

UNLOCKING KNOWLEDGE, EMPOWERING MINDS

A collection of case studies about MIT OpenCourseWare

May 2006

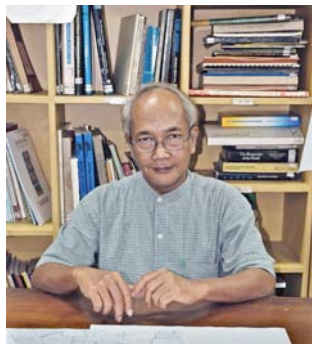
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EDUCATORS



The liberalization of learning

Triatno Yudo Harjoko, the University of Indonesia at Depok

Triatno Yudo Harjoko has a long and close association with the University of Indonesia in Depok, Indonesia. A graduate of the institution, Harjoko has also been a professor of architecture at the school since 1979, and is currently head of the architecture department. In addition, Harjoko has designed several of the university's buildings, including the expansive Faculty of Engineering complex, and the stunning University Mosque.

Harjoko characterizes the learning atmosphere at the University of Indonesia as primarily a one-way street, in which professors are assumed to be knowledge-bearers, and students are expected to master a predetermined knowledge base. This approach, while typical of many Indonesian institutions, is something that Harjoko has been attempting to change in his department. Together with his colleagues, Harjoko is redesigning the teaching model, moving toward an active, student-centered learning process.

Harjoko describes the main goal in this transition as “encouraging students to learn by themselves, and to be both critical and creative.”

In the redesign process, MIT OpenCourseWare — to which Harjoko was introduced by a colleague several years ago — has served as an immense comparative database for Harjoko and his fellow professors. Rather than directly transposing MIT OpenCourseWare syllabi to University of Indonesia courses, Harjoko and his colleagues have been scrutinizing MIT's courses to better understand how they were designed and developed. “We try to understand how the MIT courses are formulated,” Harjoko says, “and what the expected outcomes are. This gives us an important perspective on the learning process.”

Two courses for which this approach has been particularly helpful, he adds, are architectural theory and structure.

“I was surprised and amazed that such a renowned university as MIT would freely give access to almost all of its educational information to the world,” says Harjoko. “This is important, because critical thinking and creativity demand the liberalization of learning and information. But I also believe that it's not simply the information that's valuable, but also the glimpse it offers into how MIT has structured its teaching and research to become such a prestigious institution.”



Brushing up... and then some

Richard Hall, LaTrobe University in Melbourne, Australia

Richard Hall received a Ph.D. in computer science from LaTrobe University in Melbourne, Australia, in 2002. Shortly thereafter, Hall found himself playing a different role in LaTrobe's laboratories and lecture halls: teaching courses in introductory information systems, beginning microprocessors, and advanced computer-aided software engineering.

In early 2005, Hall learned that he would also be teaching a fourth-year computer graphics course later in the year. Hall knew immediately that the subject would demand a lot of work on his part, since he had had little experience with this rapidly changing field over the previous 10 years. While casting about for a means to brush up on the topic — intensively, and in hurry! — Hall recalled hearing something about MIT's OpenCourseWare from a member of LaTrobe's technical support staff. He decided to visit the site to see if he could find a solution there.

To his great relief, Hall found the lectures and labs from *6.837 Computer Graphics*, which guided him through an in-depth review of the subject. In fact, Hall credits 6.837's labs — which he completed over the course of several months — with not only fine tuning his existing skills, but also adding new techniques to his repertoire. The whole process, according to Hall, saved him "an enormous amount of time and stress."

Based on this experience, Hall plans to use a subset of the lectures and labs in his own course next semester. The MIT OpenCourseWare resource has enabled Hall to offer a course at what he calls a "stunning" level of quality. One of the best things about the MIT OpenCourseWare computer graphics materials, reports Hall, is how quickly and completely the students are empowered. "The students can get to the fun stuff immediately," Hall says. "They're generating aesthetic pictures right from the start, and all the while their math understanding is growing almost visibly in the background."

And Hall is equally impressed by the aesthetic approach of the materials. "I was also delighted by the weaving in of historical art techniques," he says, "and the way the material is so coherently presented. It is truly inspiring to see this level of excellence."



Experiencing the 'Western' approach

Kian Wah Liew, secondary school math teacher in Kuala Lumpur, Malaysia

A secondary school mathematics teacher in Kuala Lumpur, Malaysia, Kian Wah Liew introduces his 18-year-old students to a range of complex concepts, such as matrices, determinants, and differential equations. Though his lessons are conducted in Mandarin, the students use an English textbook — which tends to make Liew's life more complicated, since his students possess a wide range of abilities in both English and mathematics.

Liew, who discovered MIT OpenCourseWare several years ago while searching the Internet for self-study resources in math and physics, sometimes uses MIT OpenCourseWare video lectures to supplement his teaching. Because the topics are difficult, and the students' grasp of spoken English imperfect, Liew finds that he often has to narrate the videos as they play.

"Since a few lectures in the introductory level courses on OCW are similar to our syllabi, and because I like the way the lecturers conduct their lessons," Liew says, "I sometimes use the lectures in the classroom. I let the students watch a lecture — for example, the *18.03 Differential Equations* video — accompanied by my own explanations."

Liew readily admits that the MIT OpenCourseWare video lectures are sometimes too difficult for his students to fully grasp. But at the very least, he believes, the lectures introduce students to another approach to education. "OCW provides a chance for the students, who never learned in an English-speaking environment, to get an idea of how it would be when studying abroad," he says. In addition, Liew sometimes steers his most gifted students to other courses on the site to supplement their education. For example, he recently introduced a talented student to *18.06 Linear Algebra*.

The students are not the only beneficiaries. Liew, whose own education took place in Malaysia and Taiwan (a bachelor's of science in mathematics in Taiwan, and a master's of science in statistics in Malaysia), also appreciates MIT OpenCourseWare because it allows him to experience a Western approach to teaching: "The Western style spends more time on 'ideas' than 'examples.' Here, we spend 20 percent of the time introducing ideas and 80 percent in demonstrating these ideas through examples. At MIT, most of the time is spent on clarifying the ideas, and very few examples are given during the lectures."

Liew has only limited freedom to change his teaching approach, due to the tight syllabus-related constraints that he must work within. Even so, he says, OCW has been a very important resource to him: "The impact on my mind has been great."



Filling the management void

Ludmila Matiash, educator and management consultant in Kiev, Ukraine

More than 15 years after the Soviet economic system dissolved, management professionals and educators in Ukraine are defining a new paradigm for business. Ludmila Matiash and her colleagues at the Internet project *Management: Methodology and Practice* are addressing the need for resource materials on management education and organizational transformation in Ukraine.

"Universities can't respond fast enough to the needs of businesses here. Educators are redesigning their curricula but teaching methods take longer to change," Matiash says. "As management consultants we were experimenting with ways to improve our training and found MIT OpenCourseWare. We were inspired by the philosophy of the approach and the strategic implications. So we began to introduce the concept of open knowledge to Ukrainian institutions."

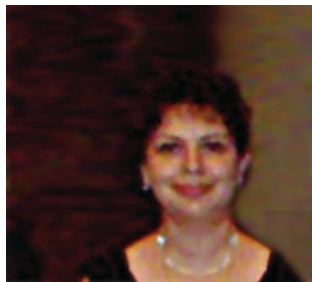
The legacy of the Soviet university system left a void in business education. "Business management is a new phenomenon in Ukraine — a completely different mentality. This calls for new skills and new thinking," Matiash says. "We started *Management: Methodology and Practice* because our business clients needed these materials. Soon we realized that the Web site is a change tool. We get to define what modern business management in Ukraine should be like."

