



Fostering Undergraduate Students' Disciplinary Learning and Water Literacy

Cory Forbes^{1,2}, Nick Brozović^{2,3}, Trenton Franz^{1,2}, Diane Lally¹, Destini Petitt¹

University of Nebraska-Lincoln

¹School of Natural Resources ²Water for Food Global Institute ³Dept. of Agricultural Economics



RATIONALE

- Water resource use and management is critical issue in the 21st Century - the 'Water Century' - in which "ensuring an adequate quantity and quality of freshwater for sustaining all forms of life is a growing challenge" (National Science Foundation, 2005, pg. 6)
- These challenges have led to increasing emphasis on systemic STEM education reform at the post-secondary level (National Research Council, 2012)
- Research has shown that water literacy in the United States remains underdeveloped
- Many studies of STEM-informed decision-making have been conducted at the K-12 level (Christensen & Rundgren, 2015; Eggert & Bögeholz, 2009; Grace, 2009; Grace & Ratcliffe, 2002; Gresch & Bögeholz, 2013; Gresch et al., 2013; Jiménez-Aleixandre, 2002; Seethaler & Linn, 2004; Siegel, 2006) but fewer such studies have been conducted with undergraduate students (Halverson et al., 2009; Sadler & Zeidler, 2005)
- More work is therefore needed to understand of STEM-informed decision-making about water issues among undergraduate students

CONCEPTUAL FRAMEWORK

Water Literacy

An enhanced capacity, both at the individual and collective levels, to make effective decisions grounded in STEM-informed analyses of complex, real-world challenges associated with socio-hydrological systems

- Component of science literacy in the Food-Energy-Water-Nexus
- Grounded in broader perspectives on science literacy
 - Science education (Bybee, McCrae, Laurie, 2009; Feinstein, 2010; Rudolph, 2014)
 - Decision sciences (Arvai et al., 2004)

"Wide Dynamic" View of Interdisciplinary Teaching and Learning about Water

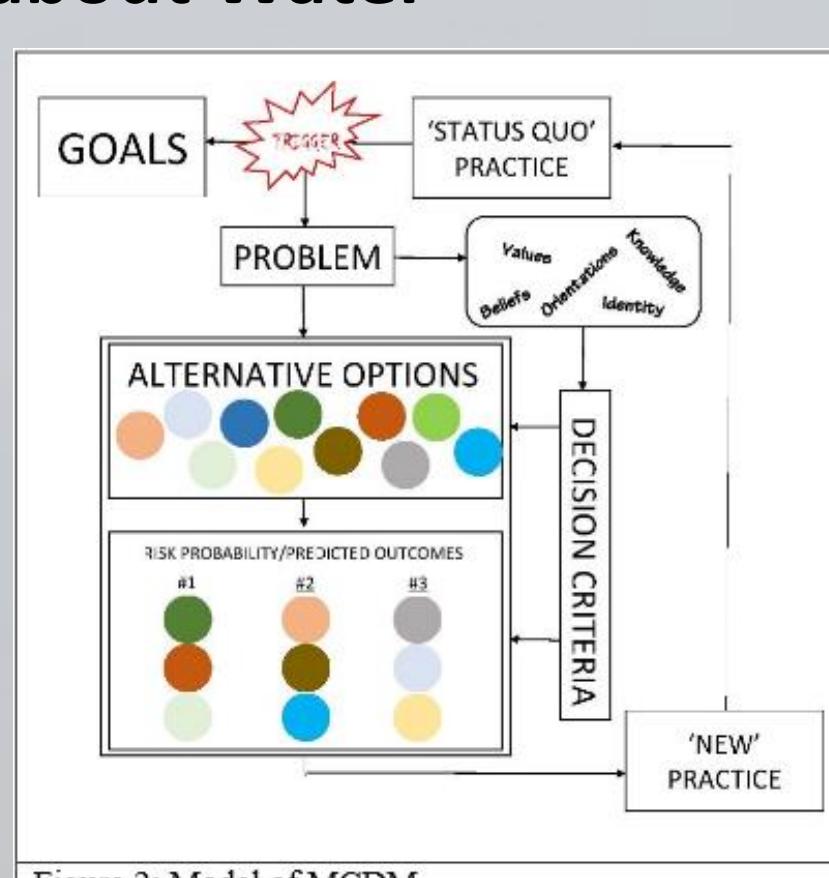


Figure 1: Wide Dynamic View (King et al., 2012)

Framework for Multi-Criteria Decision-Making about Water Issues



Figure 2: Model of MCDM

PROJECT LOGIC MODEL

Project Goals

- Support undergraduate students' learning to engage in STEM-informed analyses of socio-hydrological systems through instructional design
- Empirical research to better understand the nature of, and strategies to support, undergraduate students' learning of disciplinary concepts and decision-making competencies

Inputs

Forbes & Brozovic (instructors)

Graduate student

Theoretical framework

Prior research

Institutional priorities

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Course Elements

Structured decision-making tasks

Authentic, real-world challenges/problems

Decision-making heuristics

Instructional and curricular supports

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Outputs

200 undergraduate students

Instructional materials and strategies

Results from empirical research

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Project Research/Evaluation

Outcomes

Short-term

Improved STEM-informed analyses of socio-hydrological systems (students)

Empirically- and theoretically-informed SCIL 109 course

Long-term

Improved science literacy in the United States

Increased capacity for fostering science literacy amongst undergraduates

SCIL/AECN/NRES 109 – Water in Society

- New, interdisciplinary, introductory-level water course serving both STEM majors and non-majors at UNL
- General education course focused on global and local issues related to water and its role in society
- Two course objectives:
 - Explain fundamental hydrologic concepts and engage in scientific practices, including posing and answering scientific questions, exploring phenomena, analyzing and making inferences from data, and determining validity of conclusions
 - Engage effectively in principled analysis of and reasoning about socio-hydrologic systems, including their scientific, ethical, social, economic, cultural, and civic dimensions, to make informed decisions about water issues
- General education requirements
 - ACE #4** - Use scientific methods and knowledge of the natural and physical world to address problems through inquiry, interpretation, analysis, and the making of inferences from data, to determine whether conclusions or solutions are reasonable.
 - ACE #8** - Explain ethical principles, civics, and stewardship, and their importance to society.
- Course highlights
 - Use computer-based models and simulations to learn core, introductory hydroscience concepts
 - Engage with contemporary economic, policy, social, and cultural dimensions of water
 - Benefit from expertise of scientific, communications, and industry experts
 - Use structured decision-making frameworks to propose solutions to local, regional, and global water challenges
 - Participate in site visits and field trips to local municipal water facilities
 - Work in small-group teams to conduct independent research
 - Present coursework to scientists, policymakers, and stakeholders at the Water for Food Global conference

RESEARCH

- DISCIPLINE- and DESIGN-based education research (D²BER)
- Iterative, empirically-based course development
- Research questions
 - To what extent do undergraduate students learn to engage in more effective decision-making about socio-hydrological issues?
 - How do undergraduate students engage in decision-making about socio-hydrological issues? Which course- and student-level factors influence their STEM-informed decision-making?
- Pre-/post-course evaluation
 - Assessment of core, introductory hydroscience concepts
 - Inventories of Basic Dispositions (IBD)* for General Science
 - Decision making tasks
 - Clinical interviews

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