Philosophy of Education

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My philosophy as an educator was not informed by formal pedagogical training, but instead by the direct experience of teaching throughout the development of my scientific faculty career. As such, my approach to education and teaching evolved empirically through 20 years of contact with students in a broad range of learning environments. This philosophy is shaped primarily by the differing educational needs of the learners in each environment, and has evolved to encompass a core of guiding principles that serve students to achieve a useful knowledge base accompanied by the training and skillset to be adaptive learners throughout their chosen career.

My teaching is broadly focused on biochemistry, molecular biology, and cell biology, but the context and level at which this material is covered varies widely, involving undergraduate, graduate, dental, and medical students. My educational efforts also include middle and high school students on occasion. In addition to a range of learner types, the spectrum of my teaching environments includes large discipline-based didactic lectures, clinically focused flipped classrooms and problem-based learning, primary literature discussions in small groups, and individual research mentoring in a laboratory setting. The unique characteristics of each these contexts modulates my approach to achieving the education goals of the learning environment and meeting the specific needs of each particular student. For example, while a large undergraduate biochemistry course would employ didactic lectures focused on a canon of foundational material at a textbook level, a Ph.D. level course would center around group discussions on selected topics in the primary literature that would go beyond textbook-level knowledge. In further contrast, a medical biochemistry course would feature a mix of didactic lectures and active learning modes to achieve an applied knowledge of biochemistry in clinical scenarios to serve the unique needs of medical students. While the broad topics covered by these courses are similar, the level and context of the information is attuned to the specific needs of the different learners.

An overarching goal of all my teaching is that students achieve a working knowledge of the material that will serve them into the future. This intent mandates a careful design of the course syllabus and the content of each session, such that a sufficient depth of content is balanced by the ability of students to retain a fundamental core of useful concepts and considerations that can serve as a foundation for lifelong learning. One way in which this is achieved is to iteratively survey a topic with increasing details and complexity through the progression of an individual lecture or series on a topic, or longitudinally through the entire syllabus. In this way, important details can be incrementally added to a foundation to allow students to develop a stable and functional mental model of the concept or system. Teaching and learning in the biochemical and molecular sciences presents a unique challenge, in that the concepts discussed represent invisible processes occurring at molecular scales. Thus, the ability to construct a mental abstraction of these systems is a central aspect of successful leaning in these fields, and is the greatest hurdle for many students. This challenge thus informs how the material must be presented, and the iterative consideration of material from different perspectives helps to achieve a stable mental model.

Harnessing the benefits of repetition is also the intent of preparatory readings that are selected as part of a course syllabus, which is also a significant component of my teaching approach. These resources are taken from course textbooks and selected primary review articles, and are intended to allow cognitive frontloading by the students through previewing the material in a different format from the lecture. Heterogeneity in how a topic is presented in different sources, requiring active mental work by the student to reconcile them, is an essential element of this approach. This helps ensure that shallow graphical memorization from a sole source is not mistaken for a deeper understanding. Students may initially be resistant to delving into the reading in advance of the lectures because of the additional mental work required, but those that take advantage of this frontloading report surprise at the resulting improvement in their understanding and retention. This has been particularly true among struggling students, who invariably improve with a more proactive learning approach that goes beyond a sole reliance on reviewing lecture slides. This student-driven process is expanded in flipped classrooms, in which background preparation by students comprises the entirely of the resource material for in-class discussions and exercises. This format, in which students actively prepare for group discussions and presentations through assigned readings in primary literature, also describes an effective approach to graduate education.

Another impediment to achieving an intellectually adaptable understanding of concepts in biochemistry and molecular biology is the volume of potentially assessed information contained in the many pathways and mechanisms. In the case of a medical biochemistry course the focus of these interconnected systems should be the highly regulated steps that play into disease etiology and treatment. However, it is often difficult for students to isolate these steps from the entirety of the associated pathway, so valuable study time is spent trying to memorize entire pathways, without achieving an accompanying understanding of their relevance or regulation. In order to allow students to develop a greater working understanding of concepts that they can use in solving clinical problems, a comprehensive diagram of integrated metabolic pathways (metabolic map) is made available to students during quizzes and exams in Medical Biochemistry so that students can focus on more important functional aspects of the pathways while studying. This approach promotes the integration of biochemical knowledge conveyed through the syllabus into clinical problem solving, congruent with how these concepts are assessed in the USMLE.

While many of the broader educational goals applied in group teaching settings also inform approaches to individual mentoring, the applied technical nature of bench research presents a distinct set of objectives. In research mentoring, the guiding principle is to emphasize selected aspects of the research process that are congruent with the educational background and training needs of the learner. For example, an undergraduate student is generally seeking technical laboratory experience on a range of methods in preparation for future work in a laboratory setting or graduate program. However, these students typically have a limited theoretical background, and require a more active mentoring approach to project development and experimental design. In contrast, a graduate student performing doctoral thesis research has generally gained considerable technical experience by this time, and is in need of training on the deeper epistemological and project design aspects of the research enterprise, since they are generally on a trajectory to a career as a principal investigator or senior scientist. In this case, the student plays a greater role in experimental design and planning.

A final but important characteristic of my educational philosophy is my own expectation of students and their contribution to the learning process. As mentioned above, a primary goal of education is the development of the processes for students to become lifelong adaptive learners, possessing a skillset to continually advance leaning and identify and correct deficiencies in knowledge throughout their careers. This requires a significant shift away from a reliance on the passive receipt of lectures and expectations of memorized facts. Instead, students should become able to process large quantities of independently acquired information for essential content, and apply that acquired knowledge to novel problems. Educators can model this process through flipped classrooms and problem-based learning, but learners must take an active role in developing the knowledge base and epistemological toolkit for this task. Thus, much of my assessment of and feedback to students is focused on their thought processes to ensure that solutions to problems are derived through a logical and evidence-based system, in addition to the successful acquisition of a content knowledge base. This focus on the tangible and practical outcomes of teaching are a common thread in my educational philosophy, which also allows for an objective assessment of the success of the process in reaching this goal, and provides information for the continual improvement of outcomes.