

*Internet-based Reading Apprenticeship Improving Science Education (iRAISE)***Table of Contents**

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Internet-based Reading Apprenticeship Improving Science Education (iRAISE)**Project Narrative****PRIORITIES ADDRESSED**

Absolute Priority 2—Promoting STEM Education: This project will develop an innovative delivery system of a proven professional development program for high school science teachers, impacting 33,000 students in schools serving large numbers of high needs students.

Competitive Preference Priority 9—Improving Productivity: Through adapting proven state-of-the-art science professional development to a web-based delivery mode, this project will provide a cost-savings of approximately 50% compared to the face-to-face delivery of the same proven program, through savings on travel, consultant pay, event costs, and more.

Competitive Preference Priority 10—Technology: This project will employ web-based technology providing 150 science teachers 24/7 access to a professional development program proven to have a significant positive impact on student engagement and achievement.

A. Quality of the Project Design**Project Overview**

WestEd's Strategic Literacy Initiative (SLI), in partnership with a consortium of schools in Pennsylvania (PA) and Michigan (MI), is applying for a grant *to develop and assess the impact of an online version of the Reading Apprenticeship science professional development* that is the basis of our (highest rated) 2010 i3 validation grant. The project will build on an extensive body of research on the efficacy of SLI's face-to-face Reading Apprenticeship Professional Development (RA PD) and adapt this rigorously researched professional development model to a web-based model called Internet-based Reading Apprenticeship Improving Science Education (iRAISE). In proposing this i3 development project, SLI builds not only on the rigorous research

base and professional development design already recognized with its 2010 i3 validation grant, but also on effective state-wide partnerships in Michigan and Pennsylvania developed through that validation grant, including the strong support of the Michigan Department of Education. In addition, this proposal builds on a set of piloted online professional development courses that feature SLI's Reading Apprenticeship (RA) instructional framework.

Goals

For this development grant, SLI will work with a teacher “design partners” and other teachers from a consortium of schools in MI and PA and with external evaluators to develop and test the potential of online Reading Apprenticeship PD. The proposed project will prepare 150 teachers for meeting Common Core State Standards for literacy in science and key goals in the National Research Council's (NRC) new framework and standards for science, impacting 33,000 students over four years.

Goal 1: Develop, field-test, and refine an online 65-hour course, iRAISE, based on proven face-to-face RA PD for high school science teachers. Through iterative cycles of development, staff will develop, pilot, and field-test an online version of the already validated face-to-face professional development curriculum for science teachers. Development of iRAISE will build from the extensive existing materials and protocols used in RA face-to-face PD and on key design elements of RA PD and will leverage interactive, Internet-based technologies to enhance teachers' learning. In particular, technology in iRAISE is expected to add capacity to differentiate teachers' learning and to maximize social interaction, building professional learning in the iRAISE community of 25 teachers per course. To measure teacher and student learning outcomes, evaluators will adapt existing instruments, including innovative science literacy assessments for students developed by ETS. Beginning in January 2013, local consultants in MI and PA will recruit

25 science teachers as design partners for the first iRAISE course (RAISE v.1). Beginning in summer 2013, this cohort of teacher design partners will pilot and provide feedback on early modules of iRAISE, continuing this process through the academic year 2013-14 as staff continue an iterative process of development and refinement in response to feedback..Staff will incorporate this feedback into a second version of the course, iRAISE v.2. Beginning in summer 2014, a second group of 25 teacher design partners will begin piloting and giving feedback on RAISE v2. Simultaneously, a group of 50 “treatment” teachers randomly selected from a group of 100 teachers recruited for a randomized controlled trial (RCT) across 20 schools in PA and MI serving high needs students will also take the iRAISE v2 course. From summer 2015 through academic year 2015-16, the 50 RCT “control” teachers who were wait-listed will take iRAISE v.3.

Goal 2: Develop and field-test a facilitator training program and materials for the iRAISE course to build capacity for iRAISE scale-up. We will recruit science teacher leaders—teachers who have successfully implemented Reading Apprenticeship in their own classrooms—to participate in a pilot training program for facilitating iRAISE beginning in 2014. These teacher leaders will “apprentice” as facilitators-in-training of iRAISE v.3 in 2015-2016. Their apprenticeship will be modeled on SLI’s intensive facilitation training, developed through our 2010 i3 validation grant, which combines face-to-face with online training and has been successful in training over 50 facilitators to date.

Goal 3: Increase knowledge and skills of 150 science teachers to increase their students’ engagement in science reading and comprehension of complex science texts in biology, chemistry, earth science, and physics. By engaging in iRraise PD, teachers will gain an understanding of the role of reading in science learning and new teaching strategies for supporting students in collaborative science reading and reasoning. Over the grant period, two cohorts of 25 teachers (50 total)

will participate in the course as design partners, helping to refine iRAISE while at the same time learning from their participation. These 50 design partners plus 50 treatment and 50 wait-listed control teachers will also take iRAISE, for a total of 150 teachers.

