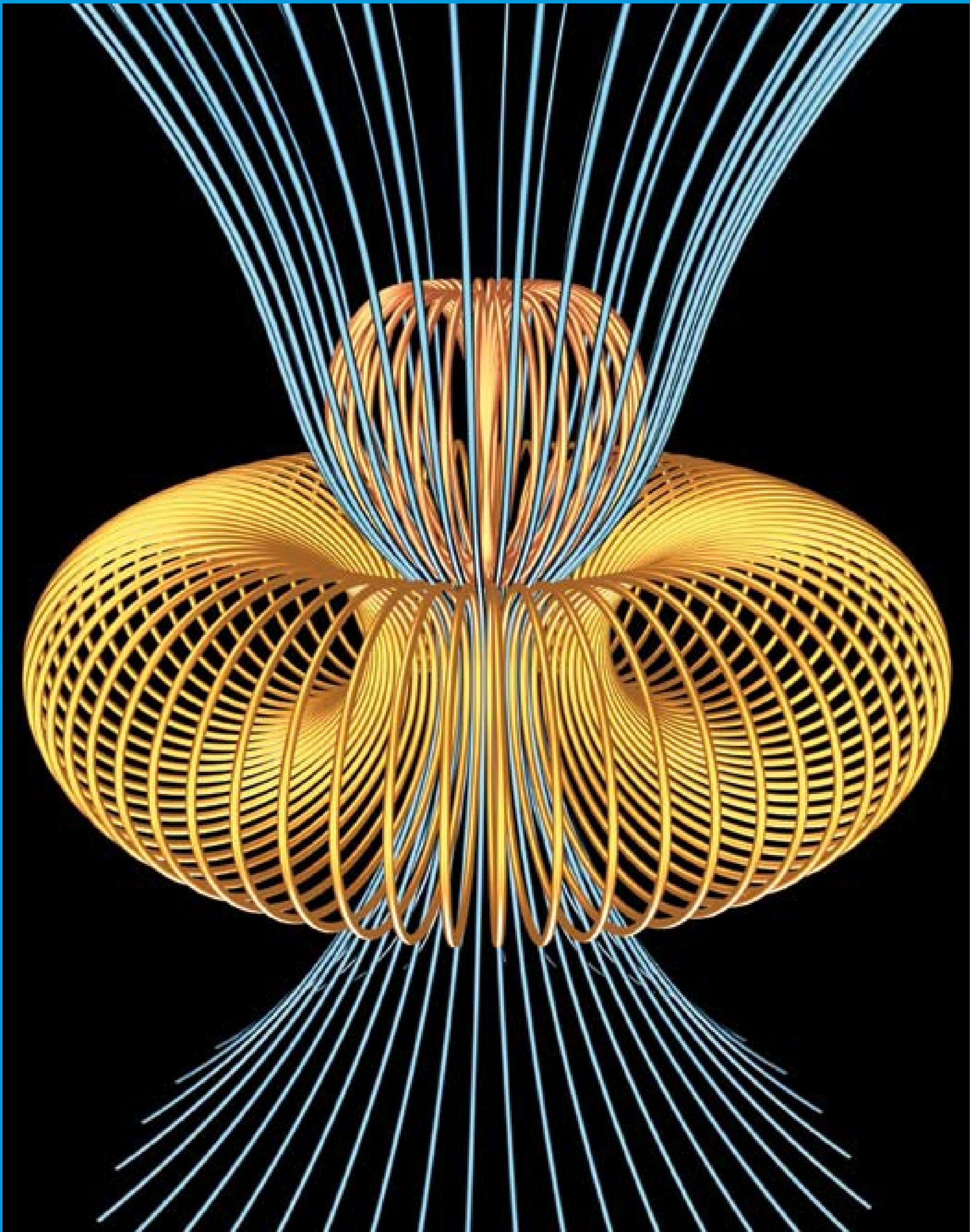
innovating
education
sharing
technology

iCampus
the MIT-Microsoft Alliance

"iCampus shows what we can achieve when researchers from Microsoft and academia work together to use technology to transform higher education. Investments like this that focus on the future of education are more important than ever."

—Bill Gates, Chairman, Microsoft Corporation



Fields of Current Rings (Mark Bessette, MIT) from “Visualizing Physics: Technology-Enabled Active Learning”

• Designate Student-Initiated Projects

iCampus: 1999–2006

Started in 1999, iCampus was a $25 million alliance forged between MIT and Microsoft Research with the goal of enhancing university education through information technology.

The iCampus initiative supported MIT's clear, overarching strategy for educational technology: to transform classrooms to accommodate active learning, promote the intellectual commons, foster new modes of inter-institutional collaboration, and build the extended university community. As a corporate partner, Microsoft Research approached iCampus as a key step toward establishing Microsoft as a leading technology partner for higher education.

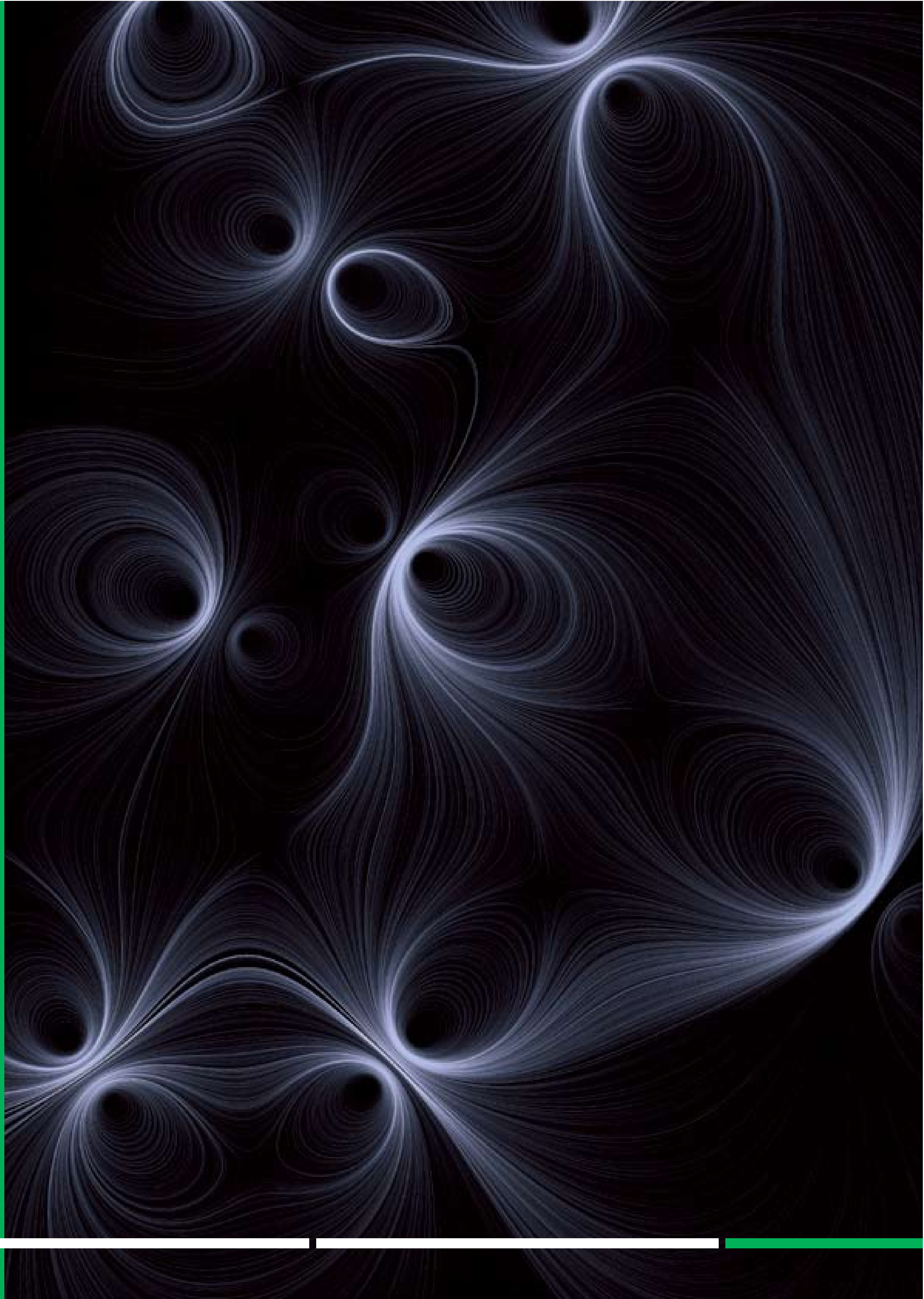
Over 50 projects in science, mathematics, and engineering—some led by faculty principal investigators and others led by students—focused on three key areas. Active Learning and Classroom Transformation projects emphasized project-based curriculum development and activities that brought concepts to life in the classroom. Another group of projects focused on Learning Services, the educational utilities needed to better manage classrooms, evaluate student understanding, move course content online, and facilitate distance learning. Emerging Technologies projects innovatively drew upon technology to enhance the everyday lives of students on the MIT campus, but also ranged from global robotics competitions to HIV/AIDS patient tracking in Africa.

At MIT, iCampus had enormous reach and influence. Over 500 MIT researchers, representing over 30 percent of MIT's engineering faculty and instructors, worked on iCampus research projects. On the student side, over 75 percent were enrolled in courses that were involved in iCampus projects. In the academic community, over 70 published papers and numerous theses were based upon iCampus research, drawing enormous interest in the U.S. and beyond. This led to 300 public presentations on iCampus research, high-profile keynotes, and substantial press.

Unique to an alliance of this scale, the creativity of MIT students was engaged directly, as iCampus evolved to accept proposals from students. Awarding over $1.5 million for projects conceived and implemented solely by students, iCampus exemplified its own objective of active learning and helped to take MIT's long practice of student involvement in research to a new level.

Perhaps the largest impact—beyond the influence of iCampus on pedagogical research—is the tangible way its technologies and practices are now being used and evolved by higher education institutions around the world with a network of hub and affiliate institutions adapting and evaluating iCampus technologies that have been made openly available. These partnerships have seen MIT students and faculty deployed to provide in-country support to help implement iCampus projects abroad.

As iCampus reaches its formal close, and outreach continues to spread its innovations globally, this book describes the faculty and student projects sponsored by iCampus and commemorates the lasting legacy of their efforts.



(right) Magnetic Trace (Michael Danziger, MIT) from “Visualizing Physics: Technology-Enabled Active Learning”

iCampus alliance joint address

The fateful choice of two men to share a car heading to the airport in the autumn of 1998 sparked the beginning of iCampus. On that ride, Bill Gates and Chuck Vest conceived a very simple but powerful idea. Could information technology impact higher education in ways that would improve teaching and learning at MIT and beyond?

Based on that premise, an alliance began to take shape over the next year—one that would affect more than 60 campuses across the globe. Building on our shared philosophical objective—to enhance university education through information technology—the exciting collaborative relationship tapped the collective, yet unique, talents of both organizations. Support from Microsoft Research—financial, technological, and human—combined with the extraordinary creative resources of MIT's faculty, staff, and students. The resulting research projects came to life across campus, making MIT a test bed for its own revolution—one that reached far beyond the MIT campus.

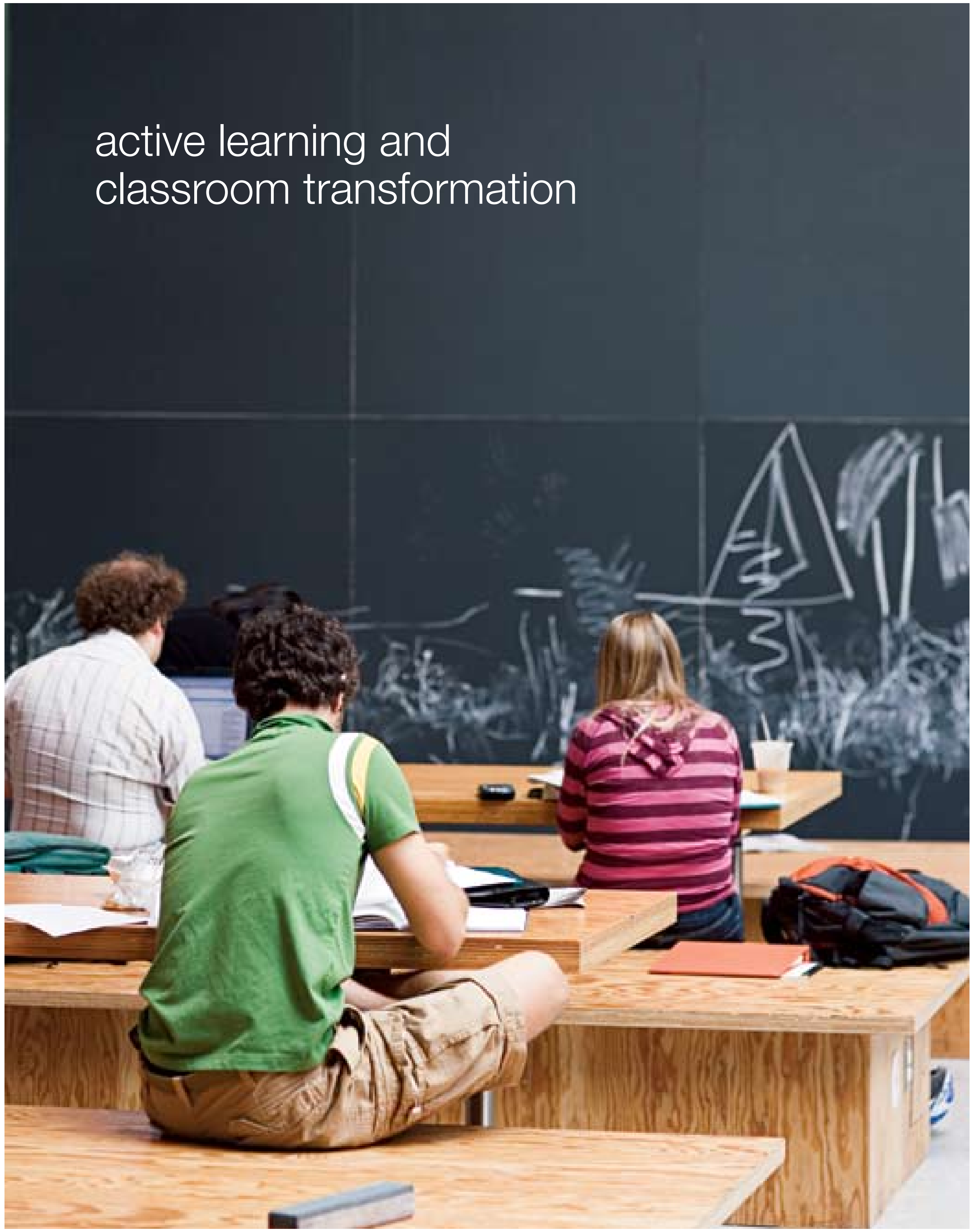
As partners embarking together on this exploration into unchartered territory, we could not have predicted where the initial vision would lead. The creation and dissemination of educational Web services, the reinvention of the higher education classroom, and the investigation of significant emerging technologies for education—all have had tremendous impact at MIT and beyond. iCampus pioneered several global learning Web-based services, including remote access to shared physical laboratory equipment (iLab) and shared services for writing instruction and essay evaluation (iMOAT). It promoted the use of IT-based "active-learning" systems in classes such as freshman electromagnetism, introductory computer science, architectural design, and Shakespearean drama. It also supported research on exciting new technologies, including pen-based computing, "magic paper," speech recognition technology, and emerging fields such as synthetic biology.

