Redesigning an Interdisciplinary Food Course from a Systems Thinking Perspective

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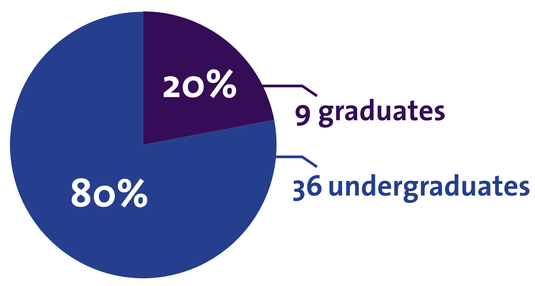
Introduction | Food, Ecology, and Globalization

- Taught from 2011-2015 as a broad survey course for science and non-science majors with a focus on the factors that influence food choice and the implications of those choices at many scales.
- Redesigned in 2017 & 2018 to integrate an interdisciplinary perspective on food with a systems thinking lens and turn the following recurrent challenges in the course into opportunities:
  - » Students' varied academic backgrounds
  - » Limited process skills such as critical thinking, in many students
  - » Students' difficulty making connections between course content elements, e.g., links between climate change and agriculture

45 students



Student Majors/MA programs

- Biology
- Biochemistry
- Conservation Biology *
- Environmental Biology
- Evolutionary Biology
- Sustainable Development
- Sustainability Management *
- Urban Studies
- Anthropology
- Science Journalism
- Political Science
- Business Management
- English Literature

*Masters level programs

The four main areas of focus for the redesigned course:

Aim 1 | Build skills in critical thinking (CT), evaluating claims & assessing evidence

Students completed:

a **Journal** on how they assess claims about food.

b **Written assignment** on a popular media article or fictional press release.

c **In-class snowball exercise** to collectively analyze pre-selected claims about food and the environment, applying CT skills and scientific analysis.

d **Second written assignment** on claim assessment.

e **Second journal entry** on progress in developing their CT skills.

Aim 2 | Build skills in systems thinking (ST)

2017: 3-part assignment to build ST skills using Mental Modeler software (MM):

In class	*In class*	*In class*
Introduction to ST & ST tools, including MM	*MM exercise and content on applied ST, leverage points, & tradeoffs*	*MM exercise and content on boundaries & uncertainty in ST and peer-review cycle on Part II*
Part I Use MM to model the US food system & answer questions.	**Part II** Use skills to create second mental model of the US food system & answer questions requiring more in-depth application of ST.	**Part III** Use MM to create final model of US food system, with credible evidence to support model structure and function, and using scenario analysis to model system behavior and analyze leverage points and tradeoffs.

2018: one capstone MM assignment following in-class skill building

Students completed a third journal to reflect on the progression of their CT skills (Aim 1) and ST skills (Aim 2).

Aim 3 | Shift to a pedagogical approach where students review preparatory material prior to class and work in small groups in class to deepen their understanding

Aim 4 | Accommodate and embrace different levels of content knowledge

- **We used innovative tools to bridge different levels of content knowledge**, such as a prerecorded DIY video on the technical background of biotechnology and genetically modified organisms. To determine learning outcomes from the video, students conducted pre- and post-assessments, then discussed the assessments in class and worked in small groups to critically assess a publication by the National Academy of Sciences on the topic.
- **We offered choices in assignments** that allowed students of different levels to select the best options for applying their newfound knowledge and skills.

Results

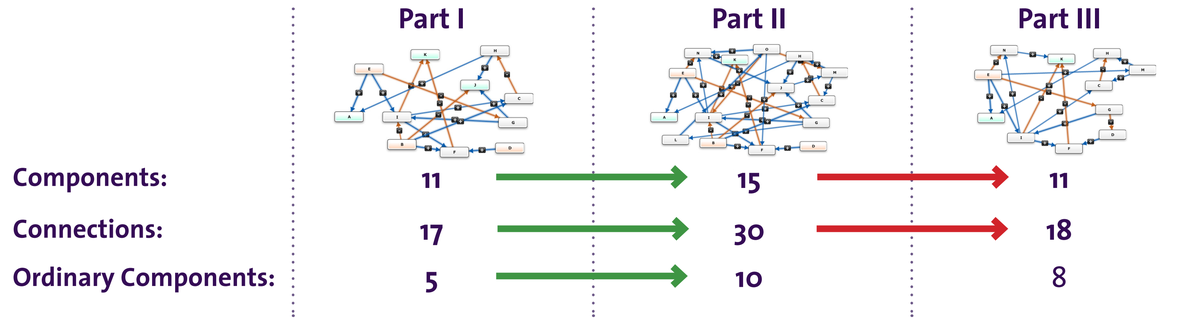
Assessed from: reflection-based journals; graded and ungraded assignments; meetings with students; and peer and course evaluations.

- Students showed improvement in CT skills as demonstrated in the sequence of claims assessment assignments; in the biotechnology course unit; and in their final projects.

In 2017, grade average across the class increased by 1.4% between assignments

- **Journal entry quotes:**
  - » *"The course taught me not just topics to think about, but how to think critically and assess claims, in a pedagogical and practiced manner"*
  - » *"The journaling process for these claims assessment assignments was one of the better formative learning experiences I have had"*

- Analysis of conceptual change over 3 - part assignment: Stylized Model. Arrows indicate significant differences (green/increase, red/decrease, $p < 0.10$) from paired sample t test comparing a sub-sample of students models (Part I vs Part II and Part II vs Part III) in terms of structural metrics of the models.



Other non-significant metrics: Density, Connections per Component, Drivers, Receivers, and Complexity

- **Journal entry quotes:**
  - » *"I really enjoy the multi-disciplinary approach of ST. It is really cool to be able to learn about so many different facets of one complex system."*
  - » *"I would like to continue exploring the concept of ST and apply the skills I learned to my professional and academic work."*
  - » 100% of students showed improvement in their pre and post assessments: *"It was really helpful to assess my baseline knowledge before watching the information-packed biotechnology video; and satisfying to correct my answers in the post assessment."*
  - » *"This is a great class for practicing working in groups."*
  - » *"I appreciated your providing choices in the assignments for those of us with less training in the sciences."*
  - » *"This is by far my favorite class that I've taken at Columbia..... I liked the mix of lectures, group work, readings, and mental mapping."*

Next Steps

The results from this redesign will inform several initiatives to rethink food systems pedagogy, including:

- A Community of Practice on integrating ST into food systems teaching
- A NSF-funded initiative to research ST learning progressions and assessment dimensions
- Open-access teaching resources developed through the Network of Conservation Educators and Practitioners

Works cited

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Further Information

- Teaching Food Systems Community of Practice https://www.ihn.cumc.columbia.edu/food-systems-workshop-community-practice
- Network of Conservation Educators and Practitioners (Center for Biodiversity and Conservation at the American Museum of Natural History) https://ncep.amnh.org/
- Mental Modeler software: http://www.mentalmodeler.org/

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