

A Canadian Snapshot: Examining the Upper-Year Student Experience in Chemistry Laboratory Courses

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Introduction

Chemistry departments worldwide invest significant resources on the laboratory experience, while students invest significant time and effort on their laboratory learning.¹ However, laboratory courses are often constructed from the faculty perspective alone, without considering student perspective.² Given the breadth of stakeholders involved in designing, administering, evaluating, and performing laboratories, it can be difficult to ensure that the full potential of lab experiences are being attained.³ To examine whether the student experience in the chemistry lab is aligned with course content and learning objectives requires a holistic examination of the laboratory experience from the perspectives of all stakeholders—faculty, staff, teaching assistants (TAs), and students.

Background

The current state of laboratory courses across Canada was analyzed through the following areas: meaningful learning, constructive alignment, time commitment vs. pedagogical value, and student partners.

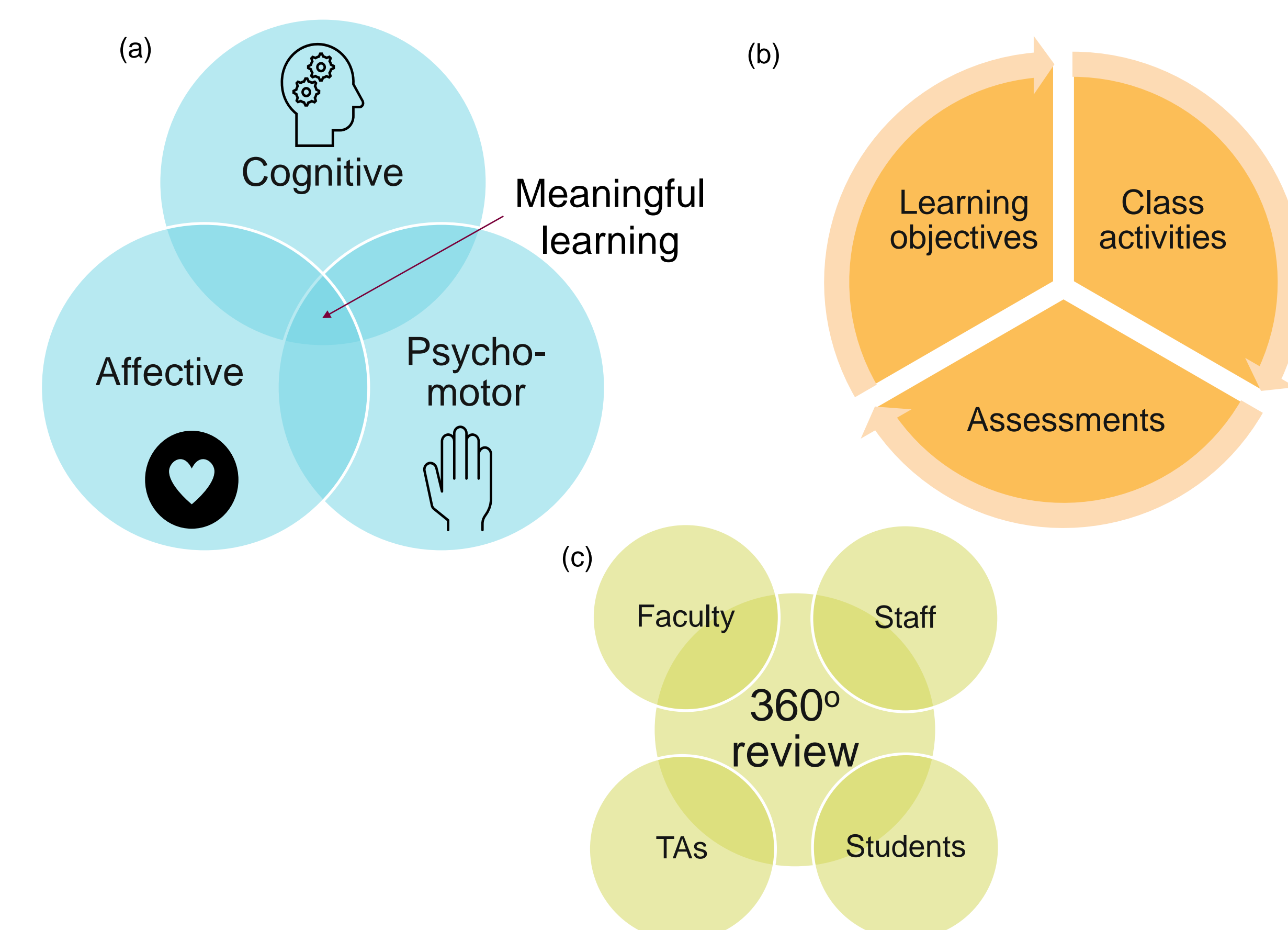