The impact of iCampus has been broad and deep. At MIT, iCampus has touched 150 courses, with a combined enrollment of over 7,200 students. Its 28 faculty-led research projects and 27 student-run projects have brought together faculty and student expertise from across traditional academic departments and disciplines, including about 400 researchers from MIT and Microsoft. Thirteen companies have been involved in collaborations such as National Instruments with the iLab project. Over its last two years alone, over 60 campuses have signed agreements involving the deployment of iCampus innovations. Projects like the MIT iLab remote laboratories have been disseminated and evaluated across the world with our university partners and have strengthened connections for inter-institutional collaboration and active learning outside of MIT and to the greater world.

We take great satisfaction in what iCampus has accomplished, both at MIT and around the world, through this seven-year collaboration. In true partnership, we have taken the best of our shared capabilities and developed something much larger than the sum of its parts. Looking ahead, we anticipate an even wider dissemination of our creations, which can create the momentum for a sea change in technology-enabled higher education.

Professor Thomas L. Magnanti
Dean of the School of Engineering, MIT

Dr. Richard Rashid
Senior Vice President, Microsoft Research



active learning and classroom transformation

TECHNOLOGY-ENABLED ACTIVE LEARNING

June 2000–June 2003

Technology-enabled active learning is a teaching format that merges lectures, simulations, and hands-on desktop experiments to create a rich collaborative learning experience. TEAL classes feature:

- Collaborative learning—students working during class in small groups with shared laptop computers
- Desktop experiments with data acquisition links to laptops
- Media-rich visualizations and simulations delivered via laptops and the Internet
- Personal response systems that stimulate interaction between students and lecturers

As a result of the TEAL project, MIT has replaced its entire two-semester freshman physics sequence (the largest lecture subjects at MIT) with studio-mode classes, where students work collaboratively on laboratory work in a computer-rich environment.

The TEAL group has also developed an extensive suite of simulation and visualization software for mechanics and electromagnetism, which is being distributed across the world through MIT OpenCourseWare.

Investigators: Prof. John Belcher, Dept. of Physics; Prof. Peter Dourmashkin, Dept. of Physics

Additional Information:
http://icampus.mit.edu/teal/

← "Today, for the first time in my life, I can say that I like Physics, because the class changed my point of view completely. I hope you will give this class again very soon, for the sake of all incoming freshmen."

—Anonymous Student in Freshman Physics

TECHNOLOGICALLY ENHANCED EDUCATION IN ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

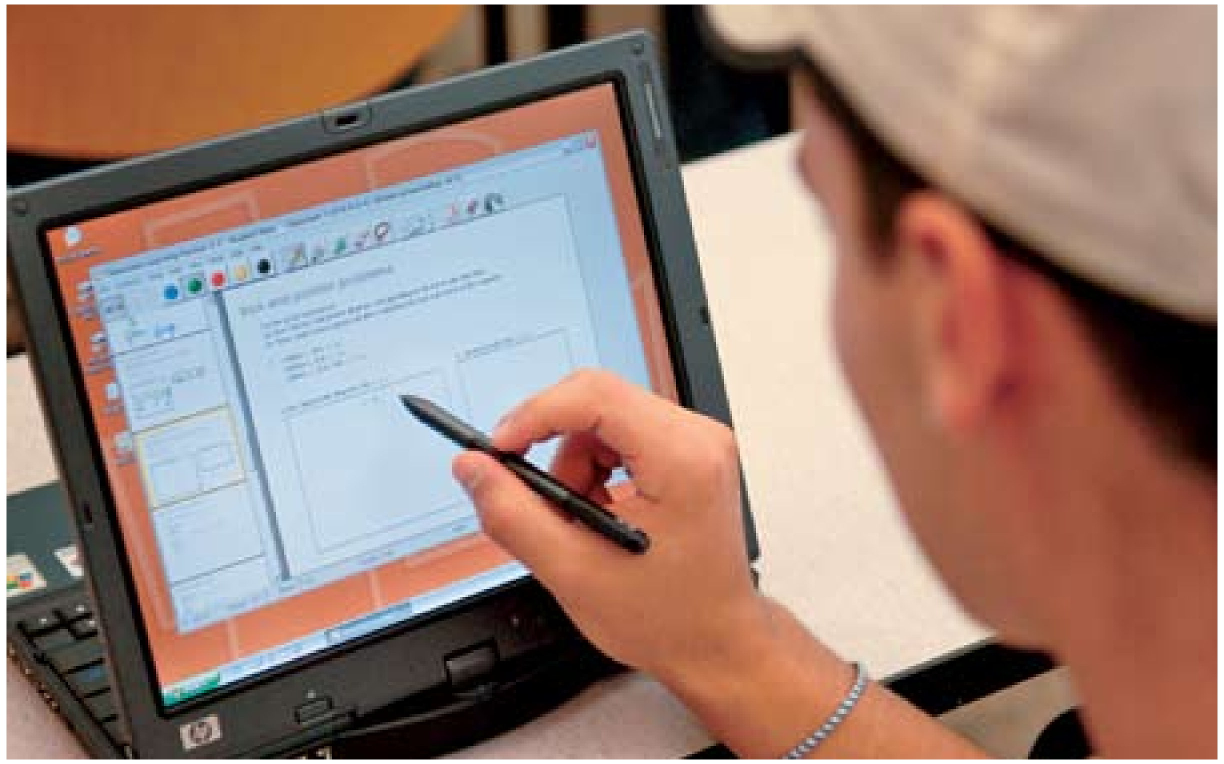
July 2000–June 2003

The Electrical Engineering and Computer Science Department created a Web-based delivery system for lectures, based on audio narrated slides and interactive uses of different combinations of online presentations based on narrated Microsoft® PowerPoint® slides and interactive assignments that provide immediate feedback, and deployed it in several core departmental subjects. This included completely eliminating live lectures in the introductory computer science course from fall 2000 through spring 2004, and continuing to use the material as lecture supplements. All students clearly agree there are strong advantages to the online lectures. It permits them to repeat missed details, clarify confusions, and works with the course material on their own schedules. The system also includes a platform (xTutor) for developing and administering online homework assignments with interactive tutorial feedback, and these assignments are now a staple feature of several department subjects.

Lectures and interactive problems in introductory computer science, artificial intelligence, and circuit design have been made publicly available via MIT OpenCourseWare, where they have been accessed by thousands of self-learners, and iCampus is working more formally with universities in China and Australia to support delivery of the lectures and tutoring problems at these institutions.

Investigators: Prof. Tómas Lozano-Pérez, Dept. of EECS; Prof. Eric Grimson, Dept. of EECS; Prof. Leslie Pack Kaelbling, Dept. of EECS; Dr. Christopher J. Terman, Dept. of EECS

Additional Information:
http://icampus.mit.edu/xtutor/



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INCREASING INSTRUCTOR-STUDENT INTERACTION AND STUDENT LEARNING IN LARGE CLASSES

June 2005–December 2006

In large classes, personal interactions between instructor and student can become almost impossible. While transmitters were already being used by students to submit answers via wireless polling, it was limited to posing closed-ended questions that could only assess recognition rather than true recall.

Using the existing Microsoft Tablet PC–based Classroom Presenter system, the Classroom Learning Partner (CLP) was designed to support exercises in large classrooms, as well as smaller ones. Lecturing with the system, instructors annotate their slides with digital ink displayed simultaneously on-screen and on student Tablet PCs. When slides containing exercises are presented, students work through them and anonymously submit their work wirelessly. The system software then applies artificial intelligence techniques to automatically classify and aggregate the student responses according to patterns specified by the instructor, enabling instructors to see aggregated views of in-class student work in real time, so that they can immediately address common misunderstandings and adapt their presentations.

In addition to developing interpretation and aggregation software, this project completed two studies that evaluated the hypothesis that the use of Tablet PC–based classroom presentation systems such as Classroom Presenter and Classroom Learning Partner increases student learning by (1) increasing student focus and attentiveness in class, (2) providing immediate feedback to both students and instructor about student misunderstandings, (3) enabling the instructor to adjust course material in real time based upon student answers to in-class exercises, and (4) increasing student satisfaction. Results indicate that this hypothesis holds true, and that use of the Classroom Presenter and the Tablet PC may be directly responsible for an increase in performance of students taking MIT introductory computer science. Particularly striking is the increase in performance of those students who might otherwise have done poorly.

The system will be disseminated to the Classroom Presenter community and made available to others via the Web.

Investigators: Dr. Kimberle Koile, Computer Science and Artificial Intelligence Laboratory; Dr. Howard Shrobe, Computer Science and Artificial Intelligence Laboratory; Dr. David Singer, Dept. of Brain and Cognitive Sciences

Additional Information:
http://icampus.mit.edu/projects/clp.shtml

NEW ASSESSMENT PROTOCOLS USING THE TABLET PC

September 2004–December 2006

Our research focused on the Microsoft Tablet PC and how it might be an asset for learning. However, even more importantly, we learned that its true value could best be assessed through the incorporation of four new research approaches. The first involved the evaluation of the Microsoft Tablet PC in combination with the specific software products with which it was used. Second, we learned that its value could be more accurately and specifically determined in the context of the teaching styles or methods that were used in different courses; third, that its value could be more accurately and specifically determined in consideration of the learning styles and preferences of the students who used the Microsoft Tablet PC.

As our research progressed, a fourth factor became paramount; that is, that more comprehensive and empirical standards for use in the assessment of educational technology were necessary. In consideration of this, we developed a number of research controls. Among others, this included carefully monitored experimental and control groups using the split-half method and a differentiated analysis of performance scores for each student. Through this process, we were able to quantify and validate some of the factors that seem to make the Microsoft Tablet PC useful and effective for learning.

In consideration of these factors, the Microsoft Tablet PC proved to be adaptable to the requirements of a wide range of university courses, including neuroscience, Mandarin Chinese, and computer science. This adaptability also served students well, individually. Students whose learning styles may not have been compatible with the teaching styles or methods of the instructor adapted the Microsoft Tablet PC to their educational advantage. One recurrent effect was to help those students who might otherwise have done poorly.

Several unique uses of the Microsoft Tablet PC seemed to have consistently positive effects on individual students. Many students benefited from the availability and convenience of using color with their notes, especially if they had a learning style or preference for using colors or the course made the use of color an advantage (e.g., biological sciences). Equally as beneficial to many students was the ability to integrate handwritten notes from the Microsoft Tablet PC with the downloaded reading material required in their courses.

Investigator: Dr. David Singer, Dept. of Brain and Cognitive Sciences

Additional Information:
http://icampus.mit.edu/projects/TabletPC.shtml

CROSS MEDIA ANNOTATION SYSTEM

October 1999–December 2006

The Cross Media Annotation System (XMAS) provides tools to enhance the use of video and image collections in humanities courses and in any subject in which precise reference to visual materials is needed. Close reading, analysis, and sharing of interpretation of textual materials have long been a central part of humanities teaching and learning. XMAS is based on the idea that humanities education is increasingly multimedial in character. We now need to reference film segments and images as rapidly and precisely as we can turn the pages of a printed book to find a marked passage to discuss or incorporate into an essay. And we need to share our interpretations in online discussions and as image-rich essays that can be read and responded to over the Internet.

