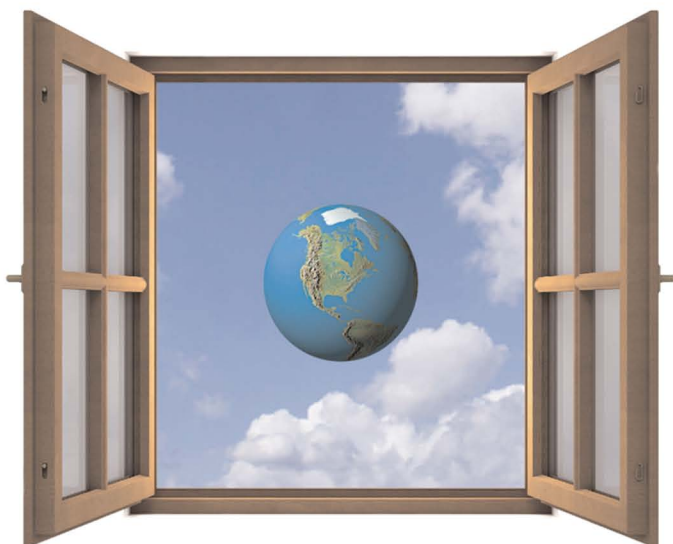


# OPENING UP EDUCATION

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.*



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## **Extending the Impact of Open Educational Resources through Alignment with Pedagogical Content Knowledge and Institutional Strategy: Lessons Learned from the MERLOT Community Experience**

Tom Carey and Gerard L. Hanley

Educational resource repositories are of growing importance in extending access and quality for higher education. New educational materials are now frequently made available through repositories for reuse and adaptation by faculty, with networks of repositories of varying scopes appearing at the national, regional, state, and discipline levels. However, educational resources can be more effective and more frequently reused when faculty have the motivation, time, and expertise to incorporate effective learning designs that meet the needs of their students.

### **The Challenges of Using Open Educational Resources**

An emerging body of research results is helping to inform our thinking about the use of—and contributions to—repositories of learning resources and teaching expertise. Studies of digital resource reuse in single disciplines have illuminated the variety of ways that faculty search for learning resources to engage their students (Borgman and others, 2004), the challenges of evolving users of learning resources into contributors of feedback and teaching expertise (Yaron, Cuadros, Leinhardt, Rehm, Karabinos, and Palucka, 2005), and the importance of a sense of community beyond a traditional information needs framework (Marshall and Bly, 2004). The recent study on the use and users of educational resource repositories across multiple disciplines, described by Diane Harley in this volume, identified the key challenges that faculty cite as obstacles to application of open educational resources, including the following:

- *Impact on teaching practices*: “The foremost reason for *not* using digital resources was that they did not support faculty’s teaching approaches.”
- *Time to identify and adapt resources*: “Lack of time was a major constraint, regardless of institution.”
- *Reusing resources in new contexts*: “Faculty, including those active and enthusiastic in their use of digital resources, identified many other obstacles to using these resources for teaching, including how to . . . reuse them in new contexts” (Harley, Henke, and Lawrence, 2006, p. 7).

Studies in specific content areas further define the nature of these challenges and describe their mutual dependence. For example, a recent project in physics demonstrated the need to rethink instructional designs when resources from a research-intensive institution are reused in the differing context of a four-year institution (Loverude, 2004). Another study, focused on geoscience faculty, noted that “While many faculty have a general knowledge of teaching methods, they are most interested in the application of these methods to the specific topics they teach, and they prefer to learn about teaching methods within such a context . . . This required a design . . . that would capitalize on faculty use of the web to find materials for class as a mechanism for bringing them into contact with materials that could be used later to support their redesign of a course” (Manduca, Iverson, Fox, and McMartin, 2005).

