Models of Open Educational Resources:

OpenCourseWare, Sofia, and the Open Learning Initiative

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In 1999, the Massachusetts Institute of Technology (MIT) began a bold journey in response to a faculty recommendation about how MIT should position itself in the distance/e-learning environment. Skeptics and supporters alike knew that the journey held implications and promise for U.S. and international higher education. At a time when access to information seemed to be tightening and to be limited to those who could pay for it, MIT committed to making its course materials available free of charge to a global community through OpenCourseWare (OCW).

At the same time a group of cognitive scientists, computer scientists, and faculty in philosophy and statistics at Carnegie Mellon University were exploring how they could use the Web not only to make course materials available free of charge but also to make effective instruction free of charge to those who otherwise would not have access to a high-quality postsecondary education.

Further west, on the coast of California, Foothill College received a grant by the William and Flora Hewlett Foundation to lead an open content initiative for community colleges. Unlike other efforts, Foothill College broadened participation in the Sofia open content initiative beyond the Foothill-De Anza Community College district. On April 4, 2004, faculty from California community colleges were invited to contribute content to Sofia. According to the Hewlett Foundation, "supporting a high-quality OCW-like effort at the community-college level would provide benchmarks of excellence for similar institutions."[1] These experiments were incubated by intellectual leadership and funding from The William and Flora Hewlett Foundation and the A.W. Mellon Foundation to create a worldwide movement to share knowledge and improve teaching methods.

The sticky questions for MIT, Carnegie Mellon, Foothill College, and other institutions that are now providing open educational resources relate to how to build and sustain these models; which economic and technical models might promote maximum accessibility; how (or if) to control the quality of the resources; and to what degree open resources can be truly open.

The idea of providing "a free and open educational resource for faculty, students, and self-learners around the world"[2] has been adopted in a variety of models by other higher education institutions, from the Fulbright Economics Teaching Program developed in cooperation with the University of Economics in Ho Chi Minh City, to Rice University, Utah State University, Tufts University, Johns Hopkins School of Public Health, and Tsinghua University in China. The models share many philosophical foundations, and they take different forms based on specific institutional goals.

This research bulletin attempts to help clarify the landscape, definitions, and key issues related to a domain that is variously referred to as opencourseware, open content, and open educational resources. Not insignificantly, it attempts to describe a continuum of the various approaches being taken in higher education today, highlighting differences in how content is designed and developed and how these content designs impact learning and teaching through programs at MIT, Carnegie Mellon University, and Foothill College.

For this bulletin, ECAR interviewed individuals at three institutions who are on the leading edge of this movement: Anne H. Margulies, executive director, OpenCourseWare, at MIT; Vivian Sinou, dean, Distance and Mediated Learning, at Foothill College and head of the Sofia Project; and Candace Thille, Director, Open Learning Initiative, at Carnegie Mellon.

Highlights of Open Educational Content

ECAR was told that one contribution this bulletin can make is to help articulate and distinguish the various terms being used to describe the field. According to Joel Smith, vice provost for Computing and CIO at Carnegie Mellon:

> We're dealing with two very different kinds of courseware here. One is an enhanced version of what faculties typically supply through course management systems—supporting course materials. OCW is largely that…. The second is what we call the "enactment of teaching online." That is, complete online courses that a learner can "take" without a faculty member being involved (although these courses may often be used as electronic textbooks in traditional courses). The Open Learning Initiative [OLI at Carnegie Mellon] aims at courses of the second variety.

Smith continued:

> This is a distinction that I think both we and MIT have found difficult to get across. People sometimes go to OCW expecting to find full MIT courses. People sometimes come to the OLI Web site expecting to find OCW-like material, only to find full online courses. I think these two kinds of materials complement each other in the benefit for higher education, but I also think the distinction is important.[3]

Definitions

ECAR: What does higher education mean by opencourseware, open educational resources, and open content? What are the various definitions?

Anne Margulies, for MIT: Generically, opencourseware is best understood as a free and open digital publication of high-quality teaching materials organized as courses. The idea here is that opencourseware is a publication of course materials created by faculty (and sometimes other colleagues or students) to support teaching and learning. For any given course, the published materials should fully convey the parameters of the course's subject matter and ideally represent a substantially complete set of all the materials used in the course.

