iCampus

Microsoft's $25 million iCampus alliance with MIT, originally planned for five years but extended for two additional years, was established in October 1999 to create and demonstrate technologies that produce revolutionary information technology (IT)–enabled teaching models and improved educational tools for higher education. This strategic initiative is managed by Microsoft Research (MSR) University Relations, whose mission is to build world-class partnerships with key universities and establish Microsoft as a leading technology partner for higher education. iCampus is one of a small number of strategic alliances that MIT maintains with major corporations. The other alliances are with Amgen, Merck, Ford, NTT, Merrill Lynch, DuPont, and Hewlett-Packard.

Now completing its seventh and final year, iCampus has provided $24 million to fund 28 faculty research projects and 27 student-run projects. As a measure of iCampus's impact at MIT, the iCampus projects have involved more than 150 courses with a combined enrollment of more than 7,200 students. About 400 MIT researchers, including 20 percent of all MIT engineering faculty and instructors, have worked on iCampus research projects.

Beyond MIT, about 50 other universities and 13 companies have been involved in collaborations resulting from iCampus projects, and MIT researchers have interacted with a dozen Microsoft product groups. Approximately 90 articles about iCampus projects have appeared in newspapers and magazines. Since the beginning of the alliance, Microsoft's hiring of MIT graduates has tripled.

iCampus is governed by a six-member Joint Steering Committee (JSC), with three members from Microsoft and three from MIT. The current JSC members are Thomas Healy (MSR University Relations), Paul Oka (MSR University Relations), and Steve Drucker (MSR New Media Group) from Microsoft and Thomas Magnanti (dean, School of Engineering), Vijay Kumar (assistant provost), and Harold Abelson (computer science faculty member) from MIT. Former Microsoft JSC members include Peter Pathe, Anoop Gupta, Doug Leland, David Salesin, Randy Hinrichs, and Sailesh Chutani. Executive sponsors for the alliance are Rick Rashid for Microsoft and Tom Magnanti. The JSC sets strategic directions, makes funding decisions, and provides ongoing project supervision and shaping of the far-reaching impact of the research. MIT's iCampus management coordinates closely with the MIT Council on Educational Technology, the MIT central body that formulates strategy for MIT's educational technology efforts.

Each iCampus project is under the direction of a faculty member who serves as principal investigator. Students work on research projects for course credit or to fulfill advanced undergraduate or graduate thesis requirements. Projects have been funded at levels between $100,000 and $800,000 per year for one to two years, with some projects continuing for three to six years.

For the first five years of the program, iCampus focused internally at MIT to test innovations through significant MIT use and integration into the MIT curriculum. The two major criteria for project selection were educational rationale rather than technology per se and expectation of commitment by MIT schools and departments to adopt the technology: iCampus did not want to fund experiments that would disappear as soon as program funding ran out.

This approach has proved remarkably successful in stimulating educational innovation at MIT. Virtually all MIT undergraduates have taken courses whose development was sponsored by iCampus. iCampus innovations have been extensively integrated into the MIT curriculum, and MIT continues to provide staffing and funding to sustain the impact of iCampus work.

In addition to faculty-led projects, iCampus also solicits and funds student projects, which are designed and run entirely by MIT student groups. This is in addition to the significant numbers of students who participate as research assistants in faculty-led projects. Student projects each receive one-year grants of $60,000. To date, $1.7 million has been awarded for 27 student projects, ranging from designing wireless sensors to monitor water quality, to integrating computer games with exercise bicycles, to implementing remote position sensing for MIT shuttles, to creating and installing screens mounted throughout the Institute on which student groups can advertise events. The availability of Microsoft funds directly to students—something unique among MIT's research alliances—has generated enormous goodwill toward the program on campus.

In March 2004, the iCampus JSC endorsed a major new strategic thrust for the program. With innovations having been proved at MIT, iCampus would move beyond just using MIT as a demonstration site and actively promote the adoption of these innovations at other universities worldwide. This has required a much more active role for the central iCampus staff, including hiring and managing staff that would bring the MIT work from its "alpha release" condition into a state ready for dissemination and creating the relationships and support structure required to maintain a global network of affiliate institutions.

