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CURRENT INSIGHTS

Recent Research in Science Teaching and Learning

Sarah L. Eddy

In this installment of *Current Insights*, three diverse research studies are highlighted: one exploring classroom talk and how it impacts conceptual learning; one identifying a unique influence on evolution acceptance: statistical understanding; and the last a genetics lesson that reduces racial bias.

EVIDENCE-BASED TEACHING GUIDES

Modeling in the Classroom: Making Relationships and Systems Visible

Kristy J. Wilson, Tammy M. Long, Jennifer L. Momsen, and Elena Bray Speth

The *Modeling in the Classroom* evidence-based teaching guide provides a combination of research-based findings and practical suggestions that will support and encourage instructors seeking to thoughtfully incorporate modeling into their teaching practice in support of their learning goals. Open research questions are also discussed.

ARTICLES

Development of the BioCalculus Assessment (BCA)

Robin T. Taylor, Pamela R. Bishop, Suzanne Lenhart, Louis J. Gross, and Kelly Sturmer

The development of the 20-item BioCalculus Assessment (BCA), created with the objective of comparing undergraduate life science students' understanding of calculus concepts in response to different methods of teaching (with and without focus on biological applications), is described.

Knowledge or Abilities? How Undergraduates Define Intelligence

Lisa B. Limeri, Jun Choe, Hannah G. Harper, Hannah R. Martin, Annaleigh Benton, and Erin L. Dolan

Our results show that undergraduates define intelligence in different ways, and these definitions are not necessarily stable across contexts or over time. Further, these definitions likely impact how students respond to the mindset scale. Implications of these results for the use and interpretation of the mindset scale with undergraduates are discussed.

Conceptual Characterization of Threshold Concepts in Student Explanations of Evolution by Natural Selection and Effects of Item Context

Andreas Göransson, Daniel Orraryd, Daniela Fiedler, and Lena A. E. Tibell

Students' understanding of evolution is a long-standing topic in science education. In this paper, students' use of abstract concepts (randomness, probability, and spatial and temporal scales) in explanations of natural selection is investigated. Overall, students use these concept less frequently than other scientific concepts in their answers to open-response questions.

Crossing Boundaries: Steps Toward Measuring Undergraduates' Interdisciplinary Science Understanding

Brie Tripp, Sophia A. Voronoff, and Erin E. Shortlidge

Education initiatives prescribe that undergraduate science students should understand the interdisciplinary nature of science. Faculty assessment strategies for measuring this competency were collected and the validity of data collected from a preexisting instrument and framework to assess students' interdisciplinary science understanding was tested.

Leveraging Multiple Analytic Frameworks to Assess the Stability of Students' Knowledge in Physiology

Matthew Lira and Stephanie M. Gardner

Learning and assessment tasks should be designed to detect students' unstable knowledge to understand learning mechanisms and guide instruction. Affordances of three analytic frameworks are examined to assess the stability of student knowledge, and an analysis of empirical data is presented to illustrate what each approach provides alone and in combination.

Peer Leader Reflections on Promoting Discussion in Peer Group-Learning Sessions: Reflective and Practiced Advice through Collaborative Annual Peer-Advice Books

Gabriela Szeinberg, Michelle D. Repice, Claudia Hendrick, Stephen Meyerink, and Regina F. Frey

This paper contributes to the literature on peer-leader training by studying annual advice books written by emergent peer leaders. Qualitative analysis was used to examine peer-leaders' practiced advice and strategies for developing robust student-student discussion as they facilitate collaborative groups in a university science course.

Factors Influencing Quality of Team Discussion: Discourse Analysis in an Undergraduate Team-Based Learning Biology Course

Sarah M. Leupen, Kerrie L. Kephart, and Linda C. Hodges

Transcribed conversations of several teams in a university physiology course taught using team-based learning were used to explore what provokes group discussions that go beyond statements of basic facts and into disciplinary reasoning.

Fostering Equitable Outcomes in Introductory Biology Courses through Use of a Dual Domain Pedagogy

Angela C. Bauer, Vernon M. Coffield, Dinene Crater, Todd Lyda, Verónica A. Segarra, Kevin Suh, Cynthia C. Vigueira, and Patrick A. Vigueira

Teaching with dual domain pedagogy, an instructional approach that combines best practices for addressing the cognitive domain of learning (i.e., active learning) with intentional efforts to address the affective domain of learning (through growth mindset messaging), minimized performance gaps in introductory biology courses at a private institution.

The Impact of High School Life Science Teachers' Subject Matter Knowledge and Knowledge of Student Misconceptions on Students' Learning

Chen Chen, Gerhard Sonnert, Philip M. Sadler, and Susan Sunbury

Students were more likely to answer an item on the posttest correctly if their teachers could answer the question correctly themselves. Teachers' ability to predict students' most common wrong answer (knowledge of students' misconceptions, KOSM) for an item predicted even better student performance. Items with strong misconceptions saw an even greater benefit for teacher KOSM.

Characterization of Instructor and Student Behaviors in CURE and Non-CURE Learning Environments: Impacts on Student Motivation, Science Identity Development, and Perceptions of the Laboratory Experience

David Esparza, Amy E. Wagler, and Jeffrey T. Olimpo

Course-based undergraduate research experiences (CUREs) provide students with access to authentic scientific opportunities. Notably, evidence indicates that engagement in CUREs promotes growth in cognitive and noncognitive student outcomes. This work expands upon prior research by examining student and instructor behaviors in CURE and non-CURE environments and their influence on such outcomes.

Evaluation of the Second Edition of *Entering Research*: A Customizable Curriculum for Apprentice-Style Undergraduate and Graduate Research Training Programs and Courses

Janet L. Branchaw, Amanda R. Butz, and Amber R. Smith

The *Entering Research* (ER) curriculum supports undergraduate and graduate research trainees participating in apprentice-style research experiences, especially those from diverse backgrounds. Results from two design and development studies of a nationwide pilot test and a facilitator training workshop are reported.

On the Cover

MicroUniverse. Image by Ivan Surovtsev, Yale University. Winner of 2nd place (tied) in ASCB's Green Fluorescent Protein (GFP) Image & Video Contest. Living systems displays spatial patterns at wide range of length and organization scales. Even at the single-cell level, patterns are present as protein gradients and in the regular arrangement of cytoskeletal structures, macromolecular complexes, and organelles. Intracellular patterning serves important functions, helping cells to organize their intracellular space, sense their geometry, and partition their cellular content. How intracellular patterns are established often remains elusive. Shown in this image are filamentous bacterial *Escherichia coli* cells (blue) with fluorescently labeled plasmids (green) and ParA protein (red). ParA together with plasmid-bound ParB protein converts random chromosome fluctuations into direct active transport and spatial patterning of the plasmids (without cytoskeletal filaments or motor proteins) inside the cell to ensure that both daughter cells inherit plasmids (and genes encoded on plasmids).