Meanwhile, we think of an open educational resource (OER) as a broader umbrella comprising an array of open resources to support teaching and learning. Certainly opencourseware is one sort of OER, but there are many others. For our own purposes, we have begun to create a taxonomy of OERs, and they seem to fall into three categories:

- *Content resources:* opencoursewares, learning object collections (for example, Rice's Connexions and MERLOT), and reference collections (for example, UTOPIA, Internet Archive, and PLoS)

- *Tools resources:* learning/course management systems (for example, Sakai and Moodle), groupware (USU's OSLO and Harvard Law's H2O), and development tools

- *Standards resources:* licensing tools (Creative Commons) and interoperability (OKI and IMS)

MIT's OCW is decidedly not a credit-bearing or degree-granting program, an online learning system, or a course management system (CMS). In particular, a user does not register to take an OCW course (in fact, our users are anonymous to us); a user receives no credit or recognition of any kind for accessing, using, or studying materials on OCW; and by design, there is no provision for interaction between users and the faculty who have authored the materials on OCW.

Vivian Sinou, for Foothill College: We don't actually use the term *opencourseware* when speaking of our open content initiative, Sofia (named primarily for wisdom and intellectual virtue, and secondarily for Sharing of Intellectual Assets).[4] Carnegie Mellon and Foothill believe that the term describes only a subset of the open content movement. The terms currently in use range from open content, to open resources or materials, to OCW, to open education, to open learning. At one end of the spectrum, you have open materials, whereas at the other end of the spectrum, you may have open learning, where self-learners can go through full courses, without teachers(!), and can learn a whole lot. The terms reflect the level of completeness of the materials and the embedded instructional guidance and support offered to learners (or lack thereof) through the use of technology, instructional design, and pedagogy (virtual tutors, tutorials, self-graded practice skills tests, and so forth). Many of us involved in open content initiatives have avoided using the term open courses, to avoid confusion with the offering of distance-learning classes for credit. However, the more you move toward the end of the continuum where you offer superb guidance and instruction within open content materials, the closer you get to offering full courses.

Candace Thille, for Carnegie Mellon: Definitions are still evolving, and there does not appear to be a commonly held set of agreed upon terms and definitions. Opencourseware is a subset of the broader category of open content or open education. Vivian Sinou and I put together a continuum as a way of framing the characteristics of the range of offerings in the field. (See Figure 1.)

Figure 1. Open Content Continuum

	Open Educational Materials	► ► ►	Full Online Courses
Content Design	Content includes syllabi, calendar, reading lists, and collections of files/docs.		Content includes self-run courses with embedded instruction.
Learning and Teaching Design	Least guidance (no instruction). Self-directed, motivated learners with high metacognitive skills can learn from these open resources. Faculty may have to develop context around the materials. Learning objects may be stand-alone, not part of a learning sequence or course.		Directed study, guidance, and feedback embedded. Learners with low study and low metacognitive skills have the highest probability to learn from these courses. Materials are presented in context and faculty are provided with use case scenarios, workshops, and support.
Development Cost Design	Materials are donated by faculty and authors. Materials are published with little or no modification from their original form in PDF, Word, or HTML.		Highly interactive courses with learning technologies embedded, such as video lectures, "smart" learning objects, multimedia tutorials, and virtual tutors.

The range shows the extent to which instruction is embedded in the offering. At the left end of the continuum are materials that support instruction and require a significant amount of additional instruction external to the materials to support the learner. At the right end of the continuum is open content that includes all of the instruction and instructional tools that a novice learner needs to learn the topic at an introductory level.

There are many additional dimensions for comparing and understanding open content offerings. For one, there is audience. Many repositories of teaching materials are targeted at least as much at educators as they are at learners. These educators are looking for materials to create or supplement their own course materials or to improve their teaching, and of course, they have different needs from learners. Another factor is intended scale and impact. Some offerings aim for breadth, with large volumes of materials for diverse audiences, while others have more limited scope. Finally, and not surprisingly, the goals of different open content projects are often influenced to some degree by costs and resources available.

ECAR: Which definition of opencourseware applies at your institution? What constitutes a full course?

Margulies: For OCW purposes, we consider a course to be a teaching-learning activity that is listed in the MIT course catalog, is faculty directed, is offered for credit, has enrollment of more than just one or two students, and is repeatable and offered currently or within the preceding two years. This standard embraces traditional courses, seminars, some short courses offered between semesters, and the like. It eliminates independent study, special projects, and one-off lectures. MIT has about 1,800 courses by this definition. For courses meeting this standard, our goal is to publish all the materials that are used in those courses other than textbooks and journal articles (we provide bibliographic references to these, although in a small number of cases we have been

able to republish or provide links to the full-text version). MIT's course materials are available at <http://ocw.mit.edu/>.

