Uniting Scholarship and Practice of Undergraduate Research

Anne Boettcher\textsuperscript{1}, James LaPlant\textsuperscript{2}, Carol Geary Schneider\textsuperscript{3}, Jillian Kinzie\textsuperscript{4}, and Heather Haeger\textsuperscript{5}

\textsuperscript{1}Embry-Riddle Aeronautical University, \textsuperscript{2}Valdosta State University, \textsuperscript{3}Lumina Foundation, \textsuperscript{4}Indiana University, and \textsuperscript{5}California State University, Monterey Bay
Uniting Scholarship and Practice of Undergraduate Research

What is your primary role at your institution?

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Uniting Scholarship and Practice of Undergraduate Research

What is the biggest challenge in uniting scholarship and practice at your institution?

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What Do Employers Want?

Anne Boettcher
Director of Undergraduate Institute and Honors Program, Embry-Riddle Aeronautical University and President Council On Undergraduate Research

Learning Outcomes Four in Five Employers Rate as Very Important

<table>
<thead>
<tr>
<th>Employers</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>The ability to effectively communicate orally</td>
<td>85</td>
</tr>
<tr>
<td>The ability to work effectively with others in teams</td>
<td>83</td>
</tr>
<tr>
<td>The ability to effectively communicate in writing</td>
<td>82</td>
</tr>
<tr>
<td>Ethical judgment and decision-making</td>
<td>81</td>
</tr>
<tr>
<td>Critical thinking and analytical reasoning skills</td>
<td>81</td>
</tr>
<tr>
<td>The ability to apply knowledge and skills to real-world settings</td>
<td>80</td>
</tr>
</tbody>
</table>

Hart Research Associates. Falling Short? College Learning and Career Success. 2015
Why Undergraduate Research, Scholarship and Creative Arts (URSCA)?

Employer Support for Applied Learning Practices

• 73% of employers believe that college graduates' preparation for careers would improve if they were required to complete a significant applied learning project.*
• College graduates are 2.4 times as likely to be engaged at work if they had an internship or job that allowed them to apply their classroom learning, were active in cocurricular activities, and worked on a project that took a semester or more to complete.**
• 91% of employers say that, whatever their major, all students should have experiences in solving problems with people whose views are different than their own.*

Employer Endorsement of High-Impact Practices*

A majority of employers say they are more likely to hire college graduates who have completed:

Internships
Internship or apprenticeship with a company or organization
94%

Senior Projects
Advanced, comprehensive project in senior year, such as a thesis, senior project, or other major assignment that requires the student to demonstrate depth of knowledge in their major AND their acquisition of research, problem-solving, and communication skills
87%

Writing-Intensive Courses
Multiple courses requiring significant writing assignments
81%

Collaborative Research
Research project done collaboratively with peers
80%

Community-Based/Service Learning
A community-based or service learning project with a community organization
69%

Study Abroad
Study abroad program in which a student lives and studies abroad for a semester or longer
51%

Teaching Students the Arts of Inquiry and Evidence-Based Analysis: *The Core Issue at Stake in the Undergraduate Research Movement*

Carol Geary Schneider  
Fellow, Lumina Foundation and President Emerita, AAC&U

- Teaching students to think through complex questions is a core purpose for quality college learning and central to the value of a liberal education. This is also a top priority for employers.

- Thinking through complex questions requires (among other capacities), examining and organizing evidence; engaging diverse and competing perspectives about the issue and the evidence; and building a reasoned analysis that takes account of the evidence and of competing views on the evidence.

- Many college seniors lack these skills. See pp. 2-3 of handout.

- To tackle this problem, faculty will need to work on program redesign. See p. 4 of handout.
Scholarship and Practice of Undergraduate Research
The Journal of the Council on Undergraduate Research

James T. LaPlant
Assistant Vice President for Research, Valdosta State University;
Editor-in-Chief of SPUR

Adapting to Change: Studying Undergraduate Research in the Current Education Environment
Making Inquiry Learning Our Top Priority: Why We Must and How We Can
An Analysis of Funding for the NSF REU Site Program in Biology from 1987 to 2014

Also in this issue:
Undergraduate Research and Staff-Staff Partnerships: Supporting the Development of Student Scholars at a Canadian Teaching and Learning Institute
Scholarship and Practice of Undergraduate Research
The Journal of the Council on Undergraduate Research

