Developing a Strategy for
Evaluating the Educational Impact of NSDL
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Background

The stated mission of the National Science Foundation's (NSF) NSDL program is to "encourage and sustain continual improvements in the quality of science, technology, engineering, and mathematics (STEM) education for all students, and serve as a resource for lifelong learning." From the program's inception in 2000, over 100 projects have been funded to engage in a collective effort to build a national digital library of high quality STEM educational materials for students and teachers at all levels, in both formal and informal settings. During this period, project activities focused on building the library infrastructure, collections, and services as well as on performing formative evaluations to guide ongoing development. As NSDL begins to mature as a technical and organizational entity, numerous program stakeholders (NSF, Core Integration, Educational Impact and Evaluation Standing Committee - EIESC, Project PIs, NVC) have asked for an evaluation strategy to ensure that future design, development, and evaluation activities can contribute effectively towards the larger NSDL educational mission. Additionally, many of these stakeholders have requested that this strategy be articulated through a community process, in keeping with the spirit and philosophy of collective effort that underpins the NSDL program.

In view of these requests, members of Core Integration and the EIESC have worked closely with NSF sponsors to plan and carry out this community-driven strategy development process, characterized in four stages:
- Articulating the Need for a Strategy (December 2002)
- Pre-Workshop Planning and Setting the Stage (January – September 2003)
- Strategy Workshop (October 2 and 3 2003)
- Post-Workshop Synthesis, Community Feedback, and Strategy Document Development (beginning October 2003)

Future documents will describe the process in more detail. For now it is important to understand that data gathered through surveys, focus groups with approximately 100 participants from NSDL projects, and the EIESC in December 2002 highlighted the need for an educational impact evaluation strategy to provide guidance on important research questions, key related theories, prior research, and appropriate research methodologies. These findings, in turn, motivated the organizers to structure the community process to support development of three interrelated documents:
- The Annotated Bibliography – detailing related empirical and theoretical research
- The User-Friendly Guide to Digital Library Evaluation – highlighting useful research methodologies and techniques
- The Evaluation Strategy document

The remainder of this preliminary report summarizes the high-level outcomes of the Strategy Workshop and represents the first step in the post-workshop activities.

Workshop Processes

37 people attended the workshop – 20 NSDL project participants, 10 invited participants, 3 NSF program officers, and 4 organizers. The workshop was organized into 3 small-group

working sessions. Based on discussions from the pre-retreat telecon, the first session considered NSDL evaluation from the perspectives of key stakeholders. Participants split into five groups to brainstorm important research questions from the perspectives of K-12 students, K-12 teachers, College (undergrad and grad) students, College faculty, and institutional/national stakeholders. Participants then reviewed the slate of questions to identify the most important questions for NSDL. In sessions 2 and 3, small groups formed around single questions to flesh them out according to a 'rich description' template. The template asked participants to characterize the research question in terms of a brief description, key theories, methodologies, prior research, etc. and to make recommendations for action at three levels: (a) to NSDL (projects, CI, Community Building), (b) to NSF, and (c) to the broader education and educational technology research community. The questions identified for elaboration within individual breakout groups were:

- What are the important contexts that shape K-12 teachers' behaviors in adopting, sharing, and creating NSDL resources with students in their classrooms?
- To what degree is NSDL satisfying the process of building and maintaining community?
- What are the unique affordances of NSDL resources for enhancing learning outcomes and what impacts do these unique affordances have on student learning?
- How do college faculty use (or not use) the NSDL now and what are the emerging behaviors and trends of faculty use of the NSDL?
- How are NSDL collections and services influencing people' beliefs and attitudes?
- How can we evaluate the educational impact of NSDL on students?
- What models of education does NSDL enable and how?
- How do we support and coordinate evaluation efforts in NSDL projects?
- How do you define the NSDL as a socio-technological system and what is its role in the larger digital library arena? How are the NSDL and its role evolving over time?

Two panel reviews, each composed of three pre-selected invited participants, were asked to comment on crosscutting issues, emerging themes, missing questions, and implications for strategy after sessions 2 and 3. This preliminary report is structured to reflect the crosscutting issues and emerging themes identified during the report-outs from sessions 2 and 3, the two panel reviews, and subsequent group discussions. Detailed analyses of the rich descriptions for evaluation questions still remain to be performed.

Workshop Outcomes

Participants felt that it was premature to look for educational impact, particularly impact on student learning, for NSDL as a holistic entity at this time. However, given that NSDL is inherently developmental, i.e., different aspects of NSDL are continually being actively designed and enhanced, and all of the projects are at different stages of maturity, it is important to begin the process of examining educational impact from two perspectives:

- Actual NSDL – This perspective acknowledges that lots of development, implementation and evaluation work has already taken place in some of the projects and that future evaluation efforts should capitalize on sharing and learning from these rich experiences, particularly the experiences of relatively mature projects.

