtual experiments with which the students can interact. In one example, students are presented with the same materials Bell had at his disposal when he invented the telephone. These materials—simple resistors, batteries, etc.—appear on the computer screen as moveable icons with adjustable values that students can set and combine in different ways. Based on known laws of physics, different arrangements produce different results, just as in a “live” experiment. Gorman explains, “I’m constantly revising how the material looks and learning ways of making this all more accessible to users. You have to build intelligence into the multimedia design, so you must absorb the important information.”

At a more profound level, Mr. Gorman wants his students to understand and adopt the cognitive processes that guided the creation and interpretation of the great experiments. In this connection he makes use of the fact that the great inventors kept detailed notebooks of their work. These notebooks provide important clues to the complex process by which the mind proceeds from the imaginary to the real. Based on the structure of these notebooks, Mr. Gorman has developed an interactive notebook on the computer that will prompt students to record key elements of the discovery process, including observations from actual experiments and details of virtual experiments. In addition, the program will aid students in the cultivation of what Mr. Gorman believes to be a key to the cognition of creativity: the rich non-verbal, visual models that all great inventors seem to have had behind their experiments.
"You invite students into the system-making process, because part of what you’re doing as a team is discovering the best ways to get your goals accomplished."

The University’s Drama Department holds a collection of over a thousand antique clothing pieces dating as far back as 1840. This extraordinary collection, largely undocumented and unpublished, is the focus of Kathryn Rohe’s TTI project. Ms. Rohe’s project involves undergraduate students in the conservation, research, documentation, and World Wide Web publication of the collection’s distinctive holdings. “The students gain a greater appreciation for the people of the past, and the ways of thinking, the values, attitudes, and behaviors of the past,” said Ms. Rohe.

In an undergraduate course, “The History of Dress”, Ms. Rohe and her students select appropriate garments from the University’s collection for study. After careful repair and preparation of the garment, each is mounted on a mannequin and photographed. The photographs are digitized for the Web-based database of the collection’s holdings. Beyond this initial task is the research each student must undertake, adding essential information for the database, providing information about the history of the article, its probable wearer, and its construction. “The technology helps to get the students to focus on the details,” says Ms. Rohe. “It’s the nature of the project, not necessarily the technology, that facilitates this focus, but without the technology their efforts would be much less meaningful.”

An additional benefit of this project, ironically, is that the clothes are not only preserved digitally but the garments themselves are steamed and more properly hung and stored: both the virtual and the real garments are preserved.

Ms. Rohe’s course allows students to be technological pioneers in the field of costume history. As they witness their efforts being transformed into an effective database, they start to fathom the significance of creating one of the first web sites of this kind. They are frequently the first observers of how a new technology can enhance the understanding of a subject. For example, students were responsible for taking the 36 shots necessary to create a digitized rotating 19th-century bustle dress, the first of its kind, made through the QuicK Time virtual reality technology.

The long-term goal for this project is to document and publish the entire costume collection and develop an extensive quantity of supplemental data valuable to scholars of costume history and design around the world. This project will provide years of significant lab work and will result in an impressive body of information developed almost exclusively by students.

Kathryn Rohe
Assistant Professor of Drama
An Interactive World Wide Web Course in Biological Chemistry

“If you really want to stay in front of the technology, do the exciting things that are coming along, and apply them to your particular situation; it’s a large investment of learning. The payoff is that it’s wonderful fun.”

Biochemistry and organic chemistry are among the most challenging of undergraduate courses. In addition to the quantity of information that students must absorb, the sheer geometric complexity of proteins and nucleic acids makes it difficult to envision how they are built and how they interact and combine to form new molecules. Traditionally, teachers of biochemistry have resorted to drawings and ball-and-stick models to represent these complex structures. However, drawings are limited to two dimensions, and three-dimensional models are difficult to construct. Then, once built, they cannot easily be altered to show the processes of molecular interaction. Students must learn to apply basic chemical principles to these complex problems. Though they have the pieces and parts, it is difficult to put them together. “It’s like teaching students the notes on a piano and then asking them to play a symphony,” says Charles Grisham.

Mr. Grisham changes all this with the use of the new multimedia technologies that have revolutionized the way we teach this material. He has begun to create a comprehensive library of three-dimensional protein models. Like plastic ball-and-stick models, these virtual molecules can be rotated and examined in a variety of ways. But they also offer the advantages of being accessible from any computer connected to the World Wide Web. These three-dimensional models of proteins and DNA show students the molecular basis of diseases such as cancer and AIDS and the chemical basis of drug action.