Goal 4: Increase 33,000 high needs students' engagement in science reading and comprehension of complex science texts in high school biology, chemistry, earth science, and physics. An estimated 33,000 students will be taught by the 150 science teachers who will participate in iRAISE over the four years of this grant. A rigorous randomized controlled trial will be conducted with a subset of 300 of these students to determine the impact of the course on their science literacy development.

Effective Use of i3 Funds

The iRAISE project total budget of \$2,860,400 will serve approximately 33,000 students over four years, at \$87 per student in the development phase. The costs of iRAISE are **reasonable** and **appropriate** for the scope of the planned activity. *Once iRAISE is developed and evaluated, the cost per student will drop dramatically to \$8 for the same 33,000 students.* [The cost of iRAISE for 33K students without research, development, and stipends = \$244,860]. The post-development costs for scaling up to 100K, 250K, and 500K students would remain constant at \$8 per student because increased numbers of students will require increased numbers of teachers, who will require increased numbers of iRAISE facilitators. *This \$8 per student cost highlights Competitive Priority 9 (Productivity), as it is 50% less than the \$16 per student costs for face-to-face RA PD* in our i3 validation grant. [The cost of our i3 validation grant for 409,500 students without research, development, and stipends = \$6,576,868].

Potential for Incorporating Project into Future Work

Project staff will disseminate knowledge gained through this development project by participating in conferences such as the South by Southwest Education conference, Computer-Using Educators conference, as well as in more general education conferences such as AERA and Learning Forward; they will also look for opportunities to publish knowledge gained through this work in similarly diverse journals and online blogs and networks.

In an era of resource scarcity and high demand for improved science teacher knowledge and practice, we predict that once iRAISE is developed, refined, and tested and a quality facilitator training course is developed, many districts will take advantage of iRAISE. In addition, lessons learned in the online “translation” of the RAISE face-to-face science professional development could be adapted to other subject-specific and grade-range-specific teacher audiences. The potential market and audience for this online work would include not only LEAs in the five states directly involved in SLI’s validation grant, where the knowledge of the transformative positive effects of RA PD for teachers, students, and schools is strong and growing, but also the broader national audience looking for solutions to the low-resource, high-quality PD dilemma. The online course (and others we could develop based on lessons learned in this project) would have the potential to generate revenue to support facilitators, technical support, and continued refinement. Also, as mentioned in Goal 2, project plans include developing and field-testing web-based training and materials for science teacher leaders to become facilitators in the next generation of iRAISE courses. Throughout this process, science teacher leaders will provide feedback to staff on the training, enabling the future development needed to build capacity for scale-up.

B. Significance

Need for the Project

The new Common Core Standards call for students to demonstrate advanced literacy proficiency not only in English classes but also in academic subjects such as science (NCCSSO & NGA, 2010). *All* students must be prepared to meet these rigorous academic standards necessary to succeed in college and career, including students with high needs such as English learners, low-income students, minority populations that experience persistent achievement gaps, and students at risk of not graduating from high school (ACT, 2007; Berman & Biancarosa, 2005).

Similarly, the new *Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* calls for *all* students to acquire knowledge and facility with the practices of science—not only with the hands-on investigations primary in science education standards to date, but, importantly, with those inquiry practices entailed in reading, writing, reasoning, and communicating about science (NRC, 2012a). The ability to make meaning of oral, written, and visual language representations is now recognized to be central to the development of robust science knowledge, to participation in scientific inquiry, and to meaningful engagement in public discourse about science (Yore, 2009).

Yet nationally, two thirds of high school students are unable to read and comprehend complex academic materials, think critically about texts, synthesize information from multiple sources, or communicate clearly what they have learned (NAEP, 2006; 2007; 2009; Snipes & Horwitz, 2008). According to national assessments, only 3% of U.S. 8th and 12th graders read at an advanced level, while fully two thirds of our adolescents score below proficient in reading (NAEP, 2006; 2007; 2009). Despite the recognized and widespread need for adolescent literacy development in the upper grade levels, *very few schools and districts provide the needed aca-*

ademic literacy instruction, particularly in the subject areas where it is most critically absent (CCAAL, 2010; Lee & Spratley, 2010).

