Teaching tools for agricultural literacy and science-informed decision-making

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Flagship course required by all majors in the College of Ag Sci & Natural Resources

~600 students per year

Science and Decision-making for a Complex World

Most common majors in Fall 2014:

Hospitality, Restaurant & Tourism Management	17%
Animal Science	12%
Pre-Veterinary Medicine	12%
Agricultural Business	7%
Forensic Science	7%
Fisheries & Wildlife	5%

(the remaining 40% comprises 28 other majors)

University of Nebraska Lincoln

Supporting students' science literacy

- Science literacy defined: "the knowledge and understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity" NRC National Sci Ed Standards
- "You can know all you need to know about your world and still not know what to do, which choices to make" Mullen & Roth, 1991

- We decided to focus on student *practices* rather than content knowledge

Science Literacy Learning Goals

Decision-making:
Supporting an opinion using both values and scientific information

Media Literacy:
Access and evaluate popular and scientific media

Socioscientific issues




Dauer & Forbes, *accepted* SECEIJ

Structure of the class

Each academic year:

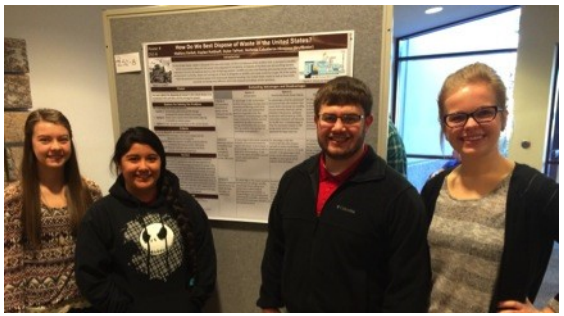
- 600 students
- 5 lecture sections (active learning strategies, peer learning)
- 5 other faculty instructors
- 10-14 Graduate student Learning Assistants

Learning Tasks

Unit Assessments

- Evaluating claims and evidence in popular media & peer-reviewed journal articles
- Seeking and applying relevant scientific information
- Making an argument about what we should do about an issue using a statement of values and substantiated information

Final group project



Preliminary Results from Fall 2014 Pilot year

- Students needed more support integrating values and scientific evidence into their argument about a solution
- Students viewed problems as black and white with single solutions

Two types of decision-making

Informal decision-making

- Used to make thousands of decisions on a daily basis
- Uses emotive, intuitive and cognitive reasoning
- Does not notice uncertainty
- Subject to cognitive biases
- Based on “value judgments”

Formal decision-making

- Most important to use with challenging, ill-structured problems
- Uses deliberate, rational and effortful reasoning
- Notices uncertainty
- Tools are used to reduce cognitive biases
- Based on optimizing a suite of values

Arvai et al 2004; Hammond et al 1999; Kahneman, 2011; Gregory et al 2012; Covitt et al 2013
Dauer, Lute, Straka submitted

Framework for Decision-Making

1. **Options**: What are the options?
2. **Criteria**: How are you going to choose between these options?
3. **Information**: What additional information do you need to help you make the decision? What is the scientific evidence involved?
4. **Analysis**: Discuss each option weighed against the criteria.
5. **Choice**: Which option do you choose?
6. **Review**: What do you think of the decision you have made? How could you improve the way you made the decision?

Ratcliffe, 1997; Grace, 2009

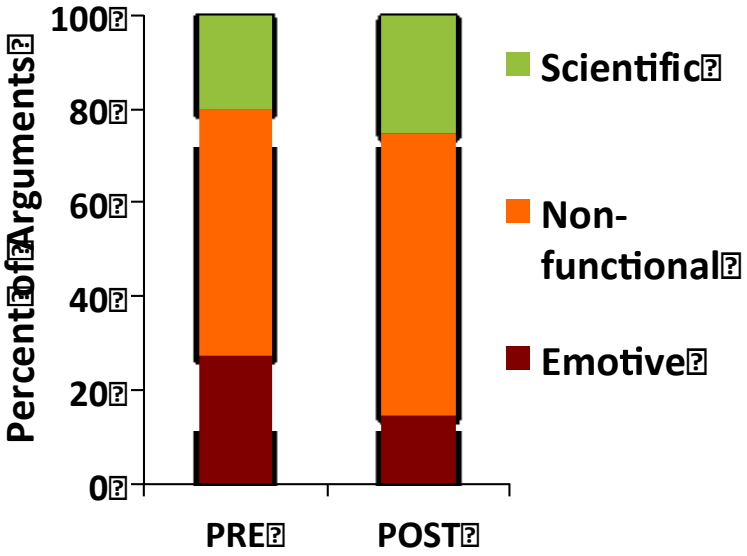
Research measuring student science-informed decision-making

- Does the course influence student's personal reasoning in support of "what we should do" about an issue?
- Is there a connection between student values and decision-making?
- What resources (scientific, in or outside of class) do students use to support their decisions?

Does the course influence students' personal reasoning?

Pre/post assessment:
"Should we burn corn ethanol for energy?"
"Why should we do it/not do it?"

Olivia Straka, Undergrad Researcher



After the class students were more likely to:

- consider potential environmental and social consequences to biofuels
- recommend alternative solutions

Fall 2015, *n*=66

Argumentation type based on Kuhn, 1997

Dauer, Lute, Straka (*submitted*)

Research findings summary

- Some evidence that the class overall supports students' reasoning about tradeoffs, consequences and alternative solutions
- More research is needed to understand
  - if student learning in the course transfers to their informal reasoning in personal decision-making
  - how well the six-step heuristic supports students formal decision-making processes

Supporting students' science literacy practices

- We are using innovative teaching tools designed to support students decision-making practices.
- Studies are underway to determine students' learning and the effectiveness of the course tools.

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Research
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Socioscientific Issues Context

3-4 issues covered every semester

- Should we further restrict the amount of irrigation in Nebraska?
- Should we use corn ethanol as a biofuel?
- Should we hunt mountain lions in Nebraska?
- Should we conserve prairie dogs?
- Should we eat organic food?
- Should we do more to reduce food insecurity in the U.S., and what should we do?

What resources do students use to support their decisions about a water-based SSI?

Qualitative analysis of interviews indicated:

- Students used resources from class to state and to support their opinion generally
- Students not use resources from class when asked to make a decision regarding voting on that issue

Jaime Sabel,
PhD student

Sabel, Dauer, Vo, Alred, Forbes (*submitted*)

Is there a connection between student values and decision-making?

Value orientation of the students:

- Altruistic (mean 5.14)
- Biospheric (mean 5.07)
- Egoistic (mean 3.97)

Presence of ecological "criteria" in 7 decision-making steps were not explained by students' value orientation, ecology knowledge, gender, or rural background.

Ashley Alred,
MS student

How do students' "criteria" play a role in decision-making about hunting mountain lions in Nebraska?