

Designing across contexts: Interdisciplinary interpretations of an ecological modeling environment



ecological modeling environment

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Motivation

- Gardens are considered to be a rich environment for learning (accessible to many, culturally inclusive, connects senses and engaging) (Williams & Dixon, 2013), incorporating the sciences, humanities, economics, mathematics, and civic engagement (Ozer, 2007; Ralston, 2011).
- Despite this variability, most research in garden education has been localized within nutrition sciences (Blair, 2009; Graham et al., 2005; Phibbs & Reif, 2005).
- Similarly, computational models, considered powerful tools for enhancing both technical and content knowledge (Harel & Papert, 1990), often remain within one specific domain by design.
- Therefore, this paper explores how a computational model of a garden is interpreted and utilized by different populations.

How can a computational model of a garden consider disciplinary and local contexts to support interdisciplinary instructional goals?

Design Process

A NetLogo (Wilensky, 1999) model of a garden ecosystem was developed with **three intended outcomes**:

1. Connect farming and gardening experiences to the model
2. Bridge across school subjects and/or contexts
3. Develop students' technical competence

Towards these objectives, a variety of features were developed within the model (see "Interface Design", top center) alongside an interview protocol (see "Stakeholders + Interview Protocol", top right).

To broaden the utility of the model, stakeholders representing a variety of teaching disciplines from a school that integrates garden instruction were invited to contribute to the design, so it can evolve to meet a variety of instructional goals.

Users were invited as co-designers (Drain, 2002) to explore the model without explicit directives, applying their own sense-making processes to the interface and code, and suggest feedback for revisions or new features. They were then asked to describe the ways they envisioned the model connecting to curricular content across domains.

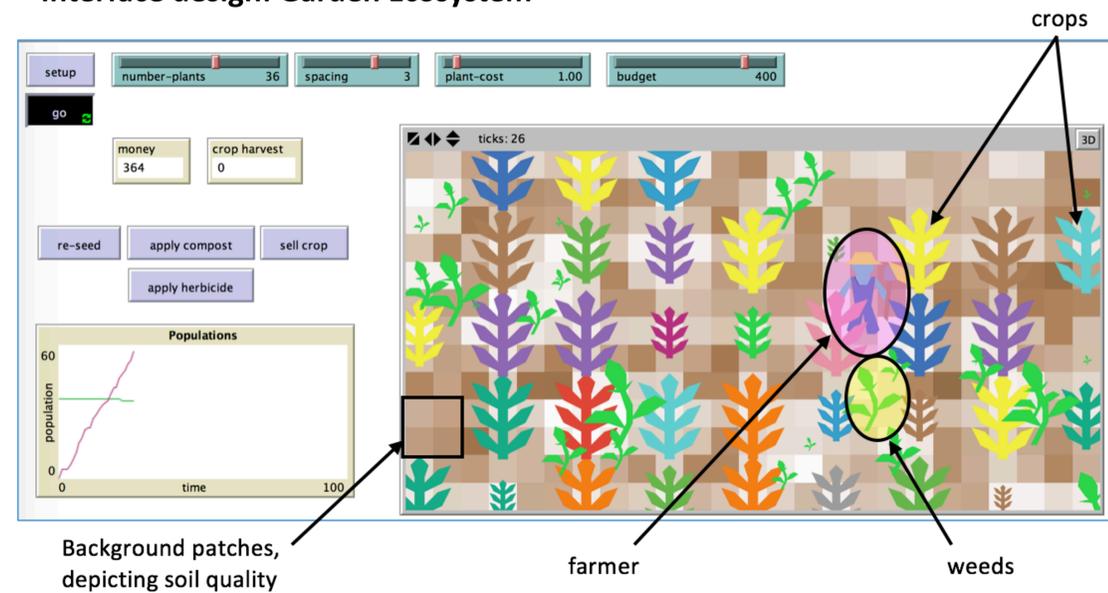
In reviewing the data, the process of **Conjecture mapping** (Sandoval, 2014, see "Analysis" figure) was used to reflect on the **intended** and **emergent** ways of adapting to the model; these were categorized as distinct "Mediating Processes".

For each participant, these were then linked to the "Intended Outcomes" they supported, and traced back to particular "Embodiments" (features of the tool or the interview task) that made them possible.

