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LETTER TO THE EDITOR

Prospective Student Database: Technological Support for Assessing the Effectiveness of Graduate Recruitment Activities

Marenda A. Wilson, Wayne Turner, Anthony L. DePass, and Andrew J. Bean

PERSPECTIVES

Special Collection of Perspectives on Broadening Participation

Kenneth D. Gibbs, Jr.

This is an introduction to a special collection of perspectives on Broadening Participation by leaders in the field on how the life sciences community can cultivate and harness the talents of people from all backgrounds.

Questioning Assumptions

Clifton A. Poodry and David J. Asai

Questioning our assumptions, a first step in addressing difficult scientific problems, is needed to develop a more inclusive scientific workforce.

Principles of Intentional Mentoring

Margaret Werner-Washburne

This essay elucidates four universal principles that have been used in a psychosocial mentoring approach to help mentors and mentees to understand themselves, learn productive reframing, build their personal and family narratives, discover their paths forward, and make decisions that fit who they are, their values, and what they love.

“Outsiders at the Table”—Diversity Lessons from the Biology Scholars Program at the University of California, Berkeley

John T. Matsui

The Biology Scholars Program at the University of California, Berkeley, provides evidence that the science community needs to 1) change the climate of STEM undergraduate education, 2) rethink the conventional notion of “STEM talent” and how we invest resources to diversify STEM, and 3) focus on “fixing our institutions, not our students.”

Broadening Participation in Undergraduate Research Experiences (UREs): The Expanding Role of the Community College

James A. Hewlett

Through the efforts of the National Science Foundation–funded Community College Undergraduate Research Initiative, community colleges have taken an active role in broadening participation in undergraduate research experiences.

Sustaining STEM Initiatives: The Challenge of a Worthy Investment

Melissa B. Crawford, Tyrslai M. Williams, Zakiya Wilson-Kennedy, Linda Hooper-Bui, Megan Stone, and Isiah M. Warner

This essay includes highlights of a program within the LSU Office of Strategic Initiatives and also addresses the challenges of sustaining successful initiatives that increase persistence and broaden participation in the STEM fields. Suggestions for securing the longevity of such efforts are also provided.

Transforming STEM Education through Collaborative Leadership at Historically Black Colleges and Universities

Zakiya S. Wilson-Kennedy, Margaret I. Kanipes, and Goldie S. Byrd

Historically Black colleges and universities (HBCUs) graduate significant numbers of minority students who attain advanced degrees and pursue diverse careers in STEM. Using a collaborative leadership model, an HBCU changed its teaching and learning paradigm to significantly broaden participation in STEM.

Preparing Students for Success in STEM: Role of Professional Societies

Irene V. Hulede

Professional societies play a critical role in the preparation and support of students for success in STEM. Outlined in this essay is an example of how the American Society for Microbiology (ASM) through its programming efforts has established programs to serve as a model and help to broaden participation and maximize diversity in the life sciences.

CURRENT INSIGHTS

Recent Research in Science Teaching and Learning

Sarah L. Eddy

In this installment of *Current Insights*, I highlight three diverse research studies out of psychology journals that address student study strategies, faculty change, and the influence of instructor style on the gap between perceived and actual learning.

BOOK REVIEW

A Well-Researched Book in Search of an Audience: *Making Sense of Genes* by Kostas Kampourakis

Geoffrey D. Findlay

Making Sense of Genes is a new book by Kostas Kampourakis that offers a well-researched commentary on the strengths and limitations of genetics. The book may be too scientifically complex and too one-sided in its opinions to assign to undergraduate students, but it is a provocative and useful read for instructors planning a genetics course.

RESEARCH METHODS

Students Are Rarely Independent: When, Why, and How to Use Random Effects in Discipline-Based Education Research

Elli Theobald

Observations are rarely independent in many common discipline-based education research designs. Specifically, students may be clustered (e.g., within sections or courses) and student outcomes may be measured more than once (i.e., repeated measures). Multilevel modeling (i.e., regression analysis with fixed and random effects) is useful for controlling for student nonindependence.

ESSAYS

Welcoming Deaf Students into STEM: Recommendations for University Science Education

Derek C. Braun, M. Diane Clark, Amber E. Marchut, Caroline M. Solomon, Megan Majocha, Zachary Davenport, Raja S. Kushalnagar, Jason Listman, Peter C. Hauser, and Cara Gormally

This essay offers recommendations for supporting deaf college students, with the goal of enhancing the inclusion of deaf students in STEM and diversifying the STEM workforce. Best practices in teaching and mentoring, awareness of Deaf culture and sign language, accommodations, discrimination, and inclusion are discussed.

