Annual Project Report for Award 1020086
Report Period - StartDate: 09-01-2010 | EndDate: 08-31-2011

Section: Participants

In this section you will be asked:

1. What people have worked on your project?

We ask PIs to provide basic information about each person who worked on the project – name, role on project, extent of time put in, and what the person has done on the project. (This information may be made publicly available.)

We then ask those in certain categories – from principal investigators to funded undergraduate assistants who worked many hours on the project and received compensation from the award – for a little more data about themselves. (This information will be held closely.) We ask for demographic data – relating to gender, ethnicity, race, disability, and citizenship, so that:

1. We can gauge whether our programs and other opportunities in science and technology are fairly reaching and benefiting everyone regardless of demographic category;
2. We can ensure that those in under-represented groups have the same knowledge of and access to programs, meetings, vacancies, and other research and educational opportunities as everyone else; and
3. We can assess involvement of international investigators or students in work we support.

Submission of demographic information is voluntary. You will suffer no adverse consequences if you fail to provide it, but we really need your information to help assure the statistical validity of our data. You can get more information about ways NSF will use this information.

Collection of this information is authorized by the NSF Act of 1950, as amended. You may also see our general Privacy Act and Public Burden Statements.

Methods for entering data

We prefer to get this data by having the person enter it directly. You can give a person direct access to the system for this purpose by letting the person use your terminal and showing her or him a link on one of the later screens. Alternatively, the person may access the same module independently via the World Wide Web. You just provide the person, by e-mail or by hand, an instruction sheet. (It includes the necessary URL.) A third alternative is available where neither of these methods is practicable. You can enter information for other participants.

(1) The table below summarizes information we have so far on persons involved with your project. Click by the appropriate name and then "Review/Revise" to review and revise the information on any person listed in the table. (You should altogether "Delete" the information on an individual only if it was entered in error or is a duplicate, not because the person's involvement in the project has ended.)

Participant's Name(s)	Project Role(s)	>160 Hours
David Campbell	Principal Investigator	Yes
Paul G. Wolf	CoPrincipal Investigator	Yes
Brett E. Shelton	CoPrincipal Investigator	Yes
Daniel Coster	CoPrincipal Investigator	Yes

2. What other organizations have been involved as partners?

Partner Organizations-What? Here you let NSF know about partner organizations outside your own institution – academic institutions, other nonprofits, industrial or commercial firms, state or local governments, schools or school systems, or whatever – that have been involved with your project. Partner organizations may provide financial or in-kind support, supply facilities or equipment, collaborate in the research, exchange personnel, or otherwise contribute. The screens will lead you through the obvious possibilities, but will also give you an opportunity to identify out-of-the-ordinary partnership arrangements and to describe any arrangement in a little more detail.

Partner Organizations-Why?- NSF cannot achieve its ambitious goals for the science and technology base of our country with its own resources alone. So we place strong emphasis on working in partnership with other public and private organizations engaged in science, engineering, and education and on encouraging partnerships among such organizations. We also seek partnerships across national boundaries, working with comparable organizations in other countries wherever mutually beneficial.

So we need to gauge and report our performance in promoting partnerships. We need to know about the partnerships in which our awardees have engaged and to what extent they have been effective.

We use a pre-established list of organizations to ensure consistency and to avoid both lost information and double counting where the same organization is identified by different names.

New York Institute of Technology

Information about Partnership

1) NYIT

2) Partner's Contribution to the project
   Collaborative research (organization's staff work with project staff on the project)

3) More detail on partner and contribution
   Our project is a collaborative project with the New York Institute of Technology (NYIT). NYIT project personnel collaborate as co-researchers on the project.

3. Have you had other collaborators or contacts?

*Other Collaborators-What & Why- Some significant collaborators or contacts within your institution may not be covered by "What **people** have worked on the project?" " Likewise, some significant collaborators or contacts outside your institution may not be covered under "What other **organizations** have been involved as partners?" Some of these collaborators or contacts may nonetheless be quite significant, and we thought you should have a place to report them.*

You might let NSF know about any significant:

collaborations with scientists, engineers, educators, or others within your own institution – especially interdepartmental or interdisciplinary collaborations; non-formal collaborations or contacts with scientists, engineers, educators, or others outside your institution; and non-formal collaborations or contacts with scientists, engineers, educators, or others outside the United States.
Many will have no such other collaborators or contacts to report. That's fine; just click the appropriate button and move on.

We have engaged with Concord Consortium on two occasions to learn more about their experiences with similar funded projects. We met in the fall with Stephen Bannasch of Concord Consortium to discuss his work with probeware and to explore how he is working to embed probeware output in web browsers. We have explored similar ways to feed live streaming data into our OpenSim platform, which will be a central focus as a 'learning with' technology in our first module of year two of our professional development.

