Evaluating Learning Objects Across Boundaries:
The Semantics of Localization
Jerry Z. Li and John C. Nesbit, Simon Fraser University, Canada
Griff Richards, British Columbia Institute of Technology, Canada

ABSTRACT
Learning object repositories and evaluation tools have the potential to serve as sites for interaction among different cultures and communities of practice. This paper outlines web-based learning object evaluation tools we have developed, describes our current efforts to extend those tools to a wider range of user communities, and considers methods for fostering interaction among user communities. We discuss the recommendation of objects across community boundaries, and approaches to mapping between languages, ontologies and work practices.

Keywords. e-learning, reviews, quality, repositories, communities, eLera, LORI, convergent participation, collaboration, professional development

THE NEED FOR EVALUATION ACROSS COMMUNITIES
Perhaps the main feature distinguishing learning objects from other educational software is their ready availability through web-based repositories, collections that can be searched with standardized metadata. Because user communities such as elementary school teachers and university instructors have different requirements and expectations, specialized repositories are emerging that are interlinked by metadata and interoperability standards. Within the next five years, the U.S. National Science Digital Library (NSDL) is predicted to grow to include as many as 100,000 collections representing over a million learning objects (Saylor, 2002).

We believe that the effectiveness of most online learning resources is severely limited because they do not conform to design principles established by research, and have not been subjected to formative user testing. Better education of instructional designers, teachers and other e-learning professionals is part of the solution. And there is an immediate need for methods and tools to facilitate the development, dissemination and retrieval of high quality resources.

The scope of the quality problem is such that a variety of specialized evaluation methods is required. For example, teachers and learners may only be induced to evaluate if the instruments are uncomplicated and demand very little additional time and effort. In
contrast, professional e-learning design teams require detailed instruments that support systematic formative assessment at different stages of product development.

The strategy of specializing learning object evaluation tools for specific user communities offers benefits through more focused support for community needs. Benefits may also be generated through strategies that foster communication and interaction among these communities. Such strategies are important to avoid the establishment of ‘multiple solitudes’ in which innovations, solutions and beliefs are not readily disseminated across community boundaries.

This paper introduces web-based learning object evaluation tools we have developed and describes the work that is now underway to extend the effectiveness of these tools to diverse social networks of practice, language and culture. We consider the prospects of several sociotechnical strategies for fostering interaction within and between these networks.

CURRENT APPROACHES TO EVALUATION

Our work on collaborative learning object review is part of a growing body of research and practice driven by a renewed awareness of learning resource evaluation as a critical complement to learning design and an essential factor in resource selection (Clarke, 2003; DLNET, 2004; Merlot, 2004). The different practices currently in place can be viewed as variations on a common model. Each is formed from (a) a searchable database of learning resources; (b) metadata describing those resources that more or less conform to the IEEE learning object metadata standard; (c) a subject taxonomy constituting one component of the metadata; (d) evaluation criteria in the form of guidelines or a structured instrument; (e) a process for conducting and publishing reviews including restrictions on who can review; (f) a structured form in which all reviews are published.

In the common model there are often two tiers of evaluation – reviews by individual users and reviews by selected experts or “peers.” These mirror the two different types of consumer product evaluation systems that have proliferated on the Web. For example, at one video game review site (www.pcgamereview.com), any user can register to rate and comment on three quality dimensions (gameplay, graphics, sound) of a video game. Similarly, at a general consumer product review site (www.reviewcentre.com), any user can rate products on the two dimensions of “quality” and “value for money”, as well as record comments. In contrast to these open evaluation systems, other product evaluation sites present only expert reviews. For example, at a DVD review site (www.dvdfile.com) experts evaluate DVD movies on the quality of video, audio, supplements, interactive features, and value for money.

Like most of the product review sites, the evaluation protocols of learning object repositories provide few opportunities for interaction among expert reviewers (e.g., content experts and instructional designers), and even fewer between expert and consumer reviewers (e.g., learners and teachers). Such interactions are potentially important because reviewers have been consistently observed to modify their evaluation of a learning object after being presented with reviews that differ from their own (Nesbit,
Interactions among reviewers also present a powerful opportunity for professional development of teachers, instructional designers and media developers.

