Scaling Deeper Learning with Virtual Laboratories and Online Community Tools to Propel Student Learning and Build Faculty Excellence.

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Partners: Tennessee Board of Regents, Oklahoma State Regents for Higher Education, and Louisiana Board of Regents

Project Overview
Q4. Briefly describe your proposed project and how it relates to the NGLC challenge areas. (completion, persistence, content mastery, mastery of deeper learning outcomes)

Our project proposes the scaling a comprehensive suite of open academic technology services and institutional support that has enabled the successes of Noyce Scholars in the California State University (CSU) through the training and use of virtual labs in teaching STEM courses (http://teachingcommons.cdl.edu/noyce), supported by academically-centered social networking tools (http://voices.merlot.org/group/noycescholarsinthecsu) and open authoring tools for ePortfolios http://teachingcommons.cdl.edu/noyce/eportfolios/index.html). Noyce Scholars are student teachers credential programs who have committed to teach STEM in high need schools, typically high school where student preparation, science lab facilities, and institutional capabilities for quality education are significantly challenged.

 Scaling exemplary practices to produce sustainable outcomes in adopting institutions will require the originating or mentoring institution with the exemplary practices to have well-established, well-documented, and effectively integrated the exemplary practices into their own sustained management and governance processes rather than "bolting on" additional practices. Our project will provide deployment guidelines for the integrated package of open educational services within the broader institutional priorities of College Readiness and Graduate Rate Improvements. For the last 5 years, the CSU has established an Early Assessment Program where over 380,000 high school juniors took a CSU-specific assessments of CSU college readiness in Math and English in 2010 (http://calstate.edu/eap/). The CSU has deployed award winning technology support services though the CSU Math and English Success Websites (http://www.csumathsuccess.org; (http://www.csuenglishsuccess.org) as well as the Road To College website http://www.calstate.edu/roadtocollege/. For the last 5 years, the CSU has established institutional practices for campuses to implementing programs to improve graduation rates; every campus implements plans across 22 service areas on campus (e.g. from advising to streamlining academic programs; http://www.calstate.edu/AcadAff/codedmemos/AA-2005-21.pdf). In 2009, the CSU established 6-year goals for their freshman 6-year graduation rates to be in top quartile of like institutions and to reduce the achievement gap by 50% (http://graduate.csuprojects.org/; see open library of implementation plans http://graduate.csuprojects.org/campus_collaboration).

Why Virtual Labs to Improve Student Learning? Research shows that interactions with the content, peers, and instructor are important to enabling students to become active, engaged learners (Lear; Ansorage; Steckleberg) and have suggested learning activities rooted in constructivist theory could improve the student's learning experience, online and on ground (Bangert, 2006; Huang, 2002; Rovai, 2004). Active learning and authentic learning tasks of constructivism match the requirements for effective technology enhanced instruction by engaging students in the learning process, promoting communication and collaboration among students and faculty, and enabling self-directed learning (Bellefeuille et al. 2005; Liu, 2007; Quilter & Weber, 2004). Constructivism uses active learning to meet the needs of learners by engaging students in their own learning and promoting interactivity described by Twigg (2003) and Swan (2002) among others.

The key elements of Noyce Scholars exemplary program are:

1. Program management services that include a proven deployment handbook on developing and managing the implementation plan of program and technology support services.

2. Open and easy to use online library of peer reviewed, high quality virtual labs (www.merlot.org) along with exemplary support materials for integrating virtual labs into course curriculum.

3. Institutional Initiative and campus leadership which provides the faculty and staff the strategic and operational alignment of the Deeper Learning with Virtual Labs activities which in turn sustains the institutional commitment to support the course redesign processes and provides meaningful recognition and accountability of the project (http://teachingcommons.cdl.edu/tcd.

4. One-Stop-Shop Teaching Commons (http://teachingcommons.cdl.edu/noyce) for instructors being introduced to using virtual labs that provides the instructors with rich and exemplary implementation strategies and "lesson plans/learning activities & direct connections to other instructors using similar materials for similar goals.

