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GENERAL ESSAYS AND ARTICLES

LETTER TO THE EDITOR

Response to “Interpret with Caution: COPUS Instructional Styles May Not Differ in Terms of Practices That Support Student Learning,” by Melody McConnell, Jeffrey Boyer, Lisa M. Montplaisir, Jessie B. Arneson, Rachel L. S. Harding, Brian Farlow, and Erika G. Offerdahl

Carl Wieman

This letter expands on the cautions about the use of COPUS discussed in the article by McConnell and colleagues in the June 2021 issue of *LSE*

CURRENT INSIGHTS

Political Identities and Science Learning

Julia Svoboda Gouvea

This *Current Insights* explores emerging work that examines how students’ political identities influence and are influenced by science learning.

ESSAY

Access Needs: Centering Students and Disrupting Ableist Norms in STEM

Daniel L. Reinholz and Samantha W. Ridgway

This essay provides concrete strategies for normalizing “access talk” and creating more accessible learning environments in STEM education. This supports both disabled and nondisabled students toward the goal of disability justice in STEM.

ARTICLES

COVID-19 and Undergraduates with Disabilities: Challenges Resulting from the Rapid Transition to Online Course Delivery for Students with Disabilities in Undergraduate STEM at Large-Enrollment Institutions

Logan E. Gin, Frank A. Guerrero, Sara E. Brownell, and Katelyn M. Cooper

This article explores how the rapid transition to online instruction as a result of the COVID-19 pandemic affected students with disabilities. Findings suggest challenges related to access to existing accommodations, unique challenges in the online environment, and factors that prevented students from being properly accommodated in STEM courses.

Design and Implementation of a Tool to Assess Students’ Understanding of Metabolic Pathways Dynamics and Regulation

Sachel M. Villafaña, Vicky Minderhout, Bruce J. Heyen, Jennifer E. Lewis, Andrew Manley, Tracey A. Murray, Heather Tienson-Tseng, and Jennifer Loertscher

This article describes a biochemistry educator community-driven effort to design and implement a course-based instrument to assess undergraduate students’ understanding of metabolic pathway dynamics and regulation.

Are Faculty Changing? How Reform Frameworks, Sampling Intensities, and Instrument Measures Impact Inferences about Student-Centered Teaching Practices

Gena C. Sbeglia, Justin A. Goodridge, Lucy H. Gordon, and Ross H. Nehm

This study highlights the risks of broad, decontextualized sampling protocol recommendations and illustrates how reform frameworks, sampling intensities, and COPUS measures interact to impact inferences about faculty change.

A Detailed Characterization of the Expert Problem-Solving Process in Science and Engineering: Guidance for Teaching and Assessment

Argenta M. Price, Candice J. Kim, Eric W. Burkholder, Amy V. Fritz, and Carl E. Wieman

A study of the problem-solving process used by skilled practitioners across science, engineering, and medicine revealed that their process can be characterized by a set of 29 specific decisions. They select and use frameworks of disciplinary knowledge to make those decisions. This work will enable better assessment and teaching of problem-solving skills.

Transfer Student Experiences and Identity Navigation in STEM: Overlapping Figured Worlds of Success

Austin L. Zuckerman and Stanley M. Lo

Successful transitions from community colleges to the university setting are essential for increasing the number of transfer students who complete science, technology, engineering, and mathematics (STEM) degree programs. In this study, Holland's framework of figured worlds was used to examine how transfer students pursuing STEM negotiated their identities in their transition to the university.

Modeling and Measuring Tree-Reading Skills in Undergraduate and Graduate Students

Thilo Schramm, Anika Jose, and Philipp Schmiemann

Reading evolutionary trees is a challenging task for students. Item response theory was used to investigate a tree-reading skill system, and the different skills were found to be empirically distinguishable, although there was no evidence for the assumed hierarchy. The results are compared with a different approach by other authors.