**ELERA**

eLera is a website designed to support a distributed network of teachers, instructors, students, researchers, instructional designers, and media developers. Under development since September 2002, the initial version of eLera was released in November 2003 at www.elera.net. eLera is a member of eduSource Canada, a network of interoperable Canadian repositories federally funded through the CANARIE eLearning Program. Like many repositories, eLera stores metadata pointers to learning objects rather than the objects themselves. A distinguishing attribute of eLera is its emphasis on the construction and dissemination of learning object quality reviews. The main premise of eLera’s design is that quality ratings and comments are metadata that can powerfully assist the search and retrieval of objects.

Developed in Zope, eLera maintains a searchable database of learning objects and reviews, and provides tools and information for learning object evaluation. eLera complies with the IEEE Standard for Learning Object Metadata (IEEE, 2002) interpreted by the CanCore application profile (Friesen, 2003). With permission of the Online Computer Library Centre, it uses a modified version of the Dewey Classification System as a subject taxonomy. eLera includes evaluation forms and reports, statistical aggregation of ratings, a “my collection” feature allowing members to assemble frequently used objects, and the ability to search other repositories and port metadata to and from other repositories using the eduSource Communication Language (Hatala, Richards, Eap, & Willms, 2003). Basic features currently under development include shareable collections, and a personalized home page listing recommended reviews and objects.

**LEARNING OBJECT REVIEW INSTRUMENT (LORI)**

The eLera website allows users to evaluate resources with the Learning Object Review Instrument (Nesbit, Belfer, & Leacock, 2003). LORI was iteratively developed through reliability and validity studies with instructional developers and teachers (Vargo et al., 2003). Version 1.5 of LORI includes nine items shown in Table 1.

**Table 1. Dimensions of learning object quality in LORI 1.5**

<table>
<thead>
<tr>
<th>Content Quality:</th>
<th>Veracity, accuracy, balanced presentation of ideas, and appropriate level of detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Goal Alignment:</td>
<td>Alignment among learning goals, activities, assessments, and learner characteristics</td>
</tr>
<tr>
<td>Feedback and Adaptation:</td>
<td>Adaptive content or feedback driven by differential learner input or learner modeling</td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Motivation:</td>
<td>Ability to motivate and interest an identified population of learners</td>
</tr>
<tr>
<td>Presentation Design:</td>
<td>Design of visual and auditory information for enhanced learning and efficient mental processing</td>
</tr>
<tr>
<td>Interaction Usability:</td>
<td>Ease of navigation, predictability of the user interface, and quality of the interface help features</td>
</tr>
<tr>
<td>Accessibility:</td>
<td>Design of controls and presentation formats to accommodate disabled and mobile learners</td>
</tr>
<tr>
<td>Reusability:</td>
<td>Ability to use in varying learning contexts and with learners from differing backgrounds</td>
</tr>
<tr>
<td>Standards Compliance:</td>
<td>Adherence to international standards and specifications</td>
</tr>
</tbody>
</table>

Figure 1 shows how LORI appears to online reviewers. For each of the nine items reviewers can enter comments and ratings on a 5-point scale. Reviewers can choose to skip items they are unable to assess. Each review is published in eLera as a separate web page. Ratings are averaged over items and reviewers to obtain a mean rating used to sort search results.
TOOLS FOR COLLABORATIVE EVALUATION

eLera supports collaborative evaluation of learning objects, specifically the convergent participation model defined and tested in previous research (Nesbit & Belfer, 2004; Nesbit et al., 2004; Vargo et al., 2003). In this model, small evaluation teams are formed from participants representing relevant knowledge sets and interests (e.g., subject matter expert, learner, instructional designer). A team leader or moderator chooses objects for review, schedules a panel review activity, and invites team members to participate on the panel. Moderators use a team creation feature in eLera to assemble teams, and a request feature to invite members to participate in panel reviews. A screen shot of the request feature is shown in Figure 2.

