Are all labs equal? An investigation of student self-efficacy and its relation to different lab types.

Lillie Pennington, University of California - Merced

Background

- Whether or not a student believes they can perform well in STEM is their self-efficacy (Bandura 1977)
- Self-efficacy can impact success in STEM programs (Dweck 1986)
- Student self efficacy is positively impacted by research experience, or hands on experience with the scientific method (Hunter et al 2009)
- Lab classes can sometimes consist of different activities (i.e. wet labs, discussions, field labs)
  - Different activities may have varying effects on self-efficacy

Questions

1) Does student self-efficacy differ across three lab types?
2) What are barriers to student self-efficacy, and what supports it?

Methods

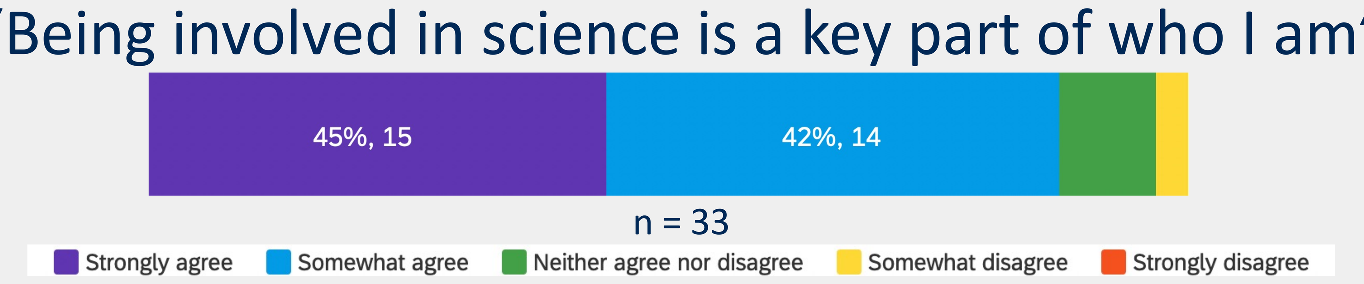
- Plant Biology Lab
  - Upperclassmen
- Three different lab types
  - Field, a trip to the vernal pools
    - Students worked in groups to identify all plant species in a quadrat, then came together to discuss what species were found where
  - Wet, dissecting flower heads
    - Students worked in groups of two or three to dissect different flowers and identified structures
  - Discussion, about plant defenses
    - Students worked together to answer questions about a case study and come up with their own experiments
- Qualtrics survey given after each lab
  - Included Likert-scale questions (1-5) and text box responses

Analysis

- Text box survey responses analyzed using inductive open coding
  - Responses could have more than one code
- Likert scale responses reported using descriptive statistics

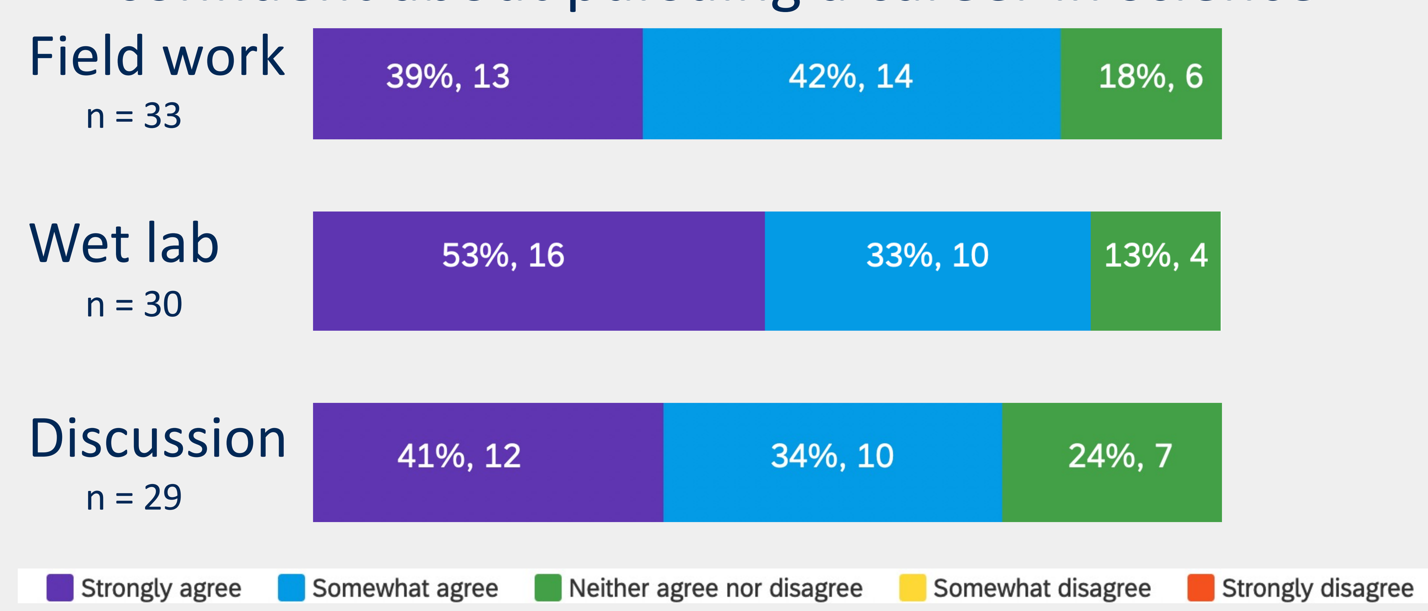
"I intend to work in a field of science"