Figure 1. Models used in the design and data analysis of this research. (a) Meaningful learning lies at the centre of the cognitive, affective, and psychomotor (CAP) learning domains (b) Course design involves constructively aligned learning objectives, activities, and assessments (c) A 360° review considers feedback from all stakeholders to provide a holistic examination.

Research Questions

1. What are the most/least relevant skills and activities that students accomplish before/during/after laboratory?
2. How much time is a typical student spending on the laboratory, including pre-/during/post-lab?
3. How do undergraduate students, TAs, and faculty differ in their consideration of the most/least relevant skills/activities and their respective time commitments?

Methods

- Participants surveyed from August 2021 to August 2022
- 22 Canadian institutions with an undergraduate chemistry program
- Stakeholders: faculty, staff, teaching assistants (TAs), and students
- Questions centered on the student experience in laboratory courses.

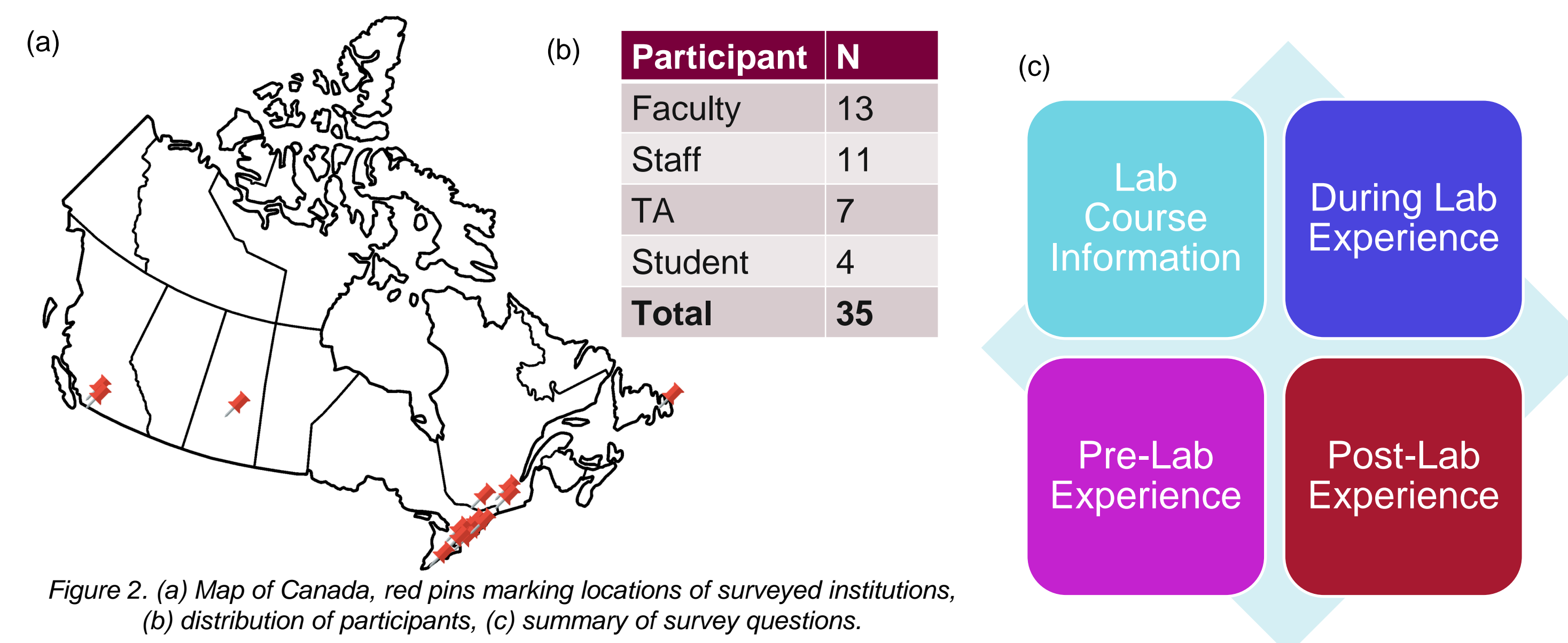


Figure 2. (a) Map of Canada, red pins marking locations of surveyed institutions, (b) distribution of participants, (c) summary of survey questions.

