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GENERAL ESSAYS AND ARTICLES

CURRENT INSIGHTS

Recent Research in Science Teaching and Learning

Sarah L. Eddy

In this installment of *Current Insights*, we feature three articles describing how different types of stress can produce different educational outcomes, how studying by writing questions can improve performance, and how faculty beliefs about intelligence can influence students' interest and evaluation of a course.

EVIDENCE-BASED TEACHING GUIDES

Fostering Metacognition to Support Student Learning and Performance

Julie Dangremond Stanton, Amanda J. Sebesta, and John Dunlosky

This essay highlights the key features of an evidence-based teaching guide on student metacognition that was created by an interdisciplinary team (<https://lse.ascb.org/evidence-based-teaching-guides/student-metacognition>). The guide focuses on ways instructors can support student learning strategies, encourage students to monitor and control their learning, and promote social metacognition during group work.

ESSAYS

Concept Inventories as a Complement to Learning Progressions

Charlotte R. Reed and Adele J. Wolfson

Concept inventories and learning progressions are both incomplete frameworks, but alignment between them allowed conclusions to be drawn about the validity of a learning progression. It also identified gaps in measuring student understanding about acids and bases in the various inventories.

Using Pathway Modeling to Evaluate and Improve Student-Centered Teaching Practices in Co-Taught College Science Courses

Xinnian Chen, John M. Redden, Aiyana Bobrownicki, Julia Gill, and Mark J. Graham

This *Essay* demonstrates how course pathway modeling can help co-instructors better represent the complexity of student-centered teaching practices. It discusses how this approach can improve curricular design, course evaluation, student assessment, and communication between co-instructors.

Development of a Certification Exam to Assess Undergraduate Students' Proficiency in Biochemistry and Molecular Biology Core Concepts

Quira Zeidan, Jennifer Loertscher, Adele J. Wolfson, John T. Tansey, Erika G. Offerdahl, Peter J. Kennelly, Daniel R. Dries, Victoria Del Gaizo Moore, Diane M. Dean, L. Michael Carastro, Sachel M. Villafañe, and Ludmila Tyler

Assessment of student learning aids in evidence-based decisions about educational efforts. This *Essay* describes the development of an annual certification exam offered by the American Society for Biochemistry and Molecular Biology and supported by a community of volunteers that assesses undergraduate students' proficiency in core concept areas.

Production Processes for Creating Educational Videos

Stephanie Castillo, Karisa Calvitti, Jeffery Shoup, Madison Rice, Helen Lubbock, and Kendra H. Oliver

A “how-to” guide for producing videos, bridging multimedia learning theory with a production pipeline. Three steps in contemporary video-making for educational purposes are outlined: preproduction, production, and postproduction. Overall, the article encourages educators to become producers by engaging in this creative medium.

ARTICLES

Inside and Out: Factors That Support and Hinder the Self-Advocacy of Undergraduates with ADHD and/or Specific Learning Disabilities in STEM

Mariel A. Pfeifer, Eve Melanie Reiter, Julio J. Cordero, and Julie Dangremond Stanton

Self-advocacy is linked to academic success and retention of students with disabilities in college. Students with ADHD and/or specific learning disabilities were interviewed to identify supports and barriers to self-advocacy in undergraduate STEM courses. STEM instructors can be supports or barriers, which influences students’ accommodation use.

Measuring Research Mentors’ Cultural Diversity Awareness for Race/Ethnicity in STEM: Validity Evidence for a New Scale

Angela Byars-Winston and Amanda R. Butz

There is a lack of measures to assess cultural diversity awareness (CDA) in research mentoring relationships. The development of and validity evidence for a new measure to assess CDA from the perspective of both mentors and mentees are reported with a summary of findings from a series of confirmatory factor analyses with national participant samples.

Interpret with Caution: COPUS Instructional Styles May Not Differ in Terms of Practices That Support Student Learning

Melody McConnell, Jeffrey Boyer, Lisa M. Montplaisir, Jessie B. Arneson, Rachel L. S. Harding, Brian Farlow, and Erika G. Offerdahl

The Classroom Observation Protocol for Undergraduate STEM (COPUS) instructional styles reliably distinguish between frequency patterns of classroom behaviors, but do not readily discern differences in formative assessment and feedback. Given the positive relationship between formative assessment and student learning, this study highlights the limitations of the COPUS in documenting the results of STEM reform.

Teaching Hardy-Weinberg Equilibrium using Population-Level Punnett Squares: Facilitating Calculation for Students with Math Anxiety

K. R. Williams, S. R. Wasson, A. Barrett, R. F. Greenall, S. R. Jones, and E. G. Bailey

The effectiveness of teaching Punnett squares as a calculation aid for Hardy-Weinberg equilibrium with a quasi-experimental design was tested. On its own, this aid may allow for increased calculation success, and it may increase mastery of equation derivation when taught before the equations. Benefits for students with math anxiety are discussed.

Science Identity among Latinx Students in the Biomedical Sciences: The Role of a Critical Race Theory–Informed Undergraduate Research Experience

Tissyana C. Camacho, Yolanda Vasquez-Salgado, Gabriela Chavira, David Boyns, Scott Appelrouth, Carrie Saetermoe, and Crist Khachikian

This study investigates science identity and intention to pursue a science career among three groups of graduating Latinx biomedical majors. Students who participated in an undergraduate research program guided by critical race theory reported the highest levels of science identity and intention to pursue a science career at the end of college.