High school achievement levels in science mirror these statistics. Recent NAEP science *performance* tests reveal that students have difficulty demonstrating deep understanding of science concepts on tasks that require them to draw conclusions about data and provide explanations or justifications for their answers (NAEP, 2009). Disparities between white and minority students as well as higher and lower SES students on these tasks were pronounced, and 12th graders performed more poorly than 4th or 8th graders. In more traditional NAEP science tests, administered in 2011 to 8th graders only, fewer than a third performed at proficient levels in science. Among students who scored below the 25th percentile on this test, 27% were White, 31% were Black, 35% were Hispanic, and 72% were eligible for free/reduced-price school lunch. Of those scoring above the 75th percentile, 76% were White (NAEP, 2012). On an international assessment of science literacy (Fleishman, et al., 2010), only 29% of U.S. 15 year olds scored at or above proficient in 2009, demonstrating ability to integrate and apply explanations to the solution of a problem; 18% scored below even a baseline level of science literacy.

Science education leaders have concluded that shifting science learning goals from rote memorization of science facts to building deeper understanding of core science concepts will require a focus on both science content knowledge and science practices. However, in large part, high school science teachers are unprepared to meet this challenge, not knowing how to simultaneously build students' academic literacy skills and engage them in a rigorous curriculum of science study (Greenleaf & Schoenbach, 2004; Pearson, Moje, & Greenleaf, 2010; Shanahan & Shanahan, 2008). Many science teachers hold misconceptions or limited conceptions of literacy teaching and learning; they tend to think of reading and writing as basic and universal skills that

are developed in elementary or middle school or down the hall in the English department. They do not expect to teach science reading and writing, yet they are confronted with students who do not comprehend science texts, the specialized language of these materials, or the many ways science ideas are conveyed in print, diagrams, images, models, graphs, and tables.

In response, science teachers typically reduce their expectations if students struggle with literacy (Weiss, et al., 2003; Cervetti & Barber, 2009). In lieu of helping students develop the proficiencies needed to read, write, and reason with the language, texts, and dispositions of science, typical instructional strategies for struggling readers involve simplifying, slowing the pace, and often abandoning more rigorous course work, virtually assuring low levels of achievement for students who are already behind (Dweck & Molden, 2005; Kamil, et al., 2008; Pearson, Moje, & Greenleaf, 2010). Students' "literacy ceiling" becomes their *de facto* achievement ceiling, undermining their academic futures and life chances (Schoenbach, Greenleaf, & Murphy, 2012).

However, science classrooms can contribute significant opportunities for students to acquire greater literacy proficiency, just as greater literacy proficiency is essential to students' acquisition of deep scientific understandings and inquiry skills. Science inquiry and literacy practices share important properties that make the integration of literacy and science particularly powerful (Goldman & Bisanz, 2002; van den Broek, 2010). Participation in investigation-oriented science relies on sophisticated literacy skills such as the ability to access scientific terminology, interpret arrays of data, comprehend scientific texts, engage in interpretive and critical reading, and read and write scientific explanations (Conley, 2008; Norris & Phillips, 2003; Osborne, 2002).

To meet the high standards of the Common Core as well as those of the NRC, science teachers must develop both the skill and the will to take up the challenge of preparing students to engage proficiently in science literacy practices, requiring a paradigm shift in their beliefs and in-

structional practices. To build the advanced literacy skills that science courses demand, teachers must help students develop the capacity to draw inferences and synthesize information from academic texts, including the multiple representations used to convey science ideas—graphs, diagrams, data tables, simulations, and exposition (Cromley, Hogan, & Dubas, 2010; Heller & Greenleaf, 2007; Mayer, 2005). The new NRC standards for science teaching underscore the urgent need to increase science teachers' access to professional development capable of helping them provide high-need students, in particular, the kind of higher-level science learning envisioned in the framework (NRC, 2012a,b).

Recent research has identified instructional characteristics necessary to meet the unique needs of adolescents: treat all students as capable learners; create a collaborative climate of inquiry; build on students' interests and curiosity; tap into students' knowledge and experience; and harness adolescents' preference for social interaction to serve academic goals (Kamil, et al., 2008; Greenleaf, et al., 2001). To meet adolescents' academic needs, we must transform high school science classes into collaborative, inquiry-oriented learning environments that challenge students intellectually while helping them build their skills in the high-level literacies characteristic of science practices (Schoenbach & Greenleaf, 2009). Recent research has also identified the characteristics of teacher professional development known to be effective in improving learning outcomes for science students (Desimone, 2009). These include a content focus on student learning in science, active learning opportunities for teachers, professional development of sufficient duration, and collective participation.

Exceptional Research-based Approach to Improve Science Education and Accelerate Advanced Science Literacy

Drawing on these understandings and to address the twin problems of student and teacher under-preparation for high-level academic reading and learning in the disciplines, SLI has developed the RA instructional framework and RA PD model through an iterative research and development process. Working collaboratively with secondary school educators, in the tradition of design research (Brown, 1992) and intentionally including educators to ensure the generation of usable knowledge (Weiss, 1979), SLI's models of supportive literacy instruction allow students with varied academic performance to engage and succeed in rigorous, disciplinary curriculum. RA is based on research showing that most students are capable of complex scientific, historical, and literary reading and thinking but have not been given the academic experiences to build the necessary skills or self-confidence to approach these tasks effectively (Lee & Spratley, 2010). Unique among literacy programs, RA builds motivation, skills, and knowledge for subject-specific literacy tasks, strengthening students' view of themselves as readers and learners, and yielding strong gains in student achievement.