5. An academic-focused social networking environment (http://voices.merlot.org/noycevoices) where users of the virtual labs consult with their fellow users that provide the users the ability to initiate and participate in discussion forums, posting documents for review and feedback, blogs, and Instant messaging

6. A very easy to use authoring tool (MERLOT Content Builder - http://taste.merlot.org/Programs_and_Projects/ContentBuilder.html) for the user to create their personalized online packaging of the virtual labs within an ePortfolio that provides the teacher and the students easy and contextualized access to the virtual lab lesson plans and resources.

Finally, the project will leverage at least three ongoing faculty development opportunities including local programs, MERLOT-SLOAN-C online workshops and all-day workshops at the annual MERLOT-SLOAN C International Conference (http://taste.merlot.org/mic.html).

The project will scale the Noyce Scholars exemplary practices to the use of virtual labs in lower division, primarily but not exclusively STEM courses by volunteer faculty within the long established institutional partners within the MERLOT Consortium.

Q5. NGLC seeks proposals for solutions that have already been investigated in at least some meaningful way and shown to generate some relevant benefits. What is the current reach of the primary solution that you propose to scale? Be brief and numeric: numbers of students currently served, numbers of courses, numbers of institutions/campuses, etc.

The project is modeled after the Noyce Scholarship programs supported by NSF in 22 of the 23 CSU campuses. Thirteen campuses are named in the 2007 National Science Digital Library Grant that has focused on the use of virtual labs. The open strategy for disseminating the CSU-Noyce services is supporting all 22 campuses. Noyce Scholars are "embedded" in teaching methods courses that are taught by "Noyce faculty" within the CSU teacher credential programs. There are currently an estimated 350 students in 22 courses per semester who are served by the Noyce curriculum in the CSU.

Q6. If your proposal is funded, by how much do you intend to increase the reach and dissemination of the solution? Again, be numeric, using the same measures as for your previous answer:

In the first year of the grant, four state systems who have been long term MERLOT partners are committing to implement virtual labs in an average of 3 GE courses per campus. With 86 campuses participating (CSU – 23 campuses, Oklahoma University System – 25 colleges and universities, Louisiana University System – 19 colleges and universities, Tennessee Board of Regents – 19 colleges and universities), an estimated 258 classes will be reached with the virtual lab strategy and engaging an estimated 7,740 students.

Q7. Briefly, please discuss the immediate (i.e., within the term of the NGLC Wave 1 grant) and longer-term scaling potential of your proposed solution. What is the potential upside? What are the primary obstacles to be overcome or risks to be mitigated?

The CSU has well established 12-year management and governance operations for deploying academic technology innovations within the CSU's MERLOT Consortium. MERLOT's monthly Leadership Council conference calls and the two face-to-face strategic planning meetings each year will all be leveraged to support the project. With the significant organizational momentum of these well established efforts, the integration of the proposed Deeper Learning with Virtual Labs will result in more timely, scalable and sustainable adoption of the Noyce Scholars strategy. The MERLOT digital library, MERLOT Teaching Commons templates, MERLOT Voices, and MERLOT Content Builder all have a proven track record for ease of use, reliable service, and no cost for individual users.

MERLOT's 22 established Editorial Boards, with many of the STEM disciplines having been building and peer reviewing their online collections for the past 10 years, will be another significant advantage in

quickly scaling this project.   The award winning virtual labs have already been identified and have significant use, pedagogical context, and user comments attached (for example, the Virtual Chemistry Lab http://www.merlot.org/merlot/viewMaterial.htm?id=89055)

Since 1999, the CSU's Center for Distributed Learning and Pearson has offered some of the most intuitive, interactive, and robust virtual lab experiences available on the web with Biology Labs Online (http://www.biologylab.awlonline.com/). Students can get instant results for experiments that would take days, years or decades in the real world. Expanding the Noyce Scholars model and increasing the number of participants will provide evidence of the robustness of the virtual lab strategy. The improvement in student learning outcomes, including the reduction of D, W, and F grades in the courses as well as student interest and satisfaction with their learning experiences will provide evidence of the greater institutional value of the virtual lab strategy.

The primary obstacles will be the sufficient allocation of staffing time and expertise to support each campuses implementation of the virtual lab strategy.   The current economic climate has resulted in significant reduction in the faculty development and academic technology support services.

