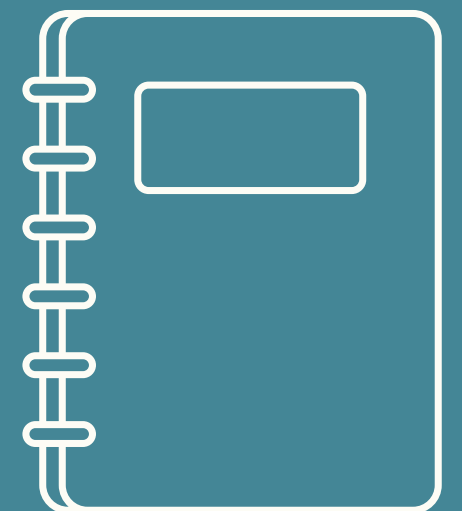


# Can simulation help us get to real-world sustainability?

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# Research Context


A 2024 review found that while making activities effectively enhance student learning, further research is needed to develop practical guidelines for integrating them into higher education curricula.

Pallaris , G., Zaphiris, P., & Parmaxi , A. (2024). Mapping the landscape of Makerspaces in higher education: an inventory of research findings. *Interactive Technology and Smart Education.*, 21(1), 1 –20. <https://doi.org/10.1108/ITSE-01-2022-0013>





# Educational Context

- **Sustainability 201** : foundational course within a Sustainability Certificate at MacEwan University
  - Primarily online delivery (50 students per section; 7 sections)
  - Winter 2026 - Pilot hybrid delivery (30 students; 1 section)
  - Student population: Year 1 -5, full-time degree and diploma students across disciplines
- 

# Systems Thinking Is...

Analyzing problems by identifying connections, causal relationships, feedback loops, and leverage points.

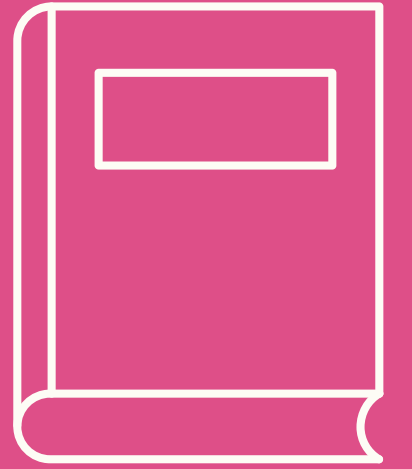
## It Supports...

- Understanding how systems function, change over time, and how different parts are interconnected, patterns.
- Evaluating how changes impact entire systems and groups, and how effects may interact and vary over time (emergent properties).
- Integrating multiple perspectives and recognizing the influence of culture and history.

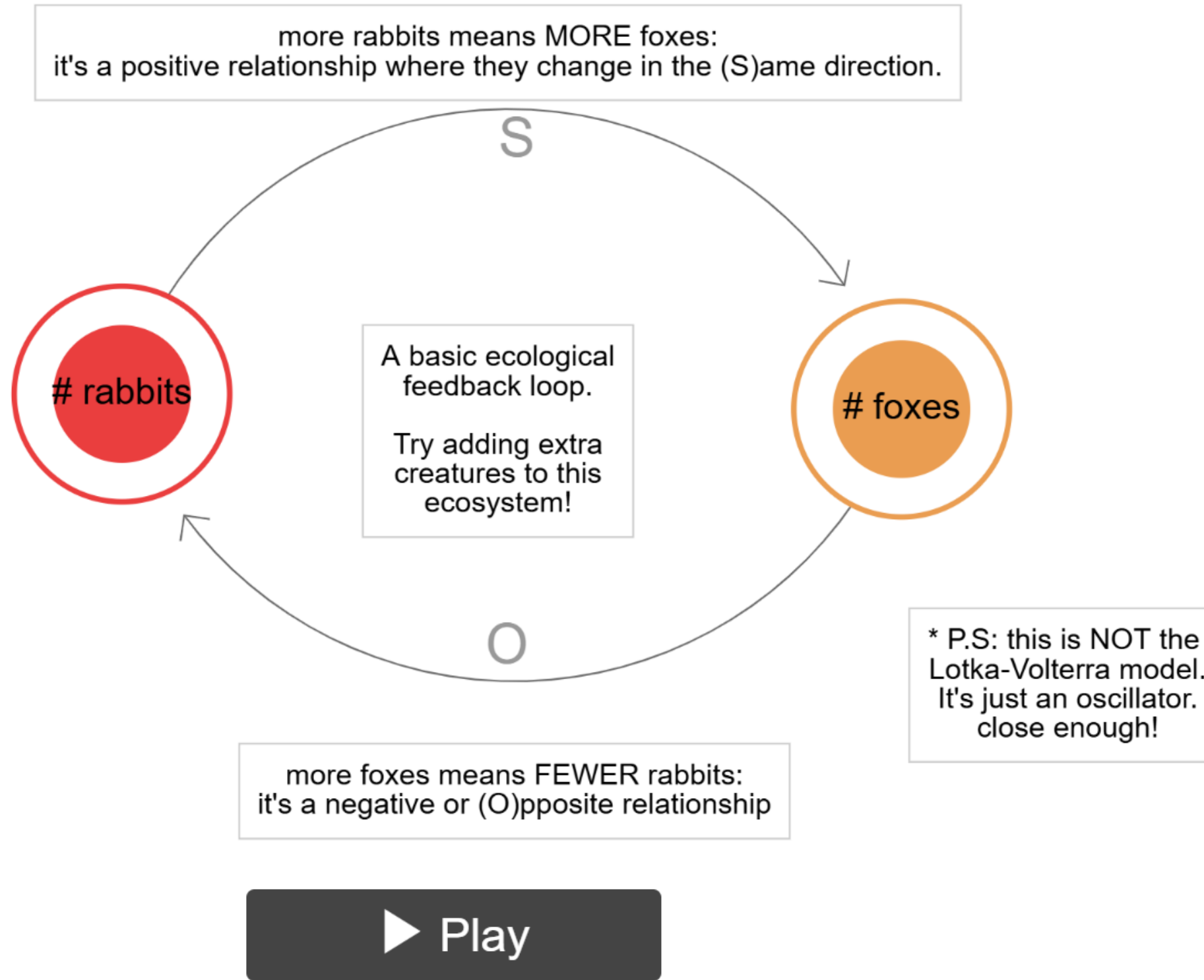
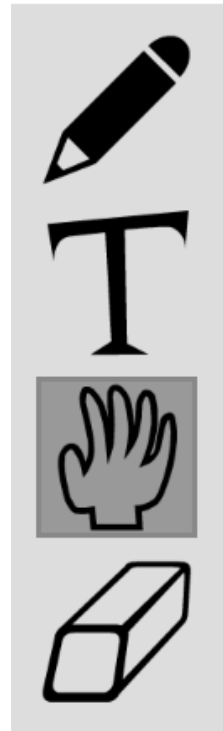