Similarly, RA PD provides a uniquely designed, inquiry-based and content area focused professional development approach that transforms teachers' understanding of their role in adolescent literacy development and builds enduring capacity for literacy instruction in the academic disciplines (Greenleaf & Schoenbach, 2004; Greenleaf, et al., 2011). In RA PD, teachers participate in carefully designed inquiries to help them unlock their own disciplinary literacy expertise and to appropriate new approaches from their peers. Science teachers inquire deeply into what they do to derive meaning with complex science texts, including explanation and exposition in scholarly journals, as well as the diagrams, data arrays, mathematical expressions, and graphs

that convey information. They learn to identify features of disciplinary texts that present stumbling blocks to learners. Teachers experience and practice classroom routines for engaging students in active inquiry and sense-making with such texts—routines for mentoring students in productive reasoning processes, for fostering metacognitive awareness of comprehension problems and problem-solving processes, and for promoting collaborative discussions of science texts. Most importantly, they inquire into classroom videos and samples of student work, building new expectations of what students can accomplish with science materials.

By implementing RA, science teachers transform their classrooms into engaging, intellectual learning spaces where reading and science literacy instruction are integrated into science learning, rather than being added on as separate curriculum. Teachers explicitly model and make visible the tacit reading and reasoning processes, strategies, and discourse rules that shape successful science readers' and writers' work.

Several rigorous scientific studies, including studies in the context of high school science, have confirmed the efficacy of RA PD to transform teaching practice and thereby increase student achievement (Greenleaf, et al., 2011; Somers, et al., 2010). Although many professional development providers focus on increasing high school science teachers' knowledge of the cross-cutting concepts and core ideas related to the new NRC framework, iRAISE is uniquely positioned to help science teachers address the NRC priority of apprenticing students to the scientific *literacy* practices called for.

Likelihood of Positive Impact on Student Achievement

In an NSF-funded, rigorous study of RA PD, an external evaluation team has shown *large effect size differences between treatment and control teachers in increasing classroom practices correlated to statistically significant differences for these teachers' students* (Greenleaf et al.,

2011). This study was cited multiple times by Schneider and McDonald in the 2012 publication *ARC-REESE Criteria & Guidelines for Rating the Methodological Rigor of Educational Research in STEM* as an example of rigorous experimental testing of an intervention (Schneider and McDonald, 2012). Multiple measures of treatment and control groups showed significant positive differences in instruction, including increases in (1) teachers' knowledge about the role science reading plays in science learning; (2) teachers' support for students to do the work of comprehending and learning from science texts rather than delivering science content through lectures, PowerPoint presentations, or notes; (3) teachers' modeling and metacognitive inquiry into science reading and thinking processes; (4) teachers' instructional strategies for supporting student science reading and learning through comprehension strategy instruction, metacognitive processes, collaborative meaning making, discussion-based pedagogies, and engagement; (5) teachers' focus on the unique disciplinary aspects of science reading; (6) teachers' adjustments in science lessons based on student responses to instruction; (7) opportunities for formative assessment and responsive instruction through metacognitive processes and collaborative meaning making; (8) the volume and kinds of science reading students are asked to do; and (9) teachers' attention to equitable participation and support for diverse students in these classrooms. These changes in practice parallel those called for in the new NRC Science Reading Standards (NRC, 2012b).

Importantly, this study found that ***robust changes in instruction resulting from the professional development intervention were linked to improved academic engagement and achievement for students***. Researchers evaluated standardized test data for a total of 5,346 students served by the participating teachers. ***Students in the treatment schools performed significantly better than their counterparts in control schools on all standardized state assessments studied***.

English language arts (ES = 0.23), reading comprehension (ES = 0.24), and biology (ES = 0.28). Students in RA biology classrooms were on average more than a year ahead of those in the control classes in their English language arts, reading comprehension, and biology knowledge by the end of the year. Moreover, estimated effect sizes for English learners in intervention classes ranged from 0.34 to 0.43 standard deviations on items related to frequency of reading in biology, instructional integration of biology and literacy, perceptions of their abilities as students, and confidence in their ability to read science.