Based on our experience over the last several years with the MERLOT community, we offer two strategies to begin to address these challenges. One strategy supports faculty in reusing open educational resources in their local contexts through the incorporation of pedagogical content knowledge as part of open educational resources. The need for expertise in adapting resources to local contexts—and the time this requires—can be addressed in part by enhancing the pedagogical content knowledge available for reusers of open educational resources. The other strategy aligns the processes and services of open education repositories with the strategic priorities of partner academic institutions to insure their ongoing support for faculty involvement and for the underlying social and technical infrastructures. In this context, the challenge of creating faculty motivation to adapt teaching practices

and make time for change can be addressed by aligning our provision and promotion of open educational resources with institutional priorities and initiatives that are already initiating changes in educational practice.

### **The Example of MERLOT**

MERLOT is a network of 16 higher education systems and seven leading institutions collaborating on strategic directions in teaching and learning through the exchange, reuse, and adaptation of exemplary learning resources and shared teaching expertise. The MERLOT open repository, [www.merlot.org](http://www.merlot.org), provides a portal to over 16,000 open educational resources and contains nearly 8,000 contributions of teaching expertise about those resources (these function as open educational resources in their own right). Use of this repository continues to experience dramatic growth: At the start of 2007, the 40,000 unique users per month seeking out shared learning resources represented a 50 percent increase from the previous year.

Behind this public face, MERLOT is also a leadership cooperative for faculty communities, sharing teaching knowledge and managing digital resources to enhance learning and student success in higher education. MERLOT has created 15 discipline communities that peer review the learning materials, as well as expand the shared teaching expertise available for reuse and adaptation. MERLOT programs enable faculty to provide exemplary learning experiences in their content areas through professional and scholarly collaborations with their disciplinary and institutional colleagues.

### **Enhancing Pedagogical Content Knowledge**

The term *pedagogical content knowledge* was first used by Lee Shulman to characterize the knowledge needed to teach effectively in a discipline (Shulman, 1986). Including but not limited to the knowledge of the discipline content, this expertise is situated in specific disciplines and topics, and both supplements and instantiates more generic pedagogical knowledge (Bransford, Brown, and Cocking, 2000). Based on a combination of practical experience and scholarly research, this knowledge includes implicit and explicit elements across a range of learning issues:

- the various outcomes associated with particular topics and student cohorts;
- the challenges students and teachers experience in engaging with the topic;
- the teaching and learning approaches which are effective, and the contexts in which they work best;
- assessment of student accomplishment and support of their learning needs.

### **A Complementary Source of Open Educational Resources**

Pedagogical content knowledge is an important component of open educational resources (OER). From that perspective, a number of additional collections or repositories come into view as potential sources of OER. Many institutional repositories showcase their exemplary teachers and share effective practices. Some repositories facilitate sharing of pedagogical content knowledge across institutions, including the KEEP Toolkit from the Carnegie Foundation, discussed in this volume, which has been used to document over 50,000 instances of exemplary teaching practices across K–12 and higher education settings (Iiyoshi, Richardson, and McGrath, 2006). However, most of the repositories do not highlight the discipline-specific contexts in which these approaches have been applied, and few of them complement the representations of teaching expertise with reusable learning materials that would accelerate the implementation of exemplary teaching approaches.

Through MERLOT, we have seen that it is possible to integrate learning materials and teaching expertise. Teaching strategies for the effective use of the resources are currently being shared and extended through evolving repository elements for pedagogical content knowledge. Below we describe some of our past experience and the new directions now being explored to make the process of using and reusing content and related resources more effective and sustainable.

### **“Segmenting” and “Capturing” Pedagogical Knowledge**

Time, motivation, and expertise affect the likelihood of instructors contributing and reusing pedagogical content knowledge as well as disciplinary content. Therefore, a key principle of MERLOT’s strategy is to segment pedagogical knowledge into units of work that can be produced

by different instructors with different levels of expertise and in small enough units that the process can be integrated into the instructor's normal workflow. Also, most of the pedagogical expertise captured in MERLOT is produced in an open process by individuals using MERLOT's user-friendly tools freely.