Sinou: At Foothill, we are committed to publishing a comprehensive set of materials per course that includes extensive content (lessons, tutorials, lecture notes), with opportunities for learners to apply themselves. In addition to content for all topics in a subject, we include assignments, projects, or exams, including sample solutions. Courses that are contributed to Sofia but do not offer a complete learning solution are not selected for publication. In addition to extensive content, we strive to publish a collection of lessons that are integrated with activities and are good examples of instructional design. And, if the instructional design is weak, we examine the feasibility of our team redesigning the course. Our goal is to publish models of courses that highlight best practices, ultimately establishing standards of quality, especially in the field of e-learning. Finally, we are interested in publishing interactive content, ideally through the use of multimedia. The Sofia courses can be found at <http://sofia.fhda.edu/gallery>.

Thille: An OLI full course covers the topics that would typically be covered in a semester-length course at Carnegie Mellon. Carnegie Mellon's OLI courses are at <http://www.cmu.edu/oli>.

ECAR: In what ways does opencourseware differ from other mechanisms of delivering courses online, such as course management systems, instructors' Web sites, and so on?

Margulies: OCW is a publication, or repository, of the lecture notes, assignments, exams, solution sets, lecture videos, syllabi, and other materials used in courses taught at the host institution. OCW does not deliver courses online in the same sense as a course management system. While a course management system does typically provide access to certain course materials, it is also a course administration mechanism that often provides capabilities for faculty-student interaction, facilitates submission of homework, manages grading, and generally supports the instructor's teaching and the students' learning activities. OCW has no such features.

Moreover, one cannot use OCW to register for or take a course, and there is no notion of awarding credit or in any way recognizing a user's use of OCW. Another typical characteristic of course management systems is that they are usually closed to people outside the institution, and specific courses are often inaccessible to anyone not enrolled in the course. One important consequence is that course management systems and instructor Web sites may contain copyrighted materials used without permission under fair use [policies]. On the other hand, materials in a publicly accessible opencourseware site must be 100% IP-cleared (fair use does not apply).

Sinou: Course management systems are vehicles for delivering, publishing, and managing course materials. In one sense, course management systems are simply "buckets" where content can be deposited and managed. At the same time, they can be robust engines that allow institutions to deliver instruction, support learning, and encourage collaboration. The vast array of tools (chat, forums, grade books, assessment tools, and so forth) available in course management systems can greatly expand what is

offered through a flat open content initiative's Web site. It is a heck of a job to develop interactive content and activities. Some of that can be done easily when the open content is developed around a course management system's capabilities. Course management systems can enable institutions or individual faculty to adopt published open content, deliver and supplement instruction, and promote dialogue on sound pedagogy. Of course, different course management systems can promote or hinder sound instructional design. Through collaborative, coordinated efforts like the Sakai open source software effort, however, pedagogical considerations will become a top priority in the design and usability of CMS tools for teaching, learning, collaboration, and research.

Thille: When many faculty think of online courses, they now think of courses that either they or someone they know has put together on Blackboard or WebCT. They think of a syllabus, some lecture notes, homework activities, some quizzes, and possibly some interesting applets delivered through a CMS that may also offer discussion boards, e-mail support, and places for students to post work. The instruction happens through a teacher and the CMS is used to manage the materials of instruction. Distance learning that relies on mentored instruction supported by Internet-based collaboration tools are also called online courses. Course materials are either available online or in traditional textbooks. The instructor communicates with the students via telephone, e-mail, discussion boards, and so forth. While the OLI project provides a wide variety of online materials to support instructors, the most challenging goal of the project is to develop online courses that are the complete enactment of instruction.

The Faculty

ECAR: How many faculty members at your institution are involved with opencourseware, and how do they feel about it?

Margulies: About 2,200 individuals have contributed materials to MIT OCW so far. This includes about 70% of MIT's tenured or tenure-track faculty, as well as other instructors, visiting faculty, teaching assistants, students, and others. In the earliest days of MIT OCW, there was some skepticism among faculty, and the faculty participants in our original pilot were often the bold experimenters. Since that time, OCW has become woven into the fabric of MIT culture. Even though participation in OCW is strictly voluntary, the vast majority of faculty today are happy to contribute their materials for publication on OCW. About OCW MIT Professor Jacob White said, "I could not be happier about its [OCW's] current state—I get very positive notes from colleagues elsewhere, and it makes me proud. I appreciate all the work OCW represents." Professor Paul Penfield, Jr., said:

> Everybody knows that the way to make progress in science is by using the best results of others—"standing on the shoulders of giants" is one way of expressing this idea. That's why we publish scientific results. OCW will let the same thing happen in education.

