'Harvesting' Ecosystem Dynamics Through a Computational Model of a Garden

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Objective: Link Experiential Learning to Classroom Content via Accessible Technological Tool

Rationales for hands-on learning experiences, particularly in extra-curricular environments, abound. Given suitable tools and technology, discoveries made in real-life settings can be built upon and re-visited in the classroom. In particular, this project aims to connect student observations of garden ecosystems to the scientific practices of developing and testing models.

Background: Challenges of Outdoor Education and the Affordances of Agent-based Models

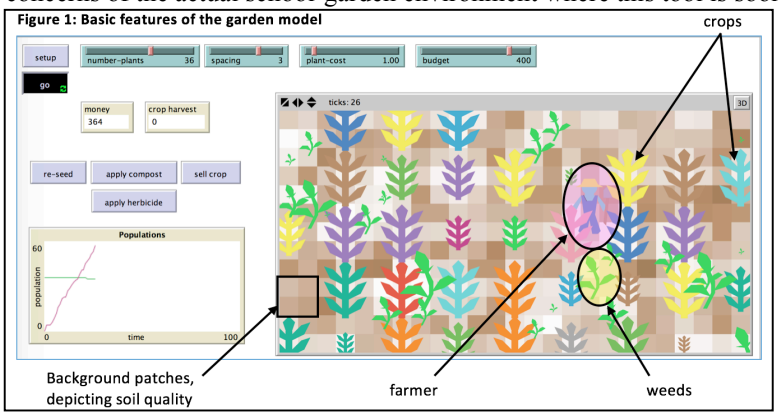
Whereas school gardens have been adopted by many as offering valuable outdoor learning experiences, classroom curriculum is not geared to incorporate the rich academic opportunities that these experiences could potentially offer (Williams & Dixon, 2013). Despite the gardens' numerous psycho-social and nutritional benefits (Ozer, 2007), construction and maintenance of gardens requires dedicated attention, funds, and curriculum, so that teachers and principals hesitate to invest in gardening programs (Graham et al., 2005). With the unveiling of Next Generation Science Standards, teachers are tasked with creating new models of instruction and assessment, yet few structures exist connecting these standards to the outdoor environment.

This project attempts to solve issues both of gardening-based academics and science standards by supplementing these with a third curricular element, computational literacy practices. In particular, agent-based modeling enables students to investigate and reason about complex scientific phenomena, such as garden ecosystems. Used to enrich instruction in many scientific domains, modeling-and-simulation environments such as *NetLogo* (Wilensky, 1999) allow users to manipulate a system's behavioral rules so as to understand how macro-scale phenomena emerge from micro-scale interactions. As a classroom resource, NetLogo models minimize time and space constraints, increase epistemological pluralism, allow for variety in data-driven inferences, and encourage mathematical and computational thinking; these practices are highly aligned with K-12 NGSS (NGSS Lead States, 2013). The models are accessible to a wide range of ages and skill levels and have been shown to deepen and enrich student comprehension of the content they dynamically animate (Wilensky & Reisman, 2006).

Design: Instructional Sequence Incorporating a NetLogo Model of a Garden Ecosystem

For this project, I designed and constructed a model of a garden ecosystem as well as a variety of tasks (see Figure 1, below). Through iterated cycles of prototyping, strategic planning meetings, and debugging sessions, the virtual garden came to life and ultimately became a space to examine soil quality, budgeting, weed growth, and the effects of plant spacing, all real concerns of the actual school-garden environment where this tool is soon to be piloted.

Figure 1: Basic features of the garden model



Toward designing a middle-school gardening unit, I conducted 4 pilot interviews with Grades 6 and 8 students. They were each shown the model, asked to run it a few times under different parameters, and make predictions about the utility of particular functions. They also explored many features and offered their own perceived connections to math and science content. Data analysis revealed students' various strategies for orienting into this virtual environment, as well as the intelligibility of interface features. Ultimately, the model should represent the actual school garden and enable students to simulate its authentic problems through modeling-based inquiry. Ongoing analyses, interface design, and debugging will allow for the continued development of a series of tasks by which students can progress in their knowledge of gardens, science, and computer-based modeling.

Conclusions

Technological tools are important resources for students to avail of learning opportunities inherent to experiential education, while satisfying current academic standards. In designing these resources and their corresponding instructional sequences, the interests and abilities of students and teachers must be simultaneously taken into consideration to promote optimal results.

References

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