The resulting iCampus Outreach project was initiated during summer and fall 2004 and was ready to accept its first affiliates in December. Over the next two years, iCampus concluded affiliate agreements involving more than 60 campuses that are now deploying iCampus innovations. Following iCampus-sponsored workshops and conferences, many more institutions have become involved.

In December 2006, a two-day symposium will be hosted by MIT and Microsoft Research. Learning without Barriers/Technology without Borders is an invitation-only event, to be held at MIT, which will mark the completion of the iCampus Alliance. The symposium will bring together national leaders from industry, academia, and government, along with selected international guests, to reflect on the challenges that affect technical education in the United States and globally, their effects on national competitiveness, and how educational technology can help address these challenges.

Central Technical and Educational Themes

iCampus projects are diverse and selected from MIT faculty responses to annual requests for proposals. The JSC has promoted projects in three broad areas, chosen for educational significance and for use of technologies that are poised for widespread diffusion among institutions of higher education. This section summarizes these themes and the most important iCampus initiatives under each theme, which we view as crucial to the impact of information technology in higher education.

Creating and Disseminating Educational Web Services

Just as with enterprise information technology, the emergence of a robust web service infrastructure through .NET and other initiatives has enormous implications for educational IT infrastructure. iCampus is pioneering the development of a few global-learning web services and initiating university consortia to promote shared infrastructure and shared services in higher education. These efforts include remote access to shared physical laboratory equipment (iLabs) and shared services for writing instruction and essay evaluation (iMOAT).

Reinventing the Higher Education Classroom

In reinventing the higher education classroom with pedagogically sound educational technology, iCampus has initiated major transformations in MIT's largest courses. Among the courses changed are freshman electromagnetism (MIT's highest enrollment subject), the introductory computer science subject (taken by half of all undergraduates), architectural design, and Shakespearean drama. The impact has been felt in all of MIT's schools, and thus responds to the needs of the entire curriculum—engineering and hard sciences as well as humanities and social sciences. Transformations include the following:

- Eliminating large lecture classes and replacing them with small-group experiences supported by online multimedia instruction and embedded feedback
- Designing project-based learning with simulations and gaming
- Targeting location-based services that support learning
- Using tablet PCs to support distributed, collaborative design

Educational Applications of Emerging Technologies

Although iCampus emphasizes work that can be deployed for large-scale use in the short term, the program sponsors a few research investigations of significant emerging technologies. Among them are tablet computing, synthetic biology, and speech recognition and transcription.

iCampus has also sponsored rigorous assessment studies of these innovations. The results of these assessments are being integrated into the projects. Initial analysis supports the conclusion that IT-based "active-learning" systems are superior to lecture methods in fostering student learning. These are high-stakes, high-profile efforts. Given

MIT's history of worldwide impact in curriculum innovation, demonstrated success here can be expected to stimulate similar transformations elsewhere in higher education.

Educational Web Services

Web service architectures—which make it possible to modularize implementations, share infrastructure, create new services, and expose interfaces—continue to have an enormous impact on enterprise IT in almost every industry. The same is true in higher education, where scarce university resources such as expensive laboratory equipment are increasingly being connected to the web. Web services can consequently be the basis for a major new educational IT framework of software and services shared among universities and between universities and industry. The iCampus JSC recognized this at Microsoft's first announcement of the .NET initiative and put into motion a plan to build major iCampus projects around web service opportunities. iCampus is evolving to explore web services as agents of change for how universities collaborate around shared educational resources and improve scholarship globally.