11. Briefly discuss the outcomes you anticipate achieving by the end of the grant, and how they align with the NGLC outcomes of interest: scaling outcomes; student outcomes (completion, persistence, content mastery, mastery of learning outcomes); and cost-effectiveness outcomes. If your project receives NGLC funding, what would be the maximum (realistic, not theoretical) level of success you would expect to accomplish with NGLC funds? What would be your minimum expectations for success? What would be your most likely level of success? Please bear in mind that, if your application is selected, your answers here may be used to inform your project's eventual evaluation.

Scaling: A comprehensive, "turn-key" package requiring very little or no startup capital along with the technical support from MERLOT makes this an attractive opportunity. In addition, MERLOT has a distribution network of system and institutional partners as well as hundreds of institutions whose faculty use MERLOT who trust MERLOT's reputation for academic quality and integrity. These four systems also share the strategic priorities of college readiness and graduation rate improvements with similar baseline levels and goals.

Student Completion & Mastery: The content and instructional approaches making up this model are consistent with the theoretical constructs of effective online, hybrid, and technology-enhanced instruction. The model enables faculty to engage the student and personalize the learning experience with customized content.   A number of our Noyce Scholars have produced 10% increases in their students' standardized test scores (Bradford, Galima, Henriquez, and Hanley, 2010) and we anticipate that the number of D, W, and F grades will be reduced after the effective inclusion of virtual labs. The CSU's systemwide course redesign project for general chemistry (http://teachingcommons.cdl.edu/tcd/) has identified using lab time and online homework tools as high priority activities to improve student success.

Cost effective: The open infrastructure to support the MERLOT *Teaching Commons* and *Voices* tool is already in place. MERLOT has supported 23 implementations of Teaching Commons for partner communities http://www.merlot.org/merlot/communities.htm   and 76 "Community Conversations" within MERLOT Voices (http://voices.merlot.org/groups). Through these resources, people can obtain new materials such as lesson plans, syllabi and best practices at no cost to the institution. MERLOT's Pedagogy Portal (http://pedagogy.merlot.org/) provides a wealth of online resources that can be easily

discovered and used to support their adoption process. Finally, The MERLOT Content Builder is a derivative of the Carnegie Keep Toolkit, which has a proven track record of a very usable technology. A collection of over 30 personalized Noyce ePortfolios at
http://voices.merlot.org/group/noycescholarsinthecsu/forum/topics/solar-neighborhood.

Q12. Briefly discuss how your proposed plans, procedures, and activities align with the objectives and criteria detailed in the "Core Values and Criteria" and "Challenge Areas" sections of the NGLC Wave 1 RFP (i.e., both general objectives criteria and those specific to the challenge area to which you are applying). Address explicitly any objectives or criteria to which you cannot or will not conform, or that you believe do not apply.

"Innovations only become disruptive when they begin to affect daily practices at a significant fraction of higher education institutions". A substantial consortium of higher education institutions has governed the CSU-led MERLOT project for "Putting Educational Innovations into Practice" for the last 12 years (MERLOT's tag line for the last 6 years). The MERLOT ELIXR program (http://elixr.merlot.org) provides over 100 video case stories modeling innovative instructional practices for faculty development. The collection was produced by over 30 partner institutions. Leveraging these established and sustained organizational and open educational resources and services infrastructure will accelerate and broaden the adoption of exemplary practices developed within nationally known programs (Noyce Scholars and NSDL). The proposal provides institutions with a remedy for promoting student interactivity, for supporting and increasing faculty engagement, and for creating low-cost or no-cost customized content. It enables the creation of a dynamic faculty community to share resources and expertise. Institutions simply implement existing infrastructure, not create their own; faculty share content, not duplicate it. The low-cost and rapid-return nature of this project promises high potential for wide spread adoption.

Earlier sections of the proposal have established the high and sustained institutional priorities of student success within the CSU which provides the necessary institutional context for the deployment of innovative practices. These politically powerful institutional drivers are also established with the Oklahoma State Regents for Higher Education, the Louisiana State Board of Regents, and the Tennessee Board of Regents, our partners in this project. With these powerful institutional drivers, proven innovative solutions, and a low-cost business model for scaling and sustaining the innovations, we believe this project will be able to quickly produce adoption of these exemplary practices for deeper learner with virtual labs.