Potential Contribution to Development of Theory, Knowledge, and Practices in the Field

SLI is now poised to translate its uniquely effective designs for teacher learning into an online learning environment to enable broad and cost-effective dissemination of professional development. By translating the core design elements of RA face-to-face PD, we expect to learn a great deal about the benefits and challenges of online learning as a setting for transformative teacher learning. Beyond developing iRAISE itself, this project will yield new understandings to address the growing national need for low-cost, high-quality professional development addressing new higher standards for teachers and students such as those embodied in the Common Core and the National Science Education Standards. These are likely to include both very specific lessons—such as the specific affordances of various online interactions for inquiry—and more general lessons about the ways in which the opportunities of online professional development—including flexible scheduling, cost-effectiveness, differentiation, and affordances of novel web-based technologies are balanced with the potential trade-offs, losses, or constraints of online versus face-to-face PD. We also anticipate learning more about differences in the ways different teachers use the online learning and about the kinds of interactions and innovations they themselves develop using social network approaches to building their own learning.

While multiple studies of online PD in the past decade have documented changes in teachers' content knowledge and classroom practices and to teacher reports of students' positive changes (Brunner and Rivas, 2006), only a few have been able to rigorously show a link from online PD to changes in student engagement and achievement (O'Dwyer et al., 2010). The proposed iRAISE project evaluation will gather overall data on changes in teachers' classroom practices related to the RA instructional framework and the new NRC science teaching standards. In addition, the evaluation will gather information about students' learning of scientific practices and ways of thinking, reasoning, reading, and writing through discipline-specific reading comprehension assessments created by ETS.

Finally, we intend to contribute to building a theoretical model for constructivist, rigorous online adult learning with the potential for changing classroom practice. In doing so, we will build on the models for our existing face-to-face PD, on models being developed by colleagues and researchers in this field (Kepp and Mike, 2009; Wiske and Perkins, 2009), and on a set of early-stage hypotheses we have been developing based on our initial online Reading Apprenticeship PD described below.

Existing Adaptations of Reading Apprenticeship PD to Online RA PD

The proposed project will build on two existing and three in-process pilots of online RA PD. The first of these is a six-week, 30-hour introduction to RA for community college faculty that has been offered nine times since April 2011, reaching more than 220 participants. The second existing pilot is an online extension of face-to-face training for our i3 validation grant facilitators. The three other pilots, currently in development, include an online course for high school principals whose teachers are participating in SLI's i3 validation study, to be launched in October 2013 serving principals in both MI and PA, and two online courses for faculty leaders in

community colleges. All five of these online courses adapt key design elements of RA PD and existing RA PD materials and processes to the unique affordances of online learning tools.

Early data for the 30-hour community college faculty course suggest significant impact on students' retention when their instructors have participated in the course. At one campus, students' retention rates increased in each of three terms when their teachers had participated in the course compared to those whose teachers had not—from a 22% advantage in the first term to a 45% advantage by the third term (Johnson, 2012). In addition to the student retention data, preliminary analyses of instructor usage and responses in the online discussion boards reveal many examples of teachers sharing classroom practice, indicating positive changes in their college classrooms including, for example, increased in-class time discussing and solving reading challenges and increased opportunities for student-to-student interaction and discussion around texts. These changes are similar to those documented in the classrooms of treatment group teachers in the NSF study cited above as well as other related studies of RA face-to-face PD.

Adapting Proven Science Reading Apprenticeship PD from Face-to-Face to Online

The iRAISE design team will incorporate the elements of RA PD that have resulted in the significant positive results in teacher and student learning found in the NSF study of RA PD (described above) into iRAISE. Table 1 below presents example for two key RA PD routines.

Face-to-Face RA PD	Online RA PD: iRAISE
<u>Timing</u> : Synchronous and inflexible.	<u>Timing</u> : Any time; flexible and asynchronous, except Skype activities, which are flexible.
<u>Location</u> : Fixed.	<u>Location</u> : Anywhere
<u>Participation</u> : Participation by all is encouraged by the instructional design; non-participation can be “invisible.”	<u>Participation</u> : Participation from all is built into the instructional design; non-participation is more visible.

Face-to-Face RA PD	Online RA PD: iRAISE
<p><u>Roles:</u> Facilitator gives directions and acts as an “itinerant mentor” eliciting and extending discussion. Small groups and pairs form flexible learning groups to practice eliciting and extending conversation. Participants have limited time for individual reading, practice, and reflection.</p>	<p><u>Roles:</u> Directions are embedded in course activities. In small groups and pairs, participants practice eliciting and extending conversation. Facilitator uses formative assessment to differentiate and mentors individuals and groups. Participants have extended time for individual reading, practice, and reflection, which is brought into pairs, groups, and whole group based on individual’s initiative to share.</p>
<p><u>Collaboration Tools:</u> Seats arranged in groups; physically shared documents and annotations; thinking aloud in pairs; whole group facilitated discussions.</p>	<p><u>Collaboration Tools:</u> The Canvas technology platform for iRAISE will allow integration of a number of web tools for collaboration at a distance including Skype, VoiceThread (a document sharing tool for posting video, audio, and text responses); and group document sharing-and-revising sites such as Google Docs and Ether Pad.</p>

