Cyber-enabled Learning:
Digital Natives in Integrated Scientific Inquiry Classrooms

USU/NYIT Collaborative DRK-12 Project

Year Two Advisory Panel Feedback

A response to feedback provided by the advisory panel in this report is also provided in [brackets, italics, and underlined] following each area in the report where a response is warranted

Introduction

This is a 2-3 page summary of feedback the Advisory Panel has based on information shared during the March 2, 2012 Advisory Panel Meeting in Old Westbury, New York.

Overall impressions of the project

What are the benefits that you see emerging from the project? In what ways is the expertise of the project personnel being leveraged? What are the transformative aspects of the project that serve as a focus of the work? What are transformative aspects that could also be considered as a broader impact of the work? What can be said about the organization of the project?

One clear benefit demonstrated thus far is that teachers are engaged in authentic science learning experiences. This results in enhanced teacher awareness of the process of scientific inquiry and enthusiasm toward the use of technology in this endeavor. The use of ICTs in the professional development is a model for its use in the classroom.

At each site, expertise is leveraged appropriately. The scientific content expert at each site is integrally involved in the development and implementation of the PD, and curriculum development for subsequent classroom delivery. The teams are responsive to issues of enactment and teacher needs.

Much attention has been paid to the professional development components of the project. However, the enactment of cyber-enabled learning as a transformative element is not yet evident. It is promising that participants had a positive overall experience with the PD; this may be laying the groundwork for the realization of the transformative elements promised in the original proposal.

[The project leadership very much appreciates and is grateful for this feedback. With respect to enacting cyber-enabled learning as a transformative element of the project, as the advisory panel suggests, we see the work that has been accomplished to date as part of the transformative elements of the project both as 'groundwork' and already including transformative elements promised in the original proposal. To date, teacher participants in Cohort 1 have participated in the first of two years of professional

development. Transformative elements outlined in the original proposal have been included in this first year, both as transformative elements and 'groundwork' for preparing teachers for future innovation. This can be seen as cyber-enabled tools such as Google-Docs and sites as well as Edmodo have been leveraged for their communicative aspects as well as for their potential to tap social networking benefits found to be influential in students' lives in informal settings. Specific examples of transformative elements include the use of ICTs beyond the topics in the modules discussed, mostly on the word processing tool, spreadsheet tool, social networking tool, and in sharing multimedia resources such as images and video link. Evidence-based transformative use of technology will be the focus of Year 3. *Importantly, as they are used in the project, they are done so with priority given to their role in supporting science learning. In addition to these technologies, online databases as well as video-capture technologies have also provided a transformative element enhancing science teaching and learning in ways not readily accessible without these resources and especially in ways aligned to teaching science as inquiry. Finally, probeware, while perhaps on the fringe of what might be described as cyber-enabled technologies, has been used to allow for quick and abundant data collection. Some forethought was given to which cyber-enabled technologies would be best included in year one of the project in comparison to year two of the professional development for teachers. And, as the advisory panel shared, these earlier technologies are ones that we felt could help ease teachers into mindsets and practices that begin to take advantage of cyber-enabled technologies before even more transformative technologies, technologies that may have been met with more apprehension early in the project, such as 3-dimensional virtual environments are introduced in the second year of professional development.]*

Important progress made to date

To what extent does the work shared to date align with what should have been developed at this point of the project to stay within project timelines? What is seen as the most important progress that was reported to date? What areas deserve additional attention most immediately based on the panels understanding of the project.

Development of the PD modules has proceeded as planned, and modules are well crafted based on teacher needs. Qualitative and quantitative data collection and analysis is strong. Effective coordination of the project is in place at each site. The evaluation from Horizon Research is informative. The timing of activities is on schedule. Research publications and dissemination through conference presentations seems on track for point in project.

[The project leadership concurs with this assessment. We feel that we have been able to succeed in keeping our timelines with respect to participant recruitment, curriculum/module development, professional development design and implementation, data collection, and early stages of dissemination through conference presentations and initial publication submissions.]

Suggestions/considerations moving forward
What suggestions would the panel offer as important considerations to enhance the work already planned and/or completed?

Alignment: The strategy to improve project alignment must be considered and stated explicitly. First, the areas of alignment and misalignment within and between sites need to be clearly identified. Efforts should be taken to identify causal factors, and strategies to address them. Possible suggestions include:

- detailed collaborative planning
- a common rubric for primary themes of new literacy and scientific inquiry
- the sharing of templates between sites
- selection of a single virtual meeting space for teachers within each cohort across sites
- a similar space for students to post/share work.

It would be particularly helpful for each team to participate in the delivery of the PD at the other site.

[“Areas of alignment and misalignment within and between sites need to be clearly identified”-areas of alignment and misalignment for all major facets of the project, as identified by project leadership, are as follows:

Research Design

- *Instrumentation-Both sites are aligned in the instrumentation that is being sued for the project as well as the research design that is being employed. Misalignment or areas where alignment could be tighter are in the area of fidelity. Fidelity measures were not originally planned in the research design or addressed in the research questions, but have been identified as important and as such have been measured to date, but more alignment in how this is measured across sites can be accomplished and is planned moving forward.*
- *Data Collection-Both sites are aligned in what data and when data is being collected.*
- *Classroom Observations- Both sites are aligned in what data and when data is being collected with respect to the original research design and research questions so that we can better understand how the project is impacting teachers overall instructional practices. With respect to measuring fidelity, some misalignment can be found, but plans are outlined in this response to bring these subsequent observations, not originally planned in the proposal, in alignment.*
- *Qualitative research-Both sites are aligned in how emergent data is part of qualitative evidences being used to further understand the research questions. The sites are less aligned in what the central data pieces are across sites, with a targeted subsample observed during the workshop, interviewed, and observed in their classrooms at the UT site and all participants with emergent artifacts informing the NY site. Original plans of starting the qualitative investigation at*

the UT site and moving into NY after year 1 has likely led to this misalignment. The unique culture and complicated school system in NYC does not encourage the original plan to have teachers interviewed/observed multiple times by different observers. The leadership is planning to revisit this before the summer workshops to bring the qualitative investigations across sites in better alignment moving forward. The possible solution is to use the existing data collected during PD, regular classroom observation, focus group, interaction on team social networking site to answer the research questions, and then come up with the plan to collect the missing data with minimum requirement for teachers' extra investment of time.

Professional Development Model

- *Summer and Winter PD-There is much alignment in how the workshops are being conducted. This has been facilitated by the use of templates for designing both the cyber-enabled modules that serve as the basis for the professional development and curriculum to be enacted in classrooms to the professional development model templates that are used at both sites. The team ensures the PD modules align with the three components addressed in the proposal: scientific inquiry skills, ICTs use and new literacies skills, and use the components to communicate. Each site has reviewed the other sites modules and PD model as an additional measure to ensure alignment. Threats to alignment come as leaders with differing expertise serve as primary leaders at the different sites (i.e., Science Educators and Biologists lead PD workshops at UT site and Instructional Technologist, New Literacy, and Biologist Faculty members lead at the NY site). Additionally, responsiveness to teachers at the different sites also threatens alignment to some extent. Ensuring that thorough review mitigates these threats and negotiation of the modules and PD model occurs sites as we have been doing, along with comparisons of project outcomes at both sites, both teachers' and students'. Some comparison of teachers' and students' work has already occurred, but more can and is planned to help mitigate alignment concerns.*

Cyber-enabled learning Modules

- *Cyber-enabled technologies-alignments are found in this area as both sites are focused on leveraging common technologies supporting of learning in science strategically. So, the focus of the first year of professional development, which is centered on the development and enactment of modules 1 and 2, is using Google Docs, Google Sites, Google Spreadsheets, Cyber Resources and Social Networking technologies (Edmodo, Google Site learning logs). Additionally each module leveraged a central data generating technology (i.e., module 1-online databases; module 2-video/image capture technology). Probeware was another technology that was leveraged at both sites. Areas where alignment focus is needed lies in continuing to be sure that these technologies are consistently leveraged with the same intention across both the NY and UT sites. While we believe these are for* *the most part, revisiting these intentions connected to specific technologies is needed yearly.*

- *Science as inquiry-alignment occurs in this area as we have adopted a backward faded scaffolding framework with three iterations of investigations (structured inquiry, guided inquiry and open inquiry) as part of each module developed. Like cyber-enabled technologies, alignment focus is needed in continuing to be sure that this framework is consistently leveraged with the same intention across both the NY and UT sites. While we believe these are for the most part, revisiting this connected to specific modules is needed yearly.*

While we do see how teams participating in delivery of PD at the other site would be beneficial, there are many constraints and considerations that have us seeking alternative strategies, such as those suggested/outlined above by the advisory panel, to ensure alignment across sites. The following are some of the constraints of cross-site participation: 1) this has proved difficult in the past and will prove to be difficult in the near future. Last summer for instance, professional development at each site overlapped so that movement between sites for PIs was not feasible. This same constraint (i.e., overlap in summer professional development scheduled in NY and UT) is consistent with what is planned for this summer also. 2) While some flexibility and movement of funds is possible for participating across sites, it was not originally planned, so any participations across sites also has budgetary implications that will limit what is possible. And, 3) because UT and NY have different state standards and influences that are unique across sites, we are hesitant to move PD leaders already familiar with one set of standards to across sites where standards familiarity may be constrained. So, instead of participation across sites, we plan to ensure that we continue to utilize a number of strategies, suggested by the advisory panel, that were in place last year (i.e., detailed collaborative planning-this is accomplished through regularly scheduled bi-monthly meetings, among other things; the sharing of templates between sites-this was done for all modules and professional development models for year 1 PD and curriculum planning and is in place for year 2 PD planning) and new strategies moving forward (i.e., common rubrics for primary themes of new literacy and scientific inquiry-these were developed last year and will serve as more intentional reflection artifacts moving forward; single virtual meeting space for teachers and students within each cohort across sites-the leadership will explore this as an option for sharing inquiry outputs for year 2 PD participants, since these modules and accompanying PD are currently being planned.)]

Fidelity of Implementation: Scheduled visits/observations during module implementation would allow for an evaluation of quality and may improve fidelity. Collection and comparison of artifacts at both sites would be useful.

[In year 1 of PD for cohort 1, NY PIs visited classrooms to make observations during the implementation of the cyber-enabled modules. In UT, one of the qualitative researchers, Jeff Olsen a graduate assistant, visited a sample of teachers during the implementation

of modules. And, both sites used fidelity surveys after the implementation of each module to identify the fidelity with which the modules were implemented. Moving forward, a more consistent plan across sites will be implemented to ensure that evaluation of quality is occurring more consistently to improve quality and fidelity. This plan for year 3 will include PI visits at both sites (NY & UT) of a subset of each cohort (Cohort 1 & 2) for classroom observations guided by an identified Fidelity of Implementation (FOI) measure, use of a common fidelity survey for participants, and reporting of quality and fidelity at the end of years 3, 4, & 5. Note: Classrooms observations of all classrooms are occurring yearly as part of the research design at a time outside of module implementation by external raters using identified observations measures for inquiry and technology to address research questions, but more is needed (i.e., the identified plan above) to get at the quality and fidelity of module implementation.]

Data Analysis: Data collected thus far represents baseline data for cohort 1.

Better evidence of the nature of student use of ICTs for informal learning is needed. The "gap" between the formal and informal use of technology on the part of the students should be demonstrated by disaggregating the quantitative FITS data.

[Based on this guidance and original plans outlined as the FITS instrument was created and data was collected, subsequent analysis of the FITS data has been completed. This analysis will be included in the final year 2 report and subsequently reported yearly to the advisory panel along with changes occurring overtime. As an example, based on this subsequent analysis, we found that the most frequently used technologies by students at home in leisure time is 1) watching videos, 2) playing games, and 3) sending emails. We also found that teachers generally use more mainstream technologies at home (e.g., word processing, spreadsheets), while students reported using more emergent technologies (e.g., web editing, movie editing). More of these findings will be revealed in the year-end report and these findings will be used moving forward to inform cyber-enabled module planning moving forward (i.e., Module 3 and 4 development for year 2 of PD for teachers planned for implementation during the 2012-2013 academic year).]

Summary Statement

Based on all feedback shared in the subsequent sections, the following 1-2 paragraph summary concisely captures the essence of the advisory panels feedback.

In summary, the project continues to have strong leadership. The project benefits from all of the talented scientists, technologists, and educationalists involved. The team should keep focused on the proposed goals for the project and original research questions and assumptions. The teams at the two sites need to develop a plan and implement strategies that will move them from professional coordination and cooperation toward a more authentic collaboration.

[Based on this feedback, we will continue to leverage the broad range of expertise available on the project. We will continue to focus on proposal goals and original research questions and believe our yearly reports where we use collected data to yearly answer the research questions supports this. Finally, continued attention will be focused on ensuring that authentic collaboration is occurring. We believe this will be accomplished as we continue to employ strategies for ensuring alignment across sites and as we employ new strategies suggested by the advisory panel. Additionally we believe authentic collaboration will also be supported as we continually identify, share, and work on authentic challenges that emerge within and across sites moving forward (e.g, interpretation of emergent data, module and PD model planning).]