# Pedagogy– Assignment

- Focus on *doing* systems thinking rather than observing completed examples
- Systems Mapping Assignment: Students build, test, revise, and reflect on their own system models and compare to a peer's
- Errors and revisions are treated as essential learning moments



# Simulation Intervention - Loopy



[Loopy Link](#)



LOOPY (v1.1)  
a tool for thinking in systems

[tutorial](#) [see examples](#) [how to](#)  
[credits](#)

[save as link](#)

[save as file](#) [load from file](#)

[make a GIF using LICEcap](#)

Zoom:

[zoom in \(+\)](#) [zoom out \(-\)](#)

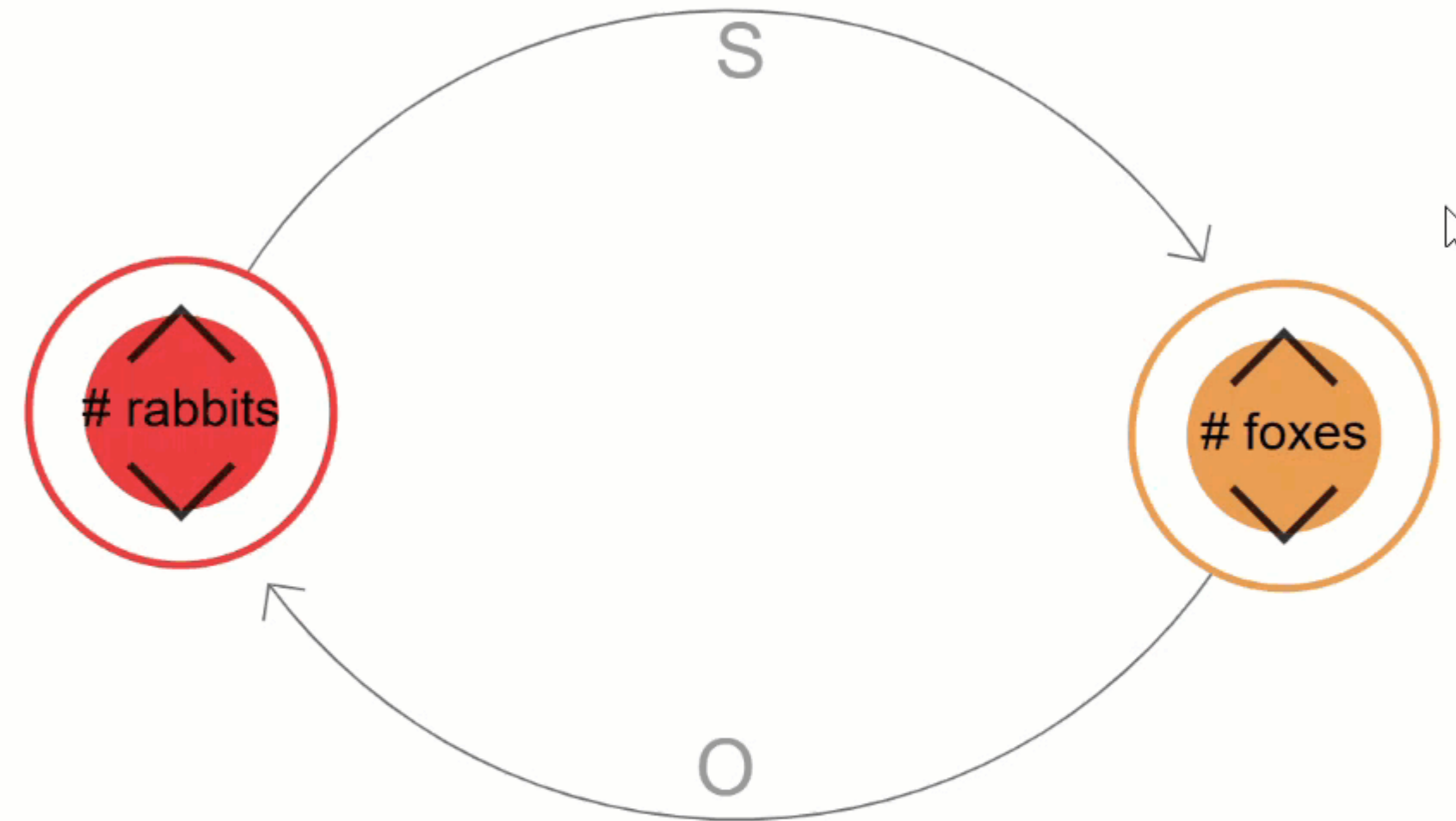
[reset zoom](#)

