Cyberlearning Awards
A Selection of Examples by Theme
(Note that each has development and research components)
December 4, 2012

1. Engaging young children in STEM

Horn, Michael, Northwestern
EXP: Augmenting household technologies for learning and whole-family participation: heating and cooling control as an exploratory case
2011

This team is building a hardware/software system designed to help families learn together about systems, energy, and natural resources, in the context of understanding how to manage heating and cooling in their homes; the big issue being addressed here is how to promote family-based learning of the science and how to help families come to recognize together the roles science plays in their lives and the roles it can play in personal and family decision making.

Moher, Thomas G., University of Illinois at Chicago
EXP: Using technologies to engage learners in scientific practices of investigating rich behavioral and ecological questions
2011

The PIs seek to learn how to bring "the field" into the classroom, in particular, to help elementary school students study natural phenomena (some distant) in a way that be engaging and allow sophisticated data collection and analysis. They focus, in this project, on the study of animal behavior and ecology in natural environments and investigate the affordances of several different technologies that can be used to instrument the outdoor environment so that it becomes accessible in the classroom (e.g., using camera traps to explore diversity, habitats, and food preferences, using RFID readers to follow the real-time movement and foraging of rabbits, using archived GPS data and video to investigate sociality of zebra herds in Africa).

Rubin, Andee and Koile, Kimberly, TERC and MIT
EAGER: Technology to support mathematical argumentation
2012

This EAGER proposal focuses on the first steps in helping youngsters learn mathematical/algebraic argumentation. The project has two complementary goals: to better define the technological tools needed to support elementary students learning about proof and argumentation and to understand better how elementary school students learn to make and defend mathematical claims when such tools are available. The PIs envision and are developing an animation tool to be implemented on tablet computers that provides infrastructure for sharing and refining arguments

in small groups and across the class and for promoting concrete math discussions. A big challenge is providing the right tools for expression; for sharing to happen, learners need to first be able to express their understanding, and much research shows that a concrete "written" (sharable) expression of understanding provides better foundations for promoting concrete discussion than do expressions of understanding that are simply verbal. The particular advance in expression that is being made in this project is providing tools for dynamic representations; that is, they are able to animate what happens when mathematical operations are carried out. These concrete expressions of understanding can then be played back, paused, and so on. Students create animations by drawing, erasing, duplicating, moving, and grouping objects. They can edit each others' animations, and the teacher will also be able to create animations for students to view and edit. They record and save their oral explanations along with the animations and play them back together, thus making their verbal descriptions concrete, examinable, and sharable.

2. Learning to use large-scale data to solve complex problems

Ahlqvist, Karl Ola, Ohio State
EXP: GeoGames -- A virtual simulation workbench for teaching and learning through a real-world spatial perspective
2011

This PIs aim to learn how to promote geospatial thinking and the ability to use data gathered geospatially to solve complex problems. The technology leverages on-line maps so that learners have access to real GIS, remote sensing, socioeconomic, agricultural and other data and models as they engage with others in GeoGames – problem solving scenarios in economics, agriculture, environment, transportation, relief, urban planning, and emergency services. The focus is on helping learners gain and use a spatial perspective in their thinking and problem solving.

Martin, Fred, U. Mass Lowell
Christy, Samuel T., Machine Science
DIP: Collaborative Research: Transforming Science Learning with an Interactive Web Environment for Data Sharing and Visualization
2011

These PIs are creating a web platform and software for communicating mobile and desktop devices that can be used in middle school and high school to engage students in collaborative scientif inquiry. The technology provides a shared repository of classroom activities and tools to enable teachers and students to create their own experiments, upload and tag data, and configure and share dynamic visual representations of the data. Research addresses the roles of sharing and of different types of activities in engaging learners in data-intensive activities and in helping them gain literacy in data-intensive science.

Uzzo, Stephen M., New York Hall of Science
DIP: Interaction Research in Complex Informal Learning Environments
2011

This project brings together learning scientists, game designers, game theory researchers, and environmental scientists to engage museum goers in the science of sustainability and sustainable development. It takes its inspiration from Buckminster Fuller's "World Game," conceived nearly 50 years ago as a tool to facilitate a participatory aprproach to addressing problems of the world. Museum goers will be able to explore the interconnected nature of the economic, social, and environmental factors that influence sustainability. Research focuses on participatory enfagement with data and finding design principles that influence effectiveness of visualizations and on development of alternative tactile, social and spatially distributed ways to help learners interact with complex multivariate data.

