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Perspectives on Teachers as Digital Library Users

Consumers, Contributors, and Designers

[Mimi Recker](#)

Utah State University

Logan UT 84322-2830, U.S.A.

<mimi.recker@usu.edu>

"...freed of the constraints of physical space and media, digital libraries can be more adaptive and reflective of the communities they serve. They should be collaborative, allowing users to contribute knowledge to the library, either actively through annotations, reviews, and the like, or passively through their patterns of resource use. In addition, they should be contextual, expressing the expanding web of inter-relationships and layers of knowledge that extend among selected primary resources. In this manner, the core of the digital library should be an evolving information base, weaving together professional selection and the 'wisdom of crowds.'" ([Lagoze, Krafft, Payette, & Jesuroga](#), 2005)

This quote, taken from an article in a recent issue of *D-Lib Magazine*, paints a compelling picture of how digital libraries should evolve in ways distinct from traditional libraries. It suggests that digital libraries should exploit "Web 2.0" capabilities in order to support collaboration, contextualization, and user contributions. In short, digital libraries should implement new models of user interaction that go beyond simple (but powerful) search, which typically relies on expressive (but expensive) metadata ([Sumner & Marlino](#), 2004).

This vision has motivated a new architecture for the National Science Digital Library (NSDL) [[1](#)], based upon Fedora [[2](#)] ([Lagoze et al.](#), 2005). This architecture, when fully implemented, will support representation of information in *context* by expressing the myriad relationships between entities that comprise a digital library.

Currently, in its more metadata-centric form, the NSDL offers access to over 1.1 million metadata records of online learning resources, harvested from hundreds of digital collections ([Lagoze et al.](#), 2006). The NSDL provides access to learning resources targeted at STEM (Science, Technology, Engineering and Mathematics) learners and teachers of all ages. These range from large granularity resources (e.g., a semester-long course in plate tectonics) to small ones (e.g., a simple graphing calculator applet) ([Zia](#), 2001).

The opening quote in this article also conveniently sets the stage for describing our small part in helping achieve this vision. This article reviews a five-year program aimed at increasing teachers' capacity for designing activities for their students by using online and digital library learning resources. As part of this program, we have developed a simple digital library service, called the Instructional Architect [[3](#)] (IA) to support teachers in collecting, sharing, and designing with online resources ([Recker et al.](#), 2006). For the past two years, we have also been offering professional development workshops to educators. The workshops help teachers learn to use digital libraries and the IA, and design instructional activities by adapting learning resources to fit their local needs and context ([Recker et al.](#), 2005).

As will be described, through an ongoing process of user-centered design ([Nielsen](#), 1993) the IA has evolved to support teacher design and collaboration activities ([Recker, Dorward, & Reinke](#), 2003). In particular, we have found that:

- Designing instructional activities around NSDL learning resources can result in more meaningful learning activities for students and hence, enhance the resources' value to teachers;
- Sharing NSDL learning resources can increase collaboration in a local community of teachers;
- Sharing and co-creating instructional activities can transform a traditionally solitary and private activity (lesson planning) to one that is more collaborative and efficient;

In the next sections of this article, I reflect from a broad perspective on our experience designing and implementing the IA, and working with teachers as they engage with the vast wealth of online resources to design learning activities for their students. The article then concludes with some thoughts, couched within the larger NSDL enterprise, on the implications of our work for a cyberinfrastructure for education ([Ainsworth et al.](#), 2005).

The Instructional Architect: A Digital Library Service

The Instructional Architect (IA) is an end-user authoring service designed to support the instructional use of online resources in the National Science Digital Library and on the Web. The IA enables users (particularly

teachers) to discover, select, sequence, annotate, and reuse online learning resources stored in digital libraries to create instruction (e.g., lesson plans, study aids, homework – collectively called *projects*). In this way, the IA is intended to increase the utility of online learning resources for classroom educators.