"Being involved in science is a key part of who I am"



"What does being a scientist mean to you?"

"The lab work I did in class today made me feel more confident about pursuing a career in science"



"When do you feel most like a scientist?"

Code	% Student, n = 27
Hands-on lab	81
Answering questions in discussion	19
Collaborating with classmates	11
Fieldwork	11
Creating hypotheses	7
Analyzing data	7
In class, learning new subjects	4

Code examples

Hands-on lab: "I feel more like a scientist when I am working with lab equipment. I really enjoyed the labs where we dissected plants and different fruits."

"Doing lab work"

Answering questions in discussion/Collaborating with classmates: "I feel most like a scientist when I can contribute to class and answer questions. Also talking in groups to help come up with an answer."

Hands-on lab/Analyzing data: "Actually experimenting and analyzing results."

Hands-on lab/Creating hypotheses: "When having to make up a hypothesis and do hands on labs."

"What makes you question your ability to succeed in a science career?"

Code	% Student, n = 27
Unable to understand, apply, or communicate concepts	41
Imposter syndrome	22
STEM careers are difficult	19
Lack of experience	15
Grades	15
Doubt interest in continuing in STEM	7
STEM careers have toxic work environments	4
Lack of knowledge	4
No question	4

Code examples

Unable to understand, apply, or communicate concepts: "How to apply the material I learn makes me question my ability to succeed in a science career."

"My communication skills."

"The ability to understand certain information from research articles."

Stem careers are difficult: "The level of work it takes to succeed in science."

Lack of experience: I have not had any research or internships associated to science which make me question if I can pursue a career in this field.

Doubt interest in continuing in STEM: "If I even want to do it. "

Conclusion

- Students' self-efficacy can be positively impacted by a variety of lab exercises
  - All responses were positive, with wet lab having the most strongly agree responses fewest neutral responses
  - Students' slight preference for wet labs reflects their preference for hands-on labs, and provide a chance for them to clearly apply concepts from lecture to real life
- Students feel that an inability to understand, apply, and communicate concepts is their biggest barrier, and hands-on labs support their self-efficacy
  - Lab courses can give student an opportunity to apply the topics they've learned in lecture

Recommendation for Instruction

- Allowing students time during lab to connect the lab work to the lecture and exam material may help them gain confidence in their ability to understand, apply, and communicate topics STEM
- Linking lab tasks to professional science can help students see they are learning relevant science skills while in lab
- Using self-efficacy assessments in lab settings can allow instructors to more precisely support student self-efficacy

Acknowledgements: Thank you to Petra Kranzfelder, Jackie Shay, and all my teaching class colleagues for their support during my journey through education research; Emily Moran for being a great IOR, and the students in my class for being great and taking the survey ☺

Contact: lpennington@ucmerced.edu

References: Bandura, A. (1977) Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review 84(2): 191–215.
Dweck, C. S. (1986). Motivational processes affecting learning. *American Psychologist, 41*(10), 1040–1048.
Hunter, A. B., Weston, T. J., Laursen, S. L., & Thiry, H. (2009). URSSA: Evaluating student gains from undergraduate research in the sciences. CUR Quarterly, 29, 15–19.