Goodman, Alyssa, Harvard
EAGER: A prototype WorldWide Telescope (WWT) visualization lab designed in the Web-based Inquiry Science Environment (WISE)
2012

The PIs are developing and testing a prototype visualization lab designed to help middle schoolers understand why the moon appears to have phases when observed from Earth. The work is being done through a partnership between (i) astronomers who have developed the WorldWide Telescope Universe Information System (WWT) and the World Wide Telescope Ambassadors program as a way of bringing the big data and visualization capabilities of astronomers to children and schools and (ii) learning scientists on the WISE team who have a long history of using what is known about how people learn to develop technology-rich middle school science curriculum. Astronomy data and tools for visualization developed by the WWT team is being integrated into WISE's technological infrastructure, which, for curriculum developers, scaffolds the development of curriculum that promotes learning, and for learners, makes available tools and resources for collaboratively making sense of what they are experiencing.

3. Distributing help for learners between computer, teacher, peers, and community members

Ashley, Kevin, Pittsburgh
DIP: Teaching Writing and Argumentation with AI-Supported Diagramming and Peer Review
2011

Artifical intelligence technology is used to provide help to learners as they construct informed arguments and write argumentative essays – in science, law, and other disciplines. This project extends work on intelligent tutoring systems, which provide help with structured problem solving. Argumentation is less constrained. The work of helping learners derive arguments is shared by the compter and peers, as is the work of helping peer reviewers review the writing of others. Research questions address the roles computers might take on in promoting writing and the technology that enables that, how to distribute scaffolding (the helplearners need) between an intelligent machine and human agents, how to promote better writing, and how to promote learning through peer review .

Baraniuk, Richard G., Rice
Marsh, Elizabeth, Duke
DIP: Collaborative Research: A Personalized Cyberlearning System based on Cognitive Science
2011

The computer uses the vast resources available on the web to find homework problems that specifically address the learning needs of individual students, providing guided practice, spacing to promote retention, and individualized feedback that a single teacher cannot provide for each student.

Kermish-Allen, Ruth, Island Institute
EXP: Weather Blur
2012

The project aims to show how to bring science home to a community, using its issues and resources to make science relevant, hopefully leading to renewed interest in science among older residents and interest and understanding among students and teachers. Over the long term, PIs are seeking to develop a model for place-based non-hierarchical learning communities that might be put to use in a variety of places, each with its own community issues and resources. Several populations of learners are addressed: school children (K-8), who can learn about science in the context of enterprises going on around them in the community; fishermen, who contribute their experiences and wisdom but may not know the science behind what they experience; other community members with similar roles; parents; and teachers. Added in will be scientists, who may or may not come from the same community, who comment on the data collection and analysis and interpretations being done by the community.

4. Bridging formal and informal learning environments (in school and out of school)

Barron, Brigid, Stanford

EXP: Developing citizen scientists through face-to-face and networked learning opportunities
2011

This research project is investigating how networked technologies can generate excitement and expertise development among middle school students acting as citizen scientists. Of particular interest how to use classroom assignments to promote outside-the-classroom data gathering and science participation and how to take advantage of the varied activities of individual students inside the classroom.

Mendez, Regina, Springfield Technical Community College
EXP: Exploring the Virtual World of Contextualized English-Language Learning
2011

The PIs are imvestigating how virtual world 3D technology can be used to address the limited opportunities adult immigrants and refugees have for exploring and practicing their English in authentic settings without risk of seeming inarticulate. Focus is on how to integrate these kinds of activities, done outside the classroom and off campus, into curriculum to better promote English language learning and how to populate a virtual world to allow that to happen.

Jones, Michael, Brigham Young
EXP: Exploring autmented reality to improve learning by deaf children in planetariums
2011

The project investigates the use of head-mounted augmented reality to improve the experience of deaf and hard-of-hearing participants in situations that are logistically challenging for them, specifically presentation situations where there is some scenario they need to pay attention to at the same time they need to pay attention to a signing interpreter.

Socia, Debra J., Open Air Boston
CAP: Mobile Pathways for 21st Century Learning
2012

Open Air Boston (OAB) is a nonprofit organization whose mission is to bridge the digital divide so that low-income, under-served populations in the City of Boston have access to digital communications technology and the Internet. The OAB Technology Goes Home (TGH) Program is an 11-year-old, award-winning City initiative that gives under-served residents the opportunity to access the tools and education required for 21st century skills development. The next step in this initiative has been conceptualized as a collaboration with local informal education organizations to design game-like community learning experiences that use mobile technologies to engage students and their parents in scientific reasoning and exploration that will help them learn STEM content and practices and perhaps

become interested in STEM careers. This Cyberlearning Capacity-Building Project (CAP) is for the purpose of building the research capacity of this already-strong team so that they have the capacity to develop an approach that is based on the best that the literature has to tell us about how people learn and how people learn with technology and so that they can use their efforts as an infrastructure for carrying out research that will advance what is known about engaging low-income, under-served populations of teens in STEM endeavors in beneficial ways.