This section surveys two iCampus research projects that promote web services and shared infrastructure, which includes creating infrastructure for sharing laboratory equipment (iLabs) and writing instruction (iMOAT).

iLabs: Sharing Laboratory Equipment via Web Services

The most ambitious of these iCampus web services projects is iLabs, a .NET-based infrastructure for placing laboratory equipment online. The iLabs project has developed an architecture and a set of foundational web services that provide remote access to laboratory equipment, allowing labs to be shared across campus or across the world. As an example, students in Singapore and Sweden have been using MIT equipment—the same equipment MIT students use—to perform transistor characterization experiments in their microelectronics course for the past three years.

iLabs has the potential to revolutionize engineering education by drastically reducing the cost to universities of providing laboratory courses. The iLabs team has released a software development kit that universities can use to put lab equipment online for sharing, and iCampus affiliates in Mexico, Brazil, Germany, the United Kingdom, Australia, China, Taiwan, Uganda, Tanzania, and Nigeria are now implementing shared laboratories. We are also beginning to work with schools in India. In March 2005, the Carnegie Corporation awarded an $800,000 grant to iLabs to further collaboration with universities in Africa.

Core services, such as status, identity, reservations, storage, events, and notifications, are being defined and implemented with .NET. A core lab server service manages access to the physical lab equipment, mediating access by users, administrators, and providers of enhanced services such as authentication of users and archiving of measurement results.

Under iCampus sponsorship and direction, MIT launched a program last year to encourage the development of web-accessible laboratories across universities worldwide. Web-based shared laboratories being developed at MIT include microelectronics, polymer crystallization, chemical reactor and gas chromatograph, heat exchanger, vibrating structures, and a dynamic signal analyzer. In the long run, all university laboratory facilities could form the core of a global shared resource for science and engineering education. We are working with MIT's OpenCourseWare initiative to make these services available to any university.

iMOAT: Shared Services for Writing Instruction

A second iCampus effort involving web services is the MIT Online Assessment Tool (iMOAT), a .NET-based web service that lets universities collaborate in administering and grading essay exams. It permits universities to set up web sites where students register, view essay questions, and submit their responses. The system stores the responses and provides workflow and tracking for administering and grading the exams. MIT has used this system for administering essay examinations to all entering students, and seven other universities are currently administering exams via the MIT site. iCampus continues to work on release engineering of the system to distribute and replicate it more easily.

Universities today operate largely as "IT islands," rarely sharing infrastructure around core educational or administrative activities. iMOAT illustrates how the increasing reliability of web services changes the IT landscape and results in a major infusion of shared and outsourced IT services into higher education. iMOAT has also established a large repository of essays (students opt in when submitting) with the potential to become one of the premier research databases for writing analysis.

iMOAT is designed for large-population exams such as the writing placement exams all entering students take at most universities. Administering these exams via the web is a major convenience for students and administrators, but few universities are able to develop or maintain their own installation. It is highly attractive for universities to subscribe to such a shared service, as presentations of iMOAT at national conferences of writing teachers have already confirmed.

iMOAT was first deployed in a beta test during summer 2002 as a shared implementation used by MIT, Caltech, the University of Cincinnati, DePaul University, and Louisiana State University. The system was used to grade more than 4,000 essays, including the writing placement essays for much of MIT's fall 2002, 2003, 2004, and 2005 entering classes. The iMOAT project has continued to expand, launching a major university consortium for supporting and sharing this web service.

Reinventing the Classroom with Educational Technology

While iCampus's web services theme explores web services as agents of change for how universities collaborate around shared educational resources, the second major theme focuses on pedagogy and classroom transformation. Here iCampus has chosen to concentrate on major experiments that aim at reducing the passivity of traditional lecture courses through active learning experiences supported by IT.

The projects selected sparked fundamental reworkings of MIT's largest courses to demonstrate the effect technology could have on scaling education, improving learning outcomes, and demonstrating innovative uses of technology in a distributed wireless environment that uses both Unix and Microsoft technologies.

These efforts have required major institutional commitments from all of MIT's departments and deans, as evidenced by multiyear rollout plans. iCampus has required intensive data collection and analysis aimed at assessing these experiments to produce scientifically sound conclusions of these new techniques. The impact has positioned both MIT and Microsoft as the thought leaders in educational technology research.

In this section, we review two large-scale course transformations: introductory computer science and freshman physics.

Computer Science

A second major iCampus project in classroom transformation has been the development of online lectures and tutoring systems for two of MIT's largest computer science courses: 6.001 Structure and Interpretation of Computer Programs (which is MIT's core software course) and 6.034 Artificial Intelligence.

