Teaching Philosophy

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What is learning?

Benner (1984) characterizes learning as the process of advancing through five stages of proficiency: from novice to expert. The idea suggests that learning happens incrementally by a combination of practice (the *doing* parts of science: observation, analysis, model building, hypothesis testing) and accumulation of experiences (the *reflective* or *communicative* parts of science: teaching, conceptual mapping, technical discussion). In other words, a student's progression from performing to-do list tasks (novice) to identifying and contributing to novel science (expert) is evidence of learning. The exact path from novice to expert depends on many factors, however, so I consistently monitor how well students are learning (and how well I am teaching) by using an evidenced-based approach known as the scholarly teaching cycle (STC, Figure 1).

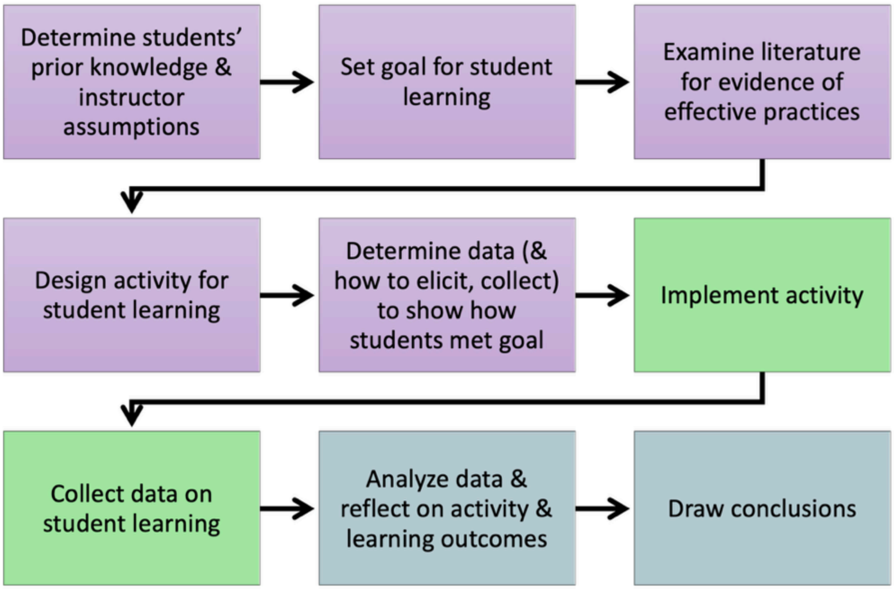

Figure 1: *The scholarly teaching cycle. From Miami University's Center for Teaching Excellence (CTE) seminar on scholarly teaching, 2022.*

The scholarly teaching cycle

My approach to higher-education can be summed up in a simple cycle consisting of: design, implementation, data collection, analysis, review. This cycle is a core focus of my professional development. For example, my CV documents my engagement in numerous activities that focus on implementing the STC.

In the initial stages of the STC, I use a backward design approach (Wiggins & McTighe, 2005) to identify appropriate materials and activities for my students. In this approach, the learning objectives are the starting point and the syllabus is constructed to support the objectives. I try to incorporate cutting-edge research, real-world applications, quantitative skill building exercises involving high-level computer programming, and student-led miniprojects where students work on a relevant research question and publicly communicate their results. I find certain references helpful during these stages of the STC like: Bloom's taxonomy (Bloom, 1956) and Thomas Angelo's *Evidence-Based Practical Strategies for Improving Teaching and Learning*(T. Angelo, 1993) and *Classroom Assessment Techniques*(T. A. Angelo & Cross, 2012).

In addition to core learning objectives, I would like students in my classroom to practice: digesting scientific literature, publicly communicating scientific results, giving and receiving peer-to-peer feedback, completing quantitative tasks, making precise observations (measurements), organizing and visualizing data in compelling ways, and defining approaches to complex problems. Other skills like metacognition, self-regulation, teamwork, organization, tenacity, and leadership are also highly encouraged.

During the latter stages of the STC, I collect feedback and assess my teaching performance. I have learned that directly asking students about their learning experience is an indispensable source of feedback, in addition to tracking quantitative measures over time (e.g., exam scores). For example, I frequently poll students in the moment to ask where "sticking points" are before moving on with an exercise. This helps me assess student engagement and identify shortcomings in my lesson plans on the fly. I also ask for more formal feedback by soliciting mid-course and end-of-term evaluations, which I evaluate in consultation with experts to improve my teaching practice. I have documented evidence of teaching effectiveness since 2020.

Feedback (in both directions) between students and instructor can effectively support learning when done purposefully (Hattie & Timperley, 2007). I emphasize student feedback in my teaching practice for two reasons: 1) it makes teaching and learning more inclusive and accessible and 2) students stake more in their education when their input is accounted for. While student feedback may be imperfect, merely asking students to evaluate their own learning helps support metacognition (Cook et al., 2013), which is a fundamental skill that is necessary for a healthy society in my view. Most importantly, feedback allows me to replace my *personal feelings* about my teaching practice with actual *evidence* of student learning.

Examples of courses I have taught

Please see my CV for a full list of courses that I have taught.