5. Making play and exploration time into learning time (without ruining the play)

Halverson, Erica, U. of Wisconsin
EXP: Learning in the Making: Studying and Designing Makerspaces
2012

Maker spaces are neighborhood spaces that are arising in many urban areas that allow and promote tinkering, designing, and construction using real materials, sometimes quite sophisticated ones. Participating in designing and successfully building working devices in such spaces can promote STEM learning, confidence and competence in one's ability to solve problems, and positive attitudes towards engineering, science, and math (among other things). The goal in this project is to learn how to design these spaces and integrate learning technologies so that learning happens more consistently (along with tinkering and making) and especially so that they are accessible and inviting to those who might not normally participate in these spaces. The work of this project is happening in an urban setting and with at-risk children, and a special effort is being made to accommodate making and learning with peers. As with Computer Clubhouses, maker spaces hold potential for their participants to identify what is interesting to them at the same time their participation gives them the opportunity to express themselves, learn STEM content, and put it to use.

Ozer, Elizabeth, UC San Francisco
EAGER: Adolescents Learning Social Problem-Solving Skills Using and Interactive Novel
2012

The project is investigating the use of graphic novels to engage teens in thinking about difficult social situations and to model for them ways of dealing effectively and in non-violent ways with those tricky situations, and they are investigating the use of associated serious games and other interactive components to promote reflection on what has been read, promote discussion around the situations, and provide opportunities for practice. This novel idea has its foundations in the approach to therapy called Cognitive Behavioral Modification and resonates with what the approach to education called Cognitive Apprenticeship suggests about

promoting skills learning. The project brings together experts in Cognitive Behavioral Modification, social psychology, interactive narrative, design of graphic novels, serious games, and adolescent health and well-being. The goals of this EAGER project are to (i) synthesize social psychology, interactive narrative, and serious games approaches to envision the experiences learners need to have to learn and take on new social problem solving behaviors, (ii) begin the design of an interactive graphic novel and experiences around it that has a good chance of promoting behavior change among the targeted population of at-risk teens, and (ii) develop a strong research team that will collaborate over the long term in following through on worthy ideas that come from this initial effort.

Squire, Kurt, U. of Wisconsin
DIP: Biosourcing: A Crowdsourcing Approach to Increasing Public Understanding in Computational Biosciences
2012

There is an increasing awareness among scientists that many contemporary science problems require (or could benefit tremendously from) an actively engaged public. Communicating the challenges and opportunities of science, and mobilizing the public to participate in and support scientific inquiry, requires shared understandings about the values, methods, and epistemologies of science (e.g., observation, data collection and analysis, reasoning from evidence, skepticism). This project focuses on design of learning opportunities that are both engaging and informative with respect to scientific literacy. The public is invited to participate in a variety of science-related "games," experiences with scientific inquiry that are engaging and exciting and that can contribute to scientific findings. Participants engage as scientists, carrying out the practices of scientists and reasoning about evidence to draw conclusions, in the process experiencing the thrills and frustrations involved in scientific discovery and inquiry. Investigators observe the participants in these games to draw out principles for designing additional learning experiences that can engage the public in science and promote scientific literacy and learning at the same time. What is learned in this analysis will also be applicable to designing engaging science experiences for use in schools.

Burke, Jeff, UCLA
EAGER: Cyberlearniing at the Los Angeles State Historic Park
2012

The venue for the work is the Los Angeles State Historic Park, a 32-acre site in downtown LA that attracts families from several nearby ethnically-diverse neighborhoods. The PIs are creating a prototype interpretive module for the park, an interactive mural that will act as an invitation to civic engagement and evolving social memory for the park and its surrounding communities. The long-term goal of this project team is to advance understanding of how technology can be used to leverage the potential of public spaces to promote civic engagement, public interaction, and ultimately, life-long learning. Foundations for the design of the

installation and experiences around it come from three theoretical perspectives: communities of practice, play and performativity, and the idea of an evolving social memory and the knowledge-building discourse that promotes such evolving memory. The challenge is to achieve civic engagement and learning goals in the context of a space people visit primarily for recreation and play.