Developed in conjunction with MIT's Shakespeare Electronic Archive project, XMAS has been used in MIT Shakespeare and Shakespeare on Film classes, with collaborators at Vanderbilt and other universities, and in distance seminars organized by the Shakespeare Association of America. XMAS can be used in conjunction with image and text collections, and is currently optimized for use with commercially available DVDs as video source.

XMAS allows users to rapidly define segments of film that can be replayed by clicking on automatically created links that can be saved in a list or dragged and dropped into discussion threads or online essays.

Students find that, when working on their own, XMAS helps them identify and define important clips, watch them repeatedly, analyze them closely, see things they believe they would not have seen without the tool's help, and generate and build on new ideas.

As the "connector" between the films and pedagogy, XMAS places the film "on a near-equivalent level with the text," reported a student. "It's like if you were in the theater and you had the actors on hand to play the scenes on demand."

Investigators: Prof. Peter Donaldson, Literature; Belinda Yung

Additional Information:
http://icampus.mit.edu/xmas/

TECHNOLOGY INFRASTRUCTURE FOR PROJECT-BASED LEARNING

January 2002–January 2004

Project-based design courses are an increasingly popular way of teaching robotics engineering because of the hands-on educational benefits. These types of classes, however, can be difficult for instructors to run because of the logistical challenges of requiring access to hardware and software laboratories, as well as a high degree of student autonomy outside of those settings.

Robot World systematized such courses to make them more deployable. The faculty team developed several tools and systems that leveraged Web-based learning services and knowledge checkpoints to ensure the learning of fundamental concepts and project-based design education stayed on a focused track. This includes "Take-A-Part," a set of modules where students used Tablet PCs to simulate the assembly of various mechanical artifacts, such as power tools; CoMeT, a design environment for creating compliant mechanisms such as springs and tweezers for micromechanical devices; PREP, a Microsoft SharePoint® –based environment to support the peer-review design process; and Inkboard, a Tablet PC–based multiuser sketching tool to support collaborative design.

Investigators: Prof. John Williams, Dept. of Civil and Environmental Engineering; Prof. Alex Slocum, Dept. of Mechanical Engineering; Prof. Martin Culpepper, Dept. of Mechanical Engineering

Additional Information:
http://pergatory.mit.edu/robotworld/
http://icampus.mit.edu/CoMet/
http://icampus.mit.edu/projects/robotworld.shtml

"This project will produce a core asset of robot-specific content, tagged in a manner such that it can be reused and repurposed. This content can form a valuable asset to drive the scale-up of the Robot World community to include other universities. Furthermore, it can function as a template for mapping and tagging content in other domains. We believe that there is an opportunity for MIT to take a world leadership position in the use of Design Project-Based Learning."

—Professor Alex Slocum, Dept. of Mechanical Engineering

ACTIVE LEARNING ENABLED BY INFORMATION TECHNOLOGY IN CIVIL AND ENVIRONMENTAL ENGINEERING

June 2000–June 2003

The goal of this project was to create activities that would empower students to take active roles in developing complex engineering systems ranging from buildings and bridges to entire cities.

Faculty in the Civil and Environmental Engineering Department developed a wide assortment of online modules that combine text, schematic figures, photographs, and simulations in the areas of solid mechanics and structural design. The modules introduce students to relevant principles, and then allow them to apply these principles in designing and analyzing structures through interactive simulations. Students manipulate the controls themselves to further explore the material. The group is also developing intelligent tutoring environments as tools to support active learning of the structural behavior of mechanical systems.

These tools enable students to answer questions as they move through the modules, and to receive feedback on the accuracy of their answers. The tools also help instructors see where students are struggling to understand the material.

The faculty also developed surveys and journaling tools to investigate students' ability to work effectively in teams on collaborative engineering design projects. The tools allow team members to see what others are doing, to share their work, and to exchange feedback in real time. Assessment of the students' performance, both individually and as a team, is considered vital and is being built into the collaborative environment.

Investigator:
Prof. Herbert Einstein, Dept. of Civil and Environmental Engineering

Additional Information:
http://icampus.mit.edu/projects/ActiveLearningCEE.shtml

"The Active Learning Project embodies both the challenge and the benefits of iCampus: teams of students and faculty working in diverse areas interact using information technology, recognize its importance in education, and, most importantly, recognize the importance of improving engineering education."

—Professor Herbert Einstein, Dept. of Civil and Environmental Engineering

ACTIVE LEARNING ENABLED BY INFORMATION TECHNOLOGY IN AERONAUTICAL AND ASTRONAUTICAL ENGINEERING

October 1999–June 2003

Beginning in 1999, the Department of Aeronautical and Astronautical Engineering undertook a comprehensive revision of its entire curriculum, integrated around the theme "Conceive, Design, Integrate, Operate" (CDIO), an educational approach adopted to better prepare students to deal with complex aerospace engineering systems. As part of this work, faculty transformed lectures to incorporate new techniques for active learning, such as personal-response systems, where lecturers pose questions to the class and students "buzz-in" their answers using handheld devices.

Faculty also incorporated the use of Microsoft Flight Simulator throughout the curriculum, developing add-ons intended to give students their own virtual aircraft and see how their design and modification ideas will affect flight performance. For example, modified gauges provide a moving target for students to track, and a second altitude needle, which oscillates at a specified frequency, helps measure pilot response and pilot-in-the-loop transfer functions. In the Air Traffic Control Subject, students have worked online with the virtual air traffic control community to simulate flying a Boeing 777 from Boston's Logan Airport to New York's JFK, using full air traffic control procedures.

The curriculum revision also established several new subjects, including a freshman "Introduction to Aerospace Engineering and Design," which features a major project where student teams design, build, fly, and race radio-controlled, lighter-than-air vehicles, and where student design teams located at different universities interact and consult with remote experts via videoconferencing software, and sharpen their individual contributions to the team, using surveys and journaling tools.

Based on these initial activities, the CDIO effort in engineering education has evolved into an international coalition that includes more than 20 universities.

Investigators: Prof. Dava Newman, Dept. of Aeronautical and Astronautical Engineering; Prof. Edward Crawley, Dept. of Aeronautical and Astronautical Engineering

Additional Information:
http://icampus.mit.edu/projects/ActiveLearningAA.shtml

DEVELOPING PUBLIC OPINIONS ON SCIENCE USING INFORMATION TECHNOLOGIES

January–December 2006

As an increasing number of complicated ethical and social issues involve scientific and technological debate, there is greater need to provide tools to further inform discussion. Museums present opportunities to explore complex scientific ideas and evidence that can shed light on current debate and hence support rich discussions. Designed for a museum environment, the POSIT project utilized Augmented Reality (AR) games previously developed by the Teacher Education Program and role-playing to help participants better understand alternative views.

These games allowed participants to move through physical spaces with a Microsoft Pocket PC and interact with virtual characters to help illuminate matters of public health, forensics, and history. Participants could express opinion ratings with a handheld slider, showing how new evidence could provide a rationale to form new opinions. These participatory simulations encouraged students to investigate the complex facets of difficult issues in order to arrive at informed decisions—a vital skill in complicated times.

Investigators: Prof. Eric Klopfer, Teacher Education Program and Dept. of Urban Studies and Planning; John Durant, MIT Museum and Science, Technology and Society Program

Additional Information:
http://icampus.mit.edu/projects/POSIT.shtml

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GAMES TO TEACH

June 2001–August 2003

This project was an interdisciplinary collaboration between faculty, staff, and students across humanities, sciences, and engineering to develop a series of conceptual prototypes for teaching science and engineering courses with games at the advanced high school and early college levels.

The project developed 10 game concepts to support learning and explored best practices in gaming and how to best apply them in education. The conceptual prototypes consisted of game design information, original creative artwork, sets of pitch materials, accompanying pedagogical rationale, and storyboards of user experiences and game play.

The goal of these prototypes was to provide grounded examples of next-generation educational gaming that would spark interest and dialogue among the game developer communities, interactive entertainment industry, leaders in higher education, and government and consortium funders.

Investigators: Prof. Henry Jenkins, Literature: Comparative Multimedia Studies; Randy Hinrichs, Microsoft Research

Additional Information:
http://icampus.mit.edu/projects/GamesToTeach.shtml
http://educationarcade.org

"What happens when you combine MIT-quality science, math, and engineering content with cutting-edge game play? Confronting this challenge forces us to not only expand the creative and technical possibilities of an emerging medium but also to better understand its cultural, social, and intellectual contexts. The Games to Teach project has allowed us to blow the lids off those dusty boxes of educational games we've come to regard as ineffective, uninteresting, and tedious. Our research has already attracted enormous interest from leaders in both industry and education."

—Professor Henry Jenkins, Literature: Comparative Multimedia Studies

ENGINEERING SCHOOL MODULAR PROGRAM FOR FLUID MECHANICS

June 2000–August 2003

The study of fluid dynamics plays a central role in many branches of engineering and science. Partly because of this ubiquity, fluid mechanics courses are offered in almost every engineering department, which results in redundancy and hinders the kind of interdisciplinary interaction that should occur. Given this challenge, a group of faculty across the School of Engineering developed a new Web-based teaching program for first-year graduate students.

The modules provide dynamic delivery that is rich in content and tailored to the students' interests, preparation, skill levels, and learning styles. By replacing the redundant courses on fluid mechanics in multiple departments with these innovative modules, educational interactions among faculty, students, alumni, and industries are enhanced.

Investigator: Prof. Chiang C. Mei, Dept. of Civil and Environmental Engineering

Additional Information:
http://icampus.mit.edu/projects/Fluids.shtml

ACTIVE LEARNING IN MECHANICAL ENGINEERING

June 2000–November 2002

Faculty in Mechanical Engineering transformed the introductory course, Mechanics and Materials, away from the traditional large lecture format and towards a Scientific Discovery model where students participate actively. The course discarded passive lectures in favor of a new instructional format where students performed small-group in-class experiments with desktop equipment, to explore phenomena before they were formally covered in lecture. The faculty also created Web-based learning modules for courses in thermodynamics, fluid mechanics, and heat transfer.

They also developed a mechatronics toolkit for use with laptops, to be used in the classroom/laboratory to run experiments and at home to interface with household appliances, power tools, toys, and workout equipment. The kit included a range of sensors, a data acquisition system, a motion controller, motors, and an easy-to-use software package, allowing users to monitor and control almost anything they desired.

Investigators: Prof. Mary Boyce, Dept. of Mechanical Engineering; Prof. Sanjay Sarma, Dept. of Mechanical Engineering

Additional Information:
http://icampus.mit.edu/projects/ActiveLearningME.shtml

LEARNING COMMUNITIES IN DESIGN EDUCATION

September 2000–December 2002

A crucial part of creative learning in studio-centered professional degree programs is the sharing of intellectual products with the greater community. StudioMIT provided an infrastructure for an open-ended collection of course curricula, digital images, workspaces, and exhibition spaces, all enhanced with communication capabilities.

The interactive personal work and exhibitions areas created by the project allowed members to represent themselves and their work to the community. In collaboration with the Social Computing Group at Microsoft Research, StudioMIT also developed StudioBridge, using radio-frequency-based location tracking graphically published over building or campus maps to better connect the MIT Architecture community. The work of StudioMIT validated how sharing of work, combined with the capability to discuss, exchange news, and share resources, stimulated social interaction between students and instructors.

Investigators: Prof. William Mitchell, Dean, Dept. of Architecture; Susan Yee, Dept. of Architecture; Lili Cheng, Microsoft Research

Additional Information:
http://icampus.mit.edu/projects/StudioMIT.shtml

"StudioMIT provides a powerful mechanism for students and instructors to interact. Coupled with the use of wireless laptops, StudioMIT not only allows students to access course content in a very dynamic way, but it also gives a real opportunity for students to participate in critical discussions, contribute creative work, and create a sense of community that supplements the traditional learning practices in the classroom."

—Franco Vairani, School of Architecture and Planning

LEARNING BY DOING

July 2000–December 2003

The exploration of fusing technology with pedagogical models is key to the iCampus Alliance. The Learning by Doing project was a collaboration between faculty in Electrical Engineering and Computer Science (EECS) that drew upon the expertise of the VaNTH Bioengineering Education Technologies project.

A collection of workshops and seminars allowed instructors, staff, and students to hear about recent developments in learning sciences and the implications on instruction. An observation system was also employed to assess what classroom interactions could benefit from constructive activities. These insights were used to distill the principles of a new framework upon which to develop technology-enabled tools for learning. Using widely available technological infrastructure and successfully proven pedagogical approaches, the project demonstrated how technology could be incorporated into educational activities in an efficient, supportable way.

Investigator: Prof. Martha Gray, Dept. of EECS

Additional Information:
http://icampus.mit.edu/projects/LearningByDoingHST.shtml

NEXT-GENERATION MOBILE CLASSROOM♦

February 2002–January 2003

Students often find it intimidating to ask questions in large lectures. Instructors, in turn, often have difficulty identifying students who are struggling to grasp course material concepts. In this project, personal digital assistants (PDAs) were distributed to students to communicate in large lectures and share questions with faculty in real time.

Designed specifically for use within the lecture hall, these PDAs displayed outlines of the day's lecture, allowing students to enter questions anonymously. Teaching assistants fielded the questions, allowing the instructors to address them at their discretion. Instructors could gauge student understanding by administering mini-quizzes via PDA. Outside of the lecture, students were able to use their devices to find study group partners and view updated exam schedules. The special-use PDAs provided a powerful example of how devices can serve to build stronger connections between instructors, their course content, and students.

