Learning with Technology: BioSITE Online

Development of a Technology-Integrated Cross-Classroom Curriculum to Promote Science Learning

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Master’s Project Proposal
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Learning, Design, and Technology
School of Education
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ABSTRACT

BioSITE (Students Investigating Their Environment) is an on-going program developed by the Children’s Discovery Museum (San Jose, California) that engages fifth grade students in authentic scientific research on local environmental issues. Students from each of the five participating schools visit and examine the water quality and wildlife at one of the five study sites along the nearby Guadalupe River. The students make several trips throughout the school year, gaining experience in collecting and interpreting data and drawing conclusions from first hand field experience.

While hands-on inquiry-based learning is an excellent way to introduce scientific concepts and methods, opportunities for data comparison and scientific discourse is limited within each class. Students only get a micro-scale view of a macro-scale ecological problem, and may miss seeing the “big picture” of the river’s health and its effects on the region’s plants and animals. Secondly, scientific discourse around these issues is limited within classrooms due to relatively low participation rates among students in face-to-face group discussions.

I propose to incorporate an online component to BioSITE, which will allow students to exchange and compare data across classrooms, as well as engage in increased scientific discourse with peers in other schools. The final product will be a prototype of a web site designed to facilitate these interactions and learning experiences.
I. BACKGROUND AND LEARNING PROBLEM

The River Alliance Team is a partnership between five science magnet schools within the San Jose Unified School District whose collective goal is to support the development of a system-wide model of improved student performance in the area of science learning. The five participating schools include Carson, Hacienda, and Randol Elementary, and John Muir Middle and Pioneer High Schools. To provide their students with authentic experiences in scientific research, the River Alliance has partnered with BioSITE (Students Investigating Their Environment), a program funded by the Howard Hughes Medical Institute and developed by the Children’s Discovery Museum of San Jose.

The BioSITE program engages students in authentic hands-on research focusing on the ecological health of the nearby Guadalupe River watershed. Throughout the school year, students make weekly visits to the river, collecting information and learning how to analyze it. Although there are five study sites along the river, each class only visits the site nearest their school. They take and test water samples for turbidity, conductivity, pH levels and dissolved oxygen content, map the contours of the creek bed, and correlate the fish and wildlife they see with variations in water quality. On each visit to the watershed, the young students are guided and mentored by BioSITE facilitators, specially trained students from Pioneer High School.

While these hands-on inquiry-based activities afford student learning of scientific concepts and methods in studying a small section of the river, students do not have the opportunity to compare data on a large-scale between schools, across the different sections of the river. Without this component, students may miss seeing a more comprehensive view of river ecology.

Additionally, participation in scientific discourse is a vital part of science learning (Cohen and Scardamalia, 1998), and though many classes make use of group discussion, research has shown that these discussions frequently reinforce social roles instead of contributing to knowledge integration (Linn and Hsi, 2000). Despite a teacher’s efforts to call on boys and girls equally, boys raise their hands more often and tend to dominate discussions by speaking out of turn (Sadker and Sadker, 1994). Another important aspect of lifelong learning that may be missing in many in-class activities is opportunity to monitor and reflect on one’s own and other students’ ideas.
II. DESIGN PROPOSAL

PROJECT DESCRIPTION AND GOALS

In order to meet the challenges of the learning problems discussed above, I propose to design an online computer-based tool to facilitate collaboration and communication among students at BioSITE’s participating school sites.

The project goals are to:
1. engage students in meaningful, inquiry-based scientific research,
2. help students understand the “big picture” of the river’s health and the effect on plants and animals of the region over time and space,
3. encourage all students to participate in respectful, productive scientific discourse,
4. foster a community of learners, and
5. help students become lifelong science learners.

To address the goals listed above, the project will attempt to integrate into the curriculum a web-accessible database that allows students to share their data and findings, and an online forum to communicate with other classes.

RATIONALE FOR THE USE OF TECHNOLOGY

While curriculum plans include hands-on field experience and classroom instruction, the integration of the computer’s unique learning affordances will increase learning opportunities in a number of valuable ways. Cross-classroom collaboration through networking can improve academic and social skills, and increase scientific discourse (Riel, 1994, 1993).

The use of Internet technology will enable students from different schools to easily share information and ideas. Previously, students studied the river at a micro-level, only comparing data with their classmates. By facilitating the exchange of data across schools, students will have the opportunity to extend the range of observations and see the river’s ecosystem on a larger scale.

