
Project Overview

Collaborative Proposal: DLConnect: Connecting Underserved Teachers and Students with NSDL Learning Resources and Tools focuses on NSDL dissemination within school settings through **usage development workshops** within the **services** track of the NSDL. The project is designed as a pair of collaborative proposals that unites two institutions with well-established credentials in NSDL and long-term partnerships with K-12 schools: **Utah State University (USU)** and **Eastern Michigan University (EMU)**. Under the leadership of **Dr. Mimi Recker** of USU, *DLConnect* brings together a team of senior researchers with extensive experience in digital libraries, science and mathematics education, teacher preparation and educational research and evaluation, including Joanne Caniglia, Jim Dorward, Ellen Hoffman, Marcia Mardis, and Patricia Williams-Boyd.

DLConnect will target underserved **middle level pre-service and in-service mathematics science, technology, engineering, and mathematics (STEM) teachers**, as well as **school library media specialists**. In addition, *DLConnect* activities will be centered on keystone educational digital libraries within the NSDL particularly relevant to these user groups. Through a design-based program of workshop development and deployment, the project is expected to directly impact 250 middle schools and, through a well-developed scheme for dissemination and sustainability, teachers and schools nationwide.

Planned actions to meet solicitation objectives

The overall objective of the proposal is to develop and demonstrate the effectiveness of a workshop model that will increase the usage of NSDL to improve student learning and support inquiry-based teaching of middle school science and mathematics. The model will be tested and refined, then widely disseminated to increase NSDL impact with the recognition that a key to NSDL success is awareness and application in K-12 schools nationwide. Project goals are designed to implement high-quality professional development to enhance classroom practices, integrate evidence-based research on improving student achievement, and improve teaching and learning in STEM areas in a sustainable manner.

In broad terms, this three-year proposal consists of the following objectives:

1. Design and implement an innovative and powerful workshop model:

- Develop a context-sensitive workshop model (*DLConnect*) on productive use of digital library (DL) resources in middle school settings. Develop an online version of the workshop curriculum for asynchronous access.
- Using iterative design and research approach, enact the *DLConnect* model in workshops with target user groups and with different kinds of digital library sites. Evaluate curriculum enactments, revise, and document contextual differences as evidenced by differences in sites and users.

2. Use evaluation and research to demonstrate effectiveness on learning and teaching:

Adapt existing and develop new research instruments for documenting curriculum

enactment and assess longitudinal change in teacher use of digital resources. Our evaluation team will use Appreciative Inquiry (Watkins and Mohr, 2001) methods to identify what workshop characteristics are particularly effective at increasing participant knowledge and practice.

3. Leverage connections for widespread dissemination: Share tested curriculum, evaluation instruments, analyses and interpretation of findings to support more rigorous and extensive understanding. Disseminate via NSDL portal, MSPnet, conferences, and professional organizations, building on established networks of *DLConnect* participants.

4. Establish a solid foundation for sustainability: Curriculum dissemination in conjunction within existing educational programs through the Utah Education Network and other Public Broadcasting System affiliates to support continuity beyond the grant.

Organizational and leadership strengths

We are uniquely positioned to conduct the proposed work for four reasons: 1) our significant historical involvement with the NSDL, 2) our existing relationships with other NSDL and Education and Human Resource (EHR) projects, 3) our backgrounds as instructional designers/technologists, researchers, and teacher educators, and 4) our previous successes in program development, implementation, and dissemination for widespread impact on teachers and students. The project team has been involved in NSDL since its inception, successfully leading funded NSDL projects, developing collections and services, and by active leadership of NSDL community committees and working groups. Through the relationships and knowledge resulting from these contacts and partnerships, the project team is well established to link *DLConnect* with the larger NSDL community and ensure the outreach efforts to disseminate results effectively.

Housing the project within the Colleges of Education at Utah State University (USU) and Eastern Michigan University (EMU) provides important educational linkages. We have access to a large cohort of school library media specialist students and pre-service STEM teachers enrolled at the university. In addition, both institutions have well-established partnerships with school districts in their states representing urban, rural, and suburban populations that mirror the demographics of schools nationwide providing a solid test-bed for project activities as well as direct impact on the teachers and students within these schools. The two proposals are tightly coupled to share all objectives, outcomes, and evaluation efforts, with overall coordination provided by USU. The only difference will be in the user groups, so that each institution partners with schools and professional organizations to build on existing long-term relationships, thus increasing the potential for impact, dissemination and sustainability.