INNOVATIVE LEARNING SPACES THAT PROMOTE UNDERGRADUATE RESEARCH

Creating a Biology "Studio" to Promote Undergraduate Research
Twenty-First-Century Spaces for Twenty-First-Century Learners
Reimagining the Library: Designing Spaces to Meet the Needs of Today's Students
Transforming Learning Spaces through Iterative Design to Support Inquiry-Driven Learning
Building, Designing, and Implementing an Augmented Reality Sandbox Laboratory
Using Old Space in New Ways to Support Undergraduate Research with Community College Students
New Spaces at the University of Detroit Mercy That Inspire Undergraduate Research and Innovation

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– James Ouano

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Creating a Biology "Studio" to Promote Undergraduate Research
– Mary Beth Hedef, Minnie Frei, and Lou Pascali

THEORY

Twenty-First-Century Spaces for Twenty-First-Century Learners: Where We Are, How We Got Here, and What Next
– Jeanine I. Nasas, Kimberly Frederick, and Michael A. Potenzio

PRACTICE

Reimagining the Library: Designing Spaces to Meet the Needs of Today's Students
– Kathleen Ball and Kelly Kibby

Transforming Learning Spaces through Iterative Design to Support Inquiry-Driven Learning
– Kimberly A. Lay and Lauren A. Lukes

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Building, Designing, and Implementing an Augmented Reality Sandbox Laboratory
– Bryan Dawson, Glenn Robertson, Steven Lloyd, and Markus Hitz

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– Elizabeth S. Roberts-Kirkhoff, Sharea Davis, and Gary A. Kulick

OTHER FEATURE ARTICLES ON ASSESSMENT

The Structure of Mentoring in Undergraduate Research: Multi-Mentor Models
– Ivan D. Bradley, Michelle Bara, Neithan M. Faz-Gibson, Carolen J. Ketcham, Britany A. Nicholson, and Megan Pulaski
Upcoming Themes of SPUR

- Undergraduate Research and Student Success Outcomes (Spring 2018)
- Leveraging Undergraduate Research to Foster Diversity and Achieve Equity (Summer 2018)
- Models of Mentoring Undergraduate Research (Fall 2018)
Assessment and Research Coordinator

Heather Haeger
Assessment and Educational Research Associate at California State University, Monterey Bay’s Undergraduate Research Opportunities Center; Assessment and Research Coordinator Fellow with CUR

- Survey of what we know and need to know
  - Assessment Bibliography
  - Interviews and focus groups

- Assessment resources
  - Webinars
  - Assessment Toolkit and website

- Academic impact of UR
  - Response to call from National Academies of Science
  - Multi-campus study
  - IRB and data storage through CSUMB
  - Propensity Score Matching (post-hoc modeling of random assignment to treatments)
  - Following IES What Works Clearinghouse standards
What are the gaps and how do you bridge gaps/disconnects among faculty cultures (educational theorists research and disciplinary-based mentors)?

**Problems:**

- *Practitioners and researchers have different spheres of interest and action*
  - Spheres of Interest
  - Spheres of Action

- Communication

- Incentives for research

**Steps to bridge the gap:**

- Research collaborations
  - Find mutually interesting and actionable questions

- How and where do we communicate results

- What research do we value and reward
  - Funding
  - Publishing
  - Tenure review

*Considering Interest and Action: Analyzing Types of Questions Explored by Researcher-Practitioner Partnerships*
CUR Transformations Project

Jillian Kinzie
Associate Director, Indiana University Center for Postsecondary Research (IUCPR), and the National Survey of Student Engagement (NSSE)

- Create research-rich, backward-designed, integrated, scaffolded curricula in 4 departments (Bio, Chem, Psych, Physics) at 12 institutions, and

- Conduct fundamental research on student, faculty, departmental and disciplinary influences on the process of integrating and scaffolding undergraduate research experiences throughout the curriculum

Acknowledgements to NSF DUE IUSE 16-25354 Grant & Credit to the CUR TP team:
Mitch Malachowski, University of San Diego; Jeffrey Osborn, The College of New Jersey; Kerry Karukstis, Harvey Mudd College; Jillian Kinzie, Indiana University; Elizabeth Ambos, Council on Undergraduate Research
How can Colleges & Universities expand, deepen and sustain student engagement UR opportunities?