Sinou: About twenty-four faculty contributed content to the Sofia pilot. Many others were interested but didn't feel that their content was up to par to submit for publication in the open domain. It is not surprising that faculty are the toughest critics of their own work.

Thille: We currently have eighteen Carnegie Mellon faculty and six faculty from other institutions working on course development and evaluation. About OLI, one faculty member said, "It is a noble cause to provide access to high-quality education to those who otherwise do not have access." Another said, "Writing the course has been one of the most challenging pedagogical tasks I have ever undertaken." And still another said:

> Working on the OLI course and meeting with the other OLI faculty has fundamentally changed and improved the way I teach. Thinking through how to explain concepts via the online course to students I will never meet has given me insight into how to present concepts to students that I work with in the classroom every day.

Standards

ECAR: To what technical and other standards does your open educational resource program adhere?

Margulies: Our goal is to make OCW accessible to as many people as possible around the world. Accordingly, our materials are designed for use with the most common hardware (even in modest configurations) and software tools and file formats. In addition, we have pursued translation partners to make materials for selected courses available in other languages (five languages besides English are now represented). We also have partnered with other institutions to create mirror sites, primarily in developing regions and on local campuses where Internet bandwidth is limited or nonexistent.

Sinou: In addition to the quality standards and comprehensive content mentioned earlier, we strive for a consistent presentation format. We want learners to move from course to course and be able to anticipate what they will find and where they will find it. Of course, variation in the instructional design is inevitable and desirable when dealing with different disciplines. We want to see different teaching models. For example, one of the courses published in Sofia, Enterprise Security, is based on Carnegie Mellon West's Story Centered Curriculum. There are no lectures. The course provides a just-in-time learning environment that transforms individual students into active learners, given that they are immediately involved in tasks and solving problems.

Additionally, we are committed to publishing accessible content and go into great lengths to add "alt" tags to images, for example, and provide closed-captioning for videos. In the future, we would like to publish Sofia open courses into Sakai, addressing portability of content with like-minded institutions that support open source and sharing. Standards supported by Sakai tools include the QTI specification in the Sakai Assessment Manager developed by Stanford and IMS Content Packaging that is supported by Melete, a lesson builder tool developed by Foothill College. These standards will enable import/export of content.

Thille: To access our courses, faculty and learners need only have Internet access and a Web browser with common and freely available plug-ins. As much as possible, we adhere closely to the developing IMS standards so that our course content and our CMS are interoperable with the various commercial and shareware course management systems that also follow IMS standards. Our project director and software engineers have both visited MIT and participated in OKI and Sakai conferences to ensure that courseware developed at Carnegie Mellon will constitute implementations of the OKI specifications whenever possible and complement the work of Sakai.

What It Means to Higher Education

To assess the impact of the open educational resource movement on higher education, ECAR explored the principles that are driving the adoption, the rationale for making materials freely accessible, and the executive level champions of this movement.

Principles Driving Adoption

ECAR: What are the fundamental principles driving the adoption of opencourseware in higher education? In your institution?

Margulies: An opencourseware initiative aligns closely with the educational and public service missions of a nonprofit institution of higher learning. At MIT, our institute mission is to "advance knowledge and educate students in science, technology, and other areas of scholarship to best serve the nation and the world." OCW clearly is a manifestation of this, at the core of why we exist. Moreover, an opencourseware effort resonates deeply with many faculty, who have a passion for teaching and who have dedicated their lives to the advancement and dissemination of knowledge. It supports the growing movement toward balancing the legitimate interests of intellectual property owners with society's need for open information sharing, learning, and debate. We have found that many in faculty and academic leadership positions subscribe to the belief that a trend toward open knowledge will help to bring people of all backgrounds together and promote mutual understanding.