We also engaged with Chad Downey, CEO of Concord Consortium, after he attended our OpenSim workshop at the National Science Teachers Association Research Dissemination Conference. Through these engagements, we were able to learn more about Chad's experiences with designing cyberlearning tools (e.g. how to balance the amount of decision making participants have as they engage). His guidance, vetted in his experiences, has begun to shape decisions we are making as we develop the student interface of OpenSim in our module.

Horizon Research Inc. (HRI) is serving as our External Evaluator. HRI has served in a collaborative capacity by providing formative feedback through bi-monthly meetings and attending the advisory panel meetings. Dr. Joan Pasley is an experienced science educator whose input has helped us continually ensure that our project objectives are central in all decisions made. This comes both as she has asked us to continually connect project goals to outputs and as she has provided considerations for enhancing the connections between project outputs (e.g. PD Model) and project objectives. A report from HRI is attached to this report in the Appendix.

In addition, to our collaborations with Concord Consortium and Horizon Research Inc., we have also gained significantly from feedback/guidance received from our Advisory Panel. A report of our interactions is in the Appendix, but a brief list of the panel members is provided here along with the expertise they are able to bring to our project in their role as advisory panel members:

Dr. Kent Crippen-Science Education and Technology Faculty Member at the University of Nevada Las Vegas
Dr. Tom Reeves-Instructional Technology Faculty Member at the University of Georgia
Dr. Shelley Phelan-Biology Faculty Member at Fairfield University
Ms. Susan Brustein-Assistant Principal of Supervision, Math Science and Technology Townsend Harris High School at Queens College, NYCDOE

Section: Activities and Findings

This section will serve as your report to your program officer of your project's activities and findings. Please describe what you have done and what you have learned, broken down into four categories:

1. Describe the major research and education activities of the project.
   Project Activities-What? Please reiterate the goals and objectives of your efforts, and summarize the research and education activities you have engaged in that aim to achieve these objectives. Include experiments you have conducted, the simulations you have run, the collecting you have done, the observations you have made, the materials you have developed, and major presentations you have made about your efforts. In a later section you will list more formally any publications and other specific products (database, collections, software, inventions, etc.) that have resulted.
   Project Activities and Findings-Why? What you tell us under "project activities" and "project findings" will inform your program officer who will be reviewing for satisfactory progress from year to year and then assessing the results from this award once it is completed. What you tell us here also lays the foundation for your subsequent description of specific products (publications, collections, software, etc.) and broader contributions.

   The overarching goal of the project is to determine whether teacher professional development and support for the use of cyber-enabled resources lead to meaningful student learning experiences, a reduction in gaps between informal and formal learning and improved student outcomes.

This is year one of our project). The following was outlined as targeted research and education activities in Phase I in our funded proposal:

"During Phase I (Year 1), a teacher leadership team will be established, consisting of six district-selected science teachers (3 each from the NYIT and USU sites), who will collaborate with the project leadership team to identify existing cyber-enabled learning resources and supporting ICTs to be tested and coordinated for delivery. At the same time, recruitment of participant teachers from one school district in NY and two in UT (comprising Cohorts 1& 2) will be finalized so that baseline data can be collected. Each Cohort will include 15 UT and 15 NY teachers, with priority given to teams of three or more teachers from the same school . . . Teachers in Cohort 2 will be matched with teachers in Cohort 1 to serve as a delayed-treatment comparison group and baseline data will be collected on both Cohorts. Baseline data will include demographics, quantitative and qualitative descriptions of current teaching practice and use of cyber-enabled learning resources in instruction, assumptions teachers have about the way students learn and their use of cyber-enabled resources and tools, and what gaps exist between teacher use of cyber resources in formal and informal settings . . . Additionally, time will be spent during Phase 1 developing and finalizing all assessments that will be used in the research.

The external evaluator will review the set of activities and baseline data before the PD begins. The external evaluator will be given the criteria used for selecting each of the three outcomes for Phase I and asked to evaluate the effectiveness of each component based on provided criteria."

Soon after receiving funding on September 1, 2010 teacher leadership teams were established both in New York and in Utah. The teacher leadership team in UT consists of three 8th grade science teachers, two school district science coordinators, and one former 8th grade science teacher who now serves as the district technology coordinator. And, the teacher leadership team in NY consists of three 8th grade science teachers. These groups have met regularly, usually monthly for whole day work sessions. During these meetings, the teacher leadership team assisted in identifying state standards/core curriculum content that, along with science as inquiry pedagogical and ICTs and new literacies targets, served as the focus of the first two modules that are being developed. These modules will serve as the focal point for the summer and winter professional development before they are enacted in teachers' classrooms as they complete the first year of professional development. To date, module development at both sites continues. Initial piloting of module drafts has occurred in teacher leaders' classes in NY and are planned for mid-May in a teacher leaders' class in UT.

In addition to module development, recruitment of participant teachers has begun with all Cohort I teachers identified in both UT and NY and many of the Cohort II teachers identified. It is expected that all Cohort I & II teachers will be identified at both sites by the end of May.