Sample Routine 1: Metacognitive Conversation

<p>Participants perform acid and base lab in pairs and take turns “thinking aloud,” with partners taking notes on what the other says.</p> <p>Partners debrief in small groups and whole group about what they learned from partners’ think-aloud, from doing think-aloud themselves, and how think-aloud might look like their classrooms.</p>	<p>In partners, participants use Skype as they “think aloud” and make notes about one another’s science reasoning processes while completing a web-based stoichiometry lab.</p> <p>Small groups use Voice Thread to discuss what they learned from partners’ think-alouds, from doing think-aloud themselves, and how think-aloud might look like their classrooms.</p>
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Sample RA Routine 2: Literacy Learning Video Case

<p>Pairs take notes as partner reads and thinks aloud about how he or she is making sense of a text on antibiotic resistance in <i>Staph. aureus</i>. In small groups, pairs discuss their own reading and sense-making processes and make predictions about challenges students might face while reading this text.</p> <p>Participants take notes as they observe a video of two students reading and thinking aloud with the same text. Small groups discuss students’ comprehension and sense-making, and ideas about how this informs how they might support science reading in their classrooms.</p>	<p>Pairs use VoiceThread to share and respond to each other’s metacognitive reflections about how they are making sense of the text. Small groups use Voice Thread to read each pair’s annotated documents, discuss their reading and predictions, and post a summary of their reading processes and predictions.</p> <p>Individuals watch the video online and contribute observation notes to a shared web-based document. Small groups view these shared notes on Voice Thread, responding to each other’s interpretations of students’ comprehension and sense-making. Individuals reflect in their private online portfolios about how this inquiry informs how they might support science reading in their classrooms and share these with the facilitator and others whom they select.</p>
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C. Quality of the Project Evaluation

Overview of the Evaluation

Empirical Education (EE), with extensive experience conducting large-scale, rigorous, experimental impact evaluations as well as formative and process evaluations, currently leading evaluations for i3 2010 (validation) and i3 2011 (development) winners will conduct the evaluation for this project. Vitas for EE evaluation team researchers are included in Appendix F. The evaluation will apply mixed methods to assess the key components of the logic model, including *presence of inputs*, such as the presence of course modules and course facilitator interactions with teachers, and teacher online interactions in the use of the program; *impacts on proximal and intermediate outcomes*, such as teacher practices; *impacts on distal outcomes*, such as student engagement or achievement; and *mediating effects* of the intermediate processes on the distal outcomes.

In years 1 and 2 EE will conduct an evaluation providing qualitative feedback concerning all aspects of implementation of iRAISE as it moves through stages of development. In year 2, researchers will also conduct a one-year randomized trial to evaluate the average impact of iRAISE on student achievement. The research questions follow:

1. *Does iRAISE have an impact on student outcomes, including achievement, attitudes about reading, classroom literacy experiences, and the use of metacognitive strategies?*
 - a. Is there a differential impact of iRAISE for different subgroups of students (e.g., depending on ELL status, prior achievement, socioeconomic status)?
 - b. Are impacts of iRAISE on student achievement mediated through impacts on students' attitudes about reading or changes in literacy instructional practices?

2. *Does iRAISE impact teacher outcomes, including the ability to integrate disciplinary literacy practices and explicit literacy instruction into science courses, and teacher knowledge or attitude towards literacy instruction?*
 - a. What are the levels of implementation fidelity, as assessed through participation in online PD and survey outcomes?
 - b. Does iRAISE have an impact on student achievement for teachers who implement with fidelity?

The evaluation relies on several key sources of data utilizing established, reliable, and previously validated instruments, along with science literacy measures under development by ETS and surveys addressing implementation to be developed and piloted in year-1. (We describe the outcome measures and their psychometric properties, where available, in Appendix D). In this developmental experiment, the subjects will consist of 100 high school science teachers, and their students, with one section per teacher selected at random to participate (to limit costs). Teachers will be randomized within schools to iRAISE or business as usual, with controls wait-listed for one year before receiving iRAISE. With approximately five teachers per school, we expect participation of about 20 schools. Recruitment of high schools will be facilitated by WestEd partner LEAs in Pennsylvania and Michigan. (With few teachers per school, we will balance assignment at each school by assigning a random number to each teacher [using a table of randomly generated values], listing the numbers from smallest to largest, and assigning to treatment all teachers with values in the top half of the list. If there is an odd number of teachers in a school, the one with the median value in the list will be randomly assigned to conditions using a coin toss.) To limit the possibility cross-over or contamination, the evaluation team will hold on-site meetings or a webinar with teacher participants to explain the rationale behind randomization, the

study design including how being wait-listed works, and the importance of adhering to the assigned condition for the trial to give accurate results. The evaluation team will use surveys to monitor for cross-over, contamination and non-implementation. If present, in addition to producing ITT estimates, researchers will calculate treatment on the treated (TOT) and local average treatment effect (LATE) estimates (Gennetian et al., 2005) to assess impact on receivers of the program.

