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Toru Iiyoshi

Cheryl Richardson

Owen McGrath

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Harnessing Open Technologies to Promote Open Educational Knowledge Sharing
by Toru Iiyoshi, Cheryl Richardson, and Owen McGrath

The Knowledge Exchange Exhibit and Presentation (KEEP) Toolkit, a set of software tools designed to help educators provide focused, detailed investigations and demonstrations of effective teaching practice, was developed in 2001 by the Knowledge Media Laboratory (KML) of the Carnegie Foundation for the Advancement of Teaching as a specialized in-house software resource. However, within five years this software steadily evolved into the hub of a distributed community of over 10,000 users, and in 2006 it was released as open source—thereby making it possible for individuals and institutions anywhere to participate in this community. Encouraged by the rapid usage growth but concerned about sustainability, we saw that the best bet for long-term viability in the software would come from inviting our user community to participate in the KEEP Toolkit's future development.

In what follows we first provide an introduction to the key features of the KEEP Toolkit, illustrate its early application as a means of promoting shared inquiry into pedagogical practice, and address its role as a tool for documenting the pedagogical value of learning objects. We then discuss the factors that led us to pursue an open source approach to further software development, and we describe the stages that characterized our implementation of this approach. While potential users may find primary interest in our account of the software itself, we believe that developers, designers, and planners may find our account of the open source transition helpful as a roadmap for their own potential efforts in this direction.

The KEEP Toolkit: Development and Functionality

Over the last several years, the KML has been devising ways to take advantage of emerging technologies and new media to transform what teachers know and do. In 1998, the KML started working in collaboration with partners at the Carnegie Foundation to design Web-based portfolios that demonstrate how teaching practice and student learning can be documented with multimedia and then shared on the Internet. Inspired by the increasing interest of faculty, programs, and institutions to develop and use these portfolios for collective knowledge building, the KML subsequently set about creating a toolkit that instructors and students could use in order to make visible the experiences of teaching and learning that permeate instructional settings every day. The resulting KEEP Toolkit has become an economical and accessible means of achieving this goal, making it possible for users to take advantage of Web technology in order to share their work and reflections on their work.

The primary functions of the KEEP Toolkit provide educators with the ability to create Snapshots, or succinct online overviews of teaching and learning experiences, along with reflections, supplements, and related resources. Creating Snapshots involves working through a set of Web-based forms that allow users to upload artifacts and evidence of teaching and learning (e.g., student work, their own reflections, sound files, pictures, videos), use either pre-established or personally-created templates that quickly organize those materials, and share the Snapshots with others in visually appealing and intellectually engaging formats. (Click here for an interactive demo illustrating the software.) Snapshots are delivered primarily online as Web sites, but they also can be distributed in printed form as handouts and posters. The underlying design philosophy of the KEEP Toolkit is that creating engaging Web representations of teaching and learning and sharing them effectively may always be intellectually challenging but need not be technically challenging.

Using the KEEP Toolkit to Share Inquiry: The CASTL Scholars Program

The first group of educators to utilize the KEEP Toolkit included participants in the Carnegie Academy for the

Scholarship of Teaching and Learning (CASTL). Initiated the same year that the KML first began offering its Web-based tools to the Carnegie Foundation, the CASTL program was established "to support the development of a scholarship of teaching and learning that: 1) fosters significant, long-lasting learning for all students; 2) enhances the practice and profession of teaching; 3) brings to faculty members' work as teachers the recognition and rewards afforded to other forms of scholarly work" (2006, ¶ 2). To support these goals, KML first developed the Snapshot Tool in 2002; since then, the tool has been further modified as part of the KEEP Toolkit, which has become a key means for the program to fulfill its mission.

The value of the KEEP Toolkit in this context derives largely from the overall emphasis on scholarly collaboration in the CASTL program. In the program, faculty participants from various universities and colleges convene at the Carnegie Foundation to explore and share pedagogical questions, processes, strategies, and outcomes in face-to-face meetings that occur in six-month intervals over the course of 12-18 months. During these meetings the participants provide each other with support and feedback on knowledge of teaching that has been exchanged online, and the CASTL leadership team helps the participants frame effective questions about their teaching practice and walk them through the process of sharing it with others. The KEEP Toolkit serves as the technological foundation for such shared inquiry throughout the duration of the program.

