

OPENING UP EDUCATION

The Collective Advancement
of Education through Open Technology,
Open Content, and Open Knowledge



edited by

Toru Iiyoshi and M.S. Vijay Kumar

foreword by John Seely Brown

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*To our wives and sons—
Hiromi, Rukmini, Ken, Suhas, and Taku
—whose support and encouragement makes this important work
possible.*

Revolutionizing Education through Innovation: Can Openness Transform Teaching and Learning?

Catherine M. Casserly and Marshall S. Smith

The need for educational access and greater effectiveness in teaching and learning is staggering. Today, there are over 30 million people qualified to enter university but denied access due to the restricted seat numbers and restricted finances. In the next 10 years, the number of potential students who will be denied access will grow to 100 million (Daniels, 2007). A major university would have to be created each week, starting now, to meet this overwhelming demand.

We need to rethink the traditional notions of where, when, and how people learn. Learning will continue within traditional structures, but it could also be more widely available through new emerging models. Can the simple but powerful notion of combining no cost high quality content with the reach of the Web fundamentally shape these emerging models and change teaching and learning? That transformation is possible, though yet untested.

Over the past five years, The Hewlett Foundation's Open Educational Resources (OER¹) Initiative has worked to equalize access to education by sponsoring the development of high quality content made freely available on the Web, removing barriers to the use of the content and carrying out research to understand and stimulate use. Together with partners from universities, the private sector, governments and intergovernmental organizations, the foundation has helped nurture the field of open educational resources from an infancy of scattered, often low quality content across the Web to a robust early adolescence characterized by energy and idealism. Major accomplishments to date include shifting the culture in higher education universities and organizations to share content previously held private; helping to create a powerful portfolio of open, high quality education materials and tools that are used all over the world;

supporting the development of a more flexible copyright system; mobilizing a strong movement of individuals, institutions, and international agencies throughout the world; supporting the preservation and open access of books, moving images, audio and text; and demonstrating the capacity of freely available high quality online content to accelerate learning.

An evaluation of The Hewlett Foundation OER Initiative and two other recent reports (Atkins, Brown, and Hammond, 2007; OECD, 2007; Salzburg Research, 2007) argue that the field now needs to move from a culture of sharing to a culture of participation. The next phase of the work should focus on using the reach and power of OER to help meet the demands for high quality education experiences across the world. The potential for OER to transform teaching and learning exists, but is still essentially untested.

How Might OER Transform Teaching and Learning?

On first blush, the only distinctive feature of OER is that the materials and tools are free and available on the Web, “24/7,” for everyone in the world. For many, this single feature, which potentially alters the balance of power around access to knowledge, is enough to justify the growth and importance of OER. Massachusetts Institute of Technology (MIT) OpenCourseWare (OCW) gives us a peek into a future where the student in East Los Angeles or Nairobi will have access to the same academic content as the student at MIT. We clearly acknowledge that the student at MIT has access to many resources that the Web users in Los Angeles and Nairobi do not, including MIT faculty, labs, and other students. The content is only part of the equation of learning—but, without question, it is an indispensable component.

However, open access is not the only feature of OER that distinguishes it from other content on the Web accessible by search engines or from behind a wall that requires status or permission or resources to penetrate. Fully open educational resources provide a license that grants permission to users not only to read the material but also to download, modify, and post it for reuse. Users are empowered to change the materials to meet their own needs. They can mix and remix. The capacity and right to reuse materials is an important step in providing users all over the world

the opportunity to actively participate in the open education resources teaching and learning processes. It creates the opportunity for the localization of the materials, where users tailor materials according to their language and culture, and for personalization, where materials can be adapted and modified for individual learners. Reuse also makes possible continuous cycles of improvement of educational materials as users quickly provide critical reactions and evaluations to developers of the quality and effectiveness of the materials. These fast feedback loops of users and developers create an environment for the improvement of content similar to the environment of open source software.

To be sure, the private sector can do some of these things with proprietary data, such as asking for feedback, for example, and modifying a product on the basis of the feedback. We encourage this practice, but it is a pale imitation of the involvement a user could have by providing feedback information, modifying the materials, and reposting them on the Web for use by others. Moreover, the users who give feedback to a proprietary vendor are by definition only those with the privilege or resources to access the original material.