Like so many other large lecture classes, MIT's introductory computer science course was taught in the traditional mode of two large weekly lectures (300 students) and two weekly section meetings (30 students per section). The goal of the project was to study the effects of eliminating the large lectures entirely and replacing them with interactive technologies that enable students to learn at their own pace.

Products of this work include complete sets of lectures—PowerPoint slides with audio narration—for each course. The faculty researchers also developed a platform for defining and administering a suite of online tutorial exercises, together with a complete semester's worth of online assignments for each course. These interactive materials are in use at MIT, and iCampus makes them available on MIT OpenCourseWare, enabling worldwide access to two signature courses of the world's top-ranked computer science program.

As a result of this effort, a verifiable model for rebuilding online learning within engineering education has been established. Students access web-based lectures designed with PowerPoint audio narration. The Computer Science faculty developing the course contend that audio is superior to video for these purposes. Among other things, the audio segments accompanying each slide can be easily updated from semester to semester, whereas updating video segments requires an expensive production process. The faculty researchers developed a platform for defining and administering a suite of online tutorial exercises. Students self-test during instruction, writing short programs that automatically validate against a test suite and report the results. Related work by the same group of faculty include, in the computer architecture course, having students design circuits and having the system run them through a verifier, and in the artificial intelligence course, having students input proofs in a formal language and having the system automatically run them through a proof checker.

Studies and models like these from MIT reinforce the overall goal that educational technology can boost comprehension of material by enabling students to learn at their own pace and schedule and obtain immediate feedback on their progress. More notable is that instructors can now spend more time developing new content and interacting with students.

Comparison studies indicate that the online material is more educationally effective than live lectures in conveying broad conceptual ideas and detailed technical content. Based on an assessment study of 168 students, preliminary results compare student performance on material covered in live lectures versus material covered in the online system—both broad concepts and technical content. To a high confidence level, online experience surpasses live lectures in both categories.

Physics

iCampus's most ambitious project in this area is Technology Enabled Active Learning (TEAL), which has replaced all lectures in freshman physics with "studio-mode" instruction, where students work in small groups using laptops that run simulations, administer short in-class quizzes, and control laboratory demonstration equipment. Freshman physics is MIT's largest course, required of all students, and while iCampus made TEAL possible, the scale of the experiment required significant additional investment by MIT, including constructing large multimedia classrooms dedicated to the experiment.

The goal of the iCampus physics project is to incorporate active learning methods into the introductory physics classroom. This work is modeled after the studio physics effort initiated at Rensselaer Polytechnic Institute in 1994. The studio format combines lecture, recitation, and hands-on laboratory experiments into a single classroom experience where students work together in small groups, seated around a table, while instructors circulate about the class.

In addition to the new instructional format, TEAL has created an extensive suite of physics simulations and visualizations, which MIT distributes via iCampus and OpenCourseWare. Along with the visualizations, the TEAL group is producing a toolkit that will enable physics instructors around the world to create their own simulations and visualizations. In addition, TEAL has conducted extensive professional evaluations, which demonstrate that MIT students perform better in studio learning instruction than with traditional lecture-style instruction.

The experimental sections were so encouraging that the Physics Department is switching first-semester physics to studio mode as well. They are also beginning to work with Harvard on integrating the model. The final goal for freshman physics at MIT is to eliminate the lectures and replace them with active, technology-enhanced learning.

TEAL's ambitious scope, together with the prominence of the MIT Physics Department, makes TEAL one of the world's most noteworthy innovations in university physics instruction. The TEAL group received a $400,000 grant from the Davis Foundation of Massachusetts to disseminate this work to other Massachusetts colleges and universities, and one of the iCampus affiliates in Taiwan received a grant from its government to build a new classroom to be dedicated to TEAL-style instruction. TEAL has continued to expand at MIT even after its three-year iCampus funding period elapsed, which is an endorsement of iCampus's decision to focus on sustainable innovations that have institutional commitment.

One major educational hypothesis behind this transformation of freshman physics is that the work with desktop experiments and simulations leads to increased conceptual understanding with no decrease in technical facility compared with standard lecture methods. Assessment results continue to be analyzed but seem to support this hypothesis.

