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Teaching Philosophy Statement

Most questions in life don't have a right answer. The world is full of decisions we make with incomplete information - from which credit card to choose to what company to invest in - for which we must make the best choice without being able to check if it's the right one. In education, though, we often hide this reality in favor of designing straightforward and clear assignments. While at times this simplification may be necessary, in general it does a disservice to students. I believe one of the fundamental principles of education is to teach students to make educated, justified decisions with limited information and to be comfortable with the choices they make.

My field – robotics – is one that is young and constantly evolving. As much as we might want to give our students the "right" answers - we can't, because we don't always know them ourselves. We have techniques that only work in some cases, and other techniques that work in different cases. We deal with problems that are largely intractable, and the best we can do is make educated simplifications. My goal in teaching is to convey this sense of uncertainty to my students and give them the ability to act competently within it. There are plenty of valid decisions; each comes with strengths and weaknesses, with a limited region in which it is valid, and with assumptions. The key is to recognize this, think each choice through, and justify it.

To that end, the core of my teaching strategy is recognizing that my students are learning to reason about problems more than they are learning to solve them. Students need clear, engaging, and concise lectures presenting the material, and they need - in STEM disciplines - lots of practice problems to give them the chance to apply the material and acquire ownership of it. But practice problems have to be well planned to optimize student benefit and increase the amount of reasoning required. Finding the correct formula and applying it to solve for the answer is only half of the solution - understanding how and why that formula was applicable is the key.

I encourage - and when possible require - students to start with the basics, clearly state all the assumptions they make, and rederive the necessary equations before solving the problem. This forces them to think critically about what steps they are taking and why, whether the formula is applicable at all, or if there is a better technique that would be more appropriate. I also grade accordingly - assigning more significance to the problem setup than the algebraic manipulations that produce the answer. In any real situation, their answers will be double and triple checked by calculator or computer, but the thinking that seeded the math is much more crucial. Often, there will be more than one way to solve the problem, but some methods will be easier or more appropriate. Putting some thought into that makes the problem easier and the solution more compelling.

I also feel strongly than assignments should be designed to encourage and enable student choice. This is especially true for projects or larger assignments where flexibility is easier to incorporate. Giving students a choice in what approach to take - structured so that all approaches provide a helpful educational experience - provides them with a stake in their own success and allows them to be

passionate about the work they're doing. This, in turn, encourages thoughtful decision making on the relevant questions.

In the introductory robotics course I've taught for two semesters, we often ask students to make modeling decisions. The assignment will be, for example, "prevent collisions between the robot and obstacles," but we won't tell them how to figure out if the robot will collide. There are plenty of ways to do this, but in general the more accurately a method predicts a collision the harder it is to implement and compute. Some degree of conservative simplification is necessary to make the problem solvable, but just how much and how to do it is up to the students. Students will often come to me and ask: "I've modeled my robot as this and that… Is that right?" I respond to them: "you tell me!" because the question is flawed at its core – it's not what is right or wrong, it's what makes sense or doesn't, what works or doesn't. If the most accurate model can't be computed in real-time – it's useless, but if the fast model allows the robot to collide – it's also useless. The crux of the assignment is not what specific decision they make - its to reason through whatever choices they make and know their limits.

Among the students I teach I've encountered plenty who have significant technical skills, but a great deal of them are afraid to take chances on problems and challenges that are less than fully defined. That lack of confidence in their own ability to reason is what I hope to address in my teaching. I believe that conveying to students the ability to reason about the problems they face, make decisions, and justify those choices, is the key to turning good students into great students and preparing them for life.