Management: Methodology and Practice serves as a learning community in the Ukrainian, Russian, and English languages, offering Internet forum discussions on such topics as leadership and authority, quality issues, and motivating employees, to name a few. "We think we can form interesting discussion groups around the use of OCW materials," Matiash says. "If the process is moderated well, this would add value to different audiences."

For example, the preparatory questions and materials from *15.269: Literature, Ethics, and Authority* are helpful training and pedagogical tools. "Business leaders here are experimenting with the guiding principles of decision-making and leadership," Matiash says. "If we include examples from Ukrainian literature and historical experience we make the discussions relevant and more meaningful."

Management: Methodology and Practice already offered users an Internet glossary of management and business terms in translated Ukrainian before MIT OpenCourseWare, but now, with the help of MIT materials and other sources, Matiash and her colleagues have upgraded the dictionary to be more interdisciplinary. "We're adding entries which define key principles of organizational development, including concepts from [MIT faculty] Peter Senge and Stephen Covey," she says.

Born in the United States after her parents emigrated from Ukraine, Matiash first went to Ukraine in 1992 with the Peace Corps. She later worked for the World Bank and served with *Management: Methodology and Practice* in Kyiv for six years.



Teaching teachers in Guatemala

Waleska Aldana Segura, educator at the University of San Carlos

Since its establishment in 1676, the University of San Carlos has served as the center of higher education in Guatemala. In the past half century, it has also been a place where alternative opinions can be voiced, and new realities envisioned.

But the institution also has limitations, many related to its age and relative isolation. Waleska Aldana Segura, a professor of physics at San Carlos, runs up against these limitations in the thermodynamics class she offers for physics instructors. “When you try to teach certain subjects and you don’t have labs, or equipment, or any kind of visualization,” she says, “the students end up lacking the expertise necessary for their future success as physics professors.”

Segura therefore found herself looking for resources to supplement her teaching. Her first Internet explorations led her to the International Center for Theoretical Physics E-journal service in 2001, and the Los Alamos National Laboratory Web site, but these resources often proved too highly specialized for her students’ needs.

Then, three years ago, she discovered MIT OpenCourseWare through a Google search — and the effects of that discovery have been transformative. In Segura’s thermodynamics class, for example, the students regularly use simulations from MIT courses to explore complex physical phenomena. For the first time, Segura’s students can actually see what’s happening, even without access to a high-tech laboratory. This past semester, Segura also used the syllabus and exams from *3.00 Thermodynamics of Materials* and *3.205 Thermodynamics and Kinetics of Materials* for her own thermodynamics class. Some of Segura’s indigenous students balk at using course materials in English; in these cases, Univerisia’s Spanish language resources have provided a crucial alternative.

Segura is also involved in a long-term initiative to implement a faculty of education at the University of San Carlos — and in this context, too, MIT OpenCourseWare is proving an invaluable resource. Guatemala’s mountainous terrain makes travel arduous — and underscores the potential importance of online communication. Segura hopes to implement a site similar to MIT OpenCourseWare at the University of San Carlos, to allow students from all over Guatemala to access the university without the difficulty and expense of daily travel. This concept has the potential to transform education in Guatemala — and according to Segura, MIT OpenCourseWare is an important inspiration as the program moves forward. “The fact that MIT provides these materials, from so far away, without cost,” she says, “is simply extraordinary.”



Recovering precious minutes of class time

Hemalatha Thiagarajan, National Institute of Technology in Tiruchirappalli, India

Hemalatha Thiagarajan first discovered MIT OpenCourseWare several years ago during a search for materials on artificial intelligence. A professor of mathematics and computer science at the National Institute of Technology Tiruchirappalli in Tamil Nadu, India, Thiagarajan was dissatisfied with the traditional textbook on artificial intelligence, and was hoping to find materials to supplement her lectures.

The materials she found for *6.825 Techniques in Artificial Intelligence* were just what she was looking for, and she quickly adapted several PowerPoint presentations and lectures to fit her syllabus. To her surprise, however, the materials didn't just improve the content of her lectures; they also allowed her to cover more material in the same number of classes. "I used to spend a lot of class time drawing the pictures on the board," Thiagarajan confesses. "In data structures, for example, I need to show a lot of pictures of data trees and structures, and I had to draw all of them. Here, with the click of a button, I can show them something which has been very neatly and very beautifully done."

Initially, Thiagarajan says, the students were not entirely happy with her new approach. "For the first month, many of them felt that the course was moving too fast. Obviously, when I have to write everything on the board, I go more slowly, so they get a lot of time to follow the whole thing. When I use the slides, everything moves more quickly."

In the end, though, Thiagarajan received rave reviews from her students — both on the amount of material she was able to cover, and the quality of the MIT materials.

Thiagarajan also has found that MIT OpenCourseWare is a valuable resource for students who would benefit from a deeper look at a particular topic. In her own teaching, Thiagarajan is constrained by a rigid university syllabus. So when a topic emerges in class that she cannot spend enough time on, she is quick to steer her students to MIT OpenCourseWare. "I've told my students that some of the OCW courses would be very, very useful for them. Things like, for example, database management, or microprocessors. I can't cover these topics fully enough, but they're important to the students. And when the students do follow up, and look at the material, they find it very useful."



Points of access in the developing world

François Viruly, University of the Witwatersrand in South Africa

As director of a leading South African real estate analysis firm, property economist François Viruly has acquired extensive experience in the South African commercial real estate market over the past decade. Viruly is passionate about his field, and makes an effort to share his expertise with students at the University of the Witwatersrand in Johannesburg, as well as the University of Cape Town and the University of Pretoria.

One of Viruly's regular courses is a property investment module for graduate students at the University of the Witwatersrand. When Viruly first began teaching the module several years ago, he chose as his textbook *Commercial Real Estate Analysis & Investments*, a graduate-level real estate text written by MIT professor David Geltner. As Viruly began to design the module as a complement to the text, he came across MIT OpenCourseWare and was excited to discover that the author himself had already structured a course, *11.431J Real Estate Finance and Investment*, to fit the text. Viruly readily adapted a similar structure to fit his module.

"OCW is just a great system," says Viruly. "It opens up knowledge across the world, which I think is critical. And it allows universities like ours—and I think this is important by itself—to benchmark our teaching. It gives us confidence that we're in close contact with the international body of knowledge, and international standards. In addition, it assures the students that they are receiving high-quality instruction. What it really means to them is that we are following a course and a methodology which is of the highest caliber."

Asked if real estate instruction can really follow the same model in countries as different as the United States and South Africa, Viruly admits that there are some crucial distinctions. "Obviously, some of the course material is focused on the United States," he says. "We have specific issues in a developing country, and so we complement the OCW materials with South African material, and substitute different assignments. Nevertheless, I think the OCW model is especially important in developing cultures. It can make such a difference to students here to have access to the best professors in the world."



Why reinvent the wheel?

James Wixson, product development instructor at the University of Idaho

When the University of Idaho asked James Wixson to design a new course on product development, the assignment struck Wixson as somewhat daunting.

