Faculty Award Proposal

When Scientific and Everyday Knowledge Grow into One Another: Designing for Robust Science Learning for Students from Non-dominant Communities
Submitted by Kris D. Gutierrez, Professor and Inaugural Provost's Chair

Problem Description/Research Focus

This project, led by Professor Kris Gutiérrez, joins CU professors, PhD and undergraduate students, and a local school in an interdisciplinary effort to create and study an innovative technology-based after-school program called El Pueblo Mágico (EPM). Joining students from CU and Alicia Sanchez Elementary, a school with low-income and Emerging Bilingual student populations, EPM engages students collaboratively in computer, science, and health science based activities to engage students in multimodal forms of learning about science. This research-based and community-based project examines how learning can be ratcheted up as students participate in "social design experiments" (Gutierrez & Vossoughi, 2010)—ecologically valid ‘experiments’ designed to leverage participants’ horizontal (e.g. everyday knowledge) expertise to develop vertical (e.g. school-based) expertise and meaningful and portable disciplinary knowledge. EPM is modeled after University-Community Links (UC Links), a University of California consortium connecting underserved K-12 youth and university students (Vásquez, 2002). The transformative learning processes and high levels of engagement of UC Links participants have been documented extensively in research studies (Cole, 1996; and Gutiérrez & Vossoughi). In fall of 2010, we launched EPM, piloting new technology and science-oriented activities, supported by our CU collaborators in Computer Science: design software by Alex Repenning & Andri Ioannidou (AgentSheets); and a computer-mediated fabrication curriculum by Michael Eisenberg & Jane Meyers (Craftopolis). We aim to examine how multi-age groups learn together in technology-mediated activity as designers who will also gain valuable forms of multimodal expertise within a vibrant, technology-rich learning community. EPM is paired with undergraduate course EDUC 4411, where undergraduates learn cultural-historical approaches to learning and development and the role of cultural mediation in learning activity, and have the opportunity to see these theories come to life at EPM, to instantiate what they learn and develop new knowledge as co-problem-solvers with children. An overarching goal of this design experiment is to introduce undergraduates and children to high status knowledge about digital design, energy-use, science, and health in ways that helps them leverage their everyday understandings to develop robust science concepts, practices, and dispositions. Specifically, we are interested in the following: maybe insert here what I sent you.

One of the most important and unique aspects of this project is its interdisciplinary approach to the design and implementation of activities of EPM. In order to accomplish our ambitious objectives of studying the uses of innovative technologically-mediated science activities in an out-of-school context, we draw on our interdisciplinary team, with our complimentary forms of expertise, to create what we expect to be long-term and highly generative collaborations. El Pueblo, a technology-saturated ecology, invites novice/undergraduate teachers to work with K-5 children to co-participate in a wide spectrum of cyber-enabled science learning activities ranging from understanding energy use in everyday practice or the health issues of the surrounding community, to writing problem-solving narratives to a cyber wizard, “El Maga,” in which children explain what is learned and how as they develop
scientific narratives about what they learn. Participants move through a virtual and activity-based maze that privileges technology-mediated health science concepts and practices central to developing new stances toward the empowering role of science in everyday life, appropriating new tools in the service of discovery and transformative understandings, and engaging in new forms of participation and collaboration in science learning activity.

The “Imagination Station” is the key activity of the maze and houses the primary cyber activities of EPM. However, in this learning ecology, technologies are not the object of activity or a kind of ‘gift-wrapping’ (Fischer, 2009) typical of much school-based use; nor is the virtual ecology disconnected from a robust learning ecology; these are nested ecologies that are mutually constitutive and supported. Of significance, EPM provides a unique opportunity to examine the cognitive and social consequences of participating in collaborative cultures where distributed expertise, discovery, and the playful imagination are privileged, and to study how health science knowledge can be leveraged across contexts and practices. Access to innovative cyber-enabled science learning activity and opportunities to generate new knowledge in tool-mediated activity is particularly consequential for the children at Alicia Sanchez Elementary School, as health related issues are the central impediment to learning and participation in this neighborhood school. At the same time, EPM is not designed to replicate school (a feature critical to its sustainability) where students are passive consumers of science facts. Instead, this ecology privileges innovative problem-solving and, thus, participants are co-designers of science and health-science related cyber activity that scaffolds active science learning, new stances toward the affordances of science in everyday activity, and new knowledge that should be of immediate use and consequence to the vulnerable families in this local community. In this way, students and families are agents in the design of new futures and school personnel (as active partners) will have new models of participation and learning. Students will:

• Explore how they use energy in their daily lives through activities that are a mixture of hands-on involvement, investigation of their energy environment (in El Pueblo, at home, and in the broader environment of their community, city, state, and world), using measurement tools and product information to understand energy ratings, and via simulations that allow them to play “what if” games.
• Write about their learning experiences, questions, thoughts, and ideas about the relationship between energy and their lives
• Explore what and how they would tell others about energy, show them, what visualizations, etc (explore with drawings, agent sheets simulations, etc)
• Engage in activities that encourage them to relate what they have learned to social problem solving activities that include teaching others what they have learned, brainstorming about how they could make things better by changing energy-use behaviors, strategize about what would encourage more people to think about their energy use, and sharing their stories with others