With respect to research activities, all quantitative project instruments have been identified and piloted with apr. 200 students and apr. 45 8^{th} grade science teachers. Based in student and teacher feedback and statistical analyses of these piloted instruments, the student and teacher instruments have now been finalized. The findings for the piloted instruments are reported in the next section. Also, plans are in place so that baseline data will be collected from participants in Cohort I & II by the end of May 2011 prior to the start of Phase II.

In addition to the survey instruments that have been piloted, we are employing observation protocols of teacher practice in classrooms. To date, we have completed training for external classroom observers and established initial inter-rater agreement for the raters for the protocols being used. Classroom observations for Cohort I baseline data is now underway and are expected to be completed prior to the end of the 2010-2011 academic year.

Collectively, we believe the instruments and the classroom observation protocols will allow us to measure current teaching practice and use of cyber-enabled learning resources in instruction, assumptions teachers have about the way students learn and their use of cyber-enabled resources and tools, and what gaps exist between teacher use of cyber resources in formal and informal settings. More about each of these instruments, including the constructs measured within each are outlined in the research findings section of the report.

Finally, the external evaluator, Dr. Joan Pasley from Horizon Research Inc., has met with us bi-monthly to review all instruments and observation protocols and has offered initial input on professional development and curriculum modules as well as the qualitative research design. A report from HRI as well as our PI responses is included as attachments to this report in the Appendix.

Based on these targets and our work completed to date, we feel that we are on track to complete Phase I as planned so that we can enter Phase II starting in the summer of 2011 with Professional Development for our Cohort I teacher participants.

In addition, to what has been reported here, we are also including the report we submitted to our Advisory Panel prior to our March 24^{th}, 2011 meeting that outlines even more specifics regarding activities research and education activities we completed this year, the Advisory Panel Report and our PI responses to their report. All of these are included as attachments in the Appendix.

2. Describe the major findings resulting from these activities.

   Project Findings-What? Please summarize the conclusions that have emerged *from your activities. Later screens will invite you to identify publications and other concrete products (collections, databases, software, inventions, and so on) and to explain the significance and implications of both findings and products for your field, for other fields, and even beyond science and engineering.*

If you have no findings to report, at least for now, please click the corresponding button. We anticipate that as the project progresses your emphasis in reporting will shift from activities to findings and products, and ultimately to contributions.

Project Activities and Findings-Why? What you tell us under "project activities" and "project findings" will inform your program officer who will be reviewing for satisfactory progress from year to year and then assessing the results from this award once it is completed. What you tell us here also lays the foundation for your subsequent description of specific products (publications, collections, software, etc.) and broader contributions.

Because we are in Phase I of our project, the major findings resulting from our activities are related to instrument development and the establishment of inter-rater agreement for all classroom raters who are currently completing baseline classroom observations for Cohort I participant teachers. The findings from our instrumentation pilots with students and teachers are reported first, followed by the findings from our inter-rater agreement training with our classroom raters.

Instrumentation Development, Pilot Results, and Finalized Instruments

As outlined in our proposal, the following research questions guide the research design of our project [*Instrumentation Intended to Quantitatively Measure Research Questions are Bracketed in Each Question*]:

1. To what extent does professional development (PD) focused on cyber-enabled cognitive tools and scientific inquiry as a central pedagogical approach support teachers' practice and development [*Reformed Teaching Observation Protocol, Technology Use in Science Instruction, Technology Integration Checklist-Classroom Observation Protocols & Teaching Science as Inquiry, ICT Capabilities-Teacher, Formal/Informal Technology Usage-Teacher, Teacher New Literacies Scenarios-Self Reporting Surveys*] and close the gap between formal and informal student cyber-enabled learning [*Formal/Informal Technology Usage-Student*]?

2. To what degree does closer alignment between informal and formal use of cyber-enabled technologies [*Formal/Informal Technology Usage-Teacher & Student-Self Reporting Surveys*] influence student attitudes about science [*Students' Motivation Toward Learning Science (SMTLS)- Self Reporting Surveys*]?

3. To what degree does closer alignment between informal and formal use of cyber-enabled technologies [*Formal/Informal Technology Usage-Teacher & Student-Self Reporting Surveys*] influence student science achievement [*UT & NY State Standardized Assessments*]?

4. How does the use of cyber-enabled technologies [*Technology Integration Checklist-Classroom Observation Protocol & ICT Capabilities-Teacher & Student, Formal/Informal Technology Usage-Teacher, Teacher & Student New Literacies Scenarios-Self Reporting Surveys*] influence student access to significant and relevant science process skills and content knowledge [*Reformed Teaching Observation Protocol, Technology Use in Science Instruction-Classroom Observation Protocols & Teaching Science as Inquiry-Self Reporting Survey & UT & NY State Standardized Assessments*]?

5. How does the use of cyber-enabled technologies [*Technology Integration Checklist-Classroom Observation Protocol & ICT Capabilities-Teacher & Student, Formal/Informal Technology Usage-Teacher, Teacher & Student New Literacies Scenarios-Self Reporting Surveys*] influence students' new literacy skills [*Student New Literacies Scenarios-Self Reporting Survey*]?