Figure 1. LORI as seen by a reviewer (only the first five items are shown).
After the panel members have completed individual reviews, they meet in an online, real-time conference to compare and discuss their evaluations. In the convergent participation model, reviewers first discuss the items showing the greatest inter-rater variability. The moderator can use statistics calculated by eLera to order items for discussion. To support comparison of evaluations, eLera presents an aggregated view of ratings and comments for each item of LORI. A screen shot of the aggregated review information is shown in Figure 3.

Panel members edit their ratings and comments during the session. When the collaborative review session is completed, the moderator can use eLera to automatically aggregate individual reviews and form a panel review that is published in the eLera database. The consent of each panel member is required before their individual review is included in the published panel review. Figure 4 illustrates the process by which individual reviews are aggregated into panel reviews and published.
Figure 3. The distribution of ratings on a LORI item (Content Quality) as seen by collaborating reviewers.

Map of the Human Heart
http://www.pbs.org/wgbh/nova/heart/heartmap.html
Overall rating: ★★★★★

Content Quality

<table>
<thead>
<tr>
<th>Score</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>N/A</th>
</tr>
</thead>
</table>

- John Nesbit: Accurate information with appropriate level of detail.
- Poh Chuah: Good detail of heart parts for both science 9 and biology 12 (basic). Should have functions of heart parts.
- Jeff may: Great for grade 9 biology
- Robert Decman: Accurate for grade 9
- Jimmy Wu:
- Jarmila Vik:
To date, the convergent participation model has been used primarily in workshops for teachers and eLearning professionals. Collaborative sessions have been conducted in face-to-face settings, text chat rooms, and telephone conference calls. Our impression, supported by reports from participants (Nesbit et al., 2004), is that the convergent participation model is highly effective for professional development. Instructional designers have commented that it helps them understand the wide variety of learning objects and the nine quality dimensions of LORI. In all cases, audiences have been very receptive to the review process and seem to enjoy the process of comparing their evaluations with those of their peers. Reviewers often bring personal expertise in media, pedagogy, instructional design or subject matter that they openly share with the others in the panel discussion. Although every participant has been willing to evaluate object quality, none have professed or demonstrated expertise across all facets of object design.

CONVERGENCE OF OPINION AND PROFESSIONAL DEVELOPMENT

In two previously reported studies we found that the collaborative review process causes participants’ ratings of learning object quality to converge (Nesbit, et al., 2004; Vargo, 2003). Participants’ ratings of learning objects were collected before and after a
collaborative evaluation session. Inter-rater reliability statistics were consistently higher after the collaborative session. Nesbit et al. asked participants to comment on the effectiveness of convergent participation as a method for professional development. There was almost unanimous agreement that collaborative evaluation of learning objects using this model is an effective professional development activity. Many commented that the activity equipped them to design high quality learning resources.

LOCALIZATION AND TRANSLOCALIZATION OF ELERA

The term localization is often used to connote the adaptation of a website to the language and culture of specific geographically or ethnically defined groups. With the growing impact of the global market created by internet applications, localization issues have recently become an important subject of research in e-commerce (Cyr, 2004). Here we also use the term localization when adapting to specific communities of practice, such as high school biology teachers or e-learning professionals. In following sections we provide examples of both linguistic and cultural localization of the eLera website. We use the term translocalization to connote methods or practices that promote communication and interaction among communities and cultures.

Internationalization is a pre-requisite for both localization and trans-localization. Web site internationalization means adherence to international standards and avoidance of content or symbols that are heavily laden with idiosyncratic cultural knowledge. Internationalization provides a “technologically, linguistically and culturally neutral platform from which to launch global e-commerce initiatives while allowing a framework that incorporates local content and functionality”(Shannon, 2000, p. 68). The eLera website was designed to comply with the IEEE standard for learning object metadata. It also avoids reference to local or national institutions, and other knowledge not likely to be meaningful to an international audience.