New York Site standard alignment

Source: http://www.p12.nysed.gov/ciai/mst/pub/livingen.pdf

Standard 1 (scientific inquiry): Students will use mathematical analysis, scientific inquiry, and engineering design, as appropriate, to pose questions, seek answers, and develop solutions.

- Key idea 1: The central purpose of scientific inquiry is to develop explanations of natural phenomena in a continuing and creative process.
- Key Idea 2: Beyond the use of reasoning and consensus, scientific inquiry involves the testing of proposed explanations involving the use of conventional techniques and procedures and usually requiring considerable ingenuity
- Key Idea 3: The observations made while testing proposed explanations, when analyzed using conventional and invented methods, provide new insights into natural phenomena.

Standard 4 (Living Environment): Students will understand and apply scientific concepts, principles, and theories pertaining to the physical setting and living environment and recognize the historical development of ideas in science.

- Key Idea 1: Living things are both similar to and different from each other and from nonliving things.
- Key Idea 2: Organisms inherit genetic information in a variety of ways that result in continuity of structure and function between parents and offspring.
- Key Idea 3: Individual organisms and species change over time.
- Key Idea 4: The continuity of life is sustained through reproduction and development
- Key Idea 5: Organisms maintain a dynamic equilibrium that sustains life.
- Key Idea 6: Plants and animals depend on each other and their physical environment.
- Key Idea 7: Human decisions and activities have had a profound impact on the physical and living environment.

<Alignment chart on page 2>

	Module 1 (Water quality)	**Module 2 (Photo-synthesis)**	**Module 3 (Evolution/ bio diversity)**	**Module 4 (Human body)**
Standard 1 Scientific Inquiry				
Standard 1 (Key idea 1)	X	X	X	X
Standard 1 (Key idea 2)	X	X	X	X
Standard 1 (Key idea 3)	X	X	X	X
Standard 4 Living Environment				
Standard 4 (Key idea 1)			X	
Standard 4 (Key idea 2)				
Standard 4 (Key idea 3)			X	
Standard 4 (Key idea 4)				X
Standard 4 (Key idea 5)		X		
Standard 4 (Key idea 6)				
Standard 4 (Key idea 7)	X			
ICTs and technology				
ICTs	X	X	X	X
Word processing				
Spreadsheet	X	X	X	X
Web search engines	X	X	X	X
Social Networking	X	X	X	X
Still images/ video clips	X	**X**	X	X
Google Earth	X		**X**	
Cyber database	**X**		**X**	
Real time response system (Google Form polling)				**X**
iPad	**X**	X	X	X
Probeware	**X**			

Utah Core Curriculum 8th Grade standard alignment

Source: http://www.uen.org/core/core.do?courseNum=3240

Standard 1: Students will understand the nature of changes in matter.

- Objective 1: Describe the chemical and physical properties of various substances.
- Objective 2: Observe and evaluate evidence of chemical and physical change.
- Objective 3: Investigate and measure the effects of increasing or decreasing the amount of energy in a physical or chemical change, and relate the kind of energy added to the motion of the particles.
- Objective 4: Identify the observable features of chemical reactions.

Standard 2: Students will understand that energy from sunlight is changed to chemical energy in plants, transfers between living organisms, and that changing the environment may alter the amount of energy provided to living organisms.

- Objective 2 Generalize the dependent relationships between organisms.
- Objective 3 Analyze human influence on the capacity of an environment to sustain living things.

Standard 4: Students will understand the relationships among energy, force, and motion.

- Objective 3: Investigate the application of forces that act on objects, and the resulting motion.

Intended Learning Outcomes:

- Use science process and thinking skills.
- Manifest science interests and attitudes.
- Understand important science concepts and principles.
- Communicate effectively using science language and reasoning.
- Demonstrate awareness of the social and historical aspects of science.
- Understand the nature of science.

<Alignment chart on page 2 & 3>

	Module 1 (Human Impact on Environment)	Module 2 (Forces and Motion)	Module 3 (Dependent Relationship of Organisms)	Module 4 (Changes in Matter)
Standard 1 Changes in Matter				
Objective 1				X
Objective 2				X
Objective 3				X
Objective 4				X
Standard 2 Energy from Sunlight and Living Organisms				
Objective 2			X	
Objective 3	X			
Standard 4 Relationship between Energy, Forces, and Motion				
Objective 3		X		
Intended Learning Outcomes				
Use science process and thinking skills	X	X	X	X
Manifest science interests and attitudes	X	X	X	X
Understand important science concepts and principles	X	X	X	X
Communicate effectively using science language and reasoning	X	X	X	X
Demonstrate awareness of the social and historical aspects of science	X	X	X	X
Understand the nature of science	X	X	X	X
ICTs and technology				
ICTs	X	X	X	X
Word processing				
Spreadsheet	X	X	X	X
Web search engines	X	X	X	X

Social Networking	X	X	X	X
Still images/ video clips	X	X		X
Google Earth/3 D Virtual Platform	X		X	X
Cyber database	X		X	
Real time response system (Google Form polling)				
iPad/iPod	X	X		X
Probeware		X		

Cyber-enabled Learning:
Digital Natives in Integrated Scientific Inquiry Classrooms

External Evaluation Report
Year Two

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April 2012

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This document contains both the original review and a response to the external evaluator's, HRI's, feedback. Based on the very positive interactions we have had meeting and interacting with HRI since our project was funded, we are convinced that our project is much better at this point, simply because of HRI's capacity to serve as a critical reviewer constantly and formatively asking questions that have kept us very cognizant of the critique other researchers might levee in the future. In addition, they have also provided us with insider/participant feedback that is beyond that which we collected to inform our project. We are grateful that we have selected such a highly reputable and regarded organization to serve as the external evaluator for our project.

To ensure that our comments are concise and aligned with HRI's review, this report is being written as an amended version of the HRI review with our responses as appropriate embedded, italicized, and underlined.

INTRODUCTION

Cyber-enabled Learning: Digital Natives in Integrated Scientific Inquiry Classrooms is a collaborative effort between Utah State University and the New York Institute of Technology. The project is studying whether teacher professional development and support for the use of cyber-enabled resources in science instruction leads to meaningful student learning experiences, a reduction in the gaps between informal and formal uses of technology for learning, and improved student outcomes in science. By reducing the gaps between informal and formal uses of technology in the science classroom, and engaging students in science learning through inquiry, the project hypothesizes that students will exhibit higher achievement in science, will gain abilities to use technology to better support their science learning, and will have improved dispositions toward science.

The project activities are being conducted at two sites, one in Utah and one in New York, in order to examine whether research findings are generalizable across different contexts. In each site, three cohorts of teachers will experience professional development over a two-year span of time. The first cohort of teachers began the professional development in the summer of 2011; the second cohort will begin in the summer of 2012, and a third cohort will be added in 2013. Each cohort of teachers will participate in a two-week summer workshop each year with follow-up sessions during the academic year. The professional development is intended to prepare participating teachers to engage students in inquiry-based experiences that utilize cyber-enabled resources. Although the professional development is focused on preparing participants to teach four instructional modules developed by the project, it is hoped that teachers will transfer what they are learning to their instruction more broadly.

The project's research is examining the impact of the professional development on teachers' instructional practices, use of formal and informal technologies, disciplinary content knowledge, knowledge of and skill in the practices of science, and "new literacy" skills.[1] In addition, the researchers will examine impact of the instruction provided by participants on students' use of formal and informal technologies, disciplinary content knowledge, knowledge and skill in the practices of science, and new literacy skills.

This report provides an overview of the Cyber-enabled Learning professional development, describes the evaluation activities in the past year, presents findings about the quality and impact of the professional development, and offers recommendations for strengthening project activities.

THE CYBER-ENABLED LEARNING PROGRAM

[1] New literacy skills are the skills needed to use digital technologies to identify research questions, recognize/locate/manage relevant information, evaluate the usefulness of the data collected, synthesize information and produce information to answer questions, and communicate results.

The purpose of the Cyber-enabled Learning professional development is to prepare teachers with the knowledge and skills to engage students in inquiry-based experiences supported by Information Communication Technologies (ICTs) that lead to deep understanding of important science ideas. In order to support teachers in this endeavor, student instructional modules are being provided to guide teachers in: (1) addressing important disciplinary content, (2) incorporating ICTs to support science learning, and (3) using the Backwards Faded Scaffolding Inquiry (BFSI) approach.[2] The modules, each which comprises one unit of instruction on a particular science topic in the New York or Utah state standards, are being developed by the project teams in each site, and piloted in the classrooms of teacher leaders who have been selected to collaborate with the project leadership team in New York and Utah. After participating in the relevant professional development, Cohort 1 teachers implement two modules with their students during their first year of participation and two additional modules in their second year. Although the modules and professional development intended to prepare teachers to use the modules will be provided for a small number of content areas, it is hoped that teachers will transfer what they learning to other content areas not addressed by the project.

The project conducted workshops for the first cohort of teachers at both the New York and Utah sites during the summer of 2011. The workshop in New York was offered at the New York Institute of Technology on the Old Westbury campus. In Utah, the workshop was held at a high school in the Davis school district. Both summer workshops focused on the first module that participants would teach during the 2011–12 school year. In New York, project staff facilitated the majority of the workshop, while this responsibility was shared at the Utah site between project staff and the teacher leaders.

A three-day workshop was held at each site during the winter to introduce teachers to the second module. In addition, project leaders provided teachers with support during the school year, Utah through monthly meetings and in New York by providing feedback via electronic social media mechanisms. The professional development program was intended to:

- Increase participants' understanding of key science idea from their state standards;
- Increase participants' understanding of scientific literacies;
- Increase participants' understanding of new literacies;
- Prepare participants to use ICTs to support their students' science learning; and
- Prepare participants to implement a science module using the BFSI approach.

A description of the aspects of the professional development intended to address these goals follows.

❖ Increase participants' understanding of key science ideas from their state standards

[2] Backwards Faded Scaffolding Inquiry is an instructional model in which the learner engages in three iterations of scientific inquiry, each time taking more ownership in the process. During the first iteration, the instructor guides the learners in exploring a research question following a procedure developed by the teacher. In the second iteration, the instructor guides the learners through the initial stages of the inquiry process and then learners complete the process independently. The third iteration involves students engaging in the entire inquiry process independently.

Due to variations in state standards, the New York and Utah sites are addressing different disciplinary content in their student instructional modules (see Table 1) and, as a result, the professional development intended to deepen teachers' disciplinary content is different at each site.

Table 1
Module Disciplinary Content

	Site	Disciplinary Content
Module 1	NY	Water Quality and Life
	UT	Human Influence on the Environment
Module 2	NY	Photosynthesis
	UT	Force and Motion
Module 3	NY	Evolution and Diversity
	UT	Energy and Ecosystems
Module 4	NY	To be determined
	UT	To be determined

In both sites, the primary mechanism used to deepen teacher content knowledge was to engage participants in inquiries that explore the targeted science ideas. In each inquiry, participants examine evidence intended to help them develop a more complex understanding of a targeted science idea. For example, New York participants investigated factors affecting water quality and Utah participants collected and examined data on the human influences on the environment. Presentations of science content were also provided as questions came up from the participants during their inquiries. In addition, at the New York site, an NYIT scientist provided background information on ideas that participants would encounter in their inquiries. For example, teachers learned about the relationship between dissolved oxygen and water quality prior to teachers' examination of water quality.

- ❖ Increase participants' understanding of scientific literacies

The workshops in New York and Utah were designed to provide participants with experiences to develop skills used in the process of scientific inquiry: engaging with scientifically oriented questions, giving priority to evidence, formulating explanations from evidence, connecting explanations to scientific knowledge, and communicating and justifying explanations. The teacher participants engaged in inquiries from the student instructional modules for a substantial portion of the workshops. There were also explicit discussions about what the participants were experiencing and how those experiences were consistent with the different scientific literacies.

- ❖ Increase participants' understanding of new literacies

The Cyber-enabled professional development is also intended to develop teachers' understanding of the new literacy skills, i.e., the ability to use digital technologies to identify research questions; recognize/locate/manage relevant information; evaluate the usefulness of the data collected; synthesize information and produce information to answer questions; and communicate results. These skills were explicitly addressed in both the New York and Utah workshops although each site approached these discussions somewhat differently.

In New York, facilitators presented information on the components of new literacies; what teachers need to know about new literacies; what ICTs teachers can use to cultivate students' new literacies skills; and how new literacies support scientific literacy. The participants also engaged in a brief activity in which they: (1) searched an article on Google timeline related to how water temperature is affected by human activity/pollution; (2) posted the link to Edmodo[3]; (3) wrote a concluding statement supported by explanations or arguments in the article; (4) described how this article could be used to enhance students' learning outcomes; and (5) critiqued two other participants' posts. Following the activity, participants evaluated themselves using a "new literacies" rubric which describes the development levels of each of the new literacy skills.

Facilitators in the Utah workshops presented the new literacies after participants engaged in science inquiries from the module, leading a large group discussion about the new literacy skills that were intended to be developed utilizing the technologies in the module. In addition, participants had opportunities to reflect on using the new literacies in teaching science during one of the daily reflections.