Broader impacts and intellectual merit

DLConnect will provide critical data for NSDL development, assist in collaborations that will enhance individual digital library efforts, and add to the knowledge base on effective integration of educational technology in schools to promote student achievement. This proposal is clearly and intentionally focused on use by pragmatists (and not early innovators or adopters) in a way that highlights the utility and usability of the NSDL, its resources, and its services. Through a focus on achieving the broad aims of the NSDL program accompanied by an innovative project design, the *DLConnect* brings both capacity for intellectual

achievement and the generation of effective products. In addition to the tangible professional development models and implementation, *DLConnect* has a strong **evaluation** component to inform project development and plan the **research** foundations for broader distribution. In this way, the project will contribute a rich data bank for in-depth analyses of teacher and student use of digital resources in educational contexts. Beyond its immediate impacts on core partners and participating schools, project findings will be distributed through explicit **dissemination** activities to reach K-12 educators, university faculty, media specialists and digital library developers. Through the professional development and research described here, the project will achieve one of the recommendations of the Glenn Commission for improving STM education by "measuring progress and making the results of these action strategies widely known" (National Commission on Mathematics and Science Teaching for the 21st Century, 2000).

Statement of Need

The National Science Digital Library (NSDL) is currently in its fifth year of NSF funding. To date, the majority of its activities have focused on developing the core technical infrastructure and collections of digital learning resources (Lagoze, 2002). However, to fully achieve its potential in terms of impact and effectiveness, effort must turn to dissemination. DLConnect has been structured to meet needs identified by the NSDL community through consultation with existing projects as well as to meet the specific needs of the target middle school audience.

Need for pragmatic services and resources that increase NSDL accessibility to K-12 audiences, and that are scalable and sustained. Barriers to digital libraries today are as much human issues as technological ones. For NSDL, this will require careful attention to the development of policies and practice to assure success in reaching its goals for impacting teaching and learning in education communities (Wattenberg, 1998; Zia, 2001). As NSDL develops, it will need to be positioned with an understanding of the breadth of constraints and incentives on web-based learning if it is to fully reach K-12 students. In the absence of adequate data on classroom practices with NSDL resources and its direct impacts on teaching and student learning, NSDL content and services may not be fully utilized by one of its key audiences. It will not be enough to deploy the library, but it must have an active and well understood program to reach the key teacher audience needed to make the NSDL vision a reality in K-12 classrooms. This requires adopting teacher and student perspectives, rather than simply focusing on technological concerns.

Need for NSDL materials and services that teachers actually use, find appealing, can be aligned with standards, and meet the requirements of those who are not necessarily early adopters. Teacher adoption and use of information technology has been the focus of many studies at many levels, from the cognitive, through the social, to the institutional (e.g., Becker & Riel, 2000; Boster et al., 2002; Means & Olson, 1997; CEO Forum, 1999; Zhao & Frank, 2003). Findings show that a key **barrier** to technology use is the excessive time it takes to learn. **Enablers** are technologies that address immediate needs, bring about maximum benefit, do not require large changes in teaching practices, are easy-to-use, provide

alignment of content with standards, and have the necessary technical support. Teachers are also more likely to adopt new technologies if they have mentors and are given time to experiment with and observe others using the technologies.

Need for professional development that is evidence-based showing increased effectiveness of middle school teachers to positively impact student achievement in mathematics and science. Multiple federal reports have recommended action to improve the quality of STEM teaching that includes the need for alignment of curriculum with standards, increased attention to outcomes and the need for achievement of each student, professional development to improve teaching capacity, and the need for leadership to promote improved practices (Loveless & Diperna, 2000; MAA, 1991; NCMST, 2000; NRC, 1999; NSB, 1999). Further, major research findings have shown that teacher understanding of their discipline, how STEM subjects are taught, and classroom environment are key to student achievement (Cooney, 1999; Darling-Hammond, 1997, 1998; NCTM, 1989; 1991; Schoenfeld, 1999; Thompson, 1992). The ability of teachers is one of the most powerful determinants of student achievement—more influential, in fact, than poverty, race, or the educational attainment of parents. But teachers must have help in the form of more intensive content-related teacher training and more thoughtful professional development (Darling-Hammond, 1997, 2000).

Need for services that can reach a range of student and teacher demographics, particularly those audiences in underserved areas (high poverty, rural, urban). Beyond the broad goals of the NSDL, the project has been designed to meet specific needs of the teachers in the pilot areas (see "Meeting high stakes needs" in Audience section below).

Target Audience

The planned program is designed to have direct impact on teachers and students through direct partnerships with USU and EMU, while having broader impacts by developing models, tools, and research results that will reach a far larger audience. The project focuses on **middle schools**, based on the recognition that multiple studies and reports have noted that this is the point where scores on standardized tests in mathematics and science begin to decline (Schmidt, McKnight et al. 1999; National Commission on Mathematics and Science Teaching for the 21st Century 2000; Falk and Drayton 2001; Nelson 2002; Stern and Ahlgren 2002). Further, Wenglinsky (1998) found higher effect sizes of computer instruction on student achievement in middle schools over elementary schools.