Note that the use of localization and trans-localization techniques does not preclude personalization of a user interface and the storage of unique user preferences. Indeed, a user may identify with more than local group, and may wish to choose among a number of personal profiles that establish localized identity and linkages to specific community resources.

Localizing Language

Over the last decade, the demographics of the web have seen a dramatic shift toward a more culturally diversified, multilingual user base. The proportion of users accessing the web in English dropped from 49.6% in 2000 (Jackson, 2002) to 35.6% in 2003 (Global-Reach, 2004). The proportion accessing the web in Asian languages (mainly Chinese, Japanese and Korean) increased from 20.6% in 2000 (Jackson, 2002) to 29.4% in 2003 (Global-Reach, 2004). Chinese-speaking web users, the second largest language group after English, increased from 1 million in 1997 to 160 million in 2004, and are expected to number 220 million by 2005 (Global-Reach, 2004).
We localized eLera to French and Chinese using the Zope localizer tool (David, 2004). Most eLera pages are composed of several elements from different sources, such as navigation menus, page body, and images with text. For every element of the web page, eLera determines in which language it will be shown. The determination is based on an ordered set of languages preferred by the user. If a user prefers French, but also knows some English, then the user can set his or her preference to {French, English}. eLera will show French by default, but if the element is not available in French it will display in English.

Chinese was selected because Chinese speaking users are the second largest language group on the web, and because they are relatively underserved by available content. Table 2 shows that the ratio of web pages per user is far lower for Chinese than other major language groups on the web. Figure 5 shows a snapshot of the LORI form rendered in Chinese.

![Figure 5. Chinese version of LORI (first five items only).](image-url)
Table 2. Ratio of web pages to users for different language groups (Global-Reach, 2004; Netz-tipp, 2004)

<table>
<thead>
<tr>
<th>Language</th>
<th>Web Pages (Millions)</th>
<th>Web Users (Millions)</th>
<th>Pages per User</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>11425</td>
<td>234</td>
<td>48.87</td>
</tr>
<tr>
<td>German</td>
<td>156</td>
<td>43</td>
<td>3.63</td>
</tr>
<tr>
<td><strong>French</strong></td>
<td><strong>113</strong></td>
<td><strong>23</strong></td>
<td><strong>4.92</strong></td>
</tr>
<tr>
<td>Japanese</td>
<td>98</td>
<td>61</td>
<td>1.61</td>
</tr>
<tr>
<td>Spanish</td>
<td>60</td>
<td>50</td>
<td>1.20</td>
</tr>
<tr>
<td><strong>Chinese</strong></td>
<td><strong>48</strong></td>
<td><strong>78</strong></td>
<td><strong>0.62</strong></td>
</tr>
<tr>
<td>Italian</td>
<td>41</td>
<td>24</td>
<td>1.71</td>
</tr>
<tr>
<td>Dutch</td>
<td>39</td>
<td>13</td>
<td>2.98</td>
</tr>
<tr>
<td>Korean</td>
<td>31</td>
<td>28</td>
<td>1.10</td>
</tr>
<tr>
<td>Portuguese</td>
<td>29</td>
<td>19</td>
<td>1.55</td>
</tr>
<tr>
<td>Dutch</td>
<td>39</td>
<td>13</td>
<td>2.98</td>
</tr>
<tr>
<td>Other</td>
<td>168</td>
<td>64</td>
<td>2.63</td>
</tr>
</tbody>
</table>
With learning object metadata and reviews represented in multiple languages in the eLera database, how can users in one language community use the information generated by another language community? Standardized metadata presents a lesser problem because standard translations can be developed for all field names and fixed vocabulary values. We used the Canadian CanCore guidelines (Friesen, 2003) for mapping such metadata between English and French, and have extended this mapping to the Chinese E-Learning Technology Standard 3.1 (CELTS, Xiang, 2003).