Literature cited

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Interface design: Garden Ecosystem



Stakeholders & Interview Protocol

Primary site: Public middle school where garden instruction (in school garden) is currently in place to link with academic class activities and curricula.

Participants:

- (4) 6th / 8th grade students with varying garden experience, and limited computer experience
- (4) Middle school teachers (1 math, 1 science, 2 humanities)

Interview: 30-45 minute semi-structured; computer focused, individuals were given a brief tutorial, then explored the dynamics of the simulation, and offered feedback. Teachers were asked to provide any curricular connections they could envision with the model.

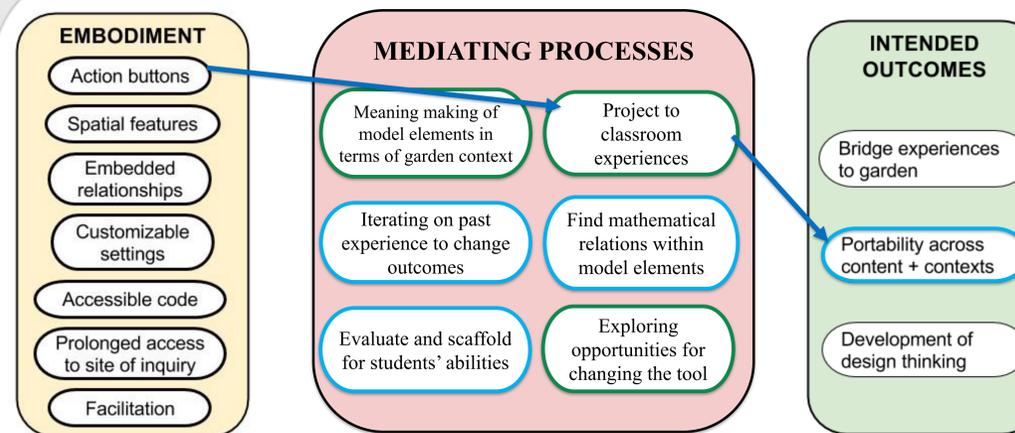
Context: I have served as a garden instructor and curriculum developer with the school for 2+ years.

Secondary site: Non-profit organization that re-contextualizes secondary school content into agricultural-based projects for students in rural communities in Honduras.

Context: I observed trainings and implementation of several science and technology units for another study. In an informal conversation with leaders of the non-profit organization, the simulation was shown and administrators conjectured about the perceived utility of the model for teachers, students, and families in their community. I also have led educational programs building school gardens in rural Nicaragua, a neighboring country.

Analysis and Results

The model was designed with intended outcomes based on particular conjectures, though left open to input from users.



Outline color indicates **intended** vs. **unanticipated** finding

While some mediating processes were anticipated, others were emergent. Some intended outcomes were also achieved or envisioned in unanticipated ways. Embodiments were elicited with varying frequencies.

In one example (shown in the conjecture map), an 8th grade literature teacher reflects on the simulation's potential utility for writing instruction:

"You could do some cause and effect writing, sequencing. Like if you play this game, should you do the compost [button] first, during... Getting them to articulate, how did it feel, did you get stressed? Sentence starters, 'When my weeds kept growing, I felt...'"

The mediating process, projecting to classroom experiences, was intended by the protocol, however this particular outcome for portability was unexpected. The compost feature, an action button, supported this connection.

Generalized Results

1. Simulating a familiar context led to many opportunities for users to make sense of model elements, and evoked several ideas for features or structures to change.
2. Teachers identified content connections within and beyond their domain experiences.
3. The physical garden was seen as both an experimental space to practice learning about the virtual model, and a valued output for implementing skills and knowledge gained through practice simulations.
4. Action buttons and spatial features were the most frequent embodiments that supported learning.

Conclusions and Next steps

Design

- Implement more action buttons, and features that resemble experiences students have in the garden (watering, varieties of crops)
- Develop scaffolds and structures for content-specific instructional entry-points, including describing causal relationships, and mathematical properties within the code.

Research

- Future research will explore the use of the simulation in conjunction with science instruction at the primary site. Using the results as guidelines, tasks will be developed that focus attention on the analysis of key model features.
- A follow up study is in progress for the secondary site, to conduct more in-depth interviews with administrators and teachers about the perceived opportunities for integrating the tool into planning field plots in agricultural lessons.