Black, John, Teachers' College, Columbia
EXP: Mobile, Movement, and Math
2012

The project team is integrating the stories, characters, math content, and research of New York's public television station's (WNET), Cyberchase multimedia project with Teachers' College's research on embodied cognition theory and gesture-base simulation games to create two mobile application prototypes to be used in studies focused on learning with technology that takes embodied cognition theory into account in the context of story narrative. The content focus of the research and development is fractions, a topic that is a major stumbling block for children in the target age group of 8-11, yet lays a crucial foundation for later success in mathematics, science, and related fields. The project's research and design context tests a design framework that integrates the promises of new technology, embodied cognition theory, and well-loved story narratives and has potential to be applicable to the teaching of other mathematics concepts and to a variety of STEM disciplines.

Ching, Cynthia Carter, UC Davis
EXP: Educating teens to understand personal health (GET-UP)
2012

This team is creating a new kind of video-game, one that incorporates the changing characteristics of the person playing the game into the game play itself. This provides game players (learners) with an alternate perspective on their own capabilities and the effects and impacts of their choices and behaviors. In this case, the game is aimed at children learning about health and nutrition, and learners (adolescents and pre-adolescents) wear a wrist band that captures personal-health data (e.g., heart rate, breathing) and incorporates that data into the capabilities of the game player within the game. Game design and game play are based on literatures on game design (especially for promoting learning), embodied cognition, identity development, and effecting behavior change. Research focuses on how learning, identity, and changes in real-life behavior unfold over time and what it is about the game that is influencing or driving those changes. While this project is aimed at promoting habits that will lead to good health, what is learned from the investigation will have potential to affect not only public health but also more basic understanding of how habits develop, how to promote habit development, and how to design engaging video games as vehicles for promoting the kind of learning that results in behavior change.

Bevalier, Daphne, U. of Rochester
DIP: 'Hard Fun': Learning Mathematics: Stimulating Number Sense
2012

This project focuses on development of number sense in 7 to 11 year old students through a 3D action game that will train the brain. The project tests a hypothesis that playing a number-sense action game can help children learn beyond the game, making them better overall at number-line sense, precision of numerosity, speed of numerical judgments, and ability to multitask numerical tasks. The innovation is twofold: a game, adapted from first-person shooter games, to train number sense, and a platform that makes it easy to vary aspects of the game (e.g., repetition, speed, number of possibilities) to be able to analyze what is it that is making a difference with respect to learning. Research is identifying the qualities of computer games that will train the brain to be automatic in its judgments and at qualities of experiences that promote such automaticity.

6. Promoting behavior change

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Ching, Cynthia Carter, UC Davis
EXP: Educating teens to understand personal health (GET-UP)
2012

7. Integrative Platforms

Ramani, Karthik, Purdue
DIP: Cyber Exploratorium
2012

Research has established the important role of exploratory "play" in the development of creativity and cognition and the central role of such exploration in ideation, especially in ideation of innovative solutions to problems and design challenges. This project leverages the possibilities inherent in natural user interfaces (NUIs) for promoting the kinds of collaborative exploration of ideas that is essential for collaborative learning, problem solving, and design. The hardware infrastructure being designed enables groups to articulate ideas visually, share them, and refine them together around a large collaborative multi-touch interface, to access those visualizations from afar and annotate them textually, and to share those ideas broadly with classmates, team-mates, and others. Such an infrastructure

provides a foundation for supporting project-based and design-based learning activities in formal learning environments in ways that give all team members chances to contribute appropriately, record the contributions of team-mates for teachers and other mentors to examine, allow sharing and advice from peers, mentors, and experts, and eventually allow automatical assessment, help,and advice. The proposed infrastructure has potential to be used across all ages, in formal and informal learning environments, and in the workplace.

Dorsey, Chad, Concord Consortium
INDP: InquirySpace: Technologies in support of student experimentation
2012

The InquirySpace project provides insight into one of the most difficult problems in science instruction -- supporting authentic scientific inquiry in a way that both promotes deep science learning and conveys an accurate understanding of the practices of science. This project will show how to integrate sophisticated software functions that support science inquiry in ways that allow middle and high school students to have scientific inquiry experiences that have a sophistication similar to the experiences of scientists but without being overwhelmed by the multitude of tools, and resources, and representations available to support their work. Findings from this project have the potential to deepen our understanding of how to help students learn science concepts and scientific inquiry through inquiry activities, and draw attention to the importance of computational tools in supporting this learning.