The sample size is based on a power analysis for detecting impacts of 0.15 standard deviations on student achievement, assuming an intraclass correlation coefficient of .15, a randomization-level R-squared of .70 (which accounts for effects of both blocking and modeling covariates [Xu & Nichols, 2010]), a student-level R-squared of .50, and 30 students per teacher. The required teacher N is 84 total. One hundred teachers will be recruited to allow for attrition (see Appendix D for details of the power analysis). This sample size will allow us to detect impacts of .21 standard deviations for English learners (assuming they constitute 20% of the sample) and impacts of .37 standard deviations on teacher outcomes.

Data on Students' Progress and Implementation

As part of the process evaluation, researchers will assess the development and implementation of the intervention and its consistency with the iRAISE logic model, providing quarterly formative feedback. Monthly surveys will identify factors impeding or facilitating implementation and the nature of implementation generally. Qualitative coding and constant-comparison analyses (Glaser & Strauss, 1967) will be used to identify themes across data sources. A key outcome of the implementation investigation is a well-documented process with benchmarks that will enable others to replicate the model. The qualitative work will help to define an index for gauging levels of fidelity of implementation. Key outcomes for assessing implementation, and

constructing a numeric index measuring fidelity, will be teacher and student survey responses and computer logs indicating usage of various features of iRAISE.

Analyses

[Redacted text block containing multiple lines of blacked-out content]

[REDACTED]

D. Quality of the Management Plan

Management Expertise and Organizational Infrastructure

Since its inception in 1995, SLI has disseminated the RA instructional framework to LEAs in 34 states. Over 77,000 teachers and 1,000 RA leaders nationwide have participated in RA professional development. Through leadership development and the certification of professional development consultants, the project manages multiple summer professional development institutes and annual national conferences, and delivers site-based professional development services under contract to LEAs around the country. With the investment and support of local and national

education foundations and agencies, SLI has built the reach and impact of RA, managing exponential growth over the past 10 years. In winning the highest-scoring i3 validation grant in 2010, SLI garnered the support of seven foundations as matching funders: Carnegie, Gates, Hewlett, JP Morgan, National Philanthropic, Stone, and Stuart Foundations. Colleagues at several of these foundations have agreed to help raise matching funds for the proposed development project (See Appendix G).

While managing this growth, SLI Co-Directors Ruth Schoenbach and Cynthia Greenleaf have at the same time published and presented the RA model broadly to education audiences, thereby influencing the field of adolescent and disciplinary literacy and building the visibility of this innovative approach (see Vitae, Appendix C). RA has received widespread recognition for its unique characteristics and effectiveness by leaders in the field, as the many publications citing it attest (e.g., Biancarosa & Snow, 2004; Lee & Spratley, 2010). In addition, SLI is a key partner in the Reading for Understanding initiative of IES, working with the University of Illinois at Chicago to develop reading interventions for the middle and high school grade span. SLI leads the science intervention development for the project. The proposed project will draw on this extensive experience and preexisting research instrumentation in planning, developing partnerships, coordinating with official partners, data collection, and preparing for evaluation activities.

Also participating in the project are key staff of WestEd's application, web, and media development team, WestEd Interactive (WEI). Since 2001, WEI has delivered web, interactive media, and information solutions for educators. In the last several years, WEI has developed particular expertise designing and supporting course delivery systems and has collaborated in the development of a variety of media-rich online communities of practice, including the College

Board AP Calculus Professional Development Research Project, Doing What Works website, Charter School Teachers Online project, and the Envision Schools Project Exchange.

As a national agency with resources of \$115 million and a stable funding base, WestEd has developed systems and processes, such as financial management and quality assurance, to support the management of large, complex and rapidly growing projects. WestEd currently manages a multitude of such projects, including a Regional Educational Laboratory, two Regional Comprehensive Centers, a national Content Center, and multiple national evaluations, providing research and technical assistance services to over 30 states.

Project Timeline and Responsibilities

Project activities, dates and milestones, and responsibilities are shown in Table 2 below. The project will recruit iRAISE participants from 18 partner schools and additional schools in Michigan and Pennsylvania as needed. Any additional schools will have high needs student demographics that at least match those of the partner schools (see Appendix C.2 Demographics). In those schools, for example, High Poverty students average 37.8% of the student population.