Although numerical ratings require no translation, the evaluative comments entered by users do present a challenge. We are exploring a method in which reviewers are able, for each item of LORI, to select comments from a closed menu in addition to entering free text. Comments selected from menus would be automatically mapped to all supported languages.

**Localizing and Translocalizing Ontologies**

Ontologies are prescribed taxonomies, or definitions of formal vocabularies, that establish a shared terminology within a social network (Gruber, 1993). Our research with ontologies for learning object evaluation has three purposes:

1. **Interoperability** -- technical interoperability of object repositories has become an increasingly important factor in resource selection because it allows the user to search a much larger set of objects than is presented by a single repository (Dennis, 2004).

2. **Localization** -- professional communities need to index, evaluate and retrieve objects using local terms that naturally arise from their work practices.

3. **Translocalization** -- Professional communities can benefit from inter-community exchange of values, design principles and evaluations.

There are different practices currently in place to address local needs or needs for a specific domain. Extending LOM elements to include domain specific metadata is one way to describe resources for a particular domain. For example, the Health Education Assets Library (HEAL) has enhanced the process of indexing resources for health education by extending the IEEE LOM to include metadata in health science (e.g. Specimen Type, Disease Process). Another example of a local taxonomy is Curriculum Online, which catalogues digital learning resources according to the National Curriculum for England.

Many repositories have adopted library classification systems as subject taxonomies. For example, iLumina (UNC, 2004), a digital library of sharable undergraduate teaching materials for chemistry, biology, physics, mathematics, and computer science, uses a modified version of the Library of Congress classification system. CanCore (Friesen, 2003) recommends the Dewey Classification System as basic subject taxonomy.

Leacock, Nesbit and Richards (2004) observed that teachers working with eLera in professional development workshops expected the subject taxonomy to follow the
With subject terms entered in a local ontology, how can users in one community (e.g., Ontario high school teachers) use the metadata generated by users in another community (e.g., French university professors)? One strategy is to adopt a core ontology such as the Library of Congress classification system as a universal subject taxonomy into which a large number of local subject taxonomies can be mapped. The development of local ontologies may be more challenging than expected. Indeed, in an effort to promote standardization the CanCore implementation guide cautions against the spurious development of local taxonomies (Friesen, 2003). In Canada each of the ten provinces has separate learning outcomes established for a given subject in the K-12 public education system. Similarly, in the United States each state has its own set of learning outcomes. It has also been observed that the learning outcomes in the sciences and mathematics tend to be more sharply defined than those for the arts and humanities (Richards & Nesbit, 2004).

The classification of learning objects is complicated by the many criteria by which they can be selected. Educators do not simply choose objects by subject matter and grade level. They are likely to examine the pedagogical model implicit in the object, the time and duration of the object’s use, and its alignment with the learning outcomes of the course. Educators are concerned for the intellectual and social development of the learners - often the content of the resource is not the main objective of a lesson, but rather is used to trigger inquiry, reflection and an exploration of values. Indeed, a brief examination of the Common Framework of Science Learning Outcomes (CMEC, 1995) reveals specific learning outcomes such as “describe how an individual’s needs can lead to developments in science and technology.” Because of the difficulties inherent in defining universal attributes in the face of the complexities we have cited, the most effective approach may be to use local taxonomies defined according to the local syllabi used daily by classroom teachers, in combination with a simple model of pedagogical approaches.

To link local repositories into an interoperable federation, the local taxonomies need to be mapped to higher order ontologies. Hatala and Richards (2004) proposed that, instead of enforcing a full metadata standard, repositories provide a narrow subset of the standard and allow extensions generated by community needs. Their “semantic cobblestone” concept enables local schemas to be articulated for interchange between search utilities. Thus, if a text search discovered a repository, or a network of repositories with sufficient content of interest to the searcher, the searcher could then re-configure their search tool to use the pertinent local taxonomy for a detailed advanced search.