The specific applications of the KEEP Toolkit in this setting may illustrate its usefulness as a structural enhancement to scholarly investigation as well as a means to support highly detailed forms of information sharing. The role of the software as a structural enhancement to investigation arises from the provision of specialized templates that allow program participants to refine the focus of their work as they use the Toolkit in the program. Before the first meeting, for example, the leadership team sends instructions on using the KEEP Toolkit along with a preliminary template that directs scholars to introduce themselves and their work. Between each of the subsequent meetings, scholars are given four more templates that provide benchmarks for their ongoing inquiries into teaching. These latter templates carefully prompt scholars to share specific information with sets of questions that are similar to those that inform a research proposal ("What is your issue?"; "How will you investigate this issue?"; "What resources do you need?"; "What is your evidence?"). Scholars answer these questions in the template itself by typing their responses in designated boxes. This process of responding in a Web-publishing format guides academic professionals in thinking about teaching and learning in scholarly ways and reflecting on teaching candidly.

Once program participants begin to define and pursue their respective areas of investigation, the KEEP Toolkit also offers them a valuable means of incorporating a range of media in their work; in this respect, the flexibility of the software is as vital as its accommodation of predesigned templates. Instead of struggling to produce a lengthy and linear report of an educational experience, program participants construct presentations that are enhanced by multiple forms of media such as interviews, images, and videos that provide engaging, detailed illustrations of pedagogical methodology and practice. The inclusion of these kinds of artifacts thus helps scholars move beyond the anecdotal as they indicate and present observable classroom exchanges for discussion. The KEEP Toolkit likewise encourages scholars to be succinct in their explanations by allowing them to use linked information and uploaded files to provide multiple layers of support for their conjectures. Rather than describing certain practices or processes, they have much more freedom to illustrate such practices and processes directly in their presentations. For example, CASTL scholar Whitney Schlegel employed the software to create a gallery of four semesters of student work; with this presentation she explored the potential value of "seeing" student learning of physiology through their layered, team-built snapshots. Other KEEP Toolkit case studies can be found at the Gallery of Teaching and Learning Web site.

In turn, the online availability of such materials both sustains and expands the process of shared inquiry in the CASTL program. The interim reports and presentations are shared with other program participants in a Sakai-based workspace (cf. Downes 2006); this workspace is an online community environment that serves as one of the primary meeting places, resource repositories, and information portals for all cohorts of CASTL scholars. The workspace is used for communication, collaboration, and documentation of the work completed

during the course of the program, allowing for tentative ideas, successes, and challenges to be addressed at every step of the process. Furthermore, by taking advantage of the KEEP Toolkit as well as other features of the workspace—a wiki, a discussion forum, chat rooms, and other tools—CASTL scholars can sustain their investigations and explorations long after the program has ended. Every few weeks new resources and Snapshots are added to the workspace, and fellow scholars comment on them. At the end of the fellowship, many scholars choose to make their inquiry process public to their universities and peers by linking to Snapshots they created during the CASTL Fellowship. In this way, knowledge about particular teaching dilemmas is shared beyond the circle of faculty who initially discussed them.

The use of the KEEP Toolkit and Sakai-based workspace to document and share teaching inquiries thus enables a select group of faculty members to explore, improve, and build teaching knowledge. They engage in a rigorous process of learning to inquire about teaching, they discuss with others their dilemmas and processes, and they use these tools to document and make these processes visible and expandable.

Using the KEEP Toolkit to Share Practice: The MERLOT Template

In light of the usefulness of the KEEP Toolkit for participants in the CASTL program, the KML and its partners at the Carnegie Foundation soon began to consider how this resource could be used to supplement teaching materials created for online sharing and thereby provide pedagogical knowledge regarding the use of such materials. One key step in this direction came from their decision to establish a partnership with MERLOT; through this partnership, contributors to the MERLOT repository are encouraged to accompany their learning objects with KEEP snapshots that provide clear documentation of the pedagogical thinking that informs such objects. By providing such additional information, any contributor can ensure that others have a greater sense of the opportunities, challenges, and successes they may face in the use of a given learning object.

