Assessing Undergraduate Research

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Shared Language

- What is Undergraduate Research?
- Operational Definition at OU

Undergraduate Research (UR) is mentored intellectual engagement using established scholarly processes to make a meaningful contribution to a project, question, or problem, where the outcomes are publicly presented or performed with review, critique or judgment, and both the process and product are based upon disciplinary standards. The work will be at least partially novel, but may result in a preliminary product, a partial solution, or additional questions for future investigation.

Photo credit: nasa.gov
Shared Language

- What is Assessment?
- Merriam-Webster.Com
  - the act of making a judgment about something: the act of assessing something

- Measuring the progress toward specific anticipated outcomes

Photo credit: nasa.gov
Take a minute & write a list of 2-3 student outcomes that you expect for students from a research experience.

Assessment
How much did the students learn or gain of the things I wanted them to?

Assessment
Measuring the progress toward specific anticipated outcomes
Examine Some Research-based Theoretical Frameworks

Research Skills Development Framework
Auchincloss Model
Undergraduate Research Student Self-Assessment
Research Skills Development (RSD) Framework

- Synthesized from the A-NZ Information Literacy Framework and Bloom's Taxonomy
- ID Six Facets of Research Process
  - Embark & Clarify
  - Find & Generate
  - Evaluate & Reflect
  - Organize & Manage
  - Analyze & Synthesize
  - Communicate & Apply
- Two variables span all facets
  - Degree of Knownness (not handled explicitly...)
  - Degree of Autonomy

http://www.adelaide.edu.au/rsd/
## Research Skill Development Framework

A conceptual framework for the explicit, coherent, incremental and spiraling development of students' research skills.

### Extent of Students' Autonomy

<table>
<thead>
<tr>
<th>Level 1 (Prescribed Research)</th>
<th>Level 2 (Bounded Research)</th>
<th>Level 3 (Scaffolded Research)</th>
<th>Level 4 (Student-initiated Research)</th>
<th>Level 5 (Open Research)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly structured directions and modeling from educator prompt student research</td>
<td>Boundaries set by and limited directions from educator channel student research</td>
<td>Scaffolds placed by educator shape student independent research</td>
<td>Students initiate the research and this is guided by the educator</td>
<td>Students research within self-determined guidelines that are in accord with discipline or context.</td>
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### Core Facets

- **Research**: Analyse and synthesise information/data critically and synthesise new knowledge to produce coherent, individual understandings. Use mainly lay language and prescribed genre to demonstrate understanding for lay audience. Apply to a similar context the knowledge developed. Follow prompts on ESC issues.

- **Communicate and Apply**: Use discipline-specific language and genres to address gaps of a self-selected audience. Apply innovatively the knowledge developed to multiple contexts. Probe and specify ESC issues in each relevant context.

- **Facet A**: Analyse and synthesise information/data to reproduce existing knowledge in prescribed formats. **Facet B**: Analyse and synthesise information/data to reorganize existing knowledge in standard formats. **Facet C**: Analyse and synthesise information/data to construct emergent knowledge. **Facet D**: Analyse and create information/data to fill knowledge gaps stated by others. **Facet E**: Analyse and create information/data to fill student-identified gaps or extend knowledge.

- **Facet G**: Collect and record required information/data using a prescribed methodology from prescribed sources in which the information/data is clearly evident. Collect and record self-determined information/data from self-selected sources using one of several prescribed methodologies.

- **Facet H**: Collect and record required information/data using a prescribed methodology from prescribed sources in which the information/data is not clearly evident. Collect and record required information/data using a prescribed methodology from prescribed sources in which the information/data is not clearly evident.

- **Facet I**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet J**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet K**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet L**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

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- **Facet N**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet O**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet P**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet Q**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet R**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet S**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet T**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet U**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet V**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet W**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet X**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet Y**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.