While *DLConnect* focuses on middle school STM teachers in the workshop development, its outcomes are aimed at multiple key audiences that are critical to NSDL development and integration into schools. As a result of this project:

- a targeted group of **middle school STM teachers and students** will increase their use of NSDL to improve learning and teaching. Through active dissemination and partnerships, middle school teachers beyond the immediate project will access *DLConnect* resources and services.

- a large pool of **future teachers** will be served directly by workshop activities at the partner institutions, and provide case studies that will help additional **teacher educators** in using *DLConnect* resources and models.
- the participation of **media specialists** as contributors as well as users of resources will expand because the design of NSDL and expand the influence of the resources and services to larger teacher audiences;
- **educational leaders**, including administrators, curriculum coordinators, and teacher leaders, will use *DLConnect* reports, tools, and recommendations in designing curriculum and implementing professional development;
- **NSDL developers** will draw on research and evaluation findings to improve their resource development and deployment designs to better reach the K-12 community.

School partners: Meeting high stakes needs

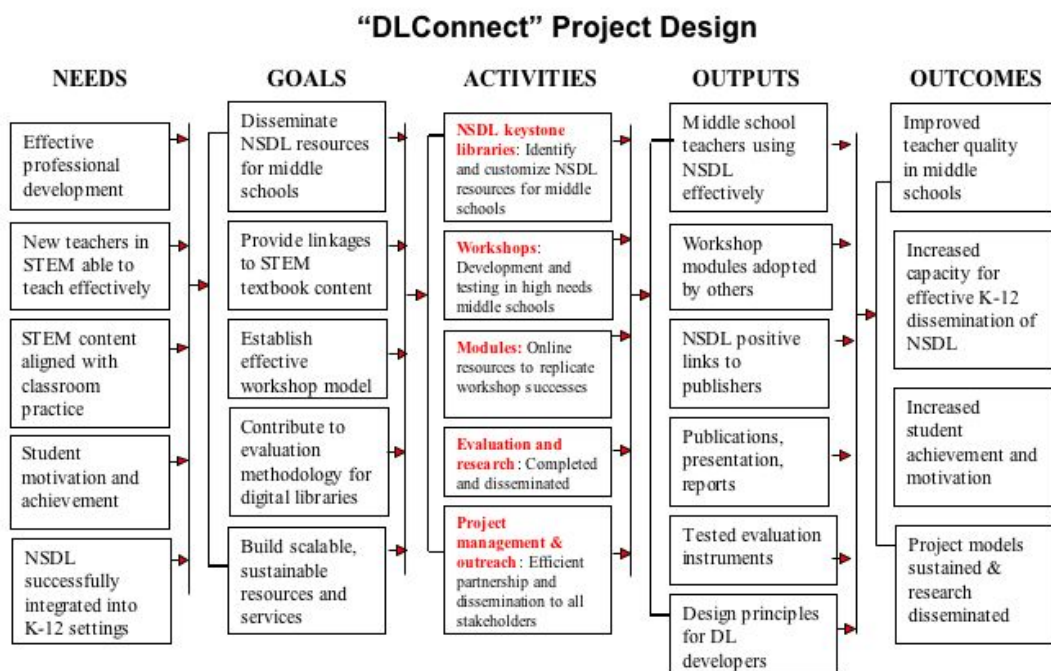
While the project will develop models with the potential to influence practice and policy nationally, the process of implementation and evaluation will have immediate impact on the school partners of USU and EMU. Practicing teachers, preservice teachers, media specialists, curriculum specialists, university STEM and education faculty and middle school students will be the direct beneficiaries of *DLConnect* professional development workshops and DL services and materials, impacting a minimum of **5,000 educators**.

Utah has many underserved students, due to its lowest average funding per pupil in the 50 U.S. states, and a proportionally large rural, Hispanic, and Native American population. Fortunately, the state of Utah has also invested in a high-quality and widespread computing and networking infrastructure for its publicly funded educational sector. As such, we intend to focus a portion of our workshop efforts with user groups in Utah led by USU researchers.

