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

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Introduction

This project explores the potential of information and communications technologies (ICT) as cognitive tools for engaging students in scientific inquiry and for enhancing teacher learning. A comprehensive professional development program of over 240 hours, along with follow-up is used to determine how teachers can be supported to use ICT tools effectively in classroom instruction to create meaningful learning experiences for students, reduce the gap between formal and informal learning, and improve student learning outcomes.

Project Purpose

While a high percentage of students are purposefully finding their way in using ICTs outside of school (Lenhart, Arafeh, Smith & Rankin, 2008; Levin & Arafeh, 2002; Pew Internet & American Life report, 2002), for the most part they currently are not doing so inside of school in ways that they find meaningful and relevant to their lives (Lenhart, Arafeh, Smith & Rankin, 2008; Levin & Arafeh, 2002). Instead, the pedagogical approaches that are most often experienced are "based on meeting the needs of digital immigrants which deny digital natives opportunities to utilize their evolved literacy skills" (Clark & Besnoy, 2009, 7). **We believe there is an increasing gap between the assumptions governing use of cyber-enabled resources in schools, and the everyday realities of this use by digital natives. The purpose of this project is to identify, implement and test activities designed to eliminate this gap**.





Project Research Questions

This project is designed to assess the impact of collaboratively developed and broadly disseminated learning activities deliberately designed to leverage informal use of cyber-enabled technologies. The research will address the following specific questions:

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 and close the gap between formal and informal student cyber-enabled learning?
2. To what degree does closer alignment between informal and formal use of cyber-enabled technologies influence student attitudes about science?
3. To what degree does closer alignment between informal and formal use of cyber-enabled technologies influence student science achievement?
4. How does the use of cyber-enabled technologies influence student access to significant and relevant science process skills and content knowledge?
5. How does the use of cyber-enabled technologies influence students' new literacy skills?

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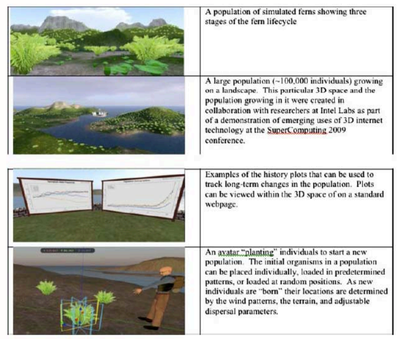
Full Description

There is an increasing gap between the use of cyber-enabled resources in schools and the realities of their use by students in out of school settings. This project explores the potential of information and communications technologies (ICT) as cognitive tools for engaging students in scientific inquiry and for enhancing teacher learning. A comprehensive professional development program of over 240 hours, along with follow-up is used to determine how teachers can be supported to use ICT tools effectively in classroom instruction to create meaningful learning experiences for students, reduce the gap between formal and informal learning, and improve student learning outcomes. In the first year, six teachers from school districts in Utah and New York are prepared to become teacher leaders and advisors. Then three cohorts of 45 teachers matched by characteristics are provided professional development and field test units over two years in a delayed-treatment design. Biologists from Utah State University and New York Institute of Technology will develop four modules that meet the science standards for both states -- the first being changes in the environment. Teachers are then guided to develop additional modules.



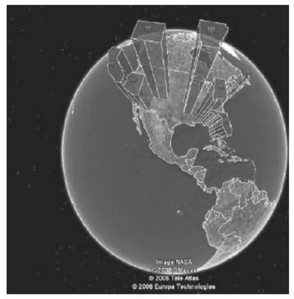


Fig. 2 3-D mapping of water consumption data across the US in Google earth (Wang et al. 2009, p. 91)

The key technological resource to be used in the project is the Opensimulator 3D application Server (OpenSim), an open source, modular, expandable platform used to create simulated 3D spaces with customizable terrain, weather and physics. The effects of the professional development program are measured by classroom observations using RTOP and Technology Use in Science Instruction (TUSI), selected interviews of teachers and students, and validated assessments of student learning. An external evaluator assesses the quality of the professional development activity and the quality of the cyber-enabled learning resources and reviews the research design and implementation. An advisory board will monitor the project. The principal outcome of this project will be insight into the professional development needed to make teachers comfortable teaching with the kinds of multi-user simulations and communication technologies that students use everyday. The enactment with OpenSim also provides an opportunity to demonstrate the level of planning and preparation that go into fashioning modules with selected cyber-enabled cognitive tools such as GoogleEarth and Biologica.

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Year 1 Project Activities

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 as well as administrative support demonstrated through a letter of commitment and agreement of administrative attendance on the final day of the summer PD.

Participating districts have been selected based on existing or previous collaborations with PI/Co-PIs and a desire for PD focused on increasing student achievement, integrating technology into instruction, and building teacher —community.

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. Measurement instruments for these are described later in Table 2. 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.

Assessment Instrumentation

- **Reformed Teaching Observation Protocol (RTOP)** to determine the level of reform and science inquiry aligned instruction that is occurring prior to the project.
- **Technology Use in Science Instruction (TUSI)** will be used to measure the extent to which technology integration in science classrooms is aligned with reformed, science inquiry focused instruction.
- **Principles of Science Inquiry-Teacher (PSI-T)** and **Principles of Science Inquiry-Student (PSI-S)** (Campbell, Abd-Hamid, & Chapman, 2010) will provide teacher and student self-reported data about student experiences in science classrooms.
- T**eaching Science As Inquiry** (Smolleck & Yoder, 2008) will be used to assess teachers' self-efficacy related to teaching science as inquiry.
- **Teacher and student ICT usage surveys** and **informal/formal technology usage teacher and student surveys** developed by selecting items from pre-existing surveys created by Markauskaite, (2007)will be completed by both groups (teachers and students).
- **Self-reporting Teacher and Student Informal/Formal Technology Usage Surveys** was 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
- **Students' Motivation Toward Science Learning (SMTSL)** instrument (Tuana, Chin, & Shieh, 2005) is a comprehensive instrument measuring multiple constructs related to student attitude.
- **Science, Attitudes, Skills, and Knowledge Survey (SASKS)** (Lawson, n.d.) measures students' understanding of science process/reasoning, nature of science, and attitudes toward science and used extensively in the Arizona Collaborative for Excellent in the Preparation of Teachers (ACEPT) Project (Piburn et al. 2000).
- **Utah Criterion Reference Test**-this is a discipline specific assessment to measure student understanding of core content specified concepts to appropriately inform instructional and accountability decisions (Utah State Office of Education, 2007).
- **New York Regents Exam**-this is the Regents examination are designed and administered under the authority of the Board of Regents of the University of the State of New York (New York State Department of Education, 2008).
- **New Literacy Scenarios Instrument** instrument was designed based on the instrument developed by ETS (Educational Testing Service): ICT Literacy Assessment, and British National ICT assessment tasks.