Two Examples

I begin the description of the Instructional Architect with two examples created by teachers using our tool (see Figures 1 and 2) [4]. The foreground of each figure shows one of the teacher's selected online resource. The background shows the output of using IA: a web page containing the content created by the teacher, consisting of activities and annotations for online resources (referred to by links). Note how the level of detail in the projects varies; the project in Figure 1, intended for middle-school students, provides detailed activities for the students, whereas the project in Figure 2 (intended for kindergarten students) seems to be more of a lesson plan sketch



Figure 1

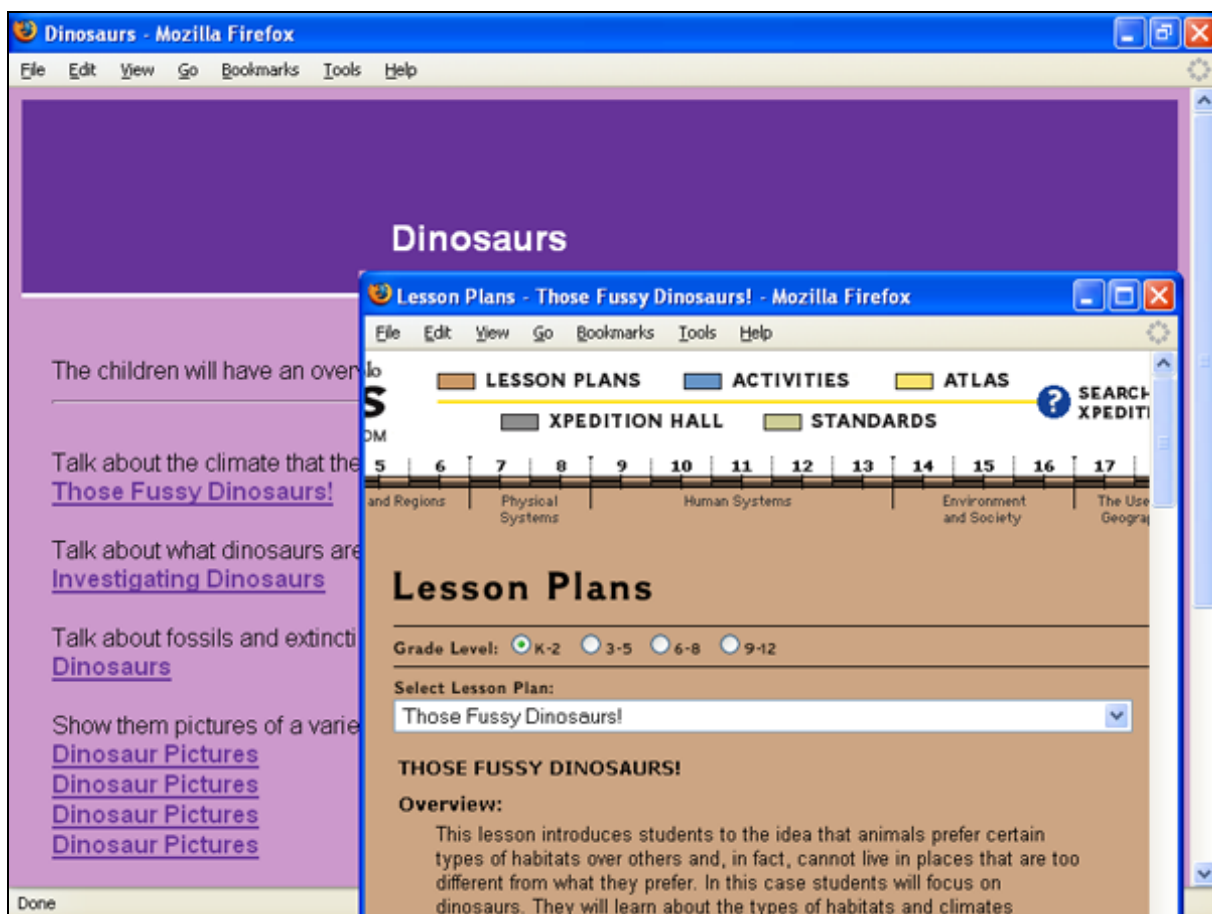


Figure 2

As is apparent from the figures above, teacher-created projects are fairly simple. Teachers are not web designers, nor should we expect them to be. Instead, they are professionals attempting to efficiently and effectively address

classroom and learning issues.