The subject matter was not the problem. Wixson — an advisory engineer in systems engineering at the Idaho National Laboratories, and affiliate instructor for the University of Idaho — had extensive experience in product development. In fact, his MBA thesis detailed techniques for improving new product development through value engineering. But Wixson had designed courses from scratch before, and he knew from experience how arduous and time-consuming the process could be. “I learned the hard way,” Wixson says. “The last course took such a long time. So I thought this time, I’ll do a little research, and find out what other people are doing out there.”

Wixson’s research led him to *15.783J Product Design and Development* on OCW, and he was impressed by both the content and format of the material. “I was looking specifically for courses in product development,” he says, “to see what texts that they were using, and get an idea of the syllabi, and see how they taught the course. I had run across some other courses out there in product development, but this really stood out. This was such a complete, complex course, and they had a good syllabus — so I decided I’d just basically use it, with some minor modifications.” These modifications included additional content on value engineering and systems engineering, reflecting Wixson’s own interests and background.

Wixson worked closely with MIT OpenCourseWare staff to adapt the MIT course content for the University of Idaho. The resulting site looks remarkably like the original MIT OpenCourseWare page — but with added lines of magenta text that reflect Wixson’s content modifications. The collaboration has resulted in a course that is deep, rigorous, and tested.

The most surprising part, for Wixson, was that MIT’s materials were available free of charge. “I couldn’t possibly have paid for this curriculum — it would have been prohibitive,” says Wixson. “So it certainly helped me out, to have this course, rather than starting from zero.”



Unexpected opportunities

Zhang Wenhua, Mudanjiang Medical College in Heilongjiang, China

When Zhang Wenhua first visited MIT OpenCourseWare, he hoped to find resources that would help him teach electrical technology to his students at Mudanjiang Medical College, in the Heilongjiang Province of China.

Zhang was not disappointed.

In fact, the MIT OpenCourseWare materials on electrical technology transformed both the content of his courses and his approach to teaching. But to his delight, Zhang also found resources that helped his own research on motor control — a topic that had fascinated him for years.

Zhang first heard about MIT OpenCourseWare in early 2004, through a program on Chinese national television. At the time, a limited amount of higher education information was available from Chinese universities, but Zhang was immediately intrigued by the possibility of getting additional material from MIT.

“I teach the students electrical technology,” Zhang says, “including information on circuitry, and the basic principles of transformers and motors. On OCW, I found information on this subject that was very helpful. And in addition, I was able to find courses on motor control — microprocessors, and control theory. This is something I’m really interested in, and I wanted to do some big research, some application, try to put the technology of motor control in practice. OCW gave me the resources to do this work.”

Zhang was also profoundly influenced by the pedagogical approach of MIT’s professors. “When I first visited OCW,” Zhang says, “I watched several clips of demonstrations in electromagnetics and other subjects. I was amazed by the fact that the professors at MIT do quite a lot of experiments. They provide us with clips, short movies, about these experiments. I realized, watching these clips, that these experiments help the students to better understand the theory. This has changed my method of teaching. Since then, I have been trying to provide the students with more demonstrations, and to ask them to do their own experiments more carefully to understand the theory.”

STUDENTS



From diving to 'surfing'

Rogelio Morales, PhD candidate at Central University of Venezuela

A metallurgical engineering graduate of the Central University of Venezuela, Rogelio Morales has some unusual entries on his resume. For one thing, he is a licensed commercial diver, and once worked as a professional diver for eight months with Titan Maritime, and as the trainer for commercial Diving with the Divers Institute of Technology, in Seattle, Washington.

Morales loved his underwater work, but quickly decided that he was more interested in underwater inspection than in commercial diving. This led him back home, to a master's program at Central University of Venezuela in non-destructive testing. "It's a less-invasive method of testing," Morales says. "You don't have to destroy something to see if it is warped. You can use different methods, like X-rays, testing magnetic particles, and ultrasonic. It fits in well with my background in metallurgical engineering."

Morales first encountered OCW when he was looking for information on stereoscopic vision, which has enormous potential for divers encountering turbid water conditions. Morales was able to find helpful information on MIT OpenCourseWare, especially in *9.537 Special Topics in Vision Science*. The projects for *13.017 Design of Ocean Systems I* also provided Morales with a wealth of new and useful concepts.

Morales acknowledges that some of the same ideas he has found on MIT OpenCourseWare are probably also available in the Central University library, in books or journals. "But with books," he says, "it's much harder to find this information in a timely fashion. And with OCW, you also know that it's new information."

Morales has been quick to share information about MIT OpenCourseWare with other students — and professors — in his program. "I often download information from the Web site in different topics," he says, "and give it to a professor in my faculty. Sometimes we discuss the information, other times they use the slides from the site in class. It's a great resource."

Morales also feels that MIT OpenCourseWare has a broader potential in Venezuela. "Not everybody in Venezuela has the opportunity to go to college," he says. "It's really hard to get into university, so OCW is a great option. For example, there's a program here called New Neighborhood. They use OCW to download information for poor people on technology, or humanities, or other areas. This has allowed a lot of people to access this information who might otherwise have been unable to do so. OCW has enormous potential for our country."



Teaching fundamentals... and hope

Margaret Adams, doctoral student at UNC-Charlotte

A first-year doctoral student in mathematics curriculum and instruction at the University of North Carolina at Charlotte, Margaret Adams hopes eventually to use her degree to help public school systems modify their math curricula to better prepare low-performing students for secondary and post-secondary educational opportunities.

As a student of education, Adams is a staunch believer in the potential of the Internet to help students of all levels and backgrounds achieve educational success outside of the traditional classroom. It is a success she has experienced first-hand: for example, Adams' use of Gilbert Strang's *18.06 Linear Algebra* has helped her develop a better grasp of the subject than classroom work alone.

"I'm not really a math major, but rather somebody who wants to get a background in math," she says. "The extra supplements on the Internet have really helped me develop the foundation that I need to be successful in this subject."

Adams is keenly aware that it is not simply placing information online that creates impact. Different teaching styles can have an enormous effect on a student's understanding — and enjoyment — of difficult concepts. As an example, Adams again cites Dr. Strang's course. "I think his down-to-earth approach is what makes the difference," Adams says. "He explains things on a very basic level, and gives wonderful examples. He'll set the stage for what's about to come. For me it's almost like reading a novel. It holds my attention, unlike most math books, which generally are very cut-and-dried. It's different from the traditional lecture format that I receive at the university."

In addition to helping her grasp the fundamentals of linear algebra, Adams adds, Strang's teaching has had a larger impact on her education. Adams describes Strang's course as giving her hope.

"If that Web site were not there," she says, "I think a lot of people would give up in their current courses, and maybe even give up in the whole field of mathematics — just like typical middle and high school students do. But he makes it so that people can start to learn, and enjoy math, and be successful overall. He gives people hope."



'Students need to know about this'

Kunle Adejumo, student at Ahmadu Bello University in Zaria, Nigeria

Kunle Adejumo is finishing up his fourth year of engineering studies at Ahmadu Bello University in Zaria, Nigeria. By all rights, he should now be in his fifth and final year, but local strikes and instability in Nigeria have added almost a full year to his studies at Ahmadu Bello.