Student Participants: Raj Dandage, Sonia Garg, Sanjay Rao

Additional Information:
http://icampus.mit.edu/projects/NextGenMobileClassroom.shtml

CLASSROOM COMMUNICATOR♦

June 2000–December 2001

Large lecture halls may inhibit student participation in class discussions if they fear a negative reaction from other students. Given this common behavior, faculty often have difficulty gauging student comprehension levels in their biggest classes. Using a cell phone equipped with a Web browser, students could communicate more comfortably with their instructors.

During breaks in class, instructors could access a frequently asked questions (FAQ) report generated by the Classroom Communicator software. The system also gave lecturers real-time quantitative measures of how well students understood the material presented, through quick evaluations like mini-quizzes. This provided lecturers the ability to focus their class time to best address the needs of the students.

Student Participant: Eric Brittain

Additional Information:
http://icampus.mit.edu/projects/ClassroomCommunicator.shtml

3D CONSTRUCTIVE ASSEMBLY SYSTEM WITH KINETIC MEMORY♦

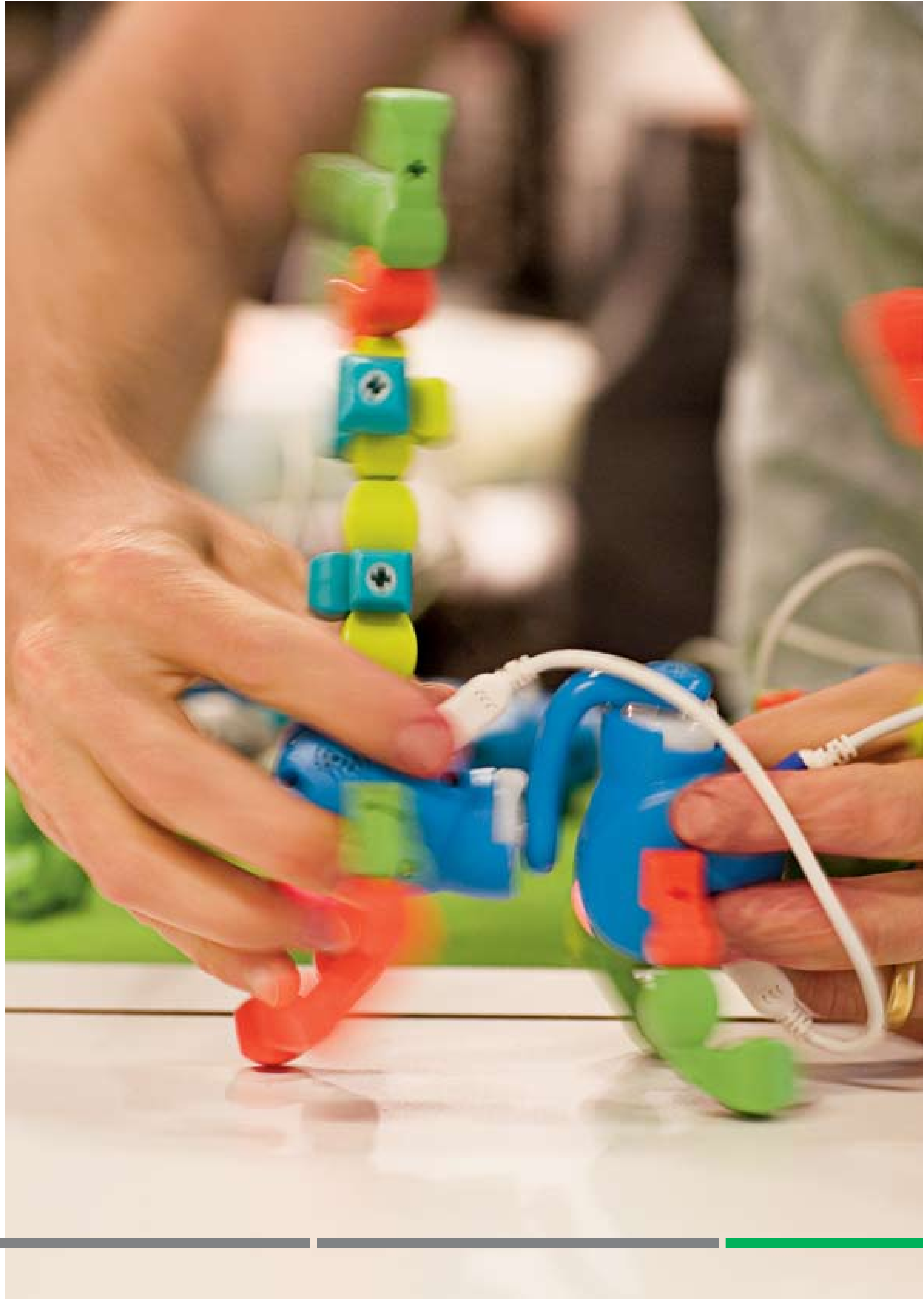
January 2005–December 2006

Computers and programming hold exciting potential for making new domains of knowledge available to children. These approaches often rely on screen-based activities, even when hands-on experimentation with physical objects is more critical to developing critical sensorimotor skills.

The project invented a constructive, 3D assembly system that was capable of recording and playing back physical motion. Just as children can learn about static systems by playing with blocks, playing with a Topobo set allows them to learn about dynamic systems and sculpt dynamic biomorphic forms in motion. By combining the most creative elements of educational manipulative toys with computation and direct manipulation abilities, Topobo investigated a compelling alternative model for using computers in elementary education.

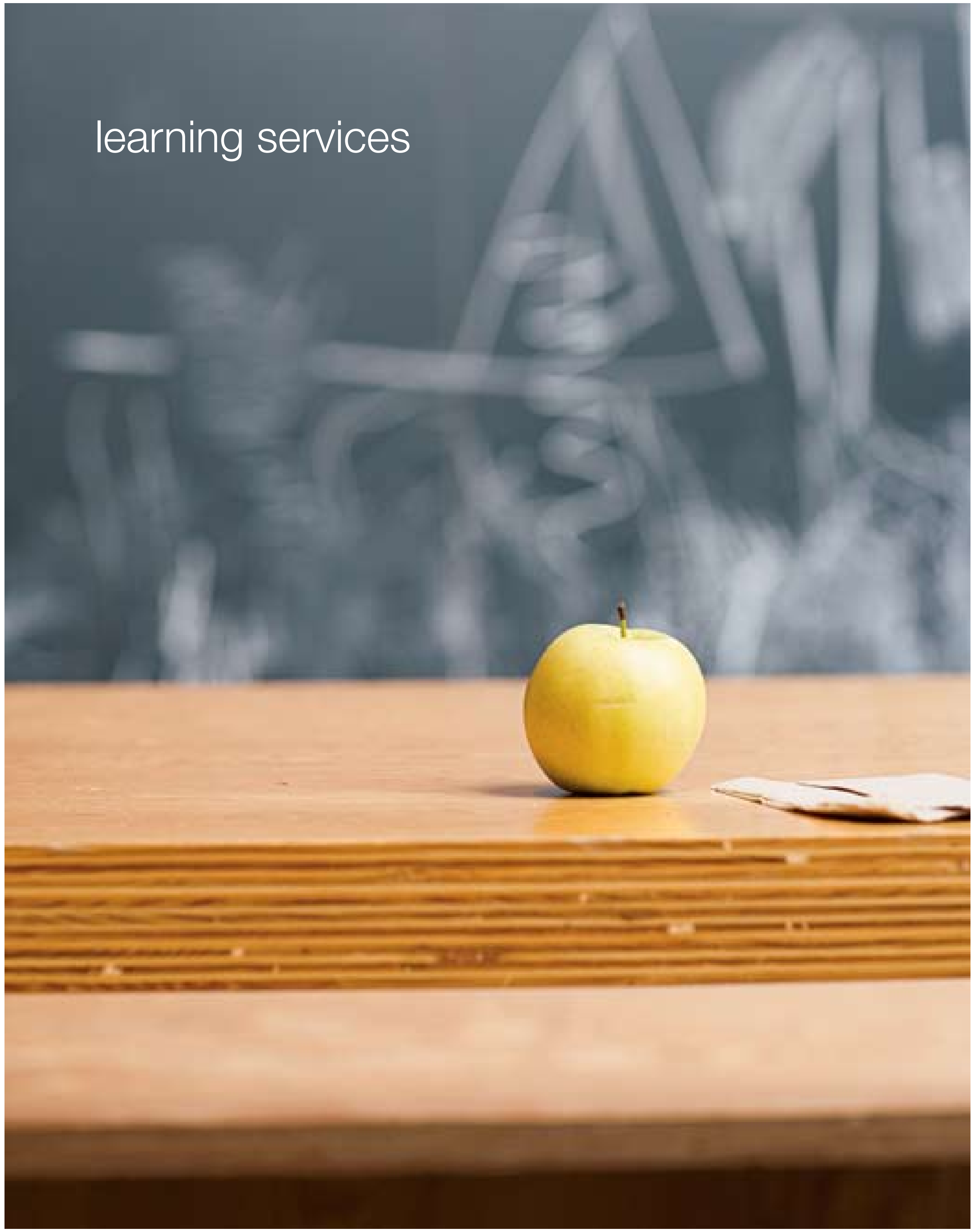
Student Participants: Hayes Raffle, Amanda Parkes

Additional Information:
http://icampus.mit.edu/projects/Topobo.shtml
http://web.media.mit.edu/~hayes/topobo/



(right) "Topobo," a 3D constructive assembly system with kinetic memory

learning services



REMOTE ONLINE LABORATORIES (iLAB)

June 2000–December 2006

iLab is dedicated to the proposition that online laboratories—real laboratories accessed through the Internet—can enrich science and engineering education by greatly expanding the range of experiments that students are exposed to in the course of their education. Unlike conventional laboratories, iLab can be shared across a university or across the world. The iLab vision is to share expensive equipment and educational materials associated with lab experiments as broadly as possible within higher education and beyond, thus profoundly changing the economics of engineering education.

iLab teams have created remote laboratories at MIT in microelectronics, chemical engineering, polymer crystallization, structural engineering, and signal processing as case studies for understanding the complex requirements of operating remote lab experiments and scaling their use to large groups of students at MIT and around the world.

"Other universities are following MIT's lead in using the Web to assess student writing abilities. This innovation, already known among writing program administrators as 'the MIT Model,' allows colleges to design tests for their institution that reflect each institution's educational philosophy and closely resemble the kinds of writing situations its students will encounter during their educational and professional careers."

—Dr. Leslie Perelman, Program in Writing and Humanistic Studies

One such laboratory, which allows students to take measurements of the current/voltage characteristics of transistors and other microelectronic devices, is now used every year in three different MIT courses. It is also regularly used by hundreds of students in several countries on four different continents. In addition, seven other iLabs were created to continue to promote shared access to high-quality laboratory equipment by educational institutions around the world.

To date, iLabs have been used in credit-bearing assignments by over 4,500 students, including students in the U.S., China, Australia, Sweden, Italy, Greece, and Sub-Saharan Africa.

Investigators: Prof. Steve Lerman, Center for Educational Computing Initiatives; Prof. Jesús del Alamo, Dept. of Electrical Engineering and Computer Science; Prof. Clark Colton, Dept. of Chemical Engineering; Prof. Eduardo Kausel, Dept. of Civil and Environmental Engineering; Prof. Greg Rutledge, Dept. of Chemical Engineering; Dr. Jud Harward, Center for Educational Computing Initiatives; Prof. Kevin Amaratunga, Dept. of Civil and Environmental Engineering; Prof. Larry Bucciarelli, Dept. of Civil and Environmental Engineering; Prof. Jackie Ying, Dept. of Chemical Engineering

Additional Information:
http://icampus.mit.edu/ilabs/
http://openilabs.mit.edu

MIT ONLINE ASSESSMENT TOOL

September 2001–June 2004

Writing skills are vitally important both in collegiate and professional environments. Yet writing placement exams in colleges are typically held in large classrooms that lack computer resources, preventing the exams from replicating the kinds of writing situations encountered in real courses.

The iMOAT project worked in collaboration with other colleges and universities to create a Web service, based on Microsoft .NET technology, that provides a more realistic environment for the assessment of student writing skills. Using this service, schools can develop, administer, and evaluate any sort of online essay examination, for example, writing placement exams for students entering the university. Because iMOAT incorporates and automates many of the best practices in writing assessment, it is superior to traditionally administered essay exams. Since students can take these exams at home, using a computer and software familiar to them, while having enough time to think about topics, plan their essay, and make revisions, iMOAT assesses the whole writing process in the environment in which students usually write. A growing consortium of universities is employing the iMOAT technology, allowing it to accommodate new best practices and needs, and engendering a system that will more accurately evaluate writing skills.

Investigators: Dr. Leslie Perelman, Program in Writing and Humanistic Studies; Chris Felknor

Additional Information:
http://icampus.mit.edu/imoat/

iCAMPUS FRAMEWORK

April 2001–December 2006

The iCampus Framework project demonstrated the benefits of a service-oriented architecture for the educational computing infrastructure at MIT. These benefits included the ability to modularize implementations of educational computing applications, create reusable components, and enable component and resource sharing within the university and across institutions.