In addition to these quantitative measures, qualitative methodologies are providing additional rich description and understandings about each of these research questions. Additional development will occur during the summer of 2011 to create assessment rubrics for student artifacts systematically collected over two-year periods as part of their scientific inquiries, so that additional richer measures are available to understand students' science process skills and content knowledge targeted in research questions 4 and 5.

In summary, aligned to the research questions, the following teacher and student instruments are needed and have been piloted:

<u>Teacher Instruments</u>

- *ICT Capabilities-Teacher* (developed by selecting items from pre-existing surveys created by Markauskaite, 2007)
- *Formal/Informal Technology Usage-Teacher* (designed based on several surveys developed by the Pew Research Center: (a) Teens and Mobile Phone, (b) Social Media & Mobile Internet Use Among Teens and Young Adults, (c) Generations Online in 2009)
- *Teacher New Literacies Scenarios* (designed based on the instrument developed by ETS (Educational Testing Service): ICT Literacy Assessment, and British National ICT assessment tasks)
- *Teaching Science as Inquiry* (Smolleck & Yoder, 2008)

<u>Student Instruments</u>

- *ICT Capabilities-Student* (developed by selecting items from pre-existing surveys created by Markauskaite, 2007)
- *Formal/Informal Technology Usage-Student* (designed based on several surveys developed by the Pew Research Center: (a) Teens and Mobile Phone, (b) Social Media & Mobile Internet Use Among Teens and Young Adults, (c) Generations Online in 2009)
- *Student New Literacies Scenarios* (designed based on the instrument developed by ETS (Educational Testing Service): ICT Literacy Assessment, and British National ICT assessment tasks)
- *Students' Motivation Toward Learning Science* (Tuana, Chin, & Shieh, 2005)

Classroom Observation Protocols & Checklist

- *Reformed Teaching Observation Protocol* (Piburn *et al*., 2000)
- *Technology Use in Science Instruction* (Campbell & Abd-Hamid, in progress)
- *Technology Integration Checklist* (designed by Wang & Hsu (NYIT PI & CoPI) based on New Literacies Scenarios framework/constructs, ICT Capabilities instrument, and Formal/Informal Technology Usage surveys as a triangulating inventory)

In addition to the overall measures targeted with each teacher and student instrument, each of the piloted instruments has 4-5 sub-constructs to ensure that a deeper understanding of each measure emerges throughout the research.

Validity of each item and subsequent construct was initially established by drawing items for each instrument from previously developed instruments, which for the most part clustered the constructs within the instruments in the same or a very similar fashion. In addition to past reliability work completed with many of the instruments (e.g. Teaching Science as Inquiry (Smolleck & Yoder, 2008), Students Motivation to Learn Science (Tuana, Chin, & Shieh, 2005)), reliability for each instrument as it assembled for use in this project was established through instrument piloting. The student instruments were piloted with 189 8th grade students in UT and the teacher instruments were piloted with 44 8th grade science teachers in UT and NY. As the teacher and student instruments were piloted, additional questionnaires were used to allow students and teachers to share any concerns or confusion caused by any portion of the instruments. In finalizing the instruments, target correlations for each item in each instrument for the respective construct to which it belonged was (> 0.4) and target Cronbach's alphas for each construct within each instrument were at least (> 0.7) and ideally over (> 0.8). As can be seen in Tables 1-8 included in the Appendix, almost all of the constructs within each teacher and student instrument had good (> 0.7) internal reliability (Cronbach's alpha) and most have very good reliability (> 0.8).

Only two instances were found within the student instrument pilot (n=189) whereby constructs within an instrument had a Cronbach's alpha below 0.7. These occurred within the *Formal/Informal Technology Usage* instrument for the social networking and the entertainment construct. We were pleased to see items gathering under one construct in this in the analysis. Because of the prevalence of social networking and entertainment technology in society and gathering this under different constructs was not thought beneficial in this specific case, the team decided to leave these as a separate constructs, but to ensure the lower Cronbach's alpha for these scales were transparently revealed in all findings. Additionally, with all instruments as a standard quality practice, these same reliabilities will be calculated and transparently revealed as all additional data collected is analyzed and reported.

When considering the teacher instruments, generally these instruments were similar to the student instruments. In these instruments, in all instruments, except the *Formal/Informal Technology Usage-Teacher,* all but one construct met our target criteria (> 0.7 Cronbach's alpha) and again most have very good reliability (> 0.8). The one construct that fell below the target (> 0.7 Chronbach's alpha) was the Communication and Metacognition construct in the *ICT Capabilities* instrument (0.62). The team made a decision to retain all items for this construct and the construct, with the belief that a larger sample size over time (> n = 44) will likely demonstrate a more reliable measure for this construct. In the *Formal/Informal Technology Usage-Teacher* instrument, like the student version of this instrument piloted, the social networking and entertainment constructs were below our target. Additionally, in the teacher version, the collaboration construct also fell below this target. Because of a desire to retain comparable instruments across the student and teacher populations and recognizing that our teacher sample was lower in comparison to the student sample, the team decided to retain all items informing these three constructs to ensure that all construct reliabilities would be determined in future use. There is an expectation that the teacher and student measures will be even more similar as our teacher population rises when additional cohorts are included as planned in the project.