- Intended NSDL – This perspective acknowledges that NSDL, as an integrated, operational socio-technical facility, is still in nascent form and the potential roles of digital libraries in educational practices are poorly understood. As such, this perspective highlights two important areas for evaluation activities: understanding the value of NSDL to major stakeholders and understanding NSDL's potential role as a 'community inquiry lab' or 'transformation engine' capable of promoting and

sustaining innovations in science education, educational technology and educational research methods.

Actual NSDL

A reoccurring theme across the panel reviews and the recommendations for action generated in the sessions is the pressing need to understand 'what we have wrought' and to learn from, leverage, and capitalize on our prior experiences. Participants suggested engaging in a variety of approaches to understand the current state of NSDL, including documentation activities, collection of baseline data, and case study analyses. In terms of documentation, day-in-the-life descriptions of NSDL as a whole, and descriptions of 'lighthouse' and 'birds of paradise' projects were identified as potential starting points. ('Lighthouse' refers to projects engaged in best practices and 'birds of paradise' refers to projects with particularly innovative processes, products, or results.) Several breakout groups grappled with the issue of what can we say or measure now. Several forms of baseline data related to educational impact were proposed, such as determining: (a) the number of resources in NSDL aligned with educational standards; (b) who is accessing NSDL in terms of geography, audience, and diversity; (c) how many faculty use NSDL in course planning via syllabi analysis, etc.

A continual tension emerged in discussions between evaluating NSDL as an entity, and evaluating the contributions of individual projects within their own context. Many of the breakout groups advocated the use of case studies, in explicit recognition of the distributed, project-oriented nature of NSDL. Examples discussed included using case studies to contribute to the overall documentation of NSDL and to examine classroom use of particular NSDL services or collections. Participants agreed that a challenge arises from the need to be able to systematically compare and generalize across cases. Recommendations focused on the need to develop (a) shared methodologies and reporting instruments to facilitate the development of cases, and (b) the organizational capacity to support and coordinate distributed case study efforts. This latter recommendation highlighted the position that these types of reflective evaluation activities should be part of NSDL culture and embedded in projects' practices; i.e., NSDL needs to take a knowledge management approach that systematizes and supports learning from project experiences within the organization.

Intended NSDL – Values

Drawing from our understandings of utilization-focused approaches to evaluation, participants advocated developing an understanding of the *value* of 'intended NSDL' and the NSDL program to key stakeholders. Stakeholders identified as particularly important included NSF sponsors (firstly) and congress (secondarily). Understanding the perceived values from the perspective of these stakeholder groups was tied to program continuity: These stakeholders represent the interests funding the current NSDL program, and for NSDL to realize its potential as an operational facility and transformation engine, there must continue to be an NSDL program in some form. Understanding values was also seen to be important information for guiding future design, development, and evaluation activities. It is important to note that participants regarded the discussion of values as a dialectical, mutual-education process. Articulating stakeholder values can inform the thinking of NSDL leaders and projects, and in turn, it is the responsibility of NSDL leaders (in particular) to provide these stakeholders with information and support to adjust their values to better align with emerging NSDL capabilities and opportunities.

Intended NSDL - Community Inquiry Lab and Transformation Engine

A central aspect of the NSDL vision is to serve as a transformation engine that fosters and sustains innovation in educational practice and technology. Research and evaluation activities are needed to guide the development and realization of this vision. Fundamental to these activities is the need to characterize the unique affordances of NSDL as a whole and to identify its benefits to teachers and learners.

Workshop participants emphasized that part of NSDL's unique capabilities was its potential to serve as a community inquiry lab, where researchers would leverage its organizational and technical infrastructure to develop new research methodologies. An example discussed was how library instrumentation could enable researchers to track and understand the online interactions of students and teachers in fundamentally new ways. Participants noted the need for advances in research methodologies that will inform the design and implementation of digital library services and collections. Several groups discussed the need for "shallow" case study methodologies (those that are easily interpretable and comparable), where design, implementation, and evaluation are tightly coupled within a specific context of use. Methodologies also should embrace the need to engage users, particularly teachers and students, in design and evaluation processes.

Participants emphasized that models and theories should play a significant role in guiding design and evaluation of digital library services and collections. Models capturing relationships between configurations of digital library technologies and potential impacts need to be identified. Participants stressed that research designs should enable ongoing work in digital library services and collections to inform educational theory and its applications.

Recommendations for NSF

The NSDL program should continue to nurture and promote a strong research component on the possible roles of digital libraries in educational practice. Workshop participants also emphasized the need for funding dedicated to research on evaluation and on the roles of digital libraries in educational practice. Future NSF program solicitations can facilitate these needs by:

- Encouraging NSDL projects to articulate the educational rationale for their activities
- Emphasizing the need for research and evaluation components as an integral part of a project's overall activities and providing the funding to support these components
- Encouraging projects to consider how library infrastructure can be instrumented and leveraged to support new models of research in education and educational technology
- Encouraging research projects to use NSDL as a community inquiry lab for conducting fundamental research in education, educational technology and learning.

Participants also expressed the need for collaboration and communication in distributed evaluation efforts and emphasized that this type of coordination needs support and funding.