- ❖ Prepare participants to use Information Communication Technologies to support their students' science learning

The appropriate use of ICTs to support science learning is a key aspect of the Cyber-enabled Learning approach. Given that New York and Utah were addressing different content areas, the sites varied in the types of ICTs used to support learning in the student instructional modules. During the first week of the New York workshop, participants were introduced to several different ICTs: iPods/probeware and credible websites for collecting data, Google Docs/Spreadsheet for organizing and manipulating data, Edmodo for communicating procedures and findings. The Utah site used fewer ICTs, introducing Google Docs/Spreadsheets to manage and organize data sets and to facilitate data analysis; Picasa[4] was used to document procedures and results. In the fall, both sites introduced additional iPod/iPad technologies; in New York they were used for generating and analyzing data, and in Utah for documenting and reporting findings.

- ❖ Prepare participants to implement a science module using the Backwards Faded Scaffolding Inquiry approach.

A substantial portion of the Cyber-enabled professional development involves participants experiencing the student instructional module which is structured to engage learners in the Backwards Faded Scaffolding Inquiry approach. Participants in both sites experienced the three iterations of the BFSI approach to various degrees as part of engaging with the module. In the summer workshop held in New York, participants were first introduced to the BFSI approach. In

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[3] Edmodo is a social networking site for teachers, students, and parents.

[4] Picasa is an image organizer and image viewer for organizing and editing digital photos.

the first iteration participants were assisted in developing their own research questions but most eventually explored a questions suggested by the facilitator: "*How do fluctuations in temperature affect DO levels in water environment?"* In the second iteration, all participants examined the same research questions: "*Does acid rain affect the pH level of a small pond? What other factors could contribute to the pH of the pond?"* As part of this inquiry participants collected data from several local water sources and were presented with additional background information on disciplinary science content related to water quality (e.g. pH levels). In the third iteration, teachers developed and investigated their own research questions related to this content area.

In Utah, all participants attending the summer workshop investigated a research question in the first iteration that was posed by the facilitator: "*How do humans impact the diversity of plant species?"* Participants worked in small groups to collect data from various outdoor locations to investigate the question. In the second iteration, facilitators supported participants in developing a small number of research questions, two of which were selected for investigation by various groups who collected/analyzed data and presented their findings. During this iteration, groups investigated human influence on soil pH and the relationship between a limited number of plant species and the number of insects/animals species. In the third iteration groups of teachers developed their own research question, collected data, and developed findings and conclusions independently.

In addition to engaging with the activities in the module, Utah participants designed "on-ramp" and "off-ramp" activities they would use to connect the module instruction to what the students will experience prior to and after the student instructional module. The teachers demonstrated a portion of their activity, and their colleagues assessed the activity using the dimensions of the Reformed Teaching Observation Protocol, which the group had explored the previous week.

DESCRIPTION OF THE EVALUATION

Horizon Research, Inc. (HRI) of Chapel Hill, NC is conducting the external evaluation of the project. The external evaluation is designed to complement the project's comprehensive research plan which includes substantial data collection to examine the impact of project activities on teachers and students. The formative evaluation component focuses on monitoring the quality of project activities, including both the research and professional development, providing feedback that facilitates reflection and helps the project to make mid-course corrections as needed. The formative evaluation questions are:

1. To what extent does the project's research plan adhere to standards for the field? What are the threats to internal validity and generalizability?

2. What is the quality of the professional development focused on inquiry and cyber-enabled learning?

3. To what extent are the selected cyber-enabled learning resources and Information Communication Technologies coordinated to support teachers' and students' opportunity to learn important science content?

4. To what extent does the project use findings from its own research to inform revisions to the professional development?

The summative evaluation component will review the project's research in light of the data collected and assess the extent to which claims based on the research appear to be justified. To that end, external reviews of research products will examine the extent to which project research adheres to standards for the field.

During the second year of the Cyber-enabled Learning project, HRI's evaluation focused mainly on the formative component of its evaluation plan, monitoring the quality of the project's professional development activities.[5] As part of this process, the following data collection activities were conducted during the period from April 2011 to March 2012.

Observations of Professional Development Sessions for Teachers

HRI researchers observed portions of the professional development sessions conducted in Utah and New York in the summer of 2011 and in the winter of 2011–12. The observations focused on the quality of the professional development and the extent to which the sessions provided teachers with the knowledge and skills needed to engage students in science learning through cyber-enabled inquiry.

Teacher Surveys

HRI surveyed all 28 Cohort One teachers participating in New York and Utah at the end of the summer workshop. (See Appendix A for copies of the teacher surveys.) In collaboration with project staff, HRI developed the survey to address the following domains:

- The quality of the professional development;
- Understanding of the disciplinary science content teachers engaged with during the workshop;
- Preparedness in areas addressed by the professional development (e.g., engage in practices consistent with the nature of science, use ICTs to support their own science learning, use ICTs to support students' science learning);
- Barriers for implementing the instructional strategies that were the focus of the professional development; and
- Suggestions for improvement.

[5] Formative feedback on the project's initial research design was provided in the first year of the project and can be found in the Year One evaluation report.

Data tables with the frequencies of teacher responses to survey items can be found in Appendix B.

Teacher Interviews

HRI conducted interviews with a sample of eight participants who attended the 2011 Summer Cyber-enabled learning workshops.[6] The interviews were conducted during September and October, 2011. Interviewees were asked about their teaching situations, reasons for attending the workshop, opinions of the quality of the workshop, understanding of the science content addressed, preparedness to use ICTs, and preparedness to implement the science module.

EVALUATION FINDINGS

This section of the report provides data on the workshop participants, the quality and impacts of the professional development, and what has been learned about transfer to the classroom. Data for this section of the report include the post-workshop survey, interviews with participants, and HRI's observations of project activities. Participant data are presented overall and for each site separately as there are some differences between the two groups. Impact data are presented combining data from the two sites because the small number of participants in each site made it unlikely that any impacts found at a single site would be statistically significant.

Cohort 1 Participants

Teacher recruitment took place during the first year of the project. In order to reduce the threat of selection bias in the research component of the project, schools with similar characteristics were matched and randomly assigned to either Cohort 1 or 2. In Utah, the majority of teachers in the first cohort were employed in a single school district outside of Salt Lake City. In New York, teachers came from multiple school districts in Queens. Data collected on the end-of-workshop survey indicated that most of the participants in both workshops were female. Nearly all of the Utah participants were white whereas in New York less than half of the participants were white. (See Table 2.) Participants had a wide range of experience teaching science, with some in their first two years of teaching and others having taught 15 or more years; most had between 3 and 10 years of experience.

[6] HRI drew a random sample of five participants from each workshop to interview. Participants were contacted through email in September. If they did not respond within a week, they were emailed again. The initial response rate was low and HRI asked project staff to send out an email informing participants of the importance of participating in interviews. HRI then sent out a third round of emails to participants who had not yet responded. HRI was able to interview 5 Utah participants, 2 of whom were replacement teachers for the original randomly selected 5; and 3 New York participants, 2 of whom were replacement teachers for the original randomly selected 5.

Table 2
Participant Demographic Data

	Percent of Respondents		
	NY (N = 14)	UT (N = 14)	Overall (N = 25)
Gender			
Female	79	64	71
Male	21	36	29
Race/Ethnicity			
American Indian or Alaskan Native	7	0	4
Asian	14	9	12
Black or African-American	43	0	24
Hispanic or Latino	0	0	0
Native Hawaiian or Pacific Islander	0	0	0
White	43	91	64
Experience Teaching Grade K–12 Any Subject			
0–2 years	14	29	21
3–5 years	14	29	21
6–10 years	57	21	39
11–15 years	7	14	11
More than 15 years	7	7	7
Experience Teaching K–12 Science			
0–2 years	14	14	21
3–5 years	29	43	29
6–10 years	43	21	32
11–15 years	7	14	11
More than 15 years	7	7	7

Across the two workshops, most participants held a degree in science education and/or a degree in Biology/Life Science. (See Table 3.)

Table 3
Participants with One or More Bachelors and/or Graduate Degrees

	Percent of Respondents†		
	NY (N = 12)	UT (N = 13)	Overall (N = 25)
Science Education	75	69	72
Elementary Education	17	0	8
Other Education	25	8	16
Biology/Life Science	83	62	72
Earth/Space Science	8	15	12
Physics	0	15	8
Chemistry	0	8	4
Other Natural Science	0	8	4
Other	42	0	20

† Responses add to more than 100 percent as participants could select multiple responses.

Quality of the Professional Development

In order to assess the quality of the professional development offered by the project, HRI observed a portion of both the summer and winter workshops. In addition, participants completed a post-workshop questionnaire in the summer and a subset of participants was interviewed in the fall of 2011. Key findings on the quality of the professional development are described below.

- **Cohort 1 teachers were positive about the quality of their experience in the Cyber-enabled professional development, with the majority indicating that the opportunity to learn about ICTs was the most useful aspect.**

On the post-workshop questionnaire, participants were asked a number of questions about their experience in the summer professional development. As can be seen in Table 4, participants' impressions were very positive. In particular, nearly all of the participants strongly agreed that the facilitators encouraged active participation and investigation, and that they would recommend the workshop to a colleague.

Table 4
Participants' Opinions of the Quality of the Summer Workshop

	Percent of Respondents (N = 28)			
	Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**
The facilitators encouraged active participation and investigation by all participants.	0	0	4	96
I would recommend this workshop to a colleague.	0	0	11	89
The facilitators were well prepared.	0	0	11	89
The views and concerns expressed by participants were valued.	0	0	11	89
This workshop reflected careful planning and organization.	0	0	11	89
This workshop was relevant to my classroom instruction.	0	0	11	89
Questions that arose were adequately addressed by the facilitators.	0	0	14	86
This workshop was worth the time that I invested.	0	0	18	82
This workshop provided adequate attention to science content.	0	0	21	79
The goals of this workshop were clear.	0	0	32	68
Adequate time, structure, and guidance were provided for participants to reflect on the substance of this workshop.	0	4	36	61

In an open-ended item on the post-workshop questionnaire, participants were asked to specify the most useful aspect of the workshop. Two-thirds of the participants indicated that learning about the ICTs had been most useful, with several singling out Google docs as particularly useful. As one participant wrote:

> *I loved learning about all the new technologies that I can use to enhance my students learning. I think it will make it fun for them.* [New York Participant]

This sentiment was also expressed in interviews conducted with participants in both sites. Nearly all interviewees indicated that entering the professional development, they wanted to learn how to incorporate technology into their science instruction and that those expectations had been met. Said one participant at the New York professional development:

> *I'd say my expectations were exceeded. Because I think it's a perfect integration between technology and teaching skills, inquiry process along with the technology process, it's sort of like a fusion between them.*

In addition to learning about technology, several New York participants noted that learning about scientific literacies, inquiry-based teaching, and new literacies was very helpful. In the words of one:

> *I found this workshop to be completely useful. The integration of new literacies and science inquires was presented in a way that was clear, palatable, and easily facilitated.*

Utah participants reported that experiencing the module and the collaborative culture of the workshop were particularly useful. As two participants wrote:

> *The overall inquiry module; taking us through it by letting us do it as learners and then as teachers. The step-by-step process of how to do things, Google docs, etc. The one-to-one help if needed, for those of us that are slower at doing things.*
>
> *I liked how it made inquiry practical and that I was able to do it. I really enjoyed being part of a learning community and hearing everyone else's ideas.*

HRI observations were consistent with teachers' impressions. In each site, facilitators were well-prepared and created a positive culture, which allowed active participation and investigation. Participants appeared to be comfortable asking questions and taking intellectual risks.

- ❖ **The Cyber-enabled workshops were successful in engaging participants in inquiry experiences supported by ICTs that were focused on important science content.**

A key aspect of the Cyber-enabled workshops in both sites was the engagement of participants in inquiry experiences focused on important science content. In both New York and Utah, participants had opportunities to generate research questions, design investigations with the support of facilitators, collect data, use evidence to make claims, and communicate their conclusions. In each site, participants used ICTs to support this process.

Not surprisingly, given that many teachers do not have a background in scientific research, participants varied in the extent to which they were able to carry out aspects of the inquiry process during the workshops. For example, at times participants were observed struggling with developing appropriate research questions. In both sites, facilitators were responsive to teacher needs and provided useful support throughout the workshops.

- **Participants may need additional support in understanding the key aspects of the Backwards Faded Scaffolding Inquiry instructional approach.**

As noted previously, the Cyber-enabled workshops are using the BFSI approach as a framework for the student instructional modules the teachers will implement. As part of the professional development provided to teachers, the BFSI approach was modeled and discussed, although the implementation was somewhat different in the two sites. In addition, the student instructional modules provide guidance on the different iterations that students are to experience. At the end of these experiences, all participants on the post-workshop survey agreed or strongly agreed that they had a good understanding of the BFSI approach. Data from the interviews also suggest that some of the participants have a solid grasp of the approach. When asked about how they would explain the BFSI approach to another teacher at their school, two participants described it as follows:

> *I would sum it up by saying, "I teach you watch; I do, you do; and you do, I watch." It's a three step process. You have to demonstrate what they are supposed to learn and how they are supposed to learn and then pass on the torch to them. It's guided; you don't let them do it all alone. Once they have some experience you let them do it themselves.* [New York Participant]

> *I would say you start out by not giving them the entire answer. In developing an experiment you have the students come up with the conclusion you have given them the procedure and hypothesis. As you go through more iterations, the students do the scientific method backwards. In the second iteration they develop their hypotheses and conclusion but you give the procedures. In the third they are doing the entire scientific method themselves.* [Utah Participant]

In contrast, half of the interviewees provided inaccurate or vague descriptions, in some cases noting that they weren't sure how to answer the question, suggesting that participants might benefit from additional support in this area. Said two:

> *I've always learned to scaffold forwards instead of backwards, so that was probably the hardest for me to understand, I don't think I took away as much. I don't know if I could explain it.* [New York Participant]

> *That it's working backwards, starting with the bigger picture and going smaller and smaller. I don't have a good answer.* [Utah Participant]

Project leaders recognized the difficulty participants had with the BFSI approach and have decided to move away from using the term "BFSI" and in future professional development refer to three levels of inquiry: structured, guided, and open. Although these two inquiry frames are conceptually consistent, project leaders believe teachers will be more familiar with the three levels.