In the end, a few items were removed from the teacher and student instruments based on either feedback from pilot participants or correlations of the items within their intended constructs. Based on these adjustments and the findings revealed in Tables 1-8 in the Appendix, the instruments are now finalized so that baseline data will be collected prior to the start of Phase II of the project.

Inter-rater Agreement with Classroom Raters

In addition to piloting the teacher and student instrument, inter-rater agreement was established for four raters, two in NY and two in UT. The individuals recruited as classroom raters are uniquely qualified for this position. Two are licensed science teachers, one is a student teacher supervisor for science teachers, and the other is a Ph.D. in science education. These four raters each completed a day-long training session where they were familiarized with the observations protocols (*Reformed Teaching Observation Protocol (RTOP)*, *Technology Use in Science Instruction (TUSI)*, and the *Technology Integration Checklist*). Additionally, inter-rater agreement was established between each rater and expert scores at a level of (> 0.7) agreement for three videos for the *RTOP* and the *TUSI*. Because the *Technology Integration Checklist* is a checklist for cataloging what technologies are being used only, no inter-rater agreement was completed for the checklist, but time was spent familiarizing raters with each section of this inventory.

Based on the findings revealed here, the project leaders feel confident in the measures that will be used in collecting baseline data by the end of May 2011, as well as the abilities of the classroom raters who are currently collecting baseline classroom observation data for Cohort I.

References (Instruments either used or foundational to the instruments developed)

Campbell T. & Abd-Hamid, N. (in progress). *Technology Use in the Science Instruction (TUSI): Aligning the Integrating of Technology in Science Instruction in Ways Supportive of Science Education Reform*.

Johes, S. & Fox, S. (2009, Jan.). *Generations online in 2009. Pew Research Interenet & American Life Project*. Retrieved from Pew Internet website: http://pewinternet.org/Reports/2009/Generations-Online-in-2009.aspx

International ICT Literacy Panel. (2009).*Digital transformation: A framework for ICT literacy*. Retrieved from Educational Testing Service website: http://www.ets.org/Media/Tests/Information_and_Communication_Technology_Literacy/ictreport.pdf

Lenhart, A., Ling, R., Campbell, S., & Purcell, K. (2010, April). *Teens and mobile phones. Pew Research Interenet & American Life Project*. Retrieved from Pew Internet website: http://pewinternet.org/~/media//Files/Reports/2010/PIP-Teens-and-Mobile-2010-with-topline.pdf

Lenhart, A., Purcell, K., Smith A., & Zickuhr, K. (2010, Feb.). *Social media & mobile Internet use among teens and young adults. Pew Research Interenet & American Life Project*. Retrieved from Pew Internet website: http://pewinternet.org/~/media//Files/Reports/2010/PIP_Social_Media_and_Young_Adults_Report_Final_with_toplines.pdf

Markauskaite, L. (2007). Exploring the structure of trainee teachers' ICT literacy: the main components of, and relationships between, general cognitive and technical capabilities. *Educational Technology Research & Development*, 55 (6), 547-572.

Piburn, M., Sawada, D., Falconer, K., Turley, J. Benford, R., & Bloom, I. (2000). Reformed Teaching Observation Protocol (RTOP). ACEPT IN-003.

Qualifications and Curriculum Development Agency. (2010*). Key stage 3 ICT onscreen assessment tasks*. Retrieved from Qualifications and Curriculum Development Agency website: http://www.qcda.gov.uk/assessment/6555.aspx

Smolleck, L., & Yoder, E. (2008). Further development and validation of the teaching science as inquiry (TSI) instrument. *School Science & Mathematics*, 108, 291–297.

Tuana, H., Chin, C., & Shieh, S. (2005). The development of a questionnaire to measure students' motivation towards science learning. *International Journal of Science Education*, 27(6), 639–654.

3. Describe the opportunities for training, development and mentoring provided by your project.

Training and Development-What? Please summarize the contributions to the research and teaching skills and experience of those who have worked on the project, including undergraduate students, graduate students, post-docs, college faculty, and K-12 teachers. If your project supported postdoctoral researchers then you must include a summary of the mentoring activities conducted.

Training and Outreach-Why?-Support for basic research in an education-rich environment characterizes the American research endeavor and distinguishes it from that in many other countries. NSF supports such research in part to attract young people to, and prepare them for, careers in science, mathematics, and engineering. Education in science, math, engineering, and technology for those who will not be making careers in science or technology, plus broad public exposure to those fields, are also part of NSF's purpose. Finally, integration of research and education is one of NSF's core strategies, for when research and education are effectively integrated, the cost of both is often reduced; and new scientific and engineering knowledge and techniques are more quickly and effectively communicated.