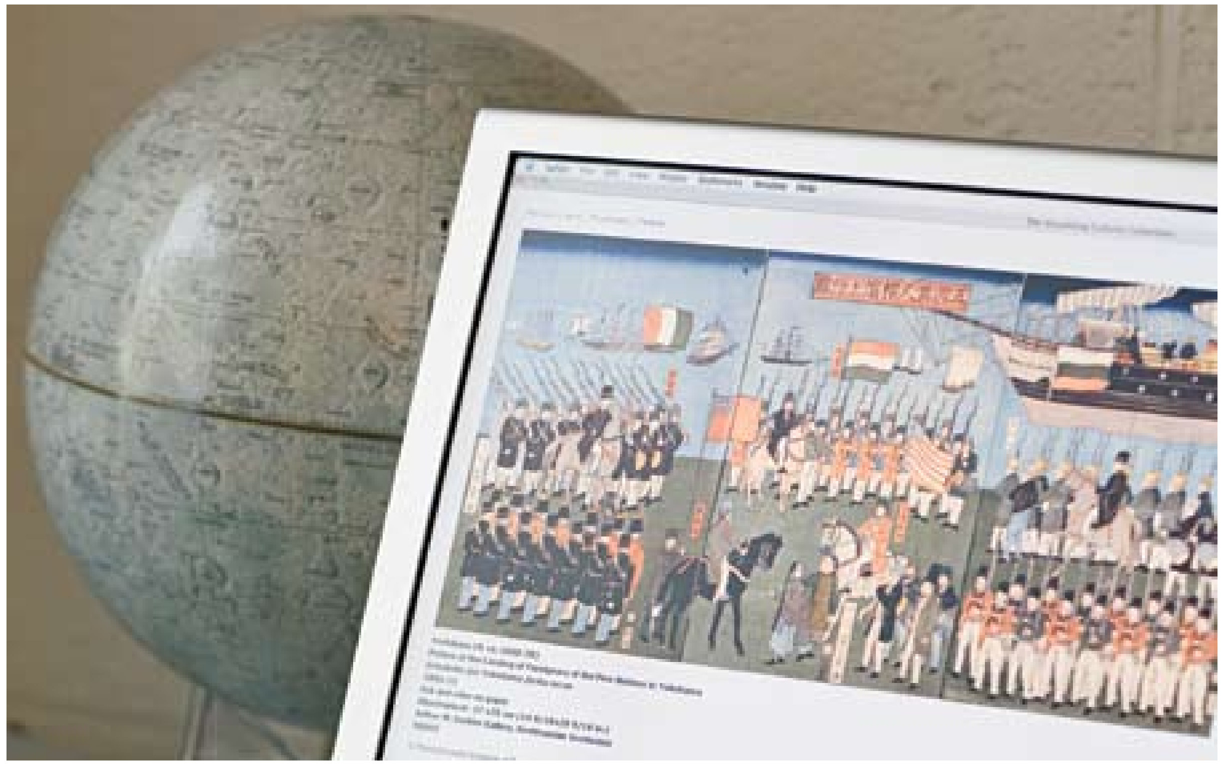
This project implemented a collection of Web services using Microsoft Windows Server System™ and the Microsoft .NET Framework to demonstrate interoperability with other Web service architectures that adhere to the World Wide Web Consortium's standards. The sample lab controllers built provided the basic authorization, resource allocation, event notification, and collaboration services required to deploy scaleable online laboratories across multiple institutions. These critical elements provided a foundation for two other iCampus projects—iLab and iMOAT.

Investigators: Prof. Hal Abelson, Dept. of Electrical Engineering and Computer Science; Dave Mitchell, Microsoft Research; Paul Oka, Microsoft Research

Additional Information:
http://icampus.mit.edu/projects/iCampusFramework.shtml

"When it comes to educational computing, most universities are technology islands, each with its own infrastructure for its own students and faculty. Web service frameworks could radically change the landscape for higher education by making it practical to create national and global shared resources for learning. Some examples we're working on in the iCampus Framework are shared laboratory equipment, shared libraries, and shared course materials, but the range of national and global collaboration on learning Web services could be limitless."

—Professor Hal Abelson, Dept. of Electrical Engineering and Computer Science



DSPACE: ARCHIVING OPENCOURSEWARE MATERIALS IN MIT LIBRARIES' DIGITAL ARCHIVE SYSTEM

January 2004–December 2006

MIT wished to use its OpenCourseWare (OCW) initiative to publish all its course materials as static course Web sites, available for free access worldwide, and to make course material available to scholars and instructors for inspiration and reuse. DSpace, MIT's institutional publication archive, makes that adaptation and reuse of materials possible with its professionally managed, structured, and sustainable digital archiving system, rather than the ad hoc methods that were used earlier.

As a result of this iCampus project, OpenCourseWare is now automatically archived to DSpace, using standards for content packaging as well as Web Services, and this valuable educational content is now under professional management for preservation over archival time frames. It can now also be disseminated from DSpace via a growing number of mechanisms, including work developed on the CWSpace project: Packager Plugins for Import/Export, an Application Profile for use of both METS and IMS Content Packages, and Web Services (WebDAV as well as SOAP) implemented on top of DSpace, called the "Lightweight Network Interface" (LNI).

Central to this project was the development of a new standard for tagging Web sites and learning objects to maximize preservation, as well as the implementation of ways to harvest content from OCW, using Microsoft Content Management System. The new approaches and standards that DSpace has applied to organization issues involving long-term archiving, content management, and Web publishing will ensure that valuable course materials from MIT will be optimized to achieve the highest-impact, longest-lasting results, both at MIT and worldwide.

Investigators: Ann Wolpert, MIT Director of Libraries; MacKenzie Smith, MIT Libraries Assoc. Director for Technology; William Reilly, Technical Analyst, Digital Library Research Group

Additional Information:
http://icampus.mit.edu/projects/dspace.shtml

VISUALIZING CULTURES: A VISUAL LEARNING ENVIRONMENT

June 2005–May 2006

Using new technologies, Visualizing Cultures weds images and commentary to illuminate social and cultural history in innovative ways. A narrative "Core Exhibit" not only gives the historical significance of the images, but also addresses issues such as genre and medium. Each unit comes with a comprehensive curriculum and carefully annotated digital archive of images from public and private sources. Through Visualizing Cultures, we are teaching students to create visual narratives on Indian culture, the Mafia, early photography, the Olympics, and so forth. Also, as part of our traveling exhibit of Black Ships and Samurai, we have established "teaching sites" for junior and senior high school teachers and students at the National Archives in Washington, D.C.; Boulder, Colorado; Tempe, Arizona; Honolulu, Hawaii; and San Francisco, California. The National Endowment for Humanities has also selected the Black Ships and Samurai site as one of the best online resources for education in the humanities.

Visualizing Cultures is a gateway to seeing history through images that once had wide circulation among peoples of different times and places. We do historical research this way as scholars to better understand how people saw themselves; how they saw others, including foreigners and enemies; and how, in turn, others saw them.

As a result of iCampus support, the Visualizing Cultures Image Database was developed and now features five online units with a federated search tool for easy access to the images collection in the Arthur M. Sackler Gallery, Smithsonian Institution, in Washington, D.C.; the Museum of Fine Arts, Boston; and the Hiroshima Peace Memorial Museum in Japan.

Investigators: Prof. Shigeru Miyagawa of Linguistics and of Foreign Languages and Literatures; Prof. John Dower of History; Jeff Merriman

Additional Information:
http://icampus.mit.edu/projects/VisualizingCultures.shtml
http://blackshipsandsamurai.com

CREATING THE GLOBAL CLASSROOM

December 1999–November 2000

The mission of enabling the truly global classroom requires international partnership. Building on the existing Singapore–MIT Alliance (SMA), the Singapore project was initiated to identify, test, and evaluate alternative pedagogies and the technology required to support them.

The Singapore project helped prioritize promising experiments and pilot tests that could be conducted as part of SMA and further its existing methodologies, with a major focus on the design of rich asynchronous content and interaction for distance education courses.

Investigators: Prof. Richard Larson, Dept. of Civil and Environmental Engineering; Jesse Heines; Melinda Cerny

Additional Information:
http://icampus.mit.edu/projects/Singapore.shtml

.NET-BASED OPEN SOURCE EDUCATION PLATFORM

November 2002–June 2004

MIT's Sloan School developed a proprietary course management system called SloanSpace. iLearn furthered this concept with a scaleable, open source e-learning platform with rich functionality for online communities, as well as management for learning and content.

Compliant with MIT's Open Knowledge Initiative and MIT's infrastructure standards, iLearn was implemented using enterprise-ready, flexible architecture based on the Microsoft .NET Framework. The development of iLearn contributed to providing valuable framework infrastructure in which software components could be shared within the university and across institutions. The work at the Sloan School evolved into the .LRN educational platform, an enterprise-class open source software for supporting online learning and digital communities, with more than half a million users in higher education, government, nonprofit, and K–12.

Investigators: Alfred Essa, CTO, MIT Sloan School of Management; Andrew Grumet; Tracy Adams; Genevieve Cuevas

Additional Information:
http://icampus.mit.edu/projects/iLearn.shtml

LEARNING FROM PICTURES

July 2002–August 2003

Scientific expeditions are life-altering experiences for the researchers who get to experience them. These expeditions generate incredible research and also incredible photography chronicling their field work, which, before this project, had no formal management or archiving methods. With the image pipeline developed by this project, everything a field team captures can be almost transparently stored in a sensible, sharable, and safe repository.

The first two expeditions in the project were to Bhutan and Cambodia. In Bhutan, MIT staff and students, as well as Bhutanese students, officials, and friends, were equipped with the latest digital photography and traditional film gear to capture a portrait of the country. Film was processed by scanning and archiving it onto a 2.54-terabyte server, and the data was merged with GPS logs. All 30,000 images collected can be viewed online. Besides the advances in digital archiving, the project also generated the world's largest bound books of fine-art-quality photography. The project's innovations in image management ensure that the magic of the visual record of MIT field research can be experienced by all.

Investigators: Dr. Michael Hawley, Dept. of Architecture; David Salesin, Microsoft Research

Additional Information:
http://icampus.mit.edu/projects/Expeditions.shtml

DISTRIBUTED MEDIA DISPLAY AND COMMUNICATION SYSTEM♦

February 2004–December 2006

This project identified the need for effective and reliable methods for large-scale communication at MIT. Overwhelmed by campus communications such as e-mails, the abundance of campus posters, and the difficulty of word-of-mouth efforts, students are provided with an alternative means of experiencing public notices with DomeView.

Using a series of electronic displays throughout the campus, DomeView allows its members to post and receive dynamic information about upcoming events and group activities. Postings are rotated on screens across campus on a timetable indicated by members. The system allows students to hear about cultural events, see updates from the Dean's office, and even get alerts from Campus Police, stimulating a greater sense of community.

Student Participants: Harel Williams, John Velasco, Rose Grabowski, Kathryn Walter

Additional Information:
http://icampus.mit.edu/projects/Domeview.shtml

A DECENTRALIZED MULTI-AGENTS APPLICATION♦

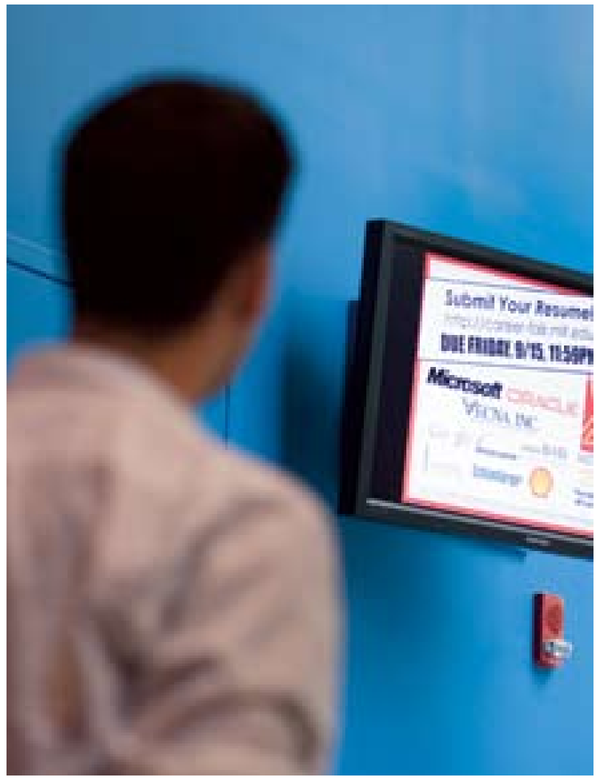
May 2001–August 2002

Finding personal academic connections at a large, highly decentralized academic environment like MIT can be a challenge. If they can be located, students can benefit from study partners or faculty mentors seeking research assistants.

Using a multi-agents framework developed for the project, PDAs, desktop PCs, and servers could authenticate and help build a trusted network of acquaintances according to matched profiles and building on research in reputation theory. The in-person interactions facilitated by this system enabled countless collaborations and study sessions for tutoring, final projects, and studying for exams. More importantly, iMatch provided a way to form a network capable of connecting students to the invaluable human experiences built around learning.

Student Participants: Lik Mui, Jennifer Louie, Michael McGeachie, Mojdeh Mohtashemi, Waikit Koh

Additional Information:
http://icampus.mit.edu/projects/iMatch.shtml



EDUCATIONAL TECHNOLOGY IN SUB-SAHARAN AFRICA♦

January–December 2006

Education is vitally important to lasting democracy and economic growth in Africa. Unfortunately, lack of learning materials, scarcity of qualified teachers, the epidemic of AIDS, and financial constraints are massive obstacles to learning across the continent. Information and communication technologies (ICTs) offer one way of delivering higher education to residents of Sub-Saharan Africa who would otherwise have no access to such institutions.