Results

Pre-Lab and Post-Lab Activities

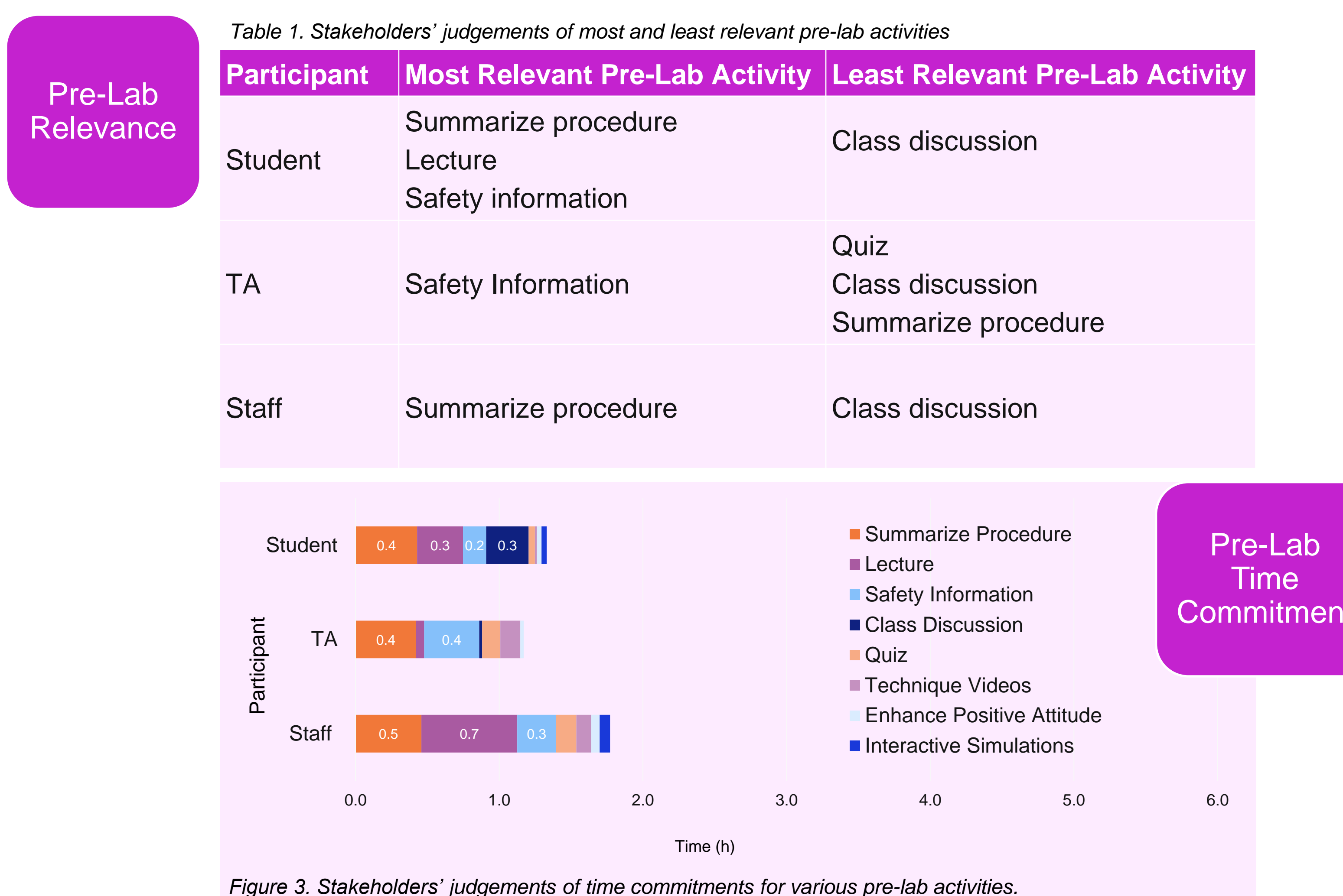


Figure 3. Stakeholders' judgements of time commitments for various pre-lab activities.