[clear canvas](#)

LOOPY is made by [nicky case](#)  
Modified by Matthieu Woo for  
Mas Frensham University

# Balancing Loop Simulation

more rabbits means MORE foxes:  
it's a positive relationship where they change in the (S)ame direction.



more foxes means FEWER rabbits:  
it's a negative or (O)pposite relationship



# Methodology

ULTIMATE

Quasi-Experimental Comparison -  
controlling for course delivery,  
pedagogy, content, and assignment.

10 sections - 500 students total  
5 control  
5 Intervention

Collecting Assignments as data  
+ Prof. Interviews  
Quantitative Analysis + Qualitative  
Analysis

Exploratory Qualitative Study

Under 50 students - variety of  
course settings

Collecting Assignment + Post  
Assignment Student Survey Data +  
Prof. Interviews + Qualitative  
Analysis

PRELIMINARY

# Analysis

**Structure of the Observed Learning Outcome (SOLO) Taxonomy** to categorize student descriptions of feedback loops and leverage point impacts.

1. **Prestructural** - Recall rules
2. **Unistructural** - Identify a singular understanding of how the loop works.
3. **Multistructural** - Describe multiple causal connections between elements and if the loop is balancing or reinforcing.
4. **Relational** - Everything in 3 plus how those concepts are interrelated as part of the whole.
5. **Extended** - theorize about implications beyond

