Augmenting the reality of ecology education

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The Desert Research Institute has limited “green box” lab kits to lend Nevada K-12 schools. Supplementing traditional lessons with computer-based labs may increase access to quality active learning. Credit: The Desert Research Institute

To prep for an Ecology 101 field trip, you might tell your students to strap on some hiking boots and grab a waterproof notebook. But how about a fully-charged smartphone? As mobile devices and computer programming become increasingly ubiquitous, many ecologists are unsure whether to welcome or be wary of new technology in the classroom.

One organized session at the Ecological Society of America Annual Meeting posed the question at the heart of this issue: Cyberlearning and Ecology— Inherent paradox or ripe with potential? The session offered

a smorgasbord of projects that stunningly integrate mobile devices, programming, and new media into ecology education. These were not designers swept away with the tide of compelling new gadgets; rather, each program or app was grounded in a specific goal in ecology education: increasing access in low-income schools, enabling student inquiry, or incorporating location-specific data.

"Mobile technology is definitely an underutilized tool," says Jere Boudell (Clayton State). "Tech is not a replacement, but an enhancement, a new way to engage people."

Access to active learning

For organizer Meghan Collins, of the Desert Research Institute, classroom technology is primarily an issue of equality for underfunded K-12 schools. If a school system doesn't have money for lab supplies, teachers have to choose between paying out-of-pocket or settling for less-effective worksheets and lectures. Collins's survey of Nevada K-12 teachers showed that teachers are interested in supplementing their traditional activities with computer-based lab exercises. "It's not an either/or question for teachers," Collins says. "They want to complement what they're already doing."

DRI currently lends out lab kits, fully stocked with experiment supplies. But these are limited. Traditional lab materials can only physically be in one classroom at a time, so DRI is designing virtual labs for multiple schools to use simultaneously—and they don't incur any shipping costs. Most importantly, virtual labs offer quality educational activities to classrooms that just don't have the money for equipment. "It's not about replacing [traditional labs]," Collins notes. "It's about letting people do something they couldn't do before, especially in K-12."

Non-destructive Tinkering

In a chemistry or physics lab, students can often design and run entire experiments in the course of a week—or even a single class period. Student-run experiments in ecology, however, are often costly and time-consuming, if not physically impossible. Many key concepts in ecology involve decades of observation or large landscapes—neither of which are easy to manipulate.

Virtual labs allow students to tinker and experiment with imaginary ecosystems that resemble their own backyards. In a simulation created by Luanna Prevost, from The University of South Florida, students try alternate methods of controlling an invasive plant before submitting their final management recommendation. Students try adding herbivores, conducting a prescribed burn, or chopping vegetation with machetes, in whatever combination they see fit. In seconds, their experimental plots respond with a year's growth. Simulations such as these aren't designed to teach field skills or practical know-how. They focus instead on letting students explore and manipulate a real-world issue—without disturbing habitats in the process.

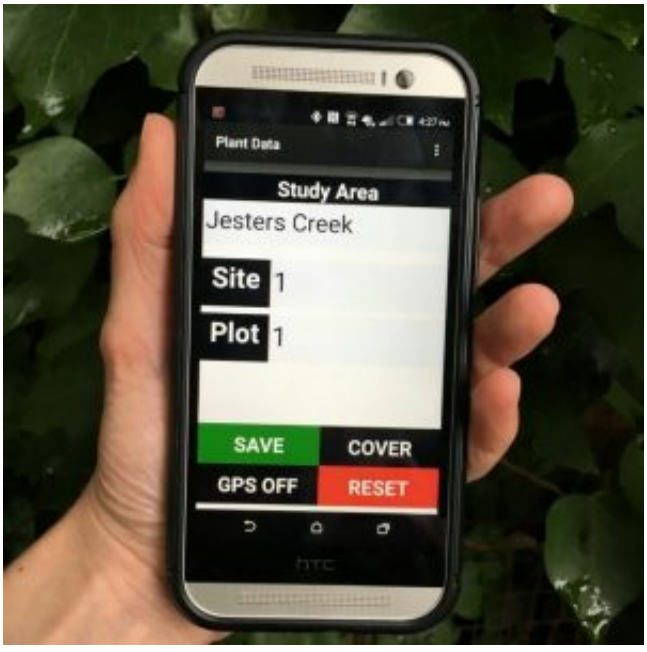
Augmented Reality (AR), GPS tracking, and other mobile features can enhance field trips with location-based inquiry. This Arboretum Living Tour app connects Clayton State Arboretum visitors to plant-specific audio, quizzes, and information. Credit: Jere Boudell

Virtual experiments speed up everything—from planting a virtual common garden, to getting feedback on experimental design. Eli Meir, of SimBio, noted that students developed and retained better experimental design skills when given immediate feedback during a virtual lab. After being introduced to the imaginary world of "Simploids," students designed studies to solve a mystery plaguing the critters. Unlike a conventional lab, students didn't have to wait for instructors to read and comment on their study designs. Experiments lacking replication or controls would trigger an automated prompt to improve the design—stopping bad habits in their tracks.

Location-based inquiry

For many ecologists, the first spark of eco-curiosity came from exploring. The field trip, a long time staple of ecology labs, however, often feels more like a museum tour than an exploration. Amy Kamarainen, of Harvard University, is interested in harnessing the power of mobile technology to put place-based inquiry (literally) in the students' hands during a field trip. After all, why take a tour when you can go on a quest?

When Kamarainen takes students to Black Nook's Pond in Cambridge, MA, they are equipped with both data sensors and smartphones. This project, called EcoMOBILE, uses augmented reality (á la Pokemon Go) to enhance a short data-collection field trip. The students may look like they're playing a game, but they're actually watching a molecule of carbon flow through the ecosystem, overlaid over their own view of the pond. "Hotspots" around the lake prompt students to collect data, answer questions, and share their findings with each other. By sharing real-time data as a group, they are also more able to conceptualize environmental variation that wouldn't be covered in a pre-packaged dataset.



Ecologists can create apps for use in field and lab settings. Jere Boudell's Field Data Collector app is being piloted this summer. Credit: Jere Boudell

Technical difficulties

Not surprisingly, the contributors to this session are already invested in eco-tech. But they're also well aware its limitations. For instance, David Gagnon, of Field Day Labs, noted that adding in a leader scoreboard to the bird ID app WeBird motivated users to collect points, but at the expense of exploring and finding a variety of critters. The long list of eco-apps that sit unused on the iPhone store are evidence that technology alone is not a panacea. Jere Boudell, from Clayton State, argues that successful technology is developed with a task and audience in mind. "It's not a one-size-fits-all scenario," Boudell says. Instead, she likens the variety of program possibilities to diverse organisms. Just like a plant or animal is adapted to survive where it lives, "each app is useful for a specific environment."

Eco-app development often falls solely on the hands of engineers, who may not understand ecologists' needs. Boudell's solution is to teach ecologists to create their own personal apps. Blocks-based programming language like MIT app inventor lowers the entry barrier for new programmers, and events like Eco-Hackathons make it fun and competitive. "It's important to have ecologists as innovators," she says.

Poorly designed programs frustrate students; tech for tech's sake distracts them. When well-designed technology addresses a demonstrated need, however, it can relieve some major headaches for both students and teachers.

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