- **Facet Z**: Collect and record self-determined information/data from self-selected sources, choosing or devising an appropriate methodology with self-structured guidelines.
RSD Facets

- **Embark & Clarify**
  - Respond to or initiate research & clarify or determine what knowledge is required, heeding ethical/cultural & social/team considerations

- **Find & Generate**
  - Find & generate needed information or data using appropriate methodology

- **Evaluate & Reflect**
  - Determine & critique the degree of credibility of selected sources & of data generated, and reflect on the research process used

- **Organize & Manage**
  - Organize information & data to reveal patterns & themes, & manage teams & research processes

- **Analyze & Synthesize**
  - Analyze information & data critically & synthesize new knowledge to produce coherent individual or team understandings

- **Communicate & Apply**
  - Write, present & perform the processes, understandings, & applications of the research, & respond to feedback, accounting for ethical, social & cultural issues.
RSD Levels

- **Level 1 – Prescribed Research**
  - Highly structured directions & modelling from educator prompt student research
  - Questions/tasks, sources, methodology, evaluation & analysis techniques prescribed; generally reproducing something that is commonly known

- **Level 2 – Bounded Research**
  - Boundaries set by & limited directions from educator channel student research
  - Methods & sources prescribed, but data/info not obvious; may have flexibility in organizing or managing

- **Level 3 – Scaffolded Research**
  - Scaffolds placed by educator shape student independent research
  - Chose from topics, suggested (but not required) methods, more self-determination for evaluation criteria, but within certain constraints

- **Level 4 – Student-initiated Research**
  - Students initiate the research within guidelines set by the educator
  - Student-generated question, methods, criteria, & analysis, all based on educator guidance especially regarding disciplinary or ethical, social, or cultural practices; may fill gaps in disciplinary knowledge

- **Level 5 – Open Research**
  - Students research within self-determined guidelines that are in accord with discipline or context.
  - Student-generated question, methods, criteria, & analysis based on students’ experience, expertise, or literature; analysis and synthesis will fill student identified gaps or extend knowledge
Auchincloss Model

- Synthesized research on research experiences and distilled the activities (and somewhat the goals) into 5 dimensions
  - Use of science practices
  - Collaboration
  - Broadly relevant or important work
  - Discovery
  - Iteration
- Created a Logic Model connecting these dimensions to student outcomes that might be reasonably expected to be attainable over time

Figure 1. CURE logic model.

Lisa Corwin Auchincloss et al. CBE Life Sci Educ
2014;13:29-40

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Auchincloss Model

**Short-term outcomes**
- Content knowledge
- Technical skills
- Analytical skills
- Project ownership
- Interaction with peers
- Interaction with mentors
- Research skills
- Skepticism

**Long-term outcomes**
- Motivation
- Self-efficacy
- Communication skills
- Collaboration skills
- Science literacy
- Understanding of the nature of science
- Professional Mentoring
- Scientific aspiration
- Professional network
- Ability to navigate uncertainty
- Science identity
- Persistence in science
- Resilience & Grit
- Science expertise
- Self-authorship
- Science enculturation

Undergraduate Research Student Self-Assessment (URSSA) Weston & Laursen

- Survey intended for assessing or evaluating a program
- Developed out of a qualitative study
- Tested for validity & reliability
- Self-reporting of gains from a research experience in four construct areas
- Aligns with critical components and outcomes from Auchincloss model
Undergraduate Research Student Self-Assessment (URSSA) Weston & Laursen

- Self-reporting of gains from a research experience in four construct areas
  - Thinking and Working Like a Scientist
    - Understanding process of scientific research & nature of scientific knowledge
  - Personal Gains Related to Research Work
    - Affective characteristics of confidence, comfort, self-efficacy
  - Skills
    - Gains in ability to perform tasks common in research or other settings
  - Attitudes & Behaviors as a Researcher
    - Related to working in a scientific community, creativity, independence, responsibility

Weston & Laursen, 2015, CBE-Life Sciences Edn., 14:1-10
How much did you gain in the following areas as a result of your research experience?

- Analyzing data for patterns
- Identifying limitations of research methods & designs
- Understanding the relevance of research to my course work
- Confidence in my ability to contribute to science (my discipline)
- Comfort working collaboratively with others
- Ability to work independently
- Writing scientific (logical, scholarly) reports or papers
- Explaining my project to people outside my field/class
- Keeping a detailed lab notebook (Creating and maintaining detailed & organized research notes)
- Understanding journal articles (research publications in this field)
- Managing my time
- Think creatively about the project
- Feel a part of a scientific community (Feel like a scholar in your discipline)

Weston & Laursen, 2015, CBE-Life Sciences Edn., 14:1-10
Summary so far

RSD Framework
- 5 Facets & 5 Levels
  - Embark & Clarify
  - Find & Generate
  - Evaluate & Reflect
  - Organize & Manage
  - Analyze & Synthesize
  - Communicate & Apply

Auchincloss model
- Activities & outputs grouped into 5 dimensions and related to 24 potential outcomes over time
  - Use of science practices
  - Discovery
  - Broadly relevant or important work
  - Collaboration
  - Iteration