In addition to a library of virtual, 3-D protein molecules, Mr. Grisham is creating a collection of animations and interactive simulations that are designed to lead the students through complex problem-solving exercises in biochemistry. A series of Java applets—small computer programs that are delivered over the Web—written by U.Va. student Edward O’Neil, allow students to study the chemical and physical principles that drive living things. In one applet, students are presented with images of molecules and must determine the chemical features of the molecules that influence how they will react with each other. Correct responses by the students in these exercises evoke animations on the screen that portray the chain of events in the reaction itself. Such tools demonstrate how the much-hyped concept of interactivity can be applied to genuine pedagogic ends. “We have tried to develop not just a web site with pictures and information,” said Mr. Grisham, “but rather interactive exercises that the students can use to do more than they would be able to do with a textbook. It’s almost, in many cases, as though they had an instructor sitting right there with them and coaching them through calculations and graphing and protein modeling.”
Support—Technological and Personal

Teaching Resource Center

The Teaching Resource Center (TRC), founded in 1990 to promote excellence in teaching, coordinates faculty interactions in the TTI program. TRC personnel organize a fall retreat and orchestrate meetings where Fellows can share ideas and progress reports. The TRC actively pursues ways to link veteran TTI Fellows with new Fellows and supports Fellows in working with other faculty on Grounds. In this way, the benefits of the TTI program can spread throughout the University community. Judith Reagan says, “In working with the TTI Fellows, the Teaching Resource Center focuses on how technology can best be used for pedagogical reasons. It’s one more way to reach students more effectively.”

New Media Center

The New Media Center assists faculty members and other instructors in preparing digital materials for classroom instruction, providing the necessary hardware and software resources for presentation of advanced multimedia including imaging, web preparation, CD-ROM creation, and digital video. Jeff Hollier, Faculty Development Coordinator at the Center, says, “We offer—to anyone involved in teaching at U.Va.—access to these resources and, more importantly, the training needed to prepare materials. We support the entire teaching mission of the University in this way.”

Administrator Michael Tuite says, “We are the resource specifically for the TTI Fellows in terms of both technology and expertise. We are constantly in search of innovative technological solutions to assist faculty with improving their instructional capabilities.”

Backbone Network

All of the buildings on the University of Virginia Grounds are connected to a network that combines broad-band copper and fiber-optic backbone components. This is the first phase of a five-year project that will link all major academic, administrative, and medical buildings on Central and North Grounds to a new fiber-optic backbone. The second phase of the project involves the installation in each building of new standard cable and connections that will support telephone, data communications, and video. This campus-wide network is in turn connected to the Internet. In addition, U.Va. users may connect to the network from their homes via dial-in connections to the University’s modem pool.
Entering a New Age of Enlightenment

The Teaching + Technology Initiative explores the interaction and collaboration of students with their professors, in projects that link traditional teaching methods with innovative uses of technology in the lab and in the classroom. In each project, different techniques and methods are investigated to determine the best possible use of technology within the context of the particular course and within the realm of what is currently available.

Involved...

“The project has encouraged me to use a much broader range of sources in the classroom, many of them primary sources, normally available only in archives or in limited access.” — Brian Balogh

Collaborative...

“In the future, I would like to see professors in common disciplines around the country having more opportunity to collaborate and share materials.”
— Kirk Martini

Interactive...

“Teachers either have to work with the technology directly or with the people who are developing the technology to mold these tools so they really can benefit the students.” — Janet Horne

Engaged...

“It’s very exciting because technologies that were once confined to research labs in major universities can now be accessed by anybody who has a computer and opens up a Web page. Bringing that information to large numbers of students requires an additional investment of time and effort, and that’s what we’re doing. It’s a really interesting adventure.”
— Charles Grisham

The possibilities for the future of TTI are limitless. Channels of communication widen as students and teachers find new possibilities. Benjamin Ray says, “I was participating with the students in the lab sessions, too—teacher as learner. It was reassuring and reinforcing for the students that their teacher was at their level of learning and taking on the challenge with them.”

According to John Alexander, Manager of Instructional Technology, “The kinds of projects that will come from a nationally ranked faculty such as we have here at the University of Virginia are going to continue to be exciting; there is going to be innovation. There will be new ideas, new approaches.” Kathryn Rohe sums up as she says, “The potential is limitless; there are numerous ways to use technology. Implementing those ways is another question.” The implementation of the technology is where the Teaching + Technology Initiative plays the key role of facilitating, supporting, and guiding the work of its Fellows.
FOR MORE INFORMATION

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