Introduction

I expect this session to be interactive. The outline that follows here presents ideas and information that I hope can serve as a starting point for different topics of conversation rather than as an outline for a conventional lecture. Please feel free to interrupt and/or challenge at any time.

Importance of Undergraduate Research

In 1989, the NSF stated that “it is clear that the academic community regards the involvement of undergraduate student majors in meaningful research…with faculty members as one of the most powerful instructional tools.”¹

From this initial percolation, the importance of Undergraduate Research has now moved to center stage, and ways to expand are now not only being considered by Natural Sciences, but many other disciplines.

What is the Desired Outcome?

1. Increased knowledge-base?
2. Improved skill-set?
3. Improved desire to continue in field? (persistence)
4. Improved confidence of ability?
5. Tolerance for risk?
6. Combination?
   a. If so, what combination?
7. Other?

¹ Notice that it did not say that it was meaningful or how it might be meaningful (e.g., confidence, persistence, skill-set, knowledge).
Some Results

Natural Sciences Results (Hakim, 1998):

Table 1

Descriptive Statistics and Paired t Tests for Interns' Pre- to Post-URE Self-Ratings and Matched Intern–Mentor Ratings of Interns' Research Skills

<table>
<thead>
<tr>
<th>Item</th>
<th>Interns' self-ratings</th>
<th>Mentors' ratings, end of URE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beginning of URE</td>
<td>End of URE</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Understand contemporary concepts in your field</td>
<td>3.19</td>
<td>0.62</td>
</tr>
<tr>
<td>Make use of the primary scientific research literature in your field (e.g., journal articles)</td>
<td>3.11</td>
<td>0.89</td>
</tr>
<tr>
<td>Identify a specific question for investigation based on research in your field</td>
<td>2.85</td>
<td>0.83</td>
</tr>
<tr>
<td>Formulate a research hypothesis based on a specific question</td>
<td>2.85</td>
<td>0.82</td>
</tr>
<tr>
<td>Design an experiment or theoretical test of the hypothesis</td>
<td>2.64</td>
<td>0.95</td>
</tr>
<tr>
<td>Understand the importance of &quot;controls&quot; in research</td>
<td>4.24</td>
<td>0.61</td>
</tr>
<tr>
<td>Observe and collect data</td>
<td>4.20</td>
<td>0.79</td>
</tr>
<tr>
<td>Statistically analyze data</td>
<td>2.13</td>
<td>1.04</td>
</tr>
<tr>
<td>Interpret data by relating results to the original hypothesis</td>
<td>2.00</td>
<td>0.73</td>
</tr>
<tr>
<td>Refurbish your original research hypothesis (as appropriate)</td>
<td>2.96</td>
<td>0.71</td>
</tr>
<tr>
<td>Relate results to the &quot;bigger picture&quot; in your field</td>
<td>2.91</td>
<td>0.86</td>
</tr>
<tr>
<td>Orally communicate the results of research projects</td>
<td>3.07</td>
<td>0.81</td>
</tr>
<tr>
<td>Write a research paper for publication</td>
<td>2.29</td>
<td>0.77</td>
</tr>
<tr>
<td>Think independently</td>
<td>4.14</td>
<td>0.81</td>
</tr>
</tbody>
</table>

Note. Each item completes the question "To what extent do you feel you can _____?" Items were rated on a 5-point scale ranging from 1 (not at all) to 5 (a great deal). URE = undergraduate research experience.

Table 2

Descriptive Statistics and t Tests for Interns' Self-Ratings and Mentors' Ratings of Interns' Research Skills at the End of the Undergraduate Research Experience as a Function of Intern Gender

<table>
<thead>
<tr>
<th>Item</th>
<th>Women</th>
<th>Men</th>
<th>t(55)*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Understand contemporary concepts in your field</td>
<td>3.57</td>
<td>0.79</td>
<td>4.17</td>
</tr>
<tr>
<td>Make use of the primary scientific research literature in your field (e.g., journal articles)</td>
<td>3.84</td>
<td>0.87</td>
<td>3.46</td>
</tr>
<tr>
<td>Identify a specific question for investigation based on the research in your field</td>
<td>3.37</td>
<td>0.86</td>
<td>3.21</td>
</tr>
<tr>
<td>Formulate a research hypothesis based on a specific question</td>
<td>3.34</td>
<td>0.81</td>
<td>3.71</td>
</tr>
<tr>
<td>Design an experiment or theoretical test of the hypothesis</td>
<td>3.22</td>
<td>0.99</td>
<td>3.34</td>
</tr>
<tr>
<td>Understand the importance of &quot;controls&quot; in research</td>
<td>4.47</td>
<td>0.79</td>
<td>4.56</td>
</tr>
<tr>
<td>Observe and collect data</td>
<td>4.45</td>
<td>0.79</td>
<td>4.48</td>
</tr>
<tr>
<td>Statistically analyze data</td>
<td>3.56</td>
<td>1.06</td>
<td>3.99</td>
</tr>
<tr>
<td>Interpret data by relating results to the original hypothesis</td>
<td>3.88</td>
<td>0.82</td>
<td>4.00</td>
</tr>
<tr>
<td>Refurbish your original research hypothesis (as appropriate)</td>
<td>3.64</td>
<td>0.96</td>
<td>3.55</td>
</tr>
<tr>
<td>Relate results to the &quot;bigger picture&quot; in your field</td>
<td>3.76</td>
<td>0.97</td>
<td>3.75</td>
</tr>
<tr>
<td>Orally communicate the results of research projects</td>
<td>3.91</td>
<td>0.80</td>
<td>3.79</td>
</tr>
<tr>
<td>Write a research paper for publication</td>
<td>2.96</td>
<td>0.81</td>
<td>2.95</td>
</tr>
<tr>
<td>Think independently</td>
<td>4.03</td>
<td>0.92</td>
<td>4.29</td>
</tr>
</tbody>
</table>

Note. Each item completes the question "To what extent do you feel you (your intern) can _____?" Items were rated on a 5-point scale ranging from 1 (not at all) to 5 (a great deal).