Fostering Students' Understanding of Complex Biological Systems

Melde G. R. Gilissen, Marie-Christine P. J. Knippels, and Wouter R. van Joolingen

The aim of this study was to investigate how students can be supported to visualize and reason about complex biological problems from a systems thinking perspective. Four design guidelines are presented to foster students' systems thinking in biology education.

Randomized Controlled Trial of a Cohesive Eight-Week Evolution Unit That Incorporates Molecular Genetics and Principles of the Next Generation Science Standards

D. Drita-Esser, J. Hardcastle, K. M. Bass, S. Homburger, M. Malone, K. Pompei, G. E. DeBoer, and L. A. Stark

Findings from a randomized controlled study comparing a new, freely available *Next Generation Science Standards* (NGSS) high school evolution unit that integrates molecular genetics with teachers' typical NGSS units are reported. Treatment students showed significantly higher evolution learning gains. Implications for secondary and postsecondary science educators are addressed.

Automated Writing Assessments Measure Undergraduate Learning after Completion of a Computer-Based Cellular Respiration Tutorial

Juli D. Uhl, Kamali N. Sripathi, Eli Meir, John Merrill, Mark Urban-Lurain, and Kevin C. Haudek

This study measures student learning with a computer-automated tool by categorizing ideas in student writing about cellular respiration after an interactive computer-based tutorial. Students from multiple institution types exhibited increased scientific thinking post-tutorial, and the tool captured students' mixed ideas.

Training Faculty as an Institutional Response to COVID-19 Emergency Remote Teaching Supported by Data

Lisa L. Walsh, Sandra Arango-Caro, Emma R. Wester, and Kristine Callis-Duehl

Biology faculty across the United States were surveyed to chronicle their experiences with the COVID-19 emergency transition to remote teaching. Polarizing differences were seen in faculty responses based on previous experience teaching online and formal training received. The results underline the importance of training and highlight difficulties to address.

Professional Development, Shifting Perspectives, and Instructional Change among Community College Anatomy and Physiology Instructors

Audrey Rose Hyson, Branden Bonham, Suzanne Hood, Megan C. Deutschman, Laura C. Seithers, Kerry Hull, and Murray Jensen

A study of how and why community college anatomy and physiology instructors shifted perspectives toward active learning following a yearlong professional development program.

A New Measure of Students' Perceived Conflict between Evolution and Religion (PCoRE) Is a Stronger Predictor of Evolution Acceptance than Understanding or Religiosity

M. Elizabeth Barnes, K. Supriya, Yi Zheng, Julie A. Roberts, and Sara E. Brownell

College biology students' perceived conflict with their religions was found to be the strongest predictor of evolution acceptance compared with student religiosity, religious affiliation, and understanding of evolution. A new instrument to measure perceived conflict between religion and evolution (PCoRE) is provided for researchers.

Meta-analysis of Gender Performance Gaps in Undergraduate Natural Science Courses

Sara Odom, Halle Boso, Scott Bowling, Sara Brownell, Sehoya Cotner, Catherine Creech, Abby Grace Drake, Sarah Eddy, Sheritta Fagbodun, Sadie Hebert, Avis C. James, Jan Just, Justin R. St. Juliana, Michele Shuster, Seth K. Thompson, Richard Whittington, Bill D. Wills, Alan E. Wilson, Kelly R. Zamudio, Min Zhong, and Cissy J. Ballen

We investigated patterns of gender-based gaps in biology and chemistry through meta-analysis, reviewing data collected in 169 undergraduate biology courses. While we did not detect a significant gender gap in performance across all studies and unpublished data, we identified several factors that moderated performance differences.

PhDepression: Examining How Graduate Research and Teaching Affect Depression in Life Sciences PhD Students

Logan E. Gin, Nicholas J. Wiesenthal, Isabella Ferreira, and Katelyn M. Cooper

This interview study of 50 biology PhD students with depression examines how aspects of graduate teaching and research affect depression and how depression affects students' experiences teaching and researching. This work identifies aspects of graduate school that PhD programs can target to improve mental health among graduate students.

