ADDRESSING EPISTEMOLOGY IN AN ONLINE ENVIRONMENTAL SCIENCE GE COURSE

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ABSTRACT

Science education researchers have often noticed a disconnect in the way students view scientific knowledge and learning (i.e., their epistemological beliefs) and the way scientists or science teachers view them. Students often see science as a body of facts to be memorized rather than a way of looking at the world and building new knowledge. Online education could easily reinforce this fact-memorization view if delivery of content is the main emphasis. For this project, redesigning ENVS 10 (Introduction to Environmental Science), I hope to not only conduct the course online but also to foster a view of science more in line with that of practicing scientists. The course fulfills the B2 (Life Science) general education requirement and serves Environmental Studies majors, engineering and construction management students, business and economics students, and other majors. Even if this is their last encounter with a science class, a view of science as a way of thinking rather than a collection of facts will help students evaluate science-related conclusions they encounter in the media or as a part of their careers. Tools that should help foster views of science as more than a collection of facts include (a) explicit discussion of ways of thinking and learning in science, (b) assignments that require students to use and identify (explicitly) scientific thinking skills, (c) required discussion of course content via small group and whole class blogs, and (d) the use of notes and textbook for at least part of the exams.

MOTIVATING PROBLEMS

We have noticed in our upper division Environmental Studies courses that many students flounder when asked to interpret data collected in the field or to build explanations of observed phenomena without the aid of someone else’s explanation. These are skills that scientists, both natural and social, need to use if we are to continue advancing knowledge. Traditionally courses may require students to use these skills to get a good grade, but the skills are not explicitly taught—those who don't naturally pick them up will perform below expectations. In some cases, students with strong views about science being a collection of facts to be memorized may blame the instructor for not teaching them the answer to the question before asking it.

Introduction to Environmental Science (ENVS 10), a Life Sciences GE course, serves Environmental Studies majors as well as a variety of other majors. For our majors, beginning their studies with explicit instruction in and practice with scientific skills like sense-making and building mental models may help them succeed in their upper division courses. Non-majors should also benefit from a good understanding of how scientists do the work that produces the information others use. In addition, analytical, problem-solving, and explanation-building skills
are by no means specific to natural science. Any student living in our information-rich world today can benefit by knowing more about where the information comes from and what its limitations are.

We also have a more structural motivating problem. As a GE course with a topic many students care about, Introduction to Environmental Science has a high demand. Increasing class size can help, but the Sac State campus has limited facilities for large classes. Also, discussion is a teaching method commonly employed for this course, and large classes make it easier for students to avoid participation. Putting the class online will open up lecture hall space and allow decisions about class size to be based on other considerations, like the amount of instructor time required to manage online interactions with students. Having students interact in groups online will give them a similar opportunity as putting them in small groups in a face-to-face class, but with the advantage that the instructor can “hear” what is said in each group.

The two motivating problems—making the course available to more students and fostering a more sophisticated epistemology (i.e., “science as a way of thinking or approaching problems” vs. “science as a collection of facts”)—seem like they could be antagonistic. A course where lectures, videos, and textbooks communicate concepts and students demonstrate that they know those concepts by answering multiple choice or short answer questions can scale up quite easily. It could also easily reinforce the idea that the goal of learning science is to know all about what others have already learned. Assessing and providing formative feedback on students’ analytical and creative thinking requires instructor effort. Thus, a final motivating problem is to look for the most efficient ways to provide meaningful feedback and assessment.

TECHNOLOGY ACTIVITIES AND CURRICULUM

For this first round of the online course I am trying to keep things simple while offering options for students with different learning styles. Here are the primary technologies that will be used to deliver content and communicate with students:

- **Blackboard Course Management**—The syllabus, lectures (see below), helpful links, etc. will be housed in SacCT, Sacramento State’s course management system. Announcements will be posted there and delivered by email.
- **Short Lectures via Power Point files**—For the two classes I have “flipped,” I created PowerPoint slides with narration attached to each slide. The narration is also written below, so the files can be read in regular view as an alternative to listening to the narration.
- **Course and Small Group Blogs**—Blogs will serve as a venue for discussion as well as a way to submit homework. Students will respond to assigned prompts on their group blog and comment on group members’ work. I will comment when needed in group blogs and share insights and challenges that arise in groups with the whole class on the course blog. For many prompts, students will have the option of responding with video or audio in addition to written responses.
- **Virtual Office Hours via Blackboard Collaborate**—Office hours will be conducted and recorded using Blackboard Collaborate. Students who are unable to “attend” office hours may submit questions ahead of time and view the recording later.
- **E-mail for Personal Communications**—As in any course, students can ask questions or bring up concerns via email (or in person during on-campus office hours).

The course will also use *Environmental Science, Toward a Sustainable Future* (Richard T. Wright and Dorothy F. Boorse), the text used in other sections of the course. Strategies for fostering desired epistemological views are adapted from Redish and Hammer (2009).

**OUTCOMES**

Expected outcomes and ways to evaluate the outcomes are listed below.

- **Move student epistemological views of science and science learning toward “ideal” views.** This outcome will be evaluated with pre- and post-test responses on questions from the CLASS (Colorado Learning Attitudes in Science Survey) instrument. An overall improvement on scores will indicate success for this outcome.
- **Improve students’ analytical and explanation-building skills.** This outcome will be more difficult to evaluate. Student work on initial blogs and ones near the end will be compared to look for evidence of specific skills addressed in the class (e.g., seeking coherence or sense-making).
- **Maintain positive student attitudes toward the course.** This outcome will be measured by student retention and results of standard course evaluations at the end of the semester. Retention and course evaluations should be at least similar to those for other sections.

**BROADER IMPACTS**

Providing students with skills that improve their ability to answer questions that can’t be answered by looking them up will be valuable to students. If Redish and Hammer’s (2009) approach works in environmental science as well as physics, it ought to be transferable (with modifications) to other science disciplines, including many social sciences. For our majors, future classes where original thought and analysis is required may be easier. Beyond the classroom, having the confidence to think a problem through without the aid of Google and Wikipedia should give students an edge in their future careers.

**REFERENCES**