Indeed, much of the functionality of IA could be recreated with blog software coupled with a social bookmarking system. However, as previously noted, by following a user-centered design process, we believe the system better meets the basic requirements of teachers who wish to use digital library technology to quickly and easily meet classroom demands.

System Description

From the home page of the Instructional Architect, users can 1) *browse* projects, 2) *register* as a new user, or 3) *login* as a registered user or guest (with reduced functionality).

1. Browse. Currently, the IA has over 650 projects made publicly available by IA users. Users can access projects by performing keyword searches or by browsing these projects by subject area, grade level, author's last name, or project title (see Figure 3). This functionality has proved especially popular among new teachers, as they are keen to see examples from other teachers. The functionality has enabled some of the teachers to become the *defacto* designer (and mentor) for a group of colleagues. This teacher, the most technology literate of her group, designed projects that were then made available to the rest of her group.

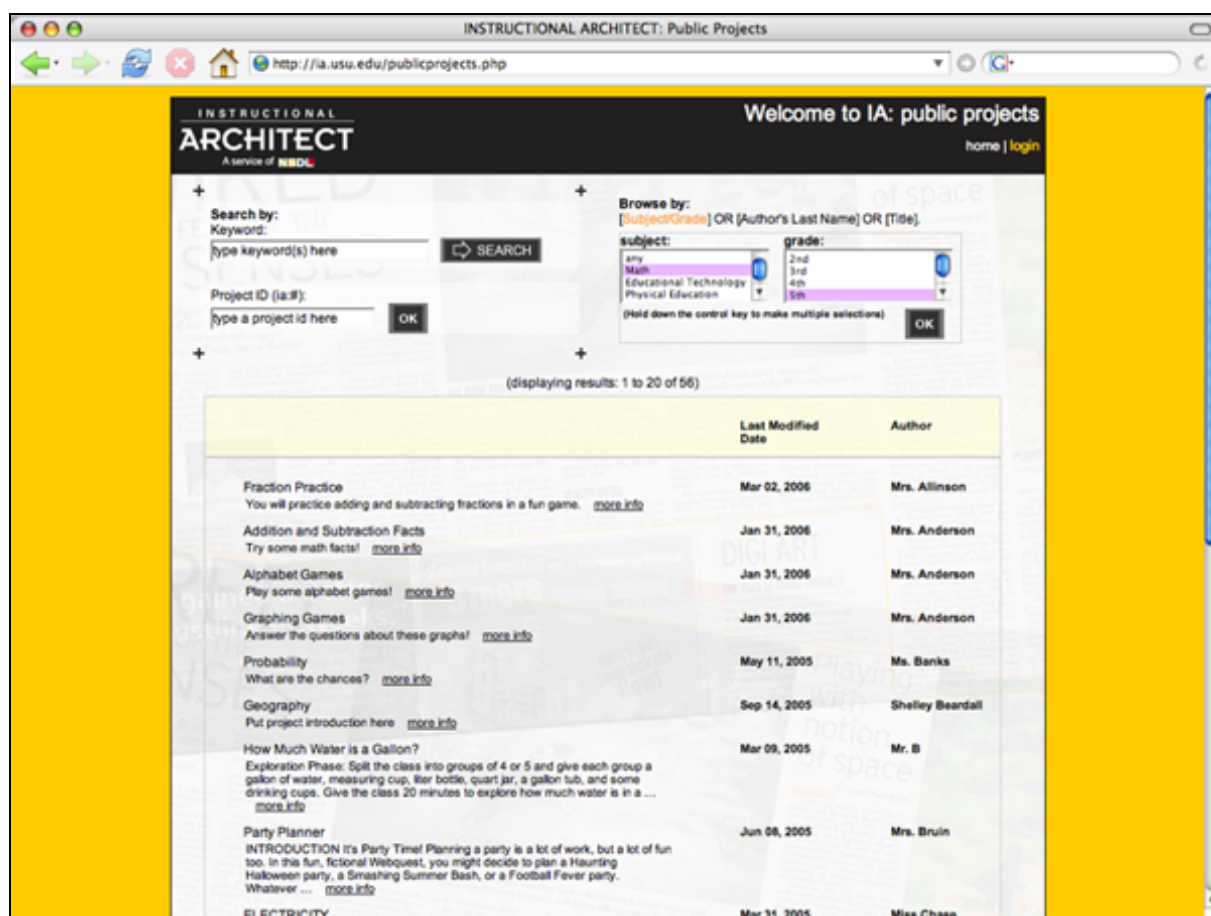


Figure 3

Register. Users can create a free account, which provides them secure access to their saved resources and projects. As an NSDL service project, IA has implemented federated secure access control via Shibboleth [5].

Login. After the user logs in, the IA offers three major usage modes. First, with the 'My Resources' tool, users can search for resources in the NSDL. Queries are sent to the NSDL search interface via REST, which searches the union metadata repository, comprised of metadata records harvested via OAI-PMH from participating NSDL digital libraries (Lagoze, 2002). The standard metadata set used by the NSDL repository consists of the Dublin Core set of 15 basic elements, the three extensions recommended by the Dublin Core Education Working Group (DCMI, 2002), and NSDL specific fields. Item-level and collection-level metadata records from participating libraries are normalized or cross-walked to the NSDL standard set.

Metadata records for matching resources are displayed to users in an abbreviated form (including title, author, brand, description, and date). After browsing these results and viewing resources, users can select desired resources for further use.

Users can also add any Web resource by entering its URL. (Of course, these Web resources do not have associated metadata records.) Users can also organize their selected resources into folders (see Figure 4).