The specialized MERLOT template provides a key foundation for such contributions to the repository. When contributors submit a learning object to the repository, they can use the KEEP Toolkit to describe their motivation for creating the object, the learning activities associated with the object, the impact of the object on student learning, and their reflections on its use in the classroom. As they do so, the MERLOT template provides them with specific prompts that require succinct and direct explanations of how the object serves to enhance teaching practice. Moreover, as they fill out the template, contributors often insert links to definitions, assignments, resources, and other materials to enhance their brief descriptions and provide further information for a potential user of the object. All of this information helps a user understand the kinds of learning issues that the experience is meant to address, the type of environment that will ideal for learning, and the kinds of outcomes someone might expect. For example, one MERLOT contributor used the template to indicate how a particular music simulation could be used to support instruction not only in music but also in other disciplines such as biology and literature.

This partnership with MERLOT has been beneficial for faculty contributors as well as for other faculty who may be considering the use of such objects. The process of writing about the context of using an object has helped authors step back and think about their teaching and not just the content of their courses. The process has also prompted faculty to think about the relationships among content, teaching practice, and student learning beyond the ways of their specific academic disciplines; faculty then share this information so that others can learn from and effectively use the learning objects they find in MERLOT. Although learning object documentation via KEEP Toolkit has not been fully integrated with the repository itself, we anticipate that such documentation will become a standard feature of MERLOT.

Developing an Open KEEP Toolkit

These early experiences with CASTL and MERLOT reveal that besides making it possible for teachers to share aspects of their teaching in a single Snapshot, the KEEP Toolkit activities also serve as an opportunity for them to reflect on their teaching over time across sequences and collections of many Snapshots. Understandably, we sought to continue developing the tools to support such activities and bring them to a

larger group of users. However, the Toolkit hosted on KML's server became popular so quickly that our original server design for storing and managing its content proved inadequate. As the number of contributions grew to many thousands, sharing and viewing content became slow and difficult.

Meanwhile, as the KEEP Toolkit experienced these growing pains, the open source trend was also on our minds. Efforts such as the Sakai Project and the Open Source Portfolio (OSP) Initiative were gaining attention in higher education as institutions began to consider shifting away from commercial or homegrown software systems (Wheeler 2004). It was at this time that we chose to make our own move toward "openness"—open source and open content—for the KEEP Toolkit. We made this decision not out of a desire to be trendy. The move to open source, we believed, was a necessary development that would allow other institutions to contribute resources (e.g., developers, designers, project managers) towards further improving the KEEP Toolkit. In addition, the move toward openness better suited the purposes and the general philosophy of KEEP. The sharing of code, for example, parallels the intent of sharing teaching resources. Allowing for collaborative development of new features should result in innovative approaches to creating and searching new KEEP content. Likewise, and practically speaking, the move to openness eased our problems with server design, content management, and storage concerns in that now our partners could set up and run their own servers. By creating an open network of distributed servers, we enabled these partners (especially those institutions that use KEEP heavily) to move their data to locally maintained systems while still being able to contribute their content to a unified, global KEEP collection.

We therefore undertook the work of opening up the KEEP Toolkit through enhancements that involved integrating the toolkit with existing open source repository software, as well as preparing KEEP source code by refactoring the program design and data model to prepare for distribution as open source software.

Integrating An Open Source Repository

By 2004, thousands of KEEP Toolkit users had already created and were currently disseminating multimedia Snapshots. As the collection grew, access to and long-term preservation of content became daunting issues. The initial KEEP Toolkit framework, for instance, did not explicitly offer archival storage and preservation management features. As far as administering the KEEP Toolkit collections, the existing relational database system presented some inherent barriers to maintaining older Snapshots in the collection. Relational databases may perform well for the storage and query of fresh units of information as specified in their current database schema, but they can fall short in the face of even small changes to their data model over time.