Additionally, scientific discourse between students in different schools may increase due to students’ need to explain differences in data, observations, sampling techniques, and conclusions. Asynchronous discussion also offers a useful addition to class discussion by allowing greater overall participation, and evening out the contributions from boys and girls (Hsi and Hoadley, 1997). An online asynchronous format also enables students to spend more time reflecting on their thoughts before they respond, worry less about confrontation or embarrassment by having the option of anonymity (Cohen and Scardamalia 1998, Hsi and Hoadley, 1997).
Students are also required to articulate their ideas in writing for an audience of peer reviewers. The process of peer review may also be enhanced by the use of technology. Although students in one class may review their own classmates’ work, they are already very familiar with each other’s work (having completed it together). An outside group of peers may provide less biased critiques. By encompassing a wider community of learners from which to learn, online discussion also prompts greater consideration of multiple perspectives.

**DESIGN PROCESS: LEARNER-CENTERED INFORMANT DESIGN**

In learner-centered design, students are encouraged to actively explore and construct knowledge through intrinsically motivating, real-world-based problems (Norman and Spohr, 1996). The needs, interests and skills of the learner are the primary focus. Thus, input from the learner throughout the design process is an extremely valuable source with which to inform the product’s design.

Although children are not able to define their own learning goals, do not know pedagogical methods, nor how to design interactive media, they can still provide valuable input on what motivates them, what learning methods are effective, and what keeps them engaged (Scaife, et al., 1997). As adults, designing for children is a difficult problem -- although we think we know what children want and like, we are often wrong and need children to tell us what we do not know (Druin, 1994; Scaife, et al., 1997).

Keeping these issues in mind, I plan to involve fifth grade students (the target audience) as well as elementary school science teachers, and BioSITE facilitators as informants in the product’s design. Teachers and facilitators will be able to draw real-world classroom and field experience to keep the goals and technology appropriate for student learning. While the product’s learning and usability design can and will be user-tested after most of the design work is completed, one of the major goals of this project us to keep a learner-centered approach throughout the design process.

**MAJOR STEPS IN THE DESIGN PROCESS**

1. **Define the learning problem** specific to a content area and audience by reviewing literature and interviewing teachers and students.
2. **Define the learning goals** for the product using input from teachers, BioSITE facilitators and curriculum standards.
3. **Explore technology opportunities** within the existing curriculum framework with informants.
4. **Brainstorm activities** with students and teachers.
5. **Storyboard activities.**
6. **Review** and receive feedback on activities from learning design experts.
7. **Prototype** interactive computer-based activities, iterating on feedback from experts.
8. **User-test** prototype in classroom setting.
9. **Evaluate** product (curriculum, hands-on activities and technology) based on user-tests along three dimensions: effectiveness, engagement, and viability.
10. **Iterate** and improve as often as time allows.
### III. Timeline and Deliverables

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<tr>
<th>Date</th>
<th>Tasks</th>
<th>Deliverable</th>
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| 2/16 – 2/22 | • Interview science teacher and BioSITE to understand learning problems and goals  
• Conduct literature review on collaborative science tools  
• Outline learning problem, background, audience, product, design process, resources | Proposal                             |
| 2/16 – 3/2  | • Continue research  
• Technology exploration - understand where technology fits into existing curriculum | Curriculum outline with tech component |
| 2/16 – 3/9  | • Brainstorm activities with and without informants                   |                                      |
| 2/24        | • Design review with LDT faculty and students                         |                                      |
| 2/24 – 3/9  | • Redesign activities based on feedback from design review  
• Storyboard activities | Storyboards                          |
| 3/16 – 4/4  | • Develop preliminary prototype  
• Write content (text)  
• Update documentation | First prototype                       |
| 4/4 – 4/20  | • User-test learning design, interface, and text readability  
• Solicit feedback from experts |                                      |
| 4/20 – 5/11 | • Redesign product using feedback from users and experts              | Final prototype                       |
| 5/11 – 5/18 | • Prepare presentation                                                | Expo presentation                    |
| 5/11 – 5/25 | • Finish all documentation                                            | Final project and all documentation   |
### IV. Resources Needed