By incorporating the technologies of MIT's OpenCourseWare (OCW) and iLabs to provide remote access to MIT laboratories, the project demonstrated a sustainable model for sharing education content with this part of the developing world, initially Cameroon, Zambia, and Kenya. Besides providing a valuable resource to the African universities involved, MIT students were also able to evaluate the effectiveness of the new technologies and prove, over great distances, the power of remote learning.

Student Participants: Mohamed Haji, Fawah Akwo, Jamira Cotton, Marta Luczynska

Faculty Advisor: Prof. Shigeru Miyagawa

Additional Information:
http://icampus.mit.edu/projects/OpenAfrica.shtml

A COLLABORATIVE INFORMATION TOOL FOR THE BIOLOGICAL RESEARCH COMMUNITY♦

January–December 2006

In the field of biology research, information resources are often incomplete, out-of-date, and difficult to search. Experimental details are often shared anecdotally between researchers, offering little stable basis for sharing ideas and holding discussions around specifics.

OpenWetWare <openwetware.org> is a portal created and maintained by MIT graduate students in biology that promotes the open sharing of research, education, publication, and discussion in biological sciences and engineering. It provides a place for laboratories and individuals to organize their own information and collaborate with others easily and efficiently. It currently hosts sharing sites for 50 research laboratories from 30 institutions, including Boston University, Brown University, Caltech, Cambridge Research Institute, CNRS, Harvard University, and many others.

Student Participants: Jason Kelly, Danielle France, Barry Canton, Jeff Gritton, Reshma Shetty

Faculty Advisor: Prof. Drew Endy

Additional Information:
http://icampus.mit.edu/projects/OpenWetWare.shtml
http://openwetware.org

iQUARIUM♦

February 2003–June 2004

The principles of fluid dynamics involved in ocean engineering are not widely understood. Using 3D modeling and rendering software, the student team created a colorful, interactive, hydrodynamically accurate display of animated swimming fish to bring these concepts to life on a public display screen.

Using libraries of existing empirical data related to fluid flow, the simulation was able to illustrate such phenomena as the vortices that form around swimming fish. The iQuarium experience allowed users to control pseudo-real-time sequences of movement, allowing them to instantly see the vortices shedding as fish swam. iQuarium was an engaging and visually striking way to pull the concepts of fluid dynamics out of the lab and into the halls of MIT.

Student Participants: Katie Wasserman, Audrey Roy, Aaron Sokoloski

Additional Information:
http://icampus.mit.edu/projects/iQuarium.shtml

INSTANT SPORTS CHALLENGE♦

February 2002–January 2003

The Instant Sports Challenge project created an online instant matching and notification Web service (Champion Zone) to facilitate the instantaneous challenge and acceptance of tennis/squash matches. Future uses could include the beginning of term book exchange, notifications of class postings, discussion forum entries, and group project events. The service framework can be generalized to other 1-to-1 and 1-to-N relationships and become a campus-wide instant notification service.

To find a partner for a tennis game with Champion Zone, a user would input her skill level, her preferred court location, and the time and day she is looking for a game. When another person who is a good match signs on, the first user is notified. She then accepts or rejects, and the other user is immediately notified through his or her preferred method: AOL Instant Messenger, MSN® Messenger, Yahoo Messenger, e-mail, or cell phone.

The notification system has been written generally enough to communicate with various clients. The framework is also general enough that it could be used as a component in anything from a class information distribution to an online store, where people can request to be notified when new products meeting their specifications become available for sale.

Student Participants: Abel Sanchez, Hai Ning, Christopher Cassa, Matthew Notowidigdo, Daniel Robey

Additional Information:
http://icampus.mit.edu/projects/ChampionZone.shtml

"The iLabNotebook allowed us to streamline the process of scientific research, offering a multimedia environment for our scientists and students to document their work efficiently."

—Dr. Patrick Anquetil, BioInstrumentation Laboratory

DISTRIBUTED COLLABORATION SYSTEM FOR MARS GRAVITY BIOSATELLITE PROJECT♦

February 2003–January 2004

The Mars Gravity Biosatellite was a student-led project spanning three universities on two continents. Students at MIT, University of Washington, and University of Queensland collaborated to design, build, launch, and recover a low-Earth-orbiting satellite to study the effects of Martian-level gravity on mammals. The Information Systems sub-group of the Mars Gravity project team needed to create an array of distributed network servers based on Microsoft .NET technology to allow real-time access to critical information needed by the team.

The project focused its efforts on data distribution, allowing all team members easy access to data and reports over the Internet, as well as on the project management needed to assign, track, and manage action items across time zones. Finally, advanced video conferencing allowed meetings to be conducted more effectively with drawing and prototypes shown in real time. Building on available software, the group worked to build a software package that could be used by any project team working across long distances and applicable to many distributed learning environments.

Student Participants: Audrey Schaffer, Ryan Damico

Additional Information:
http://icampus.mit.edu/projects/MarsGravity.shtml

iLABNOTEBOOK♦

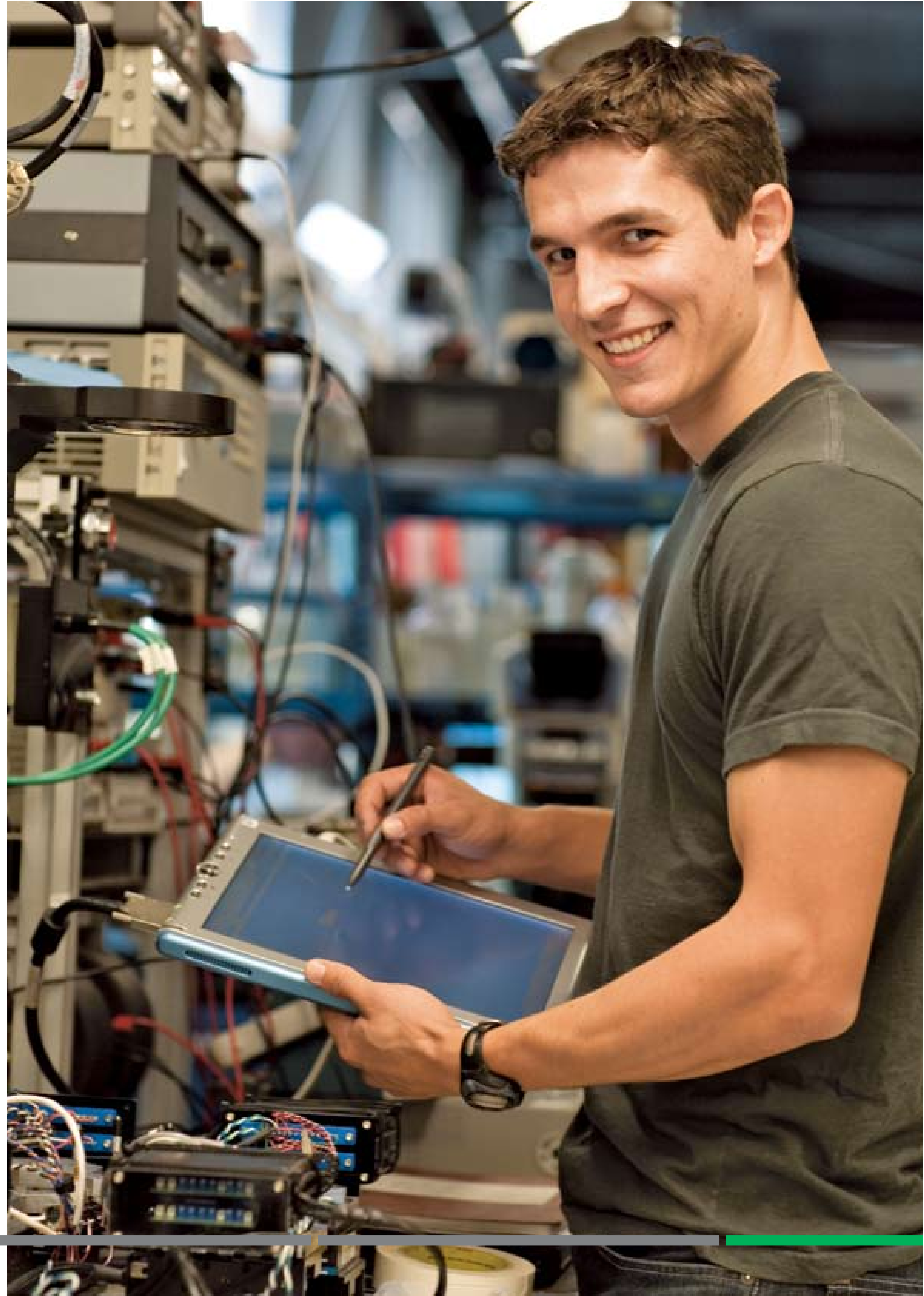
February 2003–January 2004

The traditional paper notebooks used in laboratories can limit the sharing of information with colleagues. Adding electronic media as a supplement to notes allows data to be more easily recorded and then accessed from a shared lab knowledge base.

The laboratory environment provides an ideal place for evaluating new technologies and experimenting with revolutionary concepts of conducting research. Using Tablet PC computers equipped with Windows® XP, an electronic prototype of the laboratory notebook was developed and tested. A typical lab notebook may contain setup descriptions, experimental data, chemical formulas, and other records with high value for the laboratory. With this new approach, the best lab ideas are liberated from the page to move to the people.

Student Participants: Patrick A. Anquetil, Andrew Taberner, Bryan Crane, Laura Proctor, Peter Madden, Rachel Zimet

Additional Information:
http://icampus.mit.edu/projects/iLabNotebook.shtml



(right) iLabNotebook student Nate Ball

“ShuttleTrack provides real-time Web-based tracking of MIT shuttles. We created ShuttleTrack as a novel combination of GPS-GIS, the cell-phone network, and Web services technologies. Now it is used campus-wide as a useful service for a more reliable and safer commute.”

—Sriram Krishnan

BUILDING COMMUNITY THROUGH ACTIVE CONTEXT MAPPING♦

January–December 2005

At MIT, there are a host of activities from which to choose. Identifying the best opportunities for enriching campus life requires a clear view of what is available within the contexts of location, class schedules and time.

The placeMap project provided a uniquely personalized view of a user's community life within an active spatial landscape, rather than through traditional interactive campus maps. By drawing information from databases, interpreting that data, and displaying it in relevant ways, placeMap optimizes students' views of opportunities for community interaction.

Student Participants: Matthew Hockenberry, Robert Gens

Additional Information:
http://icampus.mit.edu/projects/placemap.shtml

SHUTTLETRACK♦

February 2002–August 2003

Many MIT students who work late into the night rely on SafeRide vans to get back to their dorm or residence. Like any public transportation, however, the shuttles are subject to traffic and weather conditions, which can delay their arrival. Using GPS technology to track the shuttles online, students could access accurate, up-to-the-minute arrival times.

With the shuttles' position transmitted over radio to a network server, software used forecasting algorithms to accurately estimate arrival times at various stops along the route. This information was displayed via different methods to students, including schematic maps, telephone interfaces, and public LCD displays. Being able to accurately forecast arrival times of their transportation gave students extra time for their studies while ensuring a safe arrival back home.

Student Participants: Sriram Krishnan, Salil Soman, Sam Korb, Ilia Mirkin, Andrew Chen, Genevieve Cuevas

Additional Information:
http://icampus.mit.edu/projects/ShuttleTrack.shtml

↗

WEB-BASED DORMITORY MANAGEMENT SYSTEM♦

January 2005–December 2005

Many dormitories were plagued by inefficient and ineffective front desk systems, which often resulted in missing DVDs, lost or stolen packages, and a number of other problems. FrontDesk provided a tool for dormitories across the MIT campus to help facilitate reception desk functions. The customizable system allowed individual dorms to quickly search and locate dorm resources, such as equipment, DVDs, and other resources in real time.

Student Participants: Albert Chow, Luxiou Chen, Annie Ding, Edmund Kay, John Jackman, Zane Tian

Additional Information:
http://icampus.mit.edu/projects/FrontDesk.shtml

“STEFS was the first real opportunity for us as students to do cutting-edge research at the interface of environmental science and mobile computing. We cherished this opportunity enormously and took full advantage of the resources and momentum to develop a state-of-the-art field data collection system. The system is still innovative today, and I continue to receive frequent e-mails from folks interested in our STEFS products.”

—Enrique R. Vivoni, Graduate Research Assistant, Parsons Laboratory, MIT

STUDENT DEVELOPER'S COMMUNITY♦

February 2002–January 2003

DevHood (www.devhood.com) is an online student community for college students all over the world to come together to discuss, learn about, and teach each other about the Microsoft .NET Framework. Created by six MIT students on the Microsoft .NET platform starting in 2001, DevHood has evolved into a community with over 23,000 members from 400 colleges. DevHood incorporates a novel user experience and rating system that integrates elements of a traditional role-playing game with an online community, where user contribution metrics become the basis for players to advance in their “clan,” thus providing incentives for users to continue to contribute to the overall environment. The site also features forums and school-specific areas that can be personalized to the needs of the different communities.