These two distinctive features of OER potentially have far-reaching consequences: They alter the balance of power around the accessibility to knowledge throughout the world, and they provide the opportunity for people to become empowered by taking control of their educational content and other materials.

A third, more controversial feature of OER requires attention. Over the past few years, we have observed that much of the better known OER material is of higher quality than even the best private sector or otherwise proprietary content. One reason for this may be that government or foundations fund much of the OER content and tend to value quality over cost. Quality is important since there is an abundance of Web-based content though much of questionable value. The Hewlett Foundation's OER strategy prioritizes exemplars to demonstrate the potential of Web-based materials for teaching and learning concurrent with the priority of accessibility.

Another reason may be that transparency creates implicit and explicit incentives to raise the standard of quality. By sharing content with the global community, the reputations of scholars, educators, and other creators of open education materials are exposed. When OER

contributors know the world will scrutinize the accuracy and worth of shared content, increased levels of effort follow. A third reason may be that the private sector tends to be conservative in their approach to creating education materials in order to retain their market. For example, in the K–12 textbook space, curriculum developers do not want to get too far ahead of others for fear of being removed from approved textbook adoption lists. Mostly, curriculum developers compete on the margins with photos, engaging stories, and perhaps supplemental discs included in the book jacket. Whatever the reason, the virtual library of OER includes a variety of examples of exemplary materials which, over time, may create a positive influence over the private sector.

Finally, though no reminder is likely needed by readers of this chapter, the advent of Web 2.0 changes the face and character of the Web. The increased opportunity for serious and extended interactivity and communication and the use of software that enable three dimensional simulations and other immersive environments dramatically increase the possibilities for powerful educational experiences on the Web. These new dimensions of the Web are congruent with the OER spirit of the mix and remix culture which places the student in substantial control of her learning environment and in the role of creator as well as user.

Examples of Powerful Current OER Practice

We fully expect current innovative practices emerging from the availability of OER to evolve in ways we cannot even begin to imagine at this point. However, among the current open educational materials, some exemplify the features of OER and show promise of influencing teaching and learning across the world. Those that follow the OCW model will build on its path-breaking strengths, access to rich multi-media courses, and the influential dynamic of learning through creation.

OpenCourseWare and Open Courses

Perhaps the best known example of OER is the MIT OCW initiative. Described more fully in chapter 15, MIT OCW fits the profile for OER perfectly. Prior to OCW, MIT course materials were not accessible to the general public: Those not in the club were excluded. After 2002, the

doors were opened to the world. And it is not only accessible but also downloadable and reusable, a characteristic that has been used by institutions and faculty all over the world. Further, it exemplifies quality.

Following MIT's lead, the acts of publishing the course materials by the many worldwide institutions participating in the OCW Consortium (See <http://www.ocwconsortium.org>) represent a significant shift within higher education in the traditional notion of how knowledge is controlled and shared. One of the recent members of the OCW Consortium, the Yale University Video Lecture Project (See <http://open.yale.edu/>), extends the concept of open courseware to include all of the actual lectures of the courses along with the variety of materials. Rather than attempt to cover the university's entire catalogue, Yale also has selected specific courses on the basis of their intrinsic interest to a large audience and quality of their instructional experience.

Yale is not the only institution that provides full courses. Full, high quality courses also are available on the Web through Carnegie Mellon's Open Learning Initiative (See chapter 12 in this volume and also <http://www.cmu.edu/oli>) and the Monterey Institute for Technology and Education (MITE; See <http://www.montereyinstitute.org/nroc/nrocdemos.html>). The MITE courses cover much of the subject matter of the early years of college (and for secondary school Advanced Placement courses) and use rich, engaging, media-based content. All three open learning initiatives allow students to pace their learning as appropriate and review conceptually difficult material as needed.

Learning through Creating

With the emergence of easy-to-use wiki environments and tools, anyone can now become a creator of online content. The most recognized example of this is Wikipedia (See <http://www.wikipedia.org/>), the largest free-content encyclopedia on the Internet. Translated in more than 200 languages, it is built on the contribution of many, though there is a core group of active Wikipedians.