Use an Evidence-Based Strategy of Backward Design to Build Vertically Scaffolded, Research-Rich Curricula

**Scaffolding Framework Based on a “Student as Scholar”* Model**

- Uses a **discovery paradigm** and places UR at the center of the curricular experience
- Students move from more passive, externally motivated experience to **active, internally-motivated posture of a scholar**.
- Three stages involving:
  - Foundation Courses
  - Intermediate Learning Experiences
  - Capstone Experiences

*Hodge et al. (2007) “From Convocation to Capstone: Developing the Student as Scholar”, AAC&U Network for Academic Renewal Conference
## CUR Transformations Template for Designing Vertically-Integrated Curriculum

### Defining the Backwards-Designed Vertically-Integrated Curriculum Framework

**Overall Objective** — To scaffold undergraduate research skills throughout a four-year curriculum: (1) identify overarching learning goals; (2) determine the evidence on which student learning will be assessed; and (3) consider the learning activities and instructional strategies to be employed.

Through scaffolded research experiences, students should learn to be able to:

<table>
<thead>
<tr>
<th>Overarching Learning Goals:</th>
<th>Understand and implement the stages of the research process</th>
<th>Effectively communicate within the research team and dissemination of results to diverse audiences</th>
<th>Apply quantitative analysis to interpret disciplinary data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage of Skill Implementation:</strong></td>
<td>Skill</td>
<td>Course(s)/Evidence</td>
<td>Learning Activity/Instructonal Strategy</td>
</tr>
<tr>
<td>Research Skills in Foundation Course(s)</td>
<td>Make careful observations and record findings in an organized manner in a laboratory notebook</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Skills in Intermediate Learning Experiences</td>
<td>Design an experimental protocol based on sound methodology; Align data collection with research hypothesis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Skills in Capstone Experiences</td>
<td>Evaluate experimental evidence for consistency and possible limitations</td>
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</tr>
</tbody>
</table>
Learning from the CUR Transformations Approach: Research Component

- Conduct fundamental research on student, faculty, departmental, and disciplinary influences on the process of integrating and scaffolding UGR experiences throughout the curriculum.

- By studying these changes we will advance the academy’s understanding of effective teaching and learning and the disciplinary and cultural factors necessary for curricular integration and transformation.
CUR Transformations Research Questions

- What effect do student characteristics (e.g., preexisting academic preparation) have on scaffolded integration of UGR into the curriculum and student learning outcomes?

- To what extent are students receptive to a research-based STEM curriculum emphasizing discovery, inquiry, and analysis? Does receptivity vary with student characteristics?

- How do student-learning experiences and outcomes in the scaffolded UGR curriculum vary by student characteristics?

- How do different STEM disciplines/departments effectively integrate the components and outcomes of high-quality UGR to reach more students?

- What aspects of STEM cultures and disciplines/departments support the integration of UGR elements into the undergraduate curriculum?

- What are the best approaches to research-based curricular redesign and faculty support for creating an inclusive change process?
Join Us!

Council on Undergraduate Research Reception & Recognition of AURA Recipients

Friday January 27th, 5:30-7:00PM
Penn Quarter A
Teaching Students the Arts of Inquiry and Evidence-Based Analysis:

The Core Issue at Stake in the Undergraduate Research Movement

Carol Geary Schneider
Fellow, Lumina Foundation and President Emerita, AAC&U

Synopsis

► Teaching students to think through complex questions is a core purpose for quality college learning and central to the value of a liberal education. This is also a top priority for employers.

► Thinking through complex questions requires (among other capacities), examining and organizing evidence; engaging diverse and competing perspectives about the issue and the evidence; and building a reasoned analysis that takes account of the evidence and of competing views on the evidence.

► Many college seniors lack these skills. See pp. 2-3 of this handout.

► The charts on pp. 2-3 come from AAC&U’s VALUE/Multi-state Collaborative research, conducted in 12 states. Findings from 34 public community colleges and 41 public universities are included. Source: AAC&U, On Solid Ground: VALUE Report 2017, 37 and 39. The study examined students’ completed assignments, originally submitted for course grades and later selected by faculty for inclusion in this national study. Scoring for the study was done by faculty from other institutions trained in applying VALUE rubrics. (The full report, with discussions of how to interpret, can be downloaded from www.aacu.org/OnSolidGroundVALUE).

► The VALUE/Multi-state study is consistent with other national research on college seniors’ critical thinking and communication skills, using standardized tests rather than student work. See, for example, ETS research on critical thinking. See also employers’ views that many graduates need improvement in critical thinking and communication skills.

► These studies should be taken as a wake-up call. Helping students develop proficiency in evidence-based analysis needs to become a shared priority for all postsecondary institutions, programs, and faculty. All students, not just some students, should be prepared to complete evidence-based inquiry projects as part of their college studies.

► What will it take?

Minimally, program redesign—both in majors and in general education and connections between them—to ensure that students gain guided practice in the skills of analytical inquiry across their course of study and that students are well prepared to design and complete a significant inquiry project. Well-designed assignments are a critical key.