Student Participants: Tien-Lok, Jonathan Lau, Edmund Chu, Peter Weng, Eugene Chiu, YiFung Lin, Norimasa Yoshida

Additional Information:
http://icampus.mit.edu/projects/DevHood.shtml

SOFTWARE TOOLS FOR ENVIRONMENTAL FIELD STUDY♦

June 2001–December 2002

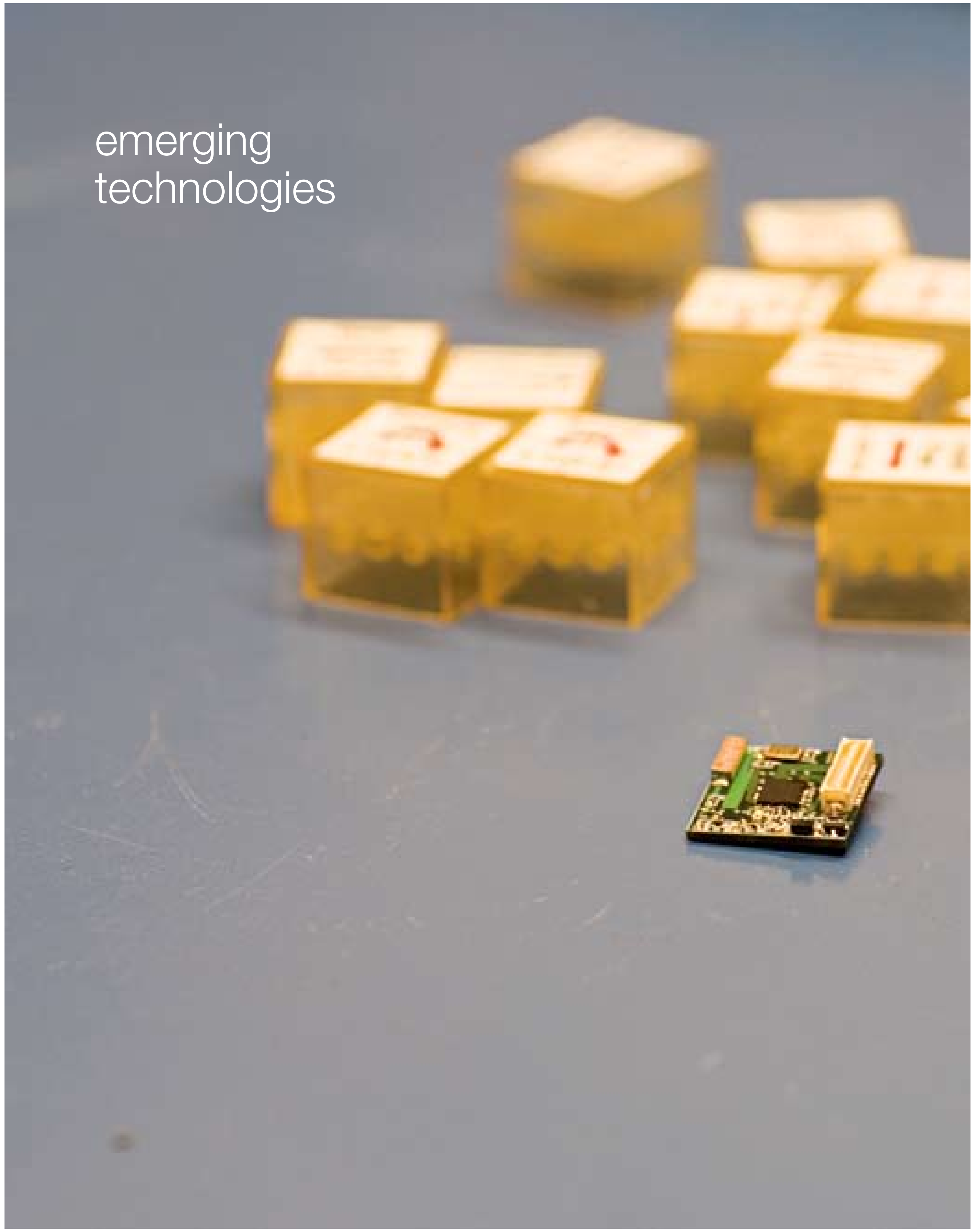
Conducting environmental field studies requires the collection of complex data and accurate computations. Often such complex recording and analysis of data still occurs with paper and pencil. The STEFS project explored ways to use mobile computing for efficient and inexpensive environmental and geo-positional data gathering through GIS, GPS, sensor, and wireless technology.

To assist these studies, the project created an electronic field notebook application that was capable of integrating and storing data collection from environmental and GPS sensors, and making computations from the field based on the data. This information could be easily displayed to field workers on-site and to others through an Internet site. The project provided hands-on product development experience to undergraduate engineering majors and incorporated programming for Windows CE, the technologies related to field studies, and actual testing on a trip to New Zealand and Australia. Projects like STEFS offer students a full view of software development—including conceptualizing, planning, developing, testing, and making the improvements needed to improve their studies out in the field.

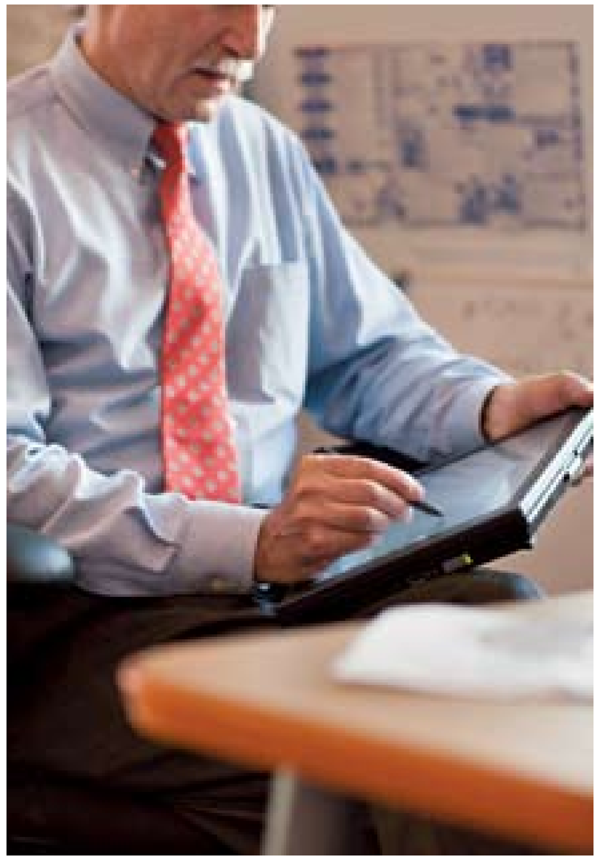
Student Participants: Enrique Vivoni, Daniel D. Sheehan, Kan Liu, Keyuan Xu, Richard Camilli, Rose Liu, Sheila Frankel

Faculty Advisor: Prof. Dara Entekhabi

Additional Information:
http://icampus.mit.edu/projects/STEFS.shtml



Wireless Sensors for Student Measurement



NATURAL INTERACTION

September 2003–October 2006

Ideally, designers should be able to sketch, gesture, and do work on their computers as naturally as they would interact with another human designer. Drawings and diagrams are common expressions of engineering ideas, but have been traditionally static and only understood by human eyes. Natural Interaction enables a novel form of interaction with software, making it possible to describe things by sketching, gesturing, and talking about them in a way that feels completely natural, yet have a computer understand the messy freehand sketches, casual gestures, and fragmentary utterances that are part and parcel of such interaction. Once the sketch is understood, the information it contains can be handed off to other applications for simulation, design checking, design completion, or refinement.

As one example, a person can sketch a simple mechanical system—a collection of balls, springs, containers, and inclined planes—and the computer can understand the drawing, "clean it up," and animate it according to the laws of physics. This application is now being distributed by Microsoft for Tablet PCs under the name "Physics Illustrator."

Investigator: Prof. Randall Davis, Dept. of Electrical Engineering and Computer Science

Additional Information:
http://icampus.mit.edu/MagicPaper/
http://rationale.csail.mit.edu/index.shtml

WEB-BASED WIRELESS SENSORS FOR EDUCATION

January 2005–December 2006

Curious students are often excited to tie theoretical knowledge acquired in the classroom to real measurements in everyday life. Taking sensitive measurements outside of traditional research settings requires sophisticated, yet low-cost, miniature sensors and software environments to support them. The iDAT project, which was designed with the hope of developing 50 such wireless sensors, eventually acquired over 100 wireless sensors for use in student projects.

Beyond the development of sensors for student measurements, the iDAT project augmented the free-form measurements that the wireless sensors allowed, with structured experiments designed to reveal specific physical principles and laws. To ensure additional student control over variables, sophisticated output devices were added. The second phase of the project culminated in the dissemination of the sensors to other institutions for evaluation. Eventually, these types of sensors will provide low-cost instrumentation for student projects at schools around the world.

Investigators: Prof. Ian Hunter, Director of MIT BioInstrumentation Laboratory, Dept. of Mechanical Engineering; Dr. Barbara Hughey, Dept. of Mechanical Engineering

Additional Information:
http://icampus.mit.edu/projects/iDAT.shtml

INTERNATIONAL GENETICALLY ENGINEERED MACHINE COMPETITIONS

February 2005–December 2006

The idea of engineering and building simple biological systems from standard, interchangeable parts that can operate within living cells is a compelling challenge. A serious obstacle in this new discipline of Synthetic Biology is the need for the development of standardized biological parts that are well specified and able to be paired with other parts of systems. Design competitions, such as robotics competitions, are a proven way of using student challenges to stimulate design, so this project was designed to bring that concept to this emerging field of biology.

After a period of productive independent activity, student teams competed against five other schools to build cellular state machines and counters, culminating in a jamboree that yielded such innovative designs as a photographic biofilm capable of capturing an image. A series of successive competitions, including ones bringing students together internationally, has helped stimulate a healthy, competitive environment that should accelerate biological systems engineering—and make its exploration more rewarding for students. Interest in the iGem competitions has grown enormously over the past two years. Where the first iGem competition in late 2004 attracted just five schools, the third competition in November 2006 attracted 450 students and teachers from 37 schools.

Investigators: Dr. Thomas Knight, Computer Science and Artificial Intelligence Laboratory; Randy Rettberg, Biological Engineering

Additional Information:
http://www.igem2006.com
http://icampus.mit.edu/projects/iGem.shtml

> "iGem has been an awesome experience. Working over the summer to create a novel project was really cool. ....I really liked the open attitude of the relatively small (but growing) Synthetic Biology [sic] and hope it continues. Innovation and creativity have been applauded, which is amazing."
>
> –Anonymous iGem 2005 Undergraduate Participant

SPOKEN LECTURE PROCESSING: TRANSCRIPTION, TAGGING, AND RETRIEVAL

September 2003–December 2006

In the digital era, it is easier than ever to record and disseminate vast amounts of audio-visual course content. For the most part, that material is not easily searchable or reusable because—unlike text—it cannot be easily searched or indexed to find, for example, a desired 10-second excerpt in an hour-long video.

This project used automatic speech recognition technologies to create systems that automatically transcribe, annotate, and even summarize recorded audio and video material by means of robust speaker-independent speech processing. The project researchers have created a publicly accessible demonstration lecture browser where video lectures from MIT OpenCourseWare and MIT World can be explored, using a search engine that indexes the automatic transcription. One goal of this work is to provide search and indexing capabilities for all OpenCourseWare video material.

Another output of this research is a Web-based spoken lecture processing server that allows users to upload audio files for automatic transcription and indexing. To help train the speech recognizer, users can provide their own supplemental text files, such as journal articles and book chapters, which can be used to adapt the language model and vocabulary of the system.

Investigators: Dr. James Glass, Computer Science and Artificial Intelligence Laboratory; Prof. Regina Barzilay, Dept. of Electrical Engineering and Computer Science; Dr. T.J. Hazen, Computer Science and Artificial Intelligence Laboratory; Scott Cyphers, Computer Science and Artificial Intelligence Laboratory

Additional Information:
http://icampus.mit.edu/projects/SpokenLecture.shtml
http://web.sls.csail.mit.edu/lectures

A ROBOTIC TOUR GUIDE FOR THE MIT CAMPUS*

January–December 2006

MIT tours traditionally involved a guide leading a group of visitors around campus as they described points of interest and fielded questions. Without a compelling view of the labs and events related to campus life, such tours provided a narrow perspective on the broad experience of life and learning at MIT.

By incorporating a robotic Campus TourBot guide, the tourist experience of MIT's Infinite Corridor and its connected buildings will be enhanced. The TourBot will tailor its path and style to the needs of specific groups, providing location-specific information and opportunities for tour participants to request additional in-depth information in multiple languages, as well as short films and greetings from faculty and administrators. Campus TourBot will provide an introductory touring experience of MIT that matches its reputation for research and innovation.

Student Participants: Collin Johnson, Jeremy Conrad, Kyle Vogt, Will Bosworth, Jason Steininger-Holmes, Behram Mistree

Faculty Advisor: Prof. Seth Teller

Additional Information:
http://icampus.mit.edu/projects/TourBot.shtml

CYCLESCORE*

February 2003–December 2004

Seeing a need to make on-campus life healthier, this project fused aerobic exercise with entertainment to provide motivation on the fitness equipment of MIT workout facilities. Treadmills and stationary cycling are important components of fitness, but they lack the stimulation of sports.