**Identifying Content** Finding and selecting prospective content to transform into curriculum is a significant challenge (Hanley, 2005). Since 2000, using pedagogical content knowledge as well as disciplinary content knowledge to facilitate finding and selecting OER has been MERLOT's key focus. Five of MERLOT's current open pedagogical resources, in particular, focus on enabling teachers and learners in discovering and researching the educational resources appropriate to their needs. Below, we summarize the lessons learned from deploying and supporting resources in this format (examples of all these formats for pedagogical content knowledge can be accessed at <http://www.merlot.org/merlot/materials.htm>).

- *Member comments* are personal reflections on the value of the MERLOT resource. This service was designed so that instructors who might consider using a MERLOT resource would have access to direct reflections of students, faculty, and staff. These reflections would provide valuable pedagogical context for their decision making. We have found that it is relatively easy to create and review member comments. About 140 new comments are being added to MERLOT per month. In April 2007, the MERLOT collection contained about 5,000 member comments on about 2,500 materials, with about half the people writing comments being students.

- *Personal collections* are individualized collections of MERLOT resources created and annotated by MERLOT members. These collections enable any user to leverage the search and review processes of their colleagues. The number of times a resource is placed in a personal collection also becomes a citation index and can be used as another indication of the resource's value. When annotations are added to a personal collection, other users can learn the member's pedagogical purpose(s) for organizing the collection. We have found that personal collections are also relatively easy to create and review. About 170 personal collections are being added to MERLOT per month. In April, 2007, the MERLOT collection contained about 8,800 personal collections created by about 4,800 members, about half created by faculty and a quarter by students.

- *Learning assignments* provide practical examples of how a specific OER can be used for a particular learning objective. The member contributing an assignment describes important pedagogical context, including the learning objectives, pre-requisite skills and knowledge for the assignment, and estimated time to complete the task. Assignments can aid other instructors in selecting resources, as they provide a lesson plan and considerations about how to use the content as curriculum. We have found that contributing an assignment is relatively easy but requires significantly more pedagogical expertise to create. About 15 assignments per month are being added to MERLOT. In April 2007, the MERLOT collection contained about 1,100 assignments on about 900 materials, about two thirds written by faculty and about one third written by students and student teachers.
- *Author snapshots* provide valuable insights into an author's rationale and design for the educational resource that can be very useful for instructors assessing if their own rationale and design aligns with the author's in the process of selecting materials. Author Snapshots were created in partnership with the Carnegie Foundation's Knowledge Media Lab. We have found that they require a comparatively significant effort and pedagogical expertise. In April 2006, MERLOT provided 16 author snapshots, all created by faculty. Without specific MERLOT interventions to invite, train, and manage the development of these snapshots, none have been generated in the last year.
- *Peer reviews* are structured evaluations of the MERLOT resources conducted by at least two trained experts in the discipline. The evaluations provide a structured report on the quality of content, pedagogical effectiveness, and usability of the resource. Other instructors considering using open resources can have some confidence in their selection of OER by reviewing the expert evaluations about its quality of content, pedagogical effectiveness, and usability. The work by peer reviewers requires significant time, motivation and expertise. The institutional support for the peer reviewers that augments the individual commitment of time, motivation, and expertise is essential to the sustainability of MERLOT's peer review process. This support can be provided through a variety of institutional reward and recognition strategies; but whatever strategy used, we have learned some strategy is essential. In April 2007, the MERLOT collection contained about 2,300 peer reviews produced by 15 editorial boards at a rate of about 25 per month.

Although there are many causes for the differences in contribution rates to Member Comment, Assignments, Personal Collections, Author Snapshots, and Peer Reviews, the differences illustrate the connection

between the richness of pedagogical content knowledge and the challenges of generating the pedagogical content knowledge in a sustainable manner. It appears that Member Comments and Personal Collections are sustainable and are growing in an open community; MERLOT simply provides the access to tools to generate this pedagogical content knowledge, and instructors freely contribute. Generating Assignments is also sustainable for MERLOT (we simply provide access to the tools, and instructors freely generate them) but is less scaleable.

