Teaching Philosophy, Spring 2021

1 Introduction

My approach to teaching has evolved from an instructor-centered philosophy that asks questions along the lines of "what do I bring to the table?" to a student-centered philosophy that seeks to answer "what do my students need to be successful?" While idealistic visions of teaching environments (like that expressed in the first line of my former teaching statement) hold value as aspirational objectives, a mature teaching philosophy should be responsive to the particulars of a given situation realized through direct experience. Maturity as an educator results from merging understanding of oneself with understanding of one's students, bringing an awareness of the strengths and weaknesses of both parties.

Three actionable principles leading to a positive learning environment define the basis of my teaching philosophy: mutual respect, a shared understanding of class expectations, and courses designed to lead students to new skills. Combined, these foundational principles support an overarching pedagogical goal of helping students become successful as measured in terms of real competency. The process of deep learning and the development of true competency takes incredible effort because at its core it is a rewiring of the brain for new ways of thinking and discipline-specific proficiency. Viewed in this way, education is a process of deep transformation that is often accompanied by discomfort and growing pains. My job as an educator is not to shield students from these pains of transformation but to help them through it, to let them know that the discomfort is natural and that struggle is an essential part of the process, and ultimately helping them emerge with a sense of joy and satisfaction in their studies. In the following, I outline some of the challenges faced in working toward these goals and my strategies for overcoming them.

2 Challenges and Observations

As the primary instructor for our 200-level physics courses, I have had the unique opportunity to develop broad experience with SUNY Cortland students majoring in science and mathematics disciplines in their first years. I have also taught required upper-division physics courses, a special topics course in Advanced Classical Mechanics, taught a voluntary summer programming course, and supervised numerous students in independent research. While the following pertain especially to patterns in introductory courses, students at all levels exhibit these qualities to varying degrees.

- Observation 1: Students in both introductory and advanced courses, though more so in the intro courses, tend to rely on old patterns of memorization as a default.
- Observation 2: Use of online answer repositories, such as Chegg, have become extremely common, even in upper division physics courses. This seems to have had a strongly negative impact on student learning, with subsequent impacts on student expectations for what constitutes reasonable work.
- Observation 3: Students seldom utilize the course textbook as a regular component of their studies, seeming to rely on lectures for the majority of information and training.
- Observation 4: Collaborative studying seems to be less common and there seems to be a significant reluctance on the part of students to forming study groups.
- Observation 5: Many students see the degree rather than the underlying education as the asset that will open doors to job opportunities.

3 Insights

Responding to this set of observations through the perspective of my teaching philosophy outlined in the introduction, I offer a set of key insights and pedagogical innovations responsive to these challenges.

3.1 Need for more inquiry-based thinking opportunities

It seems that the skills needed to succeed, and perhaps thrive, in high school and very different from typical college standards where we want students to operate with more flexible and adaptive thinking. It can be useful to look at this problem as one of helping students move toward higher cognitive function described by Bloom's taxonomy. This is both a serialized process and one of transformation. The former exists because the higher functions of understanding are built on foundational knowledge, and reflection built on experience that grows out of understanding. The latter, the process of transformation, is inherent in this process because these are likely new ways of thinking, coming with new and intimidating expectations for performance. Movement toward these higher patterns of thought requires three ingredients.

1. **Student recognition of learning as a transformative process:** This requires mutual respect between teacher and student, wherein the student feels accepted and motivated to learn, encouraged to a willingness to try that is supported by the teacher's respect. Likewise, progress toward mastery of material proceeds best when the student acknowledges the expertise of the teacher and accepts his/her guidance in this process. To support the development of positive relationships with students I will, for example, make sure to offer kind praise for answers wagered to questions in class, and when the answer is wrong I always try to connect the given answer to some aspect of the larger problem or back to common experience. With a respectful relationship established, it becomes possible to lead students toward embracing new ways of thinking and to accept that this process takes serious work and dedication.

2. **Models of behavioral patterns that support this transformation:** It is often insufficient, more so with younger students, to present content alone. Rather, a core component of effective pedagogy is modeling the process of study and the product of work. For example, in class I talk about what I thought were the important or interesting aspects of the material discussed in the textbook, thereby modeling the process of self-education that takes place outside of the classroom. To model the goals of our work and bring students into self-sufficiency, I provide students in my intro lab classes with an almost-complete lab report (introduction, body, and concluding paragraphs) on their first laboratory exercise, and encourage them to copy this verbatim. In subsequent labs I steadily remove the training wheels and reduce the amount of structure provided until students are writing lab reports fully on their own.

   Other techniques I employ in class to encourage student engagement with their studies are: (a) regular experiences of in-class work along the lines of active-learning philosophy [1,2] to give students the opportunity for self-reflection and peer instruction, (b) development of support materials like the math skills assessment guide for new students in PHY 201, my academic success plan questionnaire for advisees, and a comprehensive notes on statistical analysis for PHY 201 and 202, (c) multiple avenues for support in office-hours and online forums, (d) providing continual reinforcement of a regular pattern of problem interpretation and setup, represented as a series of common questions and in flow-chart form, The goal of this last element is to present students with a set of meta-cognitive tools for organizing their thoughts. In addition to organizing a problem through diagrams and lists of knowns and unknowns, I use a set of common questions that can be applied to a wide range of problems to help us generate a solution strategy:

   i. Identification: Do I understand what kind of problem this is (kinematic, force, energy, etc.)?
   ii. Organization: Have I drawn a picture/diagram of the problem and made a list of all the relevant information with the knowns and unknowns explicitly identified?
   iii. Translation: Have I translated all of the problem statements into a set of equations?
   iv. Formulation: Have I studied the set of equations and made a plan for solving for the desired unknown quantity/quantities?

v. Reflection: Does the answer I found make sense in the context of the problem and compared to what I believe to be true about the world more generally? If not, do I believe there is an error or does my understanding need to be updated?