Based on the recognition of differences across participants with respect to prior experiences with scientific inquiry, observed from leading the workshops and validated by this HRI finding, *we like many other science teacher professional developers realize that learning to teach 'science as inquiry' is a complex process. We see it as a process that is starts in professional development and continues as teachers begin to enact lessons in classrooms with support and are subsequently able to revisit struggles and successes with peers in long term PD experiences, such as the winter workshop during Year 1 of PD, the summer workshop during Year 2 of PD, and the final winter workshop during Year 2 of PD. So, we expect learning to teach 'science as inquiry' to take time and be enhanced over the two-year project professional development experiences that participants have in the project. But, we also expect that we can help in this process by continually revisiting our project plans and design to ensure that specific nuances regarding teaching 'science as inquiry' are attended to in the project, whether structuring discussions during PD around student work or artifacts from inquiries or through explicit discussions about the purposes of different aspects of inquiry instructional sequences. Finally, to ensure that terminology is not inhibiting participants understanding of teaching 'science as inquiry' the leadership team has elected to move away from the Backwards Faded Scaffolding Inquiry terminology and toward more simplistic terminology to align with our three iteration inquiry sequence grounding our modules: Structured, Guided, and Open Inquiry. We do NOT expect this to change our focus of developing more sophisticated and connected understandings through a sequence of multiple connected inquiries moving from a more teacher-guided iteration (Structured Inquiry) to the final student-guided iteration (Open Inquiry), but we do think it could help allay any confusion may be attributed to the BFSI terminology.*

- **Participants may need additional support in understanding the new literacies and how to develop student skills in these areas.**

The Cyber-enabled workshops in both sites explicitly addressed the new literacies as part of the professional development. In addition, the modules provided to the teachers describe where particular new literacy skills are addressed. Despite these efforts, interview data suggest that teachers would benefit from additional support in understanding these skills and how to address them with their students. For example, when asked about the specific literacies they were most/least comfortable developing in their students, about half noted areas that are not new literacies, e.g., how to use iPods and spreadsheets, creating websites, setting up on-line accounts. Others were unable to specify a particular new literacy.

Based on this finding and our own recognition that more attention is needed in this area, we expect to include more explicit discussion and reflection using the project developed New Literacy Rubric across both sites. We also expect to make clear the connections between the selected technologies that are included in the modules with the new literacies they are expected to cultivate, as well as strategies that participants can use to foster the development of these literacies using resources provided in the project/modules.

- **Both the New York and Utah sites were challenged by the varied prior experience participants had with ICTs.**

The Cyber-enabled workshops introduced participants to several ICTs that could be used to support students' science learning. Given that many ICTs are relatively new technologies, it is not surprising that there was a great deal of variability in the amount of exposure Cohort 1 participants had to these ICTs. And the different needs of the participants related to the ICTs presented challenges in the workshops. For example, teachers who were new to a particular technology needed both instructions on how to use it and time to practice doing so. Others who were comfortable with the ICTs were ready to move on more quickly. Although projects leaders worked to address the individual needs of teachers, providing one-on-one support and pairing more experienced teachers with those new to the ICT, some frustration was observed among participants when they needed more time to get comfortable with a particular technology. And on the post-workshop survey, over a third of the participants indicated that the pace of the workshop was somewhat too fast. (See Table 5.)

Table 5
Participant Opinions
of the Pace of the Summer Workshop

	Percent of Respondents (N = 28)
Much too slow	0
Somewhat too slow	4
Appropriate	61
Somewhat too fast	36
Much too fast	0

In addition, more time to practice emerged as a theme across responses to two of the open-ended questions on the post-workshop survey, one asking about aspects participants would change and the other asking participants to note additional concerns for using cyber-enabled technology to support learning. The following comments were typical:

> *[My remaining concern is] just getting a little more practice w/ iPod with respect to using it with Edmodo and other social media applications.* [New York Participant]

> *I would like to spend more time becoming comfortable with the technology pieces. I did not know anything about Google docs, sites, etc.* [Utah Participant]

This is a problem faced by all teachers and one that we faced as well. We expect to continue to monitor this closely, use pairing that provides support both at the PD and as possible into the classrooms, and to offer additional support and time for learning during the PD workshops. One approach that will be adopted this year, based on suggestions offered by HRI later in this report is additional time set aside prior to and after the workshop days to support those teachers who need additional time, beyond that which is dedicated for participants during the learning and teaching focused sequences in the workshop.

Impacts on Teacher Preparedness

In addition to examining the quality of the professional development, the evaluation collected data on the impacts of the Cyber-enabled professional development on teacher perceptions of their preparedness to implement a module. The post-workshop questionnaire asked participants about their: (1) understanding of science content addressed in the workshop; (2) preparedness to engage in practices consistent with the nature of science, (3) preparedness to use ICTs to support their own science learning, and (4) preparedness to use ICTs to support their students' science learning.

A series of retrospective pre/post items were used to assess participants' perceptions of their understanding of the disciplinary science content addressed in the workshop. This "retrospective pre" approach is useful when respondents are likely to change their perceptions of initial knowledge/preparedness as they learn more about a topic (e.g., in cases where they did not realize how much/little they knew about a topic until after their participation in the program).

Responses to these items were combined into a composite variable for each time point to test the impact of the workshops.[7] (Descriptions of how composite variables were created and their reliability information are included in Appendix C.) Scores on this composite were significantly higher after the workshop than the retrospective pre scores.[8] The 20-point difference is equivalent to a large effect size of 1.16 standard deviations. (See Table 6).

Table 6
Participants' Perceptions of Understanding of Disciplinary Science Content Composite Score (N = 27)

	Mean	Std. Deviation	Effect Size (in std. deviations)[9]
Prior to the workshop	73.25	16.67	1.16
Following the workshop*	93.42	10.34	

* Post scores significantly different than retrospective pre scores (two-tailed paired samples t-test, $p < 0.05$).

[7] Using multiple statistical tests on related outcomes requires the use of a Type I error rate adjustment to reduce the likelihood of false positives, i.e., detecting a difference when one does not truly exist. However, Type I error rate adjustments lead to a reduction in statistical power, i.e., the ability to detect a difference if it does exist. The use of a composite variable helps avoid both of these problems by reducing the total number of statistical tests used. In addition, the creation of a composite variable typically increases the reliability of an outcome measure..

[8] Because the New York and Utah workshops focused on different science content, composite scores were calculated separately for each location and then combined for statistical testing. It is important to note that the Cronbach's alpha reliabilities of the post-workshop composites were below generally accepted minimum requirements, most likely due to a lack of variance caused by a ceiling effect on these items. Consequently, the results of this analysis should be interpreted with caution.

[9] The effect size was calculated as the difference in gains, divided by the pooled standard deviation. Effect sizes of about 0.20 are typically considered small, 0.50 medium, and 0.80 large. Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates.

In interviews with teachers in both sites, nearly all of those who indicated that the workshop had increased their understanding of the content attributed it to engaging in the inquiries. As one interviewee said:

> *Being able to get out there and actually doing the iterations [deepened my content knowledge] as opposed to just sitting in a classroom and being told how it's done. Getting your hands into it.* [Utah Participant]

The post-workshop questionnaire also included a retrospective pre/post series of questions designed to measure participants' perceptions of their preparedness to engage in practices consistent with the nature of science such as identifying a scientific research question and formulating evidence-based explanations. Changes in participants' scores on this composite were statistically significant; post-workshop scores were about 24-points higher than retrospective pre scores, a large effect size of 1.67 standard deviations. (See Table 7).

Table 7
Participants' Perceptions of Preparedness to Engage in Practices Consistent with the Nature of Science Composite Score (N = 28)

	Mean	Std. Deviation	Effect Size (in std. deviations)
Prior to the workshop	69.11	16.99	1.67
Following the workshop*	93.48	10.55	

* Post scores significantly different than retrospective pre scores (two-tailed paired samples t-test, $p < 0.05$).

Participants were also asked a series of questions about their preparedness to use ICTs to support their own science learning. Some items asked about generic ICT skills, such as performing word processing tasks and creating presentations, and other items were specific to using ICTs to carry out practices consistent with the nature of science. The specific-to-science items were combined into a composite variable titled, "preparedness to use ICTs to support their own science learning."

To examine the extent to which participants were making the connections between the practices of science and the ICTs, HRI compared the scores on this composite to the post-workshop scores on the preparedness to engage in practices consistent with the nature of science composite. (See Table 8.) Scores on the preparedness to use ICTs to support their own science learning composite were about nine points lower than scores on the preparedness to engage in practices consistent with the nature of science composite (a medium effect size of 0.52 standard deviations).

Table 8
Participants' Post-Workshop Perceptions of Preparedness to Engage in Practices Consistent with the Nature of Science and Use ICTs to Support Their Own Science Learning (N = 28)

	Mean	Std. Deviation	Effect Size (in std. deviations)
Preparedness to engage in practices consistent with the nature of science	93.48	10.55	0.52
Preparedness to use ICTs to support their own science learning*	84.91	16.68	

* Preparedness to use ICTs to support their own science learning scores significantly different than preparedness to engage in practices consistent with the nature of science scores (two-tailed paired samples t-test, $p < 0.05$).

In addition, participants were asked a series of questions designed to measure their perceived preparedness to use ICTs to support *their students'* science learning consistent with the nature of science. Participants' scores on the composite created from these items were significantly lower than their scores on the composite about using ICTs to support *their own* science learning. The approximately 8-point difference translates to a small effect size of 0.44 standard deviations. (See Table 9).

Table 9
Participants' Perceptions of Preparedness to Use ICTs to Support Their Own Science Learning and Their Students' Science Learning (N = 28)

	Mean	Std. Deviation	Effect Size (in std. deviations)
Preparedness to use ICTs to support *their own* science learning	84.91	16.68	0.44
Preparedness to use ICTs to support *their students'* science learning*	76.42	21.74	

* Preparedness to use ICTs to support their students' science learning scores significantly different than the preparedness to use ICTs to support their own science learning scores (two-tailed paired samples t-test, $p < 0.05$).

It is not surprising that, at the end of the workshop, participants felt more comfortable using ICTs for their own science learning than they did using the ICTs in their science teaching. Still, it will be important for the project to monitor how teachers translate what they are learning to the classroom to determine if additional supports are needed to facilitate successful application.

We see teacher learning as the first step in facilitating teacher growth in instruction. This is an area we plan to continue to focus on in the project and believe that as the modules continue to leverage technologies (e.g., Google Docs, Google Sites) used in early modules (i.e., Modules 1 & 2) in later modules (i.e., Modules 3 & 4) also, that teacher comfort in their ability to facilitate student learning with these technologies will also increase.

Transfer to the Classroom

The primary purpose of the Cyber-enabled Learning project is to study whether teacher professional development and support for the use of cyber-enabled resources in science instruction lead to meaningful student learning experiences and improved student outcomes in science. In order for the project to study the relationship between these factors, teachers need to transfer what they are learning in the professional development to their classroom practice. To provide the project with feedback on the likelihood of transfer to practice, participants were asked at the end of the summer workshop about potential barriers to implementation. In addition, teachers interviewed in the fall who had already used the first student module were asked for information about their implementation.

On the post-workshop questionnaire, participants were asked about the supportiveness of their teaching context for implementing investigations and strategies from the summer workshop. As can be seen in Table 10, most participants agreed that they had the planning time, instructional time, materials and equipment, and principal support needed to implement the teaching approaches and investigations modeled in the workshop. The few participants who disagreed with any of the statements were teachers who attended the New York professional development which indicates that these teachers may be dealing with factors that could inhibit their implementation of the strategies and module addressed in the Cyber-enabled workshop.