Established in 1952, Ahmadu Bello is Nigeria's largest university, with 35,000 students. Though the university boasts a large and well-maintained physical infrastructure, its Internet access — like that of almost all Nigerian universities — is extremely limited. Even the computer lab does not have a Web connection. And because of the large number of students and the limited number of terminals, students can sign up for only 20 minutes each week on university computers.

When Adejumo was first introduced to OCW through a CD-ROM in the university computer lab, therefore, he had only 20 minutes to look through the material. Immediately impressed with the content, he asked the computer lab for a copy of the CD; when they were unable to give him one, Adejumo decided to find the site on his own, and copied down the address. From his home computer, he has enjoyed regular access to MIT OpenCourseWare, and has used it to complement the course materials he has gotten through Ahmadu Bello.

"For example, last semester, I had a course in metallurgical engineering," says Adejumo. "For one of the lectures, having to do with ion making, I didn't have notes, and I couldn't find the information I needed, so I went to OCW. I was able to download a course outline on this, and also some review questions. I actually took these to the university and gave them to the lecturer to answer. He was able to answer these questions, and helped me gain a deeper understanding of the material."

As much as Adejumo has benefited from MIT OpenCourseWare, it worries him that this resource is not available to the vast majority of students in Nigeria. "You see," he explains, "in this part of the world, only the rich can afford Internet access. Probably only 500 students at Ahmadu Bello have an Internet connection. In my own case, I visit about four times a week. But most cannot do this."

For this reason, Adejumo hopes eventually to work with the local radio station to broadcast MIT OpenCourseWare course material, as well as publicize the site. "I run the Web site for a local radio station," he says, "and they are interested in broadcasting educational programs. OCW would be the perfect fit. And in the process, more students will learn about the site. Students need to know that these things are available."



Setting a standard

Saud Khan, student at Mohammad Ali Jinnah University in Pakistan

Saud Khan, currently in the final year of a Masters program in Telecommunications Engineering at Mohammad Ali Jinnah University in Pakistan, has been using the resources of OCW for several years now. Khan, who is specializing in digital signal processing and adaptive filters, is about to begin a thesis on adaptive beam-forming, a process that has applications in radar, speech, and acoustic signal processing, and which distinguishes between the spatial properties of signal and noise.

Khan was first introduced to MIT OpenCourseWare by Dr. Shoaib Ahmed Khan, one of his professors during his undergraduate study at the National University of Sciences and Technology. Dr. Khan is a former visiting professor at the University of Massachusetts. He knew of Khan's interest in digital communications and suggested that he look over MIT OpenCourseWare's offerings on the subject.

Khan found the site incredibly useful, especially as a supplement to his existing courses. At the time, he was taking a difficult course on electromagnetics, and the lecture notes he found on MIT OpenCourseWare (including *6.013 Electromagnetics and Applications*) helped him gain a better understanding of the material. "I found that there was a lot of difference in the courses on OCW," Khan says. "They were very comprehensive, and very precise. There was a level of detail I hadn't experienced in my own courses."

Khan has also found the materials on MIT OpenCourseWare helpful because of the high cost of textbooks in Pakistan. "Technical books," he says, "especially from authors in the U.S. and Britain, are financially impossible for me to afford. OCW has been an important alternate source of information."

More recently, MIT OpenCourseWare has been helping Khan with his thesis work. "Mathematics are quite exceptional at MIT, and a strong background in mathematics really matters for thesis work. I have found OCW really helpful as I prepare to write my thesis." MIT OpenCourseWare also allows Khan to benchmark his own education against one of the top engineering schools in the world. "MIT is a dream university," says Khan. "Most people won't have the chance to be admitted, due to academic deficiencies or other reasons. But OCW gives people an idea of what it is to be at MIT. And if you do want to try to go to MIT, you can go to the OCW site first and experience the level of mathematics or physics taught at MIT. It sets a standard."



A more comfortable learning style

Maria Karamitsou, student at Aristotle University of Thessaloniki, Greece

A fifth-year civil engineering student at Aristotle University of Thessaloniki in Greece, Maria Karamitsou spent the summer of 2005 working at an institute of seismology studying earthquake-resistant construction techniques.

Recently, however, she found herself focusing more on the behavior of water than of earth. During the spring semester, Karamitsou completed an intensive research project on different aspects of hydraulics, including water handling, the water cycle, reservoirs, filter banks, gates, and dams.

As she began work on the project, Karamitsou realized that she needed outside sources to bolster her research, and recalled that she had once heard about information being available from MIT. "I was searching for information for this project," Karamitsou explains, "and I remembered that once in the newspaper in Larissa, where I grew up, there was an announcement and an address for OpenCourseWare. So I sent an email to MIT asking them to help me — and they did. They told me where to search for information on the site, and which courses to look for, and it was very helpful.

"*18.327 Wavelets, Filter Banks, and Applications* had lots of information," says Karamitsou. "I didn't find any videos, but I found lecture notes, handouts and slides from presentations, and some problem sets. It helped me a lot; I learned many, many things. I especially liked the fact that I saw many diagrams there. I was able to find almost the same information at my own university, but it was more theoretical. Sometimes I have a hard time with the theoretical style, and having all the information in mathematical style was very informative, and very helpful."

Karamitsou has not yet had the opportunity to use MIT OpenCourseWare as a complement to her other courses, but she plans to take advantage of it in the near future. "This coming semester," Karamitsou says, "I'm taking some courses on concrete. I have already searched for this on OCW, and found many courses in this area, so I'm sure that that is going to be a big help."



Learning from videos

Edan Kenig, student at Bar Ilan University in Ramat Gan, Israel

Twenty-three-year-old Edan Kenig is in his first year of a biophysics program at Israel's Bar-Ilan University. Bar-Ilan, which is situated on a 70-acre campus in Ramat Gan outside of Tel Aviv, has grown by 90 percent over the last nine years, and now boasts more than 32,000 students.

Kenig stumbled on OCW after searching for "physics" and "video lectures." The Walter Lewin lectures on MIT OpenCourseWare were some of his first hits, and Kenig realized that his search was over.

"I think these lectures are great," Kenig says. "And since I found them I have been using them all the time. Especially the Walter Lewin lectures. Last semester I used *8.01 Classical Mechanics*, now I'm using *8.02 Electricity and Magnetism*. In the future I plan to use *8.03 Physics III: Vibrations and Waves*."

"During the semester," Kenig says, "if I have to miss a class, I ask someone in my class what they did and then I watch it on MIT. At the moment, I am in my exam period so I'm using the lectures from MIT instead of books. And not only in physics. I also used *7.012 – Introduction to Biology*."

Kenig prefers the video lectures to the other resources available on OCW. "The lecture supplements on OCW are very helpful," he says, "but these types of things I also have here in Hebrew, which make them easier to read. But the video lectures are fantastic. I find that the level of physics work here at Bar Ilan is maybe even a higher level than at MIT, in the sense that the questions we are assigned are more difficult. But in terms of the teaching, the MIT lecturers are just extraordinary. I feel like I have a better understanding when I listen to the MIT lectures."



Revisiting an old favorite

Peteris Krumins, student at the University of Latvia in Riga

A 20-year-old physics major at the University of Latvia in Riga, Peteris Krumins chose to pursue physics in college because, he says, he's "interested in how things work in nature." It is an interest he also indulged in high school at the Riga English Grammar School, where he took (and excelled at) a course in physics in 10th grade.