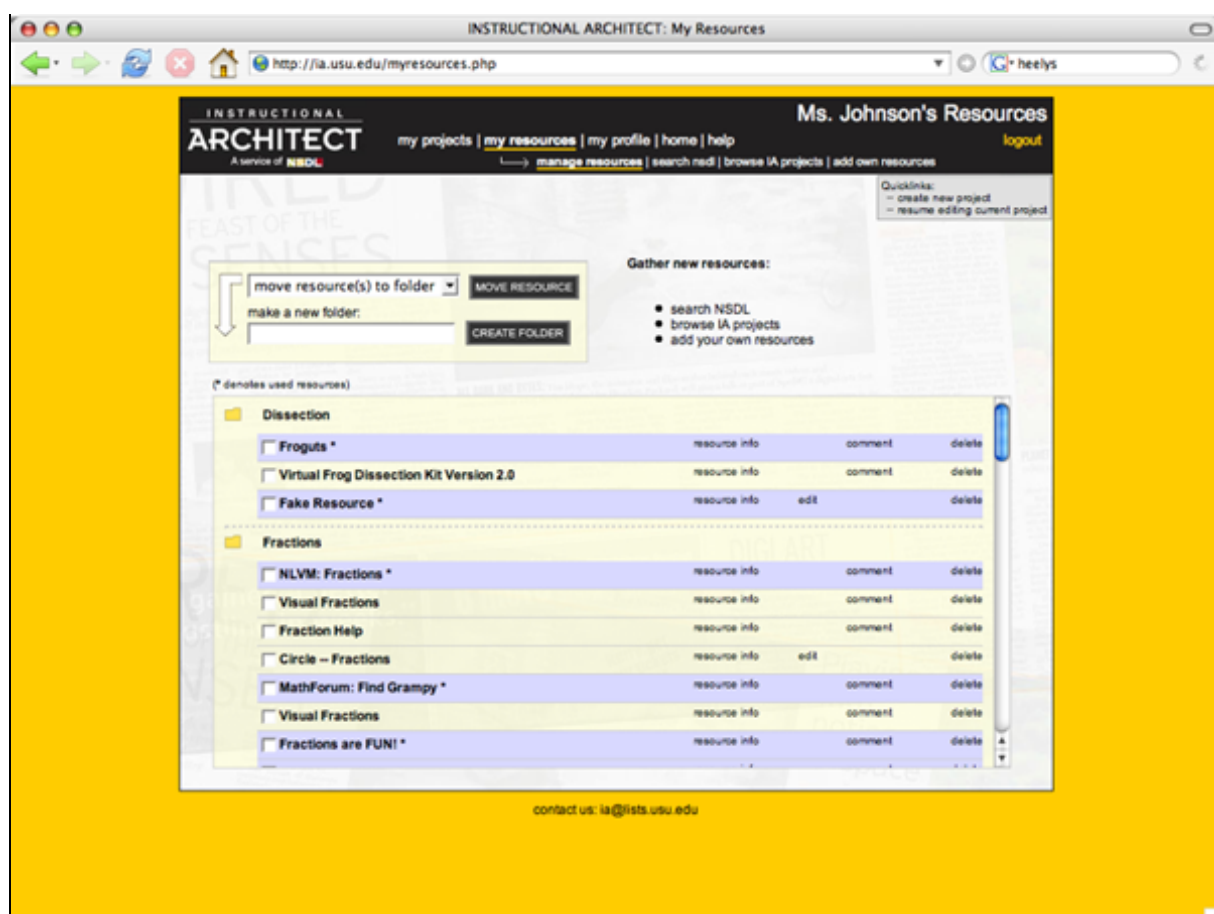


Figure 4

Second, with the 'My Projects' tool, users can create web pages in which they sequence and annotate their selected resources in order to create instructional projects.

Finally, users can share their projects by 'Publishing' them and setting permissions on them, such as a) *user-only view*, b) users and their students (*student view*), or c) *public view* (anyone browsing the IA site). Users can also add basic metadata about their projects, including subject area, grade level, and core curriculum standard. These metadata values are used to support project browse and search.

What Are Teachers Doing and Saying?

Since 2003, over 1200 users have registered with the IA, with 60% of those users registering since 2005. Analyses of user activity on the IA (webmetrics), as well as data collected from the teachers who participated in workshops, have provided an important window for understanding how and why teachers use resources from multiple educational digital libraries. This section first summarizes user activity on the IA site, then reports analyses of data collected from teachers.

User Activity

Since 2003, IA users have created almost 2400 projects, and collected over 7,600 online learning resources (see Table 1). Approximately 44% of these online resources were discovered in the NSDL; the rest were simply identified by their URL.

In analyzing usage, we noted that many IA users only logged in once or twice. We define an 'active' user as having logged in within the past 6 months and having designed at least three IA projects. Active users comprise approximately 10% of the total number of users, perhaps representing 'early adopters' (Moore, 1991). One such prolific user, a teacher in Utah, has created over 50 projects, with some of those projects having been accessed over 200 times.

Table 1: Usage data (means for active users and published projects)

