Title of Project: Performance differences among different groups of students in the chemistry curriculum at Indiana University.

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Abstract: In this exploratory project, we intend to identify the performance differences of women and minorities, as well as among students with different general chemistry preparation across our entire chemistry curriculum. Once we have an understanding of the degree to which these differences are observed and have controlled for the appropriate factors, we plan to communicate the present state of our department to the faculty, and introduce evidence-based teaching methods that can help lower the observed differences.

Project Description:

A recent study from five research universities, including IU, explored gendered performance differences (GPDs) across large foundational STEM courses.[1,2] I came across some of the results of this study (or one similar to it) at a recent Learning Analytics Call for Proposal Information Session (November 8, 2018). As a female faculty member, I was shocked to discover that a course I have taught numerous times (C342, Organic Chemistry 2) displayed a strong GPD. This revelation led to more questions, a discussion with my associate chair and my teaching faculty colleagues, and the proposal that follows.

We are interested in taking a deeper dive into the data for the chemistry department, and to look not only at gendered performance differences, but at differences among other demographic groups, as well as differences in general chemistry preparation. In addition, we want to look not only at our large introductory lecture courses, but also at our laboratory courses and our smaller upper-level courses. Our goal is to get an overall sense of how we are serving our diverse student body. Once we develop that sense, we plan to utilize our understanding in order to help faculty implement teaching tools that can help level the playing field for women and minorities, and for student with different preparation coming in to the upper-level courses.

In order to identify and characterize the different performance differences, we plan to first more closely examine C342 by asking the following questions.

1. What exactly is the grade penalty for women in C342? How does it change when controlling for other factors, including ACT scores, overall GPA (or GPAO, grade point averages in other courses), or general chemistry course sequence? Controlling for which factors gives us the most accurate understanding?
2. Are there more grade penalties in C342? For example, is there a race-based grade penalty as well. If so, how does it compare to the gender-based penalty? How do students who fall into two penalized categories fare (i.e. is the effect additive)?
3. Is the same grade penalty observed in every semester, independent of the faculty member on record? Can we generate a report for each faculty member, to show how their courses fit into the overall story?

Once we have a better understanding of this course, and are comfortable with our methods of organizing and analyzing the data, we will examine other courses in our curriculum and determine how the grade penalty observed in C342 compares to those courses. We would also like to compare our data to other STEM fields here at IU.

Once we have developed an understanding of performance differences within our ***curriculum***, we plan to generate reports, and let our faculty know what their course looks like in this context. We hope to identify some courses/faculty with a significantly

lower grade penalty compared with others, and to find out what they are doing well in order to help the rest of us better help our students.

Finally, once the state of affairs is made plain to our entire chemistry faculty, we will introduce evidence-based teaching methods that have been shown to lower the grade penalty such as those developed and disseminated within the fields of biology[3] and physics[4] education, in the hope that some of these will be incorporated.

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1. Matz, R. L.; Koester, B. P.; Fiorini, S.; Grom, G.; Shepard, L.; Stangor, C. G.; Weiner, B.; McKay, T. A. Patterns of Gendered Performance Differences in Large Introductory Courses at Five Research Universities. *AERA Open* **2017**, *3* (4), 1-12.
2. See also: Koester, B. P.; Grom, G.; McKay, T. A. Patterns of Gendered Performance Difference in Introductory STEM Courses. *arXiv.org, e-Print Archive, Physics* **2016**, 1-9. arXiv:1608.07565v1
3. Tanner, K. D. Structure Matters: Twenty-One Teaching Strategies to Promote Student Engagement and Cultivate Classroom Equity. *CBE—Life Sciences Education* **2013**, *12*, 322-331.
4. Wieman, C.; Gilbert, S. The Teaching Practices Inventory: A New Tool for Characterizing College and University Teaching in Mathematics and Science. *CBE—Life Sciences Education* **2014**, *13*, 552-569.