► See p. 4 for a model curriculum map, keyed to Lumina Foundation’s Degree Qualifications Profile (DQP) and to AAC&U’s LEAP Essential Learning Outcomes. Both curriculum frameworks call for students to complete culminating work that shows their readiness to tackle complex questions and use evidence in approaching those questions.

For more on quality learning, please visit: www.carolgearyschneider.net
Critical Thinking

Note: Assignments scored for the VALUE study came from students who completed 75% of their studies for the associate degree or for the bachelor's degree. The assignments came from a broad range of courses and disciplines.
### Written Communication

<table>
<thead>
<tr>
<th>2-Year Institutions</th>
<th>Context / Purposes</th>
<th>Content Development</th>
<th>Genre / Conventions</th>
<th>Sources / Evidence</th>
<th>Syntax / Mechanics</th>
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<tbody>
<tr>
<td>Capstone 4</td>
<td>10%</td>
<td>6%</td>
<td>4%</td>
<td>5%</td>
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<tr>
<td>Milestone 3</td>
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<td>Milestone 2</td>
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<tr>
<td>Benchmark 1</td>
<td>14%</td>
<td>20%</td>
<td>22%</td>
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<td>1%</td>
<td>2%</td>
<td>1%</td>
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</table>

<table>
<thead>
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<th>4-Year Institutions</th>
<th>Context / Purposes</th>
<th>Content Development</th>
<th>Genre / Conventions</th>
<th>Sources / Evidence</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Capstone 4</td>
<td>20%</td>
<td>14%</td>
<td>11%</td>
<td>13%</td>
<td>9%</td>
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<tr>
<td>Milestone 3</td>
<td>41%</td>
<td>38%</td>
<td>36%</td>
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<tr>
<td>Milestone 2</td>
<td>29%</td>
<td>36%</td>
<td>38%</td>
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<td>Benchmark 1</td>
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</table>

Note: Assignments scored for the VALUE study came from students who completed 75% of their studies for the associate degree or for the bachelor’s degree. The assignments came from a broad range of courses and disciplines.
# Curriculum Mapping for Cross-Cutting Learning Outcomes and Student Inquiry Projects

<table>
<thead>
<tr>
<th>Content</th>
<th>Introductory Course</th>
<th>Research Methods</th>
<th>Advanced Content Course A</th>
<th>Laboratory/Practicum</th>
<th>Advanced Content Course B</th>
<th>Advanced Content Course C</th>
<th>Advanced Content Course D</th>
<th>Capstone Work</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLO 1: Disciplinary knowledge base (models and theories)</td>
<td>Introduced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Mastery/Assessed</td>
<td></td>
</tr>
<tr>
<td>SLO 2: Disciplinary methods</td>
<td>Introduced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Mastery/Assessed</td>
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<tr>
<td>SLO 3: Disciplinary applications</td>
<td>Introduced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Mastery/Assessed</td>
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<tr>
<td>Critical Thinking</td>
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<td>SLO 4: Analysis, evaluation and use of evidence</td>
<td>Introduced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Mastery/Assessed</td>
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<td>SLO 5: Engaging and applying diverse perspectives</td>
<td>Introduced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Mastery/Assessed</td>
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<td>Communication</td>
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<td>SLO 6: Written communication skills</td>
<td>Introduced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Reinforced</td>
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<td>SLO 7: Oral communication skills</td>
<td>Introduced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Mastery/Assessed</td>
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<td>Integrity/Values</td>
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<td>SLO 8: Academic and Disciplinary ethical standards</td>
<td>Introduced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Mastery/Assessed</td>
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<tr>
<td>SLO 9: Responsibilities to society</td>
<td>Introduced</td>
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<td>Reinforced</td>
<td>Mastery/Assessed</td>
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<td>Signature Project</td>
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<tr>
<td>SLO 10: Problem-centered inquiry and project development</td>
<td>Introduced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Reinforced</td>
<td>Mastery/Assessed</td>
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<td>SLO 11: Working with diverse partners</td>
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<td>Reinforced</td>
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<td>SLO 12: Self-regulation and metacognitive skills</td>
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<td>Reinforced</td>
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<td>Mastery/Assessed</td>
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</table>

This map is based on a model provided by the Center for University Teaching, Learning, and Assessment at the University of West Florida (http://uwf.edu/cutla). It was adapted to align both with Lumina Foundation’s Degree Qualifications Profile (DQP) and with AAC&U’s LEAP Challenge on Signature Projects.