The assessment team administered pretests and posttests to students in both the experimental (studio) group and a control (lecture) group. These tests were designed to measure conceptual understanding of the material. The impact of a course on conceptual understanding can be measured by comparing the average amount students improve from the pretest to the posttest. Results show that, for students at all academic levels, the improvement in the experimental group was higher than that in the control group.

Emerging Technologies

One of these technologies is tablet computing. iCampus's natural interaction tool lets students sketch scenarios involving simple machines, such as a cart with a spring bumper at the top of the hill with a wall at the bottom of the hill. It then uses sketch understanding and simulation to animate the scenario according to the laws of physics: the cart rolls down the hill and bounces off the wall. Originally known as magic paper, natural interaction was transferred to Microsoft for release engineering, and Microsoft is now distributing it under the name "Microsoft Physics Illustrator."

iCampus is also looking at the educational implications of synthetic biology—the engineering of biological organisms at the cellular level using the organizational principles of computer science. iCampus sponsors the Intercollegiate Genetically Engineered Machine Competition, where students from more than a dozen universities compete over 10 weeks in the summer to design and build biological devices implemented as genetically engineered *Escherichia coli*. Last summer's competition included teams from MIT, Harvard, Toronto, the University of Texas–Austin, Cornell, Princeton, and others, and in 2006 more than 35 schools will participate.

A third area, which seems exceptionally promising, is the use of speech recognition technology in the automatic transcription, summarization, and indexing of audio lectures. Researchers at MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL) are creating an annotated corpus of lectures from OpenCourseWare and *MIT World* for the speech research community to use in developing transcription tools. They have also created a web service to which anyone can submit an audio recording of a lecture and obtain an automatically generated transcript synchronized to the recording. Such a service will dramatically reduce the cost of preparing materials for distance education and could play a major role in advancing education in the developing world at the university and precollege levels.

Overview of Other Faculty Research

The bulk of this report has described four projects illustrating how the work funded at MIT supports coherent themes strategic to both MIT and Microsoft. Below are brief synopses of some of the remaining iCampus faculty projects.

- iDAT web-based wireless sensors for education. The Department of Mechanical Engineering is creating a comprehensive package (iDAT) for teaching instrumentation and measurement to engineering and science students, including a suite of web-based wireless sensors specifically designed as educational tools.

- *International genetically engineered machine competitions*. Researchers in CSAIL are developing course materials for the MIT Synthetic Biology Working Group's engineered biological systems based on interchangeable, standardized biological parts and hosting international genetically engineered machine competitions for teams of students from many universities.

- *Classroom learning partner*. Researchers in CSAIL are promoting student feedback during lectures by creating software to capture, classify, and aggregate student questions and responses and integrate this into the Classroom Presenter system (University of Washington) running on tablet PCs.

- *Visualizing cultures*. The Foreign Languages and Literatures Department is deploying curriculum and software to enable university and high school students to create multimedia presentations dealing with comparing cultures, drawing on image repositories at MIT, the Boston Museum of Fine Arts, and the Smithsonian Institution's Sackler Museum.

- *CWSpace*. The MIT Libraries are extending the DSpace digital repository platform so that it can be a long-term repository for OpenCourseWare materials and implementing the standards, protocols, and web service interfaces to enable DSpace to support archiving and retrieval of OpenCourseWare content.

- *Simulations in engineering education*. The Department of Aeronautics and Astronautics initiated a major curriculum transformation to support active learning and simulation. Microsoft Flight Simulator is integrated into nearly every course in the department. The faculty created modeling and analysis tools closely coupled to Flight Simulator so that students could simulate flying aircraft of their own design.

- *Simulations in mechanical engineering*. The creation of "active paper" as a medium for mechanical engineering design with tablet PCs has been explored as a result of our emphasis on simulations, shape recognition, and immersive feedback systems to generate human inquiry while engaged in active sketching. An early prototype of this work was demonstrated at a Bill Gates review of Microsoft's academic programs. The departments of Mechanical Engineering, Civil Engineering, and Health Science and Technology have undertaken similar curriculum efforts. Once more, the emphasis has been to incorporate active learning into lectures using both physical models and simulations. Telepresence and remote white-board technologies have been evaluated for MIT's Internet 2-based collaborative courses with universities in Singapore.