NSF therefore needs to learn how those we support are pursuing these ends. Moreover, we evaluate projects in significant part on the basis of results achieved in research training, education and public outreach. So we ask you to describe for those who will be reviewing your project – both the NSF program officer reviewing for satisfactory progress and, later on, reviewers assessing the results *from past NSF support – what you have accomplished in these areas. These descriptions also lay a base from which you can later identify, both specific educational products (textbooks, courseware, and so on) that have come out of your project and broader educational contributions that resulted.*

Because we are in the early developmental phase of the project training, development and mentoring offered to date is limited. The expertise of the project leaders was leveraged as teacher leaders from districts in NY and UT were trained with the *Reformed Teaching Observation Protocol*. This was done in initial meetings with teacher leaders at each site to create stronger coherence between leadership team members with respect to reformed teacher and specifically focused on teaching science as inquiry. This occurred at one early session at each site was spent with all teacher leaders rating and discussing RTOP videos found at the online RTOP website (http://physicsed.buffalostate.edu/AZTEC/RTOP/RTOP_full/).

In addition to the teacher leader RTOP training, a workshop was offered by two project leaders (Aaron Duffey, Biology Research Assistant, and Todd Campbell, Principal Investigator) at the National Science Teachers Associations Research Dissemination Conference in San Francisco, CA. in March 2011. Two, 90 minute workshop sessions, allowed the leaders time to engage researchers, national school district leaders, and science teachers in an OpenSim 3-D environment simulation that focused on learning science 'with' technology as envisioned and outlined in the project proposal.

Finally, as part of contributing to training and development of peer researchers nationally and internationally, the PI and Co-PIs made several presentations stemming from the project at national conferences. The following are a list of all presentations that were made:

Hsu, H.-Y. *New Literacies Definition and Framework* (2010, Oct). Panel discussion conducted at the 2010 World Conference on E-Learning in Corporate Government, Healthcare, & Higher Education, Orlando, FL.

Wang, S.-K. *ICTs Teachers use to Cultivate Students' New Literacies Skills* (2010, Oct). Panel discussion conducted at the 2010 World Conference on E-Learning in Corporate Government, Healthcare, & Higher Education, Orlando, FL.

Campbell T., Wang, S., & Hsu, H., *Cyber-enabled learning: Digital Natives in Integrated Scientific Inquiry Classrooms*. (2010, December) Presentation at the Annual 2010 National Science Foundation Discovery Research K-12 Principal Investigator Meeting. Washington, D.C.

*Duffy, A., Campbell, T., & Wolf, P. *The Virtual Populations Genetics (VPG)*

Simulation System: An Example of Learning 'With' Cyber-Enabled Technologies in Science Classrooms. (2011, March). Presentation at the 2011 National Science Teachers Association Research Dissemination Conference. San Francisco, California.

*Campbell, T., Duffy, A., & Wolf, P. *OpenSim as an example of Cyber-enabled Technologies for facilitating Science as Inquiry*. (2011, March). Presentation at the 2011 Cyberlearning Tools for STEM Education (CyTSE) conference. Berkeley, California.

**Signifies work completed with students.*

4. Describe outreach activities your project has undertaken.
   If in doubt about the category in which to report a particular result, please use the buttons. If still in doubt, report in whichever category seems to you closest.

   Outreach Activities-What? Please summarize any project activities that aimed to reach out to members of communities who are not usually aware of your activities, for the purpose of enhancing participation in science learning and careers in science, public understanding of science and technology, or the like. If you have nothing (yet) to report, please click the corresponding button.

   Later screens will invite you to identify any books or concrete products that have resulted from such activities and to say how the project has contributed beyond its own boundaries to education and development of human resources.

   Training and Outreach-Why?-Support for basic research in an education-rich environment characterizes the American research endeavor and distinguishes it from that in many other countries. NSF supports such research in part to attract young people to, and prepare them for, careers in science, mathematics, and engineering. Education in science, math, engineering, and technology for those who will not be making careers in science or technology, plus broad public exposure to those fields, are also part of NSF's purpose. Finally, integration of research and education is one of NSF's core strategies, for when research and education are effectively integrated, the cost of both is often reduced; and new scientific and engineering knowledge and techniques are more quickly and effectively communicated.

   NSF therefore needs to learn how those we support are pursuing these ends. Moreover, we evaluate projects in significant part on the basis of results achieved in research training, education and public outreach. So we ask you to describe for those who will be reviewing your project – both the NSF program officer reviewing for satisfactory progress and, later on, reviewers assessing the results from past NSF support – what you have accomplished in these areas. These descriptions also lay a base from which you can later identify, both specific *educational products (textbooks, courseware, and so on) that have come out of your project and broader educational contributions that resulted.*

Because we are in Phase I of our project, which is mainly focused on project development through activities such as module development, teacher participant recruitment, and research instrument development, we do not have outreach activities to report at this time, except for communications about our project through media releases that have arisen as recognition of our project award. The following NYIT Magazine report and article in the World Journal, the Largest Chinese Newspaper in North America:

http://www.nyit.edu/index.php/about_nyit/news-full/nyit_receives_1_million_grant_from_the_national_science_foundation/

Our project was featured by the World Journal, the largest Chinese newspaper in North America.
http://tinyurl.com/69p5xf4 (Chinese version)
http://tinyurl.com/3pk83lq (English version, this is translated by Google Translator and as such is not 100% accurate.)

