

Learning About Ecosystems Through Collaborative Augmented Reality Experiences

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Abstract: EcoMOBILE is a new middle school science research curriculum that blends exploration in virtual environments with augmented reality experiences in real world ecosystems. This poster presents examples from the design of EcoMOBILE activities that demonstrate affordances of augmented reality to support collaboration during and after student field trips.

EcoMOBILE (Ecosystems Mobile Outdoor Blended Immersive Learning Environment) is a middle school science curriculum that blends virtual environments in the classroom with field trips to outdoor environments infused with digital resources. EcoMOBILE includes EcoMUVE, an inquiry-based experience in which students explore immersive virtual representations of ecosystems, as well as a complementary set of learning experiences using mobile technologies with augmented reality (AR) during field trips to a real ecosystem. The AR experiences in EcoMOBILE help students to make connections between the models that underlie the virtual environment and the real world around them, through hands-on activities and visualizations that support observation and real-world data collection.

The ability to understand ecosystems is richly enhanced by experiences in real environments. Yet that experience necessarily focuses on what is visible, at that time, in that place. Ecosystem processes are often difficult for students to understand because they are invisible, spatially distributed, and take place over considerable periods of time. Augmented Reality can provide contextualized instruction; visualizations and information triggered by geo-referenced physical locations; and self-directed, self-paced interactive activities, with feedback on student actions and responses (Squire & Jan, 2007; Klopfer, 2008; Dunleavy and Dede in press).

During a field trip, each student or student pair is given a smartphone; students log in to run an EcoMOBILE app. The experience provides self-paced directions and structure, using location-based AR to guide students to specific physical settings (“hotspots”). When students come to a hotspot, interactive content pops up, including text, images, audio, video, and questions (Figure 1). Vision-based targets in the physical environment can also trigger pop-up 3D visualizations or animated models. Students may be assigned complementary roles, using a jigsaw pedagogy with each role visiting a different set of hotspots, or there might be opportunities for students to select which hotspot to visit next; in this way the activities allow for self-directed exploration, while providing context and structure through the smartphone.



Figure 1. Students using EcoMOBILE; Example hotspot.

EcoMOBILE’s design includes two levels of AR experiences, customizable to specific locations and ecosystem features. The introductory experience supports students in observing their local ecosystem more deeply, drawing their attention to relationships among organisms and their environment (e.g., biotic and abiotic factors, habitats, food web), and causal interactions over time and across distance, which may happen at the microscopic or molecular level (e.g., photosynthesis). The second experience focuses on students collecting data about their local ecosystem, and making comparisons with the virtual world they explored with EcoMUVE.

Design for Collaboration

EcoMobile pilot activities included AR affordances targeted to support student collaboration:

- **Prompts for collaboration:** In some experiences students worked with an assigned partner. In others, each student followed a different path, but at a certain point, their phones directed them to a shared hotspot, and prompted sharing the observations made with someone who had different experiences (Figure 2a).
- **Roles and collaborative data:** In some experiences students were assigned to scientific roles, such as “chemist” or “physical geographer” – each role was then responsible for specific observations and data. In order to unlock the next experience, student teams needed to collaborate across roles, sharing data among teammates.
- **Sharing data in the classroom:** Post-field trip classroom activities centered on students sharing the data they had collected. In some cases, this involved plotting data such as pH or dissolved oxygen on a graph for comparison and discussion. In other cases, students collected geo-referenced photos of their observations, which were shared with the class using Google Earth (Figure 2b).

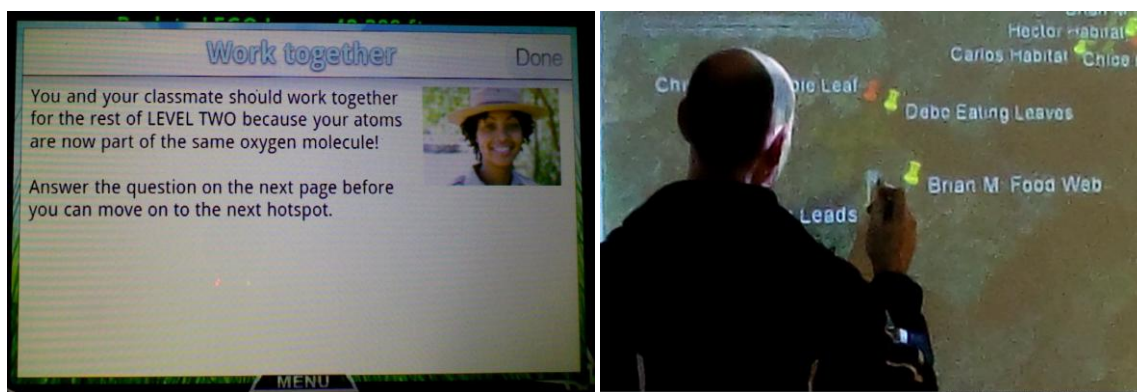


Figure 2. a) prompts for collaboration; b) sharing with Google Earth.

Preliminary results of pilot experiences with EcoMOBILE demonstrate how AR affordances can provide support for collaborative learning through interdependent game mechanisms and role-based activities.

When given the option, students naturally gravitated towards working together. One student explained that, unlike traditional activities, “we went to our friends and classmates first because this was a new experience for us and we are always kind of stuck in the classroom. Usually you go to your teacher because they know what is going on, but because this was a new experience you could go to your friend and be like I can figure this out with you.”

Interviews with pilot teachers found that the smartphones promoted student interaction both with the ecosystem and with their classmates (Kamarainen et al., 2013). One educator commented, “It invited much more student on student dialogue because they had to engage together to sort of figure out things that were coming through to them on the smartphone. So it, in some ways, I thought that their dialogue probably deepened their understanding.” Another teacher described how the impromptu collaborations worked well for his class: “We had kids group up at first with their friends, but then the hotspots would take them to different places, where they would then collaborate with other people who they would normally never work with. So you saw a lot of blending of ‘middle school social castes,’ you know, you’ve got the nerds and the popular kids, all working together, it really kind of leveled the playing field for everybody.”

References

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