The Emerging STEM Paths and Science Identities of Hispanic/Latinx College Students: Examining the Impact of Multiple Undergraduate Research Experiences

Angela Frederick, Sara E. Grineski, Timothy W. Collins, Heather A. Daniels, and Danielle X. Morales

In addition to professional and psychosocial benefits, having the opportunity to spend multiple summers in research at institutions away from home helped to strengthen Hispanic/Latinx students' comfort levels with being away from their families and helped them recognize the broad range of graduate school opportunities available to them.

Undergraduate STEM Majors on and off the Pre-Med/Health Track: A STEM Identity Perspective

Remy Dou, Heidi Cian, and Valentina Espinosa-Suarez

The purpose of this study was to explore the STEM identity of undergraduate STEM majors pursuing medical or health graduate education (i.e., pre-med/health students). It was found that pre-med/health students were more likely to identify as STEM people and perceive that their teachers recognize them as STEM people than their non-pre-med/health peers.

The Dark Side of Development: A Systems Characterization of the Negative Mentoring Experiences of Doctoral Students

Trevor T. Tuma, John D. Adams, Benjamin C. Hultquist, and Erin L. Dolan

A characterization of the negative mentoring doctoral students experience during their graduate research is presented. Students attributed their negative mentoring experiences to interacting factors at multiple levels of the academic research system, which they perceived as harmful to their development.

Gains and Losses in Virtual Mentorship: A Descriptive Case Study of Undergraduate Mentees and Graduate Mentors in STEM Research during the COVID-19 Pandemic

Julie E. Speer, Max Lyon, and Julia Johnson

The onset of the COVID-19 pandemic required an abrupt shift in how science, technology, engineering, and mathematics (STEM) research was conducted. Many undergraduate mentees and graduate mentors were forced to move into virtual mentoring. This study discusses changes in mentoring methods, research productivity, and the impact on the future plans of both mentors and mentees across six STEM departments.

Implementation of a Flipped Active-Learning Approach in a Community College General Biology Course Improves Student Performance in Subsequent Biology Courses and Increases Graduation Rate

Ann Riedl, Fan Yeung, and Tina Burke

A large-scale study on the efficacy of active learning in a community college biology class showed that students in active-learning sections earned higher exam scores, performed better in subsequent biology courses, and graduated at a higher rate compared with students from traditional sections.

Student Perceptions of Instructor Supportiveness: What Characteristics Make a Difference?

Elisabeth E. Schussler, Maryrose Weatherton, Miranda M. Chen Musgrove, Jennifer R. Brigati, and Benjamin J. England

Student perceptions of the supportiveness of their instructors identified five characteristics (relational, instrumental, pedagogical, personality, uncertain) and were used to compare higher and lower support-rated instructors. Higher-support instructors had more positive relational characteristics and fewer negative pedagogical characteristics.

Nipped in the Bud: COVID-19 Reveals the Malleability of STEM Student Self-Efficacy

Eileen Kogl Camfield, NaTasha R. Schiller, and Kirkwood M. Land

Case studies from two demographically different institutions reveal ways first-year biology students' academic efficacy is malleable and mediated in relationships. Repeated use of student narrative writing reveals hidden threats to students' perceptions of their capacity to succeed and provides instructors "real-time" feedback on pedagogy.

A Meta-analysis of University STEM Summer Bridge Program Effectiveness

Brittany C. Bradford, Margaret E. Beier, and Frederick L. Oswald

A meta-analysis of university STEM summer bridge programs found that participation had a medium-sized effect on first-year overall GPA ($d = 0.34$) and university retention (Odds Ratio [OR] = 1.747). Although the analysis reflects the limited available data, it provides much-needed research on programs' objective effectiveness and guides future program development.

GenBio-MAPS as a Case Study to Understand and Address the Effects of Test-Taking Motivation in Low-Stakes Program Assessments

Crystal Uminski and Brian A. Couch

The effects of test-taking motivation on student behaviors and performance on the GenBio-MAPS program assessment were analyzed. Filtering recommendations that GenBio-MAPS administrators can use to reduce construct-irrelevant variance in test scores associated with low test-taking motivation are offered.

A Tale of Two Institutions: Analyzing the Impact of Gamified Student Response Systems on Student Anxiety in Two Different Introductory Biology Courses

Sarah J. Adkins-Jablonsky, Justin F. Shaffer, J. Jeffrey Morris, Ben England, and Samiksha Raut

Students in two large-enrollment introductory biology classes were surveyed about their perceptions of how a gamified student response system, Kahoot!, affected their anxiety. Kahoot! was less anxiety inducing than most other classroom techniques, and this difference was more pronounced for lower-achieving students.

Brief, Written Reflections Improve Interest of Introductory Animal Science Undergraduates

MaryGrace Erickson, Michel A. Wattiaux, Danielle Marks, and Elizabeth L. Karcher

This study evaluates the effectiveness of utility-value reflections designed to improve the interest of introductory animal science students. Building on previous work, this research discusses intervention logistics and illustrates the relationships among the intervention, precourse interest, interest during the semester, and course performance.

Dancing for Parkinson's: A Gateway for Connectedness to Peers and Social Assurance

P. Izbicki, E. L. Stegemöller, J. Compton, and J. Thompson

The purpose of this study was to analyze whether a course in the Freshman Research Initiative at Iowa State University increased social connectedness and assurance and retention. Results revealed that involving freshman in translational research contributes to 1) social connectedness and assurance and 2) retention in the STEM field.

On the Cover

A binucleated cancer cell

Dylan Burnette. Vanderbilt University. Cell Bio Virtual 2020 Image and Video Contest submission. This image shows a cancer cell with two nuclei. The actin filament cytoskeleton (red), mitochondria (blue-purple) and DNA (yellow) are shown. Variations in colors of mitochondria and DNA show relative 3D positions. Technique: 3D Structured Illumination microscopy.