Connecting and Sharing Open-Content Learning Resources

Yi Zhu, Darina Dicheva, Christo Dichev, and Mike Moran

Winston-Salem State University, Computer Science Department
601 Martin Luther King J. Drive, Winston Salem, NC 27110, USA
yzhu@wfubmc.edu, {dichevad, dichevc, mmoran106}@wssu.edu

Abstract. While the number of learning repositories is increasing, there is no sufficient understanding of how to motivate and facilitate educators to share and reuse learning content. This paper proposes a framework addressing these challenges by integrating traditional approaches with Web 2.0 and Semantic Web technologies. It illustrates how the proposed approaches are used to implement LinkedCourse, a prototype repository for rapid collaborative development, sharing, and reuse of resources for emerging disciplines. The focus of the paper is on the collaborative annotation and community formation supporting the social framework of LinkedCourse.

1 Introduction

The need for sharing and reuse of learning resources is especially evident for academic courses where the content is rapidly changing. For example, in some emerging Computer Science disciplines, course content is changing extremely fast, reflecting the rapid change of technology. The lack of established practice and 'standard' learning material makes it difficult to develop a course in emerging Computer Science fields such as Internet Technologies, Web Programming, Web Design, Network Security, and others. In such cases, instructors have to develop their own materials, since available textbooks typically do not meet course objectives. Instructors need adequate information sources for the development of these materials. However, in emerging disciplines, up-to-date information typically does not exist in a ready-to-use form. Such situations call for instructors' collaboration.

At present, we are witnessing the growing popularity of online communities that rely on mass participation and constant update strategies, such as social bookmarking. Web 2.0 applications have been quick to spot the value of user-generated content. Many applications support building communities by empowering users to directly participate in a transparent collaborative process of content development.

Apparently, strengthening the learning repository initiative will depend on people's participation in repository evolution. People will be willing to participate and share if they see benefits; communication, collaboration, and recognition may turn into benefits if they are appropriately intertwined with the repository. Therefore, the new generation of learning repositories should rely on infrastructure that addresses those factors.

2 Community-Oriented Sharing of Learning Resources

Digging for resources in quickly changing (emerging) disciplines, where mature texts, supplementary materials, and controlled vocabularies are not yet available and what is available is in constant change, is a difficult task. Therefore, it is a research and design challenge to propose an infrastructure that facilitates rapid creating and sharing of learning resources. In designing such an infrastructure the following considerations should be taken into account.

Folksonomies. Most of the Web 2.0 systems provide a medium for sharing and exchange of resources such as bookmarks, photos, videos, files, etc. Currently available "folksonomies" that facilitate resource sharing through flexible social tagging, however, are geared toward casual social networking and not designed with emerging subjects in mind. A folksonomy such as del.icio.us is broad because there are no restrictions on who can tag and what tags they can use. When there are restrictions, as for example at Flickr, the folksonomy is narrow. Broad or narrow, folksonomies prove successful when there is a need for sharing and collaboration. Apparently, Web 2.0 offers a fresh approach that can be used also for sharing educational materials in emerging disciplines. It can foster the development of a diverse, worldwide community of authors who are willing to share their material and also serve as a forum for open collaboration across institutional barriers.

Lawful modification of online learning materials. At present, there is no lawful way for instructors to modify learning materials found on the web even if they are willing to give proper credit to the authors. Thus, a mechanism for declaring that certain learning material is open and freely available for modification, extension, and reuse—as long as the authors are properly credited—is urgently needed.

Collaborative authoring. The availability of an infrastructure supporting the reuse of open licensed learning material in a subject domain, can make course content creation a much simpler task. Rather than writing a complete set of course materials, individual instructors can work on single topics, which are not covered and in which they feel experts. Authors can share their lecture notes, code examples, assignments, problem sets, syllabi, reading lists, etc. The framework should enable authors to form ad hoc working groups to collaboratively develop and adapt existing units. Through reuse of shareable units, a complete set of material for a specific course can evolve without waiting for the 'definitive' textbook to be published.