Q14. What evidence do you have—direct or indirect, formal or informal—that your solution has the potential to achieve the transformative outcomes sought by NGLC? What evidence, if any, is still lacking, and how would you propose to acquire it in the process of scaling your solution using NGLC funds?

The proposed solution has multiple parts, each part with different evidence of success.
1. The practical integration of deeper learning pedagogies with virtual labs is evidenced by the collection of ePortfolios created and used by Noyce Scholars. Improve student learning has been reported by the CSU Noyce Scholars and Noyce faculty at multiple national conferences. The exemplary practices have been a contributing factor for 22 of the CSU's 23 campuses being awarded federal Noyce Scholarship grants.
2. The adoption of MERLOT's infrastructure services by higher education has been repeated demonstrated and is showcased in the "Institutional Stewardship" and Innovative Use of

MERLOT awards (see http://taste.merlot.org/MERLOTAwards/ApplicationofMERLOT.html for institutional case studies).   For a summary of the CSU's adoption of MERLOT's services to fulfill its mission, see http://taste.merlot.org/PartnerSupport/CSU_Happening.html. The instructional methods and pedagogical strategies proposed here are rooted in sound learning theory. The ongoing support from both MERLOT and their learning communities ensures the innovations will sustain themselves long enough to become part of the institutional practices.

3. The institutional capabilities to engage in sustained course redesign processes is exemplified by CSU Chico's Academy eLearning that include deeper learning pedagogies with virtual labs can be easily embedded (http://www.csuchico.edu/academy/overview.shtml) and is an open model for institutional adoption.

MERLOT partners report ongoing faculty frustration at the lack of available instructional resources and the time or skills to develop them themselves. As managers, they are frustrated by the financial and practical challenges to integrating third-party materials. By addressing both these areas, this project provides a long-term solution to creating, obtaining and deploying quality content. The project takes advantage of the proven benefits of a learning community including collaboration and professional networking.

Finally, the knowledge gained from the proposed activities of the grant will help refine the process and improve the efficiency and effectiveness of general deployments after the grant cycle.

Q15. As noted in the NGLC Wave 1 RFP, a primary objective of this wave of funding is the elimination of redundancy and unnecessary reinvention through the wide-scale adoption of proven solutions. Briefly, discuss how your proposed solution and scaling plan will leverage existing resources—created by you and/or others—to avoid duplicating previous efforts and to break the grip of "not invented here." What interoperability standards or protocols will you observe, if any? How will you overcome formal and informal resistance to "outside" innovation in your target institution(s)? How will you make it easier for others to adopt, in turn, the solution(s) that you deliver?

The core design principles underlying the continuous development of MERLOT's open educational resources and services are optimizing reusability and enabling individual and institutional success through community engagement. The MERLOT digital library, where the world's education community can freely contribute to a common and shared catalog, enables the easy discovery of quality content. With over 300 new materials being added per month, about 1,100 new members joining per month, and about 15% of the members contributing to MERLOT, we have a vibrant and sustained community and collection. The MERLOT Teaching Commons are Adobe Contribute templates that are commercial grade, low cost applications that are very easy to use and customize. With a few images and content, MERLOT can create a live and functioning Teaching Commons for a community within 1 day. The MERLOT Voices is a customized implementation of Ning which enables MERLOT to establish a custom "Community Conversation" in 1 minute literally. MERLOT Content Builder is the reuse of a production level open source application developed and continuously improved by the Carnegie Foundation for the Advancement of Teaching for many years.

The ability to share and integrate and then enhance what already exists as part of a growing community is the essence of this project. MERLOT's COMPASS program (http://taste.merlot.org/COMPASS.html) delivers an open **C**ommunity and **C**ollection, complemented by **C**onsultation and **C**ustomization of

MERLOT **P**artners **A**cademic **S**upport **S**ervices. The project will leverage this existing program to support the institutional adoption. Participating institutions will apply templates for creating the *Teaching Common,* the *Voices* networking tool, and the *Content Builder* with their own local flavor, but can be integrated with others to provide greater return. MERLOT has "building blocks" enabling integration into their course management system rather than creating a stand-alone project with duplicate access and retrieval processes (see http://taste.merlot.org/lms.html). This project will bust the "Not Invented Here" syndrome which stalls adoption of new initiatives by supporting and encouraging local customization of all components.