Learning the nature of research: Models for undergraduate research experiences?

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Adam Johnston
Department of Physics, Weber State University

Contact: ajohnston@weber.edu

(See http://physics.weber.edu/johnston/research for these slides and other research papers.)

Premise

- We presume that students gain or learn something from their undergraduate research experiences (UREs).
- What is it that we expect? Is this universal?
  - If so, what is the universal expectation?
  - If not, how should different research experiences be fit to specific expectations?

Conclusions
(in case you miss the rest of the slides)

- Students' descriptions of their UREs are overwhelmingly positive, but . . .
- . . . what students gain and what faculty set as goals are often different.
- This suggests that undergraduate research experiences may need careful, explicit design. (What models do we have for this?)

My research questions

- What do faculty expect undergraduate research students to learn?
- What do students gain as a result of their experience?
- Do either of the above have anything to do with the nature of the discipline and research (e.g., the "nature of science")?

Methods

- 4-year, undergraduate institution with a blooming commitment to undergraduate research (including summer funding)
- Students/faculty in biological and physical sciences
- Pre/post interviews/questionnaires
- (Additional collaboration with similar studies at other institutions.)

Findings: Faculty goals

- The "process of science": *"How do we come up with ideas in the first place, and what is the process for chasing them down."*
- Appreciation for science: "*I want them to experience the joy of scientific discovery."*
- Valuable skills: "…*learning how to design experiments or field work, working with groups when this occurs, developing oral and written communication skills."*
- Goals and future

Findings: Student affect/attitudes

Affective gains

- All positive! (not surprising?)
  - An opportunity to do science
  - Faculty interactions
  - Something to add to grad school applications

Findings: Student conceptions

Views of science

- Empirical – “progress” in science as information gathering
- Utilitarian purposes (technology and health applications)
- Problem solving tasks

Findings: Student conceptions

Answers to "what did you learn":

- Problem solving and analysis
- New laboratory skills: "[A]fter isolating DNA from tissue, I performed molecular sequencing tests."
- Using computers/programming
- Collecting data and doing statistics
- Reading journal articles and doing literature searches/review
- How to write

(Overarching focus on practicalities of doing research.)

Discussion

- Faculty suggest broad goals, while students focus on very specific gains.
- How does what we expect from UREs impact what students learn?
- What models could be developed for UREs?
  - Mentor designs project from scratch, tells student what to do.
  - Student designs project from scratch . . .

Future questions

- Should our learning goals for URE students be the same as for other students?
- What learning outcomes could result from specific URE models?
- How do we measure specific learning gains? Interviews, questionnaires, standardized exams, writings, etc.