Michigan is also a key target area, with its large urban districts such as Detroit and Flint (representing almost **100 schools failing to meet AYP**), impoverished suburban districts in surrounding areas of southeast Michigan, poor rural and tribal areas in the north, and new immigrant communities scattered among these areas. As the fifth largest state in terms of school populations, Michigan has been ranked low in student achievement based on the number of schools failing to meet AYP and on middle school test scores generally. EMU will bring its established partnership efforts with five regional consortia in Southeast Michigan as a target user group for *DLConnect* workshop implementations as well as using the resources in pre-service education for its large population of **future STEM teachers (approximately 500 per year)**. Further, the resources and materials will be disseminated through the Michigan Teacher Network, a premiere educational digital library resource that already has widespread usage in the state and is linked to state curriculum standards and benchmarks.

Objective 1a. DLConnect workshop design

In the first phase of the project (3 months), we will develop a context-sensitive model, *DLConnect*, for a workshop curriculum on digital resource and digital library (DL) use in middle school settings. The model will be adaptable to discipline and concepts, teachers’ experience in domain and technology, specific student demographics, local curricular requirements, levels of access to web-based technologies, and classroom textbook series.



An additional important adaptable factor is the keystone digital libraries that will be used in *DLConnect*. This DL must be relevant and motivating to the target population. Keystone DLs that will be used include the Digital Library for Earth System Education (DLESE) (Marlino et al., 2001), the Math Forum, MathTools DL, National Library of Virtual Manipulatives (Dorward & Heal, 1999), and, if funded, the Middle School Portal proposed by the Eisenhower National Clearinghouse (ENC). The model will build on findings from the "Infusing NSDL in Middle Schools" targeted research project led by EMU and TERC (Hoffman, Falk, Mardis, Caniglia & Williams-Boyd, 2003).

Curriculum topics will include an introduction to digital resources and libraries, search and browse techniques, effective classroom use of digital resources, and support for textbook content. The curriculum will also include instruction on use of the Instructional Architect (IA), an NSDL service that provides an end-user authoring environment for learning resources found in a digital library. In particular, the IA enables users to discover, select, sequence, annotate, and reuse learning resources stored in digital libraries into new instruction (e.g., homework, class lectures, lab activities) (Recker et al., in press). Participants will also be shown relevant illustrations and examples with which they can interact.

The curriculum will use problem-based learning, an effective approach for motivating students by engaging them in real world problems (Savery & Duffy, 1995). Participants will be asked to develop projects using digital resources to solve specific instructional problems. Workshop projects are adaptable and can include the development of: an instructional component followed by classroom implementation; an annotated resource list to be shared within a school community, or a NSDL instructional module for teacher training in a local district. As appropriate, participants will specify learning and assessment objectives, and will align their projects with state and national core standards.

Because schools are both increasingly reliant upon (Roseman, Kulm, & Shuttleworth, 2001; Schmidt, 2004) and financially unable to regularly update textbooks and related electronic extension materials (Manzo, 2004), workshop products will also be developed with clear links participants' classroom series. For the NSDL, this unique product can be an entrée into closer relationships with publishers as well as an opportunity to encourage teachers to supplement their textbooks with exciting and innovative free resources.

The curriculum, experiences, and evaluation from the first year will be used to develop fully online courses. The curriculum will also be made freely available via the Web for local educational agencies to use in their own teacher development efforts.

To help develop *DLConnect*, consultants will review various iterations of the workshop model. The consultants, Kim Lightle and Judy Ridgway, Eisenhower National Clearinghouse, have extensive expertise in developing and disseminating curriculum (both on and offline) to teachers (see attached resumes). A consultant from the Utah Education Network will assist with online delivery development.

Objective 1b. DLConnect workshop enactments

The target audiences of school partners with USU and EMU will be the focus of workshop efforts that deploy the model developed in objective 1a. Within these groups, we plan to focus on cultivating a strong community of users, and on understanding barriers and enablers to successful implementation. Documentation of such factors can help support effective replication elsewhere (Hoadley & Pea, 2002).

Using user-centered design (Nielsen, 1993) and design-based research (Collins, 1992) approaches, workshop enactments will be iterative. Iterations followed by analysis will support several cycles of revisions to the curriculum model, specific enactments, and the evaluation/research instruments (described later).

1. Pre-service STEM Teachers. In required educational technology, mathematics, and/or science methods courses, students will engage with our curriculum and complete relevant assignments. At USU, we expect to reach 250 prospective STEM teachers each year, including 15 enrolled in the San Juan Dine Career Ladder Program (a Native American teacher preparation program) funded by the U.S. Department of Education. At EMU, we expect to reach 1000 prospective STEM teachers.
2. In-service STEM Teachers. We plan to offer a series of one-credit continuing education summer workshops for middle-level teachers at EMU and USU. These workshops will be offered in formats that make it possible to extend the potential impact to individuals beyond each university's regional areas. Participants will complete projects for their own use as well as be required to document how these projects were implemented, describing both successes and failures.

