SABER 2021 Workshop

Assess what's important: Creating assessments that show how students use their knowledge and how instruction promotes that knowledge

Abstract:
Assessment of student learning is critically important for teaching biology and evaluating our teaching of biology. If we don't assess what is important, what is assessed becomes important! Designing assessments that demonstrate what students know and are able to do in biology are key to transforming undergraduate biology advocated by *Vision and Change in Undergraduate Biology Education* and other reports such as the Ecological Society of America's (ESA) *Four-dimensional Ecology Education (4DEE) Framework*. These two reports provide conceptual frameworks for thinking about and designing undergraduate biology courses and curricula. Importantly, both work with the idea of multidimensional learning that helps instructors define what they want students to learn (core ideas), what they want students to do with their knowledge (scientific practices), and how they want students to focus their knowledge through multiple lenses (crosscutting concepts). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas 2012)* advocates the same framework for pre-college students.

Originating from this framework, researchers (Laverty et al 2016 and Bain et al 2020) are working to transform gateway science courses by moving beyond active learning to incorporate what is known as three-dimensional learning (3DL), the dimensions that are used in concert by practicing scientists and engineers when they apply their knowledge to investigate and reason about phenomena. The 3DL is a response to the status quo of traditional science learning environments, where instruction and assessment typically focus on collections of facts and skills that often result in disaggregated and fragmented knowledge for students. In contrast, 3DL is designed to promote the development and use of interconnected knowledge that is more expert-like in nature. The afore cited research team has developed two protocols that characterize the extent to which assessments and instruction in introductory biology, physics, and chemistry courses provide opportunities for students to engage with three dimensions. The resulting tools are useful for both research and teaching professional development.

During this workshop, participants will engage in groups based on the courses they teach or are researching in biology to redesign and develop open-ended and multiple-choice assessment items, use case studies, and apply the criteria we have developed as part of the Three-Dimensional Learning Assessment Protocol (3D-LAP; Laverty et al 2016). Within this workshop facilitators will assist participants by providing guidance for item development using scientific practices. In addition, participants will be introduced to the Three-Dimensional Learning Observation Protocol (3D-LOP, Bain et al 2020) that was developed to characterize instruction in introductory biology, chemistry and physics courses. This tool can be used to evaluate courses, individual classes, and support research on course transformation efforts. Please bring a sample exam that you wish to work with as well as the core ideas students should learn in the course. Upon completion of the workshop, you will be able to design and/or characterize any

assessment item using the 3D-LAP. Concurrently, you will be able to use the 3D-LOP to characterize instruction. Both tools are useful for research because they can reliably document how assessments change in a course(s) over time and how instruction changes over time. Participants will leave with a working knowledge of how to apply multidimensional (3D-LAP) learning to modify existing assessment items and build new ones, how to apply multidimensional teaching (3DLOP) to modify existing instruction, and how to use the 3D-LAP and 3D-LOP as research tools.

Presenters:

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Jennifer Doherty, University of Washington doherty2@uw.edu, Teaching Professor, Department of Biology: Eleven years as an education researcher and faculty development provider. Member of the ESA 4DEE Framework taskforce.

Amanda Sorensen, Michigan State University, soren109@msu.edu, communication and outreach specialist in the Department of Community Sustainability. Member of the ESA 4DEE Framework taskforce.

Luanna Prevost, University of South Florida, **prevost@usf.edu**, Associate Professor, Ten years of research on biology assessment and faculty professional development. Member of the ESA 4DEE Framework Subcommittee.

Participants will be able to:

a. Describe and use the 3D-LAP and 4DEE frameworks.
b. Design and characterize any assessment item using the 3D-LAP.
c. Apply multi-dimensional learning to modify existing assessment items and build new ones.
d. Use the 3D-LAP as a research tool for evaluating assessments for research and teaching.
e. Use the 3D-LOP as a research tool for providing feedback to support the development and modification of instructional practice and materials.

Workshop Timeline

Participants will spend most of their time working in small groups using provided materials and their own. They will experience interactive, brief presentations at the beginning of the workshop, and short introductions/practice to each activity listed below.

Activities

Use the 3D-LAP to characterize participants' own research or teaching assessment items.
Use 3D-LAP and 4DEE Framework to redesign, develop and evaluate open-ended and multiple-choice assessment items. Consider embedding these assessments in case studies.
Use the 3D-LOP to characterize and evaluate instruction from sample videos and own teaching.

Each activity will conclude with a discussion among the participants led by the facilitators (*10 minutes*).