Typically, repository systems offer solutions to this common problem, which is why one phase of our move to an open KEEP Toolkit involved integrating DSpace, a standards-based, freely available digital repository system (Smith et al. 2003). This solution of adding DSpace repository connectivity to the KEEP framework is an example of the kind of functional benefits gained by moving into the open source arena. Technically, the move entailed fairly straightforward tasks: creating metadata, packaging KEEP content for export, automating ingest of the content into the repository, developing a preservation strategy, and determining access policies. Moving archived copies of Snapshots into DSpace not only began immediately to solve our preservation needs but also enabled new forms of access to the KEEP content collection. An added benefit of the repository connection is the set of options for sharing content and metadata with other systems which have all been built to standards for finding and sharing digital library content. Because DSpace repositories can be interconnected as digital libraries, the KEEP user community potentially expands to include a broader community of those interested in browsing the archive collections via digital libraries.

Distributing An Open Source Server

As mentioned previously, the KEEP Toolkit database had grown to contain tens of thousands of Snapshots from teachers and students at other institutions. Not surprisingly, KML had also received inquiries from many educational institutions and organizations requesting new features in the KEEP Toolkit software as well as

downloadable versions for local server set-up. It became clear that in order to address the requests to expand and adopt the KEEP Toolkit for a variety of institutional purposes fully, we would need to do more than simply purchase a bigger server. In the face of this formidable problem of giving an increasing number of users the customized control and extended functionality they need, an open source approach offers hope. We surmised that by providing opportunities for code customizations and contributions from developers within the community, the open source model could save KML from becoming a bottleneck to future improvements.

Of course, moving to open source development entails more than simply giving away source code. Cultivating a potential community of distributed developers necessitates preparation for issues and concerns at many levels, from code review to project governance. To prepare the server framework code for distribution and eventual extension, the KML analyzed the existing KEEP Toolkit's portability and extendibility. Taking steps in releasing a distributable version required internally reframing existing KEEP software code, testing for system dependencies, scrutinizing the database design, and anticipating where functionality to extend the tool might be needed most. A move was also made towards adding interoperability so that content and metadata mark-up would allow Snapshots to be recognized in a wide range of ways—from integrating with institutional repository systems (as described above) to sharing services with major standards-based e-learning tools and frameworks such as OSP and Sakai.

Initial Results and Future Plans

The effectiveness of the repository and server distribution efforts were finally put to the test in early 2006 with our initial open source release. Within weeks, more than a dozen institutions had downloaded and set up their own KEEP Toolkit servers. Better yet, new feature extensions are already being contributed back to the community as institutions using the distributed framework discover useful ways to integrate with their local systems. As these contributions to the KEEP Toolkit increase, we expect to face important decisions about setting guidelines for community contributions, such as how to incorporate new code into existing lines of development, how to review and test the contributions, and how and when to give outside developers ultimate responsibility over different pieces of the Toolkit code.

Currently, we classify future development of the KEEP Toolkit in two groups: new interior functionality for authoring and new exterior interoperability with outside systems for sharing. For example, interior KEEP Toolkit development has always emphasized visually appealing interfaces for the manipulation of multimedia (e.g., images and streaming video), and we will ensure that this continues to be the case for future variants of the software. Exterior development will continue to focus on interoperability of the KEEP framework content with various other open source systems such as the OSP, topic mapping software such as the Visual Understanding Environment (VUE), and presentation tools such as OpenOffice IMPRESS. Here the notion of a toolkit takes on new meaning as authoring, collaboration, and presentation functionality could be added in a modular fashion through the kinds of interoperability made possible by open source.

Conclusion

The results and lessons to be learned from the early adopters of our open source release are still being gathered and will inform the development steps we take in the future. As we consider what work the KML will undertake and what work our growing community of partners might contribute, we are mindful of the need to focus always on our users (i.e., teachers and learners). The guiding principle throughout the development and release of the KEEP Toolkit has been to promote and sustain the activities that the tool is designed to support. To that end, the technical approach has required looking beyond the functionality of the KEEP Toolkit itself towards the broader issue of interoperability of KEEP content with other open source systems for content creation and sharing. If open source systems truly begin to unify the online environments that teachers use, the KEEP framework will be compelled to provide the means of interoperating with these systems. In the future, the KML will continue to respond to requests from current and prospective users of the KEEP Toolkit for new features and work with the growing community of developers at various institutions to enhance the Toolkit's capacity to accommodate new genres and formats for representing the knowledge of

teaching and learning.

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