- *Simulations and distributed collaborative discussions in the humanities.* The Literature Section in the School of Humanities, Arts, and Social Sciences is teaching Shakespeare with the aid of XMAS, a multimedia annotation system. Students combine video clips and writing to create and share multimedia essays. It is believed that multimedia composition will become a fundamental communication skill and that learning to create effective multimedia compositions will be a regular part of higher education, just as learning to write is today.

- *Improving collaborative design with tabletPCs*. MIT's internationally famous robot design course is incorporating a .NET-based framework for teaching engineering design. The system was piloted by the International Design Contest held at MIT during summer 2002. In addition to the .NET software, students used tablet PCs and tablet-enabled applications specially developed for the course. Microsoft has showcased this work in a case study and has featured it at tablet PC launches.

- *Location-based tracking in architecture*. MIT's master of architecture program created a virtual community and location-based tracking software to identify location and access to professional architects across the world. This program was carried out in collaboration with MSR's Social Computing Group.

Combined, these projects have produced more than 60 published papers, 32 theses, and approximately 300 public talks. Taken as a whole, these projects are helping to promote a shift toward technology-based environments that provide new forms of motivation, increase student time on task, and provide a rich feedback mechanism for long-term scholastic development.

Student Projects

In addition to funding faculty projects, iCampus solicits and funds projects designed and run entirely by MIT student groups. These projects are targeted toward creating web services that will enhance campus life. Student projects each receive one-year grants of $60,000, and to date more than $1.7 million has been awarded. These student awards have generated good publicity for iCampus and for Microsoft on the MIT campus; more importantly, students have often demonstrated creative ideas for web services to improve campus life. The table below describes the life cycle of student projects.

The Life Cycle of Student Projects

Nov–Dec	Student request for proposal published and widely advertised. Web-based proposal system opens to MIT student community. Groups with most promising proposals are interviewed and proposals are refined. Final selection is completed by the end of the fall semester.
Feb–May	The chosen students are helped with project management (using MSF best practices) & presentation skills. Weekly milestone deliverables ensure the projects stay on track.
Jun–Aug	Students can elect to pay themselves or hire others to work on the project over the summer. Some students have been offered MSR internships in areas complementary to the project.

iCampus has funded 27 student projects to date. Here are snapshots of nine.

Shuttle Track

The Shuttle Track project has enhanced MIT's SafeRide shuttle van service by providing spatial location and estimated arrival times, viewable on a website. The team, composed of MIT graduate students from diverse backgrounds, has integrated three key technology components—GPS hardware, communication devices, and display technologies—in a cost-effective, sustainable manner. GPS position information is transmitted over radio to a network server, where the data is processed and stored in a SQLServer database. The data collected is also used with forecasting algorithms for estimating the arrival times of the vans at various stops along their routes. The Shuttle Track website displays updated-to-the-minute shuttle and route information and also hosts several web services that provide the same information via simple object access protocol over hypertext transfer protocol. The team continues to explore different methods of displaying the information to users, such as schematic route maps, telephone interfaces, and public displays.

iQuarium

iQuarium strives to give people a hands-on introduction to the field of ocean engineering by placing an aquarium display screen in an easily viewed setting—in this case, the Hart Nautical Gallery at MIT. iQuarium is a colorful, interactive aquarium display screen that features swimming fish and a visible flow field in their wake. The student team has created an animated fish screensaver with three-dimensional modeling and rendering software, based on libraries of empirical data that exist on fluid flow phenomena such as the complex vortices that form around live swimming fish.