Table 10
Participants' Perceptions of the Supportiveness of their Context for Implementation

	Percent of Respondents (N = 27)			
	Strongly Disagree	Disagree	Agree	Strongly Agree
My principal supports the science teaching approaches and strategies presented in this workshop.	0	4	32	68
I have the planning time needed to prepare for science lesson investigations using the tools, strategies, and information presented in this workshop.	0	0	70	30
In have the instructional time in science needed to implement investigations as they were modeled in this workshop.	0	8	40	52

I have the planning time needed to prepare for science lesson investigations using the tools, strategies, and information presented in this workshop.	0	0	70	30

Interestingly, in response to open-ended survey questions on concerns about using cyber-enabled technology to support students' learning, about a third of the participants wondered if they would have access to reliable technology—the majority of these teachers were from New York. The following responses were typical:

> *My concern would be computer/laptop access at my school. But I will begin to work on speaking up regarding the scheduling of the carts and lab.* [New York Participant]

> *My concern about using technology is the lack of tech within my building.* [New York Participant]

> *I am concerned with student availability and access to the technology at our school. The people in charge of our computer lab and library are so tight about security that I'm not sure that my will students will be able to access some of the these tools.* [Utah Participant]

A few teachers also noted concern over having support of administrators for implementing the type of instruction addressed by the Cyber-enabled professional development.

Of the 8 teachers interviewed in the fall of 2011, 5 had already implemented the student instructional module that was the focus of the summer professional development, 4 of whom were from Utah. All but 1 of these teachers were positive about the implementation of the module. Still, these teachers talked about what they would do differently in the future, with 3 Utah teachers commenting on how they would approach the technology differently. In the words of two:

> *I probably would have taken them to the computer lab first and had them learn about Google docs/spreadsheet first before they did their write-up.* [Utah Participant]

> *Specifically on the ICTs, I felt very comfortable using them at the workshop, but I don't know that I was necessarily prepared to teach [students] how to use it. Next time I would do more ramping in, I would use the tech for different things, how to use Google docs/spreadsheet. You kind of throw it all on their plate at once. It was a lot for them to digest at one time.* [Utah Participant]

Two participants who had already implemented the module expressed concern about students' ability to engage in the inquiries in the module. In their words:

> *It was hard to give kids full reign in that third iteration, but I probably would have organized groups differently. I have 36 kids and I think the groups were just too big and some of the lower learners slipped through the cracks. And when they had to do*

something independently they were lost. I just wasn't happy with how the group experience worked out. [Utah Participant]

I don't think [the module implementation] went as well as I wanted it to. [The students] are slower than I expected to grasp this and, because of their maturity level, they are not serious about it. The first iteration was kind of a disappointment. [New York Participant]

Finally, several teachers commented on the amount of time it took to implement the module noting that they had spent more instructional time on this content than in past years.

We see these as very real concerns and at the same time concerns that should be expected as teachers are asked to teach in ways they have not been taught or in ways their colleagues in their schools are not accustomed to seeing. To address these concerns, we expect to spend time with participants during Year 2 PD ensuring that barriers are articulated and strategies are crafted, by teacher and leaders in collaboration, to overcome those obstacles that concern teachers the most. As an example, time will be set aside during the summer and winter workshops for teachers to articulate concerns. And, if a concern such as the following emerges: "It was hard to give kids full reign in that third iteration, but I probably would have organized groups differently . . .", time will be spent with participants identifying instructional strategies and possible heuristics for effectively grouping students to engage in inquiry.

SUMMARY AND RECOMMENDATIONS

The Cyber-enabled Learning project is investigating how to help teachers provide meaningful student learning experiences in science that reduce the gap between informal and formal uses of technology for learning. This past year, the project created four instructional modules for students and designed and implemented an extensive professional development program for the first cohorts of teachers.

Evidence suggests that many aspects of the professional development were successful in meeting its objectives. On a survey administered to participants at the end of the summer workshops, participants indicated that they thought the professional development was of high quality and that they would recommend it to a colleague. They also reported a number of impacts on the survey, including increased understanding of science content and preparedness to use ICTs to engage in practices consistent with the nature of science. There are some areas, however, where the project may want to make adjustments in the structure of future workshops. The following recommendations are offered for the project's consideration in its ongoing efforts to provide high-quality professional development to science teachers consistent with the goals of the project, and to study the impacts of this work.

- ***Consider ways to support participants' varied needs related to ICTs.***

  Workshop participants varied greatly in their background and experience with ICTs. These differences, coupled with the number of ICTs introduced in the first summer of professional development, likely contributed to some participants reporting that the pace of the workshops was too fast and that they needed more time to practice using the ICTs. In response to early feedback, project leaders have already reduced the number of ICTs used for the second module.

The project should also consider the implication of these findings for Cohort 2 participants who will attend Cyber-enabled professional development for the first time in the summer of 2012. To help meet the diverse needs of participants, the project may want to consider using strategies during the professional development to differentiate activities so that those who need additional practice receive it without introducing "down time" for those with more experience. For example, in addition to pairing teachers who have less experience with ICTs with those who have more, the project may want to have teachers new to ICTs view the ICT instructional videos prior to attending the workshop. The project may also want to consider incorporating a "morning coffee hour" before the sessions start for the day to give individuals who need it one-on-one support with the technology.

As articulated earlier, we expect to continue to identify effective differentiation and grouping strategies that address these concerns in the moment of learning and to support those teachers needing additional time at regularly scheduled times (i.e., daily pre-/post-workshop times where support is available).

- ***Provide additional opportunities for teachers to develop the knowledge and skills they will need to support students' science learning with ICTs.***

It is not surprising that Cohort 1 teachers report being more prepared to use the ICTs for their own learning than to use them to support the science learning of their students. Prior research has shown that implementers of an innovation (e.g., a new pedagogy or set of instructional materials) typically go through several phases of understanding of the innovation, starting with a very mechanical understanding and moving toward a more nuanced understanding as they gain experience and expertise using the innovation. Although participants are provided with support to facilitate their work with students, most notably the student instructional modules, they may benefit from additional support in the professional development to help them purposefully use ICTs in support of student science learning

For teachers to use an ICT purposefully, they need to understand how the ICT is contributing to the learning of a science idea and/or of the practices of science. For example, the ICTs used in the student instructional modules have been selected to allow learners to gather data that will provide evidence for a specific science idea. In order to use the modules purposefully, teachers need to understand how the module provides the evidence for the targeted science ideas, how to guide students to attend to the important aspects of the activity, how to facilitate the use of evidence to draw conclusions by the students, and the role of the ICTs in that process.

Purposeful implementation of the modules also requires the teachers' understanding of how the ICTs support the practices of science. For example, Edmodo and Google docs are used to communicate findings and critique others' claims related to the investigations. Teachers will need guidance on how to organize the information in these ICTs to facilitate students sharing relevant information, and how to structure opportunities for students to critique others' findings in a productive manner.

In addition, if the teachers are expected to transfer the use of ICTs to other science topics, they also will need to be able to select an ICT that is appropriate for learning a particular science idea and have the knowledge and skill to use the ICT to support instruction on that concept. Although the project may want to explicitly address this area after participants are comfortable using "pre-selected" ICTs in the student modules, participants would likely benefit from project leaders being "transparent" throughout the workshops about why particular ICTs were selected and the purposes they play in the module.

Based on this feedback, we plan to ensure that explicit discussion occurs with participants to better reveal the rationale behind the selection of specific ICTs as they relate to developing students understandings of essential science concept and practices. Additionally, we expect to include time during the later parts of the PD workshops for participants to consider how the ICTs leveraged in project modules might also serve comparable purposes across other instructional units, not developed as part of the project, as well as the benefits and rationales for these uses.

- ***Provide multiple opportunities for participants to develop an understanding of the new literacy skills and how to support the development of these skills in their science instruction.***

The rich activities that integrate the use of a complex inquiry process, science literacy skills, and new literacy skills are one of the strengths of the Cyber-enabled workshops. Although it is important for participants to experience instruction that models how one would integrate these three components in the classroom, the professional development would likely have a greater impact if it also examined each component separately. In particular, science teachers are least likely to be familiar with the new literacy skills and they would benefit from additional support in this area.

In addition to understanding the new literacy skills, it will be important for teachers to develop a deep understanding of what it means to apply these skills in science and how to help students develop these skills. For example, if teachers are going to help students use technology to identify research questions or evaluate the usefulness of the data, they need to be able to identify what it looks like when these things are done well and what it looks like when these things are done poorly.
To the extent possible given time constraints, participants would also benefit from having multiple opportunities to engage with artifacts of practice, such as examples of student work or scenarios of classroom instruction that represent a range of skill in the new literacies. Participants could analyze the artifacts to identify the new literacy skills at play, assess where the individual students are in their skill development, and discuss how to move students forward in their development of the new literacies. Such experiences would provide participants with the opportunity to develop the nuanced understanding they will need to support student skill development in this area.

Based on this guidance, we expect to continue to make new literacies a more pronounced focus with teacher participants. We plan to do this by increasing our focus on the project developed New Literacy Rubric by considering artifacts, both of participants and students, measured against our constructs of new literacy. We believe these types of experiences will allow participants to see a range of literacy and consider ways to foster growth toward the desired abilities within the range found.

- ***Provide participants with additional support in understanding the use of the different levels of inquiry used in the modules and in their science instruction more generally.***

Evaluation data indicate that some of the science teachers participating in the project may be struggling to understand the BFSI approach. Although the projects' plan to use the three levels of inquiry instead of BFSI in the future, participants will still likely need support in understanding key aspects of these types of inquiry instruction. It will be important in future sessions to explicitly discuss how the three levels of inquiry are being incorporated into participants' learning experiences and how it will be used in the instruction they will provide to their students. The project may also want to consider embedding activities in the workshops that will allow facilitators to gauge where participants are in their understanding of this approach. For example, participants could reflect on how the approach is similar to and different from inquiry approaches they have used in the past. Using authentic, embedded activities that reveal how participants are thinking will be useful to participants and will provide facilitators with information to make adjustments as needed as the professional development progresses.

Also, as the project hopes that participants will transfer what they are learning to their instruction more broadly, participants will need guidance in applying the three levels of inquiry in topics not covered by the project-developed modules, including how often and with which science ideas they should use it.

Based on this guidance, we will be sure to include learning journal/Edmodo reflective prompts for participants throughout the professional development to formatively assess where participants are in their understanding of teaching 'science as inquiry', much like we did during workshops across sites during the first year of PD. The following is one past example learning journal prompt of how this was considered by participants during the workshop:

> *What does 'teaching science as inquiry' mean to you and where are you currently in respect to 'teaching science as inquiry'?[UT 2011 summer workshop prompt learning journal prompt]*

Through reviewing and discussing responses to prompts like these, we do think we were/and will continue to be responsive to the needs of the participant learners.

Additionally, while we do want to ensure that our participants better understand and are better able to teach 'science as inquiry' we are not necessarily focused on seeing participants enact additional BFSI or Structured/Guided/Open inquiries, as they will have *four of these three iteration sequences to enact as part of the project, but instead we do want to see how teachers teach 'science as inquiry' beyond the modules. So we will continue to be attentive, as suggested by HRI here, to how participants can apply teaching 'science as inquiry' "in topics not covered by the project-developed modules, including how often and with which science ideas they should use it". We have identified teaching 'science as inquiry' in alignment with the National Science Education Standards (NSES) as focused on the following facets of this process:*

1. *Learners are engaged by scientifically oriented questions.*
2. *Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions.*
3. *Learners formulate explanations from evidence to address scientifically oriented questions.*
4. *Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding.*
5. *Learners communicate and justify their proposed explanations.*

So, similar to how we have proposed considering the application of ICTs to enhance new literacies beyond in participants' classrooms beyond the application of our modules, we plan to increase our focus on the project developed Science Literacy Rubric by considering artifacts, both of participants and students, measured against our constructs of science literacy (outlined as the 5 NSES facets above). We believe these types of experiences will allow participants to see a range of science literacy and consider ways to foster growth toward the desired abilities within the range found.

- ***Address the barriers to implementation that participants are likely to encounter.***

Evaluation data indicate that there are a number of factors that could limit the extent to which teachers implement the tools, strategies, and information presented in this workshop. Three primary areas emerged as likely barriers: access to adequate technology, the amount of time needed to implement a module, and student ability to engage in the inquiry process.

It will be important to the project to ensure that the modules utilize technology that is readily available to teachers. Consequently, the project may want to identify in advance of the workshops what technologies teachers will be able to access. This information could inform what ICTs are chosen for the modules and give the project time to come up with alternative strategies for teachers who do not have access to the required technology.

The module designs should also attend to the realities of the amount of instructional time teachers have for science. After the implementation of the first module, participants communicated a concern about the amount of time the module took to project leaders, who incorporated this feedback into the design of the modules still being developed. In addition to scaling back the scope of the modules during the development phase, the module piloting process will provide an opportunity to determine the time it takes to implement the modules so adjustments can be made before participant implementation.

Finally, a few of the interviewed participants expressed concern about engaging all of their students in the inquiry process. To address this concern, the project could incorporate opportunities for teachers to discuss strategies to ensure that all students are intellectually engaged in the activities, perhaps asking teachers who have implemented the module successfully to share student grouping and other strategies they found effective.

While we feel that we have already enacted many of these strategies to avoid barriers to module implementation, we certainly see the benefit of each and the need to stay focused on overcoming these barriers. We expect to continue to rely on our teacher and district leaders to help us better understand the technologies that are available and to consider alternative technologies or strategies that can be employed in the event that central technologies available to most are not available to all. In addition, we expect to spend time with participant during the workshops to ensure they have technologies needed for implementation or to brainstorm alternatives as needed in special cases so that participants leave the workshops confident and prepared with concrete plans for implementation.