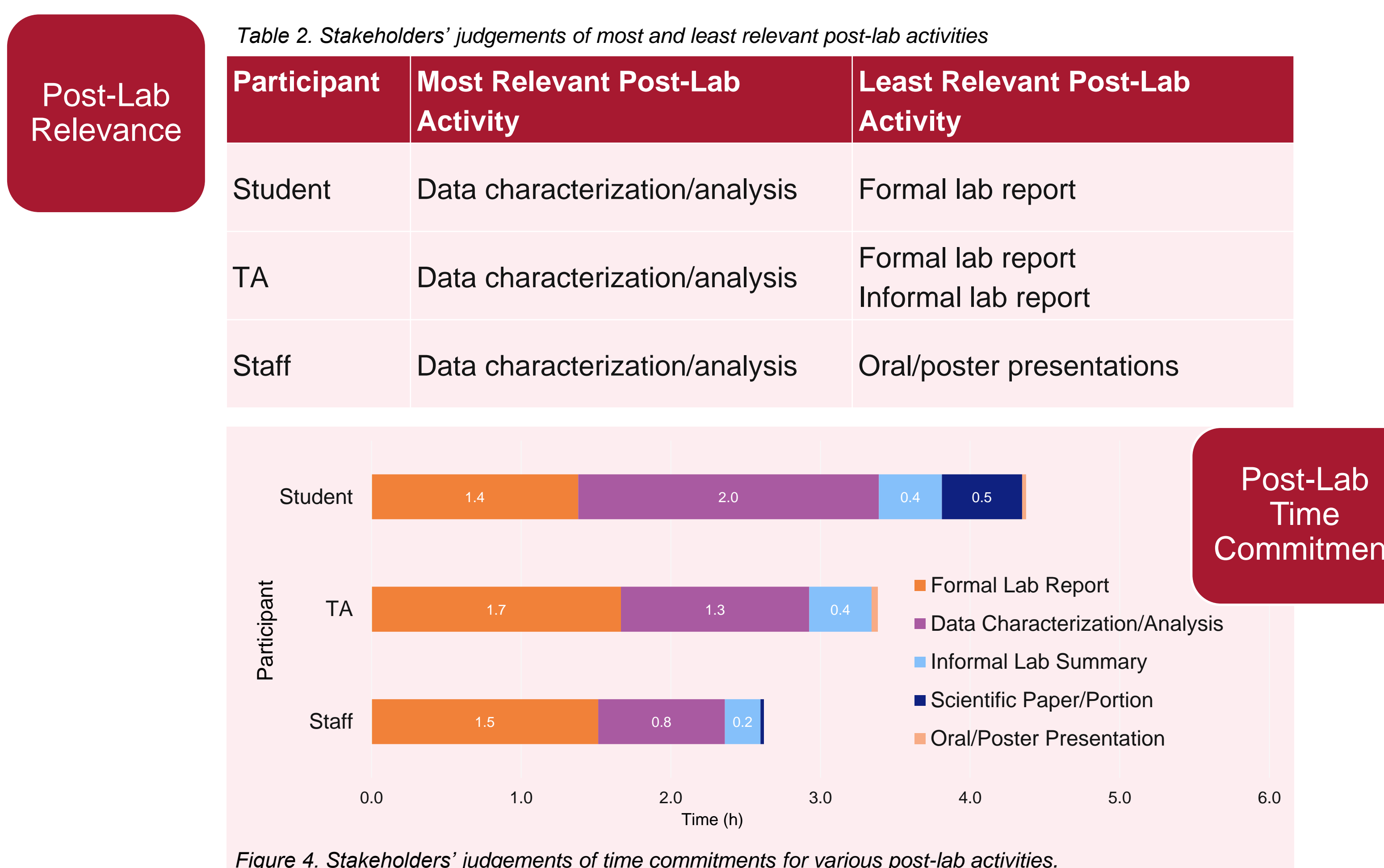


Figure 4. Stakeholders' judgements of time commitments for various post-lab activities.