*t test for differences in male and female interns' self-ratings.  **t test for differences in mentors' ratings of male and female interns.

*p < .01, two-tailed.
Natural Sciences Paradigm/Research on Undergraduate Research

Features

Undergraduate Research experiences are characterized by four features (Hakim 1998).

1. Mentorship
2. Originality
3. Acceptability
4. Dissemination
5. (Other?)

Assumptions on Nature of the Project

This Hakim bases further on four assumptions

1. Interaction between student and faculty mentor that is focused on the student’s learning
2. URE is expected to lead to a meaningful contribution by the undergrad to the research project.
3. Procedures and methods used as tools of inquiry by the undergraduate are consistent with current practices in the discipline.
4. The URE is expected to culminate in a tangible product that is critiqued by other members of the discipline (Hakim 1998).
   a. Presented by student?
5. (Other?)

Assumptions More Broadly of “Cognitive Apprenticeship Models”

1. Learning is a social process.
2. Competence in a domain is defined in terms of expertise rather than innate ability.
3. Learning needs to be active, constructive, and self-regulating.
4. Learning activities should reflect real-world rather than decontextualized academic tasks.
Social Sciences Models

1. Field Research Model
e.g., Anthropology: Observe Monkeys in Native Habitat (Sussman); Interview Chicken Farmers (Stone); Political Science: Political Internships.

Advantages:
1. Can also, like lab, allow many undergraduates to participate without intense additional effort on part of mentor.
2. Helps to inculcate the research methodology in the discipline when student collects data.
3. Gives ownership to the student.

Disadvantages:
1. Perhaps too far removed from the theoretical aspects of the discipline in some instances, learning more the politics of a discipline than the knowledge-base of the discipline. Perhaps ok?
2. Can be more difficult for the mentor to monitor.
3. Field research does not readily apply for every Social Science (e.g., Economics, Gender Studies, etc.).

2. Research Assistant Model
Student works one-on-one with faculty mentor, assists mentor in mentor’s project.

Advantages:
1. One-on-one relationship
2. Observation of research methodology of mentor

Disadvantages:
1. Lack of ownership for student
2. Uneven level of intellectual engagement for student

3. Independent Study/Honors Thesis Model
Mentor assists student with student’s project, rarely provides research benefit to mentor.

Advantages:
1. Greater student ownership
2. One-on-one relationship
3. Strong intellectual engagement

Disadvantages:
1. Often of no material research benefit to mentor
2. May even be liability to mentor—hours spent, no compensation, not directly relevant to research agenda
Humanities Models

1. Research Assistant
   Student works one-on-one with faculty mentor, assists mentor in mentor’s project.

   (See above, Social Science Models)

2. Independent Study
   Mentor assists student with student’s project.

   (See above, Social Science Models)

3. Optimal Mentor/Student Research Experience
   Student works one-on-one with faculty mentor, assists mentor in project that can be presented independently as student’s research but also provides research benefit to faculty mentor.

   Advantages of Model 3:
   1. Engages the student fully
   2. Provides ownership of project to student
   3. Close guidance promises better quality of research
   4. Other?

   Disadvantages of Model 3:
   1. Still a taxing model for professors who have intense research agendas on their plate
   2. Limited in its outreach to students—very finite resource
Cross-Modeling

What models in Natural Sciences (lab model) might creatively be applied to Social Sciences? What Social Sciences models (field research model) might apply to the Humanities and increase the number of research opportunities the undergraduate research? Might Natural Sciences take some cues from Humanities models?

1. Recent proposal to create a “lab” experience in Social Sciences. Students would study the churches in a specific area, interview members and ask a consistent series of questions regarding that church.

2. This data would be put in a central database that held the answers to these questions from all of the churches where information had been collected to date.

3. Would allow the student to author an article specific to the church, but would also provide information to the larger idea of, for example, faith trends

How might this apply in a Humanities model?

My area of research involved an effort at a statistical understanding of classical French poetries. The statistical modeling involved reducing each line of studied poetry to a numerical and phonological representation. The amount of poetry that could be submitted to such analysis is infinite. I could ask one student to focus on Ronsard, another on Baudelaire and so forth. This could expand to other periods, and even other languages. Each could present their work while also contributing to a larger body of work. Would suggest that work be verified, perhaps by additional student?

How might this apply in your discipline?

Other cross-modeling possibilities?

How the Undergraduate Research office can help

Please contact us for financial help with an undergraduate research idea at hbiggs@wustl.edu, or visit our web site at ur.wustl.edu.

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2 To be clear, this is my characterization of a model suggested by John Bowen. Since I am far from the author of the idea, I am also not the idea’s best apologist, so any possible errors in the explanation or representation of the idea are very much my own.