With respect to the "amount of time needed to implement a module, and student ability to engage in the inquiry process", we expect to continue to pilot each of the modules in teacher leaders' classrooms to ensure that the expectations within the module can be achieved in the time planned and to ensure that the modules are attuned to students' abilities to engage in the inquiry process. We also expect that as more modules are experienced by students into Year 2 of their teachers' PD, they will also be gaining more and more capabilities with inquiry processes and that our modules can/will be tuned to these advances in student abilities overtime. In addition, we expect to continue to work with teachers during PD workshops to 'talk through' the daily objectives of each module and to engage in discussions about how to foster our adopted facets of science literacy over time so that students grow in their abilities to engage in inquiries.

- ***Consider the implications, if any, of the differences between the professional development offered in New York and Utah for the project's research.***

Project leaders expected some variation in the professional development offered in New York and Utah. For example, each site addressed different science ideas, and used different ICTs, because of differences in the two states' science standards. Despite attempts to share their professional development designs and give feedback across sites, there were differences in other aspects as well. ICTs were sometimes used for different purposes and BFSI was modeled somewhat differently across the sites. In addition, New York and Utah varied in the extent to which there was explicit emphasis on the new literacies.

Project leaders in New York and Utah, as part of collaborating on the design of the 2012 summer workshops, are working to ensure consistency between sites. As part of this process, key aspects of the Cyber-enabled professional development are being identified to ensure that they are implemented in both sites. In addition, project leaders are examining activities that occurred in only one of the sites to determine if the activities should be removed or added to the design in the other location.

As the project plans to combine teacher and student data across the two sites in its research, it will be important for the project to keep its research agenda in mind as it works to determine which aspects of the professional development need to be the same at each site and which aspects can vary.

This is an area that has garnered and will continue to garner much attention in our project to ensure consistency across sites and to be sure that data is compatible for combination for research as planned. The most meaningful strategies that greatly assist in this are 1) frequent leadership meetings, 2) use of common templates for the development of modules and summer and winter PD workshops, and 3) cross site review of modules and summer/winter workshop PD models. In addition to these strategies, co-development of advisory reports, end-of-year reports, and co-presentations at PI meetings help to reveal any adjustments that are needed for consistency. Finally, through constant communication with HRI, though consistently held meetings, their post workshop survey summaries, and their end-of-year reports, we are provided with additional measures for identifying areas of inconsistencies and are subsequently able to make mid-stream adjustments. Because our project is spread across two sites, thousands of miles apart, we understand the importance of being vigilant in monitoring consistency across sites. We feel that we already have very effective ways of doing this, but will continue to seek additional measures moving forward as needed, as research remains the central priority of our project.

Appendix A

Post-Institute Questionnaire

New York: ***Enhancing Scientific Literacy and New Literacies through Information Communication Technologies***

Utah: ***Integrating Scientific Inquiry and Technology Workshop***

Enhancing Scientific Literacy and New Literacies through Information Communication Technologies: Teacher Questionnaire

Instructions: This survey is part of the evaluation of the Cyber-enabled Learning project; your feedback is very valuable. Please know that your identity will be kept strictly confidential; no names or identifying information will be shared, so please be candid.

Please complete this form using a #2 pencil or a blue or black ink pen. Darken circles completely, but do not stray into adjacent circles. Erase completely or white out any stray marks.

Place Label Here

1. Please indicate your opinion about each of the following statements regarding this workshop. (Darken one circle on each line.)

	Strongly Disagree	Disagree	Agree	Strongly Agree
a. The goals of this workshop were clear.	◯	◯	◯	◯
b. This workshop reflected careful planning and organization.	◯	◯	◯	◯
c. The facilitators were well prepared.	◯	◯	◯	◯
d. Adequate time, structure, and guidance were provided for participants to reflect on the substance of this workshop.	◯	◯	◯	◯
e. The views and concerns expressed by participants were valued by the leaders of the workshop.	◯	◯	◯	◯
f. Questions that arose were adequately addressed by the facilitators.	◯	◯	◯	◯
g. The facilitators encouraged active participation and investigation by all participants.	◯	◯	◯	◯
h. This workshop provided adequate attention to science content.	◯	◯	◯	◯
i. This workshop was relevant to my classroom instruction.	◯	◯	◯	◯
j. This workshop was worth the time that I invested.	◯	◯	◯	◯
k. I would recommend this workshop to a colleague.	◯	◯	◯	◯

2. The pace of this workshop was: (Darken one circle.)

◯ Much too slow
◯ Somewhat too slow
◯ Appropriate
◯ Somewhat too fast
◯ Much too fast

PLEASE DO NOT WRITE IN THIS AREA

[QID]

3. We recognize that people start at different places and will take different things away from any workshop. Please indicate your **level of understanding** of each of the following aspects both *prior to* and *at the conclusion of* this workshop. In the *left-hand column*, please rate your **Understanding Prior to this Workshop**. In the *right-hand column*, please rate your **Understanding Now**. (Darken one circle in each column on each line.)

	Prior to this Workshop				Now			
	No Under-standing	Some Under-standing	Good Under-standing	Strong Under-standing	No Under-standing	Some Under-standing	Good Under-standing	Strong Under-standing
a. The range of interrelationships of humans with the living and non-living environment	◯	◯	◯	◯	◯	◯	◯	◯
b. The impact of technological development and growth in the human population on the living and non-living environment	◯	◯	◯	◯	◯	◯	◯	◯
c. How individual choices and societal actions can contribute to improving the environment	◯	◯	◯	◯	◯	◯	◯	◯

4. Please indicate your **level of preparedness** in each of the following areas both *prior to* and *at the conclusion of* this workshop. In the *left-hand column*, please rate your **Preparedness Prior to this Workshop**. In the *right-hand column*, please rate your **Preparedness Now**. (Darken one circle in each column on each line.)

	Prior to this Workshop				Now			
	Not at all Prepared	Some-what Prepared	Moderately well Prepared	Very well Prepared	Not at all Prepared	Some-what Prepared	Moderately well Prepared	Very well Prepared
a. Ask/identify a scientific research question	◯	◯	◯	◯	◯	◯	◯	◯
b. Generate data to explore a scientific research question	◯	◯	◯	◯	◯	◯	◯	◯
c. Locate information relevant to a scientific research question	◯	◯	◯	◯	◯	◯	◯	◯
d. Evaluate the usefulness of data being collected about a scientific research question/problem	◯	◯	◯	◯	◯	◯	◯	◯
e. Manage information relevant to the scientific research question problem being investigated	◯	◯	◯	◯	◯	◯	◯	◯
f. Analyze/synthesize data	◯	◯	◯	◯	◯	◯	◯	◯
g. Formulate evidence-based explanations to address scientific research questions	◯	◯	◯	◯	◯	◯	◯	◯
h. Evaluate explanations in light of alternative evidence or explanations	◯	◯	◯	◯	◯	◯	◯	◯
i. Justify proposed explanations	◯	◯	◯	◯	◯	◯	◯	◯
j. Communicate and share research findings with others	◯	◯	◯	◯	◯	◯	◯	◯

5. Please indicate your level of preparedness to use **Information Communication Technologies** to support ***your own* science learning** in each of the following areas. (Darken one circle on each line.)

	Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
a. Ask/identify a scientific research question	◯	◯	◯	◯
b. Generate data to explore a scientific research question	◯	◯	◯	◯
c. Locate information relevant to a scientific research question	◯	◯	◯	◯
d. Evaluate the usefulness of data being collected about a scientific research question/problem	◯	◯	◯	◯
e. Manage information relevant to the scientific research question/ problem being investigated	◯	◯	◯	◯
f. Analyze/synthesize data	◯	◯	◯	◯
g. Formulate evidence-based explanations to address scientific research questions	◯	◯	◯	◯
h. Evaluate explanations in light of alternative evidence or explanations	◯	◯	◯	◯
i. Justify proposed explanations	◯	◯	◯	◯
j. Communicate and share research findings with others	◯	◯	◯	◯
k. Perform core computer networking tasks (e.g., create folders, manage files, use web browsers)	◯	◯	◯	◯
l. Perform word processing tasks	◯	◯	◯	◯
m. Create spreadsheets and databases	◯	◯	◯	◯
n. Create presentations (e.g., using Google docs)	◯	◯	◯	◯

6. Please indicate your level of preparedness to use **Information Communication Technologies** to support ***your students'* science learning** in each of the following areas. (Darken one circle on each line.)

	Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
a. Ask/identify a scientific research question	◯	◯	◯	◯
b. Generate data to explore a scientific research question	◯	◯	◯	◯
c. Locate information relevant to a scientific research question	◯	◯	◯	◯
d. Evaluate the usefulness of data being collected about a scientific research question/problem	◯	◯	◯	◯
e. Manage information relevant to the scientific research question/ problem being investigated	◯	◯	◯	◯
f. Analyze/synthesize data	◯	◯	◯	◯
g. Formulate evidence-based explanations to address scientific research questions	◯	◯	◯	◯

Question 6 continues on the next page...

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[QID]

6. *(continued)*

	Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
h. Evaluate explanations in light of alternative evidence or explanations	○	○	○	○
i. Justify proposed explanations	○	○	○	○
j. Communicate and share research findings with others	○	○	○	○
k. Perform core computer networking tasks (e.g., create folders, manage files, use web browsers)	○	○	○	○
l. Perform word processing tasks.	○	○	○	○
m. Create spreadsheets and databases	○	○	○	○
n. Create presentations (e.g., using Google docs)	○	○	○	○

7. Please indicate your level of preparedness to do the following. (Darken one circle on each line.)

	Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
a. Create and share documents/data using Google Docs/Spreadsheets	○	○	○	○
b. Use Google Earth to facilitate data collection and analysis	○	○	○	○
c. Use internet search engines to investigate a scientific research question	○	○	○	○
d. Use an iPod Touch to facilitate data collection and analysis (e.g., take pictures/videos, use Sparkview)	○	○	○	○
e. Use social networking tools (e.g., Edmodo, Facebook) to communicate information	○	○	○	○
f. Use Picasa web albums to store and share pictures	○	○	○	○
g. Acquire data from reliable cyber resource websites (e.g., MySound database)	○	○	○	○

8. Please indicate your level of preparedness to support **your students** to do the following. (Darken one circle on each line.)

	Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
a. Create and share documents/data using Google Docs/Spreadsheets	○	○	○	○
b. Use Google Earth to facilitate data collection and analysis	○	○	○	○
c. Use internet search engines to investigate a scientific research question	○	○	○	○
d. Use an iPod Touch to facilitate data collection and analysis (e.g., take pictures/videos, use Sparkview)	○	○	○	○
e. Use social networking tools (e.g., Edmodo, Facebook) to communicate information.	○	○	○	○
f. Use Picasa web albums to store and share pictures	○	○	○	○
g. Acquire data from reliable cyber resource websites (e.g., MySound database)	○	○	○	○

9. Please indicate your opinion about each of the following statements regarding this workshop. (Darken one circle on each line.)

	Strongly Disagree	Disagree	Agree	Strongly Agree
a. I have a good understanding of the module that I will be teaching during this school year.	◯	◯	◯	◯
b. I am well prepared to teach using the backwards faded scaffolding approach.	◯	◯	◯	◯

10. Please indicate your opinion about each of the following statements. (Darken one circle on each line.)

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't Know
a. I have the planning time needed to prepare for science lesson investigations using the tools, strategies, and information presented in this workshop.	◯	◯	◯	◯	◯
b. I have the instructional time in science needed to implement investigations as they were modeled in this workshop.	◯	◯	◯	◯	◯
c. I have the materials/equipment needed to implement investigations as they were modeled in this workshop.	◯	◯	◯	◯	◯
d. My principal supports the science teaching approaches and strategies presented in this workshop.	◯	◯	◯	◯	◯

The project plans to use teacher feedback to continue to improve the workshop design. Please be candid in your responses to questions 11 through 13. (*Please avoid writing in the markings at the side and top of the page.*)

11. Overall, what aspects of the workshop did you find particularly useful and why?

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[QID]

(***Please avoid writing in the markings at the side and top of the page.***)

12. What aspects of the workshop would you change and why?

13. What remaining concerns do you have about using cyber-enabled technology to support students' learning in science?

About You

14. Are you: (Darken one circle.)

- ◯ Male
- ◯ Female

15. Race/Ethnicity - Are you: (Darken all that apply.)

- ◯ American Indian or Alaskan Native
- ◯ Asian
- ◯ Black or African-American
- ◯ Hispanic or Latino
- ◯ Native Hawaiian or Pacific Islander
- ◯ White

16. How many years have you taught in any grade K-12, regardless of the subject? (Please enter your answer in the spaces provided, then darken the corresponding oval in each column. Enter your response as a 2-digit number; e.g., if 7 years, enter as 07.)

0	0
1	1
2	2
3	3
4	4
5	5
	6
	7
	8
	9

17. How many years have you taught science in any grade K-12? (Please enter your answer in the spaces provided, then darken the corresponding oval in each column. Enter your response as a 2-digit number; e.g., if 7 years, enter as 07.)

0	0
1	1
2	2
3	3
4	4
5	5
	6
	7
	8
	9

PLEASE DO NOT WRITE IN THIS AREA

[QID]

18. In which of the following fields have you been awarded one or more bachelor's and/or graduate degrees? (For bachelor's degrees, count only areas in which you majored.) (Darken all that apply.)