# Registered	# created projects	# online resources (% from NSDL)	Active Users/Published projects			
			Mean # projects	Mean # resources in projects	Mean # saved resources	Mean # words in projects
1196	2021	7000 (44)	4.06	14.07	21.99	646.35

We compared the activities of active and less active users with respect to their published projects, as these are good indicators of finished work. As shown in Table 1, active users published significantly more of their projects, included significantly more resources per published project, and they added significantly more words per published project than less-active users (Recker & Palmer, 2006).

Teachers' views

Over the last two years, approximately 600 educators have become acquainted with the NSDL and the Instructional Architect in a wide variety of ways. Some have been involved in teacher professional development workshops (including face-to-face and online workshops), entailing sustained engagement. These workshops have typically included rigorous evaluation methodologies. Other interactions with teachers were more opportunistic as we sought entrée into schools and the complex social institution of which the teachers are a part

([Zhao & Frank](#), 2003).

The professional development workshops were designed to help teachers integrate digital library resources into their teaching. Each workshop was evaluated in order to inform the next development cycle for the IA, the workshop curriculum, and the evaluation instruments. The evaluation activities included use of online pre- and post-workshop surveys, formal and informal interviews, participant reflection papers, and observations by project personnel. The survey items included a number of Likert-scaled and open-ended items intended to collect demographic information and to measure teachers' prior knowledge and experience regarding digital libraries and learning resources, their attitudes towards their utility, and their opinions on the usefulness of the workshop.