The Author Snapshots were not sustained within the current MERLOT context (although the use of the KEEP Toolkit is sustainable, based on other Carnegie Foundation projects). The Peer Reviews have been sustained, but MERLOT's challenge is scaling the peer review process to keep up with the rate of contributions of materials—about 200 materials per month in April 2007, for example.

### **Future Directions: Pedagogical Content Knowledge as an Open Educational Resource**

The impact of the pedagogical knowledge represented to date has been promising, and these initiatives are being shared within the OER community. Other repositories are also extending their formats for pedagogical knowledge, including representations for community expertise through Expert Voices in next-generation prototypes of the National Science Digital Library (Lagoze, Krafft, Cornwell, Eckstrom, Jesuroga, and Wilper, 2006), and student skills, misconceptions and assessments in pilot studies for extensions of the Digital Library of Earth Science Education (Kastens, 2004; Holzman, Kastens, and Arko, 2006).

**Designing for Specific Contexts** Most of these existing initiatives do not directly address the need to tailor learning designs to suit specific learning contexts, nor do they provide a link to research results and community scholarship. These are key elements in developing faculty expertise for more effective learning designs—and thereby to address the challenge of committing time and effort to adapt teaching approaches to take full advantage of open educational resources.

How might we move forward in new directions that would more directly address these needs? Within the MERLOT community, we are beginning to address these needs by experimenting with the following

innovations for pedagogical content knowledge associated with open educational resources:

- *Analytic reviews* would extend existing peer review facilities by incorporating research results on learning in the subject area. Many disciplines have maturing collections of research results that could be made available to faculty accessing shared learning resources through online repositories. (See, for example, the repository maintained by the physics department of the University of Illinois at Urbana-Champaign, <http://research.physics.uiuc.edu/PER/>.) As noted by Shavelson and Towne (2002), “We cannot expect reform efforts in science education to have significant effects without research-based knowledge to guide them” (p. 1).
- *Guides to best evidence for engaging learners* would build on existing approaches like the ERIC Digests (see <http://www.ericdigests.org>) and syntheses of evidence for clinical practice in medicine (Grolo and Grimshaw, 2003). We are developing and testing new formats for community contributions of pedagogical knowledge from both practice-based and research-based sources. This process would follow the spirit of *How People Learn: Bridging Research and Practice* in seeking to “combine the expertise of researchers and the wisdom of practitioners” (Donovan, Bransford, and Pellegrino, 1999, p. 248). This approach also allows for multiple levels of scholarly activity to match with the contexts of application (compare the distinctions amongst personal, local, and public scholarship and faculty development in Ashwin and Trigwell, 2004), and provides a base for enriched formats with stronger support for social interactions (Sumner, 2002).

These future developments fit well with the growing movement to consider the scholarship of teaching and learning as part of faculty activities as scholars. As a consequence, these experiments with pedagogical content knowledge have the potential to align with institutional strategies for the development of teacher-scholar models for faculty.

### **Aligning Reuse with Institutional Strategies**

MERLOT continues to work on the challenge of providing pedagogical content knowledge that can be produced in a sustainable manner. We know that it is important to increase the recognition resulting from these activities, both from the relevant teaching community and subsequently within the institutional reward systems. It is also important to increase

the institutional support available for these activities, which means that MERLOT must continue to enhance the alignment between these activities and the institutional goals and initiatives which are (or will be) resourced within other plans of our sponsor academic institutions. These two efforts are synergistic. We envision that most of the faculty time required to exchange, reuse, and adapt pedagogical content knowledge will be supported as part of the ongoing strategic institutional initiatives, and that the additional effort required to share pedagogical content knowledge with the wider teaching community will be supported within the institutional recognition and reward systems for teacher-scholars.

### **Shared Expenses, Shared Governance**

Other chapters in this book describe how institutional plans and strategic positioning have led to the creation and dissemination of open educational resources, through incentives to faculty and the provision of time, staff support, and the like. An ongoing challenge for OER communities is the development of sustainable programs which will continue this good work without the one-time external support that was pivotal to launching a critical mass of these creation and dissemination initiatives but is not available on an ongoing basis.