The Lecture Machine: A Cultural Evolutionary Model of Pedagogy in Higher Education

Daniel Z. Grunspan, Michelle Ann Kline, and Sara E. Brownell

This essay presents a cultural evolutionary model for pedagogical change that considers how cultural transmission processes and selection events impact pedagogy at the level of the greater academic population. This conceptual model is applied to determine how to best optimize the impact of pedagogical change strategies.

Improving Undergraduate Life Science Education for the Biosciences Workforce: Overcoming the Disconnect between Educators and Industry

Christopher Thompson, Joseph Sanchez, Michael Smith, Judy Costello, Amrita Madabushi, Natasha Schuh-Nuhfer, Rommel Miranda, Brian Gaines, Kathleen Kennedy, Michael Tangrea, and David Rivers

The needs of biosciences industries were assessed, as was determination of whether undergraduates are career ready. Life science program heads believe graduates are job ready, but employers do not share this belief. Career counselors admitted to being underinformed about jobs in the biosciences.

ARTICLES

Students' Conception of Genetic Phenomena and Its Effect on Their Ability to Understand the Underlying Mechanism

Michal Haskel-Ittah and Anat Yarden

This study shows that at least some students' difficulties in understanding genetic mechanisms may originate from nonmechanistic conceptions of genetic phenomena. The findings suggest that an initial description of a phenomenon should hint at a mechanism even if the mechanism would be learned only later.

Conceptual Demography in Upper Secondary Chemistry and Biology Textbooks' Descriptions of Protein Synthesis: A Matter of Context?

Sara J. Wahlberg and Niklas M. Gericke

This article presents the novel concept of conceptual demography to describe the domain-specific vocabulary usage in upper secondary chemistry and biology textbook sections covering protein synthesis. The impact of the context of chemistry and biology on the domain-specific vocabulary usage is also investigated and discussed.

Developing an Analytical Framework to Characterize Student Reasoning about Complex Processes

Emily E. Scott, Charles W. Anderson, K. K. Mashood, Rebecca L. Matz, Sonia M. Underwood, and Vashti Sawtelle

How students construct causal explanations of complex processes was investigated through interviews with undergraduate science majors. An analytical framework developed from these interviews describes the different explanatory frames and conceptual resources that the interview participants activated during their reasoning when considering real-world scientific phenomena.

Error-Discovery Learning Boosts Student Engagement and Performance, while Reducing Student Attrition in a Bioinformatics Course

Christopher J. Lee, Brit Toven-Lindsey, Casey Shapiro, Michael Soh, Sepideh Mazrouee, Marc Levis-Fitzgerald, and Erin R. Sanders

A strategy for helping students discover and fix blind spots in their conceptual understanding using a Web-based platform for open-response concept testing was tested. This approach dramatically increased average student engagement; reduced student attrition, especially among women; and increased median exam scores from 53% to 72–80%.

Interactive Computer Simulations as Pedagogical Tools in Biology Labs

Karen Whitworth, Sarah Leupen, Christopher Rakes, and Mauricio Bustos

The pedagogical effectiveness of a computer simulation of an enzyme kinetics experiment was evaluated. Hierarchical linear modeling analysis of posttest assessments showed that learning was improved significantly by employing a combination of physical and simulated experiments. The data support the wider use of computer simulations as learning tools in laboratory courses.

Learning Strategies for First-Year Biology: Toward Moving the “Murky Middle”

Angelique Kritzinger, Juan-Claude Lemmens, and Marietjie Potgieter

Higher education faces the challenge of high student attrition. The use of learning analytics has enabled institutions to make data-informed decisions. This research uses learning analytics to identify the “murky middle” early in the academic year and to analyze learning strategies of successful students to facilitate successful habits.

When Group Work Doesn’t Work: Insights from Students

Yunjeong Chang and Peggy Brickman

Students report unequal contributions to group work in both high- and low-performance groups. High-scoring students appreciate the benefits of group work, while low-scoring students do not. Strategies like anonymous peer-evaluation comments and ratings do not adequately distinguish group performance.

Peer vs. Self-Grading of Practice Exams: Which Is Better?

Mallory A. Jackson, Alina Tran, Mary Pat Wenderoth, and Jennifer H. Doherty

Peer and self-grading were investigated to determine whether either has a differential impact on completion of practice exam assignments, performance on practice exams or course exams, or student grading accuracy. There was no benefit of peer over self-grading on performance, so it is suggested that either can solve the challenge of providing frequent feedback to many students.

Active Learning in Flipped Life Science Courses Promotes Development of Critical Thinking Skills

Melanie L. Styers, Peter A. Van Zandt, and Katherine L. Hayden

This study investigates the effects of active learning in the flipped classroom setting across three life science courses ranging from introductory to advanced levels. Objective assessment of critical thinking via the Critical Thinking Assessment Test revealed that active learning was associated with gains in critical thinking.