The emergence of new resources such as Wikipedia generates new activities for learning. For example, the practice of using the Wikipedia Encyclopedia differs from the practice of using Encyclopedia Britannica in that users can review edits, contested points, and argument strings. The user has the opportunity to reflect on the provided information in a

different way than with the traditional static encyclopedia. Learning “by doing,” by actively engaging and editing content, being an “owner” of an entry, or by creating new entries are innovative activities enabled by the ability to use and reuse open content. WikiEducator (See http://www.WikiEducator.org/main_page), being built using collaborative development and open networks, also harnesses the participation of many.

A “participatory learning environment” is also encouraged through OER sites such as OpenLearn from the Open University of the United Kingdom (OU UK), Teachers’ Domain, of the public television station WGBH, and Connexions (See <http://www.open.ac.uk/openlearn/home.php>; <http://www.teachersdomain.org/>; and <http://cnx.org>). The OU UK site allows learners to engage with content through their own learning path and to locate other users also exploring content through instant messaging. Other tools encourage online meeting spaces and mapping of knowledge paths that can be shared with others. The OU UK LabSpace (See <http://labspace.open.ac.uk/>) invites individuals to recontextualize content from their quality-vetted OpenLearn content, or add fresh content for others to build on. WGBH is opening its video collections for use by teachers all over the world. These rich video materials can be used and reused. The Web site Connexions provides tools for collaborative content building for faculty and students and the opportunity to bundle modules of content as desired. In particular, online sites such as Connexions enable the niche communities to gather, produce, and share content.

Open reusable content in settings such as the OU UK Lab Space or the WGBH site enables a particularly innovative development process. Part of the power of the Web is that its use makes possible the development of communities of people interested in the same sets of issues. Web-based communities interested in using and improving reusable education content are able to harness fast feedback loops, a form of continuous innovation, creativity, and social networking. Individuals in the community use, reuse, recreate and repost content; others do the same, and the original materials take on many different forms and modifications based on the diverse needs of the users.

Using the Web to create fast feedback loops, we can dramatically improve the quality and usefulness of educational materials by engaging faculty and students who are users. Continuous feedback and

improvement can be applied to textbooks, lesson plans, workbooks, and professional development, to name a few. It also allows faculty to actively engage in the improvement of their field of practice by opening up the system to all.

Open Games, Simulations, and other Immersive Environments

Emerging forms of educational content that could powerfully impact teaching and learning include individual and multilayer games and simulations and other immersive environments. The potential power of the immersive environment is that the student is motivated to learn within a context that often requires them to engage in activities to continue. Players make choices, take actions, build, and often interact with other players to achieve their goals in the environment. The more complex environments often challenge learners to think in different ways to solve problems and provide rewards for success. Many environments have problems requiring the user to engage multiple times, to practice, learn, fail and retry. This sequence closely resembles the trials of real life. Embedded incentives and competition are key attributes of many immersive environments. Over time, a library of open, immersive educational environments that are explicitly educational will emerge. There are already a few examples. The game Discover Babylon teaches a user to be an archeologist with accurate historical and scientific information in three dimensional photorealistic simulations that allow open-ended exploration and discovery (See <http://www.discoverbabylon.org>). Surgery Simulator is a high fidelity laparoscopic environment that enables surgeons to practice complex operative tasks (See the ScienceDaily article at <http://www.sciencedaily.com/releases/2005/06/050627062144.htm>). The device emulates, with a high degree of accuracy, the anatomy of organs and tissues. Immune Attack teaches cell biology by placing the student into a warlike situation within a human circulatory system (See <http://www.fas.org/immuneattack>). The motivating characteristics of these games might be enough to convince students and faculty to make use of them.

Immersive environments such as these engage students in dynamic, rather than rote, learning and the opportunity to participate actively in scientific discovery. Students learn by doing rather than by simply knowing.

Looking Ahead

We imagine some powerful scenarios emerging in the years ahead, where combinations of open educational resources may be used to dramatically alter the opportunities for teaching and learning.