Section: Publications and Products

In this section, you will be asked to describe the tangible products coming our of your project. Specifically:

1. What have you published as a result of your work?
    a. Journal publications

    *Campbell T., Wang, S., Hsu, H., Duffy, A., & Wolf, P. (2010, October). Learning with web tools, simulations, and other technologies in science classrooms. *Journal of Science Education and Technology*. 19(5), 505-511. First published online 13 April 2010. DOI 10.1007/s10956-010-9217-8.

    *represents work completed with students

    b. Books or other non-periodical, one-time publications

2. What Web site or other Internet site have you created?

    https://sites.google.com/site/cyberenabledlearning/
    This is the main project website. It was created as a portal to share our work and resources. In addition, it connects to the Community for Advancing Discovery Research in Education (CADRE) sites for both USU

(http://cadrek12.org/projects/cyber-enabled-learning-digital-natives-integrated-scientific-inquiry-classrooms-collaborati) and NYIT (http://cadrek12.org/projects/cyber-enabled-learning-digital-natives-integrated-scientific-inquiry-classrooms-collaborat-0?order=title&sort=asc).

3. What other specific products (databases, physical collections, educational aids, software, instruments, or the like) have you developed?

   None reported.

Section: Contributions

Now we invite you to explain ways in which your work, your findings, and specific products of your project are significant. Describe the unique contributions, major accomplishments, innovations and successes of your project relative to:

1. The principal discipline9s) of the project;

   Contributions within Discipline-What-Having summarized project activities and principal findings in one earlier section, and having listed publications and other specific products in another, here say how all those fit into and contribute to the base of knowledge, theory, and research and pedagogical methods in the principal disciplinary field(s) of the project.
   Please begin with a summary that an intelligent lay audience can understand (Scientific-American style). Then, if needed and appropriate, elaborate technically for those more knowledgeable in your field(s).
   How you define your field or discipline matters less to NSF than that you cover (here or under the next category – "Contributions to Other Disciplines") all contributions your work has made to science and engineering knowledge and technique. Make the most reasonable distinction you can. In general, by "field" or "discipline" we have in mind what corresponds with a single academic department or a single disciplinary NSF division rather than a subfield corresponding with an NSF program – physics rather than nuclear physics, mechanical engineering rather than tribology, and so forth. If you know the coverage of a corresponding NSF disciplinary division, we would welcome your using that coverage as a guide.

   Contributions within Discipline-Why-A primary function of NSF support for research and education – along with training of people – is to help build a base of knowledge, theory, and technique in the relevant fields. That base will be drawn on many times and far into the future, often in ways that cannot be specifically predicted, to meet the needs of the nation and of people. Most NSF-supported research and education projects should be producing contributions to the base of knowledge and technique in the immediately relevant field(s).

Based on the early work completed in Phase I (Year 1) of our project to date, we believe our manuscript published in the *Journal of Science Education and Technology*, allow us to provide a vision through a position statement that sets the stage for the development of a theoretical framework. Through our manuscript, we have proposed that teacher and student learning in science classrooms can be enhanced by tapping "the enormous potential of information communication and technologies (ICTs) as cognitive tools for engaging students in scientific inquiry" (Campbell et al., 2010). In this position statement, we outlined 1) the pervasive presence of technologies in the lives of students, 2) the lack of these same technologies in science classrooms, 3) the misalignment between calls for teaching science as inquiry in standards documents and the practices found inside science classrooms, and 4) the great potential benefits that can emerge as ICTs are tapped in science instruction framed by 'learning with' technologies to enhance teacher and student outcomes (i.e. teacher learning and instructional practices & student learning outcomes [science learning & new literacies development]).

In alignment with our position statement, we have begun to develop modules that will serve as learning anchors for teachers and students focused on these important teacher and student outcomes. Additionally, as revealed in our findings and activities reported, we have developed research instruments that will allow us to investigate the inter-play between teacher learning and instruction and student outcomes. We also see these instruments informing the further development of our 'learning with' technology theoretical framework as we adhere to principles of theory building outlined by Whetten's (1989) criteria, namely 1) identifying "what" constructs or concepts should be considered in explaining the phenomena, (2) exploring "how" the constructs or concepts in the theory are related, and (3) articulating "why" the constructs or concepts and relationships merit attention and interest in a broader context.

Reference
Whetten, D. A. (1989). What Constitutes a Theoretical Contribution? *The Academy of Management Review*, 14(4), 490-495. doi: 10.2307/258554.