Likert-scale data from pre-workshop surveys show that teachers generally were very positive about the potential of using online resources from digital libraries in their classroom. Despite the potential for a ceiling effect in comparisons to the post-workshop survey, results show that the workshop still managed to have a generally positive impact on teachers' knowledge level, attitudes, and subsequent behaviors.

A subset of teachers' open-ended comments on the pre and post-workshop surveys were analyzed by identifying recurring topics regarding the design of learning activities using learning resources. These topics were then categorized into 5 major themes ([Recker et al.](#), 2006).

1. Ease. Teachers offered many comments about the benefits resulting from the ease of access to a wealth of high-quality, free resources. Teachers also appeared to value the currency of these resources, particularly in comparison to textbooks. Finally, many noted that use of the IA reduced difficulties due to students having to type in URLs.

2. Enrichment. Many teachers commented on the value of online resources for enriching classroom activities. In this vein, teachers valued the use of interactive and engaging online resources to provide more meaningful learning activities for students, or to provide supplemental information to students.

3. Research. Teachers commented on the value of online resources for supporting research. They described the important role of online resources in furthering their content knowledge as well as their teaching knowledge. This under-utilized potential has been advocated by others ([Davis & Krajcik](#), 2005).

4. Networking. A few teachers mentioned the importance of using the network to find out what other teachers are doing.

5. Barriers. Nonetheless, many teachers commented on difficulties associated with using online resources. Many of these barriers were associated with technical problems (e.g., insufficient access, draconian filters, outdated technology). Others mentioned problems with managing and sifting through the large amount of content available on the Web.

Conclusion

This article reviewed a five-year program aimed at increasing teachers' capacity for designing instructional activities using digital library learning resources. The approach involved the design of a simple service, the Instructional Architect, as well as offering professional development workshops to educators. Our experience suggests that this simple contextualization and collaboration tool, coupled with support, can help educators access and use the vast wealth of online learning resources in meaningful ways. Using the IA, educators can more easily share resources with colleagues (including new teachers), enabling a network of trust to be built. They can contextualize these resources so that their students can pursue their interests in locally relevant ways.

As a technical service, we have had less success disseminating the IA, and we have found several digital libraries re-creating the same concept. The *not-invented-here* syndrome, of course, is not uncommon, and we are grappling with how to bundle our service to support easier integration by digital libraries.

As a human-mediated service, despite the positive attitudes and interesting teacher activities, we have discovered, not surprisingly, that lasting change takes time. It is likely that we underestimated the difficulty in changing established cultural practices (teaching) within a large social institution (schools).

In the future, we are exploring ways for teacher-created projects to be incorporated within the NSDL. Technically, this is not difficult. More interesting, however, is the potential to exploit teacher annotations of digital library resources to support knowledge enhancement and context-building within the emerging Fedora architecture.

The vision of the NSDL, and our small part within it, as an incubator for a cyberinfrastructure for education has important implications.

- First, our work has shown how the NSDL is providing critical infrastructure for linking people (teachers and students) and resources. Teachers report that they are finding an abundance of high-quality digital library resources that are useful for their local context (the "long-tail" notion).
- Second, by using resources and adding important instructional context, educators are engaging in design. Exploiting teacher annotations of digital library resources to support knowledge enhancement and context-building is an important avenue for future research.
- Finally, the infrastructure is participatory. Teachers can co-design projects, mentor younger professionals, and contribute differential expertise.

In the end, for the full expression of this vision to be achieved, the digital library and education communities

must continue to develop policies that foster free and open access. These communities must continue to (co-)create extensive digital collections that are so valued by teachers. Finally, they must continue to cultivate leadership that supports the development of a cyberinfrastructure for education.

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Notes

- [1] The National Science Digital Library, <<http://nsdl.org>>.
- [2] Fedora home page, <<http://www.fedora.info>>.
- [3] Instructional Architect home page, <<http://ia.usu.edu>>.
- [4] To protect their privacy, the names of the project authors have been removed.
- [5] Shibboleth home page, <<http://shibboleth.internet2.edu/>>.

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