This research project is designed to address a range of goals central to the advancement of educational research: (a) Leverage university, community, and school expertise to address issues related to pressing needs of Sanchez students; (b) Develop robust health science and technology focused projects in alignment with Sanchez's expressed goals; (c) Create a sustainable collaboration in which the school, its surrounding communities, and the university engage in mutually beneficial partnerships that increase ongoing learning in and
outside of school for all constituents; (d) Enhance public education by positioning all elementary students as intelligent and valuable participants through purposeful inclusion of science and technology learning activities that are situated and meaningful, thus increasing the potential for deep learning and enriched engagement; (e) Expand students’ knowledge of science and health sciences learning and the role of language and discourse in learning processes, including use of children’s full linguistic toolkit in service of learning and identity development; (f) Provide future teachers opportunities to combine theory and practice in the study of learning and human development in educational and community-based settings, through acquisition of relevant theories, discussions, research, writing, and group projects. In this vein, the university class promotes robust notions of learning and culture that challenge deficit orientations to student learning; and (g) Create a prototype of successful university/school/community partnerships that are simultaneously evidence-based and theoretically grounded for future efforts in the Boulder Valley and beyond.

To meet these goals, the project draws on a cultural-historical activity theory (C/HAT) to examine the interdependent relationship between individuals and the learning ecology of El Pueblo Mágico and the centrality of cultural mediation in these processes. Gutiérrez’s use of C/HAT employs a syncretic approach, that is, “transdisciplinary perspectives for the theoretical and methodological treatment of the social practices” of learning that focuses upon the activity system as a unit of analysis (Gutiérrez & Stone, 1997, p. 125). We also draw on theoretic approaches from computer and cognitive science and studies of digital literacy, which conceptualize new relationships (and blurring boundaries) between producers, designers, and consumers in the 21st century. This work points to the need for students and citizens to be creative and critical designers in an age in which science and technology will be key to solving the major problems of our time.

Our intention is to conduct long-term research on this work, and to develop a corpus of ethnographic, video, and textual data in order to richly detail the social interactions and constructions of meaning that take place in EPM, and in our “Imagination Station” activities particularly. Now, at the end of our first semester of EPM as a program, along with the concomitant course, we are poised to refine and begin to study the individual and community learning and development that occurs through the use of computermediate design tools designed and supported by our collaborators in the Department of Computer Science. (add Gerhard’s center name here too)

References
Methodology

We will study interactions, data, and interviews to understand: “How do students’ understanding and attitudes about energy use change? " What aspects of their participation in El Pueblo encourage them to become more or less engaged in understanding or changing their energy use? " What impacts do their activities have on their surrounding social units—fellow El Pueblo students, Sanchez classmates, family—and vice-versa " In what ways do students become empowered to be more than a consumer, how do they “teach” others and become an informational resource.

Doctoral student research assistants will play a pivotal role in this data collection and analysis by documenting, over time, how small groups of undergraduates and K-5 students engage with the digital tools and design practices available at site, and what activity systems and practices develop around the use of the tools. We will also collect and analyze college students’ cognitive ethnographies (field notes that focus on fine-grained moment-to-moment learning of children and their undergraduate partners). In addition, analysis of videotaped and audiotaped interactions in learning activity at the site will serve as important data for analyzing discourse and meaning-making processes among undergraduates and children. Pre- and/or post-semester surveys will provide demographic information including information on students’ repertoires of practice (for elementary students, undergraduate students, and staff members), as well as attitudinal information about learning, technology, and science. Interviews with elementary students, undergraduate students, and staff associated with the site will also be conducted.

We will employ a mixed methods design for analyzing data ?? . As mentioned above, we will use qualitative inquiry to code surveys (pre- and post-semester measures), cognitive ethnographies, field notes, audio-taped and/or video-taped observations and use NVivo for coding purposes. We will analyze elementary student data (e.g. gender, race, grade, standardized test scores, grade point averages, attendance percentages, free and reduced lunch background, and Individual Education Program status) and explore the relationship between student learning and achievement and participation in El Pueblo Mágico.

Project Contribution

This course is a required course for undergraduates in education and will serve as a prototype for a constellation of courses in education, as we begin to implement more practicum based courses that link the study of learning and development and discipline-based learning. We have also been recently invited to join the MacArthur Foundation’s Connected Learning project. Our participation would allow us to follow the children into their homes and community to study if the knowledge the students appropriate while at El Pueblo travels across contexts and, if so, how this knowledge is leveraged in those settings. This is the most powerful form of learning—that is, knowledge that has relevance and use in the academy and beyond.