Encouraging fragmented writing. Many prospective authors are reluctant to write complete textbooks due to the required large time commitment. In emerging disciplines, there are additional barriers: the initial market is relatively small and typically fragmented, and the lifetime of the publications is often short. The rapid evolution of technologies and applications means that some textbooks fall out of date almost as soon as they are printed. Besides, the level and structure of courses in emerging disciplines may differ substantially. All these are reasons for the lack of textbooks in those disciplines. The availability of an infrastructure that supports sharing and reuse of open licensed learning material may encourage some authors to write individual chapters on newly emerged topics to be used as supplements to existing textbooks.

Participatory learning repositories. The majority of learning object repositories has been set up by education-related institutions, authorities, or professional organizations. Their success depends on the principles of volunteerism, sharing, and collaboration. However, such principles cannot be mandated; they have to be nurtured through an appropriate infrastructure and strengthen by community support. Instead of the push models that traditional repositories provide, collaborative knowledge creating and sharing requires environments that invite participation by the community, as users' participation can create content and keep it vibrant.

Content contributors vs. content consumers. In a resource-sharing community, some members are acting more as contributors and others more as consumers. Various studies report that in different participatory media—including wikis, bulletin boards, and photo-sharing sites—5-10% of the users contribute half to all of the content [4]. Although this fact might be considered as a weakness, it is also an opportunity, because the community members' interests are interdependent. Recognizing the contributors even implicitly is an important factor and their recognition comes from the resource consumers. Community filtering can serve various needs besides promoting good quality content, for example, top contributions can be considered for publication. The contributor-consumer interaction, however, offers richer opportunities and we try to exploit its potential. The basic intuition is that if someone finds an open-content resource that is not an exact match of what they need, the potential places to look for a better match is in its "consumer" resources or in resources for which this resource is a "consumer." Indeed, the content of a given resource might not match a particular teaching viewpoint, because it is targeting a different level audience, it is too detailed or too sketchy, etc. However, someone else may have already adapted this resource appropriately. Therefore, consumers of a specific resource and the resources it have consumed are a good starting point for exploration. This resource connectivity could be used as a strategy for exploration.

3 LinkedCourse Framework

To address existing needs, we propose a framework that simplifies resource finding and sharing and supports rapid, community-based development of learning resources while acknowledging and preserving the copyright of the authors. We used this framework to develop the LinkedCourse site. The keystones of the proposed framework are presented below.

3.1 Distributed Content and Intellectual Property

Learning material in the proposed repository is distributed and resides on authors' websites. The repository contains only records with metadata for the original resources and their authors, called resource entries. Thus, the information structure of LinkedCourse consists of three layers, organized as shown in Fig. 1. The lower layer consists of the original learning resources created by the community members, the middle layer contains the repository of resource entries, and the upper layer contains LinkedCourse users' personal spaces.

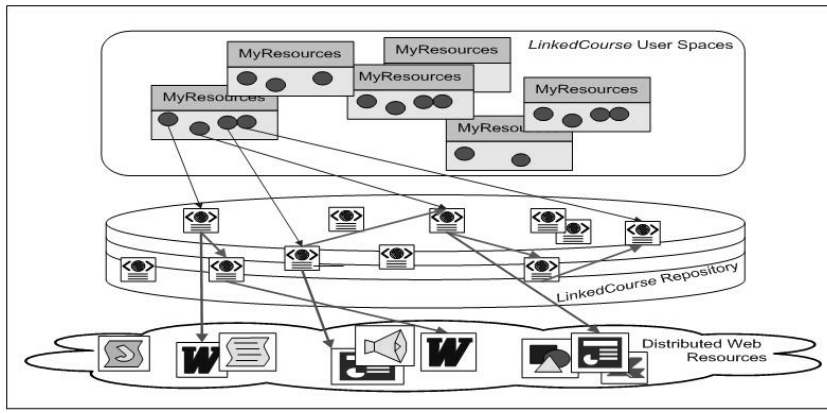

Fig. 1. Layered information structure of LinkedCourse.