2. Other disciplines of science or engineering;

Contributions to Other Discipline-What-Please identify any currently evident ways in which the project has contributed, or seems likely to contribute, to disciplines of science and engineering other than disciplines covered under "Contribution within Discipline".

Contributions to Other Discipline-Why- Many fields of science, and therefore many NSF programs and projects, contribute tools or underpinnings to other fields of science. (For example, a theoretical advance in physics may have applications in chemistry or mechanical engineering.) NSF does not routinely expect identifiable applications for other fields from individual projects. Still, *such applications often do arise (sometimes in ways completely unexpected when the project was initiated). They are often important results from NSF-funded projects. We want to know about them and report them, and to give credit for them where it is due.*

None Reported

3. The development of human resources;

Contributions to Human Resource Development-What-Describe how your project has contributed to human resource development in science, engineering, and technology by:

- *providing opportunities for research, teaching and mentoring in science and engineering areas;*
- *improving the performance, skills, or attitudes of members of underrepresented groups that will improve their access to or retention in research and teaching careers;*
- *developing and disseminating new educational materials or providing scholarships; or*
- *providing exposure to science and technology for pre-college teachers, young people, and other non-scientist members of the public.*

Contributions to Human Resource Development-Why- A major aim of NSF programs is to contribute to the human-resource base for science and technology, including the base of understanding among those who are not themselves scientists or engineers. A core NSF strategy is to encourage integration of research and education. NSF needs to know and be able to describe how the work we support actually furthers that aim and that strategy. Moreover, contributions of this sort are important in the evaluation of results from your project when we and reviewers are considering a new proposal.

In Phase I (Year 1) of the our project, we have been able to mentor numerous graduate students by providing them opportunities to engage in research and teaching science. The following are students who have been mentored this year:

<u>Utah State University</u>
Research Assistant: Atul Thapliyal – Computer Science/ITLS
Research Assistant: Yuanzhi Li-Quantitative Research Mathematics and Statistics
Research Assistant: Jeff Olsen –Qualitative Research/ITLS
Research Assistant: Jared Gee –Science Education

<u>New York Institute of Technology</u>
Research Assistant (Education): Edward Powers, John Gienau, Tammy Scandalis, Mary Connolly
Research Assistant (Biology): Anisha Thomas, Irshad Ally

4. The physical, institutional, or information resources that form the infrastructure for research and education; and

   Contributions to Resources for Research and Education-What-To the extent you have not already done so in describing project activities and products, please identify ways, if any, in which the project has contributed to resources for research and education used beyond your own group and immediate colleagues, by creating or upgrading:

   - *physical resources such as facilities, laboratories, instruments, or the like;*
   - *institutional resources for research and education (such as establishment or sustenance of societies or organizations); or*
   - *information resources, electronic means for accessing such resources or for scientific communication, or the like.*

   Contributions to Resources for Research and Education-Why-Physical, institutional, and information resources are important parts of the science and technology base that NSF seeks to sustain and build. Where particular projects build or sustain those resources for a broader community of scientists, engineers, technologists, and educators, that is a significant outcome which should be counted among the results that have come from federal support of science and engineering research and education. And you should get credit for those results. Some NSF projects serve this purpose in a direct and primary way and so might report the outputs in earlier sections. Many NSF projects do not serve it at all, and are not expected to. But many serve it in ways ancillary to their primary purposes and activities. This is the place to report such contributions.

   None Reported

5. Other aspects of public welfare beyond science and engineering, such as commercial technology, the economy, cost-efficient environmental protection, or solutions to social problems

   Contributions Beyond Science and Engineering-What-Please identify any currently evident ways in which the project has contributed to society, or seems likely to contribute, beyond the bounds of science and engineering as such. For example, the project may have contributed to the environment, commercial technology, public health or safety, economic or other policy, solution of social problems, or other aspects of the public welfare.

   Contributions Beyond Science and Engineering-Why-NSF expects that its broad programs will contribute to commercial technology, cost-effective environmental protection, solution of social problems, and other aspects of the public welfare by building our nation's science and technology base, which will then be drawn upon for all those purposes. NSF does not normally expect direct contributions of that *kind from individual projects. Nonetheless, not infrequently, individual projects, or a broader set of scientific or engineering results to which the individual project has identifiably contributed, do turn out to produce more or less direct applications to the broader public welfare. That is particularly common in fields that relate more immediately to technology and other economic or social applications – engineering and computer science being only the most obvious examples. When such contributions occur, NSF should certainly report to the public and its representatives these benefits that they realize from public support of science and engineering. And again, you should get credit for such results.*

None Reported

Section: Conference Proceedings

None Reported

Section: Special Requirements

A brief summary of the work to be performed during the next year of support if changed from the original proposal.

No changes from original proposal reported

Do special terms and conditions of your award require you to report any specific information that you have not yet reported?

None that I am aware of

Has there been any significant change in animal care and use, use of human subjects, or biohazards, from what has previously been approved?

No