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<thead>
<tr>
<th>Human Resources:</th>
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<tbody>
<tr>
<td>Consultants</td>
<td>teachers, students, BioSITE facilitators</td>
<td>30 hours</td>
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<td></td>
<td>learning design experts, user-interface experts</td>
<td>15 hours</td>
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<tr>
<td>User-testers</td>
<td>teacher, students</td>
<td>20 hours</td>
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<tr>
<td>Primary contributor(s)</td>
<td>learning designer, graphic designer, HCI specialist, programmer</td>
<td>200 hours total</td>
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<th>Materials/Equipment:</th>
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<tr>
<td>Software</td>
<td>DreamWeaver, Fireworks</td>
<td>$200</td>
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<tr>
<td>Books/articles</td>
<td>See references</td>
<td>$100</td>
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<tr>
<td>Web hosting</td>
<td>Children’s Discovery Museum</td>
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V. CONSULTANTS/COLLABORATORS

I will be consulting the following people for their expertise, guidance, and feedback throughout the project:

<table>
<thead>
<tr>
<th>Consultant/Affiliation</th>
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<tbody>
<tr>
<td><strong>Professor Shelley Goldman</strong></td>
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<tr>
<td>Learning design expert</td>
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<tr>
<td>School of Education professor</td>
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<tr>
<td>Stanford University</td>
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<td><strong>Professor James Greeno</strong></td>
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<tr>
<td>Learning design expert</td>
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<td>School of Education professor</td>
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<td>Stanford University</td>
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<tr>
<td><strong>Professor Decker Walker</strong></td>
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<tr>
<td>Learning design expert</td>
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<td>Stanford University</td>
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<tr>
<td><strong>Hunter Gehlbach</strong></td>
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<tr>
<td>Ph.D. candidate</td>
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<tr>
<td>School of Education</td>
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<tr>
<td>Stanford University</td>
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<td><strong>Rick Berg</strong></td>
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<td>Web developer</td>
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<td>Children’s Discovery Museum</td>
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<td><strong>Sandy Derby</strong></td>
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<td>Environmental Science Programs</td>
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<td>Children’s Discovery Museum</td>
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<tr>
<td><strong>Teachers and students</strong></td>
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<tr>
<td>Participating BioSITE schools</td>
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<td><strong>LDT Class of 2001</strong></td>
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<tr>
<td>Stanford University</td>
</tr>
</tbody>
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VI. REFERENCES

The following books and articles will be used to inform the design of the product:

LEARNING THEORY


SCIENCE EDUCATION AND TECHNOLOGY


AAAS Standards

National Research Council standards


River Alliance 1998-1999 Progress Summary
http://www.jointventure.org/initiatives/21st/riveralliance9899/


**CURRICULUM DESIGN**


**USE OF TECHNOLOGY IN EDUCATION**


DESIGN


Webb, B.R. (1996). “The role of users in interactive systems design: when computers are theatre, do we want the audience to write the script? Behavior and Information Technology. 15: 2, pp. 76-83.
VII. PRINCIPAL CONTRIBUTOR

CATHERINE L. SOOHOO

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San Jose, CA 95111
408.972.5265
csoohoo@stanford.edu

OBJECTIVE

To design effective, educational products for children through the application of pedagogical and design theory.

EDUCATION

Stanford University, Stanford, CA
M.A. in Education, expected June 2001
- Focus: Learning, Design, and Technology

University of Puget Sound, Tacoma, WA
B.S. in Computer Science, May 2000
- Minor: Biology

TECHNICAL SKILLS

- **Languages:** C++, Java, Visual Basic, Scripting (Java and VB), SQL, HTML, DHTML, CSS, Lingo
- **Applications:** Director, Flash, Dreamweaver, Fireworks, Illustrator, PhotoShop, MS Access, MS Office
- **Other:** Database development, Active Server Pages

EXPERIENCE

Stanford U. Medical Media and Information Technologies, Stanford, CA
Graduate Research Assistant
- Research, design, storyboard, prototype and produce web-based biology labs for Stanford undergraduates.
- Develop a personal learning agent to guide individual student learning of biology content.
- Implement multimedia projects using Flash, Director, PhotoShop, Premiere, and Dreamweaver.

Hewlett-Packard Company, Mountain View, CA
Web Development Intern
- Created databases and dynamic web pages (ASP) to track and maintain records via the web.
- Designed and produced structure and graphics for HP web sites.
- Maintained web servers (MS IIS and Netscape Enterprise Server)
- Generated scripts (Java and Visual Basic) for web site interactivity.

University of Puget Sound Multimedia Lab, Tacoma, WA
Web Developer
- Designed web sites for university courses in collaboration with faculty.
- Developed online collaboration tools for students.
- Enhanced web site interactivity with Flash, JavaScripts, and cookies.
- Wrote and edited technical help guides for faculty members.