Learning During Lab

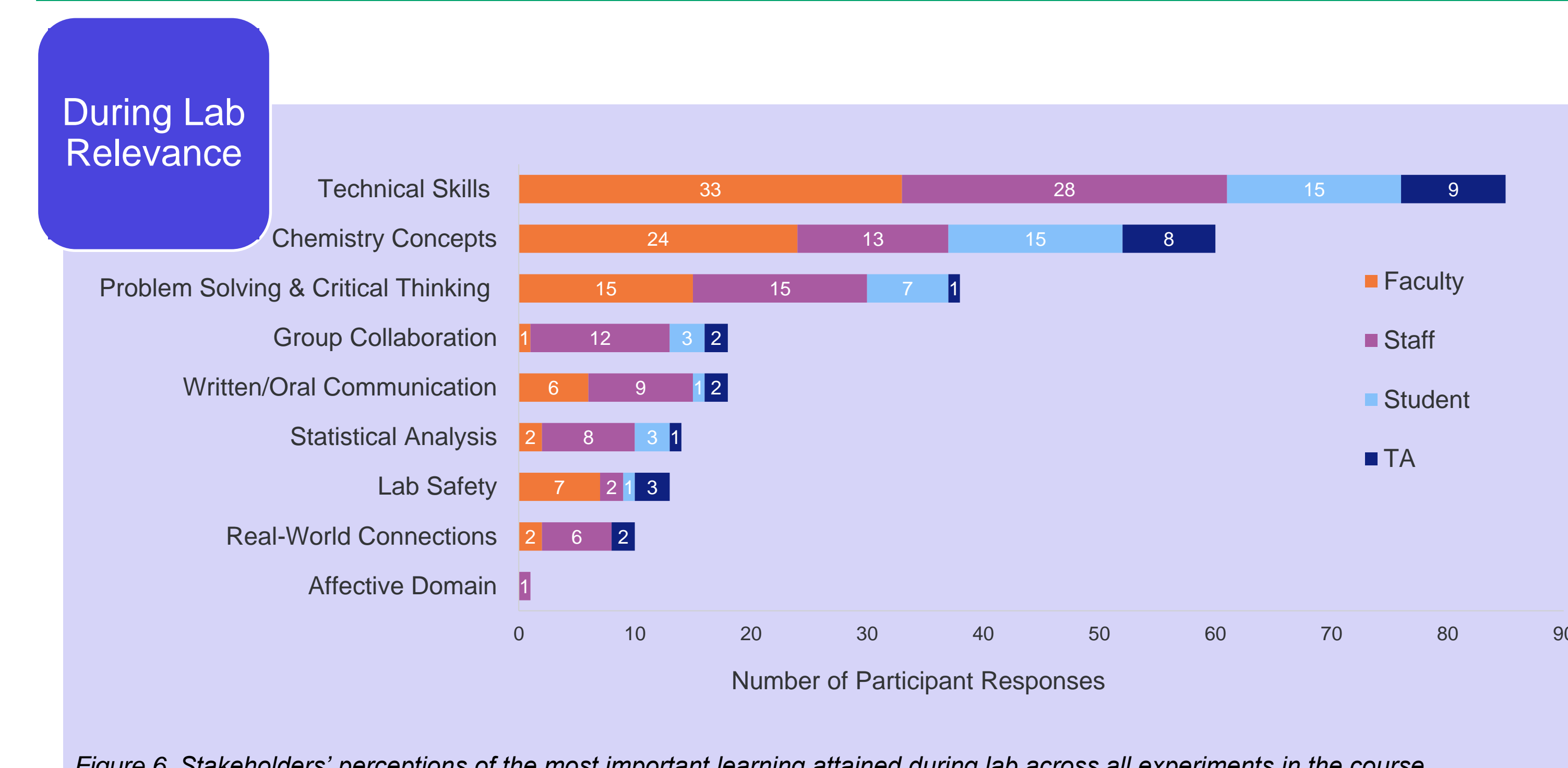


Figure 6. Stakeholders' perceptions of the most important learning attained during lab across all experiments in the course.