One of the main goals of this project is to provide a coherent intellectual property framework to all contributors based on open-content licenses. The resources provided by each contributor will be licensed under the Creative Commons license[1] that allows the content to be copied and redistributed, with or without modifying, and used for commercial or noncommercial purposes, provided the authors receive attribution throughout the use of the resource, even when modified. This promotes the greatest possible sharing of materials.

3.2 Academic Credit and Attribution

Currently, instructors who would like to reuse available online resources have two major problems: (i) they don't have authors' agreement to do that, and (ii) they are not able to publicly acknowledge the reuse of the content. A framework that supports attribution/credit connections would solve both problems. Technically, we propose the concept of a reference map, which links LinkedCourse resources to other LinkedCourse resources that use them or are used by them. Apart from providing credit to sources, the reference map provides a navigational structure and exploration principles, based on attribution/credit connections. It can also support creation of ad hoc groups of users interested in related resources.

3.3 Like "Folksonomies" but not Exactly

The advantages and disadvantages of ontologies and folksonomies are well known [1, 2]. Ontologies can make content well organized, but their creation requires time and expertise. User-generated folksonomies can be more relevant and inspire discovery, but users lack discipline and expertise. Controlled tagging can create a gap between resource providers and users of learning collections, making the retrieval process tricky [5]. Our proposal is not based on coexistence of folksonomies and taxonomies as two different and complementary tools, but on merging these two approaches. [3] The suggested approach

[1] http://creativecommons.org/

for sharing learning content is an attempt to combine some aspects from both worlds: conventional digital libraries and ad hoc classification. While it shares some concepts with folksonomy, there are also significant differences. On LinkedCourse:

- Users are expected to share not arbitrary bookmarks but links to learning content in a particular subject area.
- When sharing their own learning content, users comply with the adopted intellectual property policy.
- Tagging is based on a mix of semi-controlled and uncontrolled vocabularies.

We use three semi-controlled vocabularies. The first one comes from course names. Though course names put some boundaries on the tags, they can result in a sizeable collection. For example, similar learning content can be found in courses named "Internet Systems", "Internet Technology", "Web Programming", "Web Design", "Scripting Languages", etc. Another semi-controlled vocabulary comes from the resource types, for example, lecture notes, code examples, assignments, free software, test samples, problem sets and solutions, syllabi, reading lists, etc. A third source of "controlled classification" comes from the automatic tagging of resources with providers' information, for example, username, institution, home page, etc.

The uncontrolled part of the tagging leaves users the freedom to pick arbitrary categories for classifying learning resources besides the course name and resource type. Such a feature enable users to group resources by additional properties (content-related, instructional, presentational, etc.), for example, beginner, advanced, formal, mathematical, practical, visual, new, year offered, etc.

4 LinkedCourse Architecture

LinkedCourse is intended as a site for community-based resource development, sharing and finding. Consequently, the design requirements include support for registering and tagging of learning resources, maintaining references between resources, users' bookmarking, reviewing, and ranking of resources, 'housekeeping' for maintaining good structure and content, intuitive navigation and searching for finding courses, resources or other users with similar interests, provision of personalized resource spaces, and community building and communication [6]. This functionality is enabled by a service-oriented architecture. The main envisioned services are described below.

Registering and Exploring Resources. The learning content accessible through LinkedCourse comes from users' submissions. Users submit separate learning resources related to a particular course. All learning resources reside on their providers' websites. On the LinkedCourse website, for each registered resource only a resource entry is maintained including: the resource name, type, description, URL, tags, and course name; resource provider's name, institution, and homepage; and attribution/credit to 'used' LinkedCourse sources (if any). A predefined resource type vocabulary is provided for convenience however providers are able to add additional types. Resource providers are also able to tag resources, submit reviews and comments, or vote for the quality of resources.