Just as a given object is usually designed for a particular area of content, audience and pedagogical strategy, it should be advantageous to map a given learning object to more than one classification scheme. Rich taxonomical information indicating the local
learning outcomes, the local content descriptions, and the pedagogical design of the object would enrich the object descriptions and enable a wide range of future services related to the selection of learning objects for specific instructional contexts. The cobblestone approach would be particularly advantageous when mapping to a higher ontology results in a significant loss of local metadata.

**RECOMMENDATION ACROSS BOUNDARIES**

Through eLera we are researching models for supporting e-learning communities of practice. This research asks how online communities should be structured to foster norms of reciprocity, collective action, identity and information flow. Key questions at this stage are: How can community members recommend resources and reviews to others? How can they find, and be introduced to, other members with similar or complementary interests? How can they build the identity, interpersonal trust and reputation that are prerequisite to effective collective activity?

At present, eLera provides only rudimentary facilities for recommendation and trust. By default, search results are ordered by average rating so that the most highly rated objects are presented at the top of the list. Users can also choose to order objects by popularity, a metric that is incremented whenever an object is placed in a personal collection. To support trust and alliance building, eLera members can create personal profiles detailing their interests and areas of expertise. Thus, decisions about whether to trust and collaborate with a reviewer can be based on the combined knowledge of his or her profile and previous reviews.

As we build on these features we are researching more advanced models of trust and recommendation that will contribute to the nascent research base in this area (Recker & Walker, 2003; Recker, Walker, & Lawless., 2003; Wiley, n.d.). For example, we are implementing a “web of trust” – a social network in which members can create a list of highly trusted others. eLera will be able to recommend new members for one’s trust list, and objects and reviews associated with those members, by chaining forward through the network of trust lists.

We expect to find relatively dense patterns of trust relationships within communities and sparse connections between communities. This being so, how can relevant objects and reviews be recommended across community boundaries? Recent work on the “six degrees of separation” phenomenon (Buchanan, 2002) has demonstrated that only sparse connections between node clusters are sufficient to ensure that the distance between any two nodes in a network is fairly short. This suggests that as long as a few members of a community are connected to other communities, a strategy of recommending objects and reviews associated with near neighbors on the web of trust may ensure sufficient circulation of relevant objects across community boundaries.

**CONCLUSION**

Although the languages, tools and practices used in evaluating learning objects vary across linguistic and professional communities, this fact does not entail that these
communities must exist as independent solitudes. On the contrary, methods for recommending objects, and mapping metadata and reviews, can lead to a substantial degree of communication and interaction among communities that work with learning objects.

ACKNOWLEDGEMENTS

This work was supported in eduSource Canada, a project of the Canarie eLearning Program. Support is currently received from the Natural Sciences and Engineering Research Council of Canada, Learning Object Repository Research Network (LORNET), and the Social Sciences and Humanities Research Council of Canada Learning Kit Project.

REFERENCES


**BIOGRAPHY**

Jerry Li is a Software Systems Consultant in the E-Learning Innovation Centre at Simon Fraser University. He holds a MEd from the University of Sheffield and a MBA from the University of Salford. He is pursuing further graduate studies in e-learning in the School of Interactive Arts and Technology at Simon Fraser University.

John Nesbit is an Associate Professor in the Faculty of Education at Simon Fraser University. He has published research in learning object evaluation, self-regulated learning, and adaptive instructional systems. He is currently researching self-regulation in multimedia learning.

Griff Richards is Research Project Leader in the BCIT Technology Centre and Adjunct Professor at Simon Fraser University Surrey. Griff Richards is an educator who uses technology to promote the creation, management and transfer of human knowledge. Griff has been active in the research, development and implementation of computers in education and training for 25 years. Over the past five years he has been a leader in the Canarie POOL and eduSource projects, His research group at SFU Surrey currently champions interoperability between diverse learning repository networks and receives funding from SSHRC SAGE, NSERC LORNET and the Mellon Foundation (with Penn State's LionShare Project). He teaches online into Athabasca University’s Master of Distance Education Program.