Sustainability Infusion Project

Amanda Thomas, Tammera Mittelstet, Amy Bauer Sokoll
Department of Teaching, Learning & Teacher Education

Title of Module/Activity

Sustainability in Elementary STEM Teaching: Understanding Flooding and Flood Mitigation

Course Name and Course Number

TEAC 259A, TEAC 308, and TEAC 315 (These courses are part of the Elementary Education STEM Block for all UNL undergraduate pre-service elementary teachers. They are coordinated to include the same cohorts of students in each of the three courses.)

Length of Module/Activity

Four 75-minute classes (2–TEAC 259A, 1–TEAC 308, and 1–TEAC 315)

Primary Learning Outcomes

Outcomes are defined within and across courses as described below.

Science (TEAC 315). (1) Demonstrate the processes of evaporation, condensation and precipitation[1]; (2) Interpret hydrographic and meteorological data to draw conclusions regarding the interaction between precipitation, discharge, and flooding.[1]

Technology & Engineering (TEAC 259A): (1) Use technology to create a model of the hydrologic cycle[1]; (2) Design and test a scaled model for mitigating flood damage to a building on a hands-on 3D model.[2]

Mathematics (TEAC 308): (1) Calculate recurrence intervals of major flooding for one river system using stream gauge data[3]; (2) Define a "100-year flood" and explain why floods of that magnitude can occur in successive years.[3]

[1] Unit 1: Hydrologic Cycle
[2] Design Thinking: Water Warriors
[3] Unit 4: Hazards from Flooding

Integrated STEM: (1) Describe hazards associated with a river system and evaluate their impact on ecosystems and human society[3]; (2) Align flood mitigation design project with relevant math, science, technology, and engineering standards and adapt for use in elementary classrooms[2].

Resilience and/or Sustainability Connections

This module focuses on helping undergraduate, pre-service, elementary teachers understand science concepts relating to flooding, mitigation strategies for managing and controlling floodwater and protecting from flood damage, the impact of flooding and flood mitigation on diverse communities of people, and designing classroom learning activities and experiences for elementary students to learn about these same concepts at age-appropriate levels that align with state and professional content standards for science, technology, engineering, and mathematics. The topic of flooding and flood mitigation is locally relevant in Nebraska, thereby modeling the importance of authentic contexts (important for both college students and elementary students). In terms of sustainability, the module emphasizes long-term environmental, economic, and social aspects of flooding and the need to responsibly manage water resources as part of a larger system impacted by climate change. This logically relates to flood mitigation, which allows for greater resilience in spite of increasingly common and severe floods.

Key Sustainability Competencies Addressed

This module will address all five key sustainability competencies to some degree. By integrating this module across multiple courses in an integrated STEM block, students will have opportunities to learn about flooding and flood mitigation from a variety of content-based perspectives, all emphasizing *systems thinking* approaches. Consistent with the intermediate level for this competency, students will "construct advanced conceptual problem models that incorporate feedback loops and other advanced systems features,"[4] as they iteratively design, test, and reflect on flood mitigation models. Module activities focused on understanding 100-year and 500-year floods and their impact on diverse communities address *futures thinking* at a novice level. By incorporating reading and reflection about disparate impacts of flooding particularly on indigenous and impoverished communities, the module incorporates a social justice component that is consistent with *values thinking* at the novice level. While some aspects of *strategic thinking* may be minimally incorporated, this is the competency with which the module is least directly aligned. On the other hand, the module addresses *collaboration* in a way that meets the criteria of the intermediate or even some at the advanced level. Collaboration is already an emphasis within the STEM Block of courses and students will work extensively in groups to complete module activities, including teams that include engineering students during the design project that leads up to the module's performance assessment.

Instructional Strategies

The entire STEM Block is guided by constructivist, sociocultural, and constructionist learning theories that prioritize active learning at nearly all times. This module is comprised of multiple learning activities embedded within three coordinated courses. In science methods (TEAC 315) students will use a hands-on model (Enviroscape) to examine flooding and its impacts through guided exploration of the model and its features. A guest speaker (hydrologist) will join the class to discuss flood mitigation strategies and relate to local contexts, students will write reflections on this experience. Math methods (TEAC 308) will draw from InTeGrate curriculum resources to interpret authentic data and graphs from USGS stream gauge and weather station in Iowa and connect with the water cycle[3], calculate a recurrence interval for flooding of

[4] Wiek et al. (2016). Operationalising competencies in higher education for sustainable development. P. 262.

Cedar River in 2008, and explore the meaning of 100-year and 500-year floods in writing[3]. The technology and engineering course (TEAC 259A) will engage student in using technology to make a diagram or video of a water molecule journeying through the hydrologic cycle; immerse them in a virtual reality flooding simulation[5] to explore flood damage in a neighborhood and experience mitigation decisions and their impact (also offering opportunities to discuss trauma-informed instruction for children); and use 3D printing, a hands-on model, and a collaborative, iterative design process to scale, design, and test a flood mitigation strategy.

Assessment Strategy

The summative assessment strategy employed in this module is performance assessment. Students will use mathematics and technology to collaboratively design and 3D print a scaled model of a building, employ engineering and science knowledge to design and make a flood mitigation strategy to protect the structure, test their flood mitigation approach on a hands-on Enviroscape floodplain model; adapt and align the project for potential use with elementary children; and, write individual reflections regarding STEM-related connections and impact of flooding and flood mitigation on diverse students, schools, and communities. The performance assessment will utilize a rubric (still under development) to evaluate groups' models, their effectiveness, demonstrated understanding of STEM concepts in the project, and adaptations/alignment for elementary students. Reflections will be assessed individually by course instructors. Within the three courses where this module will be implemented, a variety of formative assessments will be utilized throughout the four class sessions. Formative assessment strategies will include observation of student work and verbal feedback, exit tickets, and in-class written work aligned with course-specific learning outcomes (e.g., worksheets, reflections).

[5] VR Experience about Flood and Resilience