Evidence-Based Research Experiences for Undergraduates

Using Assessment and Evaluation to Build Effective Research Experiences

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Outline

- Introduction
- Theoretical Perspective
- Promise and Challenges
- DLRC Approach
- Discussion and Implications
Introduction

- According to the PCAST (2012) *Engage to Excel* report on undergraduate STEM education:
  - Every college student should be given the opportunity to generate scientific knowledge through research.
  - Universities should provide increased opportunities for students to participate in faculty research programs.
Theoretical Perspective

Apprenticeship View of URE

- Learning is a social process;
- competence in a domain is defined in terms of expertise rather than innate ability;
- meaningful learning is active, constructive and self-regulating; and
Informal apprenticeship models have long been common in colleges and universities.

Student-driven Assignments are progressive. Experiences vary
NSF, NIH, USDA, HHMI, and other federal and private agencies have funded REU programs.

Goals vary, but often include increasing the graduate STEM pipeline.

The Boyer Commission’s 1998 call for increased involvement of undergraduates in faculty-mentored research experiences led to increased funding for REUs.
Programs are more formal, often very competitive, and may include wrap around activities, i.e. GRE prep.

Many grant-funded REUs involve students in 400 hours or more of research during the summer and include wrap around activities.
Promise and Challenges

REUs are credited with:
Helping students translate classroom knowledge to real-world settings
Aiding student retention, especially for groups traditionally under-represented in STEM

(Hernandez et al., 2012)
Enhancing student understanding of research and scientific processes
(Halstead, 1997; Kardash, 2005; Russell, et al., 2007; Adedokun, et al., 2014)
Clarifying career goals

(Russell, et. al. 2007; Teegarden, et al. 2011)
Enhancing interest in graduate or professional school

(Adedokun, et al, 2012; Lopatto, 2004; Landrum and Nelsen, 2002; Bauer and Bennett, 2003; Russell, et. al. 2007)
Improving critical thinking and communication skills
(Hunter et al. 2007)
Promises and Challenges

- Research and anecdotal evidence suggest that students accrue many benefits from URE participation…

But….

- Many questions remain.
The Issue

- Undergraduate research experiences absorb a lot of time, money, and effort. The costs and benefits of research experiences for building human capital, benefitting undergraduates, improving workforce diversity, and strengthening educational outcomes need better understanding.

Questions

- What defines an authentic research experience?
- What are the most effective methods for scaffolding student growth from novice to experienced researcher?
- What are the characteristics of effective mentoring?
Questions, con’t

- What activities enhance/diminish URE outcomes?
- How do student pre/misperceptions impact their URE experience and how can these be addressed?
- What are the relationships among student outcomes?
Challenges

Research aimed at understanding these and other questions is hampered by:

- Inadequate budget to support rigorous or longitudinal evaluation.
- Small sample size
- Large variability in implementation
- Nonrandom participation
- Undefined program goals
DLRC Approach

- Apply a common set of evaluation tools across a variety of programs.
- Use multiple tools when appropriate
- Use multi-point data collection
- Pool data and make comparisons across programs.
Common Evaluation Strategies

- Interviews/Focus groups
- Pre-post survey (adapted from: Kardash, 2000; Bieschke, et al., 1996; Russell, et al., 2007)
- Scenario activity (adapted from Adams et al., 2010)
- Reflective journals
- Post graduation survey
- Faculty mentor survey
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<tr>
<th>Program</th>
<th>Context</th>
<th>Goals</th>
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## Evaluation Tools

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Evaluation Domains

- **Interest/Aspiration**
  - Persistence in STEM
  - Pursuit of graduate/professional degree

- **Career Clarification**
  - Networking/Mentoring
  - Knowledge of Graduate/professional school

- **Interdisciplinary Thinking**
  - Nature, importance, function of interdisciplinary teams
  - Complex problem solving

- **Research Skills/Efficacy**
  - Disciplinary self-efficacy
  - Science process, Lab techniques, Notebooking
  - Literature review
  - Help seeking/coping skills
  - Communication

- **Program Development**
  - Challenges and benefits to students
  - Challenges and benefits to faculty
Discussion

Evaluation across programs suggests 4 key factors for a successful URE:

- Clearly defined and communicated goals and expectations;
- Students have opportunities to master skills and become part of a community;
- Student misperceptions/preconceptions about research identified and addressed;
- Undergraduate researchers have a source of support external to their faculty advisor.
Questions???
References

- Hunter, et. al. (2007). “Becoming a scientist: The role of undergraduate research in students’ cognitive, personal, and professional development.” Science Education, 91:36-74
References (con’t)