Krumins first came across OCW during this formative period. "I was really interested in video lectures in high school," Krumins says, "and I was Googling around, and I came across OCW. I opened it up, and searched for video lectures, and there they were, in different categories like physics, and mathematics, and even the English language. They were pretty cool!"

Krumins was preparing for his high school physics exam at the time, so he watched the entire set of Walter Lewin's video lectures of *8.01 Physics I* to help improve his skills. It worked. He admits, when pressed, that he did very well on his high school physics exam. Encouraged by this success, Krumins decided to watch Gilbert Strang's *18.06 Linear Algebra*, as well. These lectures were harder for him to grasp, as he had not been exposed to the material in high school. But he still enjoyed them. And years later, when taking linear algebra at the University of Latvia, Krumins returned to the video lectures to give them another try.

Krumins has also revisited the Lewin lectures while at the University of Latvia. "The very first term," he says, "we had a mechanics course in our university which followed MIT's *8.01* pretty closely. It was really great. I listened to the lectures at our university, and then I went home, opened up the media player, and watched the lecture again. It had really great demonstrations, some of which we had in our course, and some of which we didn't. It was also great to get more familiar with the terms in English."

On several occasions, Lewin's demonstrations have helped clarify topics that Krumins had been struggling with. "I think every student has difficulty understanding subjects like torque and angular momentum," Krumins explains, "and the examples in Walter Lewin's lectures really made these easier to understand. On torque, for example, he did a very clear demonstration with the wheel that showed that if he turned the wheel to the left, the motion will be in the opposite direction if he stands on a rotating wheel."

Krumins admits, happily, that he has barely scratched the surface of what MIT OpenCourseWare has to offer him. "We have electricity and magnetism next year," he says. "OCW offers this course, as well, and I look forward to watching it."



Tales out of class

Alan Ryan, PhD candidate at the University of Ireland in Galway

Currently working on his Ph.D. in information technology at the University of Ireland at Galway, graduate student Alan Ryan has spent the last several months working on background material for his thesis, which deals with fault tolerance at the virtual machine level of the Java software program.

Ryan's Ph.D. program includes an extended period of research and a dissertation, but no formal class work. So while Ryan has had frequent and intensive meetings with his supervisor on his thesis topic, he has had little opportunity to attend lectures on core subjects. Because of this, he has occasionally struggled to find clear explanations for complex mathematical concepts.

One day, in passing, a fellow student recommended that Ryan take a look at MIT OpenCourseWare. Although Ryan was intrigued by what he saw there, he initially gave the site little more than a cursory glance. Several weeks later, though he found himself stuck on the concept of differential equations. He returned to MIT OpenCourseWare, and was excited to find a reference to several lectures on the subject by MIT Professors Arthur Mattuck and Gilbert Strang. He watched the *18.03 Differential Equations* video lectures on his computer, and was stunned by the professors' ability to explain, in only 45 minutes, material that he had been struggling with for weeks.

"Just like that, my problem was solved," Ryan says. "Apart from getting me out of a tight spot, this has changed my whole outlook. I had always intended to pursue math to a post-graduate level, but felt a little intimidated by it. If the difficult stuff can be explained this clearly, maybe it won't be as difficult as I had imagined."

Ryan has also appreciated the convenience of having the lectures at his fingertips. "This is really easy to use at my own pace," Ryan says. "I can watch the lectures, pause to reference items as I need, and replay the tricky stuff. The level was just right, too. They made very fair assumptions about prerequisite knowledge, erring on the side of caution, if anything."

Ryan plans to continue to use the site over the coming year as he completes his dissertation. "I certainly intend to watch the entire video series of quite a few modules," Ryan says. "And I plan to share the information, as well. I've already shown a friend of mine the material, and I have another few people in mind whom I know will appreciate the resource."



'I feel more like a physicist'

Justin Song, student at Imperial College of London

Nineteen-year-old Justin Song is embarking on his second year of physics at Imperial College London. Malaysian by background, Song's family is based in Singapore, and the Singapore government is paying for his education in London.

Song, who heard about OCW early in his studies, regularly visits MIT OpenCourseWare as part of his study routines. Sometimes, MIT OpenCourseWare helps Song fill in information that was not covered in one of his Imperial College classes. For example, Song felt that his first-year electricity and magnetism course did not fully explain the phenomenon of electromagnetic waves, so he went to MIT OpenCourseWare — specifically, to Walter Lewin's video lecture covering resonance, electromagnetic waves, and speed of light from *8.02 - Electricity and Magnetism* — and found additional information on the topic.

More often, though, the lectures offer another perspective on material already covered by Song's professors, helping to solidify his understanding of core concepts.

Lewin's lectures from [Courses 8.01, 8.02, and 8.03](#) have quickly become favorites of Song's, and in his opinion, were a central part of his first-year physics experience. In fact, he credits these lectures with changing his whole outlook on education. "After my exposure to Professor Lewin," Song explains, "I don't study my notes as much anymore. I take a blank piece of paper and try to answer a fundamental question or problem. If I can't, I put it to a friend. When that breaks down, we turn to books or to someone more able. His lectures have made me understand that it's not knowledge alone that's important, it's how you are able to use it."

The lectures, Song adds, have also made him more trusting of his own abilities. "Lewin's lectures never fail to leave me in awe of physics. As a result, I feel more like a physicist, and that makes me feel more confident."

MIT OpenCourseWare has also had a profound effect on Song's study habits. "One thing OCW has made me do," he says, "is study constantly. Maybe study is the wrong word. I would say it's become easier to enquire constantly."

SELF LEARNERS



An intellectual gem

Captain Kevin Gannon, Southwest Regional Maintenance Center, U.S. Navy

Based at the San Diego Naval Station, the Southwest Regional Maintenance Center (SWRMC) provides maintenance support and maintenance training to more than 50 surface ships, aircraft carriers, and submarines of the U.S. Navy and Coast Guard. This is a weighty responsibility for Captain Kevin Gannon, Commander of the SWRMC — as is the complement of roughly 3,000 sailors and civilians under his command.

Captain Gannon, who describes himself as a “lifelong learner,” holds an undergraduate degree from Tulane University in mathematics, an MS in Mechanical Engineering from the Naval Postgraduate School in Monterey, and an MS in Systems Engineering from University of Virginia. But he is quick to point out that his education is not confined to formal schooling; in each of his positions in the Navy, Gannon has worked to keep abreast of new developments in his fields of expertise.

Gannon describes his main responsibilities at SWRMC as overseeing lots of industrial processes (anything from fixing a pump to overhauling a gun) — and he is constantly looking for ways to streamline these processes. This quest led him to MIT OpenCourseWare several years ago, while browsing for information on lean manufacturing.

“Lean is a tool that industry has been using for the last couple of years,” explains Gannon, “focusing on process improvement, and minimizing waste. I was looking generically for lean information, and stumbled across OCW. I was really impressed. This site is a true intellectual gem. They have a couple of lean classes in the engineering section, such as *ESD.60 Lean/Six Sigma Processes*, that were very useful.”

MIT OpenCourseWare has also proved helpful in other areas of Gannon’s job. For example: leadership training for the sailors under his command is one of his major concerns. So, soon after discovering MIT OpenCourseWare, Gannon browsed the MIT Sloan School courses. “*15.322 Leading Organizations* has turned me on to all sorts of useful references,” Gannon says. “We’ve used a bunch of books mentioned in the syllabus. And the lecture notes are also an important tool. They include documents on the problems and prospects of a changing organizational world, and models of organizational change. We’ve used these for our discussion and our teaching here.”