Student Learning in an Accelerated Introductory Biology Course Is Significantly Enhanced by a Flipped-Learning Environment

Ana Maria Barral, Veronica C. Ardi-Pastores, and Rachel E. Simmons

Flipped learning was implemented in an accelerated introductory biology course, resulting in significantly higher quiz scores than in a traditional setting, both at the time when the material was covered and at the end of the course. Gains were associated with lower-level Bloom’s questions and were not influenced by the presence and type of in-class activities.

Exploring Postsecondary Biology Educators’ Planning for Teaching to Advance Meaningful Education Improvement Initiatives

Jana L. Bouwma-Gearhart, John D. Ivanovitch, Ellen M. Aster, and Andrew M. Bouwma

Why educators select certain strategies over others, including lecturing, pushing against a lecture versus active-learning dichotomy is explored. Recommendations are made for professional development experiences that explicitly build from educators’ rationales to plan for evidence-based practices that attend to the nature of the discipline and students’ needs.

Faculty Beliefs about Intelligence Are Related to the Adoption of Active-Learning Practices

Oriana R. Aragón, Sarah L. Eddy, and Mark J. Graham

Faculty with higher fixed mindsets were less persuaded that active-learning strategies were a good idea, and this in turn was related to a lower level of implementing active-learning teaching practices in their science classrooms. Implications for addressing fixed mindsets when promoting the adoption of active-learning strategies are discussed.

Catching the Wave: Are Biology Graduate Students on Board with Evidence-Based Teaching?

Emma C. Goodwin, Jane N. Cao, Miles Fletcher, Justin L. Flaiban, and Erin E. Shortlidge

Through qualitative interviews with 32 biology graduate students from institutions nationwide, this research explores graduate student perceptions of and experiences with evidence-based teaching (EBT) and situates the progression graduate students make from awareness to adoption of EBT in the diffusion of innovations model.

Transition Experiences in MD–PhD Programs

Devasmita Chakraverty, Donna B. Jeffe, and Robert H. Tai

The study examined transition experiences among 48 MD–PhD students who had experienced at least one transition—MD to PhD and PhD to MD—during their training. Five themes emerged: mentoring, facilitating integration with students in each phase, integrating the curriculum to foster mastery of skills needed for each phase, culture change associated with each phase, and support.

Supporting the Writing Productivity of Biomedical Graduate Students: An Integrated, Structured Writing Intervention

Susan A. Gardner, Lorena M. Salto, Matt L. Riggs, Carlos A. Casiano, and Marino De Leon

Structured support for writing at the biomedical graduate level is important in training underrepresented minority students. The Initiative for Maximizing Student Development at Loma Linda University integrated a writing intervention that led students to adopt productive writing strategies, gain writing confidence, and publish successfully.

Building a Sustainable National Infrastructure to Expand Research Mentor Training

Kimberly Spencer, Melissa McDaniels, Emily Utzerath, Jenna Griebel Rogers, Christine A. Sorkness, Pamela Asquith, and Christine Pfund

An evidence-based research mentor training curricula series has been shown to improve the knowledge and skills of research mentors across disciplines and career stages. To support national dissemination of research mentor training, a train-the-trainer model was used in the context of several targeted approaches aimed at sustainability.

Student Integration into STEM Careers and Culture: A Longitudinal Examination of Summer Faculty Mentors and Project Ownership

Paul R. Hernandez, Patricia D. Hopkins, Krysta Masters, Lisa Holland, Betty M. Mei, Michelle Richards-Babb, Kimberly Quedado, and Natalie J. Shook

In the context of an intensive summer research experience, faculty mentor role modeling positively influences student scientific identity and internalization of science community values, which in turn promote scientific research career persistence intentions.

On the Cover

Distribution of interneurons expressing EGFP from the 5HT3 receptor promoter (Tg(Htr3a-EGFP)DH30Gsat, www.gensat.org) in the ventral hippocampus colabeled for the CB1 cannabinoid receptor (red) and counterstained with DAPI (blue) to show the cell layers. EGFP expression was amplified with chicken anti-GFP; cell bodies and fibers are present throughout all layers of the hippocampus but enriched in the hilus and stratum lacunosum moleculare. CB1 immunoreactivity is prominent in the axon terminals of basket cells synapsing in the pyramidal cell layer. CB1 is also enriched in axons with variable intensity in the inner and outer molecular layer of the dentate gyrus and within the hilus. Lower-level CB1 immunoreactivity is also present in the stratum radiatum and stratum oriens. This image is part of a series characterizing EGFP expression from the 5HT3 promoter throughout the brain. Image: Margaret J. Davis, doi: 10.7295/W9CIL16241.