We use a combination of browsing paradigms to support resource exploration:

- Facet-based browsing. The user interface supports a four-dimensional view on the content providing a convenient, uniform way of content browsing.
- Pivot browsing and tag clouds. Pivot browsing provides a lightweight mechanism to navigate an aggregated collection. Using a tag cloud as a categorization system allows visualizing the power of the ad hoc classification. The tag cloud allows users to navigate the collection by all properties used for grouping the resources and to discover interrelationships between groups that may not be apparent when navigating through courses.
- Attribution & credit reference map. In addition to explicating attribution and credit to sources, this browsing will provide a strategy for finding related resources.

Interface. The focus of the LinkedCourse interface design is on simplicity, intuitive exploration, and easy navigation to target resources. The interface contains two main spaces: global and private space. The global space is the space where users can browse all public information submitted to LinkedCourse: courses, resources, people, and tags. This is the space to which unregistered users have access. The private space is envisaged as a projection of the global space on a particular user. It also contains the privately saved users' objects. Therefore, it contains all courses, resources, and tags created or bookmarked by that user.

The private space contains the following tabs: My Bookmarks, My Resources, My Courses, My Tags, My Community, My News, and Settings (see Fig. 2).

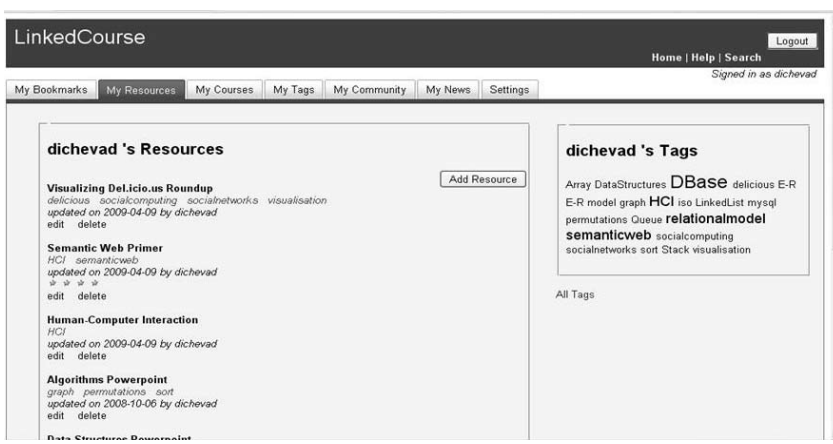

Fig. 2. LinkedCourse interface.

My Community connects a user to other LinkedCourse users. Each user can add registered users to their community for easy access to their learning resources, bookmarks, and tags, as well as for more convenient contact to them through special services. *My News* is the space where a user can receive information for added or modified resources of their interest (through RSS feeds) or such exported to them by members of their community. Users can subscribe to courses, tags, and people in order to receive information about new resources

submitted to a specific course, by a specific author, or tagged with a specific tag.

Views. We use four facets or dimensions for displaying the information in LinkedCourse: Courses, Resources, People, and Tags.

When a user selects a course name, they will see all resource types available for that course, all publicly available resources assigned to that course, all people that have used or bookmarked it, and all tags used for tagging resources belonging to that course. When a user selects a resource, they will see all courses in which that resource is used, all people who have authored or bookmarked that resource, and all tags assigned to that resource. When a user selects a resource type, they will see all resources of that type, all courses with resources of that type, all people that have submitted or bookmarked resources of that type, and all tags assigned to resources of that type. When a user selects a person, they will see all public courses and resources submitted or bookmarked by that person, and all tags used by the person. When a user selects a tag, they will see all resources that have been assigned that tag, all courses used in combination with that tag, and all people who have used that tag.