“OCW has definitely accelerated our ability to train,” Gannon says. “As far as I’m concerned, these courses are already tried-and-true. They’ve worked with a high-performing group. They’re a nicely bundled package, and they’re free. How can you beat that?”



'If we hoard information, we can't have progress'

Robert Croghan, self learner and educator in Saint Lucia

On the island of Saint Lucia, dramatic coastal peaks shelter stunning interior expanses of rainforest, punctuated by lush valleys of fruit trees. The island paradise owes its idyllic climate in part to its tropical location, and in part to a dormant volcano several kilometers below the surface of the ocean that acts as a natural heat vent. Robert Croghan, an entrepreneur in Saint Lucia, has spent the past several years looking for a way to harness this natural resource to create an alternative energy source for the region.

"I'm working on a project to develop geothermal energy in the Eastern Caribbean," Croghan explains, "and install a high-voltage grid through an undersea cable that would connect several of the islands. Currently, about 92 percent of all power generated in the Caribbean is diesel-generated. And obviously, with the price of oil significantly increasing, it's creating a serious situation in regards to fuel supply."

In his explorations of the topic, Croghan has made use of much of the available literature on geothermal heat sources, including resources from MIT OpenCourseWare, a site he has followed with interest for years (Croghan's use of the site, it should be noted, is not limited to scientific information — he has also studied Spanish using *21F.751 –Spanish I*).

Croghan also takes a broader view of MIT OpenCourseWare. As a resident of Saint Lucia (though a native of Canada), Croghan is intrigued by the concept of MIT OpenCourseWare because of the opportunities it creates for equal access to education. "In the Eastern Caribbean," Croghan says, "access to information is extremely restricted. There's no university in Saint Lucia, or on most of the other islands. If people want to earn a university degree, they have to go away to Europe, or the United States, or the University of West Indies in Trinidad."

Croghan is interested in setting up educational clinics in Saint Lucia. "I see an opportunity to set up remote educational centers," he explains. "I could have a call center in India, for example, with a bunch of tutors helping the kids here, and they could all log on the computer and have a shared work space. And the kids would be getting as good an education as they would anywhere else. To me, that's what OCW is going to enable.

"When I saw OCW," Croghan says, "it went right to the very core of what I believe: if we hoard information, we can't have progress. We get stagnant, and it gets accumulated in the hands of a few. And if that happens, we miss all sorts of incredible developments and opportunities."



Debunking myths

Nader Dehesh, self learner at the Saravel Corporation in Iran

Nader Dehesh, head of design engineering at Saravel Corporation — a prominent air conditioner manufacturer in Iran — has firsthand experience with the U.S. educational system. He received an undergraduate degree in physics from Allegheny College in Pennsylvania, a second undergraduate degree in mechanical engineering from the University of Pittsburgh, and a master's degree in metallurgical engineering from the same institution.

Since his return to Iran in 1994 to join Saravel Corporation — a family-owned business that had been taken over by the government after the 1979 Iranian Revolution, and returned to the family in 1994 — Dehesh has stayed in touch with engineering schools in the U.S. via the Internet. It is a hobby that allows him to keep abreast of new developments and review the basics in his field. And among the sites that he visits regularly is MIT OpenCourseWare.

"My primary incentive in visiting OCW is to read up on things I have already learned," explains Dehesh, "but which I have had to put aside due to the managerial aspects of my work, which often pull me away from the technical side. Through OCW, I can refresh fundamentals, as well as explore new courses on design and manufacturing.

"Unfortunately," Dehesh continues, "living in Iran can be somewhat limiting due to the speed of the Internet and long download times." When Dehesh first visited OCW, he tried to download Professor John Leinhard's textbook from *2.51 Intermediate Heat and Mass Transfer*, but he was unable to do so due to the size of the file. In the end, he had to ask a friend in the U.S. to download the file and burn it on a CD for him. "I think videotaped lectures by professors may be the best route for Third World nations which do not have high speed Internet connections," Dehesh adds.

Despite these technological drawbacks, MIT OpenCourseWare has been an important gateway for Dehesh, allowing him to keep up to date with new developments in his field. "I think OCW is a wonderful tool and can serve practicing engineers all over the world," he says.

MIT OpenCourseWare has also made the Institute more real to Dehesh, clearing up some long-held misconceptions about MIT. "Prior to my inquiry on OCW, I had a notion of MIT as an assembly line of self-operating, whiz-kid automatons," Dehesh explains. "The introductory remarks for *2.737 Mechatronics*, debunked that notion. The students are instructed on when to attend the lab and the procedures they should follow, and even the fine for non-return of the equipment! I realized that pedagogy is the driving force, rather than experimental investigation; that instructions are needed for the gifted students as well as the ordinary ones. This certainly was myth-breaking for me!"



Grounded in learning by doing and building

Malcolm Douglas, self learner at Telstra in Australia

With the exception of a brief detour into management in the late 1980s, Malcolm Douglas has spent most of his career as an engineer in the wireless and radio transmission field. For the last four years, Douglas has worked in the information technology department of Telstra — a large telecommunications firm in Australia — designing and supervising the installation of Internet protocol networks and server farms.

But Douglas also defines the term “lifelong learner.” He holds a bachelor’s degree in Communications Engineering from the Royal Melbourne Institute of Technology, as well as a postgraduate diploma in accountancy from Deakin University. He has earned Cisco certification through the Cisco Academy, and has taken Microsoft Windows and Sun Solaris 9 courses to keep him up to date in his field. In addition, he regularly trolls through the research pages of top engineering institutions — such as MIT, Stanford, Berkeley, and UCLA — to keep abreast of current trends.

From MIT OpenCourseWare, Douglas has downloaded syllabi and lecture notes for many of the courses in the computer engineering section (including 6.111, 6.823, 6.826, and 6.828). Douglas credits the detailed syllabi with creating the necessary structure and focus to allow him to systematically work through a broad subject and absorb the key concepts. Douglas also finds the references in the course notes very helpful, and often uses them to locate classic papers or publications that he had not previously encountered, opening new areas of inquiry.

In Douglas’ opinion, the MIT courses offer an unusual blend of theory and practice. “I have found that MIT has an almost unique way of looking at the learning and teaching experience,” Douglas says. “It is theoretically advanced, but grounded in learning by doing and building.”

“Many courses at other institutions offer the same old textbooks and materials that very rarely change,” Douglas says. “In fact, I often wonder how students learn to think! I am very impressed with the MIT approach, and it is also very refreshing for a practicing engineer to learn this way, because this is how we continue to learn in the workplace.”



A diverse and comprehensive resource

Kushal Duneja, Operations Manager at CitiGroup in Bahrain

An operations manager for CitiGroup in Manama, Bahrain, Kushal Duneja has spent many years in the financial services field, working for Ernst & Young, PricewaterhouseCoopers, and CDC Capital Partners as an auditor, investment analyst, and private equity analyst. Duneja — who grew up in India, Tanzania, Zambia, and South Africa — holds degrees from the University of London, the University of Delhi, and the University of South Africa.

Duneja came across MIT OpenCourseWare several years ago while surfing the Internet for information on financial engineering. “It was sometime back,” he recalls, “and I remember it was on my Blackberry, so it was really tiny. But when I started to scroll down, I was really excited. I thought to myself, ‘Wow, this is great, I’ve been looking for stuff like this!’ So I went back and looked at it on a full screen, and downloaded some courses.”