A related ongoing challenge for OER is the development of institutional plans and incentives for the reuse and adaptation of these resources. Indeed, any long-term value from creation and dissemination of resources derives from the benefits of their reuse and adaptation.

In this context, the way the MERLOT community has sustained its operations over the last seven years may be instructive for other OER initiatives. The costs of operating the Web site infrastructure and of the processes that support it are underwritten by MERLOT's sponsor academic institutions. The sponsoring institutions (currently 16 state or regional systems and seven individual universities and colleges) invest in supporting operations for the public Web site, and also provide faculty time to serve as members of the 15 MERLOT discipline-specific editorial boards to provide oversight, management, and quality control of the Teaching Commons content.

A critical investment these institutions make is supporting their leadership role in the MERLOT shared governance process. Each sponsor institution commits to support a MERLOT project director who

participates in MERLOT's yearly cycle of strategic and operational planning processes and is the steward of MERLOT services in his or her institution. Through the project directors, MERLOT aligns its services to the needs of the institution's initiatives. The key to this continued engagement of sponsor academic institutions in MERLOT over the last seven years is to reduce the costs and risks of their own strategic initiatives, as well as increase their impact through the systematic exchange, reuse, and adaptation of resources, services, and tools provided through MERLOT.

Our sponsor academic institutions contribute financial support to MERLOT because that involvement augments and accelerates their own initiatives. They contribute faculty time to the MERLOT Teaching Commons for the representation and application of open pedagogical content knowledge because it supports their institutional plans. Our plan to sustain institutional support for the innovations described in the previous section also builds directly on the success of this MERLOT positioning for academic partnerships. Aligning OER activities with strategic institutional initiatives also has the synergistic effect of overcoming other barriers to use by increasing the value and visibility of benefits.

Below we offer some examples of the institutional strategic goals that MERLOT has been able to support, and the ways that reuse of OER and MERLOT services within these institutions has helped them to address these goals—and, as a consequence, has enabled the ongoing operations of the repository and the ongoing contributions of the faculty involved. Each of these brief examples involves an institutional initiative where OER-based collaboration furthered the institutional priorities and improved the return on investment of institutional funds in the initiative.

### **1. Accelerating Course Development with Online Learning Activities<sup>1</sup>**

The Tennessee Board of Regents is a leader in engaging faculty with discipline colleagues using MERLOT. The board seeded this engagement by supporting leadership roles for key faculty as MERLOT discipline editors and coeditors, content reviewers, and so on. The contributions of these leaders are leveraged across the system, through seminars and workshops, and other faculty members who identify and submit ten exemplary learning objects that have been accepted by the peer review

team have their work recognized at the system level through support for participation in MERLOT activities.

This investment has enabled the institutionalization of MERLOT use into development of the Regents Online Degree Program. As part of the quality assurance process, course designers are expected to document their use of exemplary learning resources with high quality reviews. Online mentors for the program find additional resources and submit 10 learning objects to MERLOT as part of their contract. MERLOT is posted in every online course and highlighted on course Web sites. Students have shared on their course evaluations that they have used MERLOT as a tutorial tool for their online courses. Faculty and staff report that they use MERLOT as a curriculum enhancer for course development of online materials and for their own professional development.

Similarly, the Oklahoma State Regents for Higher Education have initiated a project to help state residents complete a bachelor's degree through an innovative statewide approach involving public universities. Tens of thousands of Oklahomans have completed more than two years of college but have not finished a degree (P. Moss, personal communication, May 19, 2006). Collaborative curriculum development, learning materials, faculty development, and technology will be important components in this effort to help working adults complete a degree. The system office will be institutionalizing use of MERLOT as a key tool in advancing this project.