Asked as a set of questions, rather than presented as prompts, these questions encourage students to be active participants in the process and to move on only once positive answers can be provided, thereby motivating an organized and efficient logic of generalized problem-solving ability.

3. **Scaffolded exercises that lead students toward these goals:** This is in essence structured pedagogy where lessons build upon and relate to prior lessons, and exercises are staged in difficulty to gently lead students to new levels of performance. I am in the process of redesigning my homework assignments for my lower-division courses to be presented in three parts, roughly corresponding to three tiers of grade-performance: conceptual questions that represent foundational knowledge of physical principles, analytical problems that represent grasp of core computational skills, and challenge problems that represent mastery of the subject matter. To further broaden my upper-division students' appreciation for related fields, I included a video assignment in the PHY 420 problem sets (see P-set #1 and P-set #8), often drawn from the "Numberphile" or "Sixty Symbols" YouTube channels, as the first part of the problem sets where they were asked to explain in their own words the meaning behind theorems or physical concepts and were often asked to describe what they found to be the most interesting aspects of these problems.

3.2 Movement from performance-based to a growth-based mindset

Behind all of these discussions is the realization that many of our students are in a stage of rapid development, moving from adolescence to young adulthood where cognitive changes take place well after they leave our halls. Many students enter college with a fixed mindset characterized by self-limiting attitudes, and most students tend toward patterns of thought that served them well enough in high-school but are not sufficiently flexible to be successful for adaptive and inquiry-based problems. One of my intermediate goals is to help students move toward a growth-based mindset [3] where they view learning as the goal of education and accept trials and failure as necessary parts of that process.

Recognizing that students have deeply ingrained patterns of thought that are most likely not the powerful and principles-based patterns that we seek to instill, we can reform patterns of thought by both showing how the old patterns are insufficient and how the new patterns are generalizable and versatile. Part of this occurs by an experience of floundering with a performance-based, "right-answer" type of mindset, in comparison to an inquiry-based mindset that is willing to say "I don't understand how to represent this problem mathematically," for example, thereby opening a discussion and actively seeking a solution to the problem. This dovetails with other support mechanisms and also represents the core principle of the scientific method where hypotheses, right or wrong, are advanced and tested as part of an iterative cycle.

One of the changes I have made to the pedagogy used in my introductory laboratory exercises is to provide students with minimal, or sometimes intentionally less-than-sufficient information necessary to complete a lab. The pedagogical goal is to let students struggle for a while, and often through personal discussions with them, encourage them to ask the questions they need to fill in the gaps in the process. I understand and accept that students are often frustrated by such experiences, but believe that it is in their best interests, both in terms of learning physics and developing confidence in their abilities, to be given some degree of independence to try, fail, try again, and ultimately succeed by their efforts. It is a good day in teaching if we can help students to understand that it is they who carry the far majority of the ability to affect to what degree they learn, and to recognize that it is their right and responsibility to ask questions to further the learning process.

Learning how to communicate effectively is an essential component of a liberal education. This means learning how to communicate with people outside of our fields of study, as was emphasized in two CPP projects, as well as communication within the discipline using genre-specific styles. In my upper-division

PHY 420 class I moved to a contract-grading system for the writing-intensive component of the class, where student writing as a guided process with the goal of motivating iterative improvement. The writing was done over three assignments: two low-stakes assignments to get us started (a professional cover letter and a resume), and a culminating technical report. Throughout the writing process I emphasize the need for revision, and discuss this from the perspective of my own work where I may revise an article ten times or more before it is finally accepted for publication. While it may not inflate the egos of my students, I tell them that all first drafts are bad, mine included, but that we can get to a state of good writing if we accept revision and refinement as a necessary part of the learning process. These discussions also serve as another means to relay that this process of revision is the way in which all learning takes places - the replacing of old ways of thinking with new ways that are achieved through patient work, accepting critical feedback (either from oneself or from another), and discussion of ideas.

4 Concluding thoughts

The experience of teaching, like that of being a student, is a process of growth and adaptation, and only progresses via experimentation. Since arriving at SUNY Cortland, my teaching has evolved to be more versatile and responsive to the students with diverse preparations and experiences. It is easy to deceive oneself that creative enterprises can unlock the doors to student engagement. The reality, however, is that there is no silver bullet and successful teaching requires a lot of patience and focus on the basics.

I believe that I have struck a good balance of developing projects and materials for my courses that both support students in the fundamentals and give them many opportunities for engaging in complex and interesting problems. Underlying all my teaching is an emphasis on helping students to develop first their meta-cognitive skills that are the key to higher learning, with a higher-level focus on the discipline-specific knowledge. Looking back at my work during this time I see many places of success that inform me that I am on the right path based on the work my students have created. Looking forward, I see multiple places for improvement, both for myself as an educator and within the College and our student body.

Strategic success in teaching requires that we determine the things over which we have control and to view our specific strategies in the context of the larger process of cognitive development and habit formation. While there is much that I cannot control, I can create a supportive environment in which I can encourage students to embrace their studies, express my clear expectations for them as mature and responsible students, and share with them the core content knowledge and the means to unlock understanding of the content and establish expectations for quality work that will ultimately serve students by fostering competence that will lead to success in the world beyond SUNY Cortland.

5 References

[1] Hake, "Interactive-engagement versus traditional methods: a six-thousand-student survey of mechanics test data for introductory physics courses," American Journal of Physics 66, 64 (1998).

[2] Meltzer and Thornton, "Active learning instruction in physics," American Journal of Physics 80, 969 (2012).

[3] C. S. Dweck, "Mindset: the New Psychology of Success," Ballantine Books (2007).