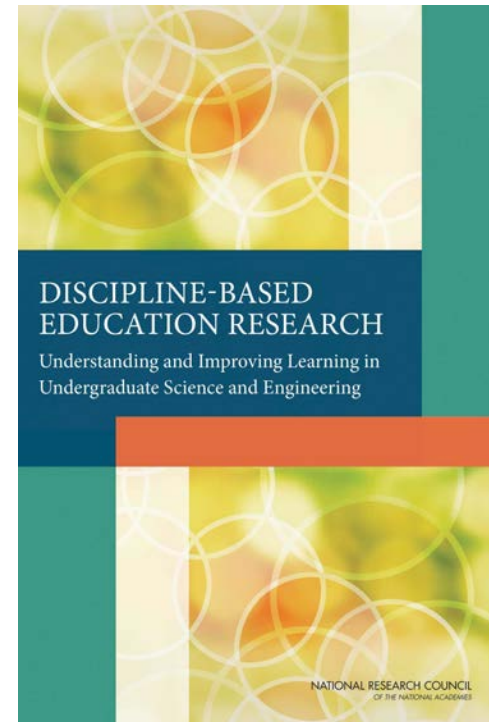


Discipline-Based Education Research

Understanding and
Improving Learning in
Undergraduate Science
and Engineering



David Mogk, Montana State University
AGU 2012 Heads and Chairs Meeting

What is Discipline-Based Education Research?

- Emerging from various parent disciplines
- Investigates teaching and learning in a given discipline
- Informed by and complementary to general research on human learning and cognition

Status of DBER: Goals

- Understand how people learn the concepts, practices, and ways of thinking of science and engineering.
- Understand the nature and development of expertise in a discipline.
- Help to identify and measure appropriate learning objectives and instructional approaches that advance students toward those objectives.
- Contribute to the knowledge base in a way that can guide the translation of DBER findings to classroom practice.
- Identify approaches to make science and engineering education broad and inclusive.

Study Charge

- Synthesize empirical research on undergraduate teaching and learning in physics, chemistry, engineering, biology, the geosciences, and astronomy.
- Examine the extent to which this research currently influences undergraduate science instruction.
- Describe the intellectual and material resources that are required to further develop DBER.

Structure of the Report

- Section I. Status of Discipline-Based Education Research
- Section II. Contributions of Discipline-Based Education Research
- Section III. Future Directions for Discipline-Based Education Research

Future Directions for DBER: Translating DBER into Practice

- Available evidence suggests that DBER and related research have not yet prompted widespread changes in teaching practice among science and engineering faculty. (Conclusion 12)
- Efforts to translate DBER and related research into practice are more likely to succeed if they:
 - are consistent with research on motivating adult learners,
 - include a deliberate focus on changing faculty conceptions about teaching and learning,
 - recognize the cultural and organizational norms of the department and institution, and
 - work to address those norms that pose barriers to change in teaching practice.

Future Directions for DBER: Some Key Elements of a Research Agenda

- Studies of similarities and differences among different groups of students
- Longitudinal studies
- Additional basic research in DBER
 - Active learning; problem-solving; representations; conceptual understanding; “Effective practices
- Interdisciplinary studies of cross-cutting concepts and cognitive processes



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Discipline-Based Education Research (DBER) Understanding and Improving Learning in Undergraduate Science and Engineering

Contributions and Opportunities for the Geosciences

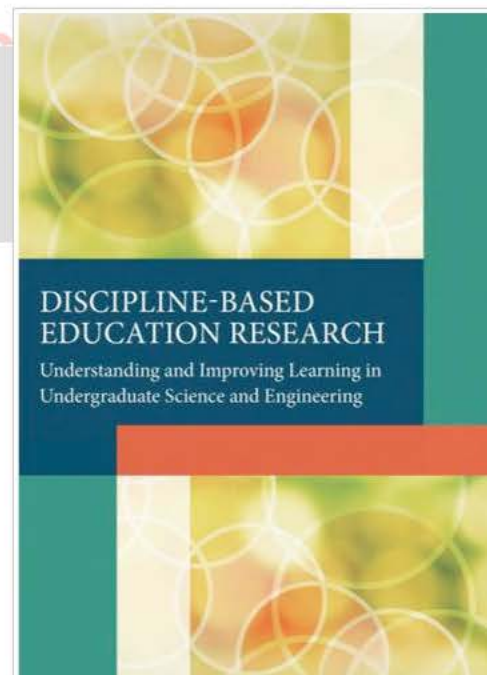
David Mogk, Department of Earth Sciences, Montana State University

A two-year study by the NRC (2012) of Discipline-Based Education Research in the STEM disciplines explored 1) the current status of DBER, 2) evidence-based contributions of DBER to STEM education and 3) future directions for collaborative discipline-based education research. Although there are commonalities in DBER among the STEM disciplines, there are unique contributions and opportunities for the Geosciences to engage DBER to support excellence in geoscience education.

Introduction

The National Research Council (Board on Science Education) recently completed a two year study, commissioned by the NSF Division of Undergraduate Education, of an emerging, interdisciplinary field of scholarship: Discipline-Based Education Research. DBER integrates the deep disciplinary priorities, worldview, knowledge, and practices employed by scientists and engineers with complementary to research on human learning and cognition. The results of DBER will support excellence in STEM education, by providing the evidence that demonstrates effectiveness of instructional strategies, methods, pedagogies and assessments to:

- Provide all students with foundational knowledge and skill towards developing a scientific literate citizenry;
- Motivate some students to complete degrees in science or engineering
- Support students who wish to pursue careers in science or engineering to create a diverse technical workforce.



<http://serc.carleton.edu/NAGTWorkshops/DBER.html>



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Recruiting a Diverse Workforce

Managing a Department

Making a Case for Your Department

Professional Preparation

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Student Recruitment

Workshops

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About this Project

Resources and Strategies for Recruiting a Diverse Faculty

David Mogk, Dept. of Earth Sciences, Montana State University

The goal of attaining a diverse faculty that is representative of our students (and of society) has yet to be achieved in the geosciences, despite gains made in recruiting and training of qualified women and students from underrepresented groups. This page provides some practical tips and resources to help you broaden your candidate pool for your next faculty hire.

Introduction

The American Geological Institute [Status of the Geoscience Workforce 2011](#) reports:

"Since 2008, the percentage of geoscience faculty positions held by women has increased by an average of two percent. In 2010, women held 16 percent of tenured and tenure-track geoscience faculty positions and 20 percent of non-tenure track geoscience faculty positions.

Participation rates of women in geoscience faculty positions still lag broader science and engineering trends where women hold 28 percent of tenured and tenure-track positions in all science and engineering fields."



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What is the root cause of this disparity in hiring patterns? Why are we not recruiting, and hiring, women to the professoriate?

A recent article published in PNAS reported on [Science faculty's subtle gender biases favor male students](#) (Acrobat (PDF) 649kB Oct24 12) (Moss-Racusin et al., 2012):

"In a randomized double-blind study(n = 127), science faculty from research-intensive universities rated the application materials of a student—who was randomly assigned either a male or female name—for a laboratory manager position. Faculty participants rated the male applicant as significantly more competent and hireable than the (identical) female applicant. These participants also selected a higher starting salary and offered more career mentoring to the male applicant."

Is it possible that your searches for new faculty are possibly promoting the same type of gender bias reported in the PNAS article?

<http://serc.carleton.edu/departments/chairs/diverse.html>