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Teaching Research in the Traditional Classroom: Why Make Graduate Students Wait?¹

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Physics graduate programs tend to divide the degree into two parts: (1) theory, taught in classes, almost totally divorced from the lab setting; and (2) research, taught in a research group through hands-on lab experience and mentorship. As we come to understand from undergraduate physics education research that modifying our teaching can rather easily produce quantifiably better results, it is reasonable to ask if we can make similar improvements at the graduate level. In this talk I will present the results of beginning research instruction in the classroom in the very first semester of graduate school, in the most traditional of classes – classical mechanics. In this approach, students build their knowledge from hands-on projects. They get immediately certified and experienced in the machine shop and electronics lab. There are no formal lectures. Students develop and present their own problems, and teach and challenge each other in the classroom. In contrast to polished lectures, both the instructor and the students together learn from their many public mistakes. Students give conference-style presentations instead of exams. As a result, students not only excel in analytical skills, but they also learn to tie theory to measurement, identify statistical and systematic errors, simulate computationally and model theoretically, and design their own experiments.

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