To encourage student exercise on a regular basis, activities, such as pedaling a bike, were linked to the progress of a simple game. By watching an attached monitor, exercising students could control the movements within the game or feel resistance to obstacles. CycleScore provided MIT's Zesiger Sports and Fitness Center with a working prototype that connected bikes to a PC to measure the relative effects of certain motivational experiences.

Student Participants: Joe Heitzeberg, Doron Harlev, Harris Rabin, David Edery

Additional Information:
http://icampus.mit.edu/projects/CycleScore.shtml
http://www.cyclescore.com

A ROBOTIC COMPANION FOR THERAPEUTIC APPLICATIONS♦

January 2005–December 2006

Many people lack access to companion animals or pet therapy. One alternative to the benefits that pets offer has been to use robots, such as Sony's AIBO, as pet surrogates. Since these types of robotic platforms were never originally designed to be used in this way, they do not invite the same types of interactions experienced with an animal, such as petting and other forms of affective touch.

The Huggable is an interactive teddy bear, designed to be a new type of robotic companion for therapeutic applications. The primary design goals are

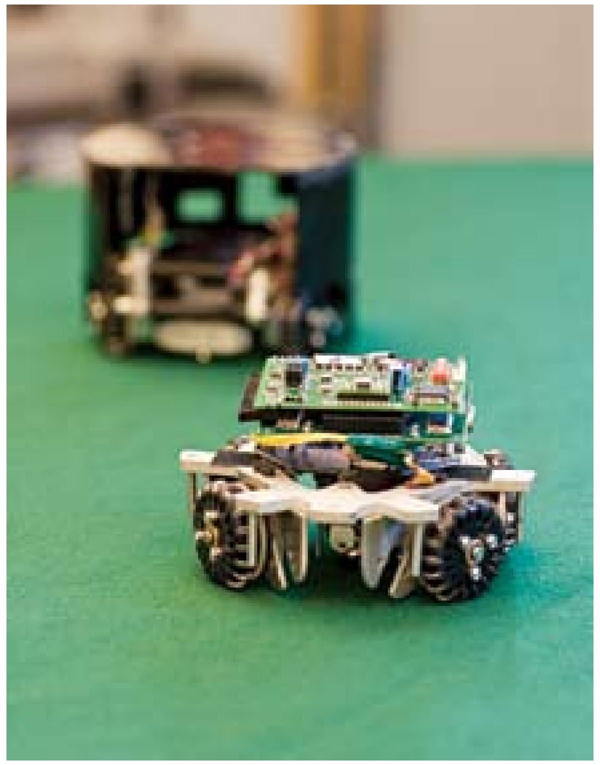
- To be viscerally and emotionally pleasing to interact with, both with respect to how it feels to touch and how it responds to people.
- To provide measurable health benefits to people.
- To be a useful tool for the nursing staff or other care providers that augments existing animal assisted therapy programs (if present).
- To be a computationally flexible platform that allows us to explore other applications for the Huggable technology.

Given these goals, the Huggable is being developed with a number of technological features—the most significant of which is a full-body sensate skin consisting of three different types of somatic sensors (electric field, temperature, and force) over the entire surface of the robot. The sensate skin technology resides underneath a soft silicone skin and fur fabric covering to make the teddy bear pleasing to touch. Other sensors include an inertial measurement unit, cameras embedded in the eyes, and microphones in the ears. We have incorporated a new kind of voice coil actuator (with position sensing) to give the Huggable silent, compliant, and backlash-free movement in the neck, shoulders, and face. These actuators are driven by a custom-designed motor controller board. An embedded Windows PC with wireless communication capabilities is used to implement the Huggable's behaviors, as well as provide the nursing staff with patient monitoring, and data collection capabilities.

Student Participants: Dan Stiehl, Jeff Lieberman

Faculty Advisor: Prof. Cynthia Breazeal

Additional Information:
http://icampus.mit.edu/projects/Huggable.shtml
http://robotic.media.mit.edu/projects/theHuggable.html



THE ROBOTIC FUTBOL CLUB OF CAMBRIDGE♦

January–December 2006

Competition is an excellent stimulant for great student design in robotics. Supporting a strong student robotics team internationally not only gives hands-on experience outside of the classroom, it also generates wider interest in robotics and artificial intelligence. The goal of this project was to design a team of soccer-playing robots to compete with other robots nationally and internationally in RoboCup and to also create a lasting foundation for an MIT team after its original members have graduated. The MIT team joined with students from Harvard, and the combined team made a striking "rookie" performance at the U.S. Open in Atlanta, qualifying to advance to the world championship.

Student Participants: Walker Chan, Matt George, Richard Gong, Kristina Haller, Andrew Harlan, Jeff Ma, Prabhas Pokharel, Jie Tang, Richard Timm, Jean Yang

Additional Information:
http://icampus.mit.edu/projects/Robocup.shtml

LIBRARY ACCESS TO MUSIC PROJECT♦

February 2002–December 2006

The illegal sharing of digital music content across users at universities has generated headlines and lawsuits. However, the availability of legal access to university music libraries can enhance the quality of life and learning for students. The LAMP project explored the idea that the licensing rules governing analog transmission are very different than for digital, and thus, using the MIT cable network, music on demand can be provided much more cheaply than over the MIT digital network.

Using a large, legally acquired library of both classical and contemporary music, LAMP allowed students to play music on demand over the analog MIT Cable network, controlling track selection via a browser. Easy access was provided through 16 TV channels of music across the MIT Cable network. This project showcased how a single university music collection could be shared and enjoyed both efficiently and legally.

Student Participants: Keith Winstein, Josh Mandel

Additional Information:
http://icampus.mit.edu/projects/LAMP.shtml

PATIENT CASE TRACKING FOR HOME-BASED CARE IN ZAMBIA♦

January–December 2005

Over the next decade, 50 million people will die from HIV/AIDS, while the number of people requiring medical care will become even larger. Sub-Saharan African agencies are already overwhelmed, as they attempt to cope with the enormous burdens placed on healthcare, which has created increasing demand for home-based care models.

To facilitate in-home care, outdated paper-based data tracking is being replaced by more powerful computer-based record keeping, which allows for more accurate, timely reporting on patient populations. Working with the 60 Community Home-Based Care (CHBC) programs of the Catholic Archdiocese in Lusaka, Zambia, the OpenHealth project helped digitize records in the form of a database with a Web-based front end allowing data entry and record analysis. The combined efforts of U.S.-based non-profits and local community healthcare have enhanced the care of over 20,000 patients.

Student Participants: Will DelHagen, Chris Emig, Joaquin Blaya, Carter Powers, Rohit Gupta, Aye Moah, Christy Eng, Jon Jackson, Zach Malchano, Tim Heidel, Christina DeFelippo, Samatha Goldstein, Nadya Oertelt, Alisa Rhee, Raja Bobilli

Additional Information:
http://icampus.mit.edu/projects/openhealth.shtml

REAL-TIME BOAT TRACKING FOR MIT SAILING♦

February 2004–June 2005

Sailing is an enjoyable sport for sailors, but not quite as enjoyable as a spectator sport. Watching races as spectators and coaches, it can be difficult to determine which boats are winning and how well they are sailing. GPS and radio technology can track sailboats in real time, displaying races on-screen so that spectators can easily observe the race and competitors can improve their skills.

The RiverRat project designed hardware and software to track MIT sailboats on the Charles River. Recording and playback of sailing tracks allowed for post-race analysis of tactics, strategy, and performance. Lightweight and robust, the tracking system is designed to follow up to 30 boats on the river, helping increase spectator involvement and serving as a tool for instructing sailing to both novices and advanced sailors. Tested at the MIT Sailing Pavilion, the RiverRat system has made the sport more accessible, safe, and easy to teach.

Student Participants: Claudio Cairoli, James Modisette, Douglas deCouto, Alissondra Springmann, Claudio Brasca

Additional Information:
http://icampus.mit.edu/projects/RiverRat.shtml

A student using XTutor—an extensible toolkit for easy customization of online courses

Continuing Innovation through Sharing: The MIT iCampus Outreach Initiative

As we commemorate the formal end of iCampus at MIT, we look to the future. In recent years, our principal investigators have focused increasingly on becoming ambassadors to disseminate iCampus innovation to institutions around the world. Using a network of hub institutions with an interest in implementing the core tools of iCampus, we have been able to provide first-tier support to other campuses—software, supporting documentation, and guidance. They, in turn, will evolve and share those tools with other affiliates, forming a strong global network.

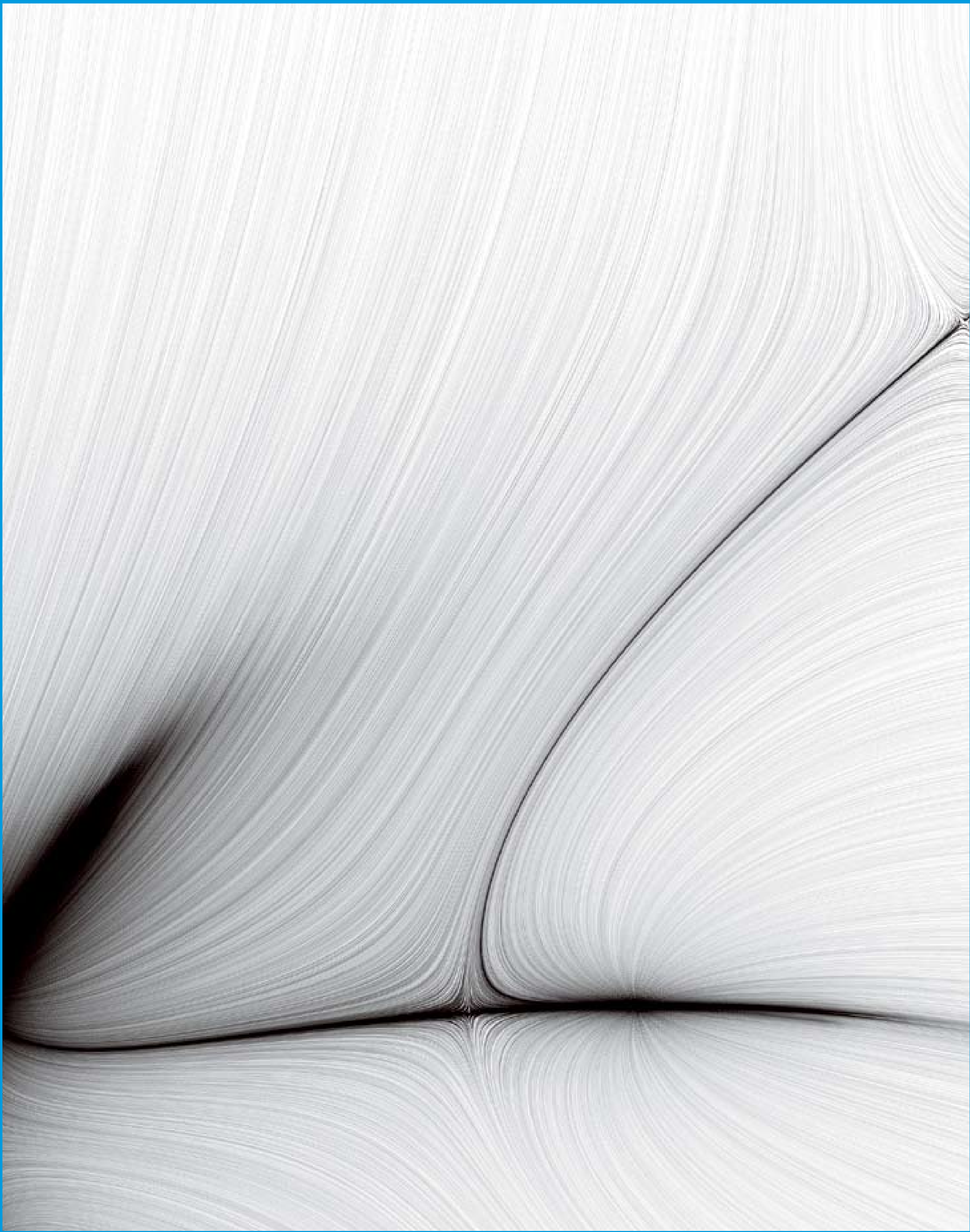
One of the most gratifying of these inter-institutional relationships has been in realizing the promise of the iLab architecture in Australia. Working with software downloaded from the iCampus Web site, the University of Queensland (UQ), an iCampus hub institution, integrated the iLab architecture into fourth-year control experiments in electrical engineering. The project was so successful that other UQ courses are seeking to adapt the iLab system architecture.

Projects like TEAL, iLab, XMAS, and XTutor will play significant roles in transforming learning around the world, spreading out from our initial hubs. These include universities in China, Taiwan, Mexico, and Brazil, as well as the University of Cambridge in the U.K., the University of Rhode Island, community colleges in the Maricopa Community College District, and even high schools such as the Windward High School in California.

We look forward to growing this community of like-minded faculty over the coming years. With Microsoft Research and these higher education partners, the iCampus Outreach Initiative will ensure continued momentum to the iCampus efforts begun at MIT.

“The fruits of the relationship of Microsoft and MIT are maturing from promise to broad, substantive, and sustainable global impact for our students and faculty. Working together, we will continue to change the educational universe.”

—Charles M. Vest, President, Massachusetts Institute of Technology, 1990–2004



Electric Trace (Michael Danziger, MIT) from “Visualizing Physics: Technology-Enabled Active Learning”

[redacted]

iCampus
the MIT-Microsoft Alliance

Microsoft Research

http://icampus.mit.edu/

Massachusetts Institute of Technology