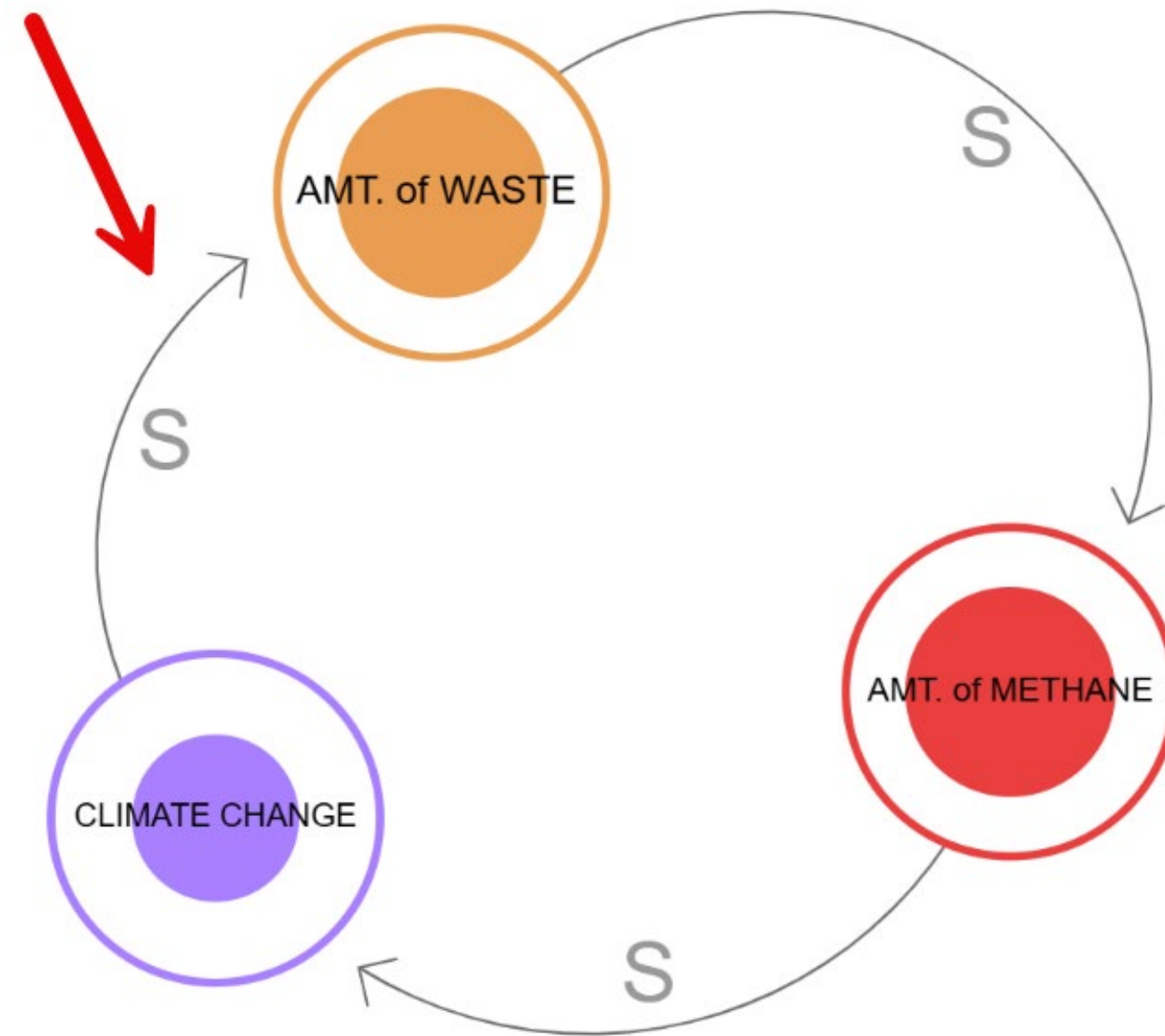


# Initial Observations

- Student reported no difficulty using the tool, but did report a feeling of frustration when the simulation did not match their mental model.
- Student demonstrated strong performance on surface competencies such as labelling, applying basic rules and concepts to build their feedback loops.
- Deeper causal reasoning remains inconsistent. The majority of students provide unistructural descriptions (SOLO 2, while some are 3 -5).
- More students did not identify their causal mistakes than did.
- The majority of students thought Loopy contributed to their confidence and understanding, but some did not. This does not appear to be connected to performance on the assignment.
- Students' descriptions often did not match their diagrams.



# Example Causal Error- Tail / Head

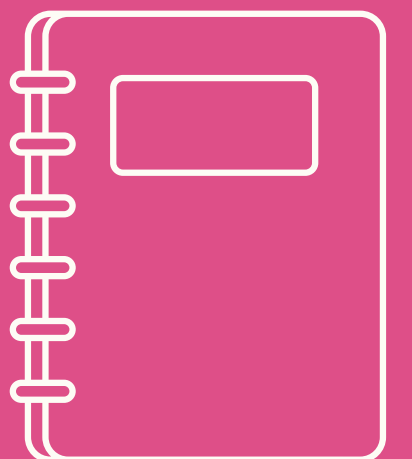


# Initial Insights

Making mistakes and revising in class was key for illustrating the mapping process as well as for using the simulation tool.

Considering background knowledge is critical for systems thinking and simulation because the boundaries are not always clear and often knowledge outside of the immediate scenario is called upon.

Potential areas for future investigation:  
Loopy may have helped some students understand change over time and delays in loops better.



# Student Advice to Future Students

This course may challenge the way you think, and at times it can feel overwhelming because sustainability problems are complex and interconnected. But that is also the point. You are not expected to solve everything on your own. You are learning to think more thoughtfully.

One thing to know is that systems thinking is a big deal in this course. Pay attention to relationships and feedback loops. Try to ask yourself not just “what is happening?” but also “why is this happening?” and “what is connected to it?” That way of thinking really helps with assignments and makes the course easier.

Overall, SUST 201 taught me to think more critically, notice connections I would have ignored before, and reflect more deeply on what real change looks like.



# Opportunities

Do you teach a tricky concept that could be improved by simulation?

Would you like to do research together?

Would you be interested in talking more about immersive/experiential/constructionist learning?

Would you be interested in a making or systems thinking workshop for your colleagues or a class?

# Get in touch!

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