Nature field trips go digital

August 30 2013, by Susan Reiss & Maria C. Zacharias

Students explore the pond ecosystem using ECOMobile on smartphones. Credit: EcoMOBILE Project, Harvard University

The buzz around the pond these days isn't coming from bees. It's coming from middle-school students on a data collection field trip to a local pond. But on this trip they've traded paper and pencil for mobile phones and environmental probes. With their smartphones, students access interactive media such as video, audio, 3-D models and animations to

learn about the ecosystem they're visiting as well as answer specific and open-ended questions about their data collection activities. Their probes measure environmental variables that contribute to water quality.

This augmented reality experience is part of a pilot program called EcoMOBILE developed by researchers at Harvard University's Graduate School of Education (HGSE). Funded by NSF and Qualcomm's Wireless Reach Initiative, EcoMOBILE has two goals. The first is to learn how technology impacts learning and the second is to help students connect abstract science concepts learned in the classroom with real-world experiences.

"Technology in and of itself does nothing for learning, but it can be a catalyst," says the project's principal investigator, Christopher Dede, Timothy E. Wirth Professor in Learning Technologies at Harvard. "We're interested in why technology impacts learning as much as whether it does or not. We are always concerned with how effective we can make these technologies and what the limits are."

Augmenting reality

The EcoMOBILE curriculum includes a pre-trip classroom session, one or more field trips and follow-up class sessions. During the initial session, students learn about water quality variables such as pH, dissolved oxygen and turbidity. They also practice using the smartphones and measurement probes they'll use at the pond. During the field trip, students use the mobile phones to navigate to "hotspots" where they collect water samples. The phone software prompts students to make observations about the pond and its organisms; provides information about concepts such as dissolved oxygen; supplies step-by-step instructions for obtaining and testing a water sample; and delivers feedback on the just-completed measurement.

Back in the classroom, students share the observations they made at the pond. They compile their data, creating graphs and calculating the range and mean of each set of measurements. They then discuss their findings and explore why variations may have occurred.

During the EcoMOBILE experience, students proceed at their own pace, personalizing their experience. "This approach engages them to a different degree than other formats," says project co-director Amy Kamarainen, a limnologist (a scientist who studies inland waters). "Students take ownership of the data and experience a new level of responsibility for their work." She adds that the EcoMOBILE experience is like a mini-apprenticeship, allowing students to see science as a creative process. "It helps students enjoy what they're doing but also understand that ecology is a very analytic field."

A smartphone shows a FreshAiR "hotspot" during an EcoMOBILE augmented

reality activity. Credit: EcoMOBILE Project, Harvard University

The technology also helps students study the complex time and spatial scales characteristic of ecosystems. "Ecosystems can be hard to learn about because kids have a limited amount of time to study them," says Kamarainen.

While at the pond, students learn about change over decades by accessing a video that simulates a visitor from 1850 discussing the pond's history. Another activity allows students to view 3-D molecular simulations of ecosystem processes such as photosynthesis.

Simulating reality

EcoMOBILE complements EcoMUVE, a multi-user virtual environment for classrooms created five years ago by Dede and co-principal investigator Tina Grotzer, an associate professor of education at HGSE. "ECOMUVE is like a flight simulator. We can create experiences not found in nature," says Dede. "EcoMOBILE is like flying the plane. You can get very good in the simulator, but ultimately you want to get people to be effective in the real world."

In EcoMUVE students assume a specific role: Water chemist, naturalist, microscopic specialist or private investigator and for eight virtual days are responsible for monitoring and collecting data in their respective areas. Students work in teams to analyze the data and create a concept map that illustrates the cause and effect relationships found in the ecosystem.

Assessing reasoning patterns

EcoMUVE and EcoMOBILE offer an opportunity to assess how students approach situations requiring complex reasoning. "We can look at where kids go in EcoMUVE and what kinds of data they collect. We see that patterns of movement shift," explains Grotzer.

When students first enter the virtual pond their movements are random. After a fish kill, the initial movement patterns give way to more purposeful ones. The changes suggest that students' thinking has changed and they are attending to different features and data sources in the environment says Grotzer, who as director of the NSF-funded "Understandings of Consequence Project" for more than a decade has studied how students reason about complex causal patterns.

Refining the technology for the future

After several years of iterative design, EcoMUVE is available as a free download through a licensing arrangement with Harvard. EcoMOBILE, however, is still under development and available only for research purposes. Although the program, built on the FreshAiR platform, runs on both Android and iPhones, some of the 3-D simulations are only available using Androids.

"We want to be able to make EcoMOBILE customizable," says Shari Metcalf, project co-director. With time, the team anticipates creating a website that would include software templates teachers can download to tailor augmented reality scenarios to their own local ecosystems.

Seventh-grade teacher Allison Kugler has worked with the EcoMOBILE project for three semesters and thinks the technology is a good fit for middle school students. "They want to be challenged but not get frustrated," she says. In a comparison of EcoMUVE and traditional hands-on activities, Kugler found that students had an easier time understanding ecosystem concepts with EcoMUVE.

As applications software becomes more refined and mobile phones more sophisticated, Dede suggests student-directed learning tools like EcoMOBILE will become commonplace. "We can't just keep loading more topics into classroom learning. We need to focus on 24/7 learning," he says. "This is the next frontier."

Provided by National Science Foundation