Teaching Undergraduates to Communicate Science, Cultivate Mentoring Relationships, and Navigate Science Culture

Diedra M. Wrighting, Jamie Dombach, Mike Walker, Jenene Cook, Marlina Duncan, Gisselle Velez Ruiz, Adán Colón-Carmona, and Bruce Birren

To promote persistence in STEM, a course implemented for undergraduate researchers teaches in an integrated manner the skills for: 1) scientific communication; 2) maximizing the effectiveness of research mentoring relationships; and 3) navigating scientific culture and its interactions with multiple social identities.

Content and Quality of Science Training Programs Matter: Longitudinal Study of the Biology Scholars Program

Mica Estrada, Gerald R. Young, Lilibeth Flores, Brook Yu, and John Matsui

The current study examined a well-established science training program, the UC Berkeley Biology Scholars Program, to see which aspects of the program contribute to students' greater integration into their professional communities and intentions to persist in science career pathways.

Student Perceptions of Authoring a Publication Stemming from a Course-Based Undergraduate Research Experience (CURE)

Ashley N. Turner, Anil K. Challa, and Katelyn M. Cooper

Course-based undergraduate research experiences (CUREs) engage students with research experiences in a course format and can sometimes result in publication of that research. This interview study identifies student-perceived benefits of authoring a publication stemming from a CURE and explores student perceptions of authorship.

Current Approaches for Integrating Responsible and Ethical Conduct of Research (RECR) Education into Course-based Undergraduate Research Experiences: A National Assessment

Laura A. Diaz-Martinez, Aimee A. Hernandez, Christina E. D'Arcy, Stephanie Corral, Jay M. Bhatt, David Esparza, Martina Rosenberg, and Jeffrey T. Olimpo

Incorporation of responsible and ethical conduct of research (RECR) education into course-based undergraduate research experiences (CUREs) remains largely unexplored despite the importance of RECR practices to the broader scientific enterprise. To address this concern, a mixed methods approach was employed to characterize the state of RECR education in biological sciences CUREs nationwide.

An Exploration across Institution Types of Undergraduate Life Sciences Student Decisions to Stay in or Leave an Academic-Year Research Experience

Logan E. Gin, Carolyn E. Clark, Deanna B. Elliott, Travis B. Roderick, Rachel A. Scott, Denisse Arellano, Diana Ramirez, Cindy Vargas, Kimberly Velarde, Allyson Aeschliman, Sarah T. Avalle, Jessica Berkheimer, Rachel Campos, Michael Gerbasi, Sophia Hughes, Julie A. Roberts, Quinn M. White, Ehren Wittekind, Yi Zheng, Katelyn M. Cooper, and Sara E. Brownell

Many studies on persistence in undergraduate research experiences have been almost exclusively conducted at research-intensive (R1) institutions, and it is unclear whether such challenges are generalizable across institution types. A study previously conducted across public R1 institutions was extended to include other institution types to address this question.

SPECIAL SECTION ON CROSS-DISCIPLINARY RESEARCH IN BIOLOGY EDUCATION

Persistence of the “Moving Things Are Alive” Heuristic into Adulthood: Evidence from EEG

Yannick Skelling-Desmeules, Lorie-Marlène Brault Foisy, Patrice Potvin, Hugo G. Lapierre, Emmanuel Ahr, Pierre-Majorique Léger, Steve Masson, and Patrick Charland

This paper investigates the EEG signature related to a scientific task in biology involving the frequent "moving things are alive" heuristic. Results show that ERP signals differ between counterintuitive stimuli and intuitive ones at N2 and LPP locations, which are commonly involved in inhibitory control.

On the Cover

Massive Mucus. Melinda Engevik. Medical University of South Carolina. Colonic mucus (purple) being expelled from goblet cell lined crypts (green), with all cells nuclei marked in blue. Submitted to the Cell Bio Virtual 2020 Image and Video Contest.