Education

- ◯ Elementary Education
- ◯ Mathematics Education
- ◯ Science Education
- ◯ Other Education

Natural Sciences/Engineering

- ◯ Biology/Life Science
- ◯ Chemistry
- ◯ Earth/Space Science
- ◯ Engineering
- ◯ Environmental Science
- ◯ Physics
- ◯ Other natural science, please specify: ____________________

Other

- ◯ Please specify: ____________________

Thank You

Integrating Scientific Inquiry and Technology Workshop: Teacher Questionnaire

Instructions: This survey is part of the evaluation of the Cyber-enabled Learning project; your feedback is very valuable. Please know that your identity will be kept strictly confidential; no names or identifying information will be shared, so please be candid.

Please complete this form using a #2 pencil or a blue or black ink pen. Darken circles completely, but do not stray into adjacent circles. Erase completely or white out any stray marks.

Place Label Here

1. Please indicate your opinion about each of the following statements regarding this workshop. (Darken one circle on each line.)

	Strongly Disagree	Disagree	Agree	Strongly Agree
a. The goals of this workshop were clear.	◯	◯	◯	◯
b. This workshop reflected careful planning and organization.	◯	◯	◯	◯
c. The facilitators were well prepared.	◯	◯	◯	◯
d. Adequate time, structure, and guidance were provided for participants to reflect on the substance of this workshop.	◯	◯	◯	◯
e. The views and concerns expressed by participants were valued by the leaders of the workshop.	◯	◯	◯	◯
f. Questions that arose were adequately addressed by the facilitators.	◯	◯	◯	◯
g. The facilitators encouraged active participation and investigation by all participants.	◯	◯	◯	◯
h. This workshop provided adequate attention to science content.	◯	◯	◯	◯
i. This workshop was relevant to my classroom instruction.	◯	◯	◯	◯
j. This workshop was worth the time that I invested.	◯	◯	◯	◯
k. I would recommend this workshop to a colleague.	◯	◯	◯	◯

2. The pace of this workshop was: (Darken one circle.)

- ◯ Much too slow
- ◯ Somewhat too slow
- ◯ Appropriate
- ◯ Somewhat too fast
- ◯ Much too fast

PLEASE DO NOT WRITE IN THIS AREA

[QID]

3. We recognize that people start at different places and will take different things away from any workshop. Please indicate your **level of understanding** of each of the following aspects both *prior to* and *at the conclusion of* this workshop. In the *left-hand column*, please rate your **Understanding Prior to this Workshop**. In the *right-hand column*, please rate your **Understanding Now**. (Darken one circle in each column on each line.)

	Prior to this Workshop				Now			
	No Under-standing	Some Under-standing	Good Under-standing	Strong Under-standing	No Under-standing	Some Under-standing	Good Under-standing	Strong Under-standing
a. Human influence on the capacity of an environment to sustain living	○	○	○	○	○	○	○	○
b. How human influence in an environment impacts the diversity of organisms in that environment	○	○	○	○	○	○	○	○
c. How human influence in an environment impacts ____________________________	○	○	○	○	○	○	○	○

4. Please indicate your **level of preparedness** in each of the following areas both *prior to* and *at the conclusion of* this workshop. In the *left-hand column*, please rate your **Preparedness Prior to this Workshop**. In the *right-hand column*, please rate your **Preparedness Now**. (Darken one circle in each column on each line.)

	Prior to this Workshop				Now			
	Not at all Prepared	Some-what Prepared	Moderately well Prepared	Very well Prepared	Not at all Prepared	Some-what Prepared	Moderately well Prepared	Very well Prepared
a. Ask/identify a scientific research question	○	○	○	○	○	○	○	○
b. Generate data to explore a scientific research question	○	○	○	○	○	○	○	○
c. Locate information relevant to a scientific research question	○	○	○	○	○	○	○	○
d. Evaluate the usefulness of data being collected about a scientific research question/problem	○	○	○	○	○	○	○	○
e. Manage information relevant to the scientific research question problem being investigated	○	○	○	○	○	○	○	○
f. Analyze/synthesize data	○	○	○	○	○	○	○	○
g. Formulate evidence-based explanations to address scientific research questions	○	○	○	○	○	○	○	○
h. Evaluate explanations in light of alternative evidence or explanations	○	○	○	○	○	○	○	○
i. Justify proposed explanations	○	○	○	○	○	○	○	○
j. Communicate and share research findings with others	○	○	○	○	○	○	○	○

5. Please indicate your level of preparedness to use **Information Communication Technologies** to support ***your own* science learning** in each of the following areas. (Darken one circle on each line.)

	Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
a. Ask/identify a scientific research question	○	○	○	○
b. Generate data to explore a scientific research question	○	○	○	○
c. Locate information relevant to a scientific research question	○	○	○	○
d. Evaluate the usefulness of data being collected about a scientific research question/problem	○	○	○	○
e. Manage information relevant to the scientific research question/ problem being investigated	○	○	○	○
f. Analyze/synthesize data	○	○	○	○
g. Formulate evidence-based explanations to address scientific research questions	○	○	○	○
h. Evaluate explanations in light of alternative evidence or explanations	○	○	○	○
i. Justify proposed explanations	○	○	○	○
j. Communicate and share research findings with others	○	○	○	○
k. Perform core computer networking tasks (e.g., create folders, manage files, use web browsers)	○	○	○	○
l. Perform word processing tasks	○	○	○	○
m. Create spreadsheets and databases	○	○	○	○
n. Create presentations (e.g., using Google Docs)	○	○	○	○

6. Please indicate your level of preparedness to use **Information Communication Technologies** to support ***your students'* science learning** in each of the following areas. (Darken one circle on each line.)

	Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
a. Ask/identify a scientific research question	○	○	○	○
b. Generate data to explore a scientific research question	○	○	○	○
c. Locate information relevant to a scientific research question	○	○	○	○
d. Evaluate the usefulness of data being collected about a scientific research question/problem	○	○	○	○
e. Manage information relevant to the scientific research question/ problem being investigated	○	○	○	○
f. Analyze/synthesize data	○	○	○	○
g. Formulate evidence-based explanations to address scientific research questions	○	○	○	○

Question 6 continues on the next page...

PLEASE DO NOT WRITE IN THIS AREA

[QID]

6. *(continued)*

	Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
h. Evaluate explanations in light of alternative evidence or explanations	◯	◯	◯	◯
i. Justify proposed explanations	◯	◯	◯	◯
j. Communicate and share research findings with others	◯	◯	◯	◯
k. Perform core computer networking tasks (e.g., create folders, manage files, use web browsers)	◯	◯	◯	◯
l. Perform word processing tasks.	◯	◯	◯	◯
m. Create spreadsheets and databases	◯	◯	◯	◯
n. Create presentations (e.g., using Google docs)	◯	◯	◯	◯

7. Please indicate your level of preparedness to do the following. (Darken one circle on each line.)

	Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
a. Create and share documents/data using Google Docs	◯	◯	◯	◯
b. Create websites using Google Sites	◯	◯	◯	◯
c. Use internet search engines to investigate a scientific research question	◯	◯	◯	◯
d. Use Picasa web albums to store and share pictures	◯	◯	◯	◯

8. Please indicate your level of preparedness to support **your students** to do the following. (Darken one circle on each line.)

	Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
a. Create and share documents/data using Google Docs	◯	◯	◯	◯
b. Create websites using Google Sites	◯	◯	◯	◯
c. Use internet search engines to investigate a scientific research question	◯	◯	◯	◯
d. Use Picasa web albums to store and share pictures	◯	◯	◯	◯

9. Please indicate your opinion about each of the following statements regarding this workshop. (Darken one circle on each line.)

	Strongly Disagree	Disagree	Agree	Strongly Agree
a. I have a good understanding of the module that I will be teaching during this school year.	◯	◯	◯	◯
b. I am well prepared to teach using the backwards faded scaffolding approach.	◯	◯	◯	◯

10. Please indicate your opinion about each of the following statements. (Darken one circle on each line.)

	Strongly Disagree	Disagree	Agree	Strongly Agree	Don't Know
a. I have the planning time needed to prepare for science lesson investigations using the tools, strategies, and information presented in this workshop.	○	○	○	○	○
b. I have the instructional time in science needed to implement investigations as they were modeled in this workshop.	○	○	○	○	○
c. I have the materials/equipment needed to implement investigations as they were modeled in this workshop.	○	○	○	○	○
d. My principal supports the science teaching approaches and strategies presented in this workshop.	○	○	○	○	○

The project plans to use teacher feedback to continue to improve the workshop design. Please be candid in your responses to questions 11 through 13. (*Please avoid writing in the markings at the side and top of the page.*)

11. Overall, what aspects of the workshop did you find particularly useful and why?

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[QID]

(***Please avoid writing in the markings at the side and top of the page.***)

12. What aspects of the workshop would you change and why?

13. What remaining concerns do you have about using cyber-enabled technology to support students' learning in science?

About You

14. Are you: (Darken one circle.)

- ◯ Male
- ◯ Female

15. Race/Ethnicity - Are you: (Darken all that apply.)

- ◯ American Indian or Alaskan Native
- ◯ Asian
- ◯ Black or African-American
- ◯ Hispanic or Latino
- ◯ Native Hawaiian or Pacific Islander
- ◯ White

16. How many years have you taught in any grade K-12, regardless of the subject? (Please enter your answer in the spaces provided, then darken the corresponding oval in each column. Enter your response as a 2-digit number; e.g., if 7 years, enter as 07.)

0	0
1	1
2	2
3	3
4	4
5	5
	6
	7
	8
	9

17. How many years have you taught science in any grade K-12? (Please enter your answer in the spaces provided, then darken the corresponding oval in each column. Enter your response as a 2-digit number; e.g., if 7 years, enter as 07.)

0	0
1	1
2	2
3	3
4	4
5	5
	6
	7
	8
	9

PLEASE DO NOT WRITE IN THIS AREA

[QID]

18. In which of the following fields have you been awarded one or more bachelor's and/or graduate degrees? (For bachelor's degrees, count only areas in which you majored.) (Darken all that apply.)

Education

- ◯ Elementary Education
- ◯ Mathematics Education
- ◯ Science Education
- ◯ Other Education

Natural Sciences/Engineering

- ◯ Biology/Life Science
- ◯ Chemistry
- ◯ Earth/Space Science
- ◯ Engineering
- ◯ Environmental Science
- ◯ Physics
- ◯ Other natural science, please specify: ______________________________

Other

- ◯ Please specify: ______________________________

Thank You

Appendix B

Post-Institute Questionnaire Responses

Number of valid questionnaires

	N
Total Participants	28

Q1

Please indicate your opinion about each of the following statements regarding this workshop.	Total		Strongly disagree	Disagree	Agree	Strongly agree
	Valid N	Missing N	Percent	Percent	Percent	Percent
Q1A: The goals of this workshop were clear.	28	0	0	0	32	68
Q1B: This workshop reflected careful planning and organization.	28	0	0	0	11	89
Q1C: The facilitators were well prepared.	28	0	0	0	11	89
Q1D: Adequate time, structure, and guidance were provided for participants to reflect on the substance of this workshop.	28	0	0	4	36	61
Q1E: The views and concerns expressed by participants were valued by the leaders of the workshop.	28	0	0	0	11	89
Q1F: Questions that arose were adequately addressed by the facilitators.	28	0	0	0	14	86
Q1G: The facilitators encouraged active participation and investigation by all participants.	28	0	0	0	4	96
Q1H: This workshop provided adequate attention to science content.	28	0	0	0	21	79
Q1I: This workshop was relevant to my classroom instruction.	28	0	0	0	11	89
Q1J: This workshop was worth the time that I invested.	28	0	0	0	18	82
Q1K: I would recommend this workshop to a colleague.	28	0	0	0	11	89

Q2

	Total		Much too slow	Somewhat too slow	Appropriate	Somewhat too fast	Much too fast
	Valid N	Missing N	Percent	Percent	Percent	Percent	Percent
Q2: The pace of this workshop was:	28	0	0	4	61	36	0

Q4 [Prior to Workshop]

Please indicate your level of preparedness in each of the following areas prior to this workshop.	Total		Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
	Valid N	Missing N	Percent	Percent	Percent	Percent
Q4A1 [Prior]: Ask/identify a scientific research question	28	0	0	18	54	29
Q4B1 [Prior]: Generate data to explore a scientific research question	28	0	0	18	57	25
Q4C1 [Prior]: Locate information relevant to a scientific research question	28	0	0	11	61	29
Q4D1 [Prior]: Evaluate the usefulness of data being collected about a scientific research question/problem	28	0	0	18	50	32
Q4E1 [Prior]: Manage information relevant to the scientific research question problem being investigated	27	1	0	33	41	26
Q4F1 [Prior]: Analyze/synthesize data	28	0	0	18	46	36
Q4G1 [Prior]: Formulate evidence-based explanations to address scientific research questions	28	0	0	21	57	21
Q4H1 [Prior]: Evaluate explanations in light of alternative evidence or explanations	28	0	0	18	68	14
Q4I1 [Prior]: Justify proposed explanations	27	1	0	15	59	26
Q4J1 [Prior]: Communicate and share research findings with others	28	0	0	25	46	29