Duneja has found a wide range of useful materials, including information on real estate investing. In addition, somewhat to his surprise, he has found *15.280 Communications for Managers*, to be a very helpful tool. “I haven’t done many of the hard skill courses,” Duneja explains. “But some of the softer skill courses have been very helpful. *Communications for Managers* is an excellent presentation of how managers can improve communication, and how we tend to use our credibility instead of the subject matter when trying to sell ideas. It also had some very useful tips on preparing presentations. That was something I could use and apply immediately.

“I thought this material was so helpful,” Duneja continues, “that I’ve also downloaded some of the stuff and shared it with my colleagues. Their feedback was very positive — they really thought it was quite insightful.”

Duneja is not the only one in his family who has benefited from MIT OpenCourseWare. “My wife actually discovered OCW without me ever mentioning it to her – it was quite funny!” he says. “One day I got home and she was looking at the site, and downloading stuff, and I said, ‘Hey, what are you doing, how did you find this?’ She’s a lecturer in computer applications, and she found OCW, and started to use material from the site.”

Duneja is an experienced consumer of information on the Web, and — in his opinion — MIT OpenCourseWare stands apart from other sites. “I think OCW certainly one of the most diverse and comprehensive collection of courses on the net,” Duneja says. “I haven’t yet come across any other university site or public institution site that provides that sort of information. You can get all the stats from the Federal Reserve and other places, but nothing as comprehensive as what exists on MIT.”



Finding the right level

Benjamin Goff, software maintenance engineer at Robins Air Force Base

Benjamin Goff, a 27-year-old software maintenance engineer, plies his trade at Robins Air Force Base in Warner Robins, Georgia. A graduate of the University of Central Florida with a degree in aerospace engineering, Goff collaborates with a team of engineers to maintain aging software for the tactical electronic warfare systems on Air Force F-15 jets.

Goff is a serious weather buff, and he often searches the Web for meteorology resources in his spare time. "There aren't many schools here in middle Georgia for technical subjects," Goff says. "So I look to the Internet to find online schools and places where I can gather knowledge. I just happened to be surfing one day and I found OCW."

Goff has explored many of the courses in the Department of Earth, Atmospheric, and Planetary Sciences area of OCW — such as *12.333 - Atmospheric and Ocean Circulations*. He tends to read the lecture notes for the courses, and then test his understanding of the concepts by working on the course assignments. "I try to do the homework assignments based on the lecture notes," Goff explains. "Sometimes I can do them, sometimes not. Sometimes I use other resources, since I have plenty of reference material right here. It depends on how hard it is."

Goff notes that the high level of the material provided is very rare online. "There aren't many weather resources on the Internet that are based on a post-secondary level," he explains. "Most of them are kiddie experiments. And on the other end of the spectrum, you can get plenty of white papers, but they're mostly over the heads of people who are trying to learn. So this type of learning experience definitely wouldn't happen without OCW, for me at least."

Though Goff has yet to use MIT OpenCourseWare materials on the job, he is definitely keeping that possibility in mind. "I could certainly see occasions when I might use OCW for my job," he says, "if I had specific programming questions or things like that. I know that in the electrical computer section, there's plenty of information about circuits and programming languages, so certainly if I wanted to learn a new language, I would look at OCW."

OCW may also help Goff make decisions about his plans after Robins Air Force base. "I definitely would like to go back to school at some point," Goff says, "but I'm not sure what subject to concentrate on. OCW is definitely going to help me make decisions about what to study in the future."



Making the most of an interlude

Vikash Hurrydoss, self learner in Mauritius

Vikash Hurrydoss recently completed a degree in software engineering from the University of Technology Mauritius. Though he wanted to continue on for Master's degree or a Ph.D. immediately, three years of university study had cut deeply into his savings. So Hurrydoss decided instead to take a position with a local software engineering firm. He plans to return to his education full-time in two to three years; in the meantime, he has turned to MIT OpenCourseWare to keep abreast of new developments in his field — and also to explore new areas of interest.

Hurrydoss, who first discovered MIT OpenCourseWare during his student years, is currently making his way through three MIT courses: Walter Lewin's *8.01 Physics I* video lectures, Professor Gilbert Strang's *18.06 Linear Algebra* video lectures, and S.P. Kothari's *15.511 Financial Accounting*.

He generally begins his day with one of Lewin's lectures. "I watch the Lewin classes in the morning," Hurrydoss says, "just after I wake up. My mind is quite fresh, you see, and I find it's a good time to think really deeply."

The courses allow Hurrydoss to pursue new interests, such as economics, and at the same time to plug some gaps in his education. "The Strang class has been very helpful to me," Hurrydoss says, "because the mathematics in my own course of study was somewhat insubstantial. There was much more focus on IT programming." In addition, Hurrydoss feels that MIT OpenCourseWare will help him determine the direction of his future studies. "I want to return to school in the next several years," Hurrydoss says, "and I feel that OCW will allow me to resume my studies without having fallen behind in any way. And OCW may also help me figure out what I will pursue when I return."

"OCW has all of the things I believe a true education system should provide," Hurrydoss says. "An openness, and a sense of sharing. Not just for the sake of money, or getting the certificate, but just for the sake of learning, of sharing knowledge. Of course you have books, and libraries. But the fascinating thing about OCW, in my opinion, is that you have access to the work of professors who are doing research in their areas that is quite new — and all this for free!"



'It's important to human evolution'

Susan Rankin, British Columbia

Susan Rankin, an artist and educator who lives on idyllic Vancouver Island, is grateful that she's been able to create a profession around the things that matter most to her. "My interests are music, science, and children's education," Rankin says. "I put that all together into a presentation that I call 'Suzee Science-Singer.' I go into schools, libraries, and daycare centers, and I sing songs about science. And then we play some games and do some art projects, all around various science concepts."

Rankin, who is also in the process of designing and programming educational video games to complement her science programs, is a strong proponent of making educational materials available to the widest possible audience. She herself uses materials from "all over the place," and is never sure where or when something she has learned will emerge in her work.

In her estimation, MIT OpenCourseWare, which she discovered several years ago through an article in the online edition of *The New York Times*, will be useful to her over a long period of time, as she continues to develop her educational software and her musical lectures.

Rankin does not tend to use OCW to find specific information, but she explores the site frequently to find interesting topics. Currently, she is working her way through a course on thermodynamics — a subject that does not have any immediate application to her lectures, but may well show up there in the future. She has also downloaded a music program from *21M.113 – Developing Musical Structures*, "to play around with," as she puts it.

"I was really excited when I heard about OCW," Rankin says, "because as far as I'm concerned, information is power. And to keep information from people because they aren't smart enough or rich enough to get it is antidemocratic.

"This is an especially important concept for rural areas," Rankin says. "In my case, the nearest library is about 30 miles away. It's a very small, rural library. I would probably have to wait several weeks to get any kind of book on an unusual topic. If I were even able to figure out which books to get. So I think that this is just a phenomenal concept, and I hope that all the universities do this. I think it's really important to human evolution."

**MIT FACULTY,
STUDENTS,
AND ALUMNI**



Finding a global audience

Professor Charles Stewart III, MIT Department of Political Science

Professor Charles Stewart III, head of the Department of Political Science in MIT's School of Humanities, Arts, and Social Sciences, is a specialist in the fields of American politics and behavior, political institutions, and research methodology.