URSSA
- Self-reported gains in 4 areas
  - Thinking and Working Like a Scientist
  - Personal Gains Related to Research Work
  - Skills
  - Attitudes & Behaviors as a Researcher
Applying the Frameworks
Recall your outcomes & assessments

- In a small group with neighbors –
  - Each group will get either Auchincloss or RSD
  - Review the examples
  - From your lists earlier select outcomes that are of common interest
  - Identify the most appropriate theoretical framework
  - Map the current assessment to the framework
  - Discuss how the assessment might be improved using the framework to guide your thinking
  - Apply a different framework or move to a different outcome
O.U.R. Resources

- URSSA administration
- Other items (CBUR or Individual-Apprentice)
  - Course-based research skill planning tool
  - Prompted, reflective writings to activate skill development and affective gains
  - Undergraduate Research Mentoring Agreement
  - Mentor training
  - Mentor Competency Assessment
  - Faculty reporting changes
Other discussions

- Most important question about course-based undergraduate research?
- What recommendations do you have for faculty wanting to teach using research?
- How could the O.U.R. support inclusion?
Course-based UR assessment meta-framework

1. Scientific Practices
2. Collaboration
3. Iteration
4. Discovery
5. Relevant Research

Course Outcomes

Facility Outcomes
- Interest/Motivation for Teaching
- Publications
- Grants

Student Outcomes
- Interest
- Self-Efficacy & Autonomy
- Career Options

Instructional Practice & Course Structure

Brownell & Kloser, 2015, Studies in Higher Education, 40:3, 525-544
<table>
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<th>RSD-based Shell Rubric</th>
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<tbody>
<tr>
<td><strong>Highly structured</strong></td>
</tr>
<tr>
<td>Embark on Inquiry</td>
</tr>
<tr>
<td>Find/Generate needed information</td>
</tr>
<tr>
<td>Critically Evaluate</td>
</tr>
<tr>
<td>Organize info</td>
</tr>
<tr>
<td>Synthesize, Analyze &amp; Apply New</td>
</tr>
<tr>
<td>Communicate</td>
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</table>
Examples of RSD Rubrics
Example Assessments based on the Auchincloss Model

- Brownell & Kloser, 2015, Studies in Higher Education
- Pull apart several dimensions of the Auchincloss model
- Present student assessments from a large introductory biology course at a Research 1 institution that was redesigned
Example Assessments based on the Auchincloss Model – Scientific Practices

- **Thinking like a scientist**
  - Pre/post near-transfer tasks focused on scientific thinking constructs (data analysis & experimental design ability measured using performance assessment)
  - Pre/post self-confidence and interest surveys

- **Communicating like a scientist**
  - Rubric based assessments of:
    - Conference style presentations with critique by peers
    - Journal article-type summative writing submission
    - Poster Presentations

- **Using the tools of a scientist**
  - Lab practical, hands-on experiments

Brownell & Kloser, 2015, Studies in Higher Education, 40:3, 525-544
Example Assessments based on the Auchincloss Model – Other dimensions

**Collaboration**
- In-class measures of student interactivity using observation tool charting questioning and discursive practices

**Discovery/broadly relevant work**
- Syllabus and course description analysis with rubrics
- Student interviews & surveys
- Publications and conference presentations

**Iteration**
- Syllabus and course description analysis with rubrics

Brownell & Kloser, 2015, Studies in Higher Education, 40:3, 525-544
Another example assessment

- More closely related to Auchincloss goal of assessing a program or class
- Asked faculty to rate the extent to which they intend students to:
  - Engage in the scholarly practices of the discipline
  - Use a study design and methods aligned with the discipline
  - Choose their own study design and methods within the discipline
  - Define the purpose for their study
  - Develop or discover insights that are unknown to both you and the student
  - Answer questions that do not have established answers in your discipline (whether research question-, hypothesis-, or problem/design-driven)
  - Engage in work that has relevance beyond the course
  - Create products that have potential for importance and meaning beyond the course
Another example assessment

- More closely related to Auchincloss goal of assessing a program or class
- Asked faculty to rate the extent to which they intend students to:
  - Engage in work that might present opportunities for additional action or study
  - Collaborate with other students in the course
  - Collaborate with you and the GRG
  - Collaborate with experts outside of the classroom
  - Confront and negotiate “messy” or conflicting data/information, to include self-collected or primary source data/information
  - Include multiple iterations of refinement or experimentation in their research process
  - Learn from failure, false-starts, dead-ends, etc