The three types of current OER content described in the section above are only a small part of a much larger virtual and somewhat inchoate Web library of free and reusable and, often, very high quality content and tools. The next few years promise amazing advances in the OER area.

The Open Content Alliance and Google Book Project will digitize a huge percentage of the books that intellectual property laws allow. Educational video archives will be at least partially open. Giant collections of original materials from government and university libraries will be open and more and more usable. New generations of teachers will be completely savvy with the Web. The technology that makes Moore's law continue to hold will drive down costs and speed up access. The telecommunications revolution will bring the Web to everyone in the world through hand-held computers, mobile phones, and other easily usable tools.

How can we capitalize on our current experiences with OER, the changes to come over the next few years, and the power of the communications and interactivity of Web 2.0 to transform teaching and learning? We do not pretend to have the answers. Transformation generally comes slowly but generally entails the changing of processes and opportunities. All we can do is to whet the readers' appetites, and stimulate their imagination with three possibilities.

Language Learning

Recently we have been involved with a very exciting example of the use of technology for learning. The Open Language Learning Initiative (OLLI), a highly innovative research and development project, will use online technology to teach foreign languages, 24/7, and be openly accessible around the world. The system is being designed to deliver a set of 24 basic English language units designed to bring 12- to 18-year-old students to the level of advanced novice proficiency by integrating the technologies of gaming, animation, and voice recognition via the Internet within a structured immersion pedagogy.

A user will also be able to communicate with others who are simultaneously using the program. This could build toward a community of learners. The initial two programs will teach English to Chinese native speakers and English to Spanish native language students. The design will then be applied to other languages. We fully expect OLLI to set the standard for a technology solution for oral language instruction and to be a motivating environment where students within schools and without can learn at their own pace. The timeline sets late spring of 2008 for a release of an open beta version of the program for Chinese speakers to learn English.

The programs will be fully open for use and reuse by others. The capacity to reuse will provide immense possibilities for tailoring the materials. Corporations, governments, and individual people will be able to adapt for their use. The demand for learning to speak English is world wide.

Secondary School and College Textbooks, Courses and Immersive Environments

In many countries, such as the United States, there is no method of validating the effectiveness of textbooks or other teaching materials. Textbooks are traditionally created by one or a few professors or teachers according to a set of publisher specifications that are selected to maximize sales rather than understanding and achievement. In some instances, such as Advanced Placement courses or freshman and sophomore college courses, the books weigh 5 to 8 pounds and, for college students, cost upwards of \$100.00 each. In California, the textbooks for a community college student ordinarily cost more than the student's tuition and fees.

Imagine instead that there were a set of high quality text books open and reusable on the Web. Each open textbook has the conventional pages and figures as other textbooks but also has embedded laboratories, interactive simulations, video, and other supporting material. One powerful component of making this textbook freely available on the Web is that it could be continuously updated for new knowledge. A version of the textbook could also be available on a hand-held device. A low-cost, printable, on demand version of the textbook would be available. Though in the print form the book would lose its interactive characteristics, it would still be as useful as current textbooks.

The design would facilitate rapid improvement cycles. Faculty who use the textbook would be able to easily feed back information to the authors or publishers about its usefulness, highlight places and concepts where the presentation is not clear and their students did not understand the materials, and otherwise comment on the usefulness and effectiveness of the material. In the best of worlds, students also would feed back information. The original author could gather the information, and when it was clear from strong data that some area was problematic, she would improve the textbook to address the issues raised.

Or, perhaps, the local instructor might take on the challenge of making changes herself and then post the text that has been modified to adapt to the local environment. In either instance, the process would be a strong and rapid user-driven feedback loop that creates a cycle of continuous improvement.

A number of projects are already exploring the idea of open textbooks, particularly for community college courses. It is quite possible that three or four years from now we will have sets of community college textbooks that have actually been validated as effective by users.

