Water in Society: Interdisciplinary Undergraduate Teaching and Learning about Water

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Earth Educators Rendezvous
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Why this new course?

• “All human and natural systems are influenced by the distribution, abundance, quality, and accessibility of water” (NSF, 2005, pg. 6)

• Research shows significant gaps in water literacy

• “Appreciating that the subject matter of hydrology is embedded in a larger context of causes and effects, which includes human decision-making and generates complex system behaviors, is a primary step in reframing hydrology education” (King et al, 2012, pg. 4025)

• SCIL 109 – *Water in Society*
The bigger picture

• CASNR Food, Energy, & Water in Society undergraduate minor
• Aligned with general education requirements
• Interdisciplinary
• Team of instructors
• IUSE: Fostering Undergraduate Students' Disciplinary Learning and Water Literacy (DUE #1609598)
Course Foundations

• Core hydrology concepts
• Active learning and effective STEM instruction
• Science communication (i.e., infographic)
• Use of computer based models: Hydrogeology Challenge and Water Balance Model

• Real-world scenarios, data-based decision making, systems thinking
Who were the students?
Who were the students?

Spring, 2017 (N = 45)
Student Majors

- Environmental Studies
- English
- Food Science and Technology
- Dietetics
- Agribusiness
- Agricultural Economics
- Applied Science
- Agronomy
- Fisheries & Wildlife
- Global Studies
- Integrated Science
- Journalism
- Mechanical Engineering
- Meteorology - Climatology
- Nutrition and Health Sciences
- Pre-Special Education
- Pre-Health
Spring, 2017 Research

• Instruments/data sources
  ▪ Pre-/post-course content knowledge assessment
  ▪ Modeling tasks
  ▪ Reasoning chains

• Research questions
  ▪ What are levels of students’ knowledge of fundamental hydrology concepts at the beginning and end of the semester? Does students’ knowledge of hydrology concepts improve during the semester?
  ▪ How did students perform on computer-based water modeling tasks and reasoning chains?
  ▪ What relationships are observable between content knowledge, modeling tasks, and disciplinary reasoning?
Pre-/Post-test Results

- Positive gains in students’ knowledge of hydrology concepts as measured by pre- and post-test ($t(45) = 8.64, p< 2.51E-11, d = 2.012$).
- Multiple linear regression indicated pre-test scores are predictive of post-test scores ($F(1.83), p< 2.27E-13$).

Pre- and Post-test Means

![Pre-test vs Post-test](image)
Hydrogeology Challenge and Water Balance Model

- Students’ scores on the Hydrogeology Challenge and the Water Balance Model were equivalent (no statistically-significant difference between the two).
- Results of multiple linear regression suggest HG Challenge score is predictive of Water Balance Model score ($F(6.33), p<2.04E-11$).
- Appears to be an inverse relationship

**HG Challenge and Water Balance Model Regression Plot**
Content Knowledge, Modeling, and Reasoning

• Student performance on the Hydrology Challenge was not predictive of performance on the post-test or associated reasoning chain.

• Student performance on the Water Balance modeling task was predictive of post-test performance ($F(5.16), p<1.8E-33$) and reasoning chain ($F(6.4582), p<2.38E-09$).
Summary and Discussion

- Students developed understanding of core hydrology concepts over the course of the semester.
- Hydrogeology Challenge and Water Balance Models seemed to elicit the same skills and abilities.
- Students who did better on one modeling task performed less well on the other.
- Water Balance model predicts content knowledge and reasoning, but not Hydrogeology Challenge – WHY?
- Ongoing data analysis to try to better understand these findings.
Next steps with the course

• Continued emphasis on active learning, moving toward flipped-style classroom
• Enhanced scaffolding for modeling activities that enable students to explore and address real-world water-related challenges
• Exploring additional computer-based modeling tools to integrate into course activities
• Utilizing InTeGrate water-focused modules
• Enhancing students’ experiences with cross-curricular content – looking for optimal integration
For More Information

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