Teaching Philosophy

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"All models are wrong, but some are useful" is one of the most praised and least practised principles of engineering. In my experience leading startups, facilitating workshops, and guest lecturing amidst learners at all career stages, I find that engineers often struggle to produce answers that are accurate enough, using methods as simple as possible. To this end, I generally teach an inverted classroom in which the first third of time is spent recapping theory with a focus on assumptions and intuition. Learners then use the remaining time on case studies and other team activities to develop a broad base of problem-solving and leadership skills.

When does this model fail?

This is the first question I ask learners once they've read up on a new topic. For example, in fluids, the ideal gas law is widespread due to its simplicity, yet it hinges on a critical assumption: that particles do not interact. After summarizing the theory, I like to remark, "when will the ideal gas fail—not if, but when?" Then I leave a few seconds for responses, thank those who do answer, and explore how flow conditions and broader context can affect our answers. In industry, I once held a workshop on automatic flight control where I asked participants to analyze experimental data from a fixed-wing pitch controller. Learners debated in groups whether PID control was adequate, and discussed practical issues such as noise filtering, clamping, integrator windup, and HPF as an alternative to D control. By integrating theory with real-world issues and data, learners build a robust mental model and they are inspired to be curious and critical.

How can I explain or solve this without equations?

Richard Feynman said, "[these] problems are not mathematical problems but physical problems". I make extensive use of visuals and everyday experience to help learners generate meaning from abstract concepts. When discussing viscosity, I often draw a molecular diagram first and ask learners to consider how temperature or chemical composition might intuitively change its value; then I delve into equations. When explaining aircraft certification to non-aerospace engineers, I like to contextualize safety requirements by stating, "one catastrophic failure every 10^9 flight hours is equivalent to a crash every 100,000 years of flying—well beyond the lifetime of the airplane". I also strive for consistency between teaching philosophy and assessments by advising learners that even if they don't produce the final answer, it goes a long way to show one's thinking. Students have expressed in anonymous evaluations that my ability to couple rigour with intuition is intellectually satisfying yet prepares them well for career realities. My experience across industry and academia helps me continually refine this balance.

Does this activity involve more than one person and have more than one solution?

Once equipped with theory, I then move to building learners' teamwork and open-ended problem-solving skills. One time when teaching aerodynamic lift, I split learners into groups to brainstorm design trade-offs and constraints (e.g. Is it better to double airspeed or wing area? What physical, operational, or environmental factors could limit each variable?) Learners and teaching observers commented that this design-thinking approach felt fun, built self-confidence, and was professionally relevant. When presenting research on airline operations at a traditionally didactic conference, I pleasantly surprised audience members by summarizing key methods and findings before creating breaking groups to critique data and imagine various business and policy implications. Participants appreciated the collaborative approach—teamwork hones communication skills and fosters new relationships. I tend to use active learning and design activities in order to solidify critical thinking, technical, and interpersonal skills all at once.

Ultimately, I believe that engineering would be better described as a people skill with technical elements rather than the pure technical pursuit it is often portrayed to be. Teaching doubt, intuition, and leadership is our best chance at creating independent thinkers who can work together to develop theory and solve tough problems.