From Feedback to Reform: Transforming Introductory Geology Labs through Student Voices

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Introduction

Students are often first exposed to the geosciences in introductory geology courses, which can serve as a chance to impact both student interest and major choice (Hoisch & Bowie, 2010). In these courses, graduate teaching assistants (TAs) often serve as lab instructors; in this role, they routinely receive informal student feedback and make their own observations about a lab's utility and impact. In Fall 2024, instructors and TAs at the University of South Carolina (USC) sought data-driven approaches to improve introductory geoscience lab activities (see Ryker et al., 2025). The instructional team developed a multiple-choice survey tool to meet this need by formalizing student feedback. Due to its modularity, the instructional team would be able to probe for specific foci within lab activities by adjusting the questions asked of students. Since its inception, the tool has served as the primary method behind targeted changes in lab curriculum for the introductory course; here, we summarize how it has been used to guide lab modifications and discuss implementation challenges and recommendations for other settings.

Context for Study

All data were collected from students in-person sections of GEOL-101 (*Introduction to the Earth*) at USC each semester since implementation in Fall 2024. GEOL-101 serves as a non-majors course that counts as a lab and science course as part of the University's required general education program. GEOL-101 is offered in both large (300+ students) and medium (120 students) lecture environments, with labs (24 students) being taught by TAs. The courses contain 11 labs as well as a lab practical midterm; these include a four-week sequence on rocks and minerals, two field-based activities (i.e., a campus rock tour and a trip to a local stream), and a series of one-off labs on common introductory topics such as earthquakes, tectonics, or geologic time (Egger, 2019).

Methods

A concise, 10-question multiple-choice survey developed by Ryker et al. (2025) was provided to students at the end of each week's lab activity. Students completed this survey on bubble sheet paper which was then turned in to the section TA. All sheets were scanned using ZipGrade, with minor corrections for lab section and activity; student comments written at the bottom of sheets were manually recorded. Both quantitative and qualitative data were discussed by the instructional team weekly, with areas for improvement documented in the meeting minutes. In total, each semester yielded feedback for 11 different labs. Lab content occasionally changed across semesters, so not all labs had direct 1:1 comparisons each time; overall topics remained similar. "Plate Tectonics" moved between being included in Labs 1 and 2 from Spring 25 to Fall 25. Surveys were optional for all semesters other than Fall 2025. Additional measures were used for semesters with lower response rates, such as asking students about their favorite labs.

Results

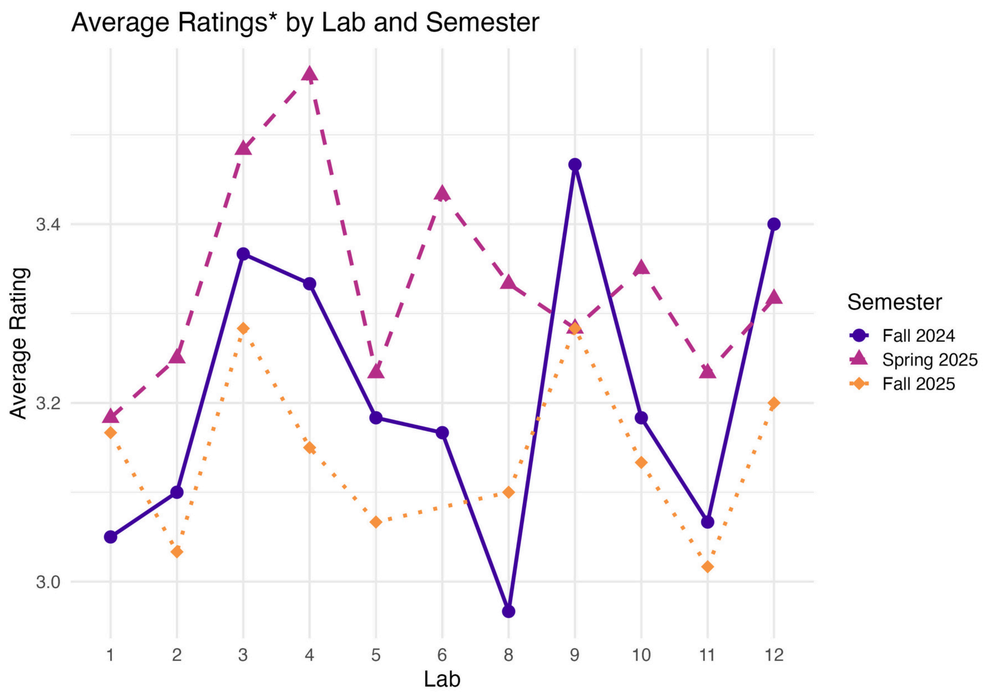

Figure 1. Average rating for a given lab by semester. Rating is calculated as the mean of item means for a lab, excluding Enjoyment and Accessibility due to them being added later. Individual scores could range from 1-5.

Lab #	Content	Fall 2024	Spring 2025	Fall 2025
1	Scientific Method*	178 (3.05)	170 (3.18)	266 (3.17)
2	Earthquakes*	165 (3.10)	158 (3.25)	297 (3.03)
3	Minerals	107 (3.37)	137 (3.48)	349 (3.28)
4	Igneous Rocks	167 (3.33)	159 (3.57)	394 (3.15)
5	Sedimentary Rocks	134 (3.18)	144 (3.23)	343 (3.07)
6	Metamorphic Rocks & Rock Tour**	114 (3.17)	140 (3.43)	NA
8	Geologic Time	119 (2.97)	133 (3.33)	358 (3.10)
9	Stream Discharge**	58 (3.47)	71 (3.28)	296 (3.28)
10	Topographic Maps	149 (3.18)	129 (3.35)	310 (3.13)
11	Groundwater	119 (3.07)	95 (3.23)	339 (3.02)
12	Climate Change	33 (3.40)	51 (3.32)	314 (3.20)

Table 1. Response rates and overall ratings by lab across semesters. Values in parentheses are the average rating. Data were lost for lab 6 during the Fall 2025 semester.
**Plate Tectonics was included in these labs at different timepoints.*
***Contains a field-based component.*

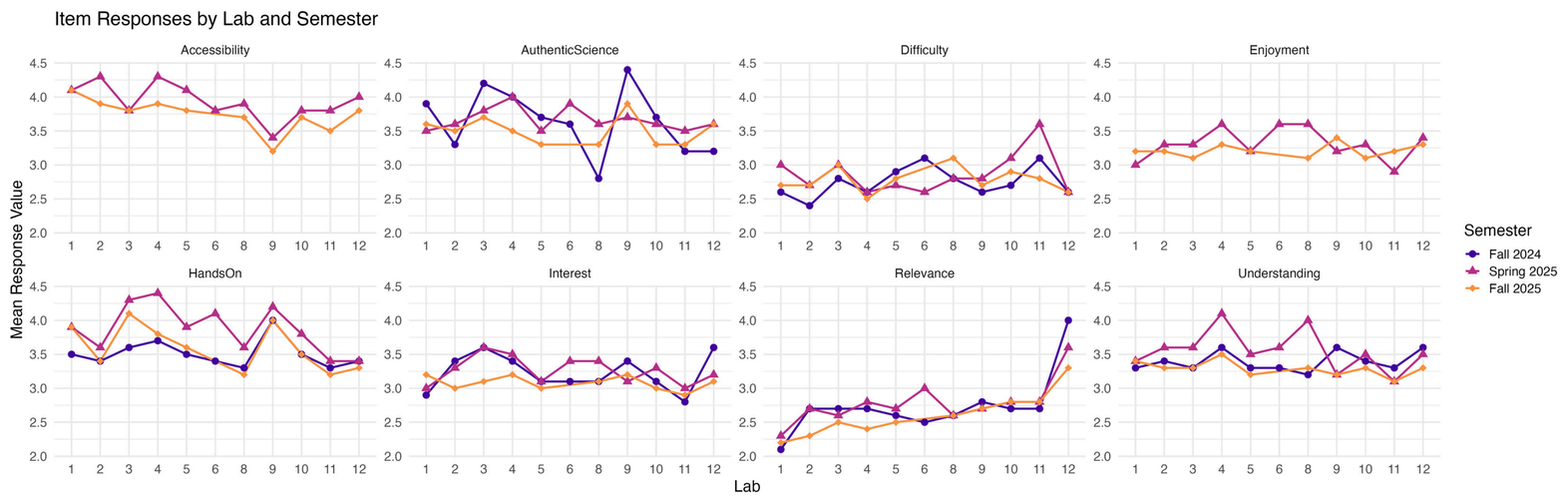

Figure 2. Mean item responses by lab and semester. Note that "Accessibility" and "Enjoyment" do not contain values for Fall 2024 as they were added as survey items after this semester. Additionally, Fall 2025 lines are missing values for lab 6 due to data being lost. Individual scores could range from 1-5.

Challenges: During Fall 2025, many values seemed to shift closer to neutral; the instructional team believed this was due to students straightlining. To reduce this, responses were no longer required in Spring 2026; however, this ended up leading to a different issue. Due to low response rates during Spring 2026, additional methods of gaining insight were required (Figure 3 below and to the left). Additionally, the large number of responses can lead to large backlogs and undue burden on instructors to scan.

Our Experiences & Recommendations: This tool has proven useful to provide tangible information about aspects of the lab activities we use. It has shown both where our changes have been successful in achieving our goals (e.g., providing graphic organizers to reduce the difficulty of Lab 6) and failures (e.g., Climate Change has had numerous changes to increase relevance, to no avail). Some recommendations for others who want to try a similar approach are provided (Table 2 below to the right).

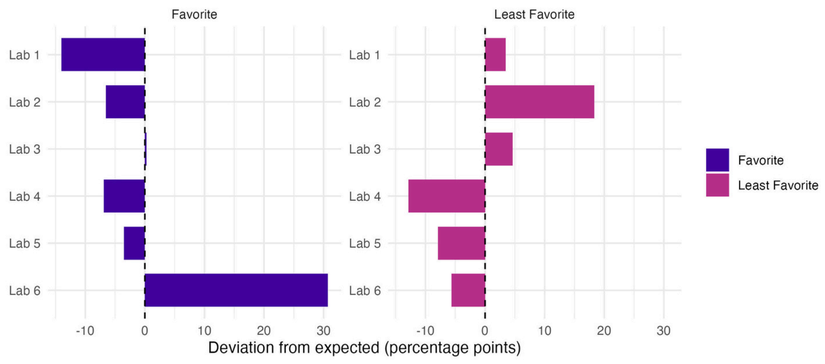

Figure 3. Deviation from the expected reported frequency of "Favorite" and "Least Favorite" labs from the first half of the Spring 2026 semester, assuming equal preference for labs. Bars show percentage points above or below the expected amount.

Recommendations for future implementations
1. Provide a digital format for students to complete. This would reduce the burden of someone needing to scan, and can reduce missing information errors.
2. TA buy-in is key. If the TAs do not want change, it's unlikely meaningful change can occur or be implemented.
3. Do not require surveys, but do incentivize them and remind students about them.
4. Multiple methods of collecting data allows for better analysis. In addition, both quantitative and qualitative methods should be used. It may be worth explicitly including a "Comments" section.
5. Create a repository of prior labs, changes made, and justifications to allow knowledge transfer to future IAs and instructional teams.
6. If overwhelmed or falling behind, reduce the frequency of distributions.

Table 2. Recommendations for future survey implementation.

Acknowledgments

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References & Figure Descriptions

For a list of references or figure descriptions, scan the QR code to the left. Permanent link is https://docs.google.com/document/d/15XhsmIQNQcUnuPTqDUcMT5a1jqG7cnPpiqfj-m4MiRo/

Example Activities

For examples of some of the labs created through this feedback, scan the QR code to the left. Permanent link is https://github.com/LeChatDeLaNuit/Developing-Virtual-Field-Trips

Questions?

If you have any questions or would like more information, please feel free to reach out to Benny Thoms-Warzecha (bennytw.geo@gmail.com) or Katherine Ryker (kryker@seoe.sc.edu)