Sinou: Developing quality online courses and materials is very expensive. The majority of faculty members now rely on Web-based resources to supplement their teaching. Students expect it. There is a great need for quality online content. Community colleges, in particular, are expected to respond to the ever-growing number of students who can't come to campus to earn a degree. The demand for fully online courses and programs is increasing, while at the same time, shrinking budgets have made it impossible for institutions to support faculty with course development. As a result, faculty are left on their own to develop courses, searching MERLOT and Google to piece together a decent collection of materials to publish a course under pressure, in the wee hours of the morning, with no expertise in instructional design and no support. The ability to teach is not the same as having expertise in curriculum design. Faculty are charged with designing online courses but are not given adequate development and design support, which puts undue strain on their time and resources. They struggle to compensate for

weak instructional design or inadequate course content when teaching fully online courses.

Thille: Small colleges face enormous budget pressures in the face of increasing competition, dwindling enrollments and increased costs. Technology development is costly and they cannot compete. Some institutions that use OLI courses do so because they wish to expand their course offerings into areas that they do not have faculty with that area of expertise (for example, a causal reasoning or formal logic course). Others wish to increase their capacity to serve students while reducing costs, or they wish to provide professional development opportunities for their teachers. Some institutions use OLI courses as a way of preserving and disseminating expertise and consistency of quality, and still others that use OLI courses or OLI course labs/activities to supplement their instruction do so because they have found that students learn better when the traditional mode of instruction is supplemented with the online labs and materials. OLI courses and course labs and activities are used at Carnegie Mellon for the last two reasons.

The Rationale of Free Access

ECAR: Why are higher education institutions getting into the opencourseware business? Why give away courses or course materials?

Margulies: Beyond fulfilling a core mission, we have found that an opencourseware effort confers many benefits back to the institution, to departments, to faculty members, and to students. It enhances the institution's image, generates pride in the community, and stimulates innovation. It showcases the offerings of our academic departments and enhances faculty and student recruitment. It also fosters collaboration among faculty members who contribute to OCW and accelerates the adoption of digital materials and Web-enabled teaching methods. Individual faculty members gain greater visibility for their published work, and the OCW program provides a service to faculty members that helps them organize and archive their materials.[5] Students find that OCW helps them plan a course of study because they can explore the course materials online. They can also use course materials like past problem sets and exams that help them with their coursework.

Sinou: The William and Flora Hewlett Foundation and the Mellon Foundation deserve a lot of credit for grabbing our attention and getting many of us to commit to and see the merits of open efforts. Frankly, the values behind this movement are a perfect match for higher education institutions, especially public institutions that may wish to improve and expand their course offerings, increase their capacity to serve students while reducing costs, offer professional development opportunities for faculty, and disseminate information that is based on best teaching practices and successful course models.

Thille: At Carnegie Mellon, the OLI project is a combination of a product development project and a research project. The faculty members involved in the project are interested in exploring how to create effective Web-based environments to teach their areas of expertise. To understand what works and does not work, we need a broad community of use. By making our courses openly and freely available we gain a broader

audience through which to evaluate effectiveness. Many faculty are motivated by the mission of providing high-quality postsecondary education to those who otherwise would not have access. They truly love their field of study and wish others to be exposed to the field in a way that shares their enthusiasm and appreciation.

<div align="right">**OER Champions**</div>

ECAR: Who is the highest-level champion in your institution, and what does he or she have to say about it?

Margulies: During his tenure, which ended December 2004, MIT President Charles M. Vest was an international spokesman for OCW. He cited OCW as one of the four greatest accomplishments at MIT during his 14-year tenure. He said:

> OpenCourseWare looks counterintuitive in a market-driven world. It goes against the grain of current material values. But it really is consistent with what I believe is the best about MIT. It is innovative. It expresses our belief in the way education can be advanced—by constantly widening access to information and by inspiring others to participate.[6]

Vest also noted:

> The computer industry learned the hard way that closed software systems—based on a framework of proprietary knowledge—did not fit the world they themselves had created. The organic world of open software and open systems was the true wave of the future. Higher education must learn from this. We must create open knowledge systems as the new framework for teaching and learning. In this spirit, MIT has asked itself, in the words of T.S. Eliot, "Do I dare ... Disturb the universe?" Our answer is yes. We call this project MIT OpenCourseWare. We see it as opening a new door to the powerful, democratizing, and transforming power of education.[7]

In his keynote address at the August 2005 Seminars in Academic Computing, Vest clarified:

> In no way does OCW equal a university education. It's a publication—a statement—about how we organize things in our courses. OCW is an adventure. Almost 70% of MIT's on-campus students make use of OCW. Educators around the world account for 15.3% of the traffic on the OCW Web site, and 66% of OCW visitors hold a bachelor's degree.[8]