In Utah, *DLConnect* will be offered in each of the eight regional continuing education centers, reaching approximately 100 people each summer. In addition, the Utah Education Network (UEN), a consortium of public education partners, will integrate workshop modules into its in-service course offerings (see attached letter of support). At EMU, this will reach six regional centers (including Detroit and Flint) and an additional 150 teachers.

3. School Library Media Specialists. Almost every state and national accreditation agency requires schools to employ media specialists with training in librarianship and teacher certification. These individuals can play a powerful role in bringing new resources to teachers and in facilitating their use in teaching.

Media specialists face challenges in keeping abreast of fast-changing developments in educational resources such as the NSDL. School library media specialists also have few targeted curriculum educational experiences and little opportunity for tailored professional development. *DLConnect* will address these deficits by leveraging existing partnerships to reach school librarians in two states: Utah and Michigan.

In these workshops, school library media specialists will learn about the availability and selection of high-quality STEM resources and strategies for working with teachers. In complement to these experiences, school library media specialists will be part of the proposed summer workshops.

The Michigan Association for Media in Education (MAME), with a very large membership comprised of school library media specialists, technology coordinators, curriculum directors, and other influential administrators in Michigan's K-12 schools, has committed pre-conference workshop slots at their fall statewide conference. This organization is also in the process of framing their spring leadership conference around STEM curriculum. Marcia Mardis from EMU is working very closely with this organization in the development of these face-to-face opportunities.

These workshops will form the basis for an online component that can be customized to various approaches to school library media support. Aimed specifically at school librarians, this online experience can address both curriculum knowledge and professional development. SLMS who participate in workshops in each state will help tailor the online content to state and local concerns.

4. Curriculum Specialists. In the final year of the grant, we will offer a version of *DLConnect* to district curriculum specialists (see attached letter of support). These will be offered in conjunction with national teacher conferences (National Council of Teachers of Mathematics (NCTM) and The National Science Teachers Association (NSTA)).

Research and Evaluation

Objective 2. Research and Evaluation

We will employ Appreciative Inquiry (Hammond, 1996) techniques to evaluate workshop development and implementation, resulting products (e.g., curriculum, on-line tutorials, teacher instructional projects), and determine the extent to which K-16 teachers attribute NSDL use to the workshops. Appreciative Inquiry evaluation methodology is useful when organizations want to actively involve stakeholders in all aspects of project evaluation, want to maximize use of evaluation results, and build capacity for change within organizations based upon what works particularly well (Coghlan, Preskill, Catsambas, 2003). Dr. Dorward will coordinate internal evaluation activities.

The evaluation component will include formal and informal evaluation methods that mirror development, dissemination, and evaluation phases. Formal evaluation methods and subsequent reports will include:

- a needs assessment to identify intended user needs with respect to the *DLConnect* workshops.
- focus groups to assess user needs, critique design features, and triangulate findings from formative and summative evaluation components.
- a content-analysis of existing dissemination models and research.
- multiple case studies of teacher involvement in workshop modules, and development and use of instructional projects.
- expert review and field testing of *DLConnect* workshop curriculum.
- longitudinal analysis of personal annotated collections to determine the degree to which participants use and refine their products.
- several tightly-focused impact studies on the influence of *DLConnect* workshops, and assessment tool use on teacher use and adaptation of digital resources.

Informal evaluation methods consistent with Appreciative Inquiry will include: observations of participant use of *DLConnect* workshops, authoring tools, and resulting instructional projects; and interviews with resident instructional technology and professional development experts and representatives of stakeholder groups.

Features of the evaluation design of this proposed project will enable researchers to determine with a high degree of certainty which project activities can be attributed to increases in participant knowledge, attitudes, and competencies. These features include the use of separate regional models of participant performance; use of estimation procedures adjusted for measurement error obtained from previous studies of teacher use of digital

resources; and aggregation of data across samples, and from multiple data points, to form