Q4 [Now]

Please indicate your level of preparedness in each of the following areas at the conclusion of this workshop.	Total		Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
	Valid N	Missing N	Percent	Percent	Percent	Percent
Q4A2 [Now]: Ask/identify a scientific research question	28	0	0	0	21	79
Q4B2 [Now]: Generate data to explore a scientific research question	28	0	0	0	11	89
Q4C2 [Now]: Locate information relevant to a scientific research question	28	0	0	4	11	86
Q4D2 [Now]: Evaluate the usefulness of data being collected about a scientific research question/problem	28	0	0	0	11	89
Q4E2 [Now]: Manage information relevant to the scientific research question problem being investigated	28	0	0	0	32	68
Q4F2 [Now]: Analyze/synthesize data	28	0	0	0	14	86
Q4G2 [Now]: Formulate evidence-based explanations to address scientific research questions	28	0	0	0	25	75
Q4H2 [Now]: Evaluate explanations in light of alternative evidence or explanations	28	0	0	0	25	75
Q4I2 [Now]: Justify proposed explanations	27	1	0	0	26	74
Q4J2 [Now]: Communicate and share research findings with others	28	0	0	0	11	89

Q5

Please indicate your level of preparedness to use Information Communication Technologies to support your own science□.	Total		Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
	Valid N	Missing N	Percent	Percent	Percent	Percent
Q5A: Ask/identify a scientific research question	28	0	0	11	32	57
Q5B: Generate data to explore a scientific research question	28	0	0	4	43	54
Q5C: Locate information relevant to a scientific research question	28	0	0	0	39	61
Q5D: Evaluate the usefulness of data being collected about a scientific research question/problem	28	0	0	4	32	64
Q5E: Manage information relevant to the scientific research question/problem being investigated	28	0	0	7	36	57
Q5F: Analyze/synthesize data	27	1	0	7	22	70
Q5G: Formulate evidence-based explanations to address scientific research questions	28	0	0	7	25	68
Q5H: Evaluate explanations in light of alternative evidence or explanations	27	1	0	4	37	59
Q5I: Justify proposed explanations	27	1	0	7	41	52
Q5J: Communicate and share research findings with others	28	0	0	11	21	68
Q5K: Perform core computer networking tasks (e.g., create folders, manage files, use web browsers)	28	0	4	7	18	71
Q5L: Perform word processing tasks	28	0	0	4	14	82
Q5M: Create spreadsheets and databases	28	0	4	7	25	64
Q5N: Create presentations (e.g., using Google docs)	28	0	0	11	18	71

Q6

Please indicate your level of preparedness to use Information Communication Technologies to support your students' science learning in each o…	Total		Not at all prepared	Somewhat prepared	Moderately well prepared	Very well prepared
	Valid N	Missing N	Percent	Percent	Percent	Percent
Q6A: Ask/identify a scientific research question	28	0	4	18	32	46
Q6B: Generate data to explore a scientific research question	28	0	4	4	57	36
Q6C: Locate information relevant to a scientific research question	28	0	0	14	29	57
Q6D: Evaluate the usefulness of data being collected about a scientific research question/problem	28	0	0	14	36	50
Q6E: Manage information relevant to the scientific research question/problem being investigated	28	0	0	18	39	43
Q6F: Analyze/synthesize data	28	0	4	14	29	54
Q6G: Formulate evidence-based explanations to address scientific research questions	28	0	0	11	36	54
Q6H: Evaluate explanations in light of alternative evidence or explanations	28	0	0	18	46	36
Q6I: Justify proposed explanations	27	1	4	11	44	41
Q6J: Communicate and share research findings with others	28	0	4	11	39	46
Q6K: Perform core computer networking tasks (e.g., create folders, manage files, use web browsers)	27	1	4	15	26	56
Q6L: Perform word processing tasks.	28	0	0	14	14	71
Q6M: Create spreadsheets and databases	28	0	4	21	32	43
Q6N: Create presentations (e.g., using Google docs)	28	0	0	21	29	50

Q9

Please indicate your opinion about each of the following statements regarding this workshop.	Total		Strongly disagree	Disagree	Agree	Strongly agree
	Valid N	Missing N	Percent	Percent	Percent	Percent
Q9A: I have a good understanding of the module that I will be teaching during this school year.	28	0	0	0	29	71
Q9B: I am well prepared to teach using the backwards faded scaffolding approach.	28	0	0	0	46	54

Q10

Please indicate your opinion about each of the following statements.	Total		Strongly disagree	Disagree	Agree	Strongly agree
	Valid N	Missing N	Percent	Percent	Percent	Percent
Q10A: I have the planning time needed to prepare for science lesson investigations using the tools, strategies, and information presented in this workshop.	27	1	0	0	70	30
Q10B: I have the instructional time in science needed to implement investigations as they were modeled in this workshop.	25	3	0	8	40	52
Q10C: I have the materials/equipment needed to implement investigations as they were modeled in this workshop.	26	2	4	12	46	38
Q10D: My principal supports the science teaching approaches and strategies presented in this workshop.	22	6	0	0	32	68

Q14

	Total		Male	Female
	Valid N	Missing N	Percent	Percent
Q14: Are you:	28	0	29	71

Q15

	Total		No	Yes
Race/Ethnicity - Are you:	Valid N	Missing N	Percent	Percent
Q15A: American Indian or Alaskan Native	25	3	96	4
Q15B: Asian	25	3	88	12
Q15C: Black or African-American	25	3	76	24
Q15D: Hispanic or Latino	25	3	100	0
Q15E: Native Hawaiian or Pacific Islander	25	3	100	0
Q15F: White	25	3	36	64

Q16

Q16: How many years have you taught in any grade K-12, regardless of the subject?	Total	Valid N	28
		Missing N	0
	0	Percent	4
	1	Percent	4
	2	Percent	14
	3	Percent	7
	4	Percent	7
	5	Percent	7
	6	Percent	18
	7	Percent	7
	8	Percent	4
	9	Percent	7
	10	Percent	4
	12	Percent	4
	14	Percent	4
	15	Percent	4
	17	Percent	4
	18	Percent	4

Q16

	Valid N	Missing N	Minimum	Maximum	Mean	Standard Deviation
Q16: How many years have you taught in any grade K-12, regardless of the subject?	28	0	0	18	6.75	4.80

Q17

Q17: How many years have you taught science in any grade K-12?	Total	Valid N	28
		Missing N	0
	0	Percent	4
	1	Percent	7
	2	Percent	11
	3	Percent	11
	4	Percent	7
	5	Percent	11
	6	Percent	11
	7	Percent	7
	8	Percent	4
	9	Percent	7
	10	Percent	4
	12	Percent	4
	14	Percent	4
	15	Percent	4
	17	Percent	4
	18	Percent	4

Q17

	Valid N	Missing N	Minimum	Maximum	Mean	Standard Deviation
Q17: How many years have you taught science in any grade K-12?	28	0	0	18	6.57	4.90

Q18

In which of the following fields have you been awarded one or more bachelor's and/or graduate…	Total		No	Yes
	Valid N	Missing N	Percent	Percent
Q18AI: Elementary Education	25	3	92	8
Q18AII: Mathematics Education	25	3	100	0
Q18AIII: Science Education	25	3	28	72
Q18AIV: Other Education	25	3	84	16
Q18BI: Biology/Life Science	25	3	28	72
Q18BII: Chemistry	25	3	96	4
Q18BIII: Earth/Space Science	25	3	88	12
Q18BIV: Engineering	25	3	100	0
Q18BV: Environmental Science	25	3	100	0
Q18BVI: Physics	25	3	92	8
Q18BVII: Other natural science, please specify:	25	3	96	4
Q18C: Other, please specify:	25	3	80	20

Appendix C

Definitions of Composite Variables and Composite Reliabilities

Definitions of Composite Variables and Composite Reliabilities

To facilitate the reporting of large amounts of survey data, and because individual questionnaire items are potentially unreliable, groups of survey questions that measure similar ideas can be combined into "composites." Each composite represents an important construct related to formative assessment. Cronbach's Coefficient Alpha is a measure of the reliability of a composite (i.e., the extent to which the items appear to be measuring the same construct). A Cronbach's Alpha of 0.6 is considered acceptable, 0.7 fair, 0.8 good, and 0.9 excellent.

Each composite is calculated by summing the responses to the items associated with that composite and then dividing by the total points possible. In order for the composites to be on a 100-point scale, the lowest response option on each scale was set to 0. As a result, someone who marks the lowest point on every item in a composite receives a score of 0, and someone who marks the highest point on every item receives a score of 100. It also assures that 50 is the true mid-point. The denominator for each composite is determined by computing the maximum possible sum of responses for a series of items and dividing by 100; e.g., a nine-item composite where each item is on a scale of 0–4 would have a denominator of 0.36.

Table C-1
Composite: Utah Participants' Perceptions
of Understanding of Disciplinary Science Content

	Prior to the Workshop	After the Workshop
Human influence on the capacity of an environment to sustain living things	Q3a-p	Q3a-n
How human influence in an environment impacts the diversity of organisms in that environment	Q3b-p	Q3b-n
How human influence in an environment impacts the connectedness of living things in an environment	Q3c-p	Q3c-n
Number of Items in Composite	**3**	**3**
Reliability (Cronbach's Coefficient Alpha)	**0.68**	**0.58**

Table C-2
Composite: New York Participants' Perceptions
of Understanding of Disciplinary Science Content

	Prior to the Workshop	After the Workshop
The range of interrelationships of humans with the living and non-living environment	Q3a-p	Q3a-n
The impact of technological development and growth in the human population on the living and non-living environment	Q3b-p	Q3b-n
How individual choices and societal actions can contribute to improving the environment	Q3c-p	Q3c-n
Number of Items in Composite	**3**	**3**
Reliability (Cronbach's Coefficient Alpha)	**0.85**	**-0.30**

Table C-3
Composite: Perceptions of Preparedness to Engage in Practices Consistent with the Nature of Science

	Prior to the Workshop	After the Workshop
Ask/identify a scientific research question	Q4a-p	Q4a-n
Generate data to explore a scientific research question	Q4b-p	Q4b-n
Locate information relevant to a scientific research question	Q4c-p	Q4c-n
Evaluate the usefulness of data being collected about a scientific research question/problem	Q4d-p	Q4d-n
Manage information relevant to the scientific research question/ problem being investigated	Q4e-p	Q4e-n
Analyze/synthesize data	Q4f-p	Q4f-n
Formulate evidence-based explanations to address scientific research questions	Q4g-p	Q4g-n
Evaluate explanations in light of alternative evidence or explanations	Q4h-p	Q4h-n
Justify proposed explanations	Q4i-p	Q4i-n
Communicate and share research findings with others	Q4j-p	Q4j-n
Number of Items in Composite	**10**	**10**
Reliability (Cronbach's Coefficient Alpha)	**0.91**	**0.93**

Table C-4
Composite: Perceptions of Preparedness to Engage in Practices Consistent with the Nature of Science and Use ICTs to Support Their Own Science Learning

	Preparedness to Engage in Practices Consistent with the Nature of Science After the Workshop	Preparedness to Use ICTs to Support Their Own Science Learning Consistent with the Nature of Science
Ask/identify a scientific research question	Q4a-n	Q5a
Generate data to explore a scientific research question	Q4b-n	Q5b
Locate information relevant to a scientific research question	Q4c-n	Q5c
Evaluate the usefulness of data being collected about a scientific research question/problem	Q4d-n	Q5d
Manage information relevant to the scientific research question/ problem being investigated	Q4e-n	Q5e
Analyze/synthesize data	Q4f-n	Q5f
Formulate evidence-based explanations to address scientific research questions	Q4g-n	Q5g
Evaluate explanations in light of alternative evidence or explanations	Q4h-n	Q5h
Justify proposed explanations	Q4i-n	Q5i
Communicate and share research findings with others	Q4j-n	Q5j
Number of Items in Composite	**10**	**10**
Reliability (Cronbach's Coefficient Alpha)	**0.93**	**0.95**

Table C-5
Composite: Perceptions of Preparedness to Use ICTs to Support Their Own Science Learning and Their Students' Science Learning

	Preparedness to Use ICTs to Support Their *Own* Science Learning Consistent with the Nature of Science	**Preparedness to Use ICTs to Support Their *Students'* Science Learning Consistent with the Nature of Science**
Ask/identify a scientific research question	Q5a	Q6a
Generate data to explore a scientific research question	Q5b	Q6b
Locate information relevant to a scientific research question	Q5c	Q6c
Evaluate the usefulness of data being collected about a scientific research question/problem	Q5d	Q6d
Manage information relevant to the scientific research question/ problem being investigated	Q5e	Q6e
Analyze/synthesize data	Q5f	Q6f
Formulate evidence-based explanations to address scientific research questions	Q5g	Q6g
Evaluate explanations in light of alternative evidence or explanations	Q5h	Q6h
Justify proposed explanations	Q5i	Q6i
Communicate and share research findings with others	Q5j	Q6j
Number of Items in Composite	**10**	**10**
Reliability (Cronbach's Coefficient Alpha)	**0.95**	**0.96**