

I³ Graduate Research Proposal for Lauren Kost

A mixed-methodology study of the origins and impacts of the gender gap in college physics.

Introduction: This proposal is made on behalf of Lauren Kost for half-time graduate research appointments (25%) funded by the CU Institutional Innovation through Integration program, starting immediately and running through Summer 2010.

Lauren Kost is currently a graduate student in the CU-Boulder Physics Department. She has passed her physics departmental comprehensive exams (level I and II) and is on track to complete her PhD in Physics by Summer 2010. Lauren has completed all her required physics graduate level courses, which include several SoE doctoral courses directly related to her research activities. Additional (matching) support will come from a combination of existing external research grants, and (if appropriate for her thesis work) partial support as a teaching assistant in the Physics department.

Project Proposal: This research study is part of a broader effort to investigate the "gender gap" documented in university physics courses. This gap manifests itself in a variety of forms, including performance on grades and conceptual measures by gender, differing attitudes and beliefs about physics (and the learning of physics) of male and female students, and documented gaps in the number of women recruited (and continuing) in the physics major. The outcomes of this study will be a research-based guide intended to inform future creation of interventions to positively impact these various forms of gender gap.

The project will be a mixed methodology study, primarily epidemiological in character - collecting and analyzing data gathered from roughly 10,000 of our undergraduate physics students over a multi-year time span. A primary research goal is to identify and quantify factors which strongly correlate with the gender gaps, and establish potential causal relationships. The research is informed by sociocultural theory, and theories (including efficacy and stereotype threat) originating from social psychology. A major objective of the research program is to model the performance and trajectory of our students, to inform where interventions can be introduced with maximal impact for all students while decreasing the gender gap.

There are two driving research questions behind this study: 1) what factors can we document which correlate with student performance in: conceptual learning (as measured by research-based assessments), attitudes and beliefs about science (as measured by research-based surveys), course performance, and retention? 2) How do these factors differ for students retained in the physics major and those who enroll in introductory physics but do not continue? We hypothesize, based on our previous and ongoing work, that a number of factors, specifically math and physics background, incoming beliefs about the nature of physics, self-efficacy, affective factors and stereotype threat, can all be used to model the differential performance and retention of women in physics.

Benefits: Lauren's application presents an opportunity for the I³ program to support a research program that lays a theoretical and empirical groundwork for identifying course practices that best address the gender gap in physics and improve the retention and recruitment of women in

physics and related sciences. The outcomes of this project have the potential to directly impact other STEM fields since introductory physics is a gateway for those disciplines. This work builds and extends knowledge about the source of the gender gaps and how these gaps in the number of, and the education of, women correlate with student background and educational practices at the college level. It will establish methodologies and investigations relevant to other STEM education work, leading to possible suggestions for interventions in areas in and beyond physics, and it has the potential to raise awareness and understanding of key factors impacting the inclusion of women in the sciences.

Timeline: Lauren has completed some preliminary studies (see references below), with a focus on Physics I data. Ongoing work includes expansion of the data set to include Physics II (summer '09), analysis of existing survey data on efficacy (summer '09), data collection from higher level physics courses for retention studies (fall '09), analysis of homework vs exam performance (fall '09), development and investigation of new survey instruments with a focus on efficacy measures (summer '09 through spring '10), classroom observation and student interviews (fall '09 - spring '10), and possibly a stereotype threat intervention (fall '09 - spring '10) in collaboration with Prof. J. Cohen. Final analysis, writeups, and thesis defense would likely take place summer '10. We anticipate presentation of the work in a regular ongoing fashion, including summer '09 and summer '10 at the annual conference for the American Association of Physics Teachers, and the Physics Education Research Conference, as well as the 2009 APS meeting and upcoming 4-corners APS meetings.

Advising: Lauren will complete her doctoral studies in the physics department under the supervision of Steven Pollock. The work described above will form the core of Lauren's PhD research work for her Physics degree.

References from Lauren Kost to date:

- 1) "Characterizing the Gender Gap in Introductory Physics.", L.E. Kost, S.J. Pollock, & N.D. Finkelstein, Phys. Rev. ST PER, 5(1), 010101 (2009).
- 2) "The Persistence of the Gender Gap in Introductory Physics.", L.E. Kost, S.J. Pollock, & N.D. Finkelstein, PERC Proceedings 2008, 139-142, AIP Press (2008).
- 3) "Investigating the Source of the Gender Gap in Introductory Physics". L. E. Kost, S. J. Pollock, and N. D. Finkelstein, PERC Proceedings 2007, AIP Press.
- 4) "Reducing the Gender Gap in the Physics Classroom." S. J. Pollock, N.D. Finkelstein and L. Kost, PhysRev: ST Phys Ed. Rsrch. 3, 010107 (2007).