Researchers usually collect this data in tow tanks and water tunnels. The tools to visualize the data are inaccessible to anyone other than researchers in the field; it takes weeks or even months to transform the sets of empirical data into visualizations using the latest software. For iQuarium, vertical flow field visualizations have been broken down into a library and brought together into a pseudo-real-time sequence that a user can control. Anyone who passes by the display is able to see the vortices shedding almost instantly as the fish swim. The iQuarium project brings hydrodynamics out of the lab into the hallway for everyone to gain a better understanding of the principles behind ocean engineering and fluid dynamics.

Software Tools for Environmental Study

Software Tools for Environmental Study has developed a mobile software application for environmental field studies that streamlines data collection and improves data accuracy. The project has created an electronic field notebook wireless PDA application that integrates the tasks of collecting data from environmental and GPS sensors, stores the data, makes computations in the field based on the data, and displays the data to the field worker and to others through an internet site. The technical project objective was to create mobile field data collection software for the environmental professional.

The project also has a strong educational component focused on providing hands-on product development experience to undergraduate environmental engineering majors. Through a six-unit undergraduate seminar, students were exposed to programming for Windows CE, technologies for field studies, and entrepreneurship in the software industry. Students in the seminar built a system prototype that was field tested during an independent activities period trip to New Zealand and Australia, offered under the auspices of the Department of Civil and Environmental Engineering. The team has recently been in talks with representatives from the government of India, who are interested in deploying this technology.

CycleScore

Aerobic exercise is not often engaging or motivating and would be more effective if it were as much fun as playing sports. The aim of the CycleScore project is to determine what kinds of motivational experiences are most effective for the use of aerobic exercise machines and to increase a person's desire to exercise by providing an exercise experience that is entertaining, motivational, and fun.

CycleScore has installed a working prototype of a stationary bicycle in MIT's Zesiger sports facility that connects an exercise bike to a PC and monitor. By pedaling the bike, riders control the flight of a hot-air balloon that floats above a mountain range on the attached computer screen. The harder they pedal, the higher the balloon soars and the higher is the cyclist's motivation to continue. The student project leaders hope to make this technology available to gymnasiums throughout the MIT campus and to the greater Boston/Cambridge area in the future.

LAMP: Library Access to Music

The Library Access to Music Project (LAMP) allows the MIT campus to share a single music collection legally and efficiently and to listen to albums on demand. LAMP showcases the good and legal efficiencies that technology and the internet can bring to music distribution while still respecting applicable law.

LAMP has assembled a large repository of recorded music, both classical and contemporary. Students use the web to access the music and to change tracks, as with a compact disc. The user hears the music through one of the 16 TV channels that MIT Cable has made available to LAMP. Once a song has been requested, others as well as the person who made the request may enjoy it.

Topobo

These researchers are using a three-dimensional constructive assembly system with kinetic memory in a series of educational workshops at the Boston Museum of Science to help children understand the relationships between natural forms and dynamic structures.

The Huggable

This project is designing and creating the Huggable, a sociable robot, designed with touch, responsiveness, and affect in mind, with the ultimate goal of distributing it to children in hospitals. Its sensate skin will allow the Huggable to know where and how it is being touched, and it will be able to move to turn toward the child.

Campus Tourbot

These students are creating an autonomous robot capable of giving multimedia-enhanced tours of the MIT campus. The robot will traverse the indoor corridors of MIT, allowing it to provide tours of the Infinite Corridor and buildings connected to the Infinite. The Campus Tourbot will enhance the tourist experience by tailoring its tour path and style to a given group. As the robot travels around campus, it will provide location specific information and opportunities for the tourist to request more in-depth information. The robot will also have the ability to communicate in many languages, eliminating the language barrier that is common in campus tours.

DomeView

DomeView is a series of electronic displays distributed throughout campus that interactively link the community by allowing its members to post and receive dynamic information about the campus. DomeView provides a portal for student groups and institute organizations to post material via the web about upcoming events and group information. A screen can show an assortment of topics, including a post for a cultural event, information from a dean's office, or an emergency post from Campus Police, all within a minute. Members of the community will become aware of the posts as they see DomeView screens along their regular routes through campus, and thus they will become vastly more aware of happenings in the community.

Hal Abelson
Director
Class of 1922 Professor of Computer Science and Engineering

More information about iCampus can be found at http://icampus.mit.edu/.