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Teaching Statement

General Statement of Teaching Philosophy

The vast majority of my experience with course development and instruction has targeted an audience of aspiring or practicing scientific researchers from various sub-disciplines. I have therefore sought over the last several years to incorporate learning objectives pertaining to scientific discovery directly into the courses I teach. In keeping with facilitating my students' comfort with the iterative nature of learning in scientific research, it is my philosophy that the core function of any course I teach is to give students the tools to uncover scientific and mathematical findings independently. To facilitate this process, I set the following general learning goals for my students: (1) to develop and apply a set of course-specific problem solving tools, (2) to independently synthesize results from course principles, and (3) to identify and seek out proficiency in topics with which they struggle most.

The first of these three goals is an acknowledgment that a course should be guided by its intended content and, in particular, not dominated by the abstract goal of scientific discovery. The second goal seeks to train students to engage in the research process. Science naturally advances over time as important discoveries are made and as emerging insights disseminate; hence, independent synthesis plays a crucial role in enhancing a student's comfort with this continual process. The third goal underscores the key idea that grappling with new concepts is an essential component of learning, and not an indication of inherent poor performance. Though what may seem arduous will vary between students, learning to identify and devote time to the most difficult content is a way to practice pushing the boundaries of discovery.

Use of Class Time and Assessment of Goals

As part of my philosophy of discovery, I aim to make in-class time interactive and engaging by integrating activities and open-ended questions. Doing so prevents me from spending too great a portion of in-class time in traditional lecture mode, thereby holding me accountable for achieving the overarching goals described above. Though lecture time is essential to convey course content, I seek to avoid giving students the impression that their sole job is to absorb as much information as they can in the hopes of subsequently regurgitating that material for an exam. Examples of the kinds of open-ended questions I ask during class include:

- Synthesizing from existing principles (e.g., "what would be the next logical step?")
- Connecting: (e.g., "how does what we just did connect with what we did previously?")
- Reflecting: (e.g., "why is the method we previously learned inadequate in this case?")

These types of questions are designed to help students achieve the learning goals. By having an opportunity to think ahead, students can practice synthesizing results from fundamental principles; understanding what methods may not work in certain scenarios serves to sharpen their set of problem-solving tools. All three classes of questions promote connections between course topics and allow students to reflect on how well they understand the material. I have found that allowing students to respond to questions aloud in class creates a positive learning atmosphere in which they feel willing to speak up when they have questions of their own.

I further seek to tailor the examples in my lectures to the specific research interests of my audience. For example, I am currently teaching a graduate level introductory statistics course to a group of twenty-four clinicians in the Health Policy Research department at the University of Pennsylvania. When introducing material on various discrete probability distributions, I began by discussing studies of women with and without breast cancer susceptibility gene mutations, which served as a basis for motivating the binomial and negative binomial distributions. One secondary goal of this unit was to demonstrate to my students how well this motivating example lends itself to many types of research questions, given the heterogeneity in the prevalence of these types of gene mutations by sub-population.

During class time, I often provide problems for students to work on independently. Time permitting, students are then asked to discuss their solutions with their neighbors. I may then ask a student to volunteer to present his or her work, or I may simply work through the problem on the board myself. Working through problems during class time provides students with an opportunity to try a problem when they may not yet fully understand the methods involved. This is an advantage for two reasons: firstly, it allows students to experience the process of uncovering a new concept. Secondly, it allows them to identify what they don't yet understand sooner than they would if they were not working through problems until a homework assignment was provided.

In order to most effectively help students meet the objectives, I need to be able to informally assess student understanding during class time and adapt when students appear to be struggling with a concept. Occasionally, I will devise examples in an *ad hoc* fashion during class time and subsequently work out a solution interactively with the class. This can also serve to slow down the instruction pace, thereby providing more time for students to digest challenging ideas.

To determine whether students have achieved the learning objectives, I aim to assess them on their ability to synthesize results based on principles and methods. Each graded assessment typically includes at least one guided question that requires students to extend course principles slightly beyond the level of problems they have previously seen. Similarly, I tend to favor exam questions that are merely *similar* to previously assigned problems as opposed to questions that are exactly identical. Through this approach, I evaluate students on their understanding of course principles rather than on their ability to memorize solutions and answers. In so doing, student performance is a more informative measure of conceptual mastery than would otherwise be the case. In turn, I can more effectively adapt my techniques when necessary.

Summary

The three general goals pertaining to discovery-based learning have been applicable to nearly all of my teaching experiences. The first goal of developing course-specific problem solving tools serves as an anchor for the latter two goals, which pertain to the more general and abstract notion of scientific research training. I update my course structure and methods based on personal reflection and feedback from students and other instructors. I often seek out new examples in order to renew the novelty and excitement for me as the instructor.

My vision of a successful course in science or related fields is one that enables students to learn through discovery rather than through rote memorization. My use of class time, evaluative methods, and self-reflection are designed to achieve this goal. Allowing students to uncover relationships between topics provides them with a set of tools for learning new concepts when the course is over. It is my hope that having these tools will make them more informed, effective scientists and mathematicians as they continue their lifelong education.