Research Questions	Activities	Outcomes	Project Phases
How are the <i>DLConnect</i> workshops increasing teacher knowledge, attitudes, and competency in using digital library resources in instructional settings?	Focus groups and surveys to establish baseline DR usage. Longitudinal case studies of representatives of underserved, using interviews, observations, and regular self-reports. Instrument adaptation and validation.	Identification of participants' background and experience in terms of subject matter and technology comfort Context for conducting workshops (location and tie with larger teacher objectives) Tested methods and instruments	Workshop design phase (first 6 months)
What are digital libraries, their resources, and services doing that is particularly beneficial and noteworthy?	Self-report documentation of participant use of digital resources. Observations of participant use as part of case studies. Focus groups with participants on design features.	Design principles for DL developers. Triangulation of data sources for formative evaluation reports.	Curriculum design and revision phase (year 1)
What is the impact of <i>DLConnect</i> workshops and subsequent activity on teacher practice and collaboration? Do they result in greater use of DL/DR? What kinds of DR and services are teachers using and how? How is teacher practice affecting school community? What kinds of resources are particularly useful, and how are they used in instruction?	Multiple longitudinal impact studies measuring degree of change between pre- and post-workshop involvement. Analysis of collections created using authoring tools. Continued observations, interviews, and analysis of self-report surveys of participants' use and adaptation of DL/DR. Correlational impact analysis of DL usage in conjunction with Evaluation and Impact Standing Committee annual survey.	Tested curriculum and instruments Impact on teacher practice and sustained use digital resources. Documenting and understanding the educational impact of the different types of interactive digital resources and services Rich data bank of teacher and student use of digital resources in educational contexts	Research and evaluation phase (years 2 and 3)

average performance ratings for specific user-profiles (Meyer, 2000). This design is unique to evaluation of NSDL projects and will serve as a model for subsequent evaluations designed to identify value-added elements.

Dissemination of evaluation findings

Internal review and regular evaluation of results to promote continuous improvement are built into project activities and meetings. The internal evaluator will communicate formative evaluation findings at all team meetings, as well as document and analyze internal communications. The evaluation team will prepare regular reports to project partners for accountability purposes, including a final summative evaluation report. Evaluation findings will be incorporated into broader project reports on activities and progress, with interim reports issued quarterly and full reports annually. All reports will be posted on the Web to

help external researchers and educators track project progress and findings, and encourage feedback from interested individuals via the Web.

Where feasible, we will co-develop and share research instruments such as surveys, structured interview protocols, and video coding schemes with other interested researchers (see attached letter of support from the Math Forum). While existing instruments measuring teacher knowledge and attitudes (e.g., Becker, 2000) may be adapted to increase the capability of attributing cognitive change to project activities, we anticipate full development of instruments to measure user competence with NSDL content and services. New or revised instruments for measuring change will be used in studies with our workshop participants. Data from this study will be shared and, as such, will help corroborate and anchor the interpretation of findings for workshop enactment. The close coordination of methodologies and analyses will support a more rigorous and extensive understanding of how the NSDL is accomplishing its educational mission. It will also provide rich documentation of enablers and barriers of successful implementation of digital libraries and services in educational contexts, and will support effective replication elsewhere.

Dissemination

By bringing together a team that has skills in communicating with groups that include technical experts, librarians, K-12 educators, and higher education faculty and administrators, researchers, and policy makers, the project is well positioned for dissemination through active outreach. Dissemination efforts will use many pathways to reach this audience. *DLConnect* has been explicitly designed for coordination with other NSDL projects as a result of the active participation of Recker, Mardis and Hoffman in this program. From the initial planning of the study, the project leaders have consulted with others in the NSDL community who are engaged in K-12 programs. As a result, our efforts will regularly be communicated to the NSDL community, and input will be continually sought to establish cooperative efforts that will have wider impact and be well known by others who can impact scalability and expansion. All materials will be available through NSDL, with a commitment to appropriate archiving and metadata exchange to make the materials highly usable.

In addition to outreach aimed at NSDL, *DLConnect* will implement a strong dissemination program specifically targeted at providing study findings in a format meaningful and useful to practitioners. With a goal of **publishing results in highly readable, non-technical terms**, *DLConnect* materials and findings will be disseminated in ways that reach teachers. Publishing in practitioner magazines, Web-based modules for teachers, and conference presentations at major events that have a teacher component are all included as a part of the dissemination plan to ensure widespread reach of workshop materials and project results. Each researcher on the project is committed to a minimum of one publication each year designed for the STEM teacher audience, as well as at least one conference presentation to a K-12 audience. This commitment reflects the personal dedication of the researchers to educational improvement and active engagement of teachers in that process. Further, research findings will be disseminated to a scholarly audience through journals, conference presentations and Web-based research reports. Where possible, publications and presentations

will include the practitioners who are directly involved in the project, and all participants will be encouraged to share their experiences and learning with other professionals.

Sustainability

Objective 4. DLConnect foundation for sustainability

The *DLConnect* program has been designed to have both short- and long-term outcomes. Critical changes will have been accomplished within each of the partner institutions that will have long-term returns, not the least of which is building K-12/higher education partnerships that are expected to lead to further cooperative efforts. Curricular materials will be continued in courses and continuing education programs at **partner universities** where additional development will be ongoing. In the state of Utah, this includes a partnership with the Utah Education Network (UEN), a consortium of public education partners, and the State Office of Education (see attached letters of support). UEN has committed to disseminate workshop modules via its professional development programs and website.