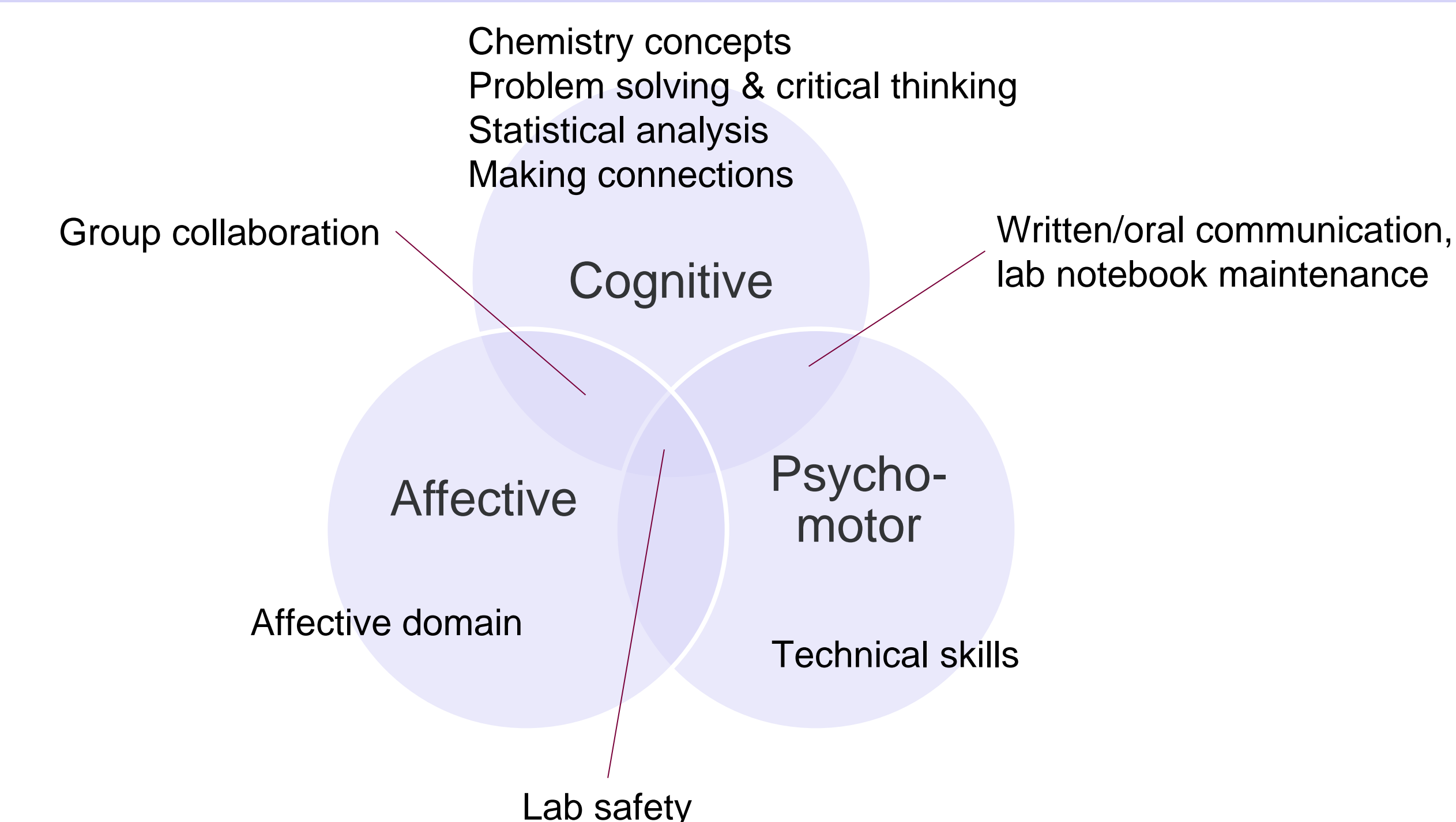


Figure 7. All stakeholders' perceptions of the most relevant learning attained during lab mapped according to cognitive, affective, and psychomotor learning domains.

Significant Findings

- Activities during lab favour the psychomotor and cognitive domain. Pre-lab and post-lab activities and assessments favour the cognitive domain. The affective domain is overlooked.
- Notable time discrepancies on pre-lab and post-lab work between stakeholders: TAs and staff allot more time to pre-lab while students spend more time post-lab.
- Misaligned time commitments/expectations and most/least relevant activities may reflect the stakeholder's level of experience and role in the course.
- Formal lab reports were less relevant to students and TAs, despite studies suggesting their importance to developing a deeper understanding of science.⁴
- Students may not fully grasp the pedagogical value of a given activity, calling upon the refinement of these activities to promote a more equalized time distribution across activities.⁵

Conclusions & Future Work

- Further research must be conducted for more detailed suggestions for course improvement.
- Institutions should utilize the students/TAs as partners approach to identify and address issues in courses, maximize pedagogical effectiveness, and foster a meaningful learning environment.
- We hope to use this study to start a conversation and share perspectives of different stakeholders about the upper-year laboratory experience, ultimately establishing a network to share ideas and resources.