

# Engineering Learning and Vice Versa

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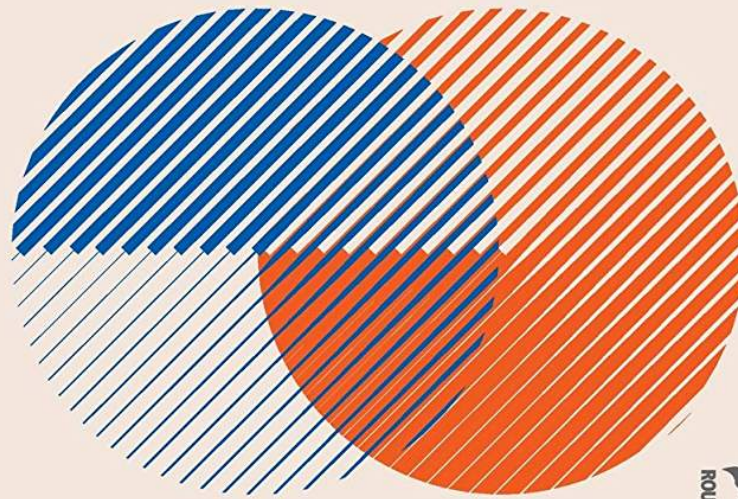
# Engineering Learning

- *Learning Engineering* applies a principled set of evidence-based strategies to the continual re-design of educational experiences to optimize their effectiveness and efficiency.
- “...learning engineers would have several responsibilities. The most important is that, working in collaboration with members of the faculty whose interest they can excite, they design and redesign learning experiences in particular disciplines.” Herbert Simon, 1967

# LEARNING ENGINEERING FOR ONLINE EDUCATION

THEORETICAL CONTEXTS AND  
DESIGN-BASED EXAMPLES

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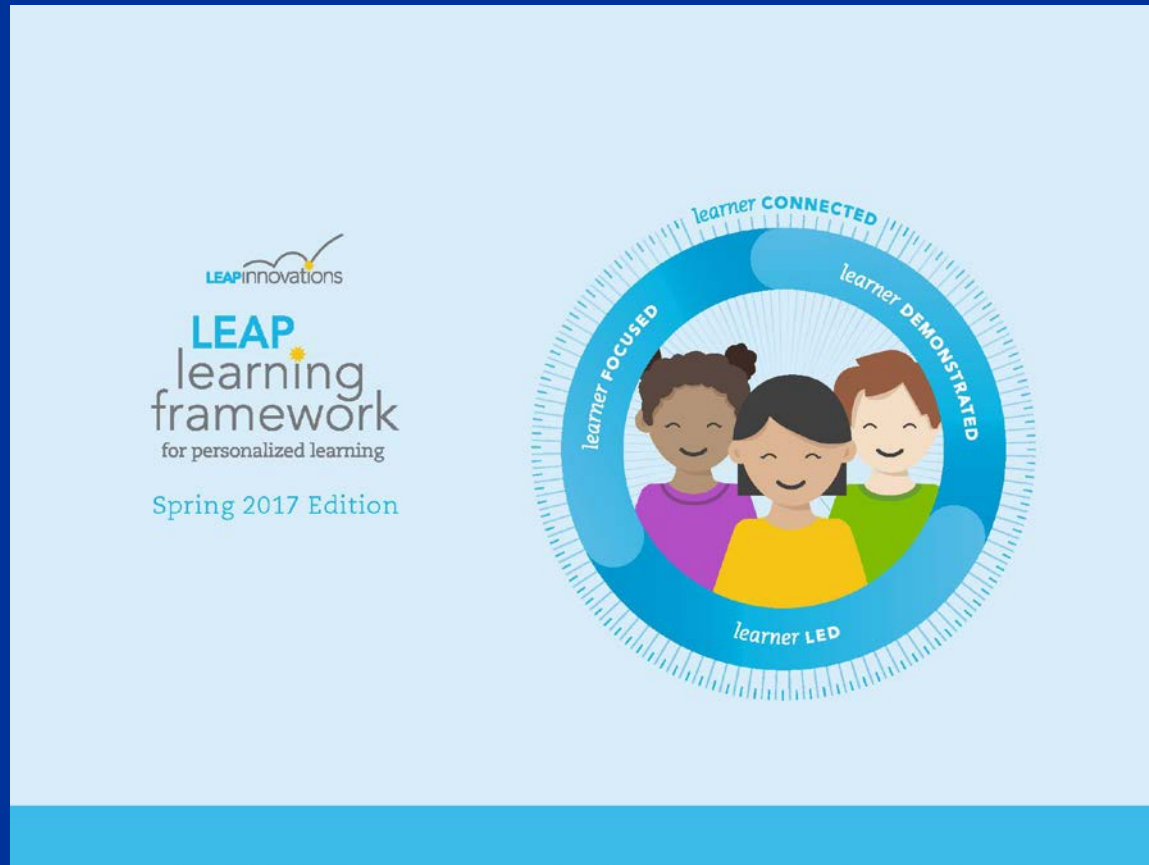