For the **middle schools**, long-term benefits come through the retention and increased capabilities of middle school STEM teachers. This includes increased capacity to use inquiry-base learning supported by NSDL, increased capability to implement professional development programs accompanied by a trained cadre of teacher leaders, and most important, a cohort of a minimum of 5,000 highly-qualified teachers, media specialists, and curriculum coordinators will make a difference over many years to students in middle school mathematics classes as well as provide leadership to colleagues.

At a more widespread level, the models disseminated through web-publication, the dedicated project web site, traditional publications and conference presentations, and other dissemination mechanisms described above will be available for continued use by other educational professionals. These tested tools and materials will provide support for new projects and collaborations, as well as the development of professional development efforts nationwide.

As a result, the **outcomes** have high sustainability even in the absence of this particular project continuing. The real measure of success will be that actual and perceived barriers to effective use of NSDL for K-12 learners have been decreased. The actual products of the *DLConnect*, including papers, presentation slides, case studies, and teacher produced curriculum materials will be made available beyond the funding period via the Web. Project materials not published in traditional journals and magazines will be **archived** through the Michigan Teacher Network, a collection carefully indexed within the NSDL domain. As a result, these materials will continue to be available to researchers and practitioners after the project concludes.

Capability to accomplish project goals and outcomes

DLConnect has organization, people, and resources that are structured for success. The design builds on earlier work by project researchers on the systemic contexts of middle school STEM classrooms, the impact of high-quality professional development on teacher quality, and research on digital libraries and information-seeking behaviors (Caniglia, in press; Caniglia & Hoffman, 2003; Hoffman, 2000; Hoffman & Fox, 2002; Hoffman & Thompson, 2000; Mardis, 2002a, 2002b; M. Mardis & Ellen S. Hoffman, 2002; Marcia Mardis & Ellen S. Hoffman, 2002a, 2002b; Mardis & Zia, 2003, Recker, Dorward, & Reinke, 2003, Recker et al. in press). While no previous program brought the collaborating institutions together around digital libraries and middle schools (this project is new), it builds on multiple smaller scale collaborative projects in mathematics, professional development, and school reform.

Dr. Mimi Recker, associate professor, will take responsibility for overall project coordination, development of the curriculum model, enactment in the Utah locations, and design and development of the online modules. With an interdisciplinary background spanning computer sciences, education, and instructional technology, she is uniquely qualified to direct a project with sophisticated technological and educational components. Her experience in leading projects, including previous NSF grants, ensure quality and effective management of *DLConnect*.

Dr. Dorward, associate professor, will coordinate the internal, formative evaluation and facilitate a productive relationship between developers and prospective users throughout all phases of the project. The internal evaluation team will be comprised of a doctoral student in Utah State University's Science, Mathematics, and Technology Education Research and Evaluation Methodology Program (REM), and two representatives of stakeholder groups (middle-level classroom teacher and a library media specialist).

EMU will provide overall program coordination under the guidance of **Ellen Hoffman**, assistant professor, educational media and technology, with her background in project management and technology integration. Additional support includes Joanne Caniglia, professor of mathematics, Nancy Copeland, assistant professors of educational media and technology, Marcia Mardis, senior research scientist, and Pat William-Boyd, professor of curriculum and instruction with a focus on middle schools. EMU's leadership represents a partnership of EMU's College of Arts and Sciences and College of Education.

Institutional strengths and qualifications

Utah State University: Utah State University offers the largest teacher preparatory program in the state. Its Department of Instructional Technology, currently ranked in the top five nationally, enrolls approximately 100 graduate students, and focuses directly on the application of technological solutions to learning problems. These students comprise both in-service teachers in the state of Utah and people planning careers in instructional design and technology, and will be available to the proposed project.

Eastern Michigan University: One of the nation's largest producers of professional educators with a long history of excellent teaching, K-12 partnerships, and project innovation, this NCATE-accredited public institution is a Carnegie class II metropolitan university with an enrollment of 25,000 that annually produces slightly more than 1% of the nation's professional educators, including 463 new teacher majors or minors in STEM disciplines in 2002-3. In its programs of graduate education, professional development, and school collaboration, EMU has developed institutional renown for its effective implementation of programs to benefit schools and practicing teachers. As an institution with a focus on teaching, EMU's long-standing tradition in K-12 education and research brings a solid foundation for assuring impact and practical results.

Timeline and Project Management

The project is governed by a **Leadership Team**. Management processes are set up with specific assigned roles so there are clear responsibilities for the administration of each activity (see Figure 1). Project management is coordinated through monthly leadership meetings accompanied by bi-weekly conference calls and ongoing interaction and sharing using Internet communication technologies, including a dedicated project website.