Activity	Milestones	Who
Assess existing materials, design principles, and online resources to begin iRAISE pilot design	Jan-Feb 2013	iRAISE Design Team
Convene Advisory Group 1 st time for early-stage design suggestions	Feb 2013	Advisory Group, SLI staff
Recruit iRAISE participants	Jan-Apr 2013	PA and MI local leaders
Translate current RA science activities to online setting for Summer Institute	Jan-June 2013	Hale, Brown, WEI
Incorporate key science units from IES Reading for Understanding grant and new video materials into iRAISE v.1	Jan 2013-May 2014	Hale, Brown, Greenleaf
Develop, refine, and manage web portals and video resources; advise PD leaders on creating dialogue and tools; troubleshoot technical issues	Feb 2013-May 2015	WEI, Hale
Pilot modules for initial user feedback	Feb-Mar 2013	Hale, Brown, WEI, 25 teacher partners

Activity	Milestones	Who
Incorporate feedback into modules for iRAISE v.1 Summer Institute	Mar-May 2013	Hale, Brown, WEI
Pilot iRAISE v.1 Summer Institute; collect feedback and revise	June-Aug 2013	Hale, Brown, 25 teacher partners, WEI
Develop modules for iRAISE v.1 Semesters 1 and 2, incorporating feedback	Sep 2013-Apr 2014	Hale, Brown, WEI
Convene Advisory Group 2 nd time for feedback and revision suggestions	Oct 2013	Advisory Group, SLI staff
Pilot iRAISE v.1 Semesters 1 and 2; collect feedback and revise	Aug 2013-May 2014	Hale, Brown, 25 teacher partners
Convene Advisory Group 3 rd time for feedback and revision suggestions	March 2014	Advisory Group, SLI project staff
Field-test 65-hour iRAISE v.2; collect feedback and revise	June 2014-May 2015	Hale, Brown, new cohort of 25 teacher partners, 50 treatment teachers
Collect data for evaluation of implementation year teacher and student impacts	June 2014-May 2015	Evaluators, 50 treatment and 50 control teachers
Field-test 65-hour iRAISE v.3; collect feedback and revise	June 2015-May 2016	Hale, 50 control teachers
Develop, field test, and gather feedback for online facilitation materials and training program; train science teacher leaders to facilitate iRAISE	Sept. 2015-Dec. 2016	Hale, Brown, science teacher leaders
Manage liaison with Evaluators and advise on findings needed for next phase of development	Quarterly	Greenleaf
Propose presentations for conferences; propose publications; present and publish	Ongoing	Project Team
Attend i3 national conferences	Annually	Project team
Manage personnel, timeline, budget, reporting, overall project fidelity, and progress toward goals	Ongoing	Schoenbach
Provide administrative support	Ongoing	Lee

Qualifications of Key Personnel

The resumes of key personnel are found in Appendix F. Brief highlights follow.

Ruth Schoenbach will serve as Project Director. She has created and managed numerous complex and innovative educational projects over her 30+ years as an educational program developer and manager. Her work includes designing and managing professional development and publications for secondary and college teachers and teacher educators using the RA framework; project management for the IES Enhancing Reading Opportunities study; and her current posi-

tion as Project Director for SLI's \$22 million i3 validation grant. She holds an Ed.M. in Teaching, Curriculum and Learning Environments from the Harvard Graduate School of Education.

Cynthia Greenleaf, who will serve as Project Director for R&D, has 25+ years of leadership experience evaluating and designing tools, protocols, and high-quality, literacy-focused professional development. She has carried out a line of cumulative research and development and developed widely acclaimed presentations and publications related to this work. Most recently, she led two teams of professional development staff, research methodologists, and assessment specialists in RCT studies of the impact of RA professional development on high school students in biology (NSF) and U.S. history and biology (IES) classes. She holds a Ph.D. in Language and Literacy Education from U.C. Berkeley.

Gina Hale will serve as Lead Curriculum Developer for this project. She led the design of the professional development curriculum of two RCT studies of RA in high school biology and U.S. history. She also designed and facilitates the online learning environments for facilitators of SLI's i3 validation project. A former secondary school teacher, she is pursuing an M.S. in Technology for Education and Training from the University of South Dakota.

Willard Brown will serve as the Lead Consultant for science content development. He has led SLI's science and math work for the past four years. Previously, as a chemistry teacher at a large Oakland high school, he incorporated RA practices for students in the full spectrum of chemistry classes there. He holds a Ph.D. in Chemistry from U.C. Berkeley.

Robert Montgomery, a Senior Project Manager for WestEd Interactive, will lead a team of content and media developers to develop and manage the project's web portal, integrating online technology and media with professional development activities. A former high school teacher, he received an M.A. in Social Sciences in Education from Stanford University.