## **2. Integrating Institutional and Discipline-Oriented Faculty Development**

Our sponsor academic institutions use MERLOT workshops and on-site presentations for faculty and professional development. The advantage that open educational resources offer in this context lies in the unique integration of expertise from multiple disciplines, across a range of teaching issues—all supported by exemplary online resources to give faculty a head start on the adoption of new methods.

In examining the cost-effectiveness of this strategy, the Office of Academic Affairs and Educational Technology of the Tennessee Board of Regents determined that the system investment for the resources provided by MERLOT, in terms of “24/7” professional development

and accessibility to the learning objects, comes to around \$3.00 for each faculty member using MERLOT. The system staff concluded that this return on the investment made a compelling argument to sustain support of faculty engagement with MERLOT (R. Melton, personal communication, May 2006).

Further developments are extending these system-wide faculty development activities with customized Teaching Commons that integrate the activities of the larger OER community with the institutional priorities and initiatives of a particular academic sponsor. For example, within the California State University, custom disciplinary Web spaces such as “Teaching Business in the CSU” (see <http://teachingcommons.cdl.edu/business/>) have been created as mini-MERLOT communities, which can provide a potential faculty development path from local disciplinary exchanges to more impact within a larger community of teaching practice.

### 3. Developing System-Wide Collaborations in Teaching and Learning

The previous example about institutional teaching commons sites demonstrates both immediate impacts in terms of faculty development and longer-term impacts in terms of fostering collaborations across a system. The OER community can provide additional benefits through focusing collaborations around specific resources and their use.

For example, K–20 MERLOT Triads program of the South Dakota Board of Regents supports faculty from public, private, and tribal colleges and universities in collaboration with K–12 teachers. Each triad within a discipline selects one MERLOT learning object, applies it in three different classrooms, and gathers student evaluations. This knowledge exchange has provided a direct return in terms of improved effectiveness in the learning process; it has also provided an indirect return in building stronger relationships across the sectors, which can support other goals like curriculum alignment and articulation across programs (Schamber, Turchen, and Sprung, 2006).

The Cooperative Learning Object Exchange (CLOE), the MERLOT sponsor academic institution in the Canadian province of Ontario, has adapted MERLOT’s peer review processes as part of the collaborative development of learning resources across 25 university and college sites. Each CLOE learning resource was developed by a team representing

several campuses, to insure reusability in multiple contexts. This intentional effort to build in collaborations in the early stages of OER development has led to increased re-usability of the resulting resources and the creation of several case stories of successful OER reuse (see, for example, <http://cloe.on.ca>).

## **The Challenges Ahead**

These collaborative approaches to exchanging, reusing, and adapting resources show how the OER community can move beyond operating on the premise “build it and they will come” and start building so that users will be supported and resourced by their own institutions to come, and providing a return on the institutional investment in terms of the institution’s strategic goals.

At the same time, pedagogical content knowledge is vital to insure an effective fit with student learning needs in the institutional context. Current efforts that focus on augmenting the learning materials in educational resource repositories with facilities for sharing (and developing) associated teaching expertise about the appropriate use and adaptation of the materials offer a way to “build it to provide more utility when they come—so they will come back.”

Both approaches show promise to help us achieve the full potential for open educational resources. Insuring an effective alignment with student learning needs is essential for the effectiveness of open educational resources in enhancing learning outcomes, and insuring the institutions can generate additional value from those enhancements is vital to the continued sustainability of the open educational resource community.

Open educational resources hold much promise. Yet there are many questions about how OER will need to be designed and implemented to fulfill its promise. The OER community must shape a strategy for continuing success: Design effective learning experiences using open educational resources, and sustain openness in the community and collection of resources. Without adaptation and embedded effective learning designs, the OER community will not be able to transform the teaching and learning needed to achieve educational outcomes. Without collaboration to provide sustaining resources and support, the OER community

will not be able to achieve the pervasive use of online educational resources needed to transform the education of the world's population.

## Note

1. We appreciate the contributions of Dr. Robbie Melton and Dr. Phil Moss to the descriptions of the MERLOT benefits for the Tennessee Board of Regents and the Oklahoma State Regents for Higher Education.

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