ROUTLEDGE  


# Montessori



# Co-Engineering Learning



LEAP Innovations  
Personalized Learning Framework

# <http://ecolearn.gse.harvard.edu>

ecoMUVE

ecoMOBILE

ecoXPT

ecoMOD

PROJECT MEMBERS

PUBLICATIONS

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Welcome. EcoLearn is an educational research group at the Harvard Graduate School of Education that explores the use of advanced immersive technologies to support learning about the complex causal dynamics of ecosystems.



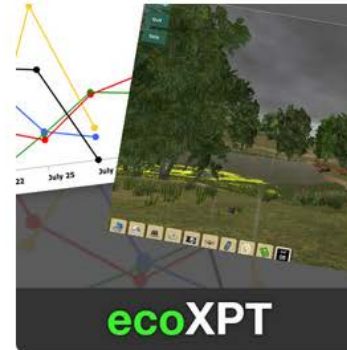
**ecoMUVE**

EcoMUVE is a curriculum that uses immersive virtual environments to teach middle school students about ecosystems and causal patterns.



**ecoMOBILE**

EcoMOBILE is an extension of the EcoMUVE curriculum that blends immersive virtual environments and real ecosystems infused with digital resources.



**ecoXPT**

EcoXPT is a new project being designed to work alongside EcoMUVE to support experiment-based inquiry in immersive virtual environments.

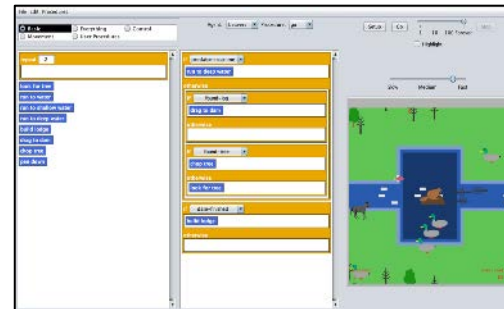
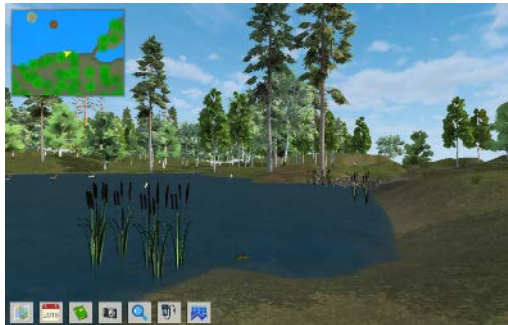


**ecoMOD**

The EcoMOD project will explore the power of immersive virtual environments to support computational thinking and ecosystem science learning in elementary grades.

# EcoMOD: Integrating Immersive Virtual Worlds and Computational Modeling for Ecosystems Science Learning

- 15 day curriculum
- Blends immersive virtual environments with computational modeling
- Supports the development of computational thinking, causal explanations and ecosystems science concepts in 3<sup>rd</sup> graders.





# Supporting Modeling by blending Immersive Ecosystems with Programming

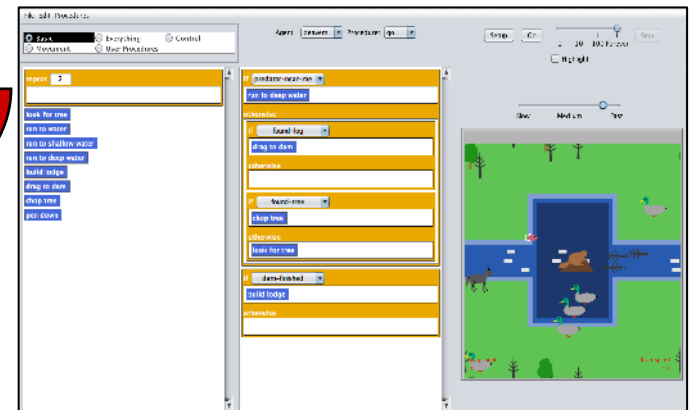
## Immersive World:

“Expert” model of a real ecosystem  
Observation and Data Collection  
Develop theories and build causal relationships