Sinou: Foothill College and district leaders have been terrific supporters of my efforts nationally—both with Sofia and Sakai. Foothill-De Anza Chancellor Martha J. Kanter said:

> The Foothill-De Anza Community College District is pleased to join with our partner community colleges and universities to provide the gateway to educational opportunity through the Sofia Project. Under the able

leadership of Foothill College, we will enable and empower students to acquire knowledge through the courses of study made available to all parts of the world that will be delivered by Sofia. We are delighted to have the first set of courses available in January 2005, with many more to come. We pay tribute to MIT, whose original design of OpenCourseWare enabled us to participate in the grand vision to make knowledge accessible to everyone in the world. We are deeply thankful to the Hewlett Foundation for its invitation to participate in a program that will change lives and futures through higher education.[9]

Foothill College President Bernadine Chuck Fong said:

Foothill College continually strives to be a leader in educational technology. The Sofia Project, along with our work in the Sakai Project and ETUDES [Easy to Use Distance Education Software], our learning management system, are but two examples. The advent of open source software and open content, as a reality and not just a theoretical construct, is providing students greater access to educational resources.[10]

Thille: Carnegie Mellon Provost Mark Kamlet believes that OLI could potentially be the most fundamental change to the nature of education since Socrates. He recognizes that we are at remarkable confluence of supply (willing faculty members); demand (students having difficulty accessing postsecondary education); and enabling technology (the Internet, data mining, and cognitive science) that has made the OLI a project whose time has come. Given Carnegie Mellon's world-class researchers in cognitive psychology, our breakthrough discoveries in the areas of cognitively informed learning and data mining, and the interest among many of our award-winning faculty in investigating electronic teaching formats, Carnegie Mellon accepted the challenge, and the OLI was born.

Key Questions to Ask

- To what degree does our institution support the concept of providing free and open educational resources, and how does this align with our mission?

- To what degree are we willing to invest, or seek investment, in building and sustaining a program that supports open educational resources?

- What pedagogical, intellectual property, and technical challenges will we face, and are we equipped to resolve them?

- Which model of open educational resources is most appropriate to our institution?

Where to Learn More

- The William and Flora Hewlett Foundation Open Content site, <http://www.hewlett.org/Programs/Education/Technology/OpenContent/>.

- MIT OpenCourseWare "How To" site designed to help other institutions jumpstart their own OCW projects, <http://ocw.mit.edu/OcwWeb/HowTo/index.htm>.

- Open Content Collections, <http://www.opencontent.org/>.

- Open Learning Support, Utah State University, <http://oslo.usu.edu/projects/>.

- Online Course Evaluation Project, <http://ocep.edutools.info/>.

Acknowledgment

Endnotes

1. The William and Flora Hewlett Foundation, Supporting research and development activities for high-quality open content, <http://www.hewlett.org/Programs/Education/Technology/OpenContent/>.

2. MIT OpenCourseWare site, <http://ocw.mit.edu/index.html>.

3. Joel M. Smith, personal e-mail, March 8, 2005.

4. The Sofia Project at Foothill College, <http://sofia.fhda.edu/>.

5. The faculty member's role in OCW is to (a) make the materials that he/she uses in the course available; (b) identify any elements of the material that are not his own (specifically, third-party objects such as charts, graphs, photos, and so forth, for which we will have to get copyright clearance); (c) clarify materials if we have questions during the production process; and (d) review and approve the course content and presentation before we publish it to the public OCW Web site.

6. C. M. Vest, OCW launch announcement, <http://web.mit.edu/newsoffice/2001/ocw-0411.html>.

7. C. M. Vest, *Disturbing the Educational Universe: Universities in a Digital Age—Dinosaurs or Prometheans?* MIT president's 2000-2001 report examining the impact of technology on higher education and assessing the future role of the research-intensive residential university, <http://web.mit.edu/president/communications/rpt00-01.html>.

8. C. M. Vest, "OpenCourseWare and the Emerging Global Meta University," Clair Maple Memorial Address, Seminars in Academic Computing, August 5–10, 2005, Snowmass, Colo., <http://www.educause.edu/sa05>.

9. M. J. Kanter, "Reflections from Foothill-D'Anza's Leadership," <http://sofia.fhda.edu/msg_leaders.htm>.

10. B. C. Fong, "Reflections from Foothill-D'Anza's Leadership," <http://sofia.fhda.edu/msg_leaders.htm>.

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