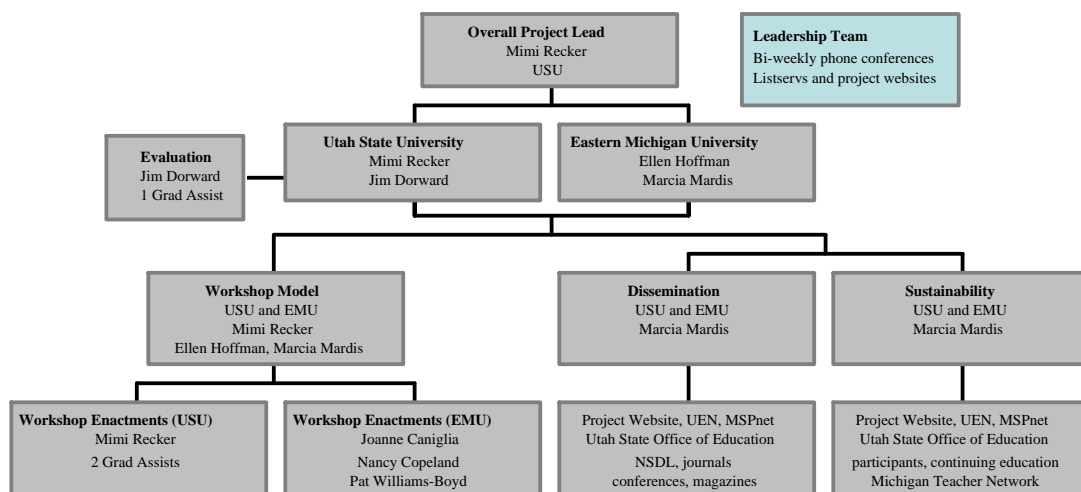


Figure 1. Leadership responsibilities

The timeline and action plan for accomplishing the goals outlined in this proposal are presented in Table 1.

Results from Prior NSF funding

Drs Mimi Recker, and Jim Dorward are PIs on NSF-DUE 0333818 (2003-2005) and were PIs on NSF-DUE #0085855 (2000-2003), grants that developed the NSDL service called **The Instructional Architect (IA)**. This work to date has resulted in eight published articles,

two book chapters, over twenty presentations at national conferences, one MS thesis, and one PhD dissertation.

Dr. Dorward has been principal investigator on several federally-funded projects and overseen evaluation of several large-scale national projects. His more recent projects include: *Building Evaluation Capacity of STEM Projects* (NSF Award No. 02333832), and *Creating a National Library of Interactive Web-Based Virtual Manipulatives for K-8 Mathematics* (NSF Award No. 9819107). The National Library of Virtual Manipulatives project has resulted in a website that records over 20 million visits a year (matti.usu.edu), activities that are being translated into five different languages, supplements to two mathematics education texts, eight referred publications, and fifteen presentations at international, national, or regional conferences.

EMU brings together researchers who are currently involved in multiple NSF programs so that the activities leverage previous and ongoing research, as well as bringing strong skills in grant management and implementation. Project principal investigator Joanne Caniglia's work as PI on the *"The Emerging Scholars Program for Teachers"* (DUE 9950679, 1999-2002) focused on standards-based mathematics coursework for under-prepared prospective teachers. Hoffman is the principal investigator for two NSDL projects (*TeacherLIBn*, NSF-0085866, 2000-2004; *Infusing NSDL in Middle Schools*, DUE-0333632, 2003-2005) and co-PI for a third (*Core Integrations*, ATM-9732665, 2002-2007). TeacherLIB—Digital Community and Collections for Science and Mathematics Teacher Education. Marcia Mardis is the principal investigator on "Viewing the Future: Aligning Internet2 Video to K-12 Curriculum" (NSF #0226323), August 2000-July 2003, a Collections project using Internet2 video resources from the University of Washington's UWTV and ResearchChannel programs to build a collection of STEM materials for the K-12 community.

Task	2004	2005				2006				2007		
	Quarter	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
DIConnect model												
Develop model		●							●			
Enact with pre-service; revise			●	●		●	●				●	●
Enact with in-service; revise				●	●			●	●			●
Enact with SLM; revise;				●	●			●	●	●		●
Develop online version; revise				●								●
Research/Evaluation												
Refine research questions and instruments		●	●									
Workshop design		●	●									
Curriculum design			●					●			●	
Research and evaluation				●	●						●	
Disseminate tools and results				●							●	
Dissemination												
		●										●
Sustainability												
		●										●

Table 1. Timeline of project activities.