Chemistry of Earth Systems

This course was designed for Geology and Environmental Earth Science majors to take in lieu of first-semester General Chemistry. Students learn about the foundations of chemistry from the perspective of nucleosynthesis in stars and chemical differentiation during the formation of rocky planets in our Solar System. The course was team taught, with the first half devoted to "high-temperature" geochemistry, including modules on partial melting, fractional crystallization, radiogenic isotopes, and mixing models. The second half of the course focused on "low-temperature" geochemistry, including modules on stable isotopes, aqueous geochemistry, and biotechnologies for environmental reclamation. This course also included a lab where students would solve problems, engage in group activities, and do experiments using bio-geochemical materials.

Structural Geology

This course design is a combination of lectures from Dr. Sean Long (Washington State University) and portfolio approach from Dr. Stephen Reynolds (Arizona State University). Learning structural geology requires a lot of spatial and geometric thinking, so students construct portfolios containing sketches and explanations of important concepts relating to the kinematics and dynamics of rock deformation. Portfolios double as study guides, as exams are small random selections of portfolio prompts. Thus, students with excellent portfolios generally feel low-pressure. This type of autonomous learning is coupled with a heavily quantitative field-based lab to cover other learning objectives. The course material includes recent and relevant tectonic research from Dr. Sean Long, myself, and others, including thermochronology and cross sections of the Himalayan and Andean orogens.

Sedimentology and Stratigraphy Lab

Great access to local sandstone quarries and other pristine exposures of lacustrine deposits near Boise Idaho allows for a heavily field-based Sedimentology and Stratigraphy laboratory. Students are introduced to field methods incrementally over several weeks of measuring section at three different sites. Up to one field exercise per week accelerates qualitative (rock descriptions) and quantitative learning (field measurements and analysis). Students are given specific tasks for data collection and guided to important features in the field. However, a more general rubric is provided for writing reports. Students are encouraged to summarize and present their field data in compelling ways, including constructing digital stratigraphic columns with photographs of unit textures and compositions.

Examples of courses for development

Computational Methods

This course will focus on reviewing, understanding, and writing code to apply geostatistical and machine learning techniques to geologic datasets. The backbone of the course will involve rotating live coding tutorials on specific geologic problems. Online notebooks, video tutorials, and peer-to-peer code sharing allow multiple pathways for students to engage with high-level computer programming. An open-ended miniproject is an opportunity for students to specifically advance their own research. Other important concepts for the modern Geoscientist to master are covered, including version control (git), FAIR data principles, and others.

Physics and Chemistry of Mountain Building

This course will focus on the petrologic and thermomechanical consequences of converging tectonic plates, especially detailing the deformation and metamorphism of Earth's lithosphere during subduction and collision. The petrologic, geochemical, and geophysical evidence supporting early tectonic models will be presented as a major course component. However, students will also practice writing and experimenting with simple numerical geodynamic models to "see" tectonic processes how geodynamicists do. Students are expected to be challenged with interpreting numerical results through hands-on exercises—hopefully uncovering fresh research questions to support a major research theme in my lab.

Raman Spectroscopic Methods

This heavily lab-based course will focus on developing cutting-edge Raman Spectroscopic methods. Students will use a Raman microscope to collect spectra, reduce raw signal, and apply elastic theory to interpret PT histories of metamorphic rocks. This course is intended to support a major research theme in my lab—likely guided by our own empirical results, theoretical updates and modifications, and other unexpected insights. The course is aimed towards several key learning objectives, including digesting scientific literature, completing quantitative tasks and exercises, making precise observations (measurements), and organizing and visualizing data in compelling ways.

Student recruiting

Undergraduate recruiting and retention is also of special interest to me. Like many first-generation students, I took a broad range of courses at University because my intellectual interests were not strongly influenced growing up, and my view of the academic landscape was narrow and uninformed. I ultimately stuck with geology because I saw a tightly-knit community of enthusiastic professors working busily on many interesting topics while promoting independent undergraduates research in their labs. I try to model the same support for my undergraduate students that I received—recognizing that these efforts dually support my Department's need for recruitment and retention.

I have not yet directly advised any MSc or PhD students, and I look forward to learning many new things from my graduate students. I intend to keep to a research theme on metamorphic petrology, geodynamics of convergent margins, and computational methods, but I am open to (co)supervising graduate students along many other potential themes (especially the application of machine learning and artificial intelligence to geological datasets).

References

Angelo, T. (1993). A" teacher's dozen. *AAHE Bulletin*, *45*(8), 3–7.

Angelo, T. A., & Cross, K. P. (2012). *Classroom assessment techniques*. Jossey Bass Wiley.

Benner, P. (1984). From novice to expert. *Menlo Park*, 465–468.

Bloom, B. (1956). Taxonomy of educational objectives: The classification of educational goals. *Cognitive Domain*.

Cook, E., Kennedy, E., & McGuire, S. (2013). Effect of teaching metacognitive learning strategies on performance in general chemistry courses. *Journal of Chemical Education*, *90*(8), 961–967.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, *77*(1), 81–112.

Wiggins, G., & McTighe, J. (2005). *Understanding by design*. Ascd.