8. Family learning; life-long learning; learning at home because you want to

Jordan, Rebecca, Rutgers
DIP: Sustaining ecological communities through citizen science and online collaboration
2012

These PIs seek a better understanding of how cyber-enabled tools can help adult learners learn disciplinary knowledge and scientific practices in informal settings. The project is also enabling citizens to play a role in locally-based environmental management; and it is working with a statewide master naturalist program through which the participation of underserved groups in science learning and resource management is encouraged. The project features collaboration among learning scientists, ecologists, and computer/information scientists, and merges citizen science with cyberlearning and social networking. The cyberlearning environment in which these interactions takes place is built on an existing cyberinfrastructure, the International Biological Information System, that the PI team is enhancing to support collaborative ecosystem modeling. The resultant online, collaborative model-based learning system enables citizen scientists to make field observations,

discuss and represent data, and collaboratively generate models and recommendations for land use resource management. Research questions center on how citizen scientists engage in scientific practice, use models to share understandings, work with professionals, and use representational tools to interpret their observations. Additional questions address the use of these tools in the context of land use management and the nature of collective and individual knowledge that results from participation in this collaborative model-based learning community.

Horn, Michael, Northwestern
EXP: Augmenting household technologies for learning and whole-family participation: heating and cooling control as an exploratory case
2011

Kermish-Allen, Ruth, Island Institute
EXP: Weather Blur
2012

9. Expressive Technologies

Wilkerson-Jerde, Michelle, Tufts
EXP: SIMSAM: Bridiging Student, Scientific, and Mathematica Models with Expressive Technologies
2012

This project is prototyping new technologies that will allow middle-school students to learn science through scientific modeling, an approach with potential for promoting deep understanding of the mechanisms underlying phenomena in the world. The software, called SimSAM, allows students to create animations and simulations of phenomena related to molecular kinetics - an important content area across grades K-16. The technology uses cross-platform, web-based technologies that do not require a special device or download and will thus be easily usable in schools without the need to download specialized software applications. The project's products will include curriculum materials for promoting learning the particle theory of matter and software that can eventually become a robust toolkit for students to engage with a wide variety of dynamic scientific phenomena across the science curriculum.

Rubin, Andee and Koile, Kimberly, TERC and MIT
EAGER: Technology to support mathematical argumentation
2012

Smith, Derrick, U of Alabama, Huntsville

EAGER: Promoting algebra learning through an accessible expression system for students with visual impairments and blindness
2012

Ramani, Karthik, Purdue
DIP: V-ICED Visually-Integrated Cyber Exploratorium for Design
2012

Polman, Joseph, Colorado
EXP" Collaborative Infographics for Science Literacy (CISL)
2012

Drawing in more high schoolers to science, promoting scientific literacy, and promoting deeper science learning among high schoolers are huge challenges to the educational system. This project focuses on addressing those challenges through design of citizen journalism activities that can be integrated with other science curriculum activities. The activities themselves revolve around collaborative critique and construction of infographics. Infographics are visual representations of data and/or information, used to express and communicate science, mathematical, technological, and sociological information and used extensively in journalism today. The project seeks both to help high schoolers learn to make sense of such graphics to use design of such graphics as a way to promote learning. The activities themselves require students to engage in data analysis and synthesis and to use science they are learning to develop visual representations that others can make sense of and learn from. The technology is authentic to what journalists use, and its use and the philosophy around its use could be powerful in drawing high schoolers to the wonders of science and helping them appreciate what scientists do, thus broadly promoting scientific literacy.

10. Automated feedback and learning analytics

Meir, Eli, SimBoitic Software
DIP: Using dynamic formative assessment models to enhance learning of the experimental process in biology
2012

This PI team aims to use artificial intelligence to exploit data collected from intelligent tutoring systems to provide feedback both to students and to teachers effectively and at the right times. The team is using a new analytic approach, which introduces hierarchical modeling to learning analytics, to investigate how to better understand students' learning states. Algorithms make valid interpretable and actionable inferences from student-learning data, drawing on cognitive theories and statistics to make it work. As in tutoring systems, analysis is at the level of component skills rather than looking at end performance on a task as a whole.

Research is around construction of the algorithms for deducing student learning and student learning states and around learning ways of signaling both to learners and to their teachers what concepts and skills learners understand and are capable of and which they are having trouble with. A learning dashboard will allow teachers to visualize the learning needs of a whole class and adapt activities to student needs. Feedback aimed at learners themselves will help learners recognize activities they need to engage in next to better their skills or understanding. Evaluation will include the degree to which learners development of metacognitive skills when such tools are available.

Lovett, Marsha C., CMU
EXP: Building a learning analytics system to improve student learning and promote adaptive teaching across multiple domains

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