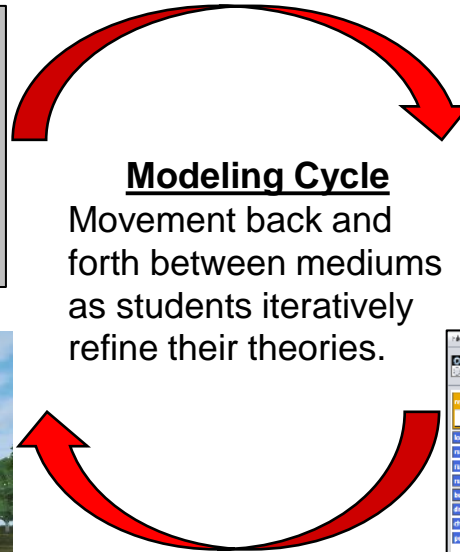
## 2D Programming Environment:

Test theories by programming the behavior of agents in the system, and assessing how well the computer model “fits” with the virtual one.



## Modeling Cycle

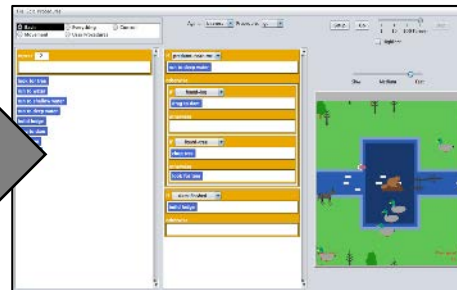
Movement back and forth between mediums as students iteratively refine their theories.





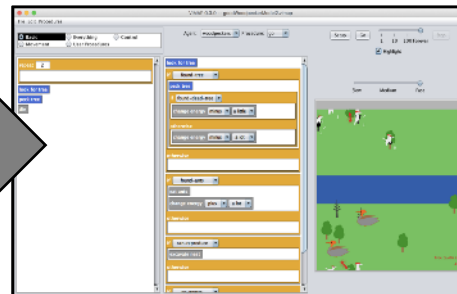
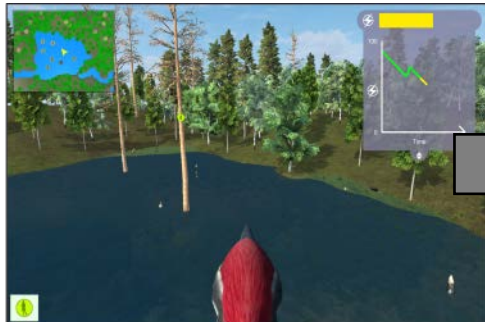
# (Virtual) Embodied modeling to scaffold agent-based programming

- Virtual Embodiment scaffolds student programming work



“You have to see through the eyes of the beaver”

-Grade 3 student



# We can personalize along many dimensions

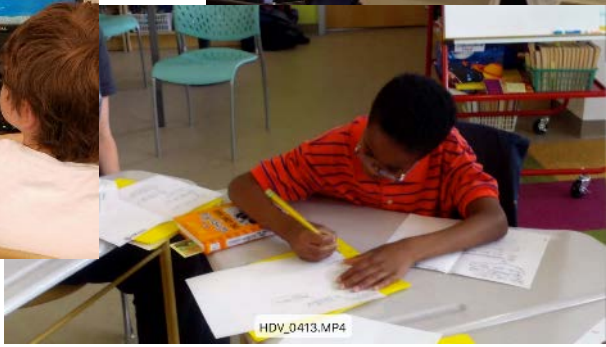
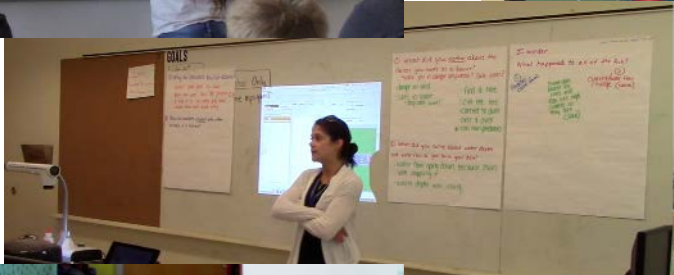
We need to observe, document, measure to create “standards”

- Time, place, path, pace
- Student choice over how to learn, choice over what to learn
- Student voice
- Learner connected, learner focused, learner demonstrated, learner led
- Social-emotional learning, cognitive domain, executive function, student background

```

look for tree
if found-dead-tree
  peck tree
  if found-ants
    eat ants
    change energy plus a little
  otherwise
    if can-reproduce
      excavate nest
    otherwise
      look for tree
  look for tree
otherwise
  if no-energy
    die
  otherwise
    look for tree
if found-live-tree
  look for tree
  change energy minus a lot
otherwise
  look for tree
  look for tree
  change

```



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# Tools for Transformational Insights