Stewart, who has long been a proponent both of using technology as a teaching aid, and also of free and open access to ideas, was an early fan of the OCW concept. And now that the concept has become a reality, he has become a strong advocate for the site. "I think that OCW serves the higher purposes that have been touted for it," Stewart says. "It really does provide opportunities for people around the world to see what we do at MIT, and perhaps learn from it. There are heartwarming stories of faculty, out in the middle of nowhere, who somehow get to the OCW site, and discover our stuff, and use it to teach classes. I think that's really important and valuable."

In addition to these global benefits, Stewart has found that OCW can provide important exposure for young faculty members in his department — and across the Institute. "I think the opportunities include getting your name associated with a particular subject area," Stewart says. "After all, for faculty at MIT, one of the things you're supposed to do is establish that you are one of the world's preeminent experts in a particular field. And OCW is a way of highlighting what you do, and how you do it. It gives you a broader audience than just purely an academic audience. It gives you a lay audience from around the world."

In the early days of OCW, Stewart often found that he had to defend OCW to peers who were uncertain about what all this public exposure might mean. More recently, however, he has found that most members of his department are eager to participate.

"These days, all I really do to promote OCW is encourage them to participate whenever there's a call for new material," Stewart says. "And by now it's gotten such a good reputation that I don't even need to do that very explicitly!"



Making the connections explicit

Karen Willcox, MIT Department of Aeronautics and Astronautics

Professor Karen Willcox, a member of the MIT faculty since 2001, has been teaching a required course in aeronautics and astronautics to MIT juniors every year since she arrived at MIT. In her first year, Willcox was surprised — and disappointed — to find that many of her students were less proficient in math than she expected, and she has been working ever since both to better understand this phenomenon, and to counteract it.

“I really had the impression coming here that all the students would just be fantastic in math,” explains Willcox. “When I realized this was not the case, the first thing I did was to try to understand the source of the problem. I started talking to the math faculty, and I realized that there was this huge disconnect between the math department and the engineering department — who are the downstream users of the material that’s taught in the math classes. For example, even though I relied heavily on material from *18.03 Differential Equations*, I had no idea how it was being taught — or for that matter, what was being taught.”

Her students were “falling into this gap a little bit,” says Willcox. “So one part of the solution — and of course, the materials on OCW were very helpful for this — was to really understand exactly what was in those courses, and for those professors to also understand how that material would be used by their downstream colleagues, and get some context for teaching it.”

Once Willcox better understood the relationships between her course and related math department classes, she realized she needed to make these connections clear to her students. “The next step,” she explains, “was to make these links explicit for the students. I got started on this last fall. So in my first lecture, I’d say, ‘This is what we’re talking about today in aeronautics, and this is directly related to what you learned in this math class.’ And then with the pointer, I could show them the OCW Web site, and the lecture, and the problem sets related to what we’re learning.”

Willcox has already seen improvements — but in her opinion, it’s only the beginning. “I think there are even more opportunities in this direction,” she says. “Down the line, I’d like to bring more of the technology into the classroom, so that while I was giving a lecture, I could give them a flashback to something they had seen in a previous course — a visual reminder up on the screen of something that they would have seen in their math class, or a little clip of a video. My sense is that this will really enable us to create better linkages, and to fully integrate the learning experience. Our students will have the opportunity to look broadly across their education, and that will have enormous implications for learning.”



The intangibles of an MIT education

Aron Walker, MIT undergraduate student

MIT junior Aron Walker is an environmental science and chemical engineering major who hails from San Francisco. Walker decided to attend MIT, he says, because he wanted to study in a vibrant atmosphere, filled with people who were passionate about what they were doing.

Though he had never experienced MIT OpenCourseWare before coming to the Institute, Walker heard about the site from a friend soon after his arrival in Cambridge, and quickly found that it was a valuable resource for MIT students.

“As far as a practical use,” Walker says, “students here visit OCW to get a sense of what a class is like. Yes, MIT also has course evaluations, which are compiled, quantified and put online — and people definitely use those, as well. But the evaluations don’t offer much information about the actual content of the class. It’s more, ‘What have my peers thought of this class in past years? What have my peers thought of this professor?’ The OCW course sites are more detailed than an evaluation, or a course description, because they include the actual course material.”

Students also visit the site to find materials for review purposes. “I think students also use it,” Walker says, “if they’re taking some class one year, and they want more practice doing things. They look at material from a previous year, and they adopt that as something to practice with.”

But for Walker, the most valuable aspect of OCW is the perspective it offers on the unique aspects of an MIT education. “I think that for me,” he says, “the biggest advantage of OCW is that it brings into focus the things that you can only find here at MIT, and not on the Web. It highlights the programs that aren’t on OCW because they can’t be — things like research, and doing programs with other students who are all really focused and excited about the work. Not to mention the discussions that happen here, the people who are here, the ideas floating around.

“For me, it moves the educational focus back towards the intangibles, rather than just, ‘Here’s a sheet of paper with some problems on it, and I want you to do them,’” he says. “There’s a very strong community of ideas here, and there’s a lot of energy in that community — and that’s what really sets MIT apart.”



A cross-fertilization of ideas

Mark Horowitz, MIT alumnus and learner at Towers Perrin in Philadelphia

A 1972 MIT graduate with degrees in Applied Math and Electrical Engineering, Mark Horowitz went on to complete a Master's degree at the University of Chicago in Information Sciences in 1973 before pursuing a career as an actuary. For the past 12 years, Horowitz has worked as a consultant for Towers Perrin in Philadelphia, PA, designing and implementing software that supports benefits valuation tasks.

Horowitz, who is an active supporter of the Institute and has followed the development of MIT OpenCourseWare with great interest, uses the site both to pursue academic interests and to help him solve problems on the job. "One area that I've gotten interested in over the last couple of years," Horowitz says, "is behavioral economics. So when I discovered *14.127 – Behavioral Economics and Finance* on OCW, I downloaded a bunch of the readings to look at."

Horowitz tends to browse the site to find areas of interest, though he says his interaction with the materials is rarely comprehensive. "In general," he says, "I tend to do some reading from the courses, as opposed to imposing the discipline on myself to take each course. But it's been so helpful to be able to find information on OCW that's organized in a way that allows you to really learn the material."

OCW also comes in handy when Horowitz encounters challenges in the course of his work. In general, Horowitz tries to keep abreast of advancements in Course 6 (Electrical Engineering and Computer Science), to see if there are any new developments that can help him on the job. His investigations are not limited to this area, however. "At one point," he says, "we were looking into doing some work in options pricing. In order to try to get some background for that, I looked around at about three or four different sites, one of which was OCW. In *15.433 Investments*, I was able to find some lectures on option theory. I did some reading on the subject, and learned something about pricing of options, primarily lattice models. It was a useful place where I could go to get background for this very specific need."

On a more philosophical level, Horowitz also credits OCW with helping him achieve success in his life and work. "In some respects," Horowitz says, "to the extent that I've had success in my life, it's been because I'm curious about a lot of things. I find that when I allow myself to read lots of different things, it has an effect of a cross-fertilization of ideas for the work that I do. So where I can't always justify the time for something in the moment, a lot of what I learn finds its way back into what I'm doing."