This four-dimensional view allows flexible navigation enabling a meaningful analysis of the classification power of each dimension. For example, it will indicate which terms are useful to the LinkedCourse users; what new concepts (and terms for naming them) are suggested by the users; what tags and objects has a person used, etc.

The principle of uniformity is used to present course or resource information, accessed through any of the above views. For each course, the following information is displayed: the number of and a link to courses in LinkedCourse that have been used in the development of this course's materials, the number of and a link to other courses that have used this course's materials, and the number of bookmarks of this course and a link to a list of courses with the same name but a different provider.

Each resource entry contains the following information about the resource: name of the resource (linked to the actual online resource), type of the resource, author(s) along with their institutions, last revision date. Each resource is associated with (i) all resources that use this resource and (ii) all resources that are used in the development of this resource. This feature is intended to enrich the navigation and provide credit to contributing authors as well as acknowledgment of users that have used the resource.

The listing of all objects in a specific view is by default in alphabetical order. Two other sort options are available: by submission time and by popularity. We also use a tag cloud as it visually shows the ad hoc classification.

The popularity score of a LinkedCourse object are defined based on the following:

- For Resources: the number of other LinkedCourse resources using this resource and the number of bookmarks of this resource (with appropriate weights).
- For Courses: the popularity scores of the resources linked to them.
- For Tags: the number of LinkedCourse objects tagged with the particular tag.
- For People: the number of user's contributions (submissions, annotations, bookmarks, tags), the number of other users' bookmarks and

positive votes for that user's resource entries and user's involvement in maintaining the site (with appropriate weights).

Community building and communication. One of our major goals is to explore the best ways to support the creation of an online professional community (community of practice). We use standard social applications' practices and are implementing a set of services to support the creation and development of a community of users that guarantees project vitality and sustainability.

6 Conclusion

The ideas of this work arose from a set of intuitions shared by a wide range of academics: that knowledge should be open to use and reuse; that collaboration should be easier; that people should get credit and kudos for contributing to instruction-related activities; that there should be a way for instructors to publicly acknowledge reuse of open content; and that the ability of authors and instructors to readily and dynamically access and update learning material is especially important in rapidly changing fields.

A community of practice will succeed if the participating members perceive some value in their participation. In the case of emerging disciplines, the value is in the developed content that no single instructor is able to do on their own. The pool of up-to-date teaching materials made available to community members through sharing and collaboration provides value and motivation for sustainability. Providing an audience and means for expressing the self is another value factor for contributors seeking reassurance. We believe that an appropriate, specialized infrastructure can turn a learning repository into a space where content attracts people and people bring other people who use and further evolve the content.

Acknowledgments. This research was partly supported by the US NSF 2008 HBCU-UP Program and the Bulgarian National Science Fund Project D002-111/15.12.2008.

References

1. Al-Khalifa, H., Davis, H.: FolksAnnotation: A Semantic Metadata Tool for Annotating Learning Resources Using Folksonomies and Domain Ontologies. In: Proc of the 2nd Int'l IEEE Conference on Innovations in Information Technology, Dubai, UAE (2006)
2. Bateman, S. Brooks C., McCalla G. Collaborative tagging approaches for ontological metadata in adaptive e-learning systems. In: 4th Int'l Workshop on Semantic Web for E-Learning - SWEL'06 (2006)
3. Dicheva, D., Dichev, C., Zhu, Y.: Sharing Open-Content Learning Resources in Emerging Disciplines, SWEL'09 Workshop at AIED 2009, Brighton, UK (2009) 23-30
4. Open Learning Initiative, available at: http://www.cmu.edu/oli/
5. Report on the Workshop of Learning Object Repositories as Digital Libraries, D-Lib Magazine, 2006, available at: http://www.dlib.org/dlib/october06/artacho/10artacho.html
6. Yi Zhu: A Framework for Sharing Learning Resources, Master Thesis, Computer Science Department, Winston-Salem State University, Winston Salem, NC (2008)