Secondary School and College Courses

Textbooks are only a start. High quality full courses are openly available online. With the high quality courses from MIT, Yale, Carnegie Mellon, Monterey Institute, and others, we are tantalizingly close both to covering the academic track of a U.S. secondary school or the first two years of many colleges and universities. It would not be a great step to expand these materials to cover all of the key courses for secondary schools or colleges. As with textbooks, these materials could be used and reused to fit local and personal learning needs. The Carnegie Mellon and MITE courses are already highly interactive, and all of the courses could have the built-in communication devices so users could easily link to other users. And, the materials would be open to feedback from users so they could be continuously improved.

While open textbooks do not necessarily threaten the traditional ways of teaching, the existence of complete, very high quality, open, 24/7, Web-based instructional courses may. Why would an instructor lecture if similar, and sometimes more engaging, instruction, were available to

students any time of the day or night? At a minimum, instructors might pause and reconsider their teaching styles, perhaps moving from a didactic to a coaching approach.

On the other hand, why would we need the technology materials at all since lecturers are doing just fine, thank you? We can think of three important reasons. One is simply that the materials supply a student with an alternative way of learning and reviewing the material of the course, just as enhanced textbooks would, or even as current textbooks lamely do now. A second is that it is possible that students might actually learn better or more or faster using the courses. And the third is that people outside of schools and colleges who do not have access to instructors may wish to learn the material on their own.

The first of these reasons will not be transformative. The second two might be. Indeed, regarding effectiveness, Carnegie Mellon has just completed the first in a series of evaluations of the OER programs. As with many technology-driven courses, a typical head-to-head evaluation of the effectiveness of the Carnegie Mellon cognitive tutor course with the effectiveness of the same course delivered by lecture ends in a draw: no difference. This, of course, is evidence of the effectiveness of the technology course and if the lecture course is effective, but it does not provide a strong argument for replacing the lecturer.

However, the fact that the technology course was available 24/7 for students and that lectures were at given times spaced across a semester suggested a different kind of evaluation, one that varied the time for learning, as well as the medium for learning. In this evaluation of an introductory statistics cognitive tutor course, one set of students took the cognitive tutor course with a meeting once or twice a week with the instructor but no lectures; a second set of students took the regular lecture course and had the technology-driven course available, but it was not required. All students carried a full load for the semester.

One other requirement, however, distinguishes this evaluation from other studies of course effectiveness. The students in the cognitive tutor course were given only one-half the semester in which to complete the course. The evaluation found that the students in the technology-driven course did slightly better in half the time than the students in the

lecture course that took the entire semester. This is a very interesting finding, which Carnegie Mellon will need to replicate to see if it generalizes to other courses, and perhaps to explore whether a 50 percent reduction in time is the limit.

For many people in the field of education this is not a surprising finding. They point out that the lecture and semester structures have not changed over the past centuries and that many students attest that they learn little from lectures that they could not learn from textbooks and other students. Powerful and engaging instruction available 24/7 via laptop and, in the near future, cell phone would fit more naturally into the lives of students than do early morning lectures.

But while predictable, what are the implications for transforming the ways in which we traditionally think of learning academic materials? Perhaps college could be shortened to two or three years if students will learn just as much as before—or more. Perhaps instructors might only meet their students once a week to provide some emergency coaching. Instructors would be free to do more of their own research.

A third implication is for people who are not officially students in a college or university. The evaluation suggests that those prepared for college level courses could, with minimal support, learn the material at home or in a library on their own schedule. This is a great result in itself, and we can imagine corporations encouraging employees to engage themselves in relevant open learning courses.

In the long run, the possibilities for self-directed learning of this sort are wide open. There is, however, an important implication. If someone learns the material independently, why not get some credit or certification for the effort? Figuring this out might require that rigorous course final examinations be developed to determine if the person has actually achieved an adequate level of understanding of the material. Then an organization or organizations would have to be established to administer such an exam, and certify that the person has learned the material. The Western Governor's University, located in Utah, provides a service something like this.

Finally, the existence of a body of complete, free online courses suggests that it might be possible to populate courses that satisfy a full college major. These online courses would be made available to anyone and could carry credit for graduation without a residency. But, it also

might be useful to create some new forms of institutions that would facilitate the self-directed learner both in obtaining the free, online learning materials and for providing opportunity for students to interact with other self-learners with like interests.

To extend this thought, it is now entirely within our technology capacity to create a virtual university in a simulated, interactive, three-dimensional setting like Second Life. Virtual student avatars guided by self-learners from all over the world would interact with each other, take rich media courses or cognitive tutor courses or lecture courses alone or with others, and participate in seminars that might be created by students or interested others (for example, professors who are taking a “busman’s holiday,” experts, practicing people in the field). Within the virtual university, music, performing arts, sports, clubs of all sorts could exist while cafés for conversation would spring up. Over time, perhaps a “silicon” league of universities would emerge.

Through our work with The Hewlett Foundation, we have talked with people all over the world about the possibilities for using OER to restructure teacher training, to provide medical practitioners with up-to-date information, to alter the opportunities for those millions of people who are now capable of attending university but do not have places in the conventional institutions. These three examples of how OER might influence teaching and learning only scratch the surface of possibilities.

Overcoming Obstacles

Not all is sanguine in the OER world. There are many possible impediments to bringing OER to the mainstream of education. Moreover, as progress is made from the perspective of an increasing use of OER in interesting ways, the more treacherous the landscape will become. There are obstacles to extending the use of OER to transform teaching and learning, but we believe they can be overcome.

As discussed throughout this volume, for example, intellectual property laws and customs are a very significant obstacle to the effective use of open educational content. Creative Commons and other organizations offer substantial help, but the basic structure of the laws tends to impede innovation in this area.

Sustainability is another major impediment. It is facile to argue that there is an inherent contradiction in the proposition that free content may be sustained through a business model. Yet a variety of models are springing up. In the most straightforward ones, the government or an institution such as MIT provides, updates, and otherwise maintains collections of materials; these entities do so because the content is either a public good or it is in the best interests of the institution to provide ongoing support. A second model comes from experience with open source software and may be called a “Red Hat” model. The content would be fully open, even to commercial use. Thus a company might take a set of fully open courses and provide a professional development service around the courses, and feed back a small percentage of the fees for the professional development service to the content developer to sustain and upgrade the content. A third sustainability model might arise from a group of volunteers who decide that they will maintain the integrity of a body of open content. The general area of models of sustainability is rapidly maturing.

A third obstacle is interoperability, as other discussions in this book have pointed out. The most important obstacles to rapid innovation, however, are not technical. They have to do with the customs, standard practices, and vested interests of people in the universities and schools and within the markets, such as publishing, that may be forced to change as OER strategies gain more traction. Traditions have stood schooling well in the developed world and should not fall, unless there are overriding reasons of effectiveness, cost, and the public good. In the developing world, where the needs are far more dire and more urgent, the possibilities for major innovation may be better.

We have attempted to indicate that the criteria for change of effectiveness and cost might well be met by innovations in teaching and learning that stem from the use of open educational resources. On the matter of the public good, we argue from Amartya Sen’s (1999) position that knowledge is an enabler of freedoms. Poor and oppressed peoples have an inherent right to the opportunity to better themselves, yet a lack of knowledge and information impedes that opportunity. And, in the long run, confining knowledge so that it benefits only those privileged and wealthy will limit the growth of knowledge for all.

Note

1. Open Educational Resources (OER) is a term fashioned in Paris in 2002 at a UNESCO Forum that engaged developing and developed world participants to envision the potential for digitized educational materials and tools freely offered for educators, students and self-learners to use and reuse for the purposes of teaching, learning and research. They envisioned OER content as knowledge, and argued that knowledge is not static but rather an ongoing dynamic process—interpretations, uses, and contexts vary—and the process of additions and modification advances the evolution of ideas.

Open Educational Resources includes high quality content, tools, and implementation resources. Educational content includes full courses, courseware, journals, data, modules and learning objects games, simulations, interactive instructional materials, journals, collections and data. Open search and management systems, easy to use content development systems, user-friendly repositories and portals and online resources that facilitate virtual learning communities are all part of the tools category. Implementation resources such as flexible intellectual property licenses and translation mechanisms are needed to ensure use, reuse and localization, and to facilitate dissemination.

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