Report on "Modernization of common lab activities for introductory geology classes"

An Innovations in Teaching and Learning project funded in 2014

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Goals of this ITL project

Our goal is to update the now decades-old laboratory activities that are common to all of our introductory geology courses (GEOL 110, 120, and 210). These courses collectively serve approximately 80 Whitman College students each year (both majors and non-majors).

Summary of project proposal

The Geology department recognized that our introductory lab activities were not meeting our common teaching goals, for four reasons:

1. Modern techniques and tools that professional geologists depend on, particularly tools that leverage the wealth of available geospatial tools and online datasets, were completely absent from our lab activities.

2. Decades of improvement in our understanding of pedagogy and the value of experiential learning[1] were not implemented in our lab activities.

3. The development of the lab activities pre-dated the hiring of half of the instructional team in Geology (Bader, Nicolaysen, Cota, and visiting faculty), and thus, instruction in the lab topics didn't make optimal use of the teaching talents that each department member can offer.

[1] National Research Council. Improving Undergraduate Instruction in Science, Technology, Engineering, and Mathematics: Report of a Workshop. Washington, DC: The National Academies Press, 2003

4. With the change in department personnel, there had not been a recent conversation among department faculty regarding a common vision for the purpose of and content covered by each lab.

In our proposal, we outlined a plan of action to meet during the summer of 2014 in order to decide on a course of action and generate ideas that we would implement during the summer. We also budgeted a set of iPad tablets to test the use of this technology in the classroom and field, and we additionally requested funds for Pogue to collect imagery and samples from key locations in Utah and Nevada.

Summary of team activities as a result of this grant

As a result of this grant, we did the following in 2014:

1. We developed and implemented a lab survey designed to assess students' confidence in critical areas of mastery.

2. We met in early June in order to discuss the four problems outlined above and to generate solutions. In addition to the team members listed above, Bryn Kimball joined us for this meeting. The outcome of the meeting was this set of shared goals for our new labs:
    a. As much as possible, student activities should closely match "real activities" as practiced by geologists in the field or lab.
    b. Student activities should be more experiential, with less time devoted to reading text and writing answers in a packet.
    c. Student activities should better make use of technology used by practicing geologists and researchers.
    d. At least some assessment should occur during the lab time, so that students can learn immediately from their mistakes.
    e. Where possible and applicable, students should be able to ask real research questions that can be answered using publicly available datasets.

3. Pogue traveled to Utah and Nevada to collect high-resolution imagery and rock samples.

4. Individual team members, especially Shimer, Bader, and Cota, worked on individual labs during the summer. Bader was responsible for new mapping and flood-frequency activities, and contributed part of a new sedimentary rock lab. Shimer worked on supporting materials and lab activities for all the labs in his course. Cota worked on a plate tectonic activity using seismic and volcanic data.

5. Bader and Shimer implemented the new labs in their courses in Fall 2014.

Outcomes of this ITL grant

Our work on introductory labs is far from complete, and will presumably always require adjustment to advances in technology and new pedagogical research. Nonetheless, we were able to improve some of our lab activities so that they are more aligned with our key learning goals.

Learning goal A: As much as possible, student activities should closely match "real activities" as practiced by geologists in the field or lab. **Outcome example:** The sedimentary rock identification lab now includes samples taken from a single real outcrop. Students now examine high-resolution Gigapan imagery and reconstruct the history of the outcrop as a geologist would.

Learning goal B: Student activities should be more experiential, with less time devoted to reading text and writing answers in a packet. **Outcome example:** Activities for topographic maps and structural geology now include work using field instruments on Whitman campus.

Learning goal C: Student activities should better make use of technology used by practicing geologists and researchers. **Outcome example:** New tools including the use of Google Earth, Gigapan images, and data analysis in Excel have ben incorporated successfully into several of our labs.

Learning goal D: At least some assessment should occur during the lab time, so that students can learn immediately from their mistakes. **Outcome example:** Some of the rocks labs have been changed so that students can check their observations in the first half of the lab, before applying their new skills in the second half of the lab.

Learning goal E: Where possible and applicable, students should be able to ask real research questions that can be answered using publicly available datasets. **Outcome example:** The discharge and flood lab uses real-time data available online from the USGS to answer societally-important questions about flood frequency.

Notes on new technology

We experimented with new technology in the field and in the classroom. Here are some of our observations:

- The iPads purchased with this grant are outstanding for working in the field, and are rapidly replacing conventional mapping technology. However, they are not as useful in the classroom, due to key deficiencies in the iOS versions of software programs such as Google Earth and Apple Numbers. Consequently, we are not currently pursuing the purchase of additional student iPads until these deficiencies are addressed.
- Bader experimented with having all students bring their laptop computers. To his great surprise, every single student in his Fall 2014 lab owned a portable computer of some sort (in varying states of repair). However, about 20% of students did not own Microsoft Office.

- Because of the high-quality, consistent experience they provide, Whitman